WESTERN AUSTRALIAN SALMON AND AUSTRALIAN HERRING CREEL SURVEY

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Objectives:

The objectives for this project as stated in the original report are as follows.

To determine from a major one year survey:

1 the catch rates, levels of recreational fisher participation and recreational catch of Australian herring and salmon in the various coastal fishing regions of temperate Western Australia;

2 the overall catch of each species, and the recreational and commercial proportion of the overall catch.

To use the result from the major survey to develop methodology for ongoing, more restricted surveys to be undertaken in subsequent years.

Non-Technical Summary:

Resource sharing of Western Australian salmon and Australian herring catches between commercial and recreational sectors has had a high profile and has been perceived as being inequitable by fishers from both user groups in Western Australia. In order to address this conflict, it is necessary to establish the magnitude of the catch for both user groups. While the Western Australia Fisheries Department-Research Division records the annual commercial catches for both species, the recreational catch and fishing effort for these species has not been monitored. Regional estimates of the recreational catch for both species would aid resolution of the present catch sharing issues and facilitate improved stock assessment and future management strategies for both species.

A recreational anglers' survey for Western Australian salmon and Australian herring was initiated to collect catch and fishing effort information. The roving creel survey focused on the southwest coastline from Cape Arid in the south to metropolitan Perth in the north. This area was partitioned into 14 fishing regions, with each region having a number of sites which were surveyed by interviewers living in these regional areas. Interviews were conducted on both weekdays and weekend days during one of three periods between February 1994 and December 1995. A reduced survey involving only five regions was initiated between January 1996 and June 1996. Interviewers collected information on the start and end time of fishing, demographic information, fishing gear used, the anglers catch and their awareness of fishing rules. The majority of interviews came from shore based anglers which were the target

group in this study, however a small amount of data were collected from boat based anglers.

Over the course of the 2.5 year study, 5,350 site visits were conducted, of which 2,553 visits produced interviews with anglers. There were 15,054 interviews with anglers. During the main survey period, between 1 March 1994 and 31 December 1995, the greatest number of interviews were conducted in south metropolitan, Busselton, Albany, north metropolitan and Mandurah regions. These five regions were selected for the reduced survey which began on January 1, 1996 to 30 June 1996.

The demographic information indicated that the majority of anglers were male and did not belong to a Western Australia angling club. Most anglers had not obtained their bag limit for salmon (4 fish/day/angler) or herring (40 fish/day/angler). In general, anglers surveyed at a particular site had come from the "home' postal subdivision or a nearby inland subdivsion.

The total number of finfish caught and identified to the species level was 78,053. Both Australian herring and Western Australian salmon were placed in the top 10 species which accounted for 89% of the total catch. Australian herring accounted for 49% of the recreational catch while Western Australian salmon accounted for only 2.4% of the total catch.

The total participation level for shore anglers from the surveyed sites for the entire study period was 327,999 angler days with the bulk of participation occurring in 1994 and 1995. Following the participation levels, the angler hours of shore based fishers were 1,168,124 hours. The catch rates varied by year and season within each region and between regions. In general, the catch rates varied between 0 fish per hour to 7.5 fish per hour. Combining the regions into three fishing zones, analogous to the commercial Western Australian salmon and Australian herring fishery, indicated that consistent higher values of approximately 3.0 fish per hour were recorded on the west coast as compared to the south coast and southeast coast zones. The catch rate of Western Australian salmon was generally low (up to 1.4 fishper hour per angler) compared to Australian herring (up to 5.9 herring per hour per angler).

Adjusting the participation levels to account for the fishing sites in each region which were not surveyed, and using this adjusted participation level an adjusted total catch (in tonnes) was calculated. The adjusted total catches of Western Australian salmon for 1994 and 1995 from the south coast zone were 168 tonnes followed by the west coast zone with 119 tonnes and the southeast zone with 50 tonnes. During 1996 the west coast zone catch was 72 tonnes, contributed mainly from the Busselton region. These figures must be interpreted cautiously however, because the number of regions comprising each zone are not equal. During 1994 and 1995, the west coast zone produced a higher adjusted total catch for Australian herring of 208 tonnes, compared to 86 tonnes from the south coast and 24 tonnes from the southeast coast.

The recreational catch of Western Australian salmon by shore (and boat based) anglers compared to the commercial catch for 1994 and 1995 on the west coast zone was 6.7% and 16.4% respectively, of the total; in the south coast zone it was 3.9% and 6.2%, respectively, of the total; and in the southeast coast zone it was 99% of the total. During 1994 and 1995, the recreational catch of Australian herring by shore

(and boat based) anglers compared to the commercial catch on the west coast zone was 65.1% to 51.3% respectively, of the total; in the south coast zone it was 9.0%-4.5%, respectively, of the total; and in the southeast coast zone was 92% to 85.5% of the total. For both species, the distribution of the toal catch between the two principal user groups reflects both the distribution of the commercial fishing sector, the regions of greatest angler participation and the vulnerability/availability of the fish to capture.

These data will continue to be more completely analysed and presented to the Western Australian Australian salmon and herring resource allocation committee which was set up by the Minister for Fisheries to assist in the resolution of allocation issues for both species.

Keywords: creel survey, Western Australian salmon, Australian herring

Background:

The "allocation" of Western Australian salmon *(Arripis truttaceus)* and Australian herring *(Arripis georgianus)* catches between commercial and recreational sectors has had a high profile and has been perceived as being inequitable by fishers from both user groups. In an effort to address this conflict, it is critical to establish catch data for each species by both user groups. The commercial catches of Western Australian salmon and Australian herring have been monitored through the Catch and Effort System (CAES), daily factory receival billets and daily Western Australian salmon and Australian herring research log books. The recreational fishery, which has increased steadily in the number of participants, has little data available on the catch or participation rates in various regional west and south coast areas. Clearly, the issue of resource allocation can only be addressed after a comprehensive examination of the recreational catch and effort to compare with the commercial sector.

In 1993, the Minister for Fisheries convened the Australian Salmon and Herring Resource Allocation Committee (ASHRC) to develop a process to address resource sharing issues between commercial and recreational fishers in Western Australia. A key issue was the need for recreational catch and fishing effort data on a regional basis as well as the economic benefits of recreational fishing. This information would complement existing data from the commercial fishery and assist ASHRC with assessments on resource allocation in the Western Australian salmon and Australian herring fisheries.

Need:

The need for this project as stated in the original report is as follows and has not changed since the original application.

Issue:
The ability to advise on allocating appropriate shares of the Australian salmon and herring catch to recreational and commercial fishers in the various coastal fishing regions of temperate Western Australia.

Addressing the Issue:
The regional commercial catch and effort is monitored in detail by the Fisheries Department through mandatory statistical returns. Surveys were conducted during weekend days and weekdays at key recreational fishing localities to determine both recreational fisher catch rates and the level of recreational fisher participation in the fishery. Resultant regional estimates of recreational catch will enable the determination of the total catch of each species, and the commercial and recreational proportion of the catch.

Regional estimates of recreational catch for both species will provide information to aid resolution of the present catch sharing issues, and facilitate improved stock assessment for both species.

Objectives:

The objectives for this project as stated in the original report are as follows.

To determine from a major one year survey:

1 the catch rates, levels of recreational fisher participation and recreational catch of Australian herring and salmon in the various coastal fishing regions of temperate Western Australia;

2 the overall catch of each species, and the recreational and commercial proportion of the overall catch.

To use the results from the major survey to develop methodology for ongoing, more restricted surveys to be undertaken in subsequent years.

After the first year of the full survey there were enough financial resources to continue the anglers survey for a second Western Australian salmon and Australian herring season and to examine the feasibility of implementing a reduced anglers survey. The reduced survey, including only the most popular fishing sites both in terms of angler participation and catches of Western Australian salmon and Australian herring as determined from the first two years of the survey, was conducted for the final six month period of the survey. Thus the 2.5 year survey which commenced in February 1994, covered three consecutive Western Australian salmon and Australian herring fishing seasons with the peak season being February to May inclusive.

Methods:

Recreational fisheries catch and effort data collected using direct, on-site surveys may take the form of roving creel surveys or access point surveys. A roving creel survey was selected rather than the access point techniques after review of the various advantages and disadvantages of each method and appropriateness of each method for the sites chosen for surveying (Malvestuto 1983).

The roving creel survey also involves on-site interviews of anglers during their fishing trip (termed an intercept survey). In general, the advantages of this survey design are; 1) the enhanced feasibility of the method when anglers are dispersed along the shoreline and have multiple access points, 2) the ability to contact all anglers on the shoreline as the interviewer makes a complete circuit of the study area, 3) having high response rates from anglers, and not requiring anglers to recall catch information. The disadvantages of this method include; 1) a high cost per interview, 2) collecting information from anglers during their fishing trip instead of upon completion, 3) computational difficulties involving extrapolating the results from the survey to the entire fishing population, and 4) surveying a representative sample of anglers (Malvestuto 1983). Despite these disadvantages, the roving creel survey methodology was considered superior in the robustness of its design to allow the surveying of anglers on Western Australian shorelines (beaches, rock groynes, headlands etc) many of which have multiple direct access points.

Regional locations:
After consultation with research scientists at the WA Department of Fisheries, Fisheries Department personnel from district offices and angling club members in the southwest of WA, 14 fishing regions were chosen to be included in the roving survey. These regions are all well known recreational fishing areas, and facilitate direct comparison with commercial Western Australian salmon and Australian herring catch information. These regions were; north metropolitan Perth, south metropolitan Perth, Mandurah, Bunbury, Busselton, Augusta, Windy Harbour, Walpole, Denmark, Albany, Bremer Bay, Hopetoun, Esperance and Cape Arid (Figure 1). Each region was apportioned equal sampling weight in this study. This decision was made based on the fact that 1) in general, we had no previous information to indicate which regions had the greatest recreational fishing pressure, and 2) during the Western Australian salmon and Australian herring fishing season (summer and autumn) there is an influx of fishing 'tourists' into country fishing regions such as Busselton and Albany.

These 14 regions were later combined into three zones to correspond to the commercial fishing zones (Figure 1). The west coast zone consisted of north and south metropolitan Perth, Mandurah, Bunbury, Busselton, Augusta and Windy Harbour. The south coast zone comprised Walpole, Denmark, Albany and Bremer Bay. The southeast coast zone comprised Hopetoun, Esperance, and Cape Arid. While the catch and fishing effort will be presented for the three fishing zones and for each year, no in-depth comparisons will be made for the participation rates and catch between these zones because of the unequal number of regions.

Sites within regional locations:
There were a total of 131 sites chosen from all possible sites within the 14 regions (Appendix 1). This included 115 beaches, groynes, piers/jetties and headlands and 16 boat ramps. Within each region each survey site was apportioned equal sampling weight. The catch rates, fishing effort and total catch were calculated separately for shore and boat anglers (dive fishers comprised a small fraction of fishers and were not included in the analyses). The catch and effort information for fishing sites in each region not chosen was assessed on the basis of subjective comparisons with chosen sites (see later). In many regions there were no formal boat ramp structures, however it was possible to launch and retrieve a boat directly from the beach. These anglers were surveyed and counted as boat anglers. However, this study was not aimed at boat based anglers. Thus only a preliminary assessment of the fishing effort and catch can be made for this group of anglers.

Stratified random sampling:
Four levels of stratification were applied to each site in the creel survey; year, season, day type and daily interview times (Table 1). The sampling design was based on the premise that the Western Australian salmon and Australian herring fishing is mainly a daytime recreational activity which occurs principally in the summer and autumn. However, it is recognized that a small proportion of salmon and herring will be caught outside of the sampling timeframe. Assuming a greater proportion of the fishing effort comes from weekend fishers, a greater number of weekend interview days than weekdays were allocated per season for each year (Table 2). Weekend and week day interviews were conducted throughout the three month sampling season.

Development of the survey questionnaire and survey schedule:
The survey questionnaire included region and site information and start and finish time for the interviewer, instantaneous counts of shore based and boat based fishers and boat trailers at the start and finish of the interview period, weather conditions, demographic data, fishing effort and catch data, catch measurements from a portion of the catch, gear type and bait, attitudinal and general information questions (Appendix 2).

Survey schedules were designed with Excel Version 5.0 (Microsoft 1993) which randomly assigned sites, days and interview times for each region. Sites were chosen without replacement on a given day, but with replacement within the month. In general, two sites were assigned during an interview period (7:00-10:00, 10:00-15:00 or 15:00-18:00). However, there were several cases when it was only possible to attend one site during the interview period (eg. distances too great or access too difficult).

During the winter and spring, alternate sampling days were provided in the event of 'bad weather' days. A 'bad weather' day was designated as winds blowing onshore at 15-20+ knots and rain falling. The interviewer recorded the 'bad weather' day and did not follow the prescribed sampling route for that day. Counts of fishers were assumed to be zero on the bad weather days. An alternate day, of the same day type (eg. weekday, weekend), was substituted.

Fourteen creel survey interviewers conducted on site interviews of shore and boat based anglers during the study period. Thirteen of these interviewers were hired by the WA Fisheries Department in casual employment and the fourteenth interviewer was a member of the WA Fisheries Research staff.

Interviewers were trained in fish identification and face to face interview procedures during January and early February 1994. Interviewers received their survey schedules on a seasonal basis. Schedules were issued to all fourteen interviewers during the main survey period between early February, 1994 and December 31, 1995. February 1994 was considered a trial survey period and the results from this month were not included in any statistical analyses. The reduced anglers survey was conducted between January 1 and June 30, 1996,in the Albany, Busselton, Mandurah, and Metropolitan north and south fishing regions.

The results from the creel survey are presented by 'year' with each year beginning with the autumn season (March) and ending with the summer season (February). A complete 'year' was surveyed during 1994 for all regions. The 1995 survey included autumn, winter and spring for all regions. Summer 1995 was represented by December only in Augusta, Bremer Bay, Bunbury, Cape Arid, Denmark, Esperance, Hopetoun, Walpole and Windy Harbour. Five regions, Albany, Busselton, Mandurah, north and south metropolitan participated in the reduced anglers' survey which began in December 1995 and concluded in June 1996. Therefore these five regions had a complete summer 1995 and autumn 1996 but winter was represented by only June 1996.

Data analysis:
Summaries of angler ages, gender, postcode, and angling club affiliation were prepared for each of the 14 fishing regions. Gear type and bait preferences were tabulated for all fishers. The proportion of the angling public who knew the fishing rules, had their daily bag limit for any of the species in their possession, had purchased any of the five recreational licences required in Western Australia, and had been interviewed more than once by the same creel officer during this survey, were calculated for each region.

Participation levels and fishing effort:
Calculations for estimating participation levels and fishing effort from creel surveys are based on angler count data (Weithman and Haverland 1991). These count data are termed an 'instantaneous count' and describe the number of anglers fishing at a particular time. A count of shore anglers/boat trailers was taken at the start and end of each interview period. This count best represents the actual number of anglers. However, in some cases counts were not made and the number of angler interviews (shore or boat based) has been used as a proxy. In most cases all anglers fishing were interviewed. In some circumstances the number of interviews conducted was less than the number of anglers fishing. This was particularly true during holiday periods. In these instances the number of interviews would underrepresent the number of anglers fishing. Approximately 60% of all site visits produced instantaneous counts equal to the numbers of angler interviews.

The angler participation levels were calculated using the average instantaneous counts on a per site basis for each region, year, season, day type and interview period. In order to extrapolate the recorded number of people fishing on surveyed days to include the non-surveyed days, the average instantaneous counts were multiplied by the number of days of that day type during that season and year. The values for participation levels were then summed for all sites within a region.

The instantaneous count (C) of shore anglers or boat trailers was either the number of anglers interviewed, or the mean count of anglers from the start (C_S) and end (C_F) of each interview period,

$$C = \sum \frac{(C_S + C_F)}{2}.$$

The average instantaneous count ($\overline{C}$) of shore anglers or boat trailers per day over the number of sample days (d) is,

$$\overline{C} = \sum C / d,$$

where days are stratified by site, region, year, season, day type, time of interview.

Participation level (P) is the average instantaneous count of shore anglers or boat trailers multiplied by the number of aggregated days (D) in each year and season of that day type in each of the interview periods,

$$P = \overline{C} * D.$$

Participation levels have been calculated by site for each year and season. The participation level was calculated over three levels; each of the 14 regions for each

year and season, into three fishing zones by year to match the commercial fishery, and a total participation level by year for the entire study area along the southwest coastline.

Boat angler participation levels were computed using the average instantaneous count of the number of boat trailers at a site multiplied by the average number of anglers per boat which were actually interviewed on a given day. This took into account all of the boat fishing activity at a site on a particular day. It was assumed that all boats were engaged in fishing and not any other recreational activity. This assumption may lead to an overestimate of fishing activity for those sites surveyed; however since coverage of boat ramps was minor, this survey has underestimated boat based fishing participation along the southwest coastline.

Angler hours (A) is calculated as the participation levels multiplied by the number of hours (H) in the interview period for each site, year and season,

$$A = P * H .$$

The interview periods were 7:00-10:00, 10:00-15:00 or 15:00-18:00. The number of hours (H) in these interview periods was 3, 5 and 3 hours respectively, which represents the entire fishing day. The estimate yields fishing effort in angler hours by site for each season and year. These estimates were summarised separately over three levels; each of the 14 regions for each year and season, the three fishing zones by year to match the commercial fishery, and a total fishing effort by year for the entire study area along the southwest coastline.

Variance estimates for participation rate and angler hours are not presented here but have been calculated.

Catch rate:
In the recent literature (Jones et al. 1995) concern has been expressed about the estimation of angler success or catch rate. They have proposed that for roving creel surveys, the 'per-angler' catch rate estimates be based on data from interviews undertaken while anglers are still fishing.

The per-angler estimate of catch rate, *R*, is calculated as the average angler's catch.

$$R = \frac{\sum_{i=1}^{N} \frac{y_i}{x_i}}{N}$$

where: y_i = catch by the *i*th angler, x_i = fishing trip duration at the time of interview of the *i*th angler in hours, and N = number of anglers interviewed in the fishery by region, site, year, season, day type and time of interview. The per-angler estimate was calculated separately for shore and boat-based anglers.

The exact variance of the per angler estimator for sampling proportional to fishing trip length is given (Cochran 1977:253) as:

$$Var(R) = \frac{\sum_{i=1}^{N} x_i \left(\frac{y_i}{x_i} - \frac{\sum_{i=1}^{N} y_i}{\sum_{i=1}^{N} x_i}\right)^2}{N \sum_{i=1}^{N} x_i}$$

Variance estimates have been calculated for each site within a region.

The per angler catch rate estimators were calculated from the 2,553 site visits which produced angler interviews. The estimate was computed for the total number of fish caught (kept and released) for anglers fishing for 0.5 hour or more. These estimates were produced for shore or boat fishers separately for each region, site, season, year, day type and interview period. The following three assumptions have not been validated at this time; catch rates did not vary significantly between the three daily interview periods, catch rates did not vary significantly between weekdays and weekend days, catch rates did not vary significantly between sites within a region. Therefore, separate catch rates were calculated for both shore and boat anglers for all species combined, Western Australian salmon, and Australian herring in order to aggregate the per angler catch rate estimates

Catch:
The catch for Western Australian salmon and Australian herring was calculated using the fishing effort and 'per angler' catch rates. This gives only the catch at the interviewed sites over the period covered by the interviews. The calculation of catch follows from Caputi (1976):

An estimate of the shore and boat catch of Western Australian salmon and Australian herring can be obtained by multiplying the fishing effort by the mean catch rate of shore and boat anglers,

$$S = R * A, \qquad or \qquad B = R * A,$$

where S= shore catch and B= boat catch.

The recreational catch was calculated by region, site, year, season, day type and time of interview. The catch was then compiled separately over three levels; each of the 14 fishing regions by year and season, the three fishing zones, and for all fishing zones for each year along the southwestern coastline.

Converting catch from numbers to weight:
The catch of Western Australian salmon and Australian herring for shore and boat anglers was converted to weight by multiplying the catch from each of the three fishing zones by the average weight for that species as determined by this survey. The weight of the catch was not be calculated for all species combined because of the high degree of variation in weights between large and small species of finfish.

Total catch and fishing effort for sites not surveyed:
It was not possible to sample all fishing sites in a given region given the vast number of fishing sites and the difficulty assessing the extent of fishing activity at fishing sites along the southwest coast. In order to determine the total catches and participation levels along the southwest coastline, a list of all possible fishing venues for each of the 14 regions was compiled using mapping information provided by the WA Department of Land Administration. This list contained all of the sites surveyed in this study and a set of non-surveyed sites.

For each region, the WA Fisheries Department district fisheries officer, the creel survey interviewer and a local fishing club member were interviewed by telephone and asked to estimate the number of anglers expected at each surveyed and non-surveyed site. The responses from the telephone interviews were recorded and the average number of anglers (participation levels) expected on each surveyed and non-surveyed site was calculated. In some cases no information was available for a site from either the creel survey or telephone interviews, these sites were assumed to have 0 participation levels. Additionally, no information was available from the telephone interviews for particular creel surveyed sites. To adjust the participation level for this missing information the participation level from the surveyed sites from the phone interviews were multiplied by the proportion of the participation level from the surveyed sites during the creel survey by the proportion of the participation level from the sites common to both the creel survey and the phone interviews.

These adjusted participation levels for each region were used to produce a conversion factor for each region (participation level from phone interviews from all sites, adjusted for missing data, in the region by the phone interviews from surveyed sites) which were used as multipliers for the total participation level for the entire southwest coastline. These conversion factors indicate how complete the surveyed fishing site coverage was for each region. For example a conversion factor of 1 indicates that 100% estimation of the participation level, while a conversion factor of 3 indicates that the surveyed participation level was 3 times less than the participation level for that region.

The total catch (numbers) was recalculated using these adjusted participation levels and multiplied by the catch rate for each of the 14 regions producing the adjusted total catch numbers. The adjusted total catch numbers were converted to weight by multiplying by the average weight for Western Australian salmon and Australian herring.

Comparisons between recreational and commercial Western Australian salmon and Australian herring fishers:
Commercial and recreational catches for Western Australian salmon and Australian herring were compared based on 1) the three commercial fishing zones and 2) the total catch of each species by the commercial and recreational sectors. Comparisons between catches were made for the 1994 and 1995 Western Australian salmon and Australian herring fishing seasons.

Methodology for restricted surveys in the future:

The methodology for future restricted creel surveys for Western Australian salmon and Australian herring in Western Australia was developed after thorough examination of the results from the present main and reduced surveys. Multiple regression analysis was used to explain 95% of the variation in the adjusted total catch for the season and year combinations all species. The combination of the fewest regions which contributed to 90% of the adjusted total catch for 1994 (full sampling year) were identified.

Results:

Interviewers and the number of on site interviews:
Many of the original 131 sites could not be surveyed on a regular basis because of difficulties experienced gaining access to these sites on a regular basis. For example, Black Point and White Point in Augusta, Malimup in Windy Harbour, Bornholm in Denmark, Rose and Quagi Beaches in Esperance and Kennedy Bay in Cape Arid were impossible to access regularly due to poor track conditions. Sites with less than 10 site visits over the entire study period were excluded from further analyses. The reduced data set contained 119 shoreline and boat ramp sites distributed throughout the 14 regions (Appendix 1). The majority of regions had between six and eight interview sites; with Denmark and Esperance having 10 sites and Busselton having 14 sites.

The number of site visits to conduct interviews varied according to the number of sites allocated to each region and the survey period. Likewise, the total number of hours conducting interviews at sites varied within a region and between regions, reflecting, in general, participation levels at the site (Table 3 and Appendix 1). The greatest number of site visits were conducted by the Busselton interviewer, and the fewest by the Windy Harbour interviewer. The metropolitan south interviewer spent the greatest number of hours conducting on site interviews during 1994-95 while the Bunbury interviewer spent the least number of hours. During 1996, the metropolitan south interviewer spent the greatest number of hours conducting interviews while the metropolitan north interviewer spent the least number of hours (Table 3).

In general, all interviewers followed their schedules, however there were days missed which resulted from 1) bad weather days late in the month leaving no opportunity to conduct another interview on an appropriate type of day during that month; 2) unforseen difficulties causing the interviewer to miss their appointed interview time period. The minimum and maximum percent of bad weather days from the scheduled days was approximately the same for the winter as the spring season (Appendix 3). Summer and autumn seasons were not assigned bad weather days. These seasons were investigated for number of scheduled interview days which were not attended, but were replaced by the appropriate weekday or weekend day. The minimum and maximum percent of replaced days from the scheduled days was similar between the summer and autumn seasons. The percent of missing days (days without replacement) was fairly consistent between seasons.

There were a total of 5,350 site visits (including replacement days) of which 2,553 visits (47.7%) produced interviews with anglers. There were 15,054 interviews conducted between March 1, 1994 and June 30, 1996 (Table 3). During the main survey period (1 March 1994 through 31 December 1995) the greatest number of

interviews were conducted in south metropolitan, Busselton, Albany, north metropolitan and Mandurah regions; while the fewest interviews were conducted in Windy Harbour and Cape Arid. The five regions with the greatest number of interviews are well known Western Australian salmon and Australian herring fishing areas and were chosen for the reduced survey (January 1, 1996 through 30 June 1996). As in the full survey, the south metropolitan and Busselton interviewers provided the greatest number of angler interviews.

Within each region the greatest number of interviews were conducted during the autumn and summer seasons which results from the greater number of scheduled interview days and the greater number of anglers interviewed as compared to the spring and winter seasons (Table 2 and Appendix 4). Additionally, the low number of interviews during summer 1995 for nine regions (Augusta, Bremer Bay, Bunbury, Cape Arid, Denmark, Esperance, Hopetoun, Walpole and Windy Harbour) reflects the fact that this season was represented by December 1995 only, as compared to the remaining five regions which had the full complement of months. These nine regions completed the main survey at that time. Similarly, low numbers of angler interviews were recorded for the reduced survey during the winter 1996 because this season was represented by only June. For all regions, there was a greater number of shore angler interviews than boat angler interviews (Table 4).

Demographics of the angling population:
Four age categories of anglers were assigned; 0-19, 20-39, 40-59, 60+ years old (Figure 2). The age distribution of the angling population by region over all years revealed the majority of anglers were between 20 and 59 years old. There were some exceptions, including; Esperance which had a high percentage of 60+ year old anglers and Walpole and Hopetoun which recorded a relatively high percentage of anglers between 0 and 19 years of age. In general, the greater Perth metropolitan area (north and south metropolitan and Mandurah regions) recorded a similar age distribution pattern to the country areas.

All 14 regions showed a greater percentage of male anglers than female anglers comprising the fishing population (Figure 3). The percentage of male anglers ranged from a minimum of 76.9% of all anglers in the Walpole region to 90.6% of all anglers in the north metropolitan region.

The percentage of angling club members interviewed at sites within each region ranged from 0.93% in Bunbury to 16.22% in Windy Harbour (Figure 4). The Augusta, Walpole, Denmark and Albany regions showed angling club membership between 8% to 16% while the remaining regions showed membership at less than 8%..

