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Estimation of recreational catch and effort in Paterson Inlet from a diary survey

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Objectives 1 & 2

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Report title: Estimation of recreational catch and effort in Paterson Inlet from a diary survey

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7. Executive Summary:

In order to determine the effects of the 1994 fishing regulation changes (reduced bag limits, method restrictions, no commercial take) in Paterson Inlet, a fishing diary-monitoring programme was introduced specifically to Paterson Inlet one year prior to the regulations taking effect (1993). The scheme was designed to show general recreational trends, and track changes in diarist catch per unit effort as an indicator of any changes in fish stocks in the area.

The three main Paterson Inlet fisheries were blue cod, paua and scallops and their distribution is discussed. Together, line fishing from boats and diving accounted for most trips, with boat fishing the more popular of the two methods.

Analysis of blue cod catches per hour over the period of highest fishing effort (summer) showed some year to year changes in average harvest rate, which can be taken as significant. However, no significant difference between the first and last summers of the survey could be detected.

A distribution of effort in terms of hours and trips is illustrated. The area surrounding Ulva Island (zone 4) was most heavily fished, followed by the Neck (zone 1) and the Bravo Group (zone 3). All of these areas have been the subject of marine reserve or taiapure applications.

8. Objectives:

1. To monitor changes in recreational catch-per-unit effort for major fish species in Paterson Inlet, Stewart Island from a fishing diary survey.

2. To determine the distribution of current fishing effort

9. Introduction

Paterson Inlet, Stewart Island (Figure 1) supports a unique and publicly highly valued fishery in the South region. For more detail of the history and physical nature of Paterson Inlet, the reader is directed to Elvy *et al* (1997) and Higham (1994).

Increasing levels of recreational fishing activity in Paterson Inlet have raised concerns about the long-term sustainability of fishing in the Inlet. In 1993, the Ministry of Fisheries (MFish) established a Working Group to consider management options and develop a Fisheries Plan. The plan was implemented on 1 October 1994 and banned commercial fishing, reduced bag limits for blue cod, and scallops and removed bulk fishing methods such as dredging and netting (See Appendix 1, and Elvy *et al* 1997).

Prior to the survey reported here, there was no detailed information available on recreational fisheries in Paterson Inlet. While there was limited information available from the MFish South region fishing diary survey of 1991/92 for species caught and methods used (Teirney and Kilner, in prep.), it was not able to provide detailed information on CPUE or areas fished in the Inlet.

A wide range of techniques are available for implementing recreational fisheries surveys(e.g., Kish, 1965; Pollock *et al.*, 1994), each with their own strengths and weaknesses which need to be assessed in relation to the survey objectives and area of study. Telephone or postal sample surveys have been widely used for studying New Zealand freshwater fisheries (Teirney *et al.*, 1982; Unwin and Davis, 1983). Another approach known as a creel survey, involves interviews of fishers at selected access points to record catch and fishing time etc. This is usually done in conjunction with a roving counter recording the position fished and number of fish taken (Guthrie *et al.*, 1991). A third alternative involves volunteer diarists, each diarist recording all information relevant to each fishing trip made (e.g., Graynoth, 1974).

In an attempt to determine the effectiveness of the Fisheries Plan, MFish chose to monitor trends of fisher catch-per-unit-effort (CPUE) through a fishing diary scheme in Paterson Inlet over a five-year period. The diary scheme began ten months prior to the implementation of the Fisheries Plan in October 1994, and continued until February 1998, a total of 17 quarters covering four full years and five summers.

Despite the implementation of the Paterson Inlet Fisheries Plan, concerns about over-fishing also lead to proposals for a marine reserve around much of Ulva Island (advertised in December 1994 and June 1995, See Appendix 2 & Higham, 1994) and talk of a taiapure (Elvy et al, 1997) at The Neck (Figure 1). While the initial intent of the diary scheme was to determine the effectiveness of the Fisheries Plan using CPUE data, information showing the distribution of fishing effort may identify areas of

potential user conflict resulting from the establishment of marine reserves and/or taiapure. This information would aid the Minister of Fisheries in making an informed judgement as to the effect of these and future proposals on the activities of recreational fishers in the Inlet.

In summer 1994/95, a creel and roving count survey was done in Paterson Inlet to see if the data received from diarists were representative of all those fishing over the summer period. This information is currently being prepared for release by MFish (Kilner, in prep) and is partly summarised in Elvy et al, (1997). It does not form part of this report.

10. Methods

Given the objective of the monitoring programme was to detect trends in fishing success, a random sample of diarists was not required (Elvy, et al, 1997). Consirquintly, participants in the diary survey (n=65) were recruited in 1993 from the earlier catch and effort diary survey and an earlier telephone survey (Teirney & Kilner, in prep), from local boat or fishing clubs, or via other Paterson Inlet recreational fishers.

Each diarist was issued with a waterproof diary containing a map of the Inlet with marked fishing zones (Appendix 3), a fish identification guide (Appendix 4), and detailed instructions on how to fill in the diary (Appendix 5). From each fishing trip the following infomation was asked for:

- Date of trip
- Name of place and number of zone fished in
- Hours spent fishing
- Type of fishing
- Fish species targeted
- Species caught
- Number of each species caught
- Total whole weight of each species caught (to nearest 100g)

Data were collected from the diarists quarterly through mail outs and entered on a customised Excel© database and information extracted using pivot tables.

CPUE data do not provide immediate information concerning the status of fish stocks. Therefore, in order to determine and then monitor changes in CPUE of recreational fishing in Paterson Inlet, the diary survey collected catch and effort data over five sequential years following the initiation of the Fisheries Plan. Changes in mean CPUE were then analysed to indicate any possible change in either the status of the fish stocks in Paterson Inlet, or some other variable affecting catchability.

The three tests used here to determine significant difference in CPUE are fully described in Appendix 6. The Wilcoxon rank test does not require any assumptions about the statistical distribution of data, while the *t*-test assumes normality. The permutation test should give the best results. These tests are applied to three different ways of examining the data.

It has already been shown that it is possible to detect a statistically significant change in blue cod CPUE from the Paterson Inlet recreational diary data (Bradford, 1996). A change in catch rate of only 1.5–2.0 blue cod per hour is required. Provided diaries are filled in accurately, they can provide reliable CPUE information.

In addition to providing information required for calculating CPUE for the main Paterson Inlet fisheries, the diary survey also gives fishing locations by zone (Fig 1, Appendix 3). This allows the formation of a picture of the distribution of fishing effort and methods over the survey period.

Information ordered by the zones fished was extracted from the survey data as hours fished and mapped by season, target and catch species. This provided a description of fishing method, effort, target and catch within different areas of Paterson Inlet. The chi-square test was used to compare between total hours fished in each zone.

Time spent fishing for each diarist was then examined with a linear model ANOVA using year, season, zone and diarists to determine which factors were significant in affecting the number of trips and hours fished. Log transforming the data (the hours of fishing done) increases the proportion of variance explained, but not the inferences.

11. Results

1. To monitor changes in recreational catch-per-unit effort for major fish species in Paterson Inlet, Stewart Island from a fishing diary survey.

The Paterson Inlet diary survey was run for four full years and five summers, but the bulk of fishing took place during the summer months (December to February inclusive, Fig 2 and 3). Blue cod (*Parapercis colias*) was the main species caught and targeted in Paterson Inlet and the only one caught on sufficient trips to allow an estimate of the average harvest rate in each summer and a test of the significance of any changes.

The blue cod harvest rate (HPUE) estimates in the five summers of the survey are compared (Figure 2). The trips included are those where a diarist targeted or caught blue cod was reporting only his/her own catch.

The distribution of the data was almost symmetric, though somewhat skewed. The non-parametric Wilcox test would be less affected by any non-normality and therefore acted as a check.

Table 1 contains summary statistics of the blue cod harvest in each summer. The number of diarists and the number of trips made declined during the survey. The total number of blue cod harvested (H) by the participating diarists dropped accordingly from 730 in 1993–94 to 227 in 1997–98, with a rise in 1996–97. The total number of hours fished (E) also declined from 138 in 1993–94 to 48 in 1997–98.

The ratio-of-means harvest rate (*HPUE* = *H/E*) was lowest in 1994-95 (4.37 h^{-1}) and largest in 1996-97 (7.35 h^{-1}) (See Table 1). However, throughout the survey, harvest rate declined after 1993–94, increased again by 1996–97, but declined again in 1997–98.

The value of the average harvest rate in a summer depends upon how it is calculated (*see* Appendix 6 for the two main definitions of average harvest rate that are used). Different methods of estimating the average harvest rate apply to different circumstances. However it is estimated, the average harvest rate is liable to be biased as are all ratio estimators (Jones *et al* 1995). The ratio-of-means estimator above is applicable when total harvests are to be estimated from a harvest rate and an independent measure of effort (Jones *et al* 1995). For recreational satisfaction, the mean-of-ratios estimator is suggested (Jones *et al* 1995) and that estimator is used in the following discussion.

The three tests used to determine significant difference are described in Appendix 6. In diary surveys, the diarist should be used as the basic statistical unit. However, in the first instance, the individual trips are assumed to be independent and the tests applied to them (Table 2). The estimated mean harvest rates in the two summers being compared, M_1 and M_2, are mean-of-ratios estimators. All the tests show no significant difference between the first and last summers of the survey. However, all the tests show a significant decrease between the 1993–94 and 1994–95 summers and a significant increase between the 1994–95 and 1996–97 summers (Table 2).

The *t*-test shows a significant difference between the 1996–97 summer and the 1997–98 summer, and the permutation test shows a significant difference between the 1994–95 summer and the 1997–98 summer.

Next, the estimated average harvest rates for individual diarists are compared (Table 3). The average harvest rate is calculated for each diarist as a mean-of-ratios estimate. The annual means are calculated as mean-of-ratios estimators. When the diarists are assumed independent from summer to summer, only the difference between the 1994–95 and the 1996–1997 summer is significant. The small sample size means that changes have to be large before they become statistically significant. If the individual diarists' harvest rates for the summer are calculated as ratio-of-means estimators, the same results are obtained, though the overall average harvest rates are somewhat different.

More powerful statistical tests are obtained by using paired data for the same diarists in different years even though the sample size is smaller. The tests using paired data are formally different from the test using unpaired data (Appendix 6). The results are given in Table 4. The difference between the 1994–95 and 1996–97 summer is one where the data sets involved contained ties and the normal approximation for the Wilcoxon test statistic was invoked. Again, there is no significant difference between the estimated mean harvest rate in 1993–94 and 1997–98. The difference between 1994–95 and 1997–98 is significant, and the other changes tested gave a significant difference between 1993–94 and 1994–95 and a significant increase between 1994–95 and 1996–97 (Table 4).

Two diarists in 1994–95 made high catches and few trips and these diarists were omitted to give the results labelled with an asterisk (*) in Table 4. Removing them made little difference to the results.

Figure 2 plots the blue cod harvest versus fishing time for each trip in the five summers of the survey. The least squares regression line (harvest versus fishing time) in each year is added to the plots. The slope of the regression line gives another estimator of mean harvest rate and changes in much the same way as the *HPUE* estimator. There is a weak positive correlation between harvest and fishing time.

2. To determine the distribution of current fishing effort.

At the conclusion of the study, 50 of the original 65 diarists (77%) were still active, two (3%) could not be located, 10 (15%) had withdrawn, and three (5%) had died. Of those still active, 21 (42%) were from Stewart Island, 19 (38%) from Southland, seven (14%) from Otago, and three (6%) from Canterbury.

Diarists varied significantly in the number of trips they made ($F_{(50,473)}=3.52$, $p<0.0001$), the total hours they fished ($F_{(50,473)}=4.45$, $p<0.0001$), and the length of their trips ($F_{(50,473)}=7.70$, $p<0.0001$).

Most fishing trips were about one hour. Average trip time varied between seasons, with summer trips usually shortest in most fishing zones (Fig 4), but not significantly so ($F_{(3,473)}=1.02$, $p=0.306$). While trip time also varied between zones, this was not significant ($F_{(9,473)}=0.92$, $p=0.510$).

Within years the majority of trips were done in the summer quarter (December – February), then autumn (March – May) or spring (September – November). This seasonal pattern of summer fishing was significant ($F_{(3,473)}=3.02$, $p=0.029$) and relatively consistent in all fishing zones (Fig 3), except zone two, which accounted for only 2.39% of fishing time.

Log transforming the data (the hours of fishing done) increases the proportion of variance explained, but not the inferences.

Distribution of fishing effort

A total of 1352 hours fishing in Paterson Inlet were recorded throughout the five years of the diary survey. These hours were done over 1374 trips giving an overall average trip time of 59 minutes. However the distribution of these trips between fishing zones differed between years ($\chi^2_{(8)}=89.1$, $p<0.001$; Fig 3).

Overall, zone 4 was most fished, this area surrounding Ulva Island at the eastern end of Paterson Inlet (Fig 1) accounting for 42.28% of all fishing. The next most utilised areas were zones 1 (19.39%) and 3 (12.96%) also at the eastern end of Paterson Inlet (Fig 5). Zones 2, and 5 through to 9 accounted for only 25% of all fishing time (Fig 5).

Fishing in zone 4 was greatest over winter (53.31%) and spring (55.30%). Per diarist, the zone effect was highly significant for both numbers of trips ($F_{(3,473)}$=8.80, p<0.0001) and hours fished ($F_{(3,473)}$=5.14, p<0.0001).

Species targeted and caught

Although some trips had more than one target species, counts of target species showed that blue cod (*Parapercis colias*) was the most frequently targeted species (54.04%) followed by scallops (*Pecten novaezelandiae*) (14.25%), paua (*Haliotis iris*) (13.92%), flat fish (*Rhombosolea* species) (5.42%), mussels (*Mytilus edulis*) (3.33%), tuatua (*Paphies subtriangulata*) (1.9%), crayfish (*Jasus edwardsii*) (1.76%), trumpeter (*Tasmanian trumpeter*) (1.63%), and oysters (*Ostrea lutaria*) (1.05%). All other species were targeted less than one percent of the time (See Appendix 6).