Anglers were asked if they currently possessed any of the annual recreational licences for rock lobster, abalone, recreational netting, freshwater fishing and/or marron. Anglers are entitled to line fish for marine fishes without holding a licence. There was considerable variation in the percentage of anglers reporting having purchased a recreational licence in the past 12 months (Figure 5). East of Bremer Bay the percentage of recreational licence holders was low reflecting the lack of species for which licences are required.

Anglers were asked “Have you caught your bag limit of any of the species you have been catching? If so, which species?”. For those anglers who had caught at least one fish their responses show that few had attained their bag limit at the time of the interview (Figure 6). Only the Busselton and Cape Arid regions showed a response rate of over 5% of anglers having met their bag limit.

The bag limit for Western Australian salmon is 4 fish per fisher per day and for Australian herring is 40 fish per angler per day. The percentage of anglers having attained their bag limit of Western Australian salmon, from those anglers who had caught at least one salmon at the time of the interview, varied between 3.2% in Mandurah to 20.4% of anglers in Cape Arid (Figure 7). None of the anglers interviewed had achieved their bag limit of salmon in the north metropolitan, Bunbury, Windy Harbour and Hopetoun regions. The percentage of anglers reporting achieving their bag limit for Australian herring, from those anglers which had attained at least one A. herring, was 0.6% in Esperance to a high value of 6.0% of anglers in Hopetoun and Cape Arid (Figure 8).

Anglers were asked if they were aware of the bag limits and size limits on WA fishes (Figure 9). Most anglers not only replied to the question but offered additional comment on the various educational fishing aids provided by the Fisheries Department. Many anglers also used this opportunity to discuss their feelings on the management and regulation of recreational fisheries in Western Australia. In general there was a high rate of fishing awareness with between 65.3% of anglers in Denmark and 98.3% of anglers in Cape Arid stating that they knew the fishing rules.

The final question asked of each angler was “Have I interviewed you before?” This question was asked to investigate the proportion of the angling population within each region which were repeat anglers (Figure 10). Over 20 % of anglers had been interviewed more than once in the south metropolitan, Augusta, Albany, Esperance and Cape Arid regions. The fewest repeat interviews were conducted in Windy Harbour, Walpole, Denmark and Bremer Bay. In the case of Windy Harbour, this result is complicated as the interviewer had the fewest number of beach visits and interviewed the least number of anglers. In general, the regions with the greatest number of repeat interviews showed the greatest percentage of anglers resident to the region (see results below).

The angler’s postcode was recorded during the interview. This information was used to analyse the residential composition of the angling population in a particular region. A detailed record of postcodes, the postal subdivisions in Western Australia were obtained from the Australian Post Office and entered into the database. The postcode of each angler interviewed was assigned to a postal subdivision. The number of anglers reporting a postcode from each subdivision were tallied for each region (Figure 11). Anglers came from 13 postal subdivisions in Western Australia; eight were coastal and contained one or more of the surveyed fishing regions and five were inland. There were two additional categories included, ‘other WA’ which included anglers not resident to the general southwestern portion of the state and represents fewer than 2% of interviewees in a particular region; and ‘other than WA” represents interstate anglers.

Both the north metropolitan and south metropolitan regions had the majority of anglers interviewed from the Perth subdivision. Anglers interviewed in the Mandurah region were mainly from the Perth metropolitan and the 'home' Dale subdivisions with 7.6% from five other west coast subdivisions. The Bunbury region was numerically dominated by 'home' anglers from the Preston subdivision. The remainder of the anglers interviewed had travelled from the metropolitan Perth and 'other WA' subdivisions. Busselton and Augusta regions had a diverse angling population. Anglers from the metropolitan Perth, the 'home' Vasse, and nearby Preston subdivisions constituted the majority of anglers visiting Busselton sites with a small percent of anglers travelling from the Blackwood, Dale, and 'other WA' subdivisions. Anglers travelled from the 'home' Vasse, metropolitan Perth, Preston, Blackwood, Dale and 'other WA' subdivisions to fish at Augusta sites. Anglers travelled to Windy Harbour sites from the 'home' Blackwood subdivision, Preston and 'other WA' subdivisions.

Anglers interviewed at Walpole sites came from nine subdivisions. 'Home' Blackwood and metropolitan Perth fishers comprised over half of the interviewed anglers while the King, Preston, Pallinup, Hotham, and 'other' WA subdivisions contributed to the remainder. Anglers interviewed at Denmark sites were either predominantly 'home' King subdivision or visiting Perth metropolitan residents. Anglers from 'other WA', Preston, Hotham and Pallinup subdivisions comprised the remainder of the Denmark angler population. The majority of the anglers interviewed in the Albany region were from the 'home' King subdivision followed by visitors from the Perth metropolitan subdivision. Surprisingly, 'other than WA' anglers comprised 10.3% of the anglers; while Hotham, Pallinup, Dale, 'other WA' and Lakes subdivisions contributed the remainder. The Bremer Bay region was fished by the 'home' Pallinup residents. However a large percent of the fishing was conducted by 'inland' residents visiting the Bremer Bay region from the King, Hotham, and Lakes subdivisions. Fishing tourists from the Perth metropolitan, 'other WA' and 'other than WA' and Preston subdivisions comprised the remainder of the angling population.

The southeast portion of coastline included three fishing regions; Hopetoun, Esperance and Cape Arid. Each area had a large proportion of anglers from the 'home' Johnson subdivision, with this proportion increasing from 39.3% in Hopetoun to 65.4% in Esperance and 71.2% in Cape Arid, the eastern most fishing region. The Hopetoun region had the greatest diversity of angler postcodes with 12 of the 15 postal subdivisions represented. The variety of angler postcodes did not persist in Esperance where other anglers were from the Lefroy, Perth metropolitan, 'other than WA' and 'other WA' subdivisions. Cape Arid anglers were typically from the 'home' Johnson subdivision, followed by Lefroy, Perth metropolitan, 'other than WA' and 'other WA' subdivisions. While tourists are a component the more important fishers are from 'home' or nearby inland residents for each region.

Catch composition:
The total number of fish recorded over the duration of the creel survey from both boat and shore anglers was 78,053 finfish, identified to the species level. There were several invertebrate species also recorded, however they have not been included.

The total number of finfish recorded from interviews with shore anglers was 50,956. Boat based anglers had caught 27,097 finfish. The top 10 species from both shore and boat anglers combined were Australian herring, garfish, skipjack trevally, yellow finned whiting, school whiting, King George whiting, Australian salmon, yellow tailed scad, tailor and blowfish. These species accounted for 89% of the total catch. Australian herring accounted for 49% of the total catch while Western Australian salmon accounted for only 2.4% of the total catch.

Fishing effort:
The fishing effort was determined for all species because anglers were not asked what species they were targeting. This effort will be used to determine the total catch of Western Australian salmon and Australian herring. Overall, the highest shore angler participation levels (angler days) and angler hours from surveyed beaches occurred during the autumn season for all regions, except Denmark where the summer season had the greatest number of anglers (Table 5 and 6). Angler participation levels and angler hours were lower during the winter and spring seasons prior to the beginning of the summer fishing season in most regions.

During 1994, the greatest number of anglers and angler hours were recorded for the south metropolitan region, followed by Mandurah, Albany and Esperance. The 1994 total participation level was 151,943 angler days and 567,831 angler hours for all surveyed sites in the 14 regions. Comparison between regions is subjective as the regions have different numbers of sites.

During 1995, for the autumn, winter and spring seasons, the highest shore angler participation levels and angler hours were reported from Busselton, south and north metropolitan and Mandurah. Of the nine regions which only interviewed anglers during December 1995 (summer), Walpole and Denmark had the highest participation rates for that season. The total participation level during 1995 for these nine regions was 36,098 angler days (129,883 angler hours). In the five regions with a complete summer 1995 season, the Busselton and south metropolitan regions had the highest shore angler participation levels and angler hours. The participation level and angler hours during 1995 for these five regions, was 106,590 angler days and 355,599 angler hours. For all 14 regions during 1995, the total shore participation level was 142,688 angler days, only slightly lower than the 1994 value, even though 1995 contained fewer number of surveyed days. The Busselton region reported the highest angler participation level during 1996 (complete autumn season and June). In the five regions, the total participation levels and angler hours were 33,368 angler days and 114,659 hours during 1996.

When the participation levels and angler hours are aggregated into the three fishing zones consistently higher values result for the west coast zone which includes many of the most popular fishing and tourism location (Busselton and Mandurah) as well as the heavily populated metropolitan regions. Additionally, this zone included the greatest number of regions. During 1994 and 1995, the west coast zone produced values of 352,535 and 350,707 angler hours respectively. The south coast zone produced substantially lower participation levels and angler hours than the west coast zone for both 1994 and 1995. Only one region in the south coast zone, Albany, was involved in the 1996 reduced survey. The southeast coast zone had the lowest angler participation levels and angler hours for both years.

Boat anglers were interviewed during most seasons in the Albany, Busselton, Hopetoun, Mandurah, metropolitan north and south and Walpole regions. Participation levels and boat angler hours from these surveyed sites peaked during the summer and autumn seasons for both years (Table 7 and 8). The south metropolitan region reported the highest boat participation levels and angler hours for each season and year; contributing over 55% to the overall total participation levels of 199,418 boat based anglers during the entire survey. This may reflect higher participation by boat anglers in this region or may be an artefact of the number of ramps surveyed in that region compared to other regions.

When the participation levels and boat based angler hours are aggregated by fishing zones for each year, the west coast zone had the highest values each year as compared to the other two zones. This may result from the greater number of regions in the west zone, the greater number of boat ramps surveyed, the greater number of boat anglers or a combination of all these factors.

Angler catch rates:
Overall species:
The catch rates for all species were aggregated from the daily interview period and day type to yield estimates of the catch rate for shore and boat anglers separately by region, year and season. The catch rates for all finfish species by shore anglers varied between 0 fish/hour during summer 1995 in Augusta, Bunbury (1 angler interviewed only) and Mandurah (1 angler interviewed only) to 7.5 fish/hour (s.e.=0.06) during autumn 1996 in Albany (Figure 12).

Examining the catch rates aggregated into the three zones showed a consistently higher mean catch rate along the west coast (2.87-3.24 fish/hour: s.e.=0.08-0.17), than the other two zones for the three years (Table 9). However, there was a very high catch rate of 7.27 fish/hour in 1996 in the south coast zone. The only seasons sampled in 1996 were the summer and autumn and these higher catch rates may be expected. The southeast coast zone had the lowest catch rate of 1.11 fish/hour in 1995.

The per angler catch rate for all species caught by boat anglers was highly variable (Figure 12) both between seasons within a region and between regions, and reflected possibly the low number of boat interviews. The highest values were reported from 28 Mandurah boat anglers during the summer of 1994 with an average catch rate of 39.51 fish/hour (s.e.=3.18), and eight boat anglers from Mandurah during autumn 1995 with an average catch rate of 20.33 fish/hour (s.e.=1.59).

The boat angler catch rates showed more variation than the shore angler catch rates (Table 10). Aggregated by zone and year, the most consistent catch rates were reported from the west coast zone (3.18-4.52 fish/hour; s.e.=0.20-0.62). Both 1995 and 1996 produced high catch rates for the south coast zone (8.71 and 6.59 fish/hour; s.e.=0.84 and 1.02, respectively), while a low catch rate was recorded in the southeast coast zone in 1995 (2.65 fish/hour; s.e.=0.52).

Western Australian salmon:

Adult and juvenile (colloquially called 'salmon trout) Western Australian salmon were considered traditionally to be vulnerable to capture only during the main westward migration in the late summer and autumn (coinciding with the commercial fishing season). Western Australian salmon were caught by shore anglers in all 14 regions, however catches were reported from the majority of seasons from Albany, Bremer Bay, Busselton, Cape Arid, Denmark, Mandurah, Walpole and Windy Harbour (Figure 13). Examination of the catch rates for these regions by season showed no pattern of higher catches associated with particular seasons. The per angler catch rate estimates across regions ranged from 0 salmon /hour in several regions to 1.42 salmon/hour (s.e.=0.19) in Bremer Bay during the summer of 1994. In general, however, the catch rates were quite low compared to the general finfish catch rates.

The catch rates for Western Australian salmon by shore anglers in the west and south coast zones were higher in 1996 than either 1994 or 1995 (Table 11). In the southeast coast zone the 1995 catch rate was almost double the 1994 value.

Western Australian salmon were caught by boat anglers during all seasons; however this represented only a minor portion of their catch. The boat based anglers yielded catch rates of less than 0.01 salmon/hour except for the south coast zone where the catch rate was 0.03 salmon/hour in 1994 and 0.08 salmon/hour in 1995. Annual catch rates of Western Australian salmon by boat based anglers were higher in 1995 than 1994, with no Western Australian salmon caught in 1996. Boat anglers experienced catch rates of Western Australian salmon approximately five times lower than for shore anglers.

An earlier study of the amateur fishery for Western Australian salmon indicated that although no data were available, amateur fishing effort and catches had increased during the late 1970's and early 1980's (Walker 1982). This resulted from increased access to fishing locations, the use of 4WD vehicles, the use of boats to troll for salmon and more leisure time. At that time the fishery was, and still remains, composed of anglers fishing throughout the year, intensifying during the autumn spawning migration.

Australian herring:

With few exceptions, the shore based angler catch rates for Australian herring were reported for all 14 regions and were a part of the creel nearly every month (Figure 13). The catch rates for this species were much higher than for Western Australian salmon for each of the 14 regions. The highest catch rates were reported by anglers fishing at sites in Augusta where catch rates were between 0 and 5.98 herring/hour (s.e.=0.17), and Albany where catch rates ranged from 0.56 (s.e.=0.17) to 3.63 herring/hour (s.e.=0.01). No seasonal or annual pattern was observed for catch rates from each region, instead there appeared to be considerable variation within each region.

The catch rates for the three zones indicated the highest rates were found in the south coast zone during 1996 (Table 12). Consistent catch rates were reported for the west coast zone for the three years. The lowest catch rates were reported for the southeast coast zone for both 1994 and 1995.

The annual shore based angler catch rates for the three zones showed similar values of 1.34 herring/hour (s.e.=0.05) in 1995 and 1.56 herring/hour (s.e.=0.11) in 1996 for all zones.

Boat based Australian herring catch rates were sporadic, both between regions and within a region by season and year (Figure 14). Catch rates for Australian herring were reported for the majority of seasons and years in Albany, Hopetoun, and north and south metropolitan regions. In all other regions either no boat anglers were interviewed, or less than two records of herring catches were reported during the survey period. The Albany region recorded catch rates between 0.27 herring/hour (s.e.=0.06) during spring 1995 to 2.79 herring/hour (s.e.=0.16) during summer 1995. Hopetoun reported the most consistent catch rates for this species, ranging between 0.79 herring/hour (s.e.=0.06) during winter 1995 and 1.92 herring/hour (s.e.=0.10) during spring 1994.

Aggregating the catch rates by the three zones showed consistently higher catch rates for Australian herring in the south coast zone than the other two zones. The catch rates in the west coast and southeast coast zones were higher in 1994 than subsequent years. In the south coast zone the catch rates was higher in 1996 followed by 1994 (Table 13).

Australian herring catch rates were approximately 0.5 herring/hour higher in 1994 than 1995 for all zones; with annual catch rates of 1.30 herring/hour (s.e.=0.06) during 1994 and 0.72 herring/hour (s.e.=0.07) during 1995.

The present shore and boat based catch rates for Australian herring from the Augusta region is similar to the 0.16 to 4.0 herring per angler per hour reported from the Blackwood River Estuary between May 1974 to April 1975 (Caputi 1976). While Caputi (1976) indicated that catch rates were highest during the autumn period, the present study has found high autumn and winter catch rates for herring.

Total catch (in numbers and tonnes) for surveyed sites:
Overall species:
Between region and zone comparisons of the total catch should be interpreted cautiously due to the different number of sites within regions and regions within zones. The estimate of total catches for all species were greatest during the autumn season (except for Denmark and south metropolitan) with summer and winter seasons ranking second and third, in most cases (Table 14). There was substantial variation in the estimates of total catch between seasons within a year and between years. Within a region, the autumn total catches were often two to three times larger than for other seasons and there was no consistent pattern between seasons and year. The five regions which conducted surveys for 2.5 years comprised 66% of the total catch of 2,875,902 fish for all regions in 1994 and 1995.

Total catches of all species in the three zones showed very high catches for the west zone compared to the other zones, however there are more regions in the west coast zone contributing to the total (Figure 15). The 1994 and 1995 total catches were more similar within the west coast zone than the south or southeast coast zones.

The estimates of total catch for all species for boat based anglers are based on a small data set and should be interpreted conservatively. In general, the autumn season produced the highest total catch figures for those regions reporting boat information. The south metropolitan region provided consistently high total catches followed by Busselton and Albany (Table 15). The five regions comprising the 2.5 year survey with two complete years of catch information, showed considerable variation in the total annual catch rate between 1994 and 1995.

The west coast zone produced a higher catch for all species caught by boat based anglers than either the south or southeast regions (Figure 15). The catch across all years in the west zone was greater than the south coast zone and greater than the southeast coast.

Western Australian salmon:

Catches of Western Australian salmon were reported from nearly every season throughout the survey period for Albany, Busselton, Cape Arid, Denmark and Walpole. The estimated total catch by number was converted to weight, using the average weight for this species for each of the three zones (Table 16). Within the west coast zone, the Mandurah and north and south metropolitan regions reported average weights much lower (359 g) than the other regions in the west coast zone (3,978 g) indicating that catches were predominantly of juvenile 'salmon trout'. For this reason, the total catch by number for these regions was converted to weight using the average weight for these three regions and summing with the remaining regions in the west coast zone.

The estimated total recreational catch showed that the highest catches were from the autumn season, coinciding with the commercial fishing season (Table 17 and 18). The highest catch of 15,953 salmon (63 tonnes) was reported from Busselton during autumn 1996. There was considerable variation in catches with many regions reporting high catches during the winter (Albany, Busselton, Denmark, Mandurah), spring (Cape Arid, Denmark) and summer (Albany, Bremer Bay and Denmark). While this fishery is often considered only an autumn fishery, in the Busselton, Cape Arid, Denmark and Walpole regions, salmon were available during all seasons for recreational anglers. The availability and catches of salmon outside the main autumn season may be prevalent particularly in years where there is a considerable 'back run' of salmon along the south coast in the late autumn and early winter. During 1995 schools of salmon were consistently sighted on beaches throughout the winter and spring seasons.

During 1994 and 1995 high catches were reported from Albany, Cape Arid, Busselton, Denmark and Walpole. Low catches (often no catches) were reported from Augusta, Bunbury, Esperance, Hopetoun, north metropolitan and Windy Harbour regions. Catches were greater in 1994 than 1995 in Bremer Bay, Bunbury, Esperance, Hopetoun, Mandurah, north and south metropolitan regions, while 1995 catches were greater than 1994 in Albany, Augusta, Busselton, Denmark, and Walpole. This variation may result from the availability of salmon on different beaches in different years in response to environmental factors. Catches from the Mandurah and south and north metropolitan regions consisted primarily of juvenile salmon.

The 1994 estimated total catch by regions showed an overall catch of salmon for the west coast and south coast zones of 15,981 (40 tonnes) and 16,012 (67 tonnes) salmon respectively; while the southeast coast zone catch was approximately half with 8,162 (20 tonnes) fish (Figure 16). In 1995 the south coast zone catch was substantially higher than the west coast zone catch with 22,379 (89 tonnes) salmon reported versus 10,896 (42 tonnes) salmon. Again the southeast coast zone catch was low with 7,653 (19 tonnes) salmon reported. Similar catches were reported between 1994 and 1995 with 40,155 (127 tonnes) and 40,928 (150 tonnes) fish, respectively. This result includes the summer 1995 season for which anglers were only interviewed in five of the regions for the complete summer season. Higher catches would be expected if all regions had interviewed anglers for the full three months of the season. The total catch for all zones and years was 100,127 fish (352 tonnes).

The total catch of boat anglers fishing for Western Australian salmon were low and sporadic throughout the year. Catches were only reported from Albany (1353 fish; 5 tonnes), Busselton (918 fish; 4 tonnes), Mandurah (530 fish; 0.1 tonne), south metropolitan (504 fish; 0.1 tonne) and Walpole (65 fish; 0.3 tonne). The highest seasonal catch of 952 salmon was reported from Albany during autumn 1994. In general, catches were reported from the autumn and summer seasons; however there were catches reported from the south metropolitan and Walpole regions during the winter and spring seasons.

Boat based angler catches were more prevalent in the west coast zone (1,953 fish; 4 tonnes) compared to the south coast zone (1,418 fish; 6 tonnes) and southeast coast zone (0 fish). This may result from the greater number of regions in the west coast zone and the greater number of boat ramps. The total catch during 1994 was 1,671 fish (4 tonnes) compared to 1,700 fish (5 tonnes) in 1995.

Australian herring:

In contrast to the total catches of Western Australian salmon, the total catches of Australian herring (numbers and weight) were reported from all seasons for each fishing region (Table 19 and 20). Highest catches were reported during the autumn and summer seasons, in most regions; which were often an order of magnitude greater than winter and spring catches. The total catch weight of Australian herring for each region was calculated using the weights reported from each of the 14 regions (Table 21).

The highest catches over the entire survey were reported from the south metropolitan (349,353 fish; 44 tonnes), Busselton (316,716 fish; 46 tonnes), Albany (264,312 fish; 73 tonnes), and Augusta (244,747 fish; 30 tonnes) regions. The lowest catches were recorded from the Cape Arid (11,100 fish; 2 tonnes) and Hopetoun (12,896 fish; 2 tonnes) regions. No catches were reported from the Bremer Bay, Bunbury, Esperance and Mandurah regions during the winter season, the Bunbury and Mandurah region during the spring season and the Augusta, Bunbury, Cape Arid and Walpole regions during the summer season. There was considerable variation between years in the total catch for most regions, however this was not consistent for either 1994 or 1995.

Total catches by zones showed higher catches in the west coast zone (1,207,034 fish; 183 tonnes) than the south coast (343,845 fish; 86 tonnes) and southeast coast (107,375 fish; 21 tonnes) zone (Figure 16). Again, there are more regions

summarised in the west coast zone than either of the other two zones. The total catch was highest in 1994 (779,460 fish; 130 tonnes) followed by 1995 (688,911 fish; 109 tonnes) and 1996 (189,883 fish; 32 tonnes). The total catch of herring does not represent a full year for 1995 and 1996. The total catch over all regions and years was 1,658,254 herring (270 tonnes) which comprised 48% of the total catch of all species.

Boat based anglers from the Albany, Augusta, Bremer Bay, Busselton, Cape Arid, Denmark, Esperance, Hopetoun, Mandurah, north and south metropolitan and Walpole regions caught a total of 815,356 herring (115 tonnes) between 1994 and 1996 (Table 22 and 23). Catches occurred across most seasons and years in the Albany, Busselton, Hopetoun, north and south metropolitan regions only. The total catch of Australian herring by boat based anglers was greatest during the autumn season, for all regions where herring were caught, except for the Busselton region in 1995 and the Walpole region in 1994. The greatest catches during the study period (1994-1996) were from the south metropolitan region (411,451 fish; tonnes) which were approximately 5 times greater than the second ranked Mandurah region (86,795 fish; tonnes).

Total catches of A. herring by boat anglers were greatest in 1994 (455,990 fish; 67 tonnes) followed by 1995 (182,924 fish; 25 tonnes) and 1996 (176,442 fish; 25 tonnes) (Figure 17). Although 1996 was represented by the reduced survey the catches were only 6,482 herring less than during 1995 which may reflect the high autumn 1996 catches of herring from Busselton. The total boat based herring catch is approximately 50% of the shore based herring catch.

Adjusted total catch (by number and tonnes) for surveyed and non-surveyed sites:
A conversion factor was developed to determine the adjusted total catch (in numbers and weight) for both surveyed and non-surveyed sites along the southwest coastline. The conversion factor also indicated how successful the survey was at interviewing the number of anglers fishing in a region. The conversion factor was 1.0 to 1.7 for each region, except the Augusta region which had a value of 2.5.

Overall species:
The west coast zone had a higher adjusted total catch by shore anglers during 1995 (1,534,935 fish) than 1994 (1,425,360 fish) and 1996 (410,453 fish) (Table 24 and Figure 18). However in the south coast zone the 1994 catches (393,997 fish) were higher than 1995 (281,980 fish) and 1996 (101,704 fish). Annual catches from the southeast coast zone were considerably lower in 1995 (45,416 fish) compared to the 1994 catches (179,587 fish). The adjusted total catch from the west coast zone (3,370,749 fish) was four times greater than the south coast zone (777,681 fish) and 15 times greater than the southeast coast zone (225,002 fish)

The adjusted total catches for boat based anglers by zones yielded the highest catches from the west coast zone (4,902,425 fish) which contributed 93% to the overall catch (5,264,068 fish) (Figure 18). The catches from the south coast and southeast coast zones (275,047 fish and 86,596 fish, respectively) contributed the remainder to the total. The overall catch by boat based anglers was greater than the shore based anglers as a result, primarily of the high catch from the Mandurah region during the summer season of 1994 (Table 25). Annual catches were greatest during 1994 for which interviews were conducted over all seasons (3,417,184 fish) followed by 1995

(1,419,609 fish) and 1996 (427,275 fish). The boat based estimates are an underestimate of the true figures as this survey did not target that group specifically.

Western Australian salmon:
Adjusted total catches of Western Australian salmon by shore anglers were greatest during the autumn season, except for the Albany region during the spring season 1995, and the Bremer Bay and Denmark regions during the summer season of 1994 (Table 26 and 27). Catches were reported from most seasons in the Albany, Busselton, Cape Arid, Denmark and Walpole regions; but only from the autumn season in the Augusta and Esperance regions.

The south coast zone had the greatest adjusted total catch of salmon during 1994 and 1995 of 45,553 salmon (168 tonnes) followed by the west coast zone with 33,526 salmon (119 tonnes) and the southeast zone with 20,145 salmon (50 tonnes) (Tables 26 and 27). During 1996, the west coast zone catch was 18,291 salmon (72 tonnes), contributed mainly from the Busselton during the autumn. The south coast adjusted total catch for 1996 was 3,123 salmon (12 tonnes) contributed solely from the Albany region. The 1994 adjusted total catch for the three zones was comparable to the 1995 values (Figure 19).

Adjusted total catches of Western Australian salmon by boat based anglers were 33 times lower (3,710 salmon; 11 tonnes) than catches by shore anglers (99,226 salmon; 337 tonnes) (Figure 19). The highest adjusted total catch was reported from the west coast zone (2,115 salmon; 4,421 tonnes) followed by the south coast zone (1,595 salmon; 6,357 tonnes). Annual adjusted total catches were similar between 1994 (1,820 salmon) and 1995 (1890 salmon).

Australian herring:
With few exceptions, Australian herring were reported from shore anglers' adjusted total catches from all seasons and years (Table 28 and 29). The highest adjusted total catch was recorded during the autumn seasons from 1994 (121,130 herring; 15 tonnes) and 1995 (293,313 herring; 36 tonnes) from the Augusta region; which had the greatest regional catch of 617,436 herring (76 tonnes) for 1994 and 1995.