The fishing zones in which these species were targeted are shown in Figure 6. Zones 1 and 4 include all species except oysters, which were targeted mostly in zones 3 and 9. While most species were targeted in several zones, catches of paua and tuatua were almost exclusively from zone 4.

Throughout the five years of the survey, 16 468 individual fish were caught by the 65 participating diarists in Paterson Inlet (See Appendix 7). No information on fish weights are presented here as that information was spasmodic and considered unreliable. However, numbers of catch by fishing zone (Fig 7) largely reflected targeting (Fig 6) except for flat fish which seem to be easier to catch in zone 3.

Methods used

Over the entire survey, most zones showed a variety of methods used, but the major method of fishing was line fishing from a private boat. The exception was zone 9 where it was diving from a private boat (Fig 8). Areas to the south-east of the inlet showed more line fishing from charter boats (zones 1-3, & 6) and diving occurred in most zones (Fig 8).

When presented seasonally (Figs 9-12), summer (Fig 9) most reflects overall fishing patterns as most fishing is done at this time. However, over the other seasons line fishing from a private boat was no longer the main method, and comparatively (not absolutely) more diving is done in autumn and winter (Figs 10 & 11). The pattern of charter boat line fishing in zones 1, 3 and 6 persists in all seasons (Figs 9-12).

12. Conclusions

1. To monitor changes in recreational catch-per-unit effort for major fish species in Paterson Inlet, Stewart Island from a fishing diary survey.

There appear to have been some year to year changes in average harvest rate, which can be taken as significant. However, no significant difference between the first and last summers of the survey could be detected. It is possible that the number of diarists is too small and the variability in the harvest rates is a gross underestimate of the true variability leading to spurious significance levels. Alternatively, the blue cod harvest

rates may be governed by some undetermined factor, unrelated to management measures. Natural variability in blue cod catches clearly occur between summers, however, these could be attributed to a host of factors such as fish biology and behaviour, weather conditions, fishers behaviour etc.

2. To determine the distribution of current fishing effort

Diarists varied in the number of trips they made and the number of trips made varied among years, seasons, and zones; most strongly among zones.

Diarists also varied in the total amount of fishing they did (in hours) between years and zones, but not among seasons. Again, the zone effect was the strongest (after the diarist effect). Diarists vary in the average length of their fishing trips but the average length of a fishing trip is relatively constant among years, among seasons, and among zones.

The three main Paterson Inlet fisheries were blue cod, paua and scallops; their distribution is discussed. Together, line fishing from boats and diving accounted for most trips, with boat fishing the more popular of the two methods.

The proposed marine reserve (Appendix 2) is located within zones 3 and 4 of the current study areas (Appendix 3). As these areas account for 55% of all fishing in Paterson Inlet there is considerable potential for displacement of recreational fishing activity due to the establishment of the marine reserve.

13. Publications

There are no publications relating to this project other than internal reports such as the 1997 progress report and Bradford 1997.

14. Data Storage

The data collected in this project is stored on the MFish recreational database housed at Greta Point.

Acknowledgement

The diarists who generously donated their time for five years of this project are thanked. Work done by Elizabeth Bradford and Jill Parkyn, and advice from Martin Cryer was greatly appreciated. MathSoft Inc. owns the SPLUS software program and its documentation. Both the program and its documentation are copyrighted with all rights reserved by MathSoft. This study was carried out under project REC9704 as part of the contract for fisheries research services funded by the New Zealand Ministry of Fisheries.

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Table 1: Summary statistics of the blue cod harvest as obtained from the Paterson Inlet diary survey during the summer months (December to February) over the 5 years of the survey

	1993–4	1994–5	1995–6	1996–7	1997–8
Number of diarists: N_D	29	24	11	12	11
Number of trips: N_T	128	100	50	47	39
Total BCO harvest: H	730	478	279	357	227
Total hours fished: E	138.25	109.33	57.58	48.58	48.41
$HPUE = H/E$ (fish per hour)	5.28	4.37	4.85	7.35	4.69

Table 2: Results from statistical tests using individual trip harvest rates (not paired). Mean harvest rates (fish per hour) in the first and second summers (M_1 and M_2), the degrees of freedom (df), t-statistic and its p-value, Wilcoxon Z statistic and its p-value, and the significance level of the permutation test (perm-test). S9394 —S9495 compares data from the 1993–94 summer with the 1994–95 summer and so on

	M_1	M_2	df	t-statistic	p-value	Wilcoxon-Z	p-value	perm-test
S9394 — S9495	6.330	5.002	226	2.386	0.018	2.077	0.038	0.011
S9394 — S9798	6.330	6.993	165	-0.733	0.475	-0.099	0.921	0.227
S9495 — S9697	5.002	8.822	145	-4.350	0.000	-3.267	0.001	0.000
S9495 — S9798	5.002	6.993	137	1.275	0.206	-1.443	0.149	0.009
S9697 — S9798	8.822	6.993	84	-2.423	0.017	1.357	0.175	0.107

Table 3: **Results from statistical tests using diarist mean harvest rates (not paired). Mean harvest rates (fish per hour) in the first and second summers (M_1 and M_2), the degrees of freedom (df), t-statistic and its p-value, Wilcoxon Z statistic and its p-value, and the significance level of the permutation test (perm-test). S9394 —S9495 compares data from the 1993–94 summer with the 1994–95 summer and so on**

	M_1	M_2	df	t-statistic	p-value	Wilcoxon-Z	p-value	perm-test
S9394 — S9495	6.213	5.174	51	0.935	0.354	1.117	0.264	0.178
S9394 — S9798	6.213	7.063	38	-0.538	0.594	-0.257	0.797	0.285
S9495 — S9697	5.174	9.222	34	-2.177	0.037	-2.048	0.041	0.021
S9495 — S9798	5.174	7.063	33	-1.155	0.257	-0.729	0.466	0.136
S9697 — S9798	9.222	7.063	21	0.803	0.431	0.893	0.372	0.216

Table 4: **Results from statistical tests using paired diarist mean harvest rates. Mean paired difference harvest rates in the first and second summers (mean diff), the number of diarists (N_D), t-statistic and its p-value, Wilcoxon Z statistic and its p-value, and the significance level of the permutation test (perm-test). S9394 —S9495 compares data from the 1993–94 summer with the 1994–95 summer and so on. * indicates results minus the two diarists with largest harvest rates**

	mean diff	N_D	t-statistic	p-value	Wilcoxon-Z	p-value	perm-test
S9394 — S9495	2.041	18	2.861	0.011	144	0.009	0.044
S9394 — S9798	-1.131	7	-1.618	0.157	5	0.156	0.313
S9495 — S9697	-4.674	11	-2.382	0.039	-2.446	0.014	0.051
S9495 — S9798	-3.354	8	-2.281	0.057	4	0.055	0.010
S9697 — S9798	0.116	6	0.099	0.925	14	0.563	0.479
S9394 — S9495*	1.984	17	2.632	0.018	126	0.017	0.053
S9495 — S9697*	-2.574	9	-2.425	0.042	5	0.039	0.014

Appendix 6

Estimators

Let x_i and y_i represent the effort and catch on an individual trip i (i = 1 .... n). The harvest rate for that trip is $h_i = y_i/x_i$. Two methods of estimating average harvest rates for the total n trips are called the mean-of-ratios estimator (H_1) and ratio-of-means estimator (H_2) which are formally defined as

$$H_1 = \sum_{i=1}^{n} h_i / n \quad \text{and} \quad H_2 = \sum_{i=1}^{n} y_i / \sum_{i=1}^{n} x_i$$

where the sample size cancels out in the definition of H_2.

Statistical hypotheses and assumptions used when comparing two data sets

The SPLUS© implementations of the *t*-test and the Wilcoxon test are used.

Let x and y represent the two data sets.

t-test

Null hypothesis: For the standard two sample *t*-test, the null hypothesis is that the population mean for x minus that for y is μ. For the paired t-test, the null hypothesis is that the population mean of x - y is equal to μ. The alternative hypothesis indicates the direction of divergence of the difference of population means for x and y from μ.

Assumptions: Equal population variances have been assumed. The value of μ is 0. Two sided tests are used. No corrections are applied.

Wilcoxon rank sum and signed rank sum tests

Null hypothesis: For the Wilcoxon rank sum test, the null hypothesis is that the locations of the distributions of x and y differ by μ. For the two-sample paired case of the Wilcoxon signed rank test, the null hypothesis is that the median of the distribution of x - y is μ.

Assumptions: For the Wilcoxon rank sum test, the x and y vectors are independent samples from their respective distributions, and there is mutual independence between the two samples. For the Wilcoxon signed rank test the values of x and x - y are independent observations from the same symmetric distribution. The value of μ is 0. Two sided tests are used. No corrections are applied. A normal approximation is used when the length of x or y is greater than 49 for the Wilcoxon rank sum test and greater than 25 for the Wilcoxon signed rank test. Normal approximations are used when there are ties in the data. (The test statistic is an integer when the standard formula is used, and a value similar to a *t*-statistic when one of the normal approximations is used.)

Permutation test

This test combines the two data sets x and y of length n_x and n_y. The combined data are sampled without replacement assigning the first n_x values to the new x' and the remainder to the new y'. The statistic to be used (in this case the difference of the means of x' and y') is then estimated for the new data. The test counts the proportion of times the values of the test statistic is equal to or greater than (equal to or less than to) the value of the test statistic from the original data. This is one of the earliest of the resampling tests and was introduced by Fisher (1936) in the pre-computer days and is described in Manly (1991) for example.