The west coast zone produced adjusted total catches three times greater (1,765,727 herring; 208 tonnes) than the south coast zone (352,919 herring; 86 tonnes) and an order of magnitude greater than the southeast zone (121,112 herring; 24 tonnes) (Table 28 and 29). The west coast zone comprised 77% of the overall adjusted total catch. Annual adjusted total catches yielded 1,064,178 herring (168 tonnes) in 1994 compared to 1,175,580 herring (149 tonnes) in 1995 and 215,925 herring (35,148 tonnes) in 1996 (Figure 20).

The largest boat based adjusted total catches for herring during 1994 and 1995 were recorded from the south metropolitan region (349,550 herring; 44 tonnes) followed by the Busselton (168,155 herring; 10 tonnes) and north metropolitan (105,476 herring; 13 tonnes) regions (Tables 30 and 31).

During 1994 and 1995, the west coast zone comprised 88% (641,291 herring; 83 tonnes) of the overall adjusted total catch for boat based anglers. The 1994 and 1995 adjusted total catches were considerably lower from the south coast (66,171 herring)

and the southeast coast (46,558 herring) zones than the west coast zone. The annual adjusted total catch was two times greater in 1994 (546,824 herring) compared to 1995 (201,000 herring) and 1996 (194,405 herring) (Figure 20).

Lenanton and Hall (1973) reported a total catch rate of 664,000 herring from shore and boat anglers along the south and north metropolitan regions during April, May and June 1973. The adjusted total catch, from the present study, for the north and south metropolitan regions for both shore and boat anglers during autumn 1994 was 314,725 herring. It is unclear whether this difference in the total catches reflects a decline in recreational herring catches during the past 20 years or is an artefact of the different sampling methodology.

Comparison of the recreational catch to the commercial catch:
During this creel survey, the commercial catches for Western Australian salmon and Australian herring have been monitored through factory receivals and log books. The commercial catches for both species for 1994 and 1995 show the large portion of the total catch attributed to the south coast zone fishers as compared to the west coast zone (Figure 21). For both species there was a minor contribution by the southeast coast zone fishers.

The recreational catch of shore and boat based anglers were summed and compared to the commercial catch for 1994 and 1995 by fishing zone for each species (Figure 22). The recreational catch of Western Australia salmon, by weight, for 1994 on the west coast was 6.7% of the total; in the south coast zone it was 3.9% of the total; and in the southeast coast zone was 99.9 % of the total. During 1995, the recreational portion of the catch accounted for more of the total for the west and south coast zones, with 16.4% and 6.2% respectively, while the southeast zone had 99.8% of the total catch.

The recreational catch of Australian herring from the west coast zone comprised 65.1% of the total catch, the south coast zone yielded only 9% of the total and the southeast zone produced 92% of the total for that zone. During 1995, the recreational portion of the total catch, by weight declined to 51.3% of the total in the west coast zone, 4.5% of the total in the south coast zone and 85.5% of the total in the southeast coast zone.

For both species, the distribution of the total catch between the two principal user groups reflected both the distribution of the commercial fishing sector along the southwestern coastline, the regions of greatest angler participation and the availability/vulnerability of the fish to capture. For both species, the southeast zone produced high recreational catches compared to the commercial catches which may be explained by the lack of commercial fishing in this remote area. In the west and south coast zones, the commercial sector comprised the substantially greater portion of the salmon total catch. In both regions, the commercial fishery operates salmon fishing teams during the autumn and early winter seasons while the fish are migrating close to the coast and are vulnerable to capture. During this season certain beaches have been

designated as commercial salmon beaches where commercial operators maintain priority for fishing when a school of salmon has been sighted. While recreational fishing for salmon is also prevalent during these seasons, it has been suggested that only 12% to 30% of anglers actually target salmon (ABS 1987; van Bueren et al. 1996). In addition, the unpredictable presence of salmon on the fishing beaches, the skill required to catch a salmon and a low bag limit of four reduces the potential catch for recreational anglers.

In contrast, the recreational catch for Australian herring was greater than for salmon along the west coast resulting from a combination of the very high participation levels, the greater availability of the fish in all seasons, the generous bag limit of 40 fish/angler/day and the few commercial operators. However, the south coast is the focus of the commercial herring fishery and these operators catch the greater share of the total catch. Again, little commercial fishing occurs in the southeast coast zone resulting in a predominantly recreational fishery. It has been estimated that between 30% and 39% of anglers target herring (ABS 1987; van Bueren et al. 1996); however the high vulnerability of this species to capture using a wide range of fishing tackle results in a large proportion of herring being caught by anglers not targeting the species.

A reduced Western Australian salmon and Australian herring anglers' survey:
A forward stepwise linear regression model was applied to the adjusted total shore catches for all species to develop a reduced creel survey for future shore angler catch and effort surveys. The model required season and year combinations for all regions. If this information was missing for any region then that season and year combination was deleted from the data set. In addition, Windy Harbour and Bunbury were deleted from the data set because of the number of missing season and year combinations. The regression model chooses the combinations of regions (up to three regions) which will best explain the observed adjusted total catch.

In order to explain 99% of the variation of the observed adjusted total catch between regions, years and seasons, a future survey could interview anglers at the following combination of regions; Busselton, Esperance and north metropolitan or Augusta, Mandurah and south metropolitan. While this method allows us to understand the variation in observed adjusted total catch between the sampling regions, seasons and years, it does not provide a reduced set of regions which will yield a catch estimate comparable to the present survey catch estimate. For example, the regression model indicates that the combination of Cape Arid, Hopetoun and north metropolitan explains 99% of the variation in observed adjusted total catch; however these three regions only account for 14% of the observed adjusted total catch for shore fishers.

The regions required to participate in a reduced survey that would produce 90% of the 1994 estimated adjusted shore based angler total catch for all finfish species would be south metropolitan, Augusta, Albany, north metropolitan, Busselton, Esperance, Mandurah and Bunbury. There would be nine regions included in a reduced survey to estimate the Western Australian salmon adjusted shore based angler total catches, including; Albany, Cape Arid, Bremer Bay, Busselton, Bunbury, Mandurah, Denmark, Windy Harbour and south metropolitan. Eight regions would participate in a reduced survey to estimate the Australian herring adjusted shore based angler total

catches, including; Augusta, south metropolitan, Albany, north metropolitan, Esperance, Busselton, Mandurah, and Bunbury (Figure 23).

Direct Benefits and Beneficiaries

The beneficiaries of the Western Australian salmon and Australian Herring Angler Survey are both the commercial and recreational fishing community and managers of both resources in Western Australia. The annual value to the fishers of the commercial catch of Western Australia salmon and Australia herring is respectively $0.4m and $0.6m. The realised value to the access rights to the fishers is estimated to be worth in the order of $1.0m.

The value of the recreational catch, in terms of expenditure and economic surplus, is greater than the value of the commercial catch, though the two are not directly comparable (see FRDC Final Report Project 93/080). Sustainable catches and resolution of the catch sharing issues between the commercial and recreational sector will perpetuate the income and flow-on effects to the WA regional community. Recreational fishers support for an equitable compensation system to commercial fishers will be dependent on the results of this research.

These results will be prepared for presentation to WA Australian Salmon and Herring Resource Allocation Committee and the Recreational Fishing Advisory Committee. Both committees advise the West Australian Minister of Primary Industries on the resource allocation issues for these species. The results will form the basis for the adoption of appropriate resource allocation and incorporated into the fisheries management plant. Results will also be presented at scientific meetings and prepared for publication in referred scientific journals and Fisheries Department reports and Western Fisheries magazine. The benefits and beneficiaries discussed in the original proposal remain the same.

Intellectual Information and Valuable Information

Not applicable.

Further Development

The Western Australian Salmon and Australian Herring Anglers Survey has been successful in providing catch and effort data to the recreational sector for these two target species as well as other valued recreational species in Western Australia. The information continues the results of an earlier survey (1987) that showed that Australian herring were the most popular recreational species, but salmon were not as popular. An additional spin-off benefit has been the development of an educational role concerning recreational fishing provided by the Fisheries Department to anglers and the wider community.

Analysis of the catch and effort data from this research and the calculation of appropriate variance estimates for the catch rates will continue. These variance estimates will allow for a degree of confidence around the estimates of catch and effort.

As a result of this research, a year long recreational boat based anglers survey is currently being undertaken in the Kalbarri to Augusta region. Designed to

concentrate on boat anglers catches this survey compliments the West Australian Salmon and Herring Anglers Survey. It is also anticipated that a reduced shore-based on-site anglers survey for the southwest of WA will be repeated in 3 to 5 years to compare with the present research.

The importance of Australian herring to the creel of shore based anglers in southwest WA was a key result of the present research. This has provided the rational for a further FRDC funded research project which is conducting a more in-depth examination of the biology of the species in WA and SA, culminating in the assessment of the status of the stock of this important species.

Staff employed on the project

The following staff were employed as interviewers on this project:

Metropolitan south	Barry Fenn
Mandurah	John Beaton
	Warren Monk
Bunbury	Lloyd Goodlad
Busselton	Henry Voyer
	Nigel Kelly
	Harry Hall
	Tony French
Augusta	Merv Newton
	Trevor Earl
Windy Harbour	Brendon and Marcia Johnson
Walpole	Max Horne
Denmark	Laurence Cuthbert
Albany	David Heales
Bremer Bay	Michael Aggiss
	Peter Spurr
Hopetoun	Elizabeth and Hugh Carruthers
Esperance and Cape Arid	Mark Tyrell and Brent Montgomerie

Final Costs

The final costing for this research are:

FRDC Component:	$202,640
Non-FRDC Component:	$129,000
Total	$331,640

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Appendix 1. Angler interviews for 1994-1995 for all 131 sites in the 14 regions and 1996 for five regions only. The number of visits to each site, and the hours spent at each site, for the Western Australian salmon and Australian herring creel survey are presented. Boat ramps are in bold. Twelve sites were excluded from analysis if the number of visits was less than 10 (indicated by *).

Year	Region	Site	Site Visits	Hours at Sites
1994-95	Albany	Bayonnet Head -Oyster Harbour	45	35.98
		Cheynes Beach	40	62.50
		Nanarup	38	37.03
		Norman's Beach	41	29.75
		Princess Royal Harbour Jetty	43	40.62
		Salmon Pools	51	42.22
		Sandy Patch	47	44.17
1994-95	Augusta	Barrack Point	59	44.42
		Black Point	4*	8.50
		Cape Freycinet	51	24.75
		Cape Hamelin	15	11.33
		Cape Leeuwin	57	39.87
		Conto's Beach	46	19.92
		Hamelin Beach and Boat Ramp	35	23.33
		Isaac's Rock	2*	2.25
		Knobby Head	40	29.92
		North Point	1*	1.50
		White Point	4*	6.50
1994-95	Bremer Bay	Back Beach	44	10.68
		Boat Harbour	38	11.67
		Bremer Beach	2*	0.77
		Cape Riche	38	15.05
		Dillon Beach	38	10.85
		Little Boat Harbour	42	12.45
		Point Ann	33	11.92
		Reef Beach	38	21.97
		Triglelow Beach	34	33.27
1994-95	Bunbury	Belvidere	51	13.33
		Binningup Beach	43	7.82
		Dalyellup Beach	45	5.58
		Myalup	30	12.50
		Peppermint Grove Beach	39	7.08
		Rocky Point	44	14.75
		The Cut at Leschenault	41	22.40
1994-95	Busselton	**Abbey St. Boat Ramp**	24	6.17
		Bunker Bay (Rocky Point)	51	39.27
		Busselton Jetty	62	85.98
		Canal Rocks	32	12.87
		Castle Rock	45	25.50
		Cowaramup (Cape Mentelle)	1*	4.50
		Dolphin St. Boat Ramp	29	4.80
		Dunsborough Boat Ramp	57	27.42
		Eagle Bay	55	35.48
		Elmore St. Boat Ramp	24	5.45
		Meelup	52	17.18
		Quindalup Boat Ramp	36	6.20
		Smith's Beach	50	27.45
		Sugarloaf Rock	11	2.98
		Yallingup	52	32.58
1994-95	Cape Arid	Alexander Bay	48	36.00
		Duke of Orleans	59	42.58
		Hellfire Bay	2*	0.50
		Kennedy's	6*	3.33
		Lucky Bay Beach	27	9.83
		Poison Creek	47	67.67
		Rossiter Bay	22	11.00

		Thomas River	45	33.83
1994-95	Denmark	Boat Harbour	31	8.07
		Bornholm	23	17.10
		Cosy Corner	27	5.88
		Light's Beach	36	10.40
		Madfish Bay	36	12.32
		Mutton Bird	26	6.65
		Ocean Beach	27	18.08
		Parry's Beach	31	14.93
		Little River Jetty Boat Ramp	36	4.72
		Poddy Point Jetty Boat Ramp	34	3.83
1994-95	Esperance	Bandy Creek	56	23.42
		Dunn's Rock	48	24.00
		Esperance Pier	65	55.25
		Esperance Wharf	29	19.58
		Four Mile Beach	50	11.57
		Fourteen Mile Beach	1*	2.00
		Nine Mile Beach	53	21.05
		Quagi Beach	10	10.00
		Rose's Beach	10	11.67
		Salmon Beach	53	17.78
		Twilight Beach	1*	2.00
		Wylie - Cape LeGrande	49	48.42
1994-95	Hopetoun	Four Mile Beach	59	38.17
		Hopetoun Groyne	60	100.08
		Margaret Cove	26	38.92
		Mason's Beach	62	82.92
		Munglinup	47	61.33
		Starvation Boat Harbour	62	95.67
		Two Mile Beach	60	27.92
		West Beaches	2*	4.00
1994-95	Mandurah	Dawesville Cut	50	86.42
		Falcon Bay	46	36.50
		Madora	42	51.50
		Mary St. Lagoon Boat Ramp	25	37.67
		Preston Beach	44	85.42
		San-Remo	45	52.08
		Singleton	35	41.75
		Tim's Thicket	42	44.75
		White Hill	2*	2.33
1994-95	Metro North	Cottesloe	52	33.02
		Floreat Beach	50	28.00
		Hillarys Boat Ramp	49	32.50
		Pinnaroo Point	64	21.32
		Swanbourne	55	25.92
		Trigg Beach	60	16.92
1994-95	Metro South	Ammunition Jetty	1*	2.25
		ASI Groyne	29	23.42
		Leeuwin Boat Ramp	54	65.55
		North Mole	67	127.43
		Safety Bay Boat Ramp	63	111.07
		Shoalwater Bay Boat Ramp (3)	61	104.97
		Warnbro Sound	51	92.08
		Woodman's Pt	35	32.48
		Woodman's Pt Boat Ramp/ Shore	38	33.37
1994-95	Walpole	Banksia Camp	33	8.15
		Blue Hole	44	22.38
		Conspicuous Cliffs	42	12.80
		Herring Rock	41	14.70
		Irwin Inlet	24	7.10
		Mandalay Beach	33	10.62
		Peaceful Bay	35	20.33
		Sandy Beach (at Irwin Inlet)	16	5.00
		Sandy Beach by Peaceful Bay	44	12.73
		The Knoll	38	11.70
		Walpole Inlet (Rest Point Jetty)	32	11.50

1994-95	Windy	Coodamirup	30	19.92
		Fish Creek	31	26.17
		Malimup	10	9.00
		Salmon Beach	37	18.75
		Windy Harbour - Gardner River	39	52.00
		Yeagarup Beach	14	13.92
1996	Albany	Bayonnet Head -Oyster Harbour	13	7.00
		Cheynes Beach	13	18.75
		Nanarup	15	12.75
		Norman's Beach	13	9.50
		Princess Royal Harbour Jetty	15	9.25
		Salmon Pools	13	9.25
		Sandy Patch	14	10.00
1996	Busselton	**Abbey St. Boat Ramp**	16	3.33
		Bunker Bay	16	12.58
		Busselton Jetty	16	24.08
		Canal Rocks	17	13.83
		Castle Rock	16	10.83
		Dolphin St. Boat Ramp	15	5.00
		Dunsborough Boat Ramp	16	4.92
		Eagle Bay	16	5.67
		Elmore St. Boat Ramp	16	2.50
		Meelup	16	12.92
		Quindalup Boat Ramp	16	3.50
		Smith's Beach	17	9.25
		Sugarloaf Rock	16	4.67
		Yallingup	17	16.25
1996	Mandurah	Dawesville Cut	15	21.83
		Falcon Bay	16	13.82
		Madora	11	12.08
		Mary St. Lagoon Boat Ramp	6	8.03
		Preston Beach	13	32.32
		San Remo	10	10.08
		Singleton	17	21.52
		Tim's Thicket	12	16.45
1996	Metro North	Cottesloe	14	6.17
		Floreat Beach	9	10.33
		Hillarys Boat Ramp	12	4.50
		Pinnaroo Point	10	3.17
		Swanbourne	16	5.92
		Trigg Beach	24	7.08
1996	Metro South	Ammunition Jetty	4	5.75
		ASI Groyne	4	5.55
		Leeuwin Boat Ramp	16	17.08
		North Mole	17	33.43
		Safety Bay Boat Ramp	14	25.17
		Shoalwater Bay Boat Ramp (3)	20	29.52
		Warnbro Sound	13	23.00
		Woodman's Pt	7	9.45
		Woodman's Pt Boat Ramp/ Shore	12	9.85

Appendix 2. Western Australian salmon and Australian herring creel survey questionnaire form.

Appendix 3. Summary of the percent of bad weather and missing days from the total number of scheduled sampling days by region, year, season.

Region	Year	Season	Scheduled Weekdays & Weekend Days	% Bad Weather Days	% Missing Days
Albany	1994	Autumn	27	3.7	
		Winter	15		6.6
		Spring	18		
		Summer	24		
	1995	Autumn	27	3.7	
		Winter	15	13.3	
		Spring	18	11.1	
		Summer	24	4.1	4.1
	1996	Autumn	27	3.7	3.7
Augusta	1994	Autumn	27	3.7	33.3
		Winter	15		40.0
		Spring	18	38.0	5.5
		Summer	24	12.5	
	1995	Autumn	27	18.5	7.4
		Winter	15	53.3	
		Spring	18	22.2	5.5
		Summer	24	20.8	12.5
	1996	Autumn	27		
Bremer Bay	1994	Autumn	27	14.8	
		Winter	15		
		Spring	18	27.7	
		Summer	24		
	1995	Autumn	27		
		Winter	15		
		Spring	18	5.5	
		Summer	24	12.5	
	1996	Autumn	27		
Bunbury	1994	Autumn	27		14.8
		Winter	15	26.6	
		Spring	18	22.2	
		Summer	24	4.2	12.5
	1995	Autumn	27	11.1	11.1
		Winter	15		33.3
		Spring	18	5.5	5.5
		Summer	24		4.2
	1996	Autumn	27		
Busselton	1994	Autumn	27	14.8	
		Winter	15	33.3	
		Spring	18	44.4	
		Summer	24	12.5	25.0
	1995	Autumn	27	7.4	3.7
		Winter	15	13.3	20.0
		Spring	18	33.3	
		Summer	24		
	1996	Autumn	27		
Cape Arid	1994	Autumn	27	11.1	
		Winter	15	13.3	26.6
		Spring	18	16.6	27.7
		Summer	24	12.5	8.3
	1995	Autumn	27		
		Winter	15	60.0	
		Spring	18	5.5	
		Summer	24		4.1

	1996	Autumn	27		
Denmark	1994	Autumn	27	7.4	
		Winter	15	20	
		Spring	18	22.2	22.2
		Summer	24	16.6	
	1995	Autumn	27	22.2	
		Winter	15	26.6	5.5
		Spring	18	55.5	
		Summer	24	16.6	
	1996	Autumn	27		
Esperance	1994	Autumn	27	3.7	3.7
		Winter	15	6.6	
		Spring	18	5.5	11.1
		Summer	24	4.2	16.7
	1995	Autumn	27	11.1	11.1
		Winter	15	20.0	13.3
		Spring	18	11.1	5.5
		Summer	24	4.2	8.3
	1996	Autumn	27		
Hopetoun	1994	Autumn	27	3.7	
		Winter	15	26.6	
		Spring	18	22.2	
		Summer	24	4.2	
	1995	Autumn	27	7.4	3.7
		Winter	15	33.3	13.3
		Spring	18	22.2	5.5
		Summer	24	8.3	
	1996	Autumn	27		
Mandurah	1994	Autumn	27	7.4	
		Winter	15	40.0	
		Spring	18	5.5	
		Summer	24	4.2	
	1995	Autumn	27		3.7
		Winter	15	13.3	
		Spring	18	16.6	
		Summer	24		
	1996	Autumn	27		
Metro North	1994	Autumn	27	29.6	3.7
		Winter	15	53.3	6.6
		Spring	18	16.6	26.6
		Summer	24	16.7	12.5
	1995	Autumn	27	25.9	7.4
		Winter	15	60.0	
		Spring	18	55.5	5.5
		Summer	24	33.3	20.8
	1996	Autumn	27	37.0	14.8
Metro South	1994	Autumn	27		3.7
		Winter	15	60.0	
		Spring	18	66.6	
		Summer	24	25.0	8.3
	1995	Autumn	27	18.5	11.1
		Winter	15	46.6	
		Spring	18	22.2	5.5
		Summer	24	16.7	4.2
	1996	Autumn	27	18.5	7.4
Walpole	1994	Autumn	27	7.4	
		Winter	15	13.3	6.6
		Spring	18	11.1	
		Summer	24	4.2	4.2
	1995	Autumn	27	3.7	7.4

		Winter	15	26.6	
		Spring	18	16.6	5.5
		Summer	24		
	1996	Autumn	27		
Windy Har	1994	Autumn	27	7.4	3.7
		Winter	15	20.0	33.3
		Spring	18		11.1
		Summer	24		41.7
	1995	Autumn	27	7.4	59.3
		Winter	15	6.6	66.6
		Spring	18		66.6
		Summer	24		37.5
	1996	Autumn	27		

Appendix 4. The number of on site interviews with anglers by region, year and season. Summer 1995 is represented by December 1995 only for Augusta, Bremer Bay, Bunbury, Cape Arid, Denmark, Esperance, Hopetoun, Walpole and Windy Harbour but by all summer months for the five regions participating in the reduced survey (Albany, Busselton, Mandurah, metropolitan north and south). Winter 1996 is represented by only June 1996 for the five regions.

Region	Year	Season	Number of interviews
Albany	1994	Autumn	523
		Winter	142
		Spring	161
		Summer	225
	1995	Autumn	240
		Winter	89
		Spring	112
		Summer	202
	1996	Autumn	165
		Winter	20
Augusta	1994	Autumn	149
		Winter	45
		Spring	30
		Summer	77
	1995	Autumn	271
		Winter	54
		Spring	72
		Summer	7
Bremer Bay	1994	Autumn	173
		Winter	22
		Spring	11
		Summer	26
	1995	Autumn	42
		Winter	5
		Spring	10
		Summer	7
Bunbury	1994	Autumn	167
		Winter	18
		Spring	52
		Summer	134
	1995	Autumn	112
		Winter	17
		Spring	27
		Summer	9
Busselton	1994	Autumn	312
		Winter	88
		Spring	54
		Summer	139
	1995	Autumn	767
		Winter	166
		Spring	138
		Summer	310
	1996	Autumn	430
		Winter	35
Cape Arid	1994	Autumn	99
		Winter	7
		Spring	19
		Summer	41
	1995	Autumn	51
		Winter	19
		Spring	42
		Summer	13
Denmark	1994	Autumn	72
		Winter	45
		Spring	28
		Summer	105

	1995	Autumn	231
		Winter	57
		Spring	51
		Summer	22
Esperance	1994	Autumn	240
		Winter	78
		Spring	49
		Summer	132
	1995	Autumn	101
		Winter	11
		Spring	24
		Summer	7
Hopetoun	1994	Autumn	192
		Winter	50
		Spring	67
		Summer	158
	1995	Autumn	155
		Winter	39
		Spring	41
		Summer	17
Mandurah	1994	Autumn	338
		Winter	162
		Spring	80
		Summer	203
	1995	Autumn	262
		Winter	21
		Spring	55
		Summer	119
	1996	Autumn	142
		Winter	1
Metro North	1994	Autumn	453
		Winter	106
		Spring	100
		Summer	174
	1995	Autumn	197
		Winter	39
		Spring	76
		Summer	142
	1996	Autumn	94
		Winter	5
Metro South	1994	Autumn	618
		Winter	258
		Spring	317
		Summer	463
	1995	Autumn	518
		Winter	236
		Spring	271
		Summer	429
	1996	Autumn	359
		Winter	60
Walpole	1994	Autumn	173
		Winter	29
		Spring	41
		Summer	103
	1995	Autumn	65
		Winter	21
		Spring	21
		Summer	37
Windy Harbour	1994	Autumn	92
		Winter	10
		Spring	24
		Summer	14
	1995	Autumn	8
		Winter	0

LIST OF FIGURES

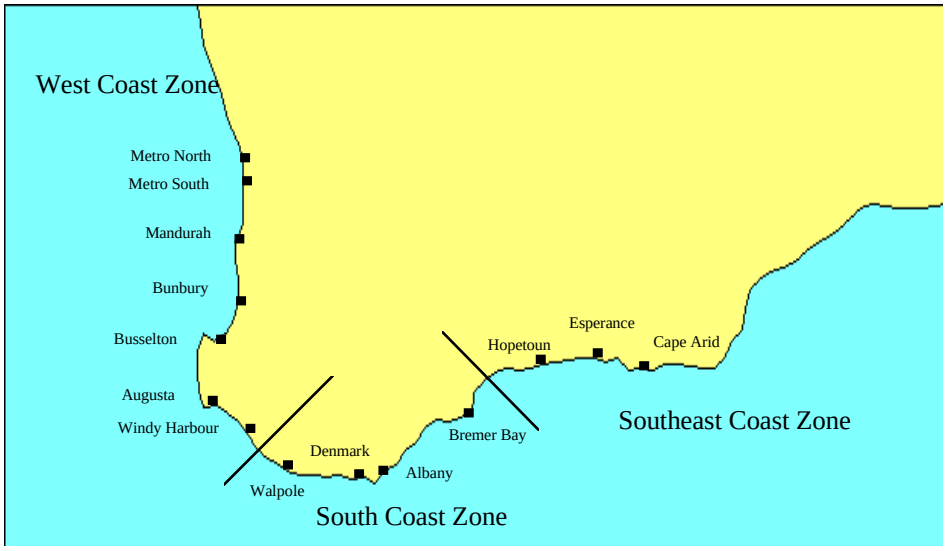


Figure 1. Western Australia salmon and Australian herring creel survey regions along southwestern Australia.

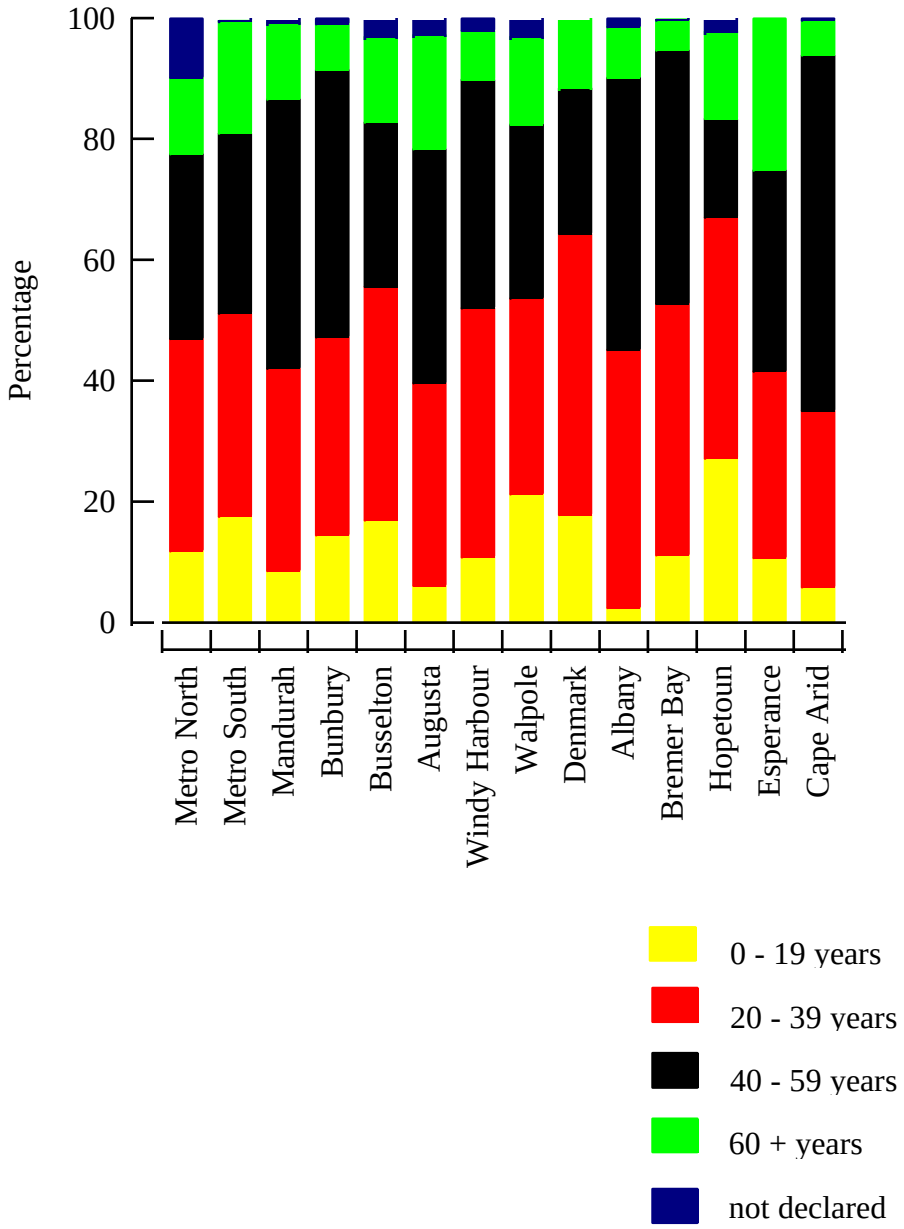


Figure 2. The percentage of anglers interviewed from each age category for each fishing region.

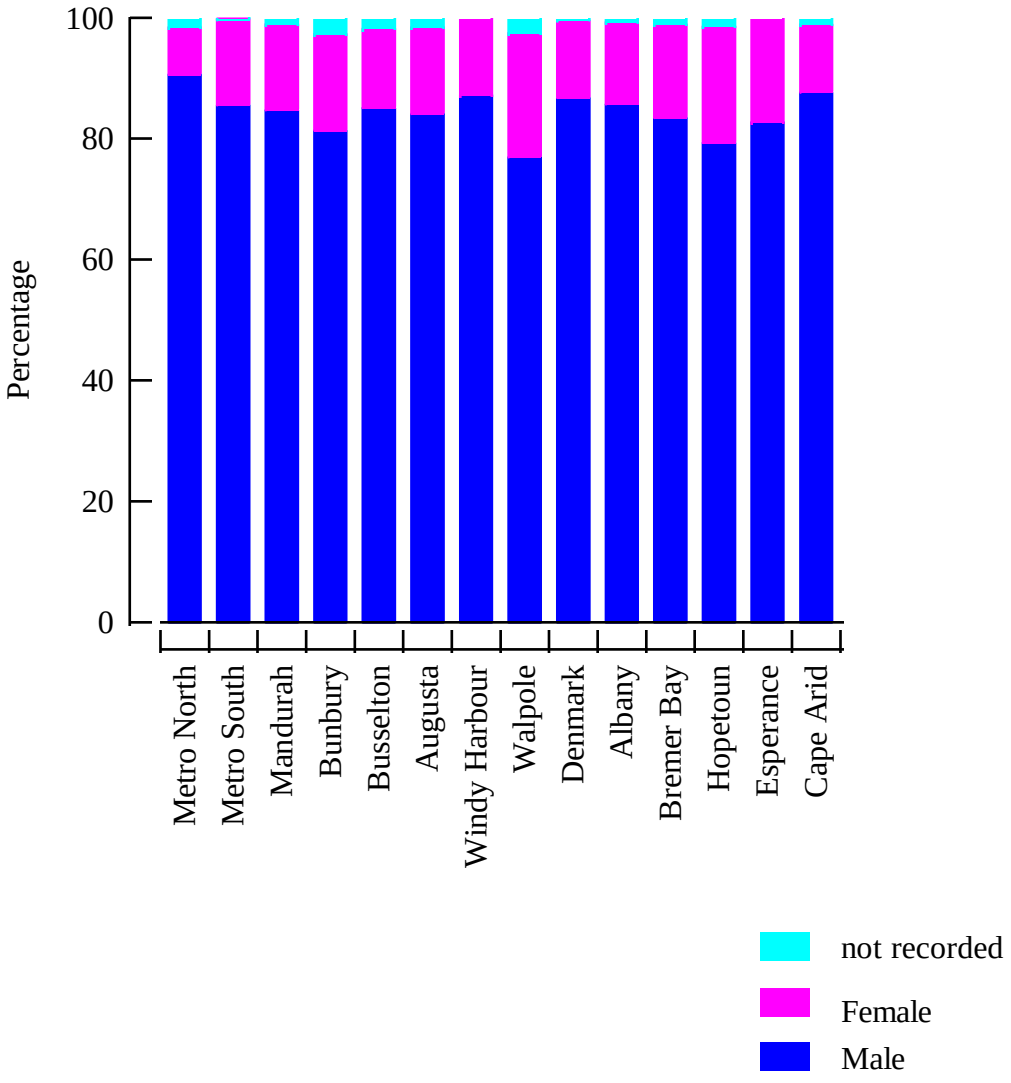


Figure 3 The percentage of male and female anglers by fishing region.

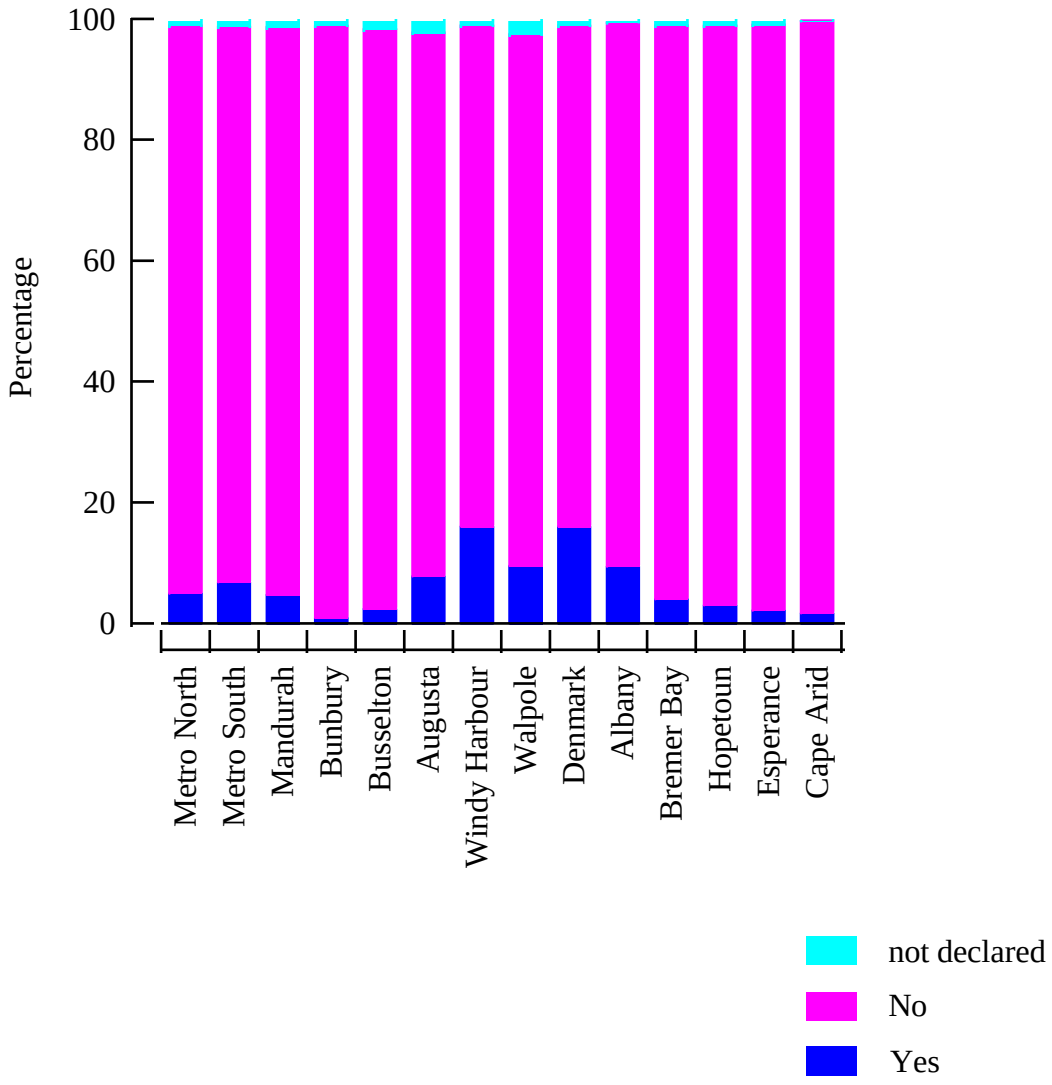


Figure 4. The percentage of angling club membership for anglers interviewed for each fishing region.

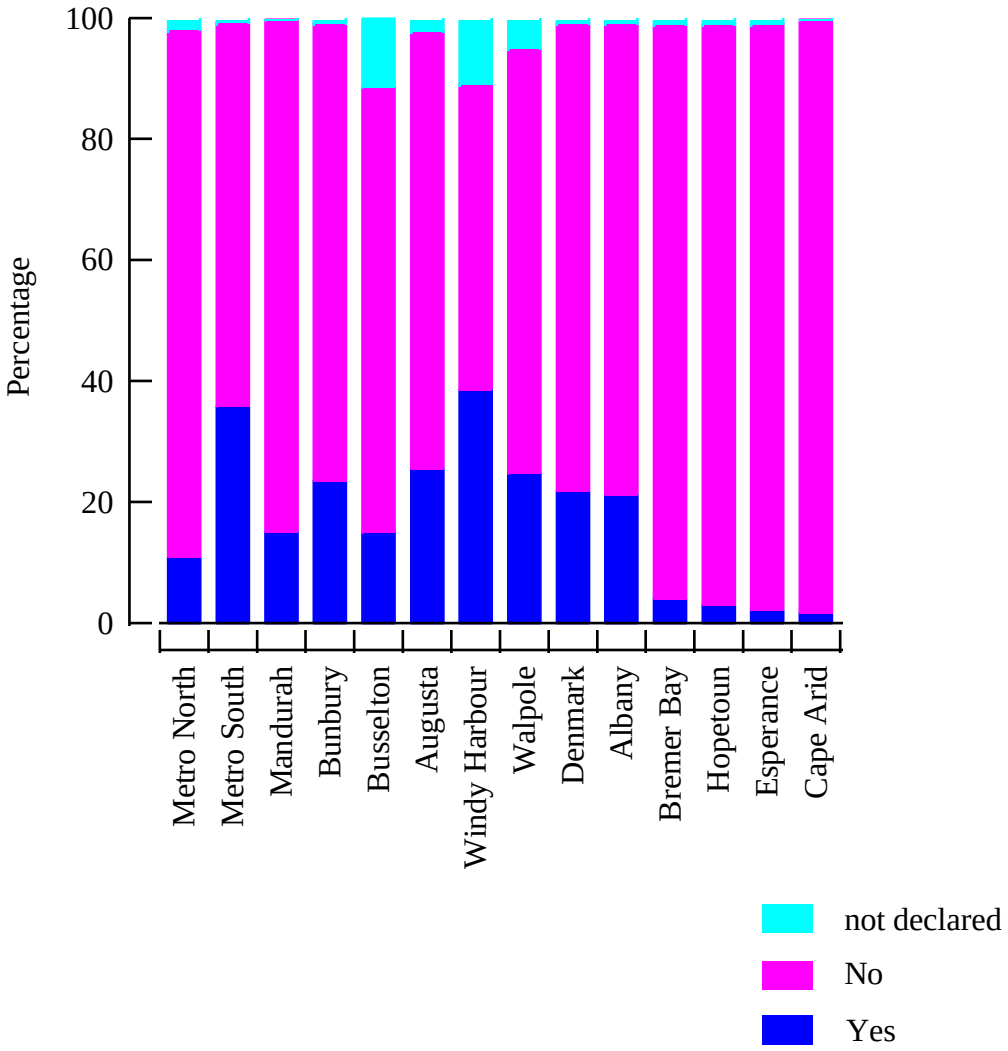


Figure 5. The percentage of anglers who possess W.A. recreational fishing licence(s).

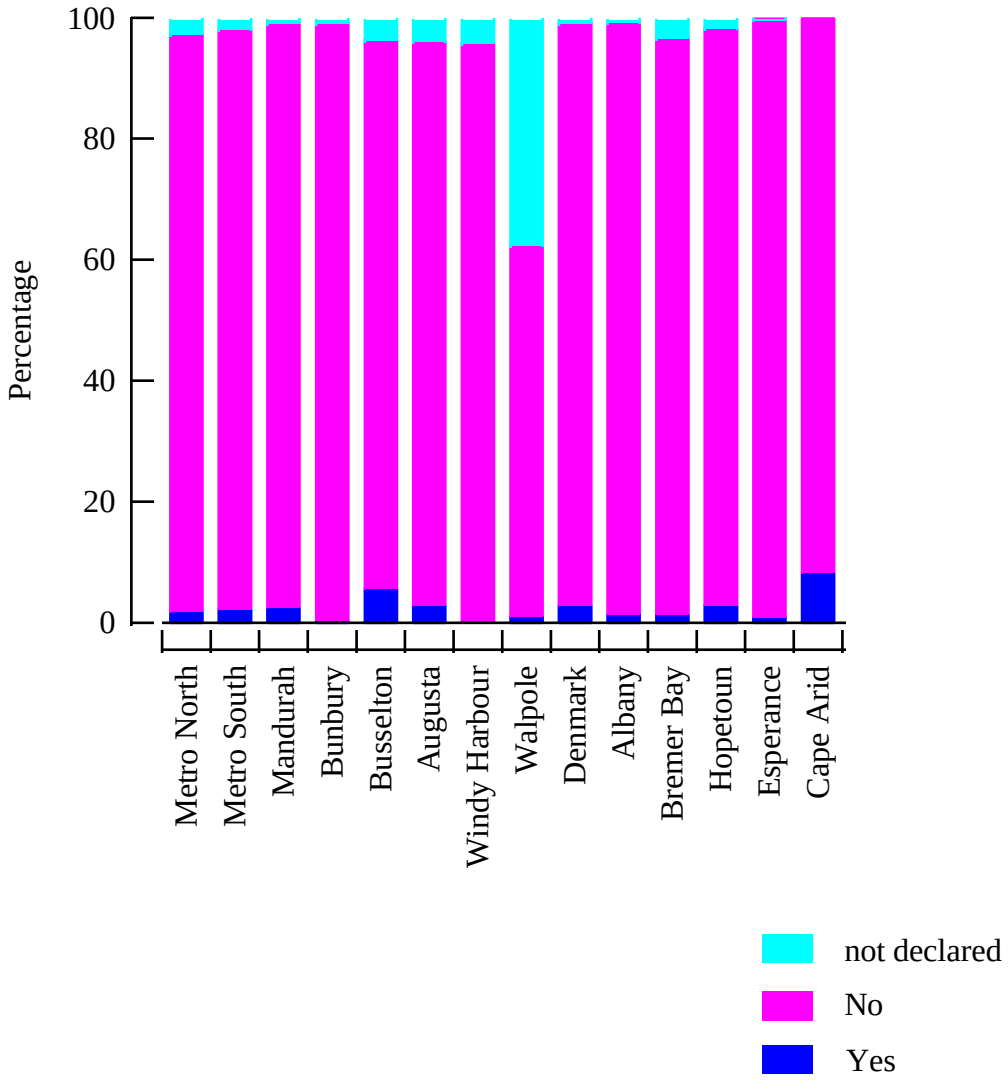


Figure 6. The percentage of anglers by fishing region who had attained their bag limit for any species, of those anglers who had caught at least one fish at the time of interview.

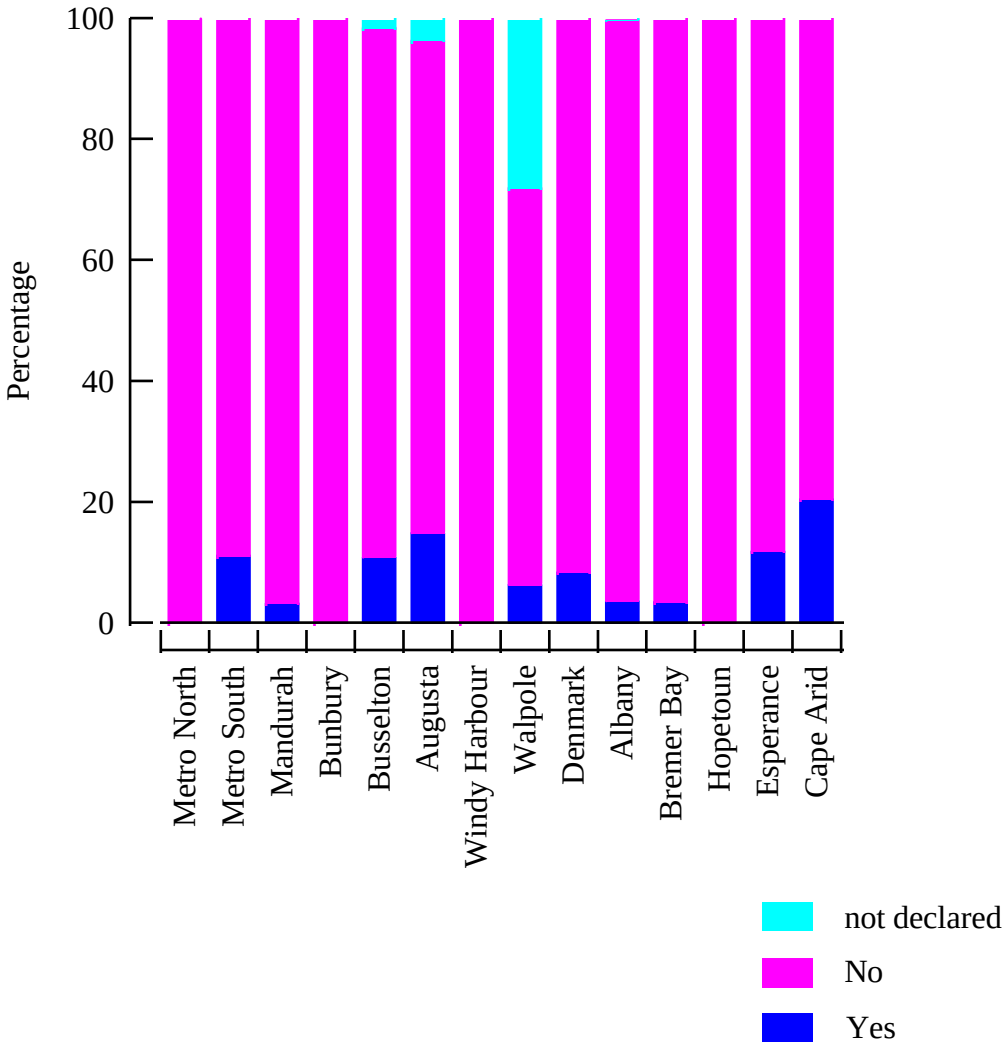


Figure 7. The percentage of anglers by fishing region who had attained their bag limit for Western Australian salmon, of those anglers who had caught at least one Western Australian salmon at the time of interview.

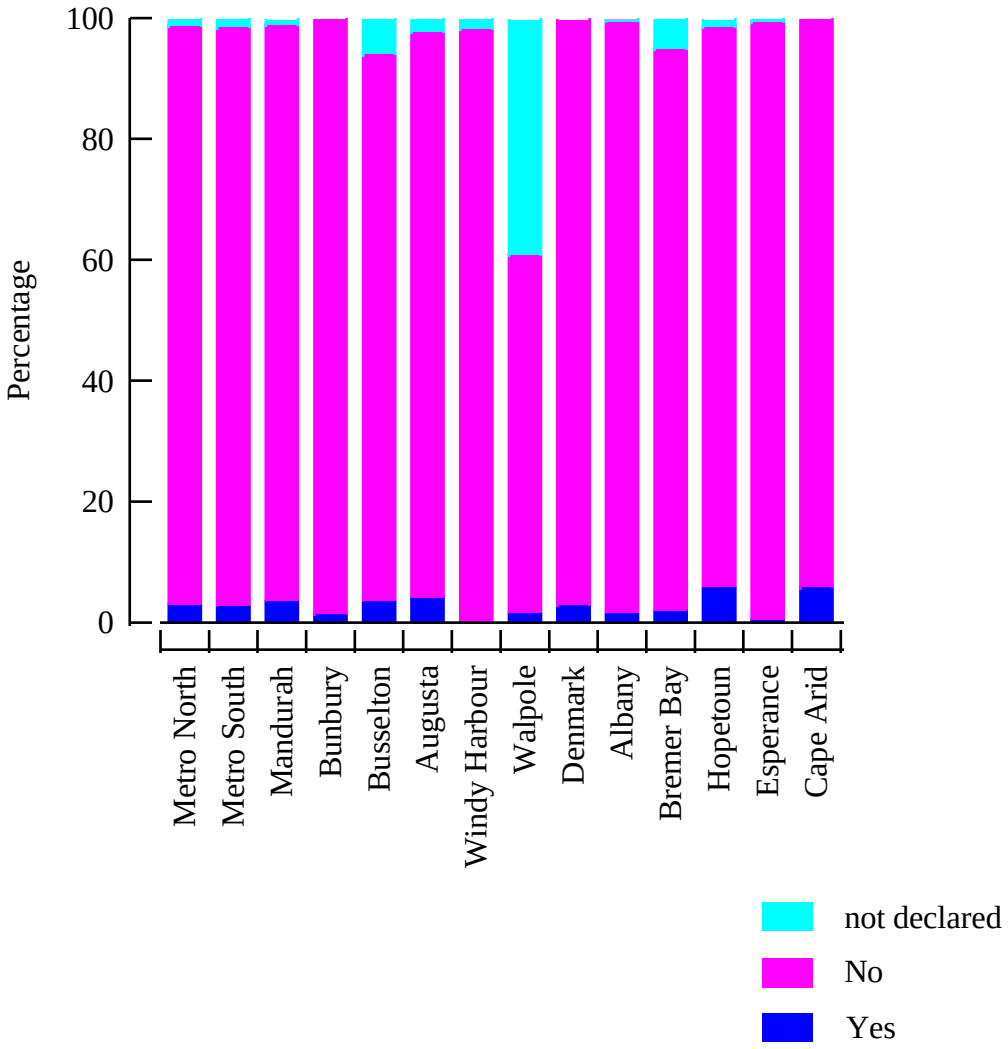


Figure 8. The percentage of anglers by fishing region who had attained their bag limit for Australian herring of those anglers who had caught at least one Australian herring at the time of interview.

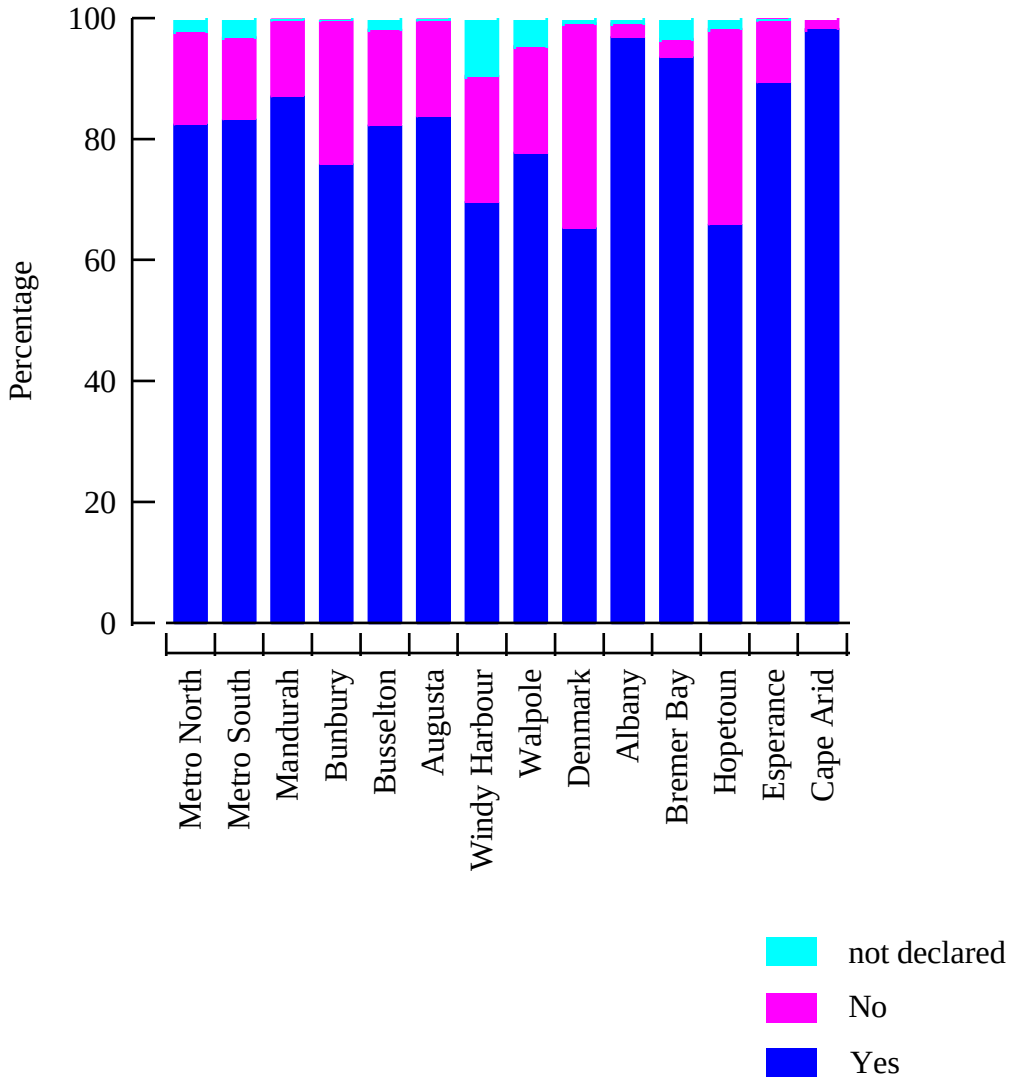


Figure 9. The percentage of anglers with knowledge of the Western Australian recreational fishing regulations (bag limits and size regulations) by fishing region.