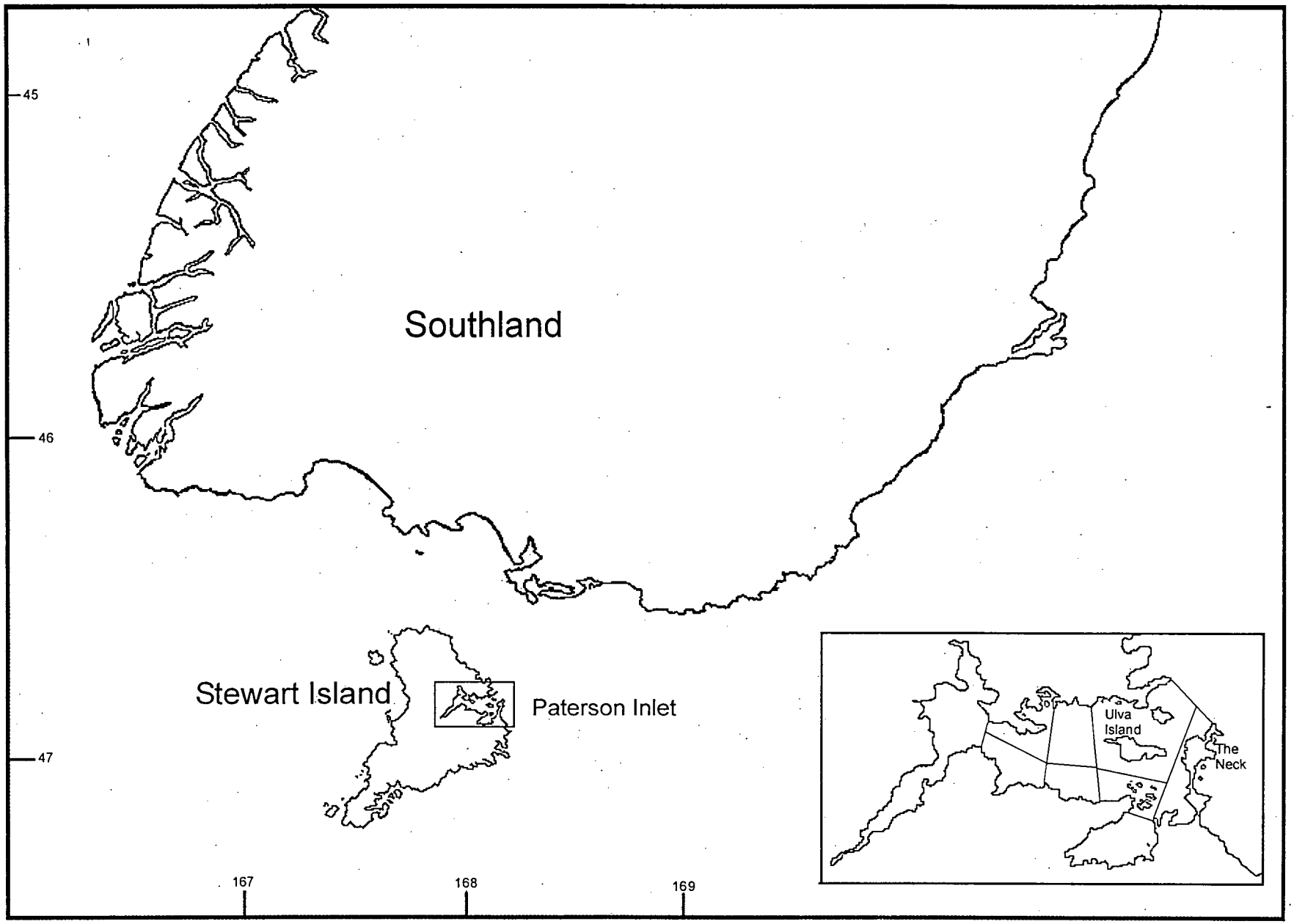


Figure 1: Map of Southland and Stewart Island with inset of Paterson Inlet

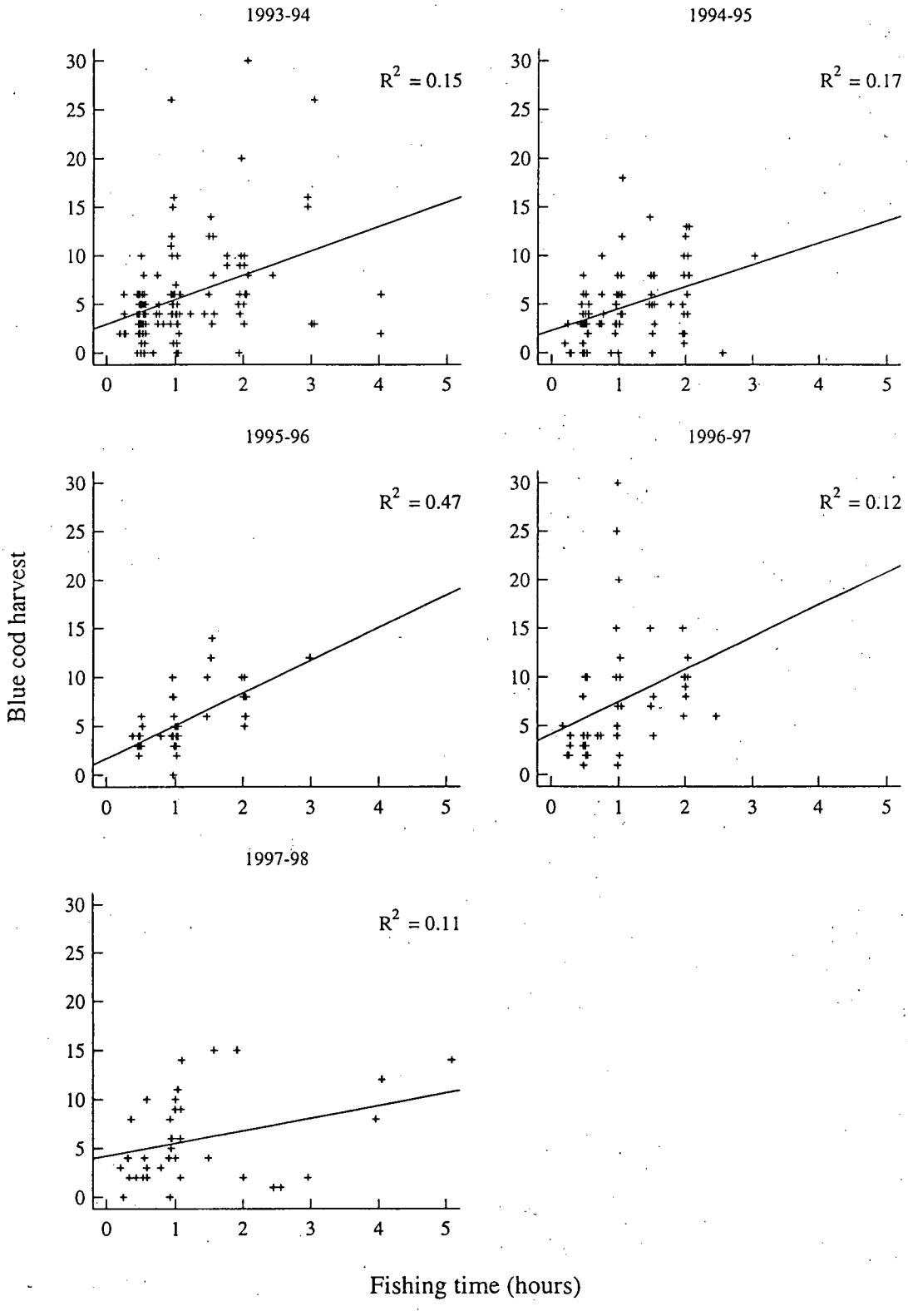


Figure 2: Blue cod harvest versus fishing time for individual trips in the five summer (January to February) of the Paterson Inlet diary survey. The fishing times are jittered to reduce the number of overlying points. The regression lines of harvest versus catch and their R^2 values are added.

Figure 3
Total seasonal hours per fishing zone

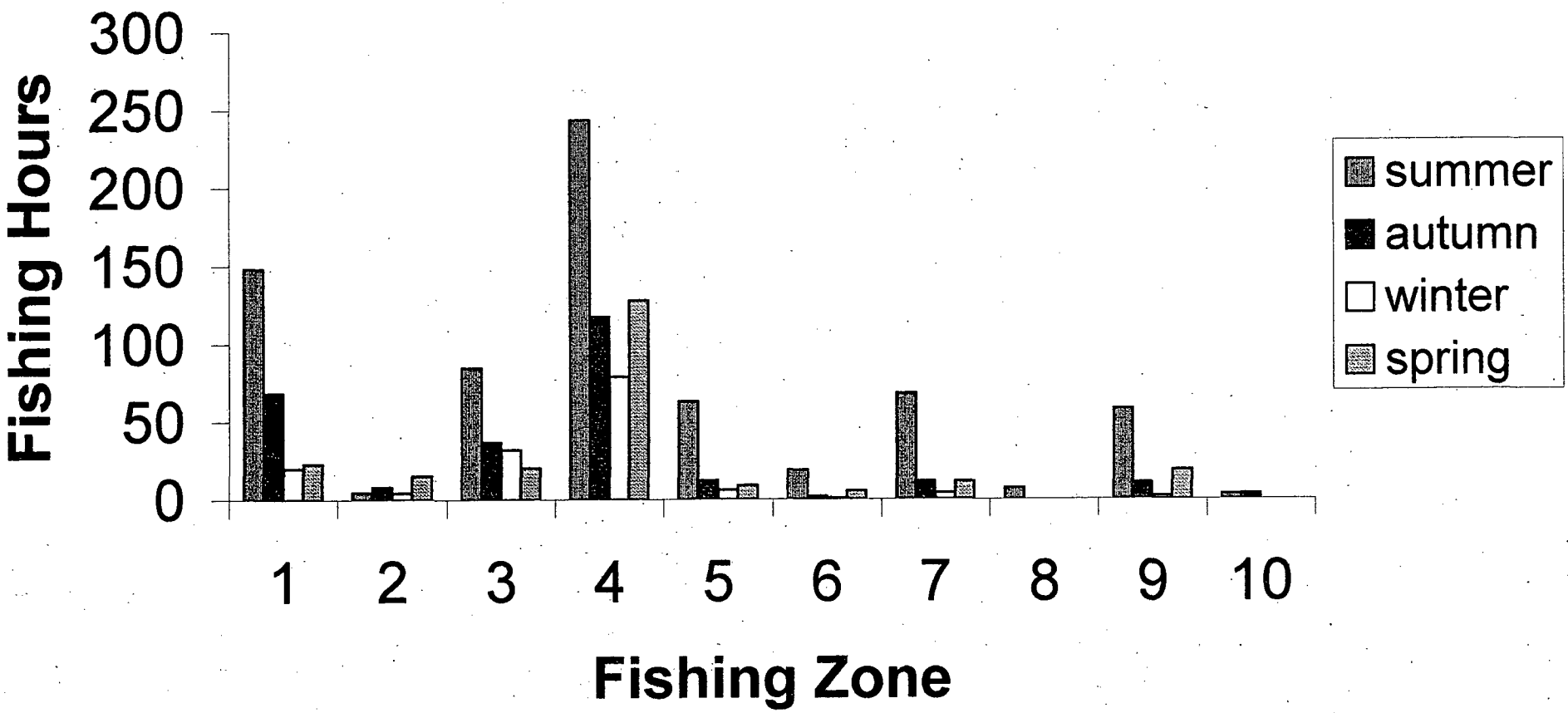
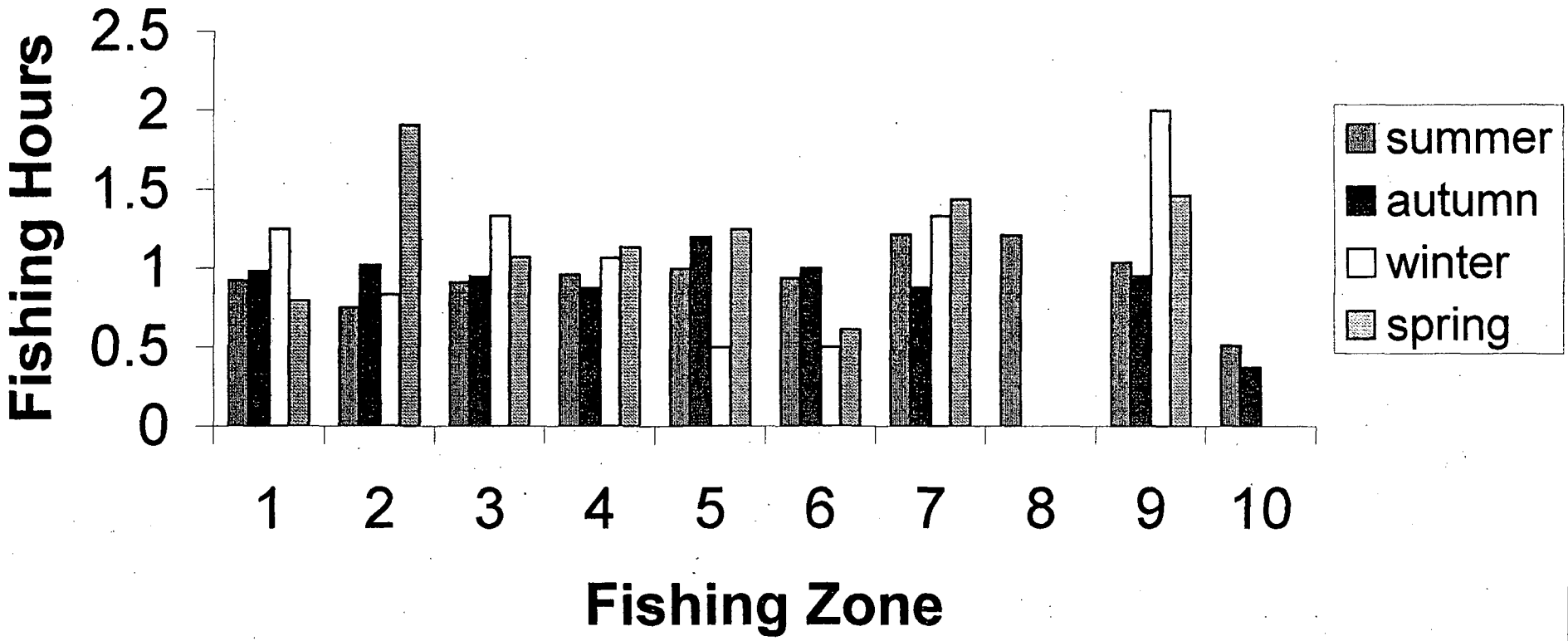


Figure 4
Average trip time for each season per fishing zone



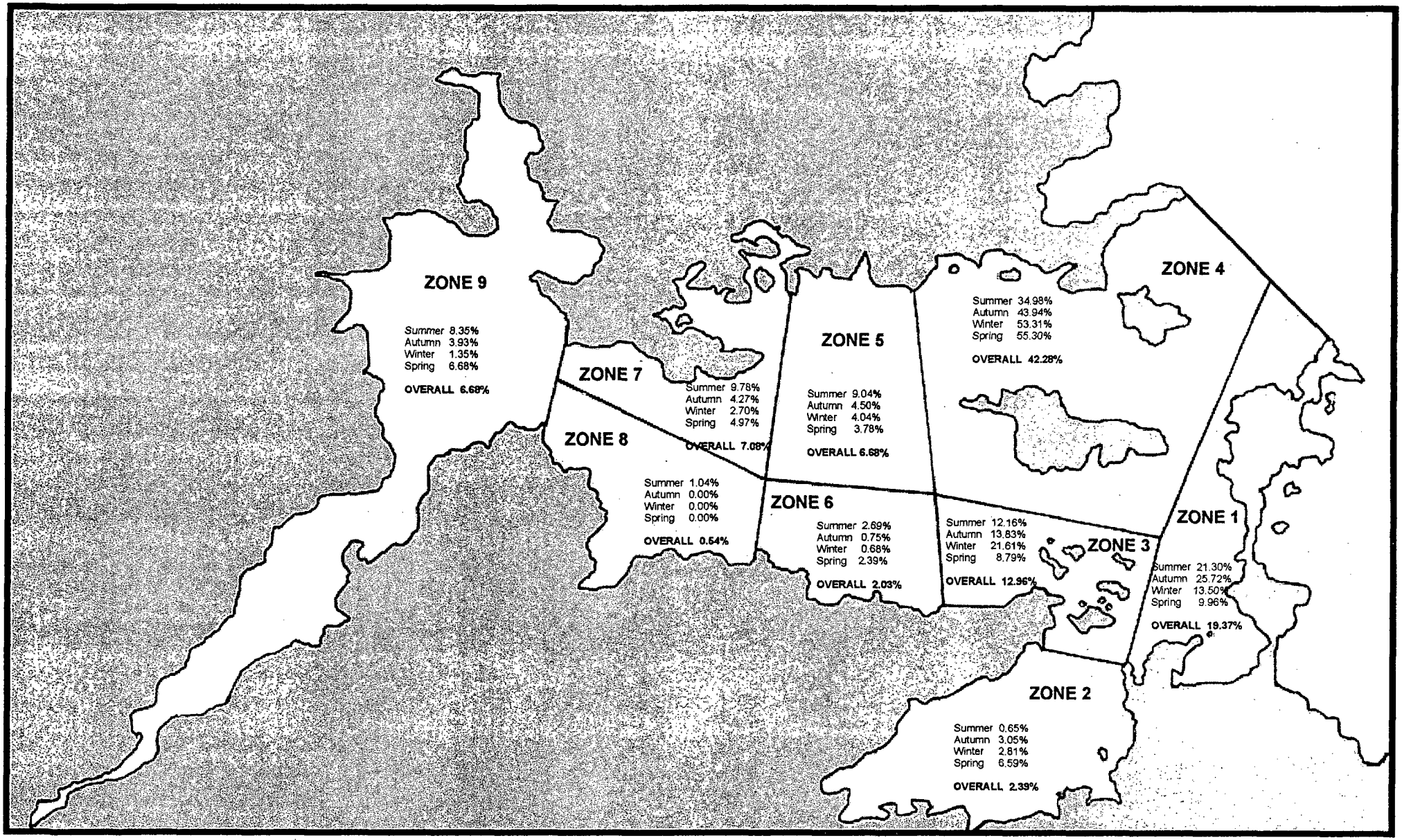


Figure 5: Map of total seasonal hours and total hours overall spent fishing in each zone