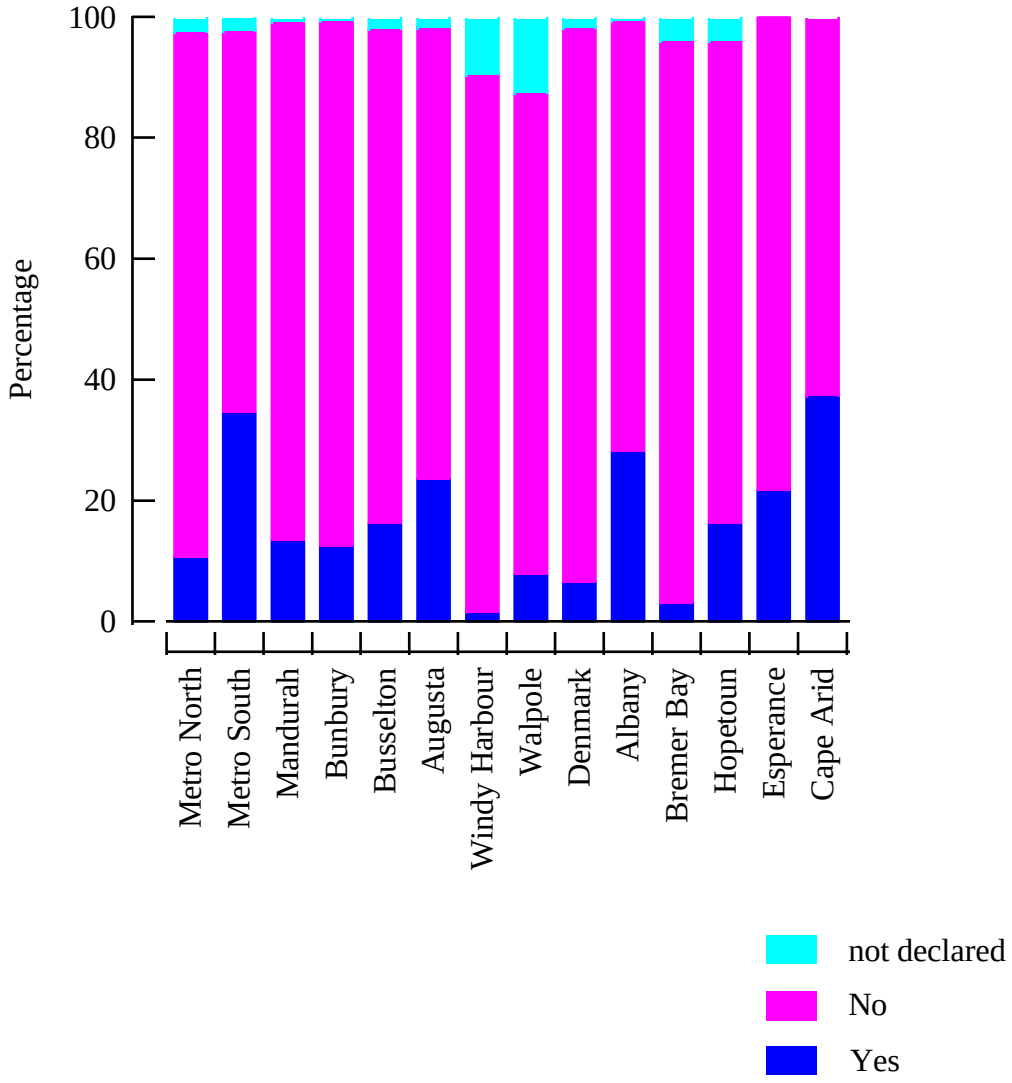


Figure 10. The percentage of anglers who had been interviewed before by the same interviewer for each fishing region.

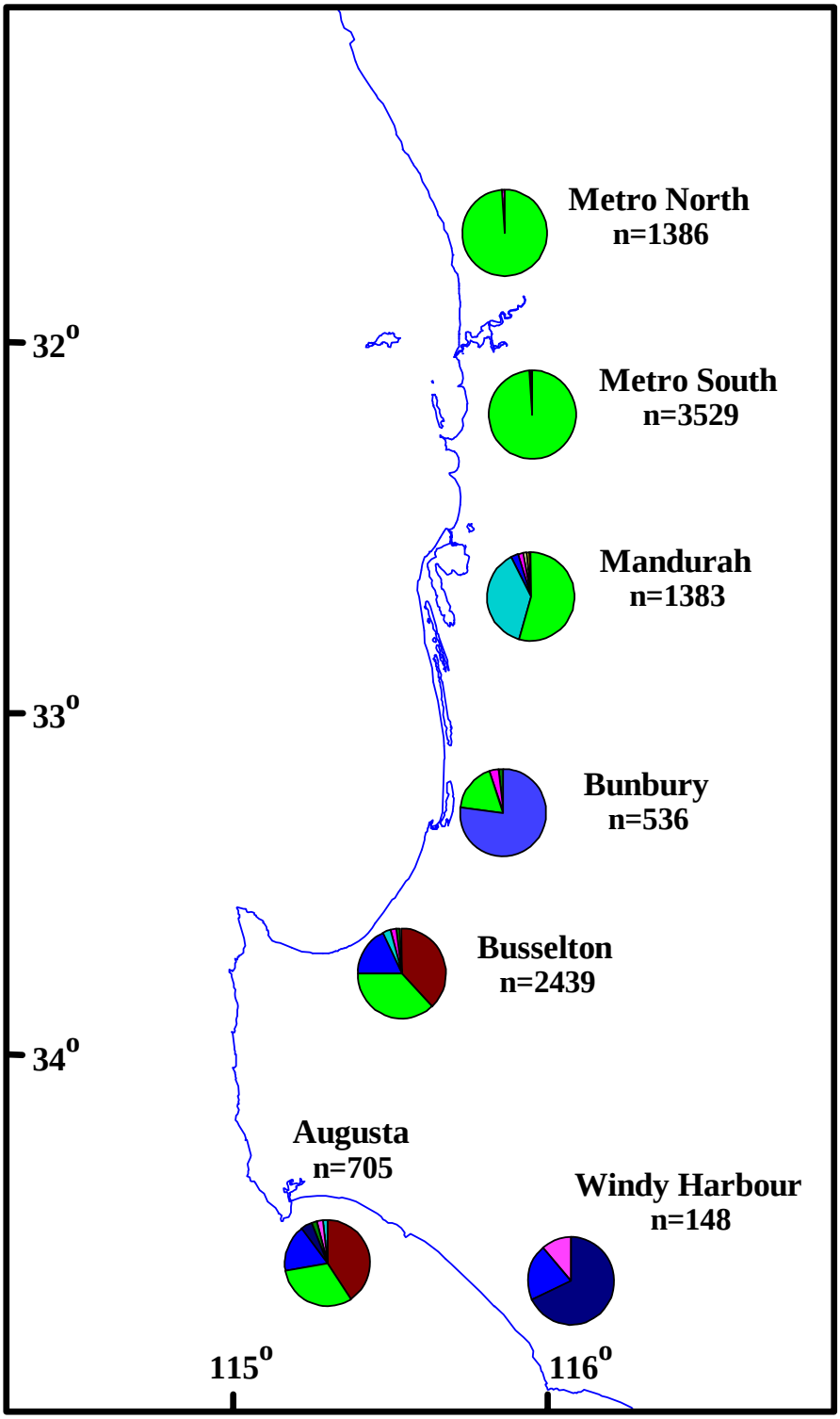
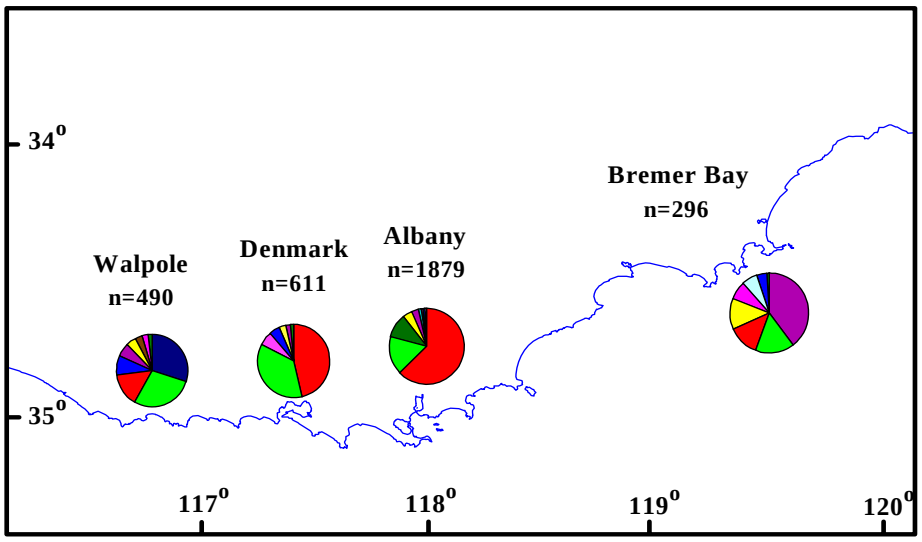


Figure 11. Home postcode region of anglers interviewed in each fishing region along the coast of southwestern Australia. The three maps represent, in consecutive order, the western, southern and southeastern fishing zones (Legend is included below).



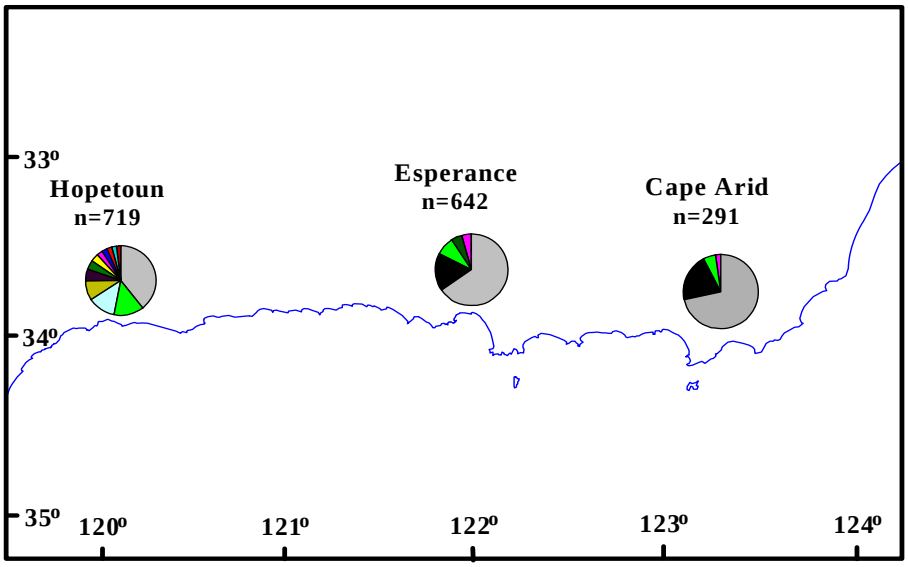


Figure 11. Cont'd.

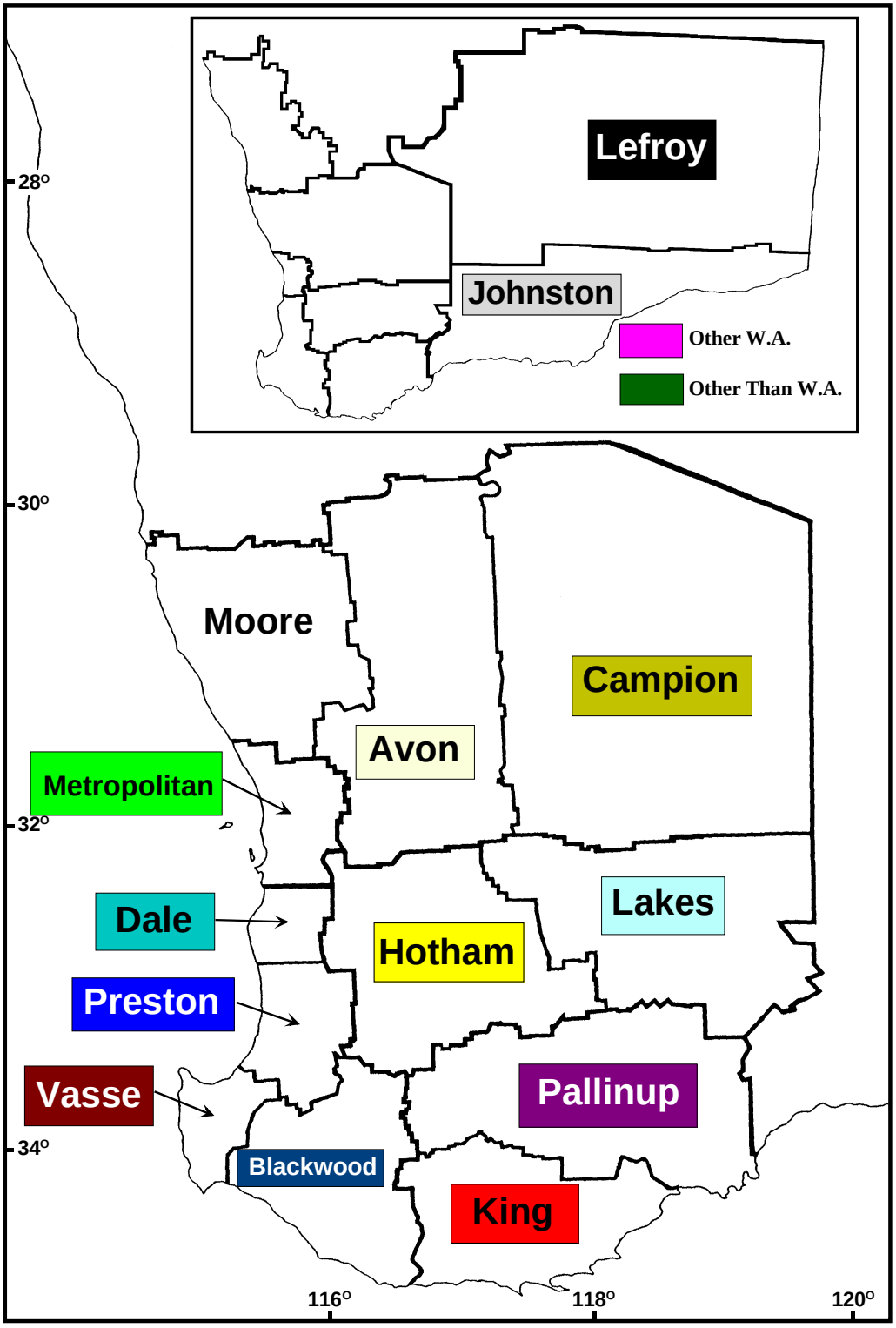


Figure 11. Legend .

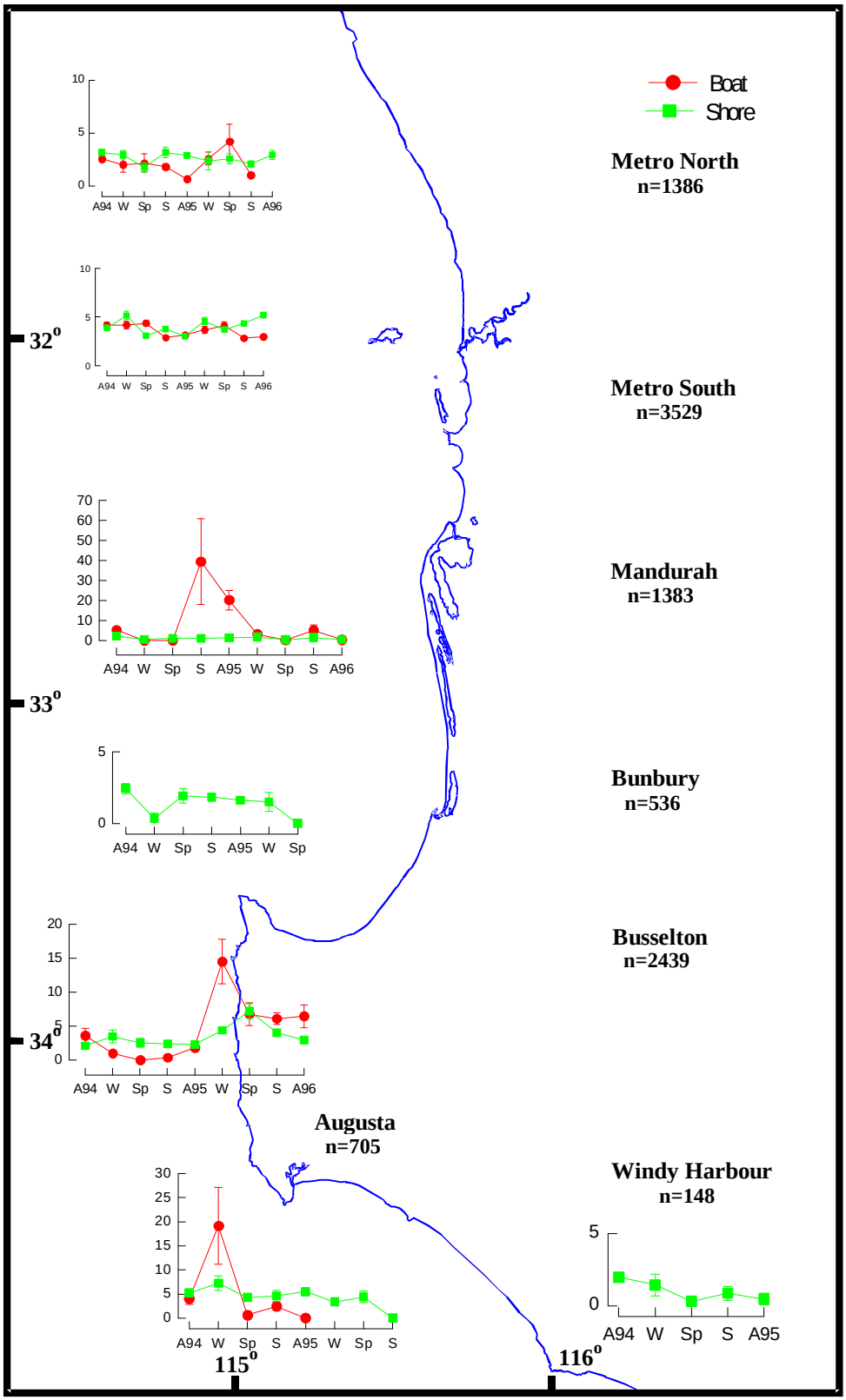
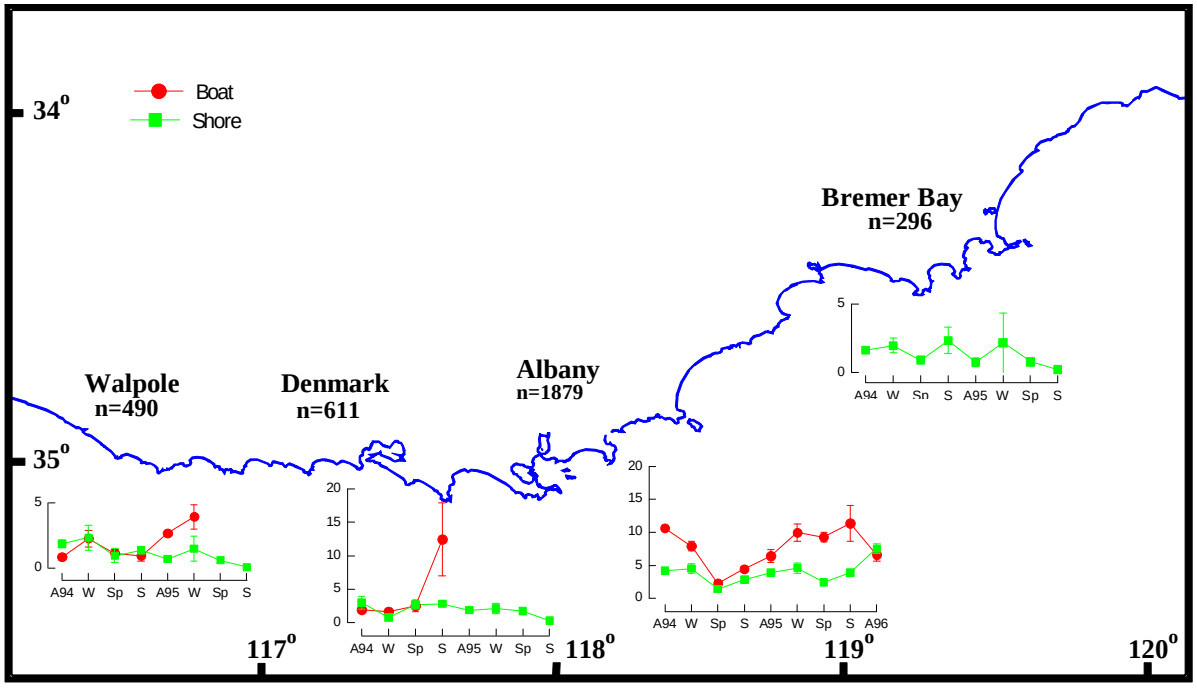


Figure 12. Shore and boat angler mean catch rates for all species by season and year fishing region (Standard error bars are included however, they may be masked by the symbol).



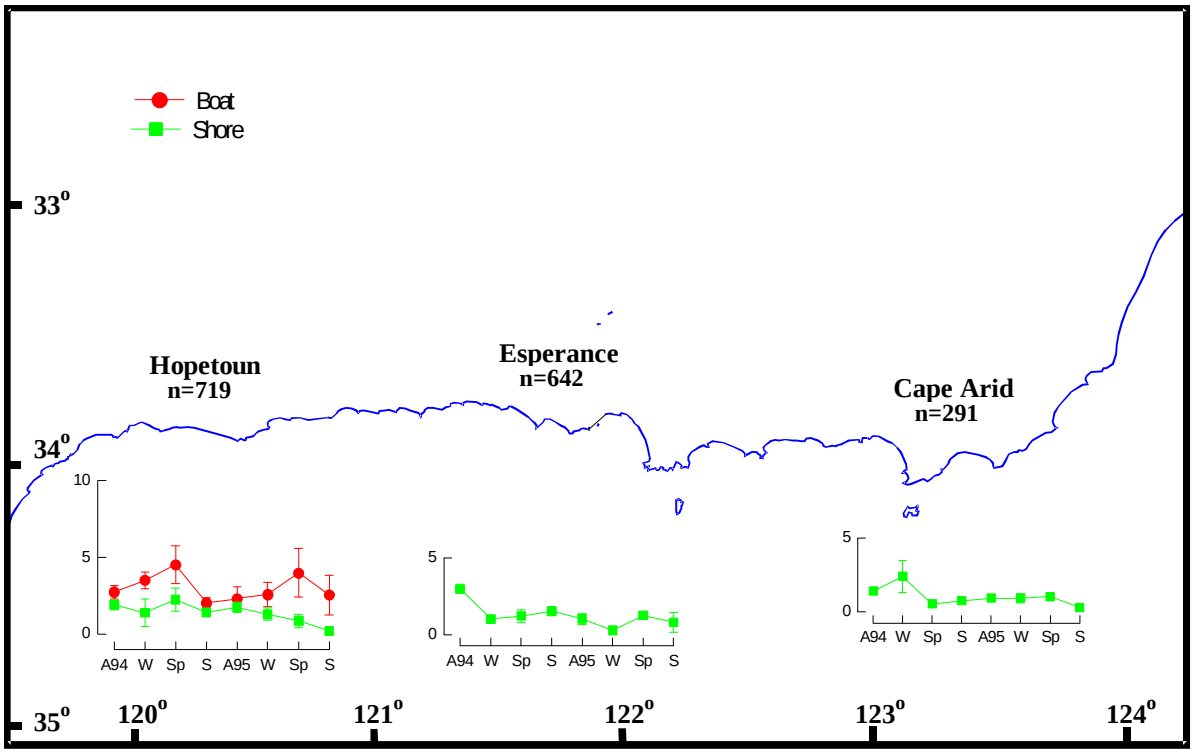


Figure 12. Cont'd.