Figure 6. Targeting per fishing zone for major target species in Paterson Inlet

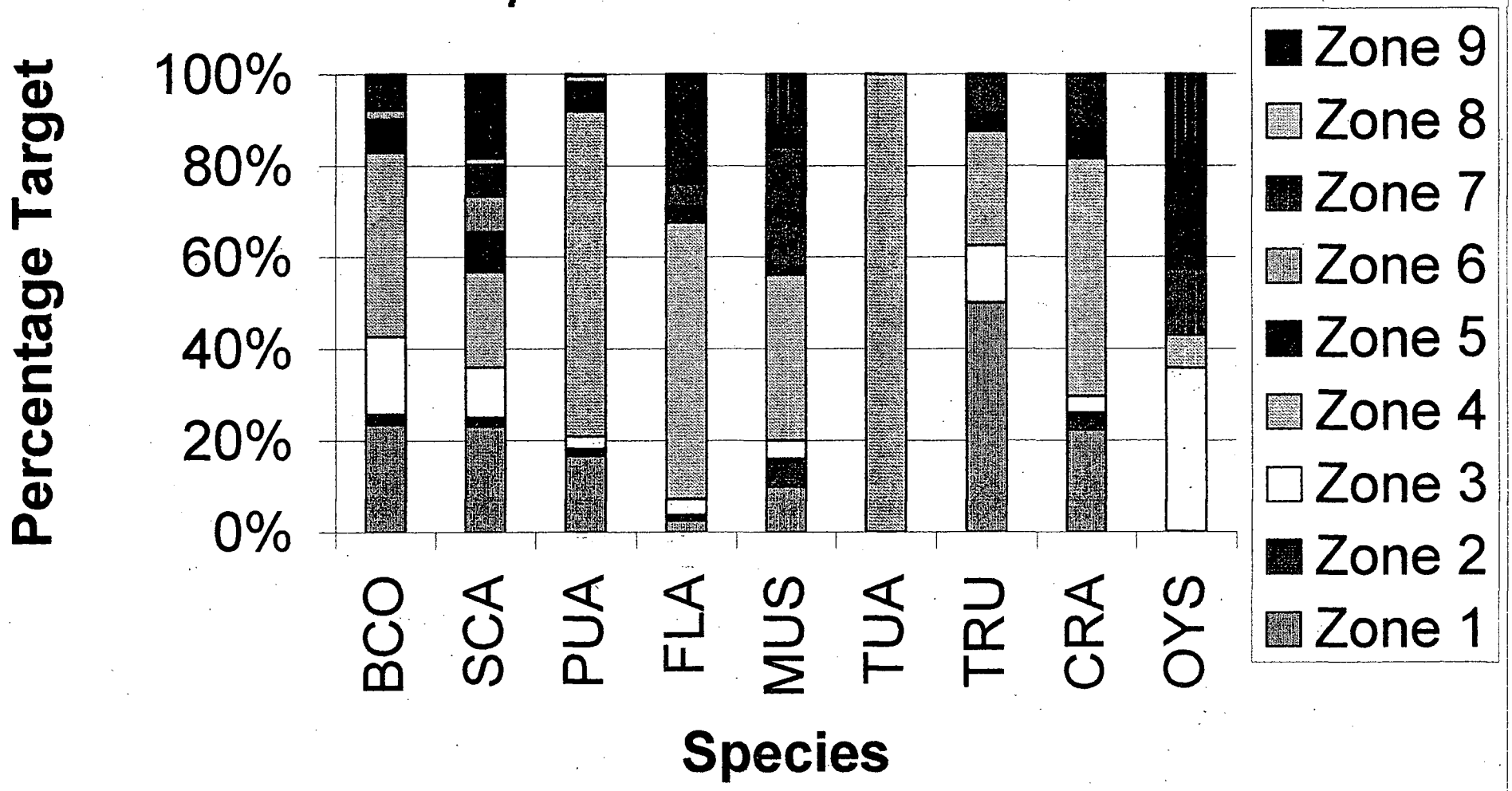
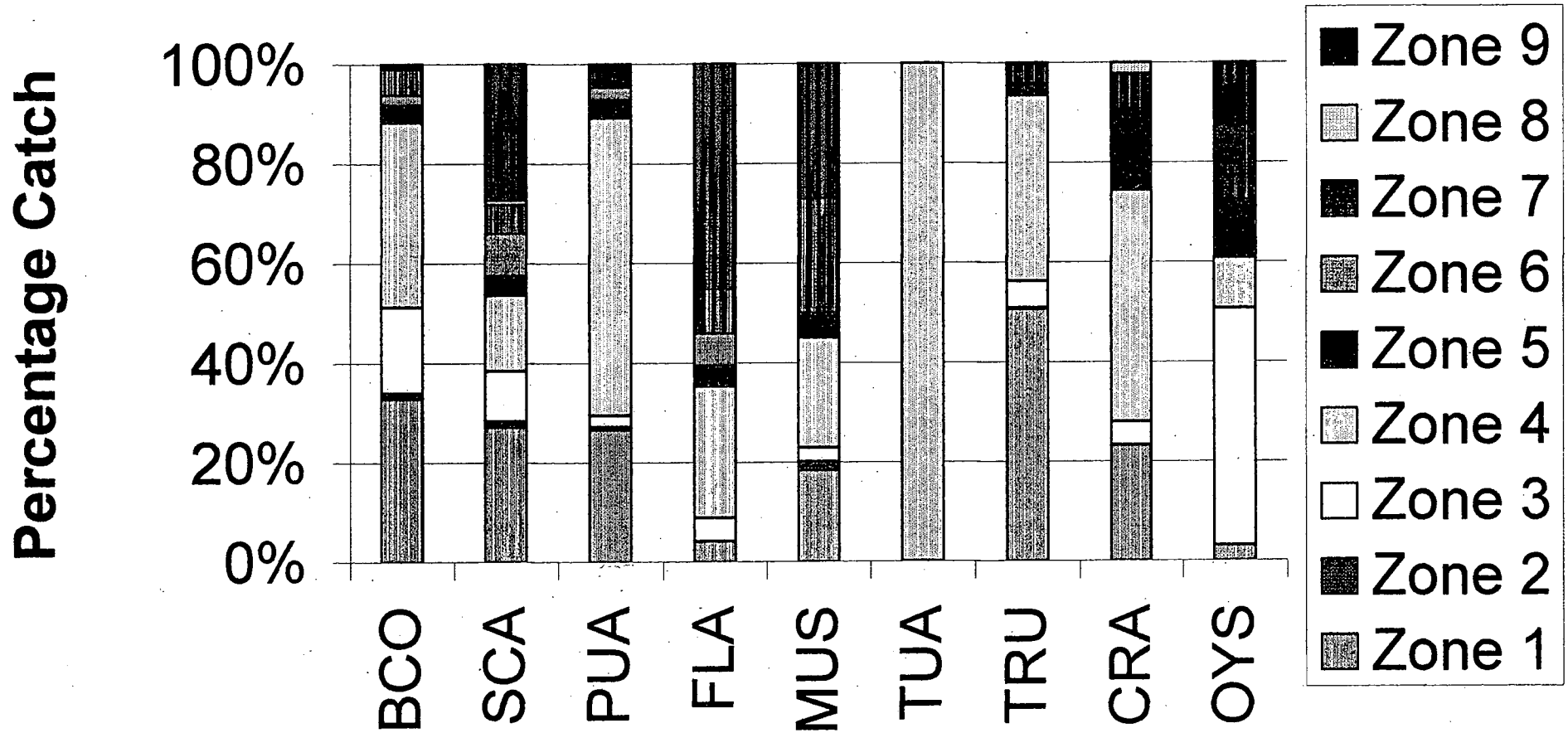


Figure 7. Catch per fishing zone for major target species in Paterson Inlet



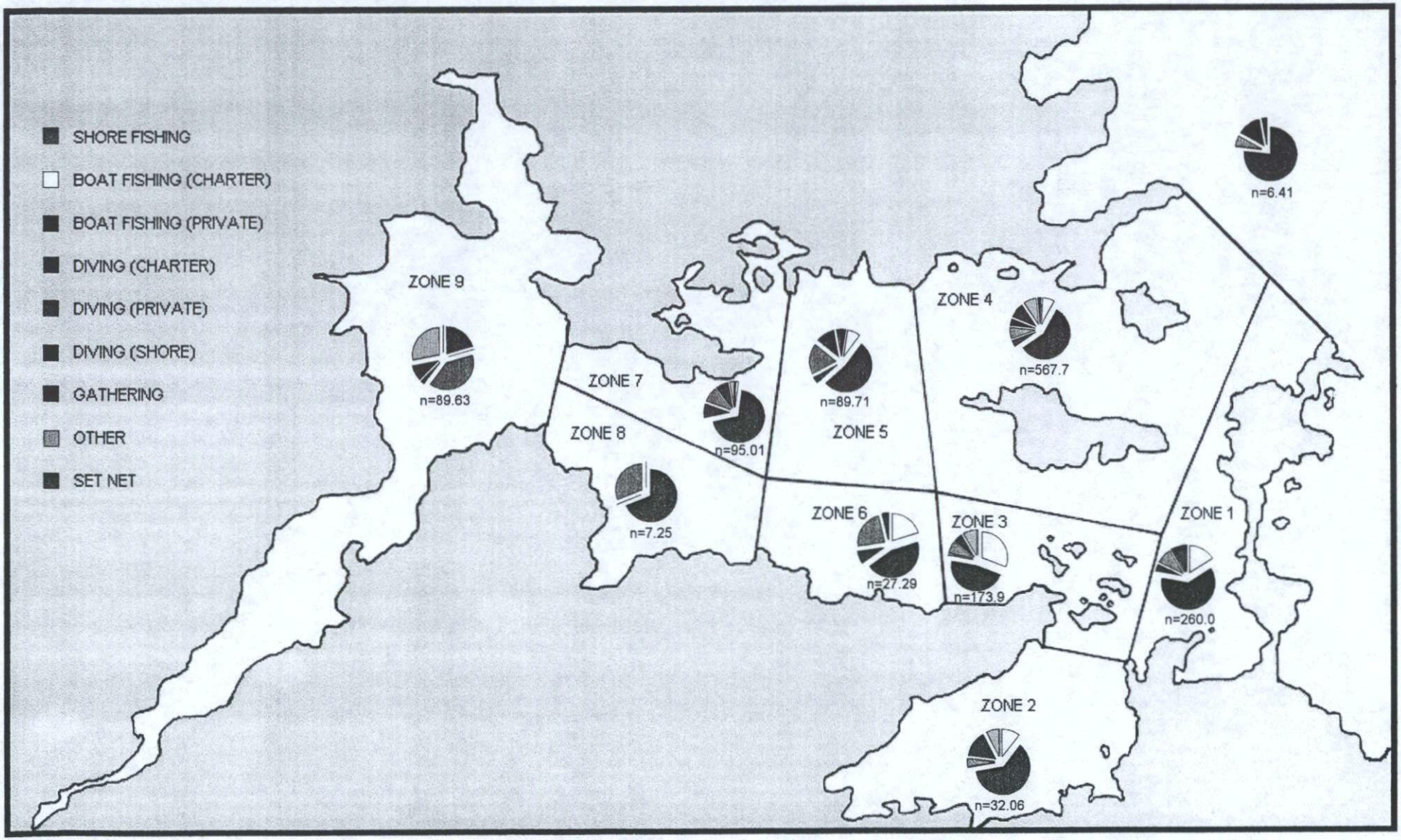


Figure 8: Methods by zone for overall fishing, n=total hours fished.

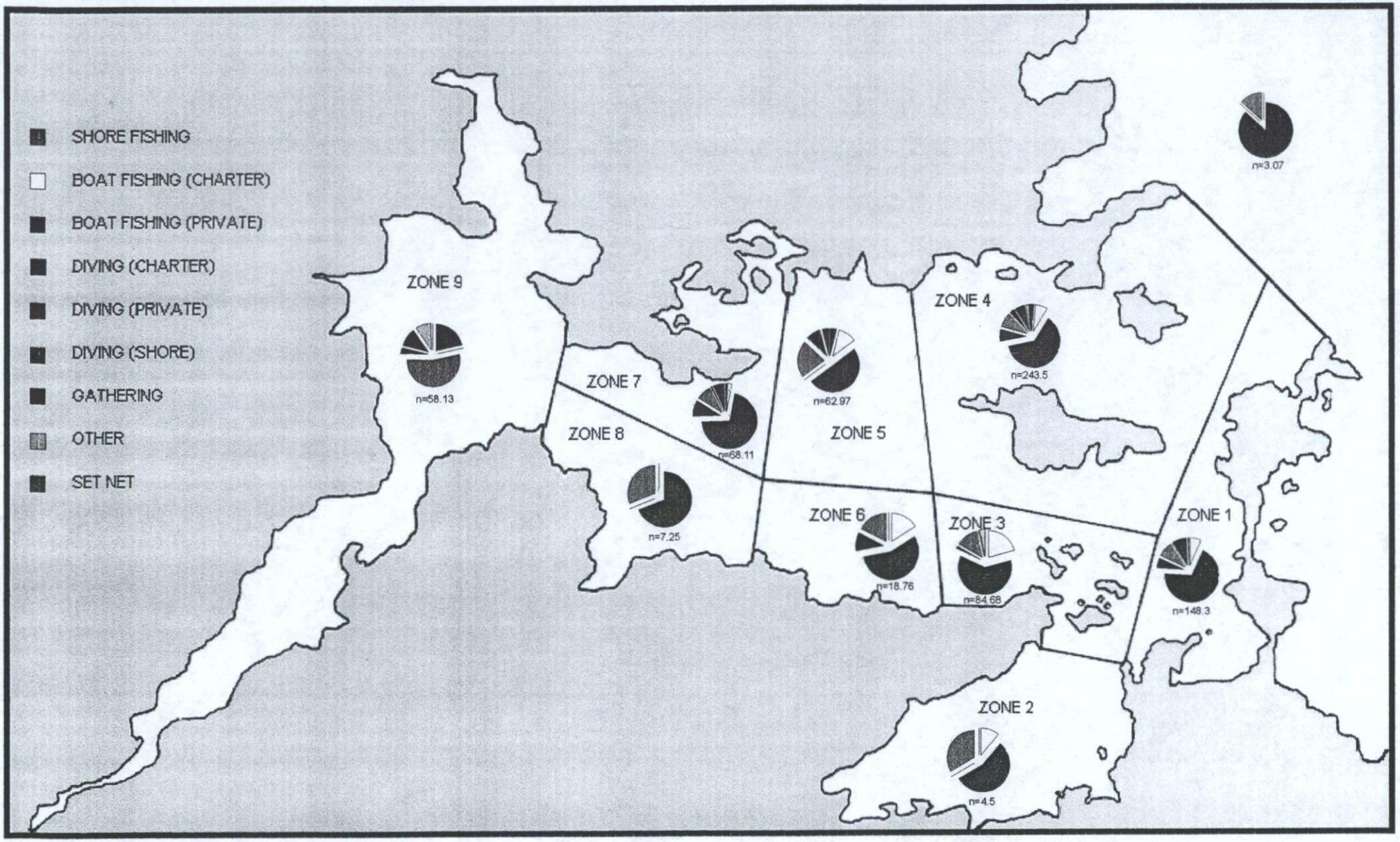


Figure 9: Methods by zone for cumulative summers fishing, n=total hours fished.

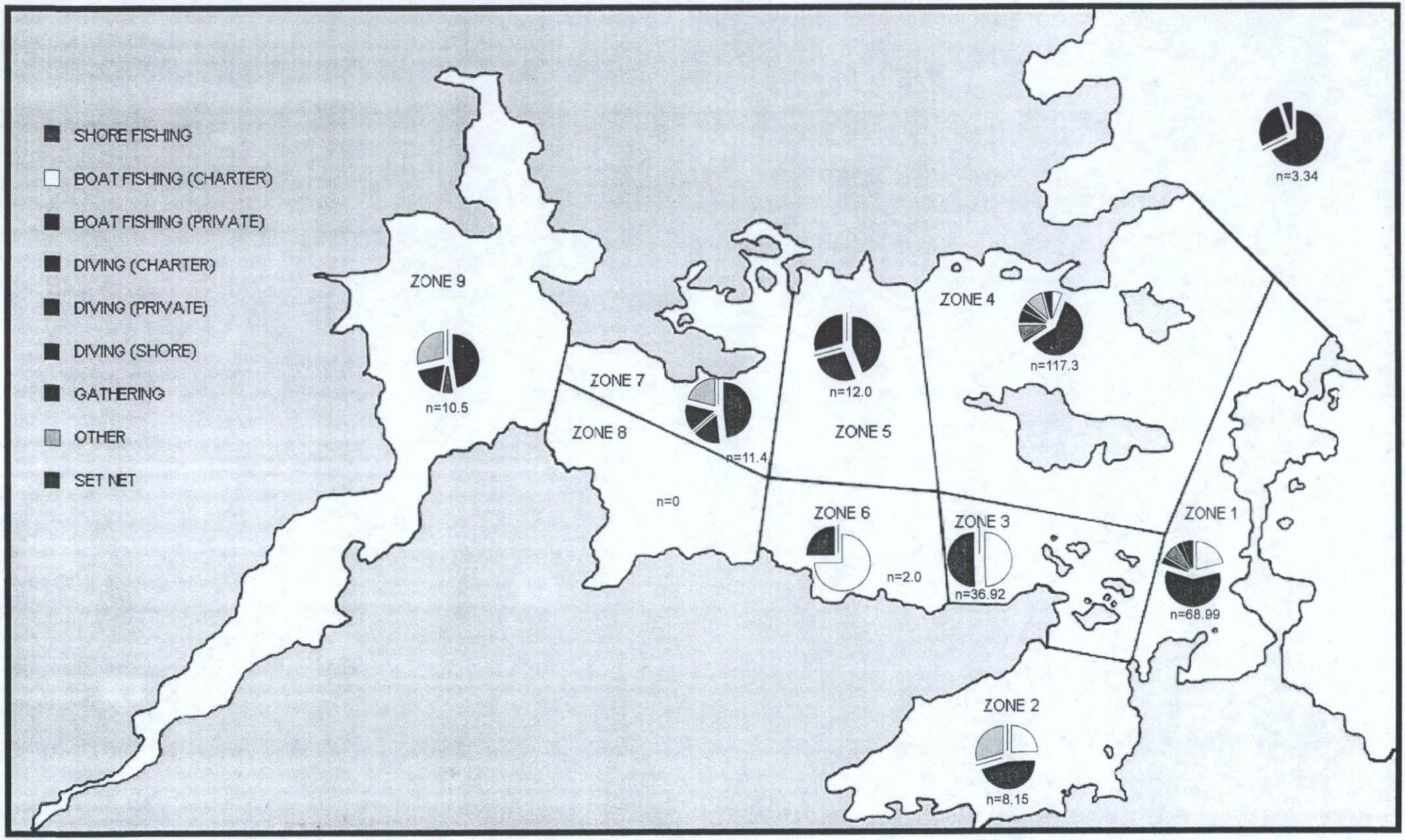


Figure 10: Methods by zone for cumulative autumns fishing, n=total hours fished.

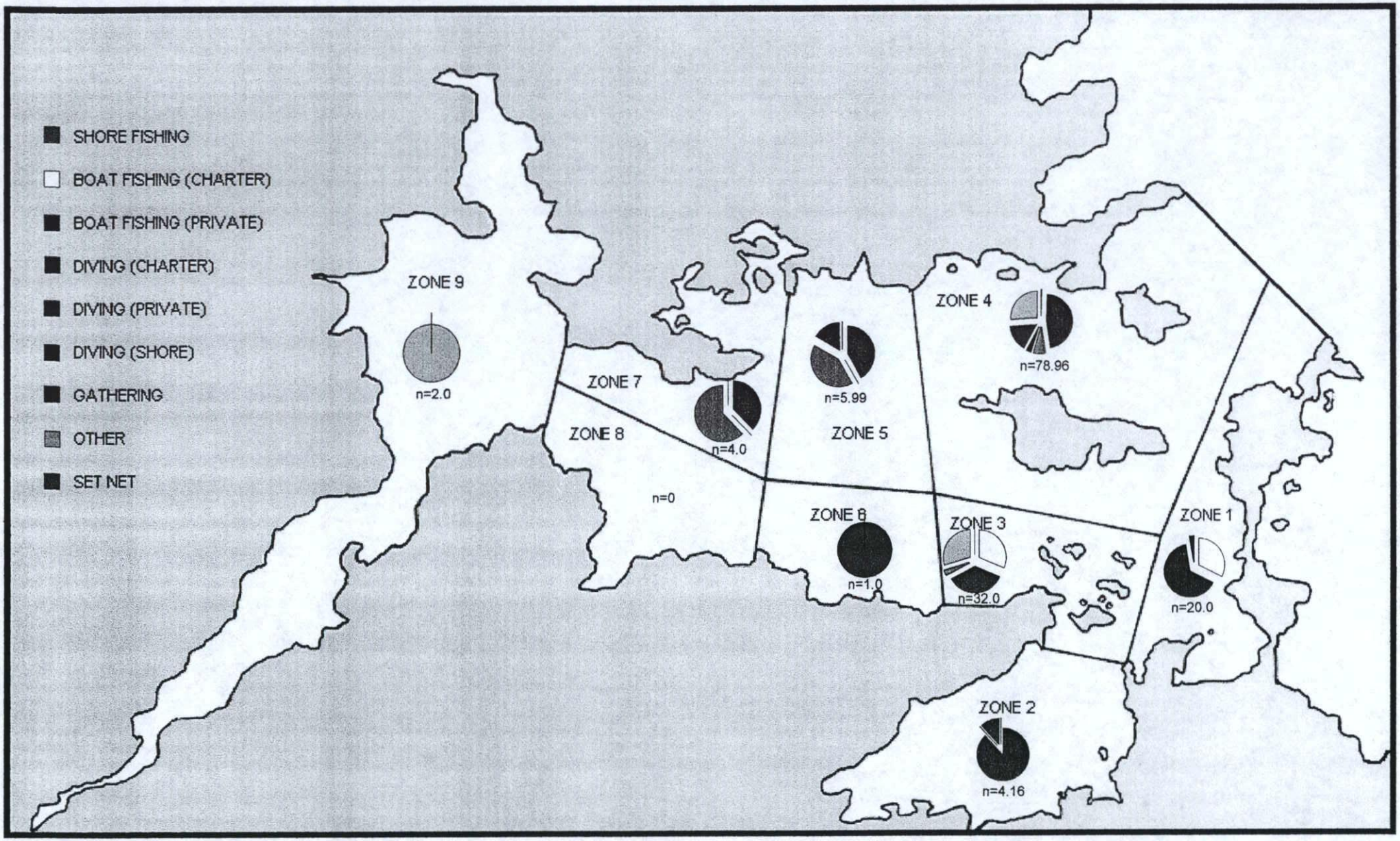


Figure 11: Methods by zone for cumulative winters fishing, n=total hours fished.