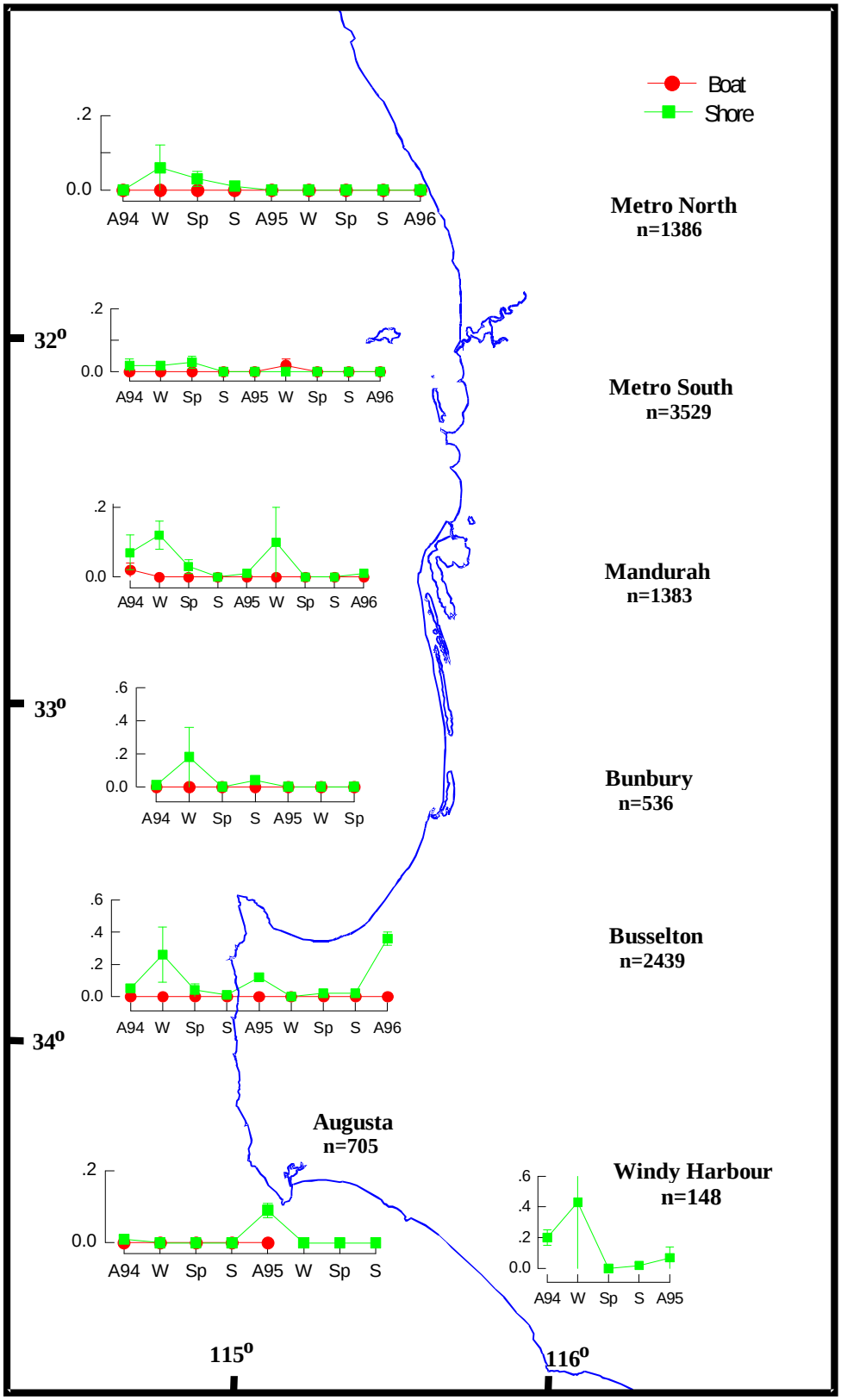
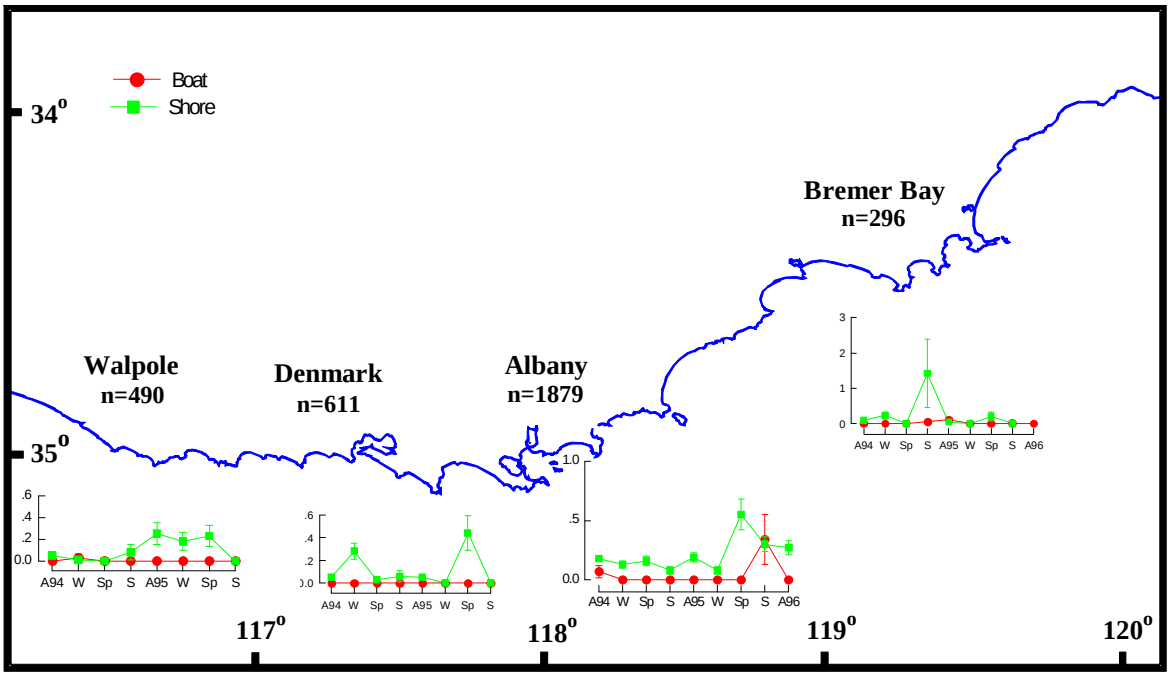


Figure 13. Shore and boat angler mean catch rates for Western Australian salmon by season and year for each fishing region (Standard error bars are included however, they may be masked by the symbol).



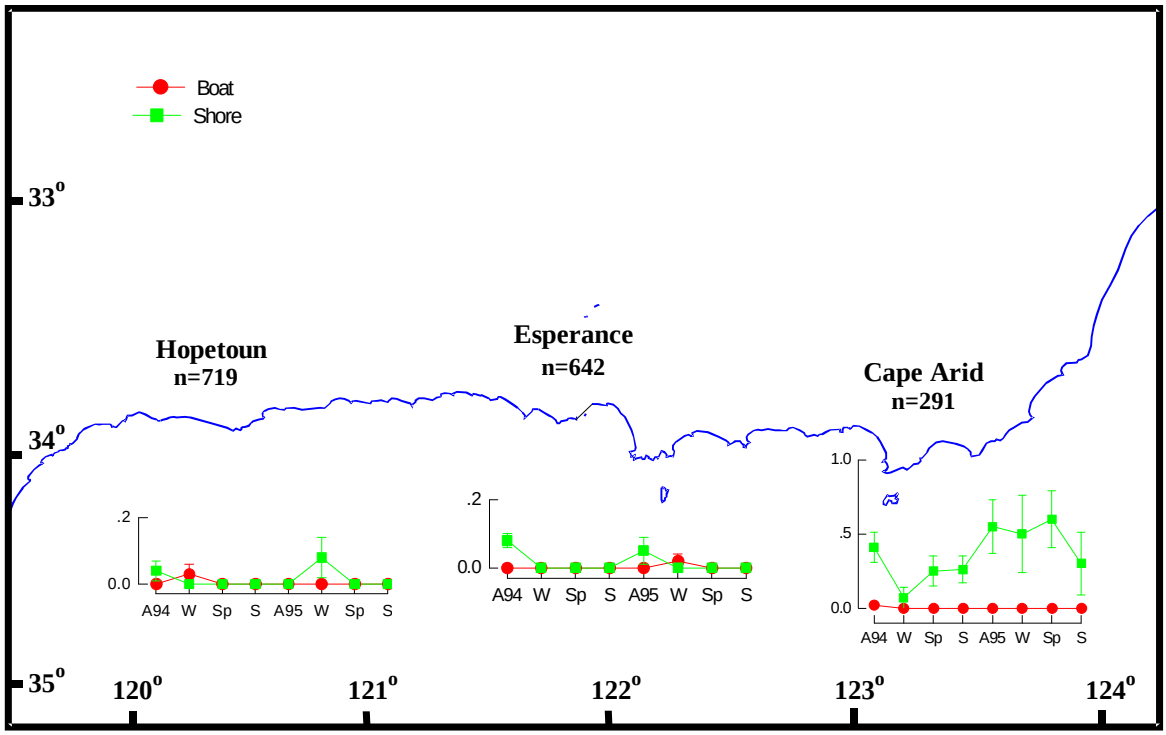


Figure 13. Cont'd.

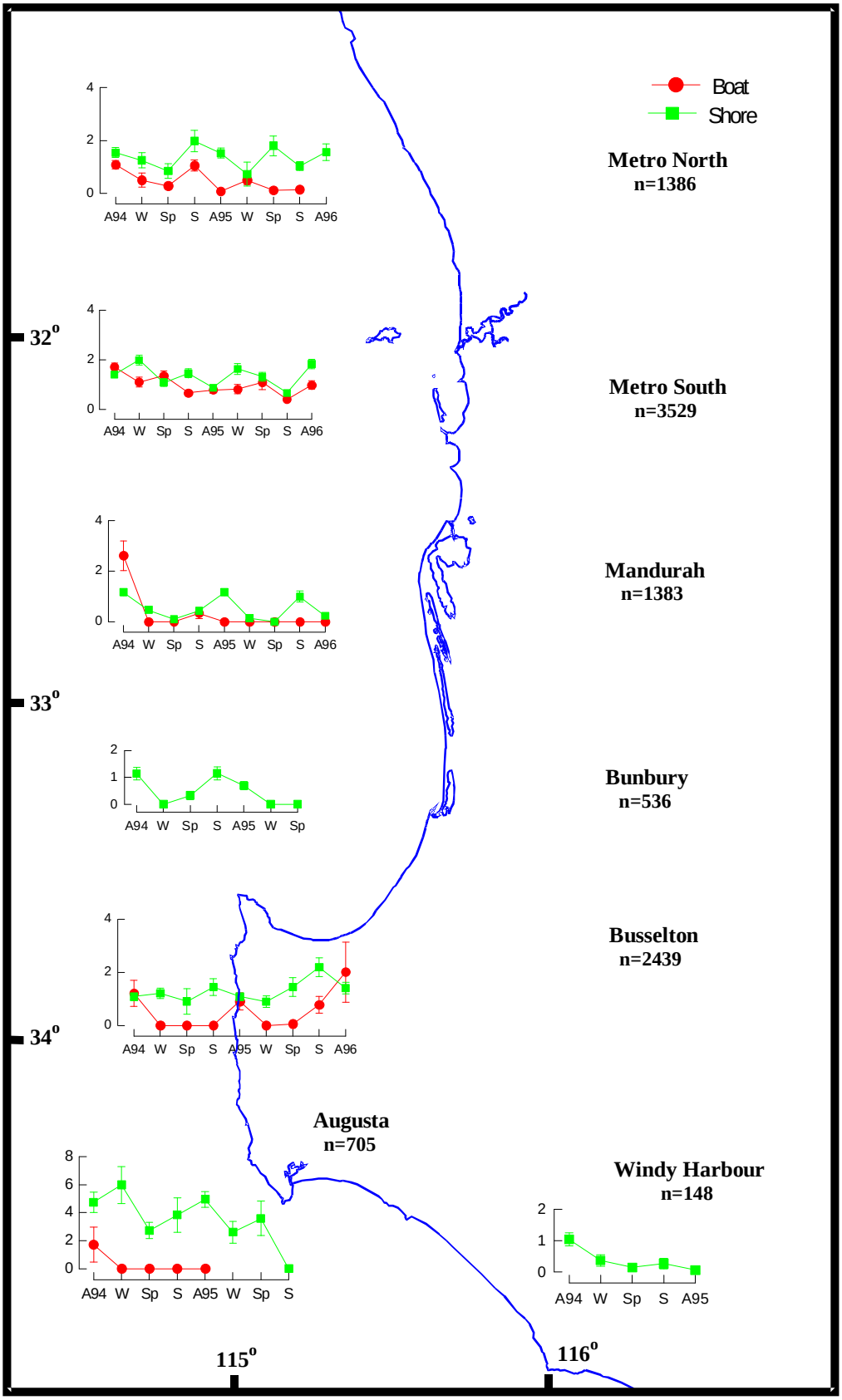


Figure 14. Shore and boat angler mean catch rates for Australian herring by season and year for each fishing region (Standard error bars are included however, they may be masked by the symbol).

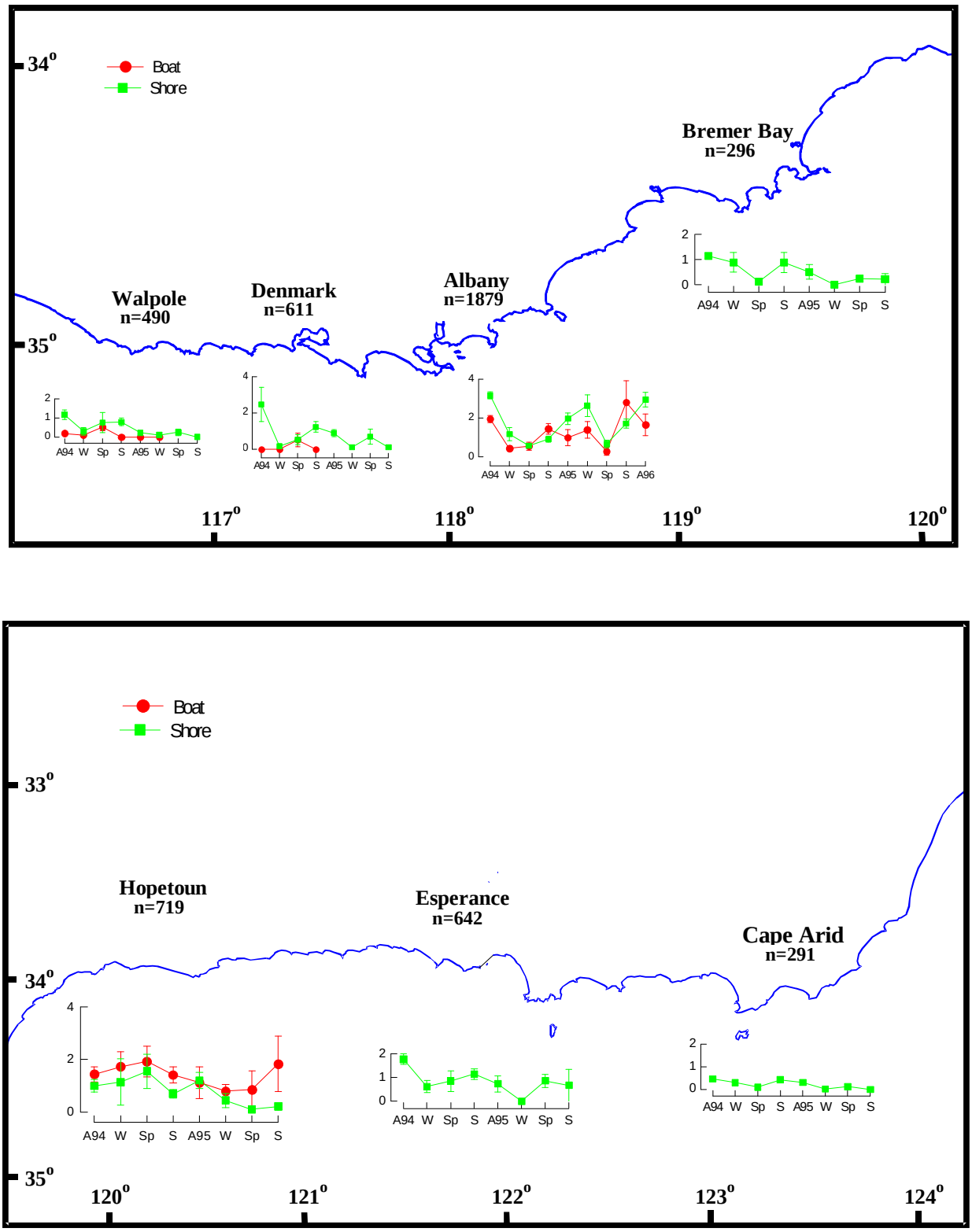


Figure 14. Cont'd.

All species combined

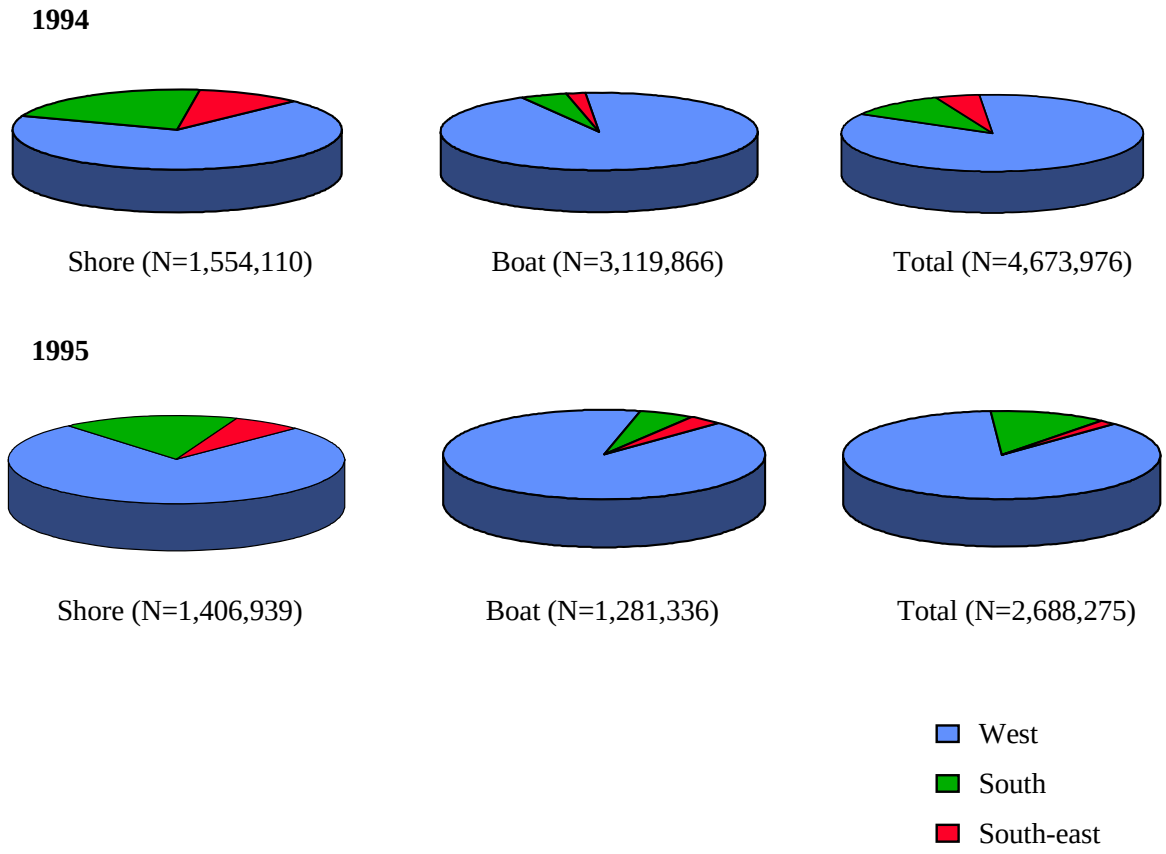
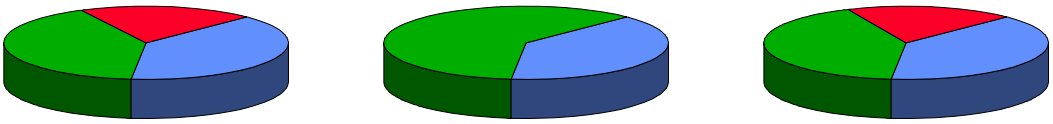


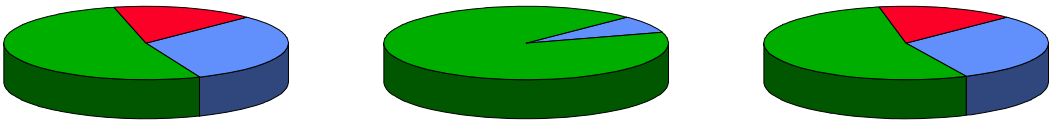
Figure 15. **Total catch (number) of all species by shore and boat based anglers, for all zones in the survey beaches during 1994 and 1995 and the combined total catch. (Complete survey data for 1994. Data for 1995 represents a complete**

Western Australian salmon 1994



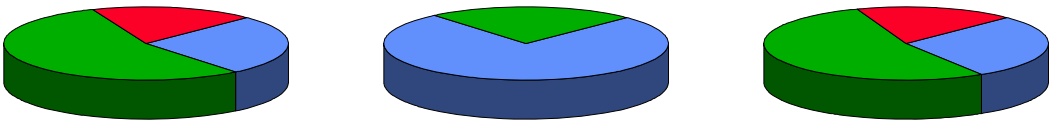
Shore (N=40,936) Boat (N=1,671) Total (N=42,607)

Western Australian salmon 1994



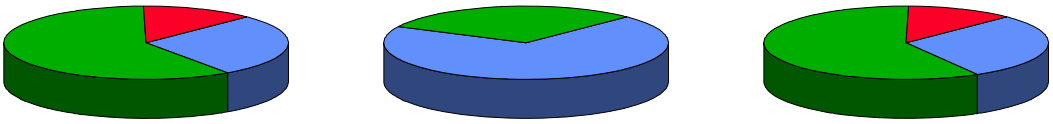
Shore (127 t) Boat (4 t) Total (131t)

Western Australian salmon 1995



Shore (N=40,928) Boat (N=1,700) Total (N=42,628)

Western Australian salmon 1995

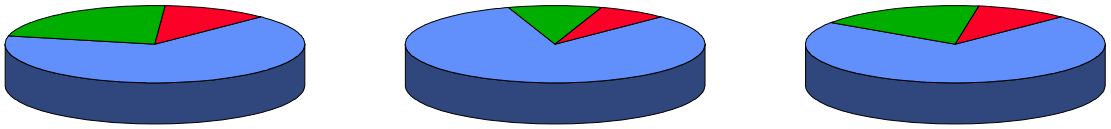


Shore (149 t) Boat (5 t) Total (155 t)

West
South
South-east

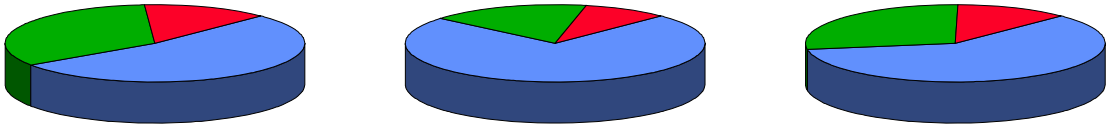
Figure 16. Total catch (number and weight in tonnes) of Western Australian salmon by shore and boat based anglers and the total by zones, for each region in 1994 and 1995.(complete survey data for 1994. Data for 1995 represents a complete sampling year for 9 regions only.)

Australian herring 1994



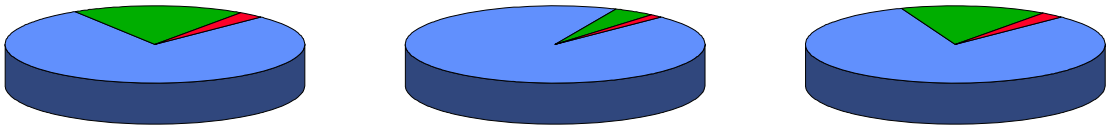
Shore (N=779,460) Boat (N=455,990) Total (N=1,235,450)

Australian herring 1994



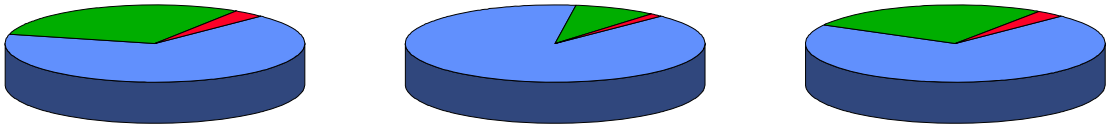
Shore (129 t) Boat (66 t) Total (196 t)

Australian herring 1995



Shore (N=688,911) Boat (N=182,924) Total (N=871,835)

Australian herring 1995



Shore (108 t) Boat (25 t) Total (133 t)

Figure 17. Total catch (number and weight in tonnes) of Australian herring by shore and boat based anglers and the total by zones, for each region in 1994 and 1995.(complete survey data for 1994. Data for 1995 represents a complete sampling year for 9 regions only.)

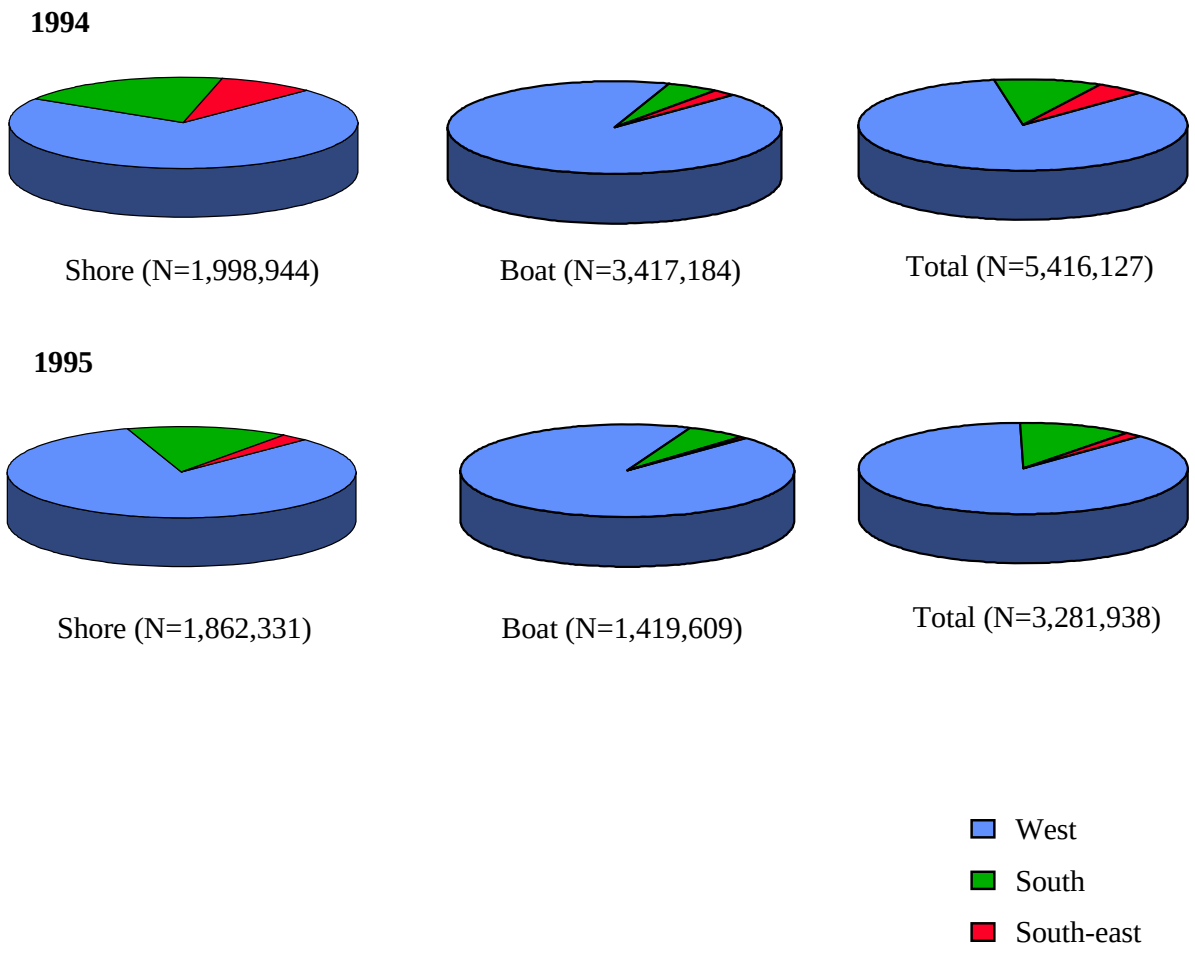
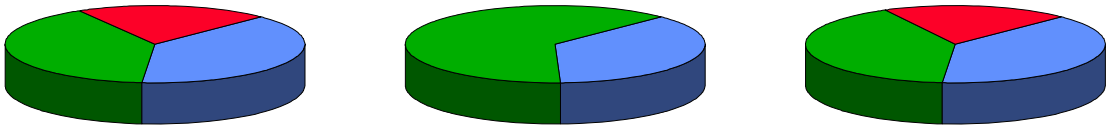


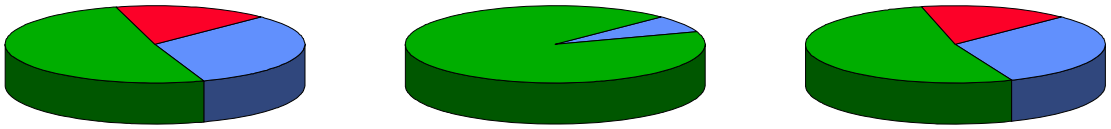
Figure 18. Adjusted total catch (number) of all species by shore and boat based anglers and the total by zones, for the whole state (adjusted for non surveyed beaches) during 1994 and 1995.