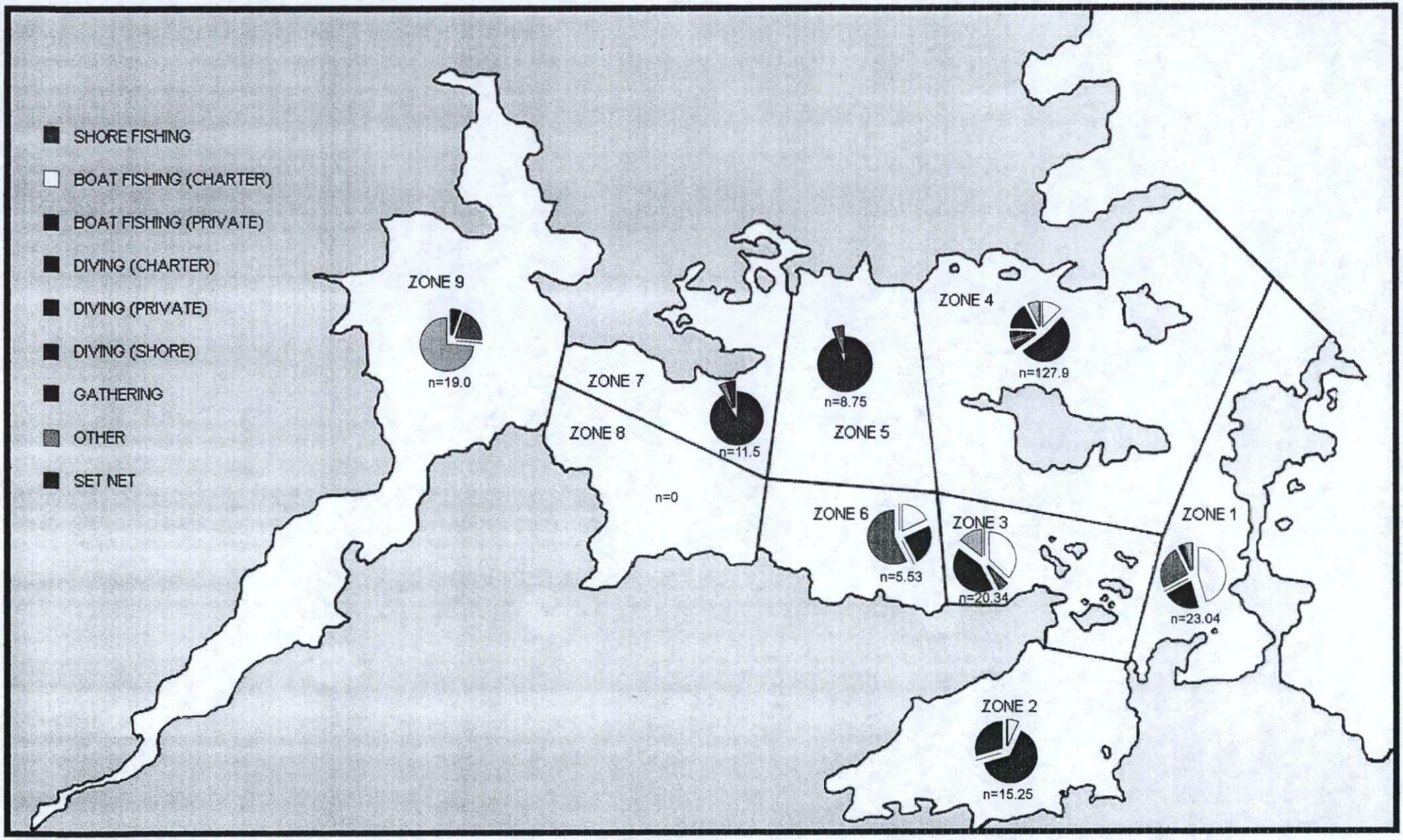
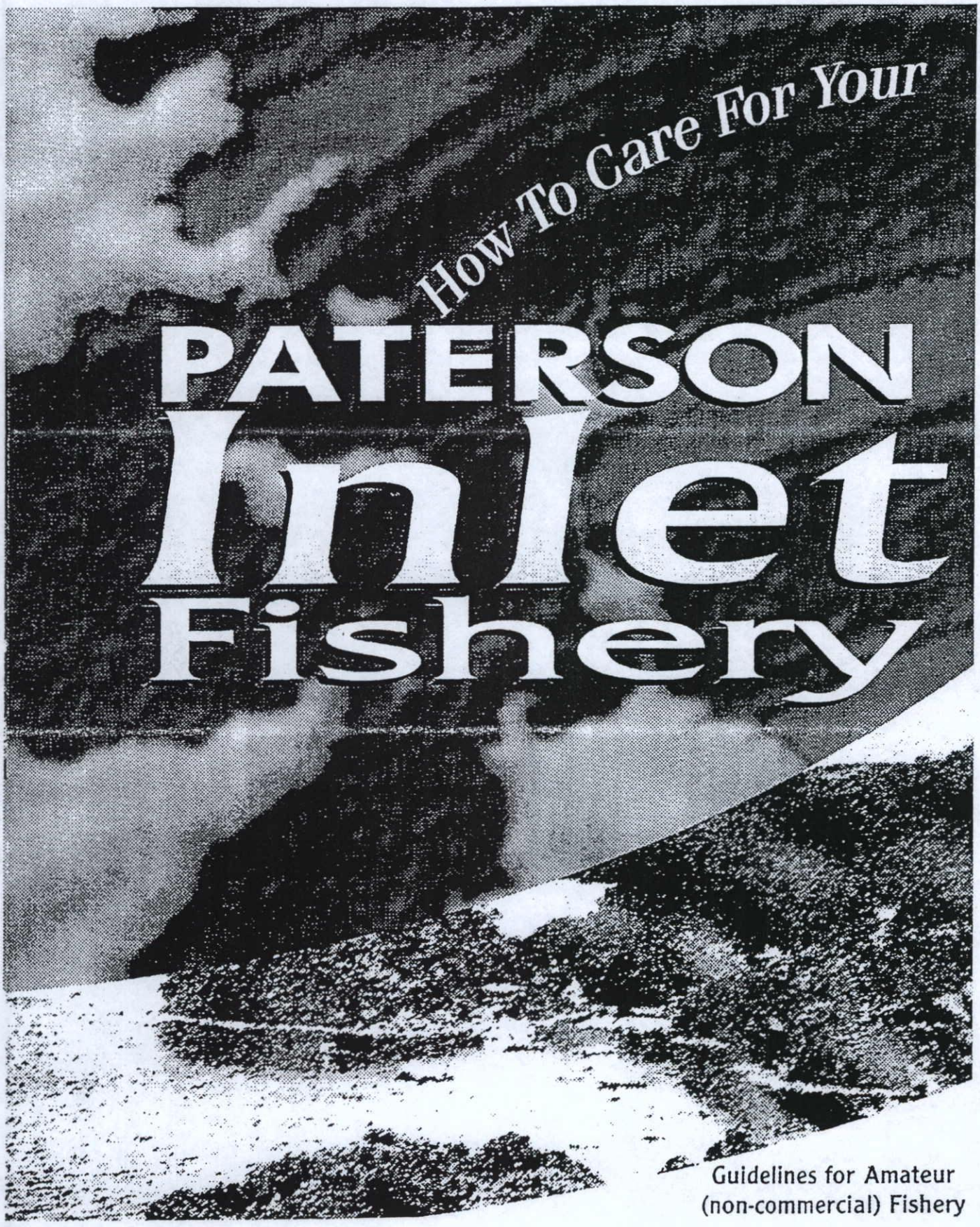
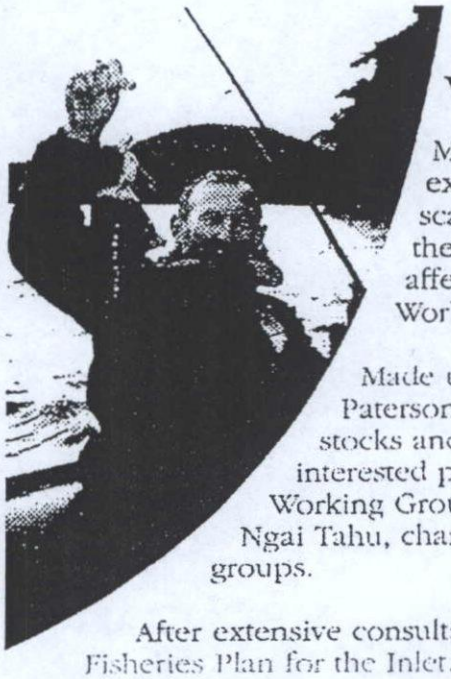


Figure 12: Methods by zone for cumulative springs fishing, n=total hours fished.

EDUCATIONAL PAMPHLET





Working for Paterson Inlet

Many locals and visitors are coming to Paterson Inlet expecting to catch some of the Inlet's famous blue cod, scallops and paua. Should the numbers of fishers increase, the sustainability of the fishery in the Inlet could be seriously affected which is why in 1992, the Paterson Inlet Fisheries Working Group was set up.

Made up of fishers with a long term commitment to the area, the Paterson Inlet Fisheries Working Group aims to look after the fish stocks and the marine environment in which they live. The many interested parties involved in the fishery are represented in the Working Group, including: noncommercial and commercial fishers, Ngai Tahu, charter boat operators, marine farmers and environmental groups.

After extensive consultation, the Working Group produced a Fisheries Plan for the Inlet. This comprehensive package of management measures resulted in:

- *commercial fishers volunteering to no longer fish the Inlet;*
- *charter boat operators adopting a fishing code of practice.*
- *revised Amateur Fishing Regulations that came into force on 1 October 1994;*
- *monitoring, education and publicity about the fishery.*

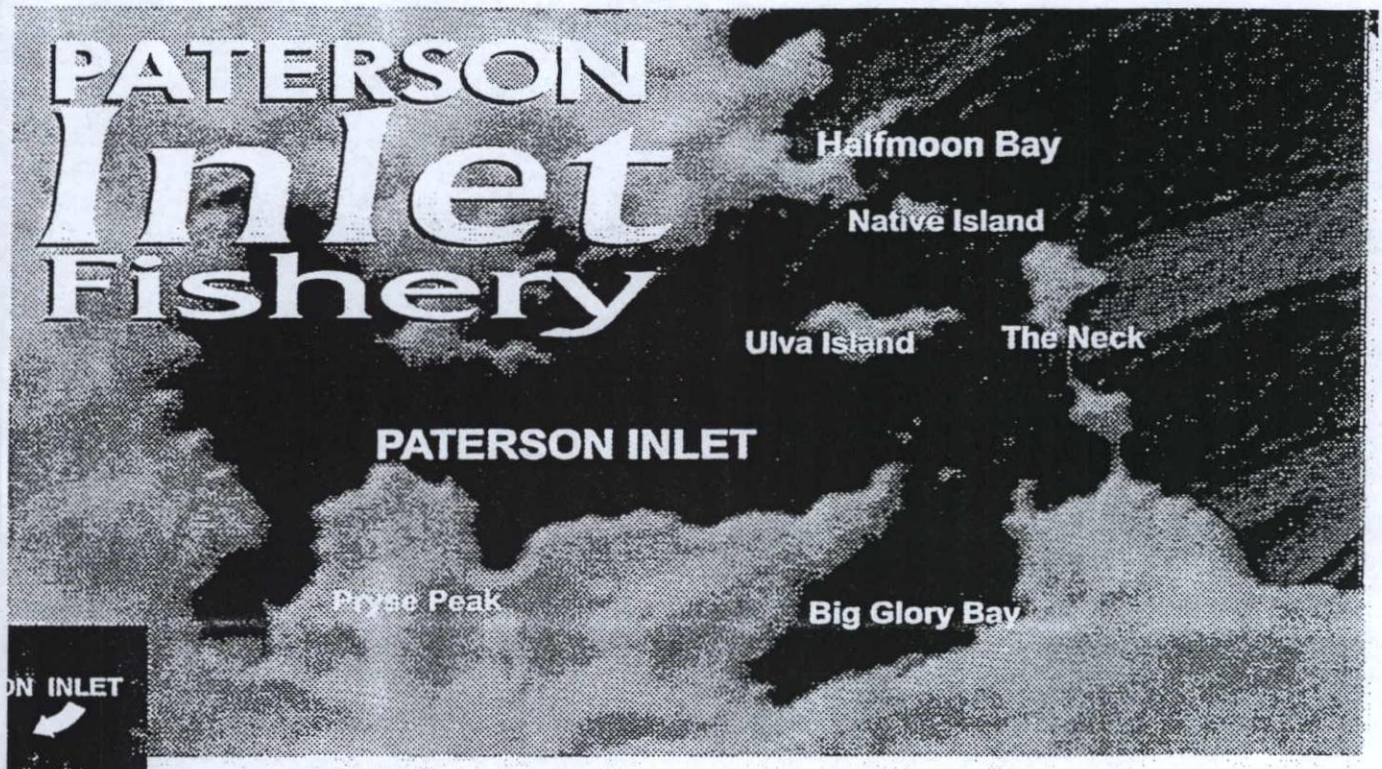
No more Commercial Fishing in the Inlet

Commercial fishers were as enthusiastic as any to ensure the sustainability of the Paterson Inlet fishery. They generously offered to forgo future commercial opportunities, and on 1 October 1994 they withdrew from the Inlet.

A Fishing Code of Practice for Charter Boat Operators

Some of the fishing practices in the code that will conserve the Inlet's fish stocks include:

- *take only what you need - restrict your catch to two or three fish per person;*
- *fish in difference places to avoid localised depletion;*
- *measure all fish and return the undersized carefully, alive and unharmed;*
- *take the first legal size fish you catch - don't keep fishing to try for larger fish.*



A Guide to Responsible Fishing

If you follow these simple rules you can manage your fishing so that you will have a great time in Paterson Inlet, while ensuring that everything will still be there, just the same for your next visit. The amateur fishing rules are relatively simple. There are three main things to remember.

Stay Within the Daily Limit

Taking more than the bag limit means that you are removing the parents of your future catches. Remember that only those people who are actually catching the finfish or shellfish are able to claim a daily limit.

Take Only for Your Own Use

Feed your family, not the neighborhood. Selling or trading your catch leads to more fish being taken than the Inlet's fishery can sustain.

Return any Undersize Fish

Undersize fish will grow to become your future catch. It is important to quickly return to the sea, alive and unharmed, any undersize fish, or fish taken in excess of your limit. Remember that paua and rock lobster need to quickly find a place to hide from predators, so return them as close as possible to the place they were found.

Paterson Inlet's Special Fishing Rules

The Paterson Inlet Fisheries Working Group used its wealth of knowledge and experience to develop a special set of fishing rules. They differ from the rules that apply outside the Inlet, and are designed to ensure the health and welfare of the fishery for the future.

Blue Cod Daily Limit - 15 per person per day.

As the finfish most popular with amateur fishers, blue cod is likely to feel the pressure from increased fishing in the Inlet. A lower daily limit will protect the population and spread the catch so that more people can enjoy fishing for blue cod.

The Scallops of Stewart Island

There are other general fishing rules which apply to all of Stewart Island, and those applying to scallops are particularly important to Paterson Inlet.

Scallop Daily Limit - 10 Per Person Per Day

The scallop bag limit for Southland, including Stewart Island, is lower than in other parts of New Zealand. The lower limit is important in Paterson Inlet, given the generally large size of the scallops and the potential for increased fishing pressure.

Scallop Open Season - From 1 October to 15 March

The open season has been changed to protect those scallops that are still spawning in July and August.

No Dredging for Shellfish

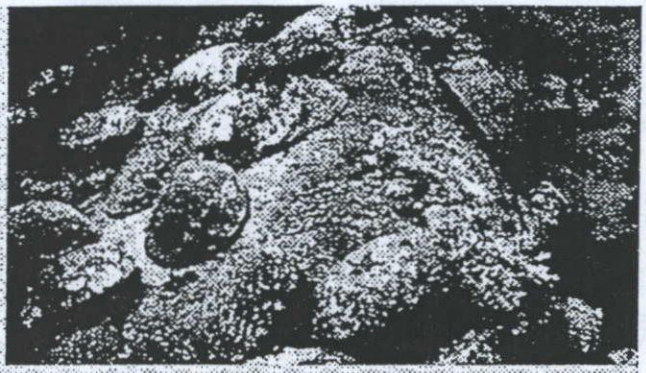
Dredges can damage the seabed and the large seaweed meadows that are home not only for scallops, but a wide range of other animals. Both the fish and their habitat need to be looked after.

No Set Nets, Long Lines or Cod Pots

Fishing techniques like cod pots, long lines (any line having more than seven hooks) and set nets are designed to catch several fish at a time. These are not the best methods to use if you want to stop fishing once you've taken what you can use.

Only Two Rock Lobster Pots per person Per Day

Paterson Inlet has few rock lobsters, so there is a restriction on the number of pots each person can set. This is to help conserve those animals left for both divers and fishers.



The Paterson Inlet Fishery

Beneath the clean, clear waters of Paterson Inlet, Stewart Island, is a wonderful diversity of underwater habitats supporting an abundance of marine life. Paterson Inlet has a healthy fishery prized by the local community and amateur fishers from around New Zealand and further afield.