Western Australian salmon 1994



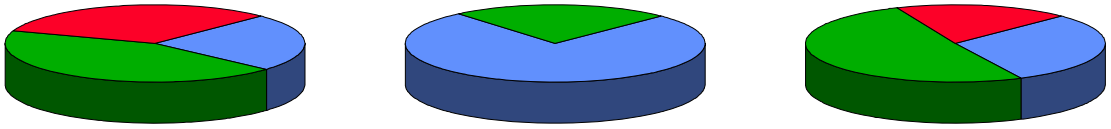
Shore (N=49,118) Boat (N=1,820) Total (N=50,938)

Western Australian salmon 1994



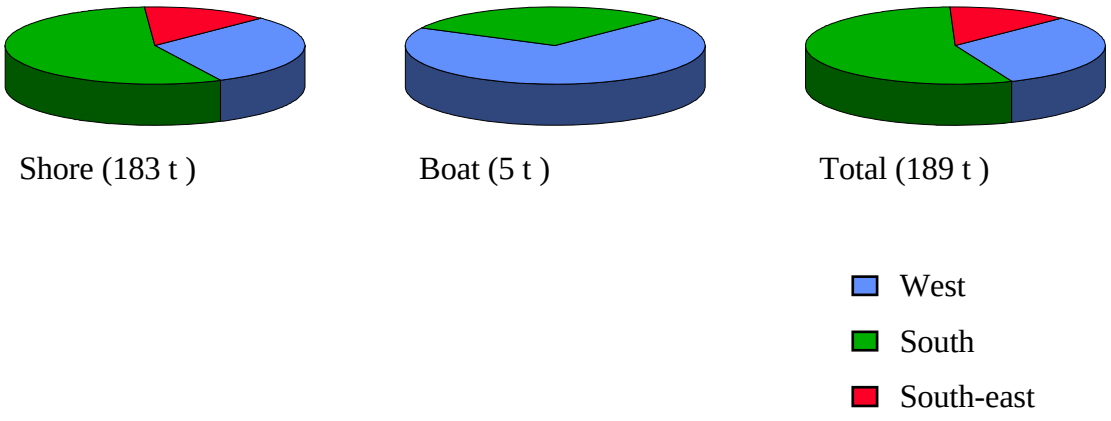
Shore (153 t) Boat (4 t) Total (158 t)

Western Australian salmon 1995



Shore (N=50,101) Boat (N=1,890) Total (N=51,991)

Western Australian salmon 1995



Shore (183 t) Boat (5 t) Total (189 t)

Figure 19. Adjusted total catch (number and weight in tonnes) of Western Australian salmon by shore and boat based anglers and the total by zones, for the whole state adjusted for non survey beaches during 1994 and 1995.

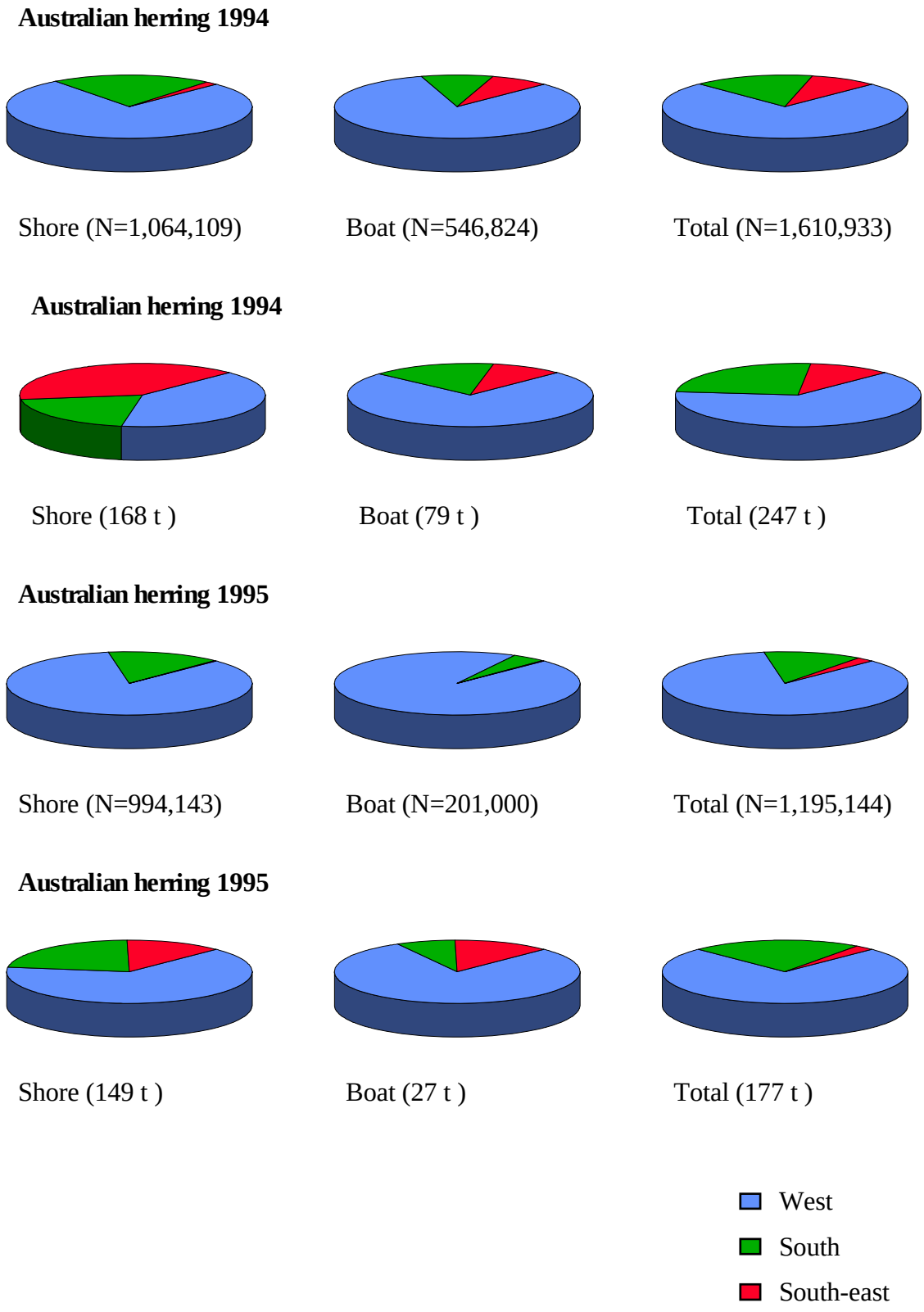


Figure 20. Adjusted total catch (number and weight in tonnes) of Australian herring by shore and boat based anglers and the total by zones, for the whole state adjusted for non survey beaches during 1994 and 1995.

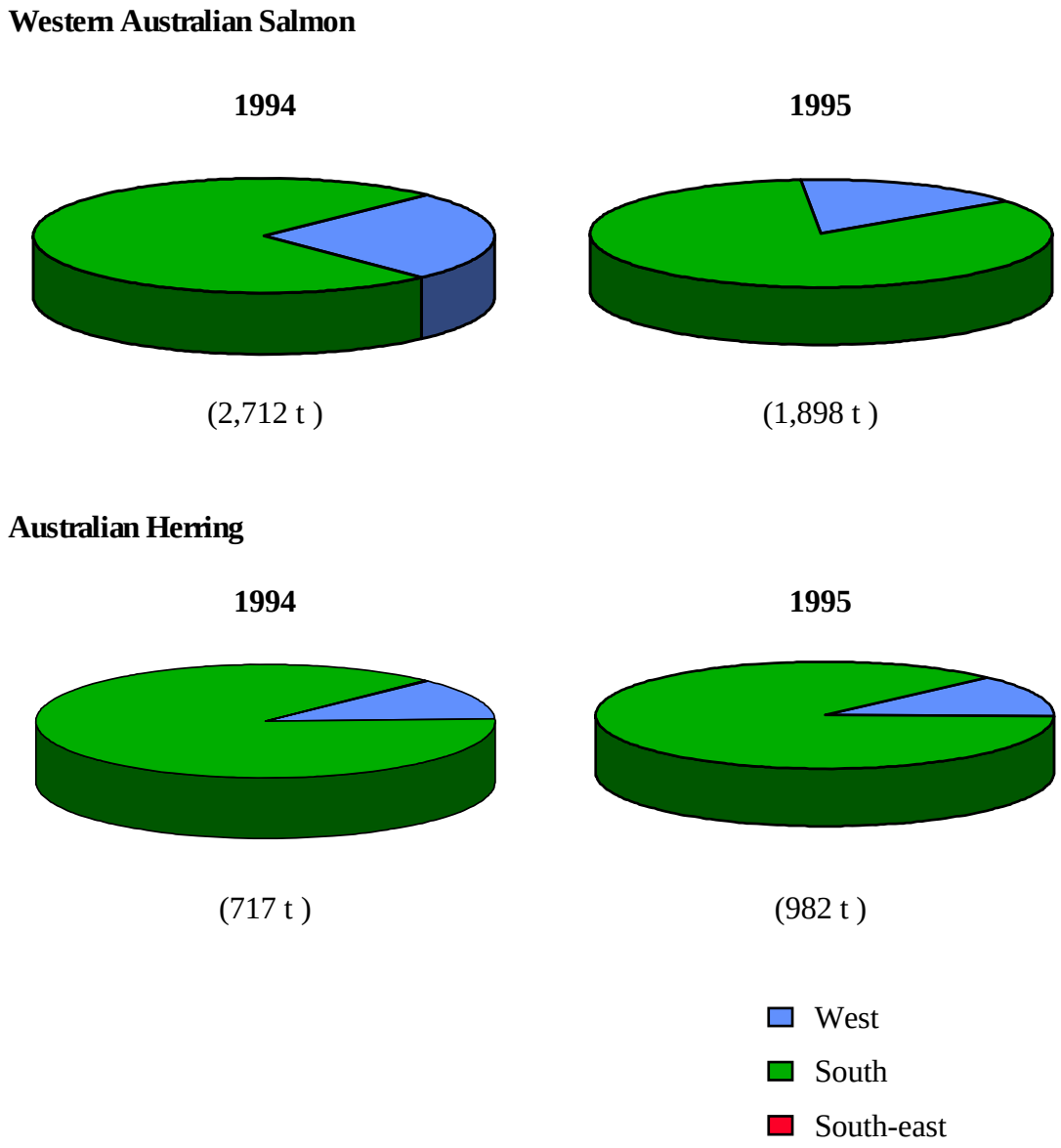
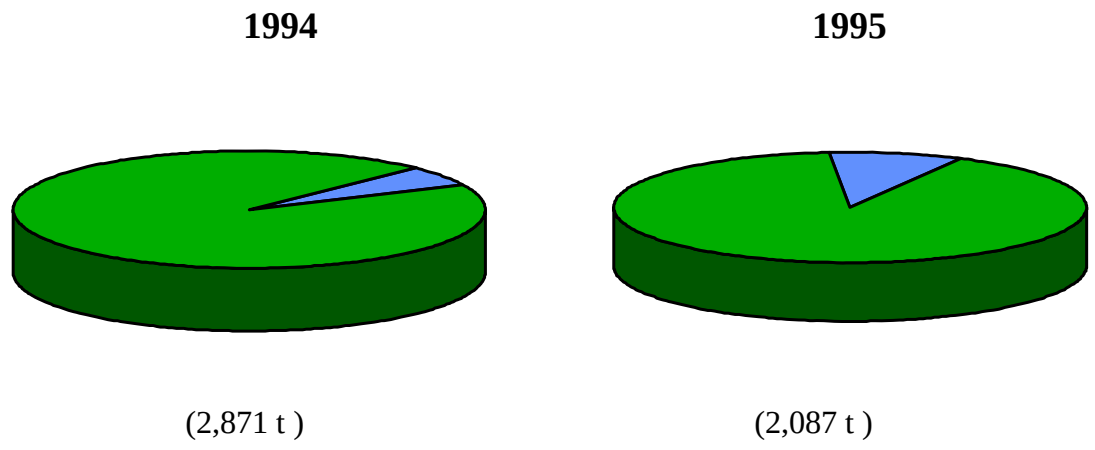


Figure 21. Commercial Western Australian salmon and Australian herring catch (tonnes) for 1994 and 1995 from the three fishing zones

Western Australian Salmon



Australian Herring

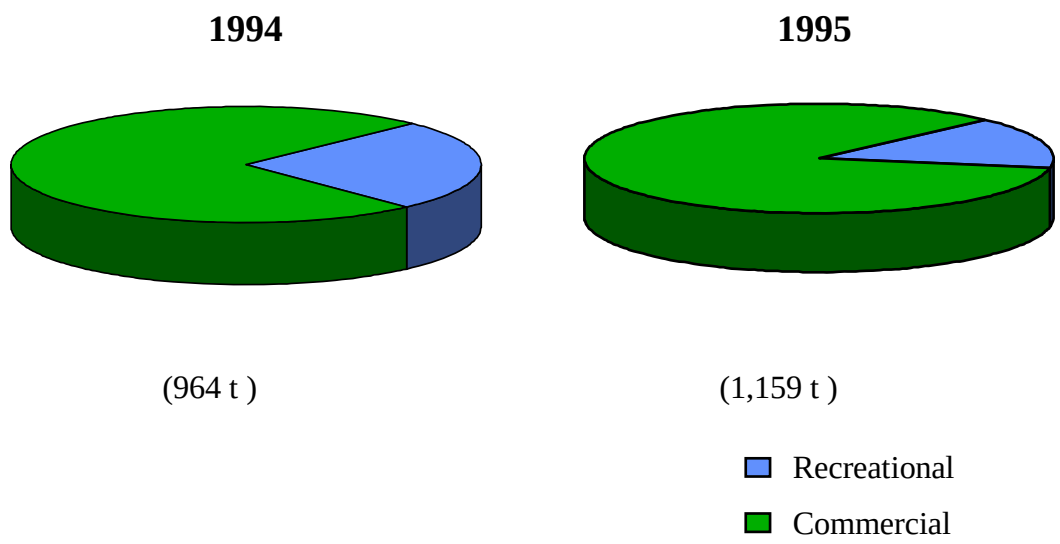


Figure 22. Commercial and recreation Western Australian salmon and Australian herring catch (tonnes) for 1994 and 1995.

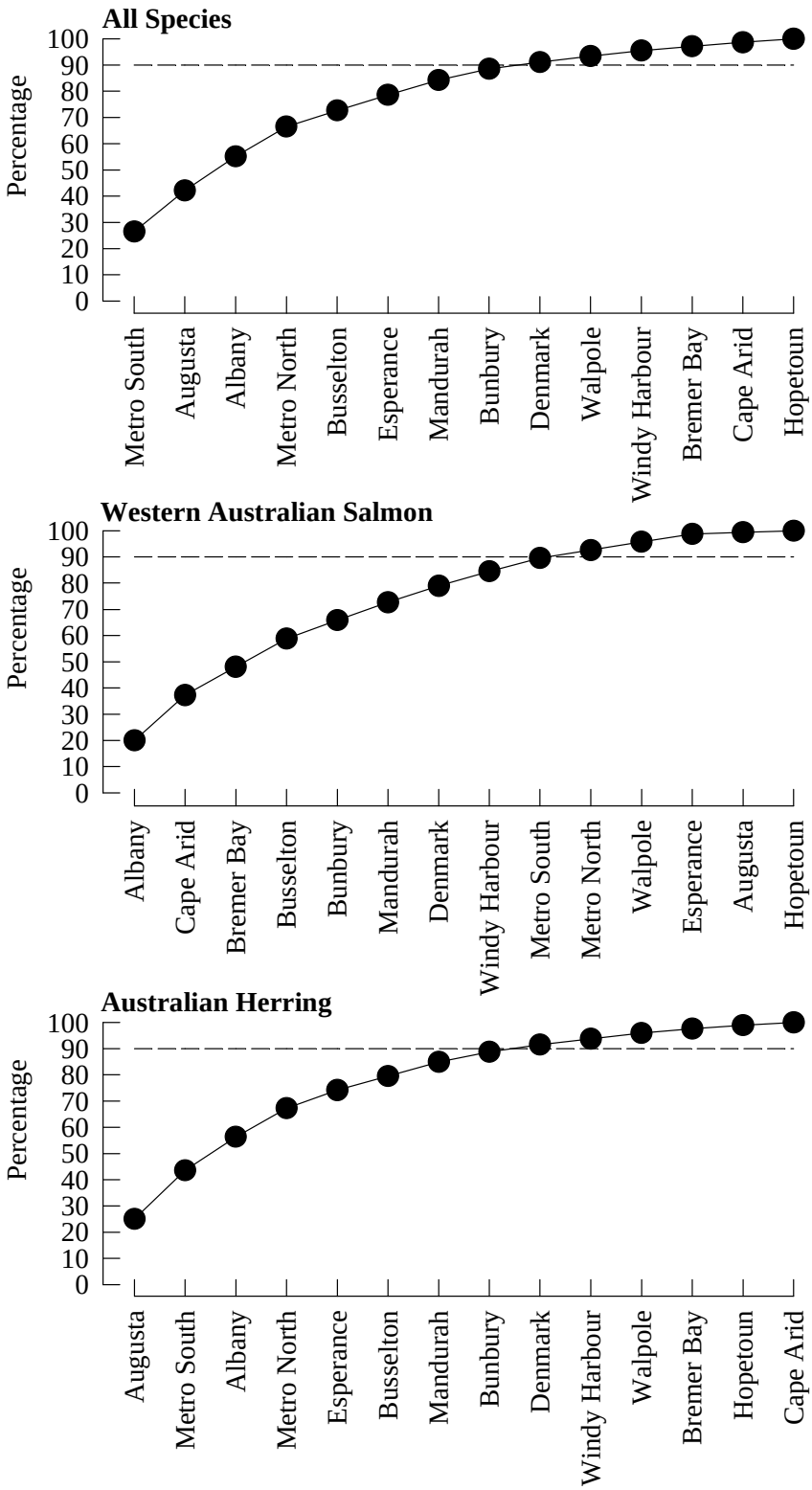


Figure 23. Accumulation of adjusted total catches for 1994 shore based anglers by each of the 14 regions in decreasing order; for all species, Western Australian salmon and Australian herring. The dashed line represents 90% of the accumulated adjusted total catch and the regions comprising this 90% could be used in future reduced creel surveys.

LIST OF TABLES

Table 1. Stratified random sampling design for each of the 14 fishing regions.

Variables	**Levels of Stratification**
Years	1994, 1995, *1996*
Seasons	summer, autumn, winter, spring
Day type	weekday or weekend and public holidays
Daily interview times	7:00-10:00, 10:00-15:00, 15:00-18:00

Table 2. Number of weekend and weekdays assigned as interview days over the entire sampling period.

Year	**Season**	**Months**	**Number of regions sampled**	**Number of weekdays**	**Number of weekend days**
1993	Summer	February 1993	trial period-14	15	9
1994	Autumn	Mar-May	14	18	9
	Winter	Jun-Aug	14	9	6
	Spring	Sept-Nov	14	12	6
	Summer	Dec-Feb 1994	14	15	9
1995	Autumn	Mar-May	14	18	9
	Winter	Jun-Aug	14	9	6
	Spring	Sept-Nov	14	12	6
	Summer	Dec-Feb 1995	Dec-14 Jan and Feb-5	15	9
1996	Autumn	Mar-May	5	18	9

Table 3. The number of visits to survey sites, the number of interviews conducted and the hours spent interviewing anglers by survey period and region. *Appendix 1* contains a breakdown of the number of visits to individual survey sites and the number of hours spent interviewing at each site.

Survey	Region	Number of visits	Number of interviews	Hours at sites
1994-95	Albany	305	1548	292.3
1994-95	Augusta	303	705	193.5
1994-95	Bremer Bay	305	296	127.9
1994-95	Bunbury	293	536	83.5
1994-95	Busselton	580	1769	329.3
1994-95	Cape Arid	248	291	200.9
1994-95	Denmark	307	611	102.0
1994-95	Esperance	423	642	242.7
1994-95	Hopetoun	376	719	445.0
1994-95	Mandurah	329	1133	436.1
1994-95	Metro North	330	1170	157.7
1994-95	Metro South	398	2808	590.4
1994-95	Walpole	382	490	137.0
1994-95	Windy	161	148	139.8
1996	Albany	96	331	76.5
1996	Busselton	226	670	129.3
1996	Mandurah	100	250	136.1
1996	Metro north	85	216	37.2
1996	Metro south	103	721	153.1

Table 4. The number of boat and shore angler interviews, the total number of interviews and the number of boat ramps for each region.

Region	Boat angler interviews	Shore angler interviews	Total number of interviews	Number of boat ramps
Albany	395	1484	1879	
Augusta	50	655	705	1
Bremer Bay	19	277	296	
Bunbury		536	536	
Busselton	216	2223	2439	5
Cape Arid	8	283	291	
Denmark	30	581	611	2
Esperance	7	635	642	
Hopetoun	243	476	719	
Mandurah	126	1257	1383	1
Metropolitan north	347	1039	1386	1
Metropolitan south	1165	2364	3529	6
Walpole	90	400	490	
Windy Harbour		148	148	

Table 5. Participation level (angler days) of shore anglers on surveyed beaches only in each region by year and season. The total participation level is the sum of all months sampled for each season in that year. Where there were missing values, total participation levels were calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995.)

Region	Year	Autumn	Winter	Spring	Summer	Total
Albany	1994	6904	2857	3366	3545	16672
	1995	4899	2262	2857	4259	14277
	1996	2989	218*			3207
Augusta	1994	3264	619	686	1918	6487
	1995	6125	920	1353	217+	8615
Bremer Bay	1994	2364	210	352	345	3271
	1995	976	74	95	124+	1269
Bunbury	1994	3352	716	974	2996	8038
	1995	2520	243	715	341+	3819
Busselton	1994	5428	2349	1400	2472	11649
	1995	17188	2627	3852	11526	35193
	1996	15001	492*			15493
Cape Arid	1994	4087	154	563	1080	5884
	1995	1553	402	1238	574+	3767
Denmark	1994	1304	1260	466	2077	5107
	1995	3645	1310	1363	589+	6907
Esperance	1994	7929	3537	807	4295	16568
	1995	2440	441	1131	341+	4353
Hopetoun	1994	933	244	626	920	2723
	1995	967	206	156	264+	1593
Mandurah	1994	9825	3365	1750	4395	19335
	1995	6098	611	1590	5133	13432
	1996	4807	19*			4826
Metro North	1994	5105	2500	2034	2496	12135
	1995	7264	704	1097	4293	13358
	1996	1947	55*			2002
Metro South	1994	16248	7499	3341	7598	34686
	1995	11042	4119	7044	8125	30330
	1996	7062	778*			7840
Walpole	1994	2576	966	839	1265	5646
	1995	1607	503	769	992+	3871
Windy Harbour	1994	2706	149	607	280	3742
	1995	1904	0			1904

Table 6. Angler hours for shore anglers on surveyed beaches only in each region by year and season. The total angler hours are the sum of all months sampled for each season in that year. Where there were missing values, the total angler hours were calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total
Albany	1994	25859	11348	13034	12285	62526
	1995	20017	7970	10633	13400	52020
	1996	10917	958*			11875
Augusta	1994	10760	2333	3067	7044	23204
	1995	23291	3772	4762	651+	32476
Bremer Bay	1994	10336	938	1326	1326	13926
	1995	3788	306	310	310+	4714
Bunbury	1994	12426	2660	3298	9529	27913
	1995	9682	728	2374	1147+	13931
Busselton	1994	21105	10459	5963	10168	47695
	1995	65724	10101	14816	30166	120807
	1996	50593	1702*			52295
Cape Arid	1994	15122	574	1851	4450	21997
	1995	6153	1344	5353	2372+	15222
Denmark	1994	5018	4780	2126	6978	18902
	1995	14782	4770	4898	1767+	26217
Esperance	1994	31377	13583	2667	17535	65162
	1995	8589	1820	4490	1271+	16170
Hopetoun	1994	3524	1052	2724	3405	10705
	1995	3100	831	645	884+	5460
Mandurah	1994	40275	12539	7193	15885	75892
	1995	20020	1961	6036	13276	41293
	1996	16256	57*			16313
Metro North	1994	17572	11295	6980	8410	44257
	1995	25280	2496	3481	13948	45205
	1996	6281	165*			6446
Metro South	1994	53740	27934	13400	23012	118086
	1995	31564	14524	25882	24304	96274
	1996	25154	2576*			27730
Walpole	1994	10477	3342	3192	4815	21826
	1995	5673	1620	3276	4402+	14971
Windy Harbour	1994	11336	747	2444	960	15487
	1995	722	0			722

Table 7. Participation level (angler days) of boat anglers on surveyed beaches in each region by year and season. The total participation level is the sum of all months sampled for each season in that year. Where there were missing values, the total participation level was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autum	Winter	Spring	Summer	Total
Albany	1994	2881	604	1117	2026	6629
	1995	570	420	405	403	1798
	1996	670				670
Augusta	1994	2052	370		180	2602
	1995		280		310+	590
Bremer Bay	1994	140				140
	1995					
Bunbury	1994					
	1995					
Busselton	1994	4061	112	216	345	4734
	1995	2256	284	2131	13929	18600
	1996	3070				3070
Cape Arid	1994	30			180	210
	1995					
Denmark	1994	225		283		568
	1995	248			60+	308
Esperance	1994	450				450
	1995					
Hopetoun	1994	792	70	309	700	1870
	1995	332	84	54	31+	501
Mandurah	1994	7898	196	175	10868	19137
	1995	1877	112	2226	2864	7079
	1996	324				324
Metro North	1994	7766	1036	512	5007	14322
	1995	825	462	1269		2556
	1996	690				690
Metro South	1994	15331	4918	8078	12240	40567
	1995	12460	3878	5796	27342	49477
	1996	19723	565*			20289
Walpole	1994	576		401	1110	2087
	1995	60	28		62+	150
Windy Harbour	1994					
	1995					

Table 8. Angler hours of boat anglers on surveyed beaches in each region by year and season. The total angler hours is the sum of all months sampled for each season in that year. Where there were missing values, the total angler hours was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autum	Winter	Spring	Summer	Total
Albany	1994	11301	2780	4937	8213	27231
	1995	2610	1372	1215	1178	6375
	1996	2870				2870
Augusta	1994	8586	1530		540	10656
	1995		1400		930+	2330
Bremer Bay	1994	700				700
	1995					
Bunbury	1994					
	1995					
Busselton	1994	18959	560	1080	1155	21754
	1995	8584	916	9174	54656	73329
	1996	12290				12290
Cape Arid	1994	150			900	1050
	1995					
Denmark	1994	855		903	300	2058
	1995	1240				1240
Esperance	1994	1770				1770
	1995					
Hopetoun	1994	3690	350	1492	3138	8670
	1995	1480	364	189	155+	2188
Mandurah	1994	32177	980	526	38171	71854
	1995	6171	560	8155	8593	23480
	1996	972				972
Metro North	1994	37354	3136	2050	18194	60735
	1995	2475	1386	6345		10206
	1996	2070				2070
Metro South	1994	64492	20558	29075	43965	158089
	1995	44371	16386	21439	100176	182373
	1996	74444	2391			76834
Walpole	1994	2756		2005	5310	10071
	1995	300	84		186+	570
Windy Harbour	1994					
	1995					

Table 9. Annual catch rates for all species by shore anglers on surveyed beaches from the three zones.