How To Care For Your

PATERSON Inlet Fishery

Finfish

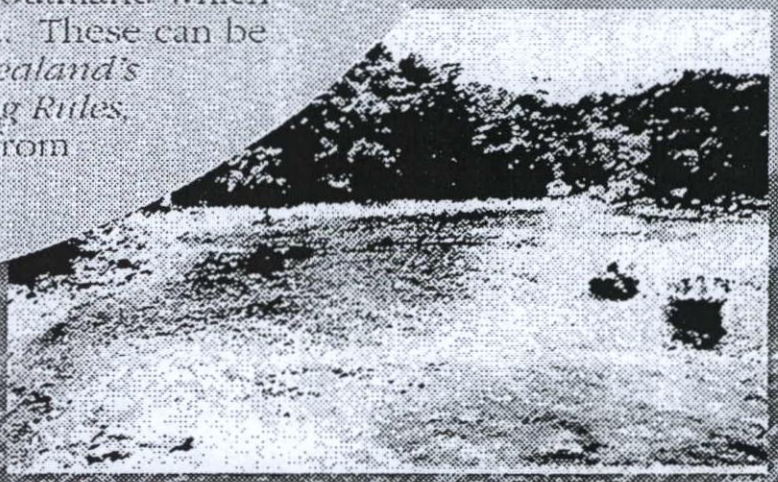
The Inlet is most famous for its blue cod, but fishers also commonly target trumpeter, flatfish and perch (Jock Stewart). Thanks to the range of aquatic communities in the Inlet, it is also possible to catch blue moki, tarakihi, red cod, gurnard, spotties, parrotfish, dogfish, barracouta and shark.

Shellfish

The huge scallops from Paterson Inlet are famous and all the more special because the Inlet is virtually the only area in southern New Zealand to support a scallop fishery. The Inlet's paua are frequently sought-after and to a lesser extent mussels, rock lobster, kina and cockles.

Use this pamphlet to help maximise your fishing pleasure while minimising the impacts on the Paterson Inlet fishery. It is a guide to responsible fishing practices and the regulations about catching finfish, shellfish and rock lobsters in Paterson Inlet.

There are other important restrictions relating to fish in Stewart Island and Southland which also apply to Paterson Inlet. These can be found in *A Guide to New Zealand's Marine Recreational Fishing Rules, Southern Region* available from your nearest Ministry of Fisheries office.



Further Information

For full details on amateur fishing restrictions, contact your nearest Ministry of Fisheries office. The complete regulations (Fisheries Act 1983 and associated regulations) are available from Bennetts Government Bookshops.

Produced by the Ministry of Fisheries and the Paterson Inlet Fisheries Working Group - September 1996

MINISTRY OF FISHERIES
Te Tautiaki i nga tini a Tangaroa

Appendix 2
Marine Reserve proposal

PATERSON INLET MARINE RESERVE PROPOSAL

Newsletter December 1994

Progress Report

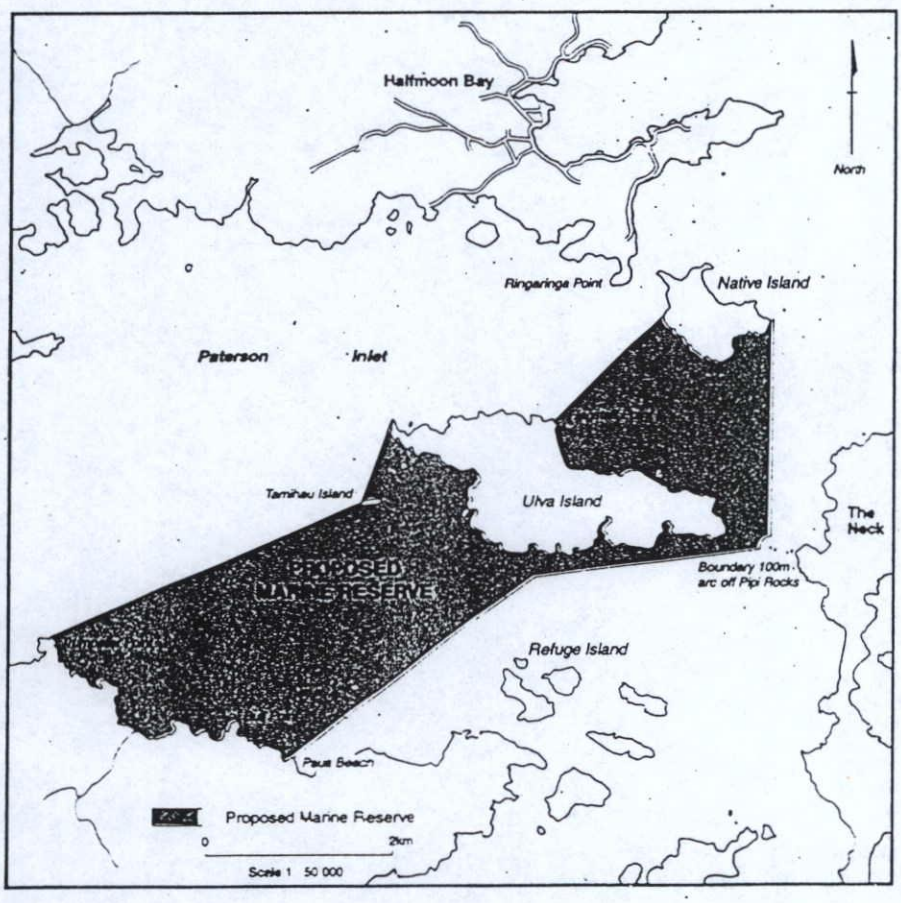
This newsletter gives an update on the Paterson Inlet Marine Reserve proposal for people who have made comment on earlier discussion documents, and for anyone else who has an interest in the proposal or Paterson Inlet generally.

Formal Application

The Department of Conservation (DOC) is notifying a formal application for a marine reserve in Paterson Inlet, Stewart Island, on 17 December 1994. Under the Marine Reserves Act 1971 people now have until 17 February 1995 to object to or support that application before it is lodged with the Minister of Conservation for his consideration.

Paterson Inlet is a drowned river valley on the eastern side of Stewart Island. It is 18 kilometres long, with a coastline of 188 kilometres and an area of 8900 hectares. The proposed marine reserve centres on Ulva Island in the outer reaches of Paterson Inlet and covers about 1400 hectares (one sixth of the Inlet's total size). It includes about 14.5 km of coastline (7.7 per cent of the Inlet's total coastline).

The map below shows the proposed reserve's boundaries. On the western side the boundary extends from Native Island to Flagstaff Point on Ulva Island, and from the western tip of Ulva Island, via Tamihau Island to Trumpeter Point. Its eastern boundary extends from Native Island to just west of Pipi Rocks, then around Ulva Island to Paua Beach on the southern shore of the inlet.



The application is the result of nearly three years investigation and consultation by the Paterson Inlet Marine Protection Committee (PIMPC). This committee was set up under the Southland Conservation Board with the task of advising the Director-General of Conservation on options to protect the Inlet's natural marine resources.

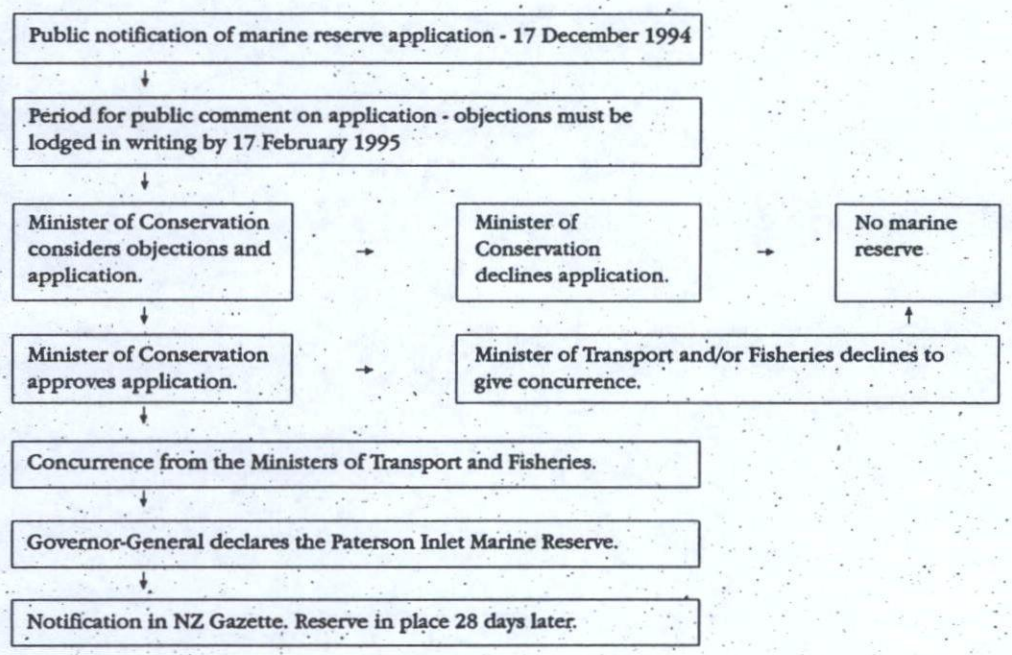
The committee worked with a wide range of interest groups including local communities and crib owners, tangata whenua, commercial fishers, MAF Fisheries, recreational fishers, dive clubs, marine farmers and the Southland Regional Council. A public discussion document released in December 1992 drew 228 submissions, of which 82 per cent supported a marine reserve around Ulva Island. This application reflects that enormous public support for a marine reserve.

Department of Conservation
Te Papa Atawhai

MARINE RESERVE

Where to From Here?

The statutory process for creating the Paterson Inlet Marine Reserve is set out in the following flow chart. The application being notified on 17 December 1994 is the first step of this process. Any person or organisation who wishes to object to the application may do so during the two months to 17 February 1995. These should be made in writing, no later than 17 February 1995, to the Director-General of Conservation, c/o Regional Conservator, Southland Conservancy, P O Box 743, INVERCARGILL. Submissions in support may also be sent to the above address.



Further Information

If you want to know more about the Paterson Inlet Marine Reserve application, please contact the Stewart Island or Invercargill offices of the Department of Conservation.

Copies of the full application document are available from these offices. The application document can also be viewed at the DOC Te Anau and Queenstown offices, and at DOC Conservancy offices throughout the country, including Dunedin and Christchurch. Copies are also available from the public libraries in Invercargill, Gore, Balclutha, Riverton and Bluff.

The following documents can also be viewed at the Department of Conservation offices at Invercargill and Stewart Island:

Hare, I.J. 1992: Paterson Inlet Marine Benthic Assemblages: Report on Coastal Investigations. Southland Conservancy Technical Series No. 5. Department of Conservation Invercargill. 88 pp.

Ballantine, W.J. 1991: Marine Reserves for New Zealand. Leigh Laboratory Bulletin No. 25, University of Auckland.

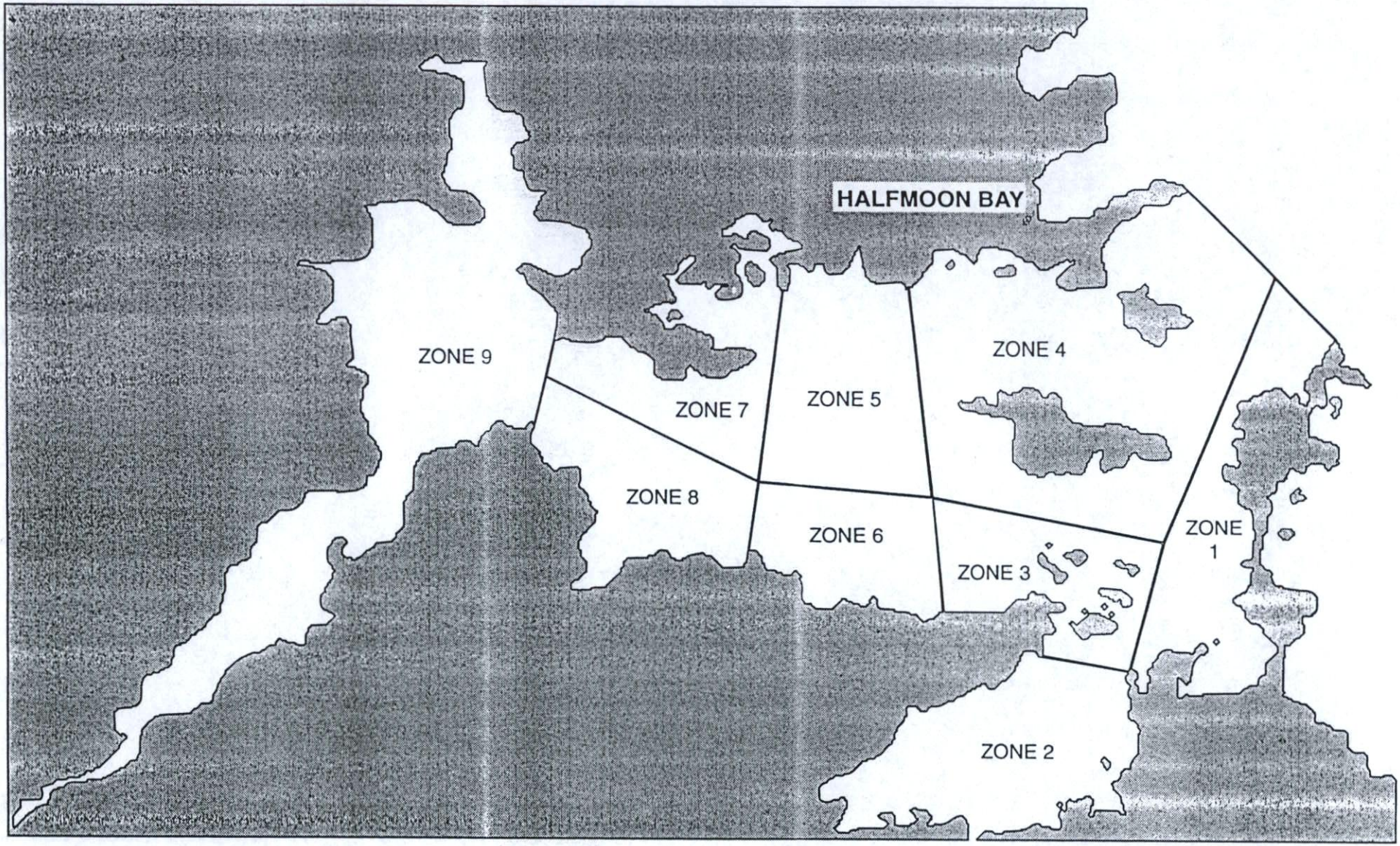
MAF Fisheries South. 1993: Draft Fisheries Plan for Paterson Inlet, Stewart Island. Paterson Inlet Fisheries Management Working Group. 35 pp.

Southland Conservancy Office
Department of Conservation
PO Box 743
INVERCARGILL

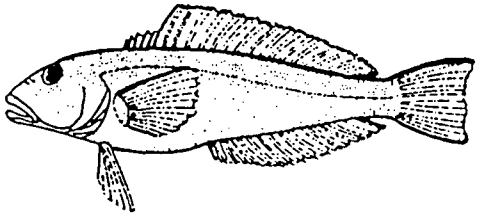
Stewart Island Field Centre
Department of Conservation
PO Box 3
STEWART ISLAND

Appendix 3
Diary map of zones

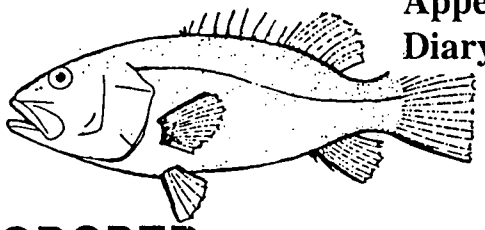
Fishing Zones in Patersons Inlet



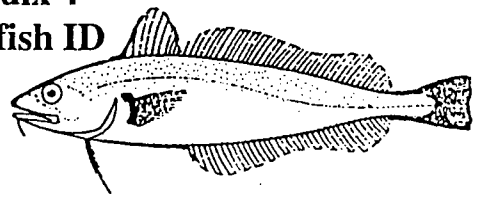
Appendix 4
Diary fish ID



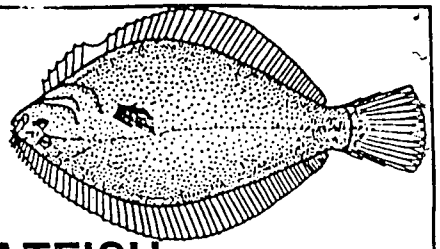
BLUE COD



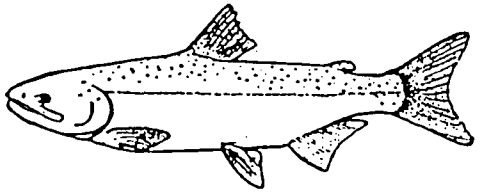
GROPER Hapuka



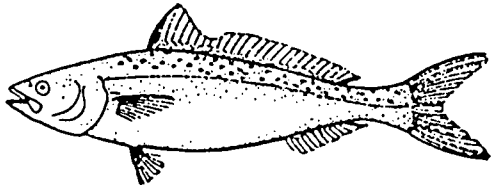
RED COD



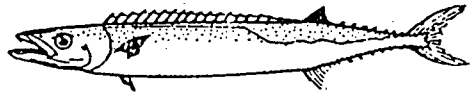
FLATFISH



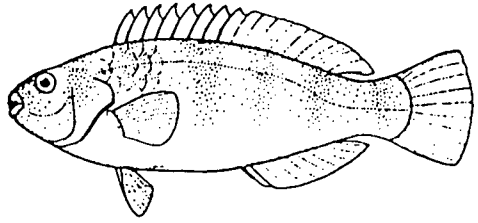
SALMON



KAHAWAI

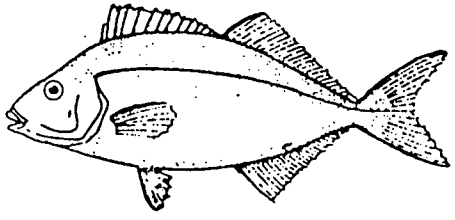


BARRACOUTA

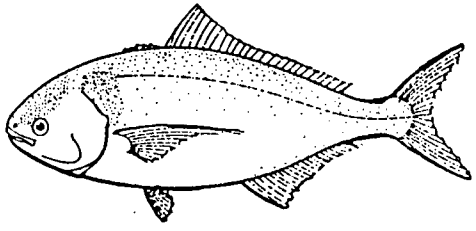


PARROT FISH Wrasse

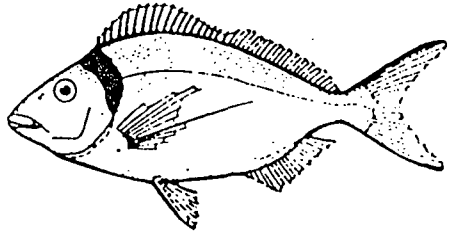
GREEN BONE Butterfish



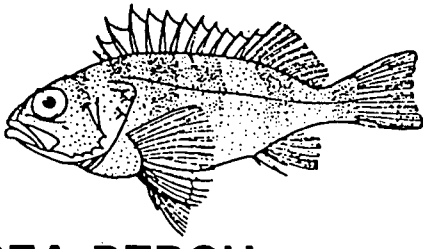
BLUE MOKI



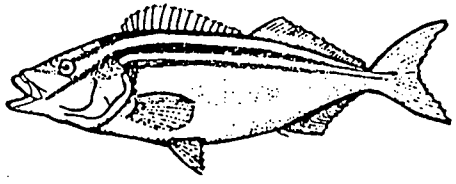
WAREHOU



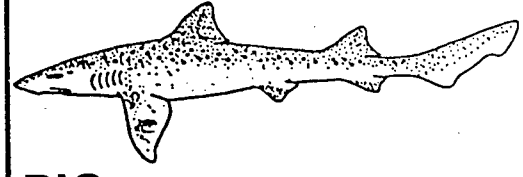
TARAKIHI



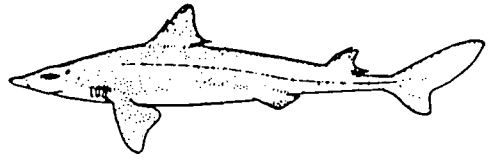
SEA PERCH Jock Stewart



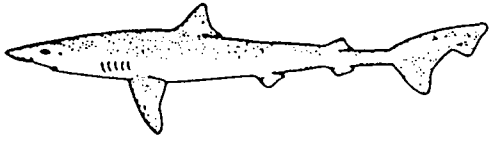
TRUMPETER



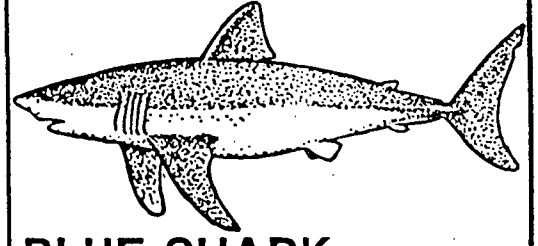
RIG Spotted dogfish



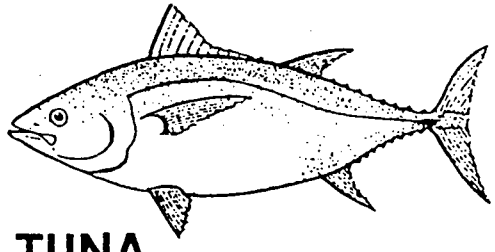
SPIKY DOGFISH



SCHOOL SHARK Greyboy



BLUE SHARK Whitepointer Mako



TUNA

FISH
IDENTIFICATION
CHART

Appendix 5
Diary instructions

Name _____ Diarist Number _____
Address _____
_____
_____
_____

Thank you for participating in this survey of recreational marine fishers in Paterson Inlet. The records of your fishing trips, along with those of 100 others who fish in Paterson Inlet, will provide the Ministry of Fisheries with vital information on catch rates, fish sizes and the effort people spend on marine fishing. Such information is essential if the Ministry is to make sensible fisheries management decisions about the Paterson Inlet fishery.

Thank you for your support of this programme.

INSTRUCTIONS

1. Please fill the diary each and every time you go sea fishing or dive for or gather seafood.

2. Record **YOUR** efforts only. **DO NOT** record the efforts of your companions.

3. Please keep this diary for the next five years. Every 3 months someone will ring you, asking you to send in your record for that period. Simply tear out the relevant page(s) from the diary and post them back in the reply envelopes supplied in the pocket on the back cover.

4. If you are unable to continue to keep your diary, please contact the survey coordinator.

5. Even if you did not catch anything we still want you to record the fact that you went fishing, diving or gathering. It is just as important that we know you didn't catch anything as it is that we know what you caught when you did catch something.

6. It is very important that we know what time of year people **DO NOT** go fishing, so please send in your 3-monthly trip record sheet even if it is blank, showing that you didn't go fishing during that period.

7. Please fill in the diary for each trip you make as shown in the example over the page.

8. If you have any questions about the diary or the survey please phone **Allan Kilner (03) 474-0333,** or write to

Ministry of Fisheries
Private Bag 1926
Dunedin

FOR EXAMPLE

Date of trip	Number of place and number of zone fished in (see page 3)	Hours spent fishing	Type of fishing (see page 2)	Fish Species targeted (see page 4)	Catch		
					Species Caught	Number of each species caught	Total weight (kilos) of each species caught.
12/12/94	Zone 4 Sydney Cove	2½	private boat fishing	blue cod	blue cod	2	2.5 kg
					trumpeter	1	0.9 kg
13/12/94	Zone 7 Prices Point	¾	gathering	pawa	pawa	2	0.8 kg

1. **Date of trip:** Please record the day\month\year. If your trip lasted more than one day, please treat each day as a separate trip filling out a record for each day.

2. **Name of place and number of zone fished in:** Please record the name of the place where you went fishing **AND**, referring to the map on page 3, work out which zone the place is in; record this also. If you fished in more than one zone during the trip, please treat each zone as being a separate trip and fill out a record for each zone fished in.

3. **Hours spent fishing:** In this space please record, to the nearest half hour, the hours you actually spent fishing/diving/gathering. **DO NOT** count the time spent travelling or resting.

4. **Type of fishing:** Please specify the type of fishing you did on the trip: The options are 1) shore fishing, 2) boat fishing from a charter boat, 3) boat fishing from a private boat, 4) diving from a charter boat, 5) diving from a private boat, 6) diving from the shore, 7) gathering, 8) other - please specify. If you did more than one type of fishing during the trip, please treat each type as being a separate trip and fill out a record for each type.

5. **Fishing species targeted:** Please specify the species of fish that you set out to catch on this trip.

6. **Catch:** Please record here all the details of what you actually caught, the number of each species and if possible, the total weight of each species (to nearest 100 grams) If you are unable to weigh the fish, please leave the "total weight" column blank. **PLEASE DO NOT TRY TO GUESS THE WEIGHT**. If the catch was the result of a group effort then divide the catch evenly among the people involved (even if in reality some people received more than others) and record YOUR SHARE ONLY. Record the weight of the whole fish ungutted. If shellfish then weigh them while in the shell.

7. **Comments:** If you have any comments that you would like to make, please write these on the back of the trip record page.

TRIP RECORD (this copy for MAF)
See page 1 for instructions

Diarist name ____________________
Diarist number ____________________

Date of trip	Name of place and number of zone fished in (see pg3)	Hours spent fishing	Type of fishing (see pg2)	Fish species targeted (see pg4)	Catch		
					Species caught	Number of each species caught	Total weight (kilos) of each species caught whole fish ungutted incl. shell to nearest 100g

If you have any comments please write these on the back of this page.

Appendix 6

Trips Targeting		Numbers Caught	
t BCO	827	c BCO	5685
t SCA	218	c MUS	3037
t PAU	213	c SCA	2456
t FLA	83	c PAU	2180
t MUS	51	c TUA	794
t TUA	29	c TRU	776
t CRA	27	c OYS	615
t TRU	25	c SUR	193
t OYS	16	c FLA	170
t OTHER	9	c WRA	80
t SUR	8	c SPO	64
t ANY	7	c ANY	62
t BAR	6	c PIP	50
t MOK	4	c SPD	43
t BUT	3	c CRA	43
t SALmon	2	c COC	42
tWSE	1	c SPE	35
t COC	1	c RCO	20
		c MOK	19
TOTAL	1530	c STY	17
		c BAR	13
		c OSD	12
		c BUT	12
		cKINA	10
		cSKA	7
		c WSE	7
		c OCTOPL	6
		cTAR	5
		cEEL	4
		c STA	3
		cPAD	2
		cCAR	2
		c GUR	2
		c SALMON	1
		c KAH	1
		c HPB	0
		TOTAL	**16468**

Trips Targeting		Numbers Caught	
t BCO	54.05%	c BCO	34.52%
t SCA	14.25%	c MUS	18.44%
t PAU	13.92%	c SCA	14.91%
t FLA	5.42%	c PAU	13.24%
t MUS	3.33%	c TUA	4.82%
t TUA	1.90%	c TRU	4.71%
t CRA	1.76%	c OYS	3.73%
t TRU	1.63%	c SUR	1.17%
t OYS	1.05%	c FLA	1.03%
t OTHER	0.59%	c WRA	0.49%
t SUR	0.52%	c SPO	0.39%
t ANY	0.46%	c ANY	0.38%
t BAR	0.39%	c PIP	0.30%
t MOK	0.26%	c SPD	0.26%
t BUT	0.20%	c CRA	0.26%
t SALmon	0.13%	c COC	0.26%
tWSE	0.07%	c SPE	0.21%
t COC	0.07%	c RCO	0.12%
		c MOK	0.12%
TOTAL	1	c STY	0.10%
		c BAR	0.08%
		c OSD	0.07%
		c BUT	0.07%
		cKINA	0.06%
		cSKA	0.04%
		c WSE	0.04%
		c OCTOPL	0.04%
		cTAR	0.03%
		cEEL	0.02%
		c STA	0.02%
		cPAD	0.01%
		cCAR	0.01%
		c GUR	0.01%
		c SALMON	0.01%
		c KAH	0.01%
		c HPB	0.00%
		TOTAL	**1**