Year	Zones	Number of anglers interviewed	Catch rate (fish/hour)	Catch rate standard error
1994	west	2977	2.87	0.08
1995		3093	3.20	0.08
1996		871	3.24	0.17
1994	south	1240	2.79	0.11
1995		850	2.66	0.15
1996		139	7.27	0.66
1994	southeast	728	1.87	0.11
1995		349	1.11	0.12

Table 10. Annual catch rates for all species by boat anglers on surveyed beaches from the three zones.

Year	Zone	Number of anglers interviewed	Catch rate (fish/hour)	Catch rate standard error
1994	west	1009	4.52	0.62
1995		608	3.80	0.20
1996		148	3.18	0.30
1994	south	415	4.05	0.20
1995		83	8.71	0.84
1996		23	6.59	1.02
1994	southeast	171	3.07	0.35
1995		71	2.65	0.52

Table 11. Annual catch rates for Western Australian salmon by shore anglers on surveyed beaches from the three zones.

Year	Zone	Number of anglers interviewed	Catch rate (fish/hour)	Catch rate standard error
1994	west	2977	0.04	0.01
1995		3093	0.03	<0.01
1996		871	0.16	0.02
1994	south	1237	0.14	0.02
1995		850	0.20	0.02
1996		139	0.24	0.05
1994	southeast	728	0.10	0.02
1995		349	0.19	0.04

Table 12. Annual catch rates for Australian herring by shore anglers on surveyed beaches from the three fishing zones.

Year	Zone	Number of anglers interviewed	Catch rate (fish/hour)	Catch rate standard error
1994	west	2977	1.40	0.06
1995		3093	1.47	0.07
1996		871	1.33	0.11
1994	south	1237	1.61	0.08
1995		850	1.21	0.10
1996		139	3.04	0.36
1994	southeast	728	1.06	0.09
1995		349	0.56	0.10

Table 13. Annual catch rates for Australian herring by boat anglers on surveyed beaches from the three zones.

Year	Zone	Number of anglers interviewed	Catch rate (fish/hour)	Catch rate standard error
1994	west	1009	1.23	0.07
1995		608	0.62	0.65
1996		148	1.00	0.19
1994	south	415	1.34	0.12
1995		83	1.24	0.31
1996		23	1.65	0.55
1994	southeast	171	1.64	0.22
1995		71	1.02	0.35

Table 14. Total catch (numbers) of all species for shore anglers on surveyed beaches by region, year and season. The total catch is the sum of all months sampled for each season in that year. Where there were missing values, the total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total
Albany	1994	108934	68901	19347	38815	235997
	1995	77828	36753	23901	51332	119768
	1996	84881	6685*			91566
Augusta	1994	52633	17794	12749	42144	125320
	1995	128495	12045	21685	0+	162225
Bremer Bay	1994	18478	2378	1159	5008	27023
	1995	3043	543	188	67+	3841
Bunbury	1994	27728	3216	5201	17530	53675
	1995	16914		3642	0+	20556
Busselton	1994	36864	36315	14138	22330	109647
	1995	146364	40536	78478	125155	390533
	1996	179168	6171*			185339
Cape Arid	1994	19981	964	789	2124	23858
	1995	5988	1238	4335	759+	12320
Denmark	1994	16542	3296	3925	19045	27808
	1995	28763	7901	8753	347+	45764
Esperance	1994	73201	15509	3550	25092	117352
	1995	10428	451	4903	1182+	16964
Hopetoun	1994	5730	1356	5399	5510	17995
	1995	5373	666	1622	173+	7834
Mandurah	1994	73668	9713	10032	18285	111698
	1995	34298	2746	1434	26887	65365
	1996	11431	0*			11431
Metro North	1994	60640	35375	11504	29420	136939
	1995	76541	6588	5748	21509	110386
	1996	18526	396*			18922
Metro South	1994	206993	146365	41159	85823	480340
	1995	101172	68645	98228	105069	373114
	1996	136718	10465*			147183
Walpole	1994	15276	9356	3120	5754	33506
	1995	3726	2075	1902	85+	7788
Windy Harbour	1994	35638	604	785	925	37952
	1995	334				334

Table 15. Total catch (numbers) for boat anglers on surveyed beaches of all species by region, year and season. The total catch is the sum of all months sampled for each season in that year. Where there were missing values, the total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total
Albany	1994	60384	21742	10197	35663	127986
	1995	16453	13547	11992	13343	55335
	1996	18905				18905
Augusta	1994	26367	29950		347	56664
	1995		3399		0+	3399
Bremer Bay	1994	3635				3635
	1995					
Bunbury	1994					
	1995					
Busselton	1994	67894	560	0	438	68892
	1995	15501	14776	61245	327010	418532
	1996	144629				144629
Cape Arid	1994	109				109
	1995				2928+	2928
Denmark	1994	1112		1211	732	3055
	1995	17027				17027
Esperance	1994	33748				33748
	1995					
Hopetoun	1994	11197	1057	7214	6389	25857
	1995	3563	856	758	397+	5574
Mandurah	1994	148925	0	0	1895709	2044634
	1995	125477	1833	2943	44805	175058
	1996	507				507
Metro North	1994	95940	5863	4494	33217	139514
	1995	1665	3608	26822		32095
	1996	1919				1919
Metro South	1994	250699	88043	125197	134718	598657
	1995	146511	63812	99046	263686	573055
	1996	216506	6434*			222940
Walpole	1994	2712	224	4545	6927	14408
	1995	285			731+	1016
Windy Harbour	1994					
	1995					

Table 16. Average weights (g) of Western Australian salmon caught by shore and boat based anglers during the anglers' survey for each fishing region and the three fishing zones.

Western Australian salmon	**Average weight (g) and sample size (n)**
north and south metropolitan	507 (4)
Mandurah	290 (10)
three regions	*358*
Bunbury	1525 (1)
Busselton	4180 (128)
Augusta	4087 (37)
Windy Harbour	2258 (16)
west zone	*3978*
Walpole	3009 (21)
Denmark	4031 (70)
Albany	4196 (107)
Bremer Bay	3175 (6)
south zone	*3987*
Hopetoun	-
Esperance	3417 (3)
Cape Arid	2440 (46)
southeast zone	*2500*

Table 17. Total catch (numbers) of Western Australian salmon for shore anglers on surveyed beaches by region, year and season. The total catch is the sum of all months sampled for each season in that year. Where there were missing values, the total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total
Albany	1994	4418	1174	2213	1020	8825
	1995	5287	773	6643	4391	17094
	1996	2748	64*			2812
Augusta	1994	139	0	0	0	139
	1995	1512	0	0	0+	1512
Bremer Bay	1994	793	236	0	3328	4357
	1995	156	0	32	0+	188
Bunbury	1994	210	1608	0	348	2166
	1995	15		0	0+	15
Busselton	1994	843	3518	254	72	4687
	1995	7499	42	918	378	8837
	1996	15953	0*			15953
Cape Arid	1994	5454	20	320	746	6540
	1995	3456	776	2418	732+	7382
Denmark	1994	204	1428	35	870	1754
	1995	566	0	2137	0+	2703
Esperance	1994	1435	0	0	0	1435
	1995	227	0	0	0+	227
Hopetoun	1994	187	0	0	0	187
	1995	0	44	0	0+	44
Mandurah	1994	1812	1241	248	0	3301
	1995	191	220	0	0	411
	1996	279	0*			279
Metro North	1994	0	692	170	47	909
	1995	0	0	0	0	0
	1996	0	0*			0
Metro South	1994	1277	673	340	0	2290
	1995	71	0	0	0	71
	1996	0	0*			0
Walpole	1994	664	41	0	371	1076
	1995	1344	231	819	0+	2394
Windy Harbour	1994	2347	119	0	23	2489
	1995	50				50

Table 18. Total weight (tonnes) of Western Australian salmon for shore based anglers on surveyed beaches by region, year and season. The total catch is the sum of all months sampled for each season in that year. Where there were missing values, the total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total (tonnes)
Albany	1994	17.6	4.7	8.8	4.0	35.0
	1995	21.0	3.0	26.5	17.5	68.2
	1996	11.0	0.2			11.0
Augusta	1994	0.5	0	0	0	0.5
	1995	6.0	0	0	0+	6.0
Bremer Bay	1994	3.1	0.9	0	13.3	17.3
	1995	0.6	0	0.1	0	0.7
Bunbury	1994	0.8	6.4	0	1.4	8.6
	1995	<0.1		0	0	<0.1
Busselton	1994	3.4	14	1.0	0.3	18.6
	1995	29.8	0.2	3.6	1.5	35.1
	1996	63.5	0*			63.5
Cape Arid	1994	13.6	<0.1	0.8	1.8	16.3
	1995	8.6	1.9	6.0	1.8	18.3
Denmark	1994	0.8	5.7	<0.1	3.5	10.1
	1995	2.2	0	8.5	0+	10.7
Esperance	1994	3.6	0	0	0	3.6
	1995	0.6	0	0	0+	0.6
Hopetoun	1994	0.5	0	0	0	0.5
	1995	0	0.1	0	0+	0.1
Mandurah	1994	0.6	0.4	<0.1	0	1.1
	1995	<0.1	<0.1	0	0	0.1
	1996	0.1	0*			0.1
Metro North	1994	0	0.2	<0.1	<0.1	0.3
	1995	0	0	0	0	0
	1996	0	0*			0
Metro South	1994	0.4	0.2	0.1	0	0.7
	1995	<0.1	0	0	0	0.3
	1996	0	0			0
Walpole	1994	2.6	1.6	0	1.5	5.7
	1995	5.4	1.0	3.3	0+	9.7
Windy Harbour	1994	9.3	0.5	0	0.1	9.9
	1995	0.2				0.2

Table 19. Total catch (numbers) of Western Australian herring for shore based anglers on surveyed beaches by region, year and season. The total catch is the sum of all months sampled for each season in that year. Where there were missing values, the total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total
Albany	1994	82147	19645	8386	12179	122357
	1995	52038	22543	7203	23614	105398
	1996	31660	4897*			36557
Augusta	1994	48015	14671	5868	37241	105795
	1995	116267	8813	13872	0+	138952
Bremer Bay	1994	11911	1171	244	1642	14968
	1995	2548	0	102	67+	2717
Bunbury	1994	12480	0	882	12606	25968
	1995	8760		0	0+	8760
Busselton	1994	20768	11796	5180	12957	50701
	1995	73244	18771	21576	68055	181646
	1996	83346	1023*			84369
Cape Arid	1994	6971	155	137	1128	8391
	1995	1945	37	727	0+	2709
Denmark	1994	14185	663	1006	8239	24093
	1995	15034	376	3870	115+	19395
Esperance	1994	40834	9317	2235	18717	71103
	1995	7820	0	3421	1033+	12274
Hopetoun	1994	2611	1095	3453	2297	9456
	1995	2796	147	324	173+	3440
Mandurah	1994	42309	5102	725	8041	56177
	1995	26463	219	0	20621	47303
	1996	2994	0*			2994
Metro North	1994	31889	15533	5251	16892	69565
	1995	39958	2064	3344	8044	53410
	1996	10057	344*			10401
Metro South	1994	78022	58875	15799	30293	182989
	1995	30644	24156	39064	16938	110802
	1996	51706	3856			55562
Walpole	1994	9263	817	2491	3734	16305
	1995	1074	159	820	0+	2053
Windy Harbour	1994	20533	307	466	282	21588
	1995	50				50

Table 20. Total weight (tonnes) of Australian herring season for shore based anglers on surveyed beaches by region, year and. The total catch is the sum of all months sampled for each season in that year. Where there were missing values, the total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total (tonnes)
Albany	1994	22.6	5.4	2.3	3.3	33.6
	1995	14.3	6.2	2	6.5	29.0
	1996	8.7	1.3*			10.0
Augusta	1994	5.9	1.8	0.7	4.6	13.0
	1995	14.3	1.1	1.7	0+	17.1
Bremer Bay	1994	2.7	0.3	<0.1	0.4	3.4
	1995	0.6	0	<0.1	<0.1	0.6
Bunbury	1994	1.7	0	0.1	1.8	3.6
	1995	1.2		0		1.2
Busselton	1994	3.0	1.7	0.8	1.9	7.4
	1995	10.7	2.7	3.1	9.9	26.5
	1996	12.1	0.1*			12.3
Cape Arid	1994	1.5	<0.1	<0.1	0.2	1804
	1995	0.4	<0.1	0.2	0+	0.6
Denmark	1994	2.4	0.1	0.2	1.4	4.2
	1995	2.6	<0.1	0.7	<0.1+	3.3
Esperance	1994	8.3	1.9	0.5	3.8	14.5
	1995	1.6	0	0.7	0.2+	2.5
Hopetoun	1994	0.4	0.2	0.5	0.3	1.4
	1995	0.4	<0.1	<0.1	<0.1+	0.5
Mandurah	1994	6.0	0.7	0.1	1.1	8.0
	1995	3.8	<0.1	0	2.9	6.7
	1996	0.4	0*			0.4
Metro North	1994	4.0	2.0	0.7	2.1	8.7
	1995	5.0	0.3	0.4	1.0	6.7
	1996	1.3	<0.1			1.3
Metro South	1994	9.8	7.4	2.0	3.8	23.0
	1995	3.9	3.0	4.9	2.1	13.9
	1996	6.5	0.5			7.0
Walpole	1994	1.0	0.1	0.3	0.4	1.8
	1995	0.1	<0.1	0.1	0+	0.2
Windy Harbour	1994	4.8	0.1	0.1	0.1	5.1
	1995	<0.1				<0.1

Table 21. Average weights (g) of Australian herring caught by shore and boat based anglers during the anglers' survey for each fishing region and the three fishing zones.

Australian herring	**Average weight (g) and sample size (n)**
north and south metropolitan	125 (76)
Mandurah	142 (183)
Bunbury	139 (12)
Busselton	145 (257)
Augusta	123(359)
Windy Harbour	232 (19)
Walpole	114 (51)
Denmark	172 (88)
Albany	274 (128)
Bremer Bay	222 (8)
Hopetoun	145 (150)
Esperance	203 (69)
Cape Arid	215 (23)

Table 22. Total catch (numbers) of Western Australian herring for boat based anglers on surveyed beaches by region, year and season. The total catch is the sum of all months sampled for each season in that year. Where there were missing values, the total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region		Autumn	Winter	Spring	Summer	Total
Albany		22982	1176	2540	11091	37789
		2467	2150	193	3293	8103
		4737				4737
Augusta		10788	0		0	10788
			0		0+	0
Bremer Bay		3362				3362
Bunbury						
Busselton		22633	0	0	0	22633
		7726	0	450	32386	40562
		85772				85772
Cape Arid		0			1183	1183
Denmark		0		0	156	156
		0				0
Esperance		18487				18487
Hopetoun		6258	652	3091	4485	14486
		1715	416	163	283+	2577
Mandurah		70178	0	0	16617	86795
		0	0	0	0	0
		0				0
Metro North		40396	559	566	19182	60703
		180	690	725		1595
		146				146
Metro South		102452	23017	40766	29342	195577
		37156	13998	40495	38438	130087
		83801	1986			85787
Walpole		490	0	196	3346	4032
		0			0+	0
Windy Harbour						

Table 23. Total weight (tonnes) of Australian herring by region, year and season for boat based anglers. The total catch is the sum of all months sampled for each season in that year. Where there were missing values, the total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total (tonnes)
Albany	1994	6.3	0.3	0.7	3.0	10.3
	1995	0.7	0.6	0.1	0.9	2.3
	1996	1.3				1.3
Augusta	1994	1.3	0		0	1.3
	1995		0		0+	0
Bremer Bay	1994	0.7				0.7
	1995					
Bunbury	1994					
	1995					
Busselton	1994	3.3	0	0	0	3.3
	1995	1.1	0	0.1	4.7	5.9
	1996	12.5				12.5
Cape Arid	1994				0.3	0.3
	1995					
Denmark	1994				<0.1	<0.1
	1995					
Esperance	1994	3.8				3.8
	1995					
Hopetoun	1994	0.9	0.1	0.4	0.7	2.1
	1995	0.2	0.1	<0.1	<0.1+	0.4
Mandurah	1994	10.0			2.4	12.4
	1995					
	1996					
Metro North	1994	5.1	0.1	0.1	2.4	7.7
	1995	<0.1	0.1	0.1		0.2
	1996	<0.1				<0.1
Metro South	1994	12.9	2.9	5.1	3.7	24.6
	1995	4.7	1.8	5.1	4.8	16.4
	1996	10.5	0.2*			10.7
Walpole	1994	0.1		<0.1	0.4	0.4
	1995		0		0+	0
Windy Harbour	1994					
	1995					

Table 24. Adjusted total catch (numbers) of all species for shore anglers from surveyed and non-surveyed sites by region, year and season. The adjusted total catch is the sum of all months sampled for each season in that year. Where there were missing values, the adjusted total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total
Albany	1994	120995	76530	21489	43112	262126
	1995	86445	40822	26548	57016	210831
	1996	94279	7425*			101704
Augusta	1994	132779	44889	32162	106318	316148
	1995	324160	30387	54704	0+	409251
Bremer Bay	1994	22522	2898	1413	6104	32937
	1995	3709	662	229	82+	4682
Bunbury	1994	44296	5318	8308	28005	85927
	1995	27021		5818	0+	32839
Busselton	1994	41612	40993	15959	25207	123771
	1995	165218	45757	88587	141276	404838
	1996	202247	6966*			209213
Cape Arid	1994	25947	1252	1025	2759	30983
	1995	7763	1608	5629	985+	15985
Denmark	1994	20080	4001	4765	23118	51964
	1995	34913	9591	10625	422+	55551
Esperance	1994	75644	16026	3669	25929	121268
	1995	10777	466	5067	1222+	17532
Hopetoun	1994	8705	2060	8201	8370	27336
	1995	8160	1012	2465	263+	11900
Mandurah	1994	74657	9843	10167	18530	113197
	1995	34758	2783	1454	27247	66242
	1996	11585	0*			11585
Metro North	1994	101520	59223	19259	49252	229254
	1995	128140	11029	9623	36009	184801
	1996	31016	662*			31678
Metro South	1994	222175	175099	44178	92117	533569
	1995	108592	73680	105551	112775	400598
	1996	146745	11233*			157978
Walpole	1994	21414	13115	4374	8067	46970
	1995	5223	2909	2666	119+	10917
Windy Harbour	1994	39131	663	862	1016	41672
	1995	367				367

Table 25. Adjusted total catch (numbers) of all species for boat based anglers from surveyed and non-surveyed sites by region, year and season. The adjusted total catch is the sum of all months sampled for each season in that year. Where there were missing values, the adjusted total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total
Albany	1994	67069	24149	11326	39612	142156
	1995	18275	15047	13320	14820	61462
	1996	20999				20999
Augusta	1994	66517	75556		876	142949
	1995		8575		0+	8575
Bremer Bay	1994	4431				4431
	1995					
Bunbury	1994					
	1995					
Busselton	1994	76640	632	0	494	77766
	1995	17498	16679	69135	369133	472445
	1996	163259				163259
Cape Arid	1994	142			3802	3944
	1995					
Denmark	1994	1350		1469	889	3708
	1995	20669				20669
Esperance	1994	34875				34875
	1995					
Hopetoun	1994	17009	1606	10959	9705	39279
	1995	5412	1331	1152	604+	8499
Mandurah	1994	150923	0	0	1921138	2072061
	1995	127161	1857	2983	45406	177407
	1996	514				514
Metro North	1994	160618	9816	7524	55610	233568
	1995	2788	6040	44904		53732
	1996	3212				3212
Metro South	1994	269086	94500	134379	144599	642564
	1995	157256	68492	106310	283025	615083
	1996	232385	6906*			239291
Walpole	1994	3802	314	6371	9710	20197
	1995	400			1025+	1425
Windy Harbour	1994					
	1995					

Table 26. Adjusted total catch (numbers) of Western Australian salmon for shore anglers from surveyed and non-surveyed sites by region, year and season. The adjusted total catch is the sum of all months sampled for each season in that year. Where there were missing values, the adjusted total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total
Albany	1994	4907	1304	2458	1133	9802
	1995	5873	858	7378	4877	18986
	1996	3052	71*			3123
Augusta	1994	350	0	0	0	350
	1995	3815	0	0	0+	3815
Bremer Bay	1994	966	287	0	4057	5310
	1995	190	0	39	0+	229
Bunbury	1994	336	2569	0	556	3461
	1995	24		0	0+	24
Busselton	1994	952	3971	287	81	5291
	1995	8465	47	1036	427	9975
	1996	18008	0*			18008
Cape Arid	1994	7082	27	416	968	8493
	1995	4488	1007	3140	950+	9585
Denmark	1994	248	1734	43	1056	3081
	1995	687	0	2594	0+	3281
Esperance	1994	1483	0	0	0	1483
	1995	235	0	0	0+	235
Hopetoun	1994	284	0	0	0	284
	1995	0	67	0	0+	67
Mandurah	1994	1837	1257	251	0	3345
	1995	193	223	0	0	416
	1996	283	0*			283
Metro North	1994	0	1159	365	0	1524
	1995	0	0	0	0	0
	1996	0	0*			0
Metro South	1994	1370	723	365	0	2458
	1995	77	0	0	0	77
	1996	0	0*			0
Walpole	1994	931	57	0	520	1508
	1995	1884	324	1148	0+	3356
Windy Harbour	1994	2578	131	0	26	2735
	1995	55				55

Table 27. Adjusted total weight (tonnes) of Western Australian salmon for shore anglers from surveyed and non-surveyed sites by region, year and season. The adjusted total catch is the sum of all months sampled for each season in that year. Where there were missing values, the adjusted total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total (tonnes)
Albany	1994	19.6	5.2	9.8	4.5	39.0
	1995	23.4	3.4	29.4	19.4	75.7
	1996	12.2	0.3			12.5
Augusta	1994	1.4	0	0	0	1.4
	1995	15.2	0	0	0+	15.2
Bremer Bay	1994	3.9	1.1	0	16.2	21.2
	1995	0.8	0	0.2	0+	0.9
Bunbury	1994	1.3	10.2	0	2.2	27.9
	1995	0.1		0	0+	0.1
Busselton	1994	3.8	15.8	1.1	0.3	21.0
	1995	33.7	0.2	4.1	1.7	39.7
	1996	71.6	0*			71.6
Cape Arid	1994	17.7	0.1	1.0	2.4	21.2
	1995	11.2	2.5	7.8	2.3+	24.0
Denmark	1994	1.0	6.9	0.2	4.2	12.3
	1995	2.7	0	10.3	0+	13.0
Esperance	1994	3.7	0	0	0	3.7
	1995	0.6	0	0	0+	0.6
Hopetoun	1994	0.7	0	0	0	0.7
	1995	0	0.2	0	0+	0.2
Mandurah	1994	0.7	0.5	0.1	0	1.3
	1995	0.1	0.1	0	0	0.1
	1996	0.1	0*			0.1
Metro North	1994	0	0.4	0.1	<0.1	0.5
	1995	0	0	0	0	0
	1996	0	0*			0
Metro South	1994	0.5	0.3	0.1	0	0.9
	1995	<0.1	0	0	0	<0.1
	1996	0	0*			0
Walpole	1994	3.7	0.2	0	2.1	6.0
	1995	7.5	1.3	4.6	0+	13.4
Windy Harbour	1994	10.3	0.5	0	0.1	10.9
	1995	0.2				0.2

Table 28. Adjusted total catch (numbers) of Australian herring for shore anglers from surveyed and non-surveyed sites by region, year and season. The adjusted total catch is the sum of all months sampled for each season in that year. Where there were missing values, the adjusted total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total
Albany	1994	91241	21820	9315	13527	135903
	1995	57799	25039	8000	26228	117066
	1996	35166	5439*			40605
Augusta	1994	121130	37012	14804	93950	266896
	1995	293313	22232	34995	0+	350540
Bremer Bay	1994	14518	1427	298	2001	18244
	1995	3106	0	124	82+	3312
Bunbury	1994	19938	0	1409	20139	41486
	1995	13995		0	0+	13995
Busselton	1994	23443	13315	5847	14626	57231
	1995	82679	21189	24355	76821	205044
	1996	94081	1155			95236
Cape Arid	1994	9052	201	178	1465	10896
	1995	2526	48	945	0+	4464
Denmark	1994	17219	805	1221	10000	29317
	1995	18249	457	4698	139+	23543
Esperance	1994	42197	9628	2309	19342	73476
	1995	8081	0	3535	1068	12684
Hopetoun	1994	3966	1664	5245	3490	14365
	1995	4248	224	492	263	5227
Mandurah	1994	42876	5170	735	8149	56930
	1995	26818	222	0	20897	47937
	1996	3034	0*			3034
Metro North	1994	53386	26005	8792	28280	116463
	1995	66895	3456	5598	13467	89416
	1996	16836	576*			17412
Metro South	1994	83744	63193	16958	32515	196410
	1995	32891	25927	41929	18180	118927
	1996	55498	4139*			59637
Walpole	1994	12985	1146	3492	5234	22857
	1995	1505	22	1150	0+	2677
Windy Harbour	1994	22545	337	512	310	23704
	1995	55				55

Table 29. Adjusted total weight (tonnes) of Australian herring for shore anglers from surveyed and non-surveyed sites by region, year and season. The adjusted total catch is the sum of all months sampled for each season in that year. Where there were missing values, the adjusted total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total(tonnes)
Albany	1994	25.1	6.0	2.6	3.7	37.4
	1995	15.9	6.9	2.2	7.2	32.2
	1996	9.7	1.5			11.2
Augusta	1994	14.9	4.6	1.8	11.6	32.9
	1995	36.1	2.7	4.3	0+	43.2
Bremer Bay	1994	3.2	0.3	<0.1	0.4	4.1
	1995	0.7	0	<0.1	<0.1+	0.7
Bunbury	1994	2.8	0	0.2	2.8	5.8
	1995	2.0		0	0+	2.0
Busselton	1994	3.4	1.9	0.8	2.1	8.3
	1995	12.0	3.1	3.5	11.1	29.8
	1996	13.7	0.1			13.8
Cape Arid	1994	1.9	<0.1	<0.1	0.3	2.3
	1995	0.5	<0.1	0.2	0+	0.8
Denmark	1994	2.9	0.1	0.2	1.7	5.0
	1995	3.1	<0.1	0.8	<0.1+	4.1
Esperance	1994	8.6	1.9	0.4	<0.1	14.9
	1995	1.6	0	0.7	0.2+	2.6
Hopetoun	1994	0.5	0.2	0.7	0.6	2.0
	1995	0.6	<0.1	<0.1	<0.1+	0.8
Mandurah	1994	6.1	0.7	0.1	1.2	8.1
	1995	3.8	<0.1	0	2.9	6.9
	1996	0.4	0*			0.4
Metro North	1994	6.7	3.3	1.1	3.6	14.7
	1995	8.4	0.4	0.7	1.7	11.2
	1996	2.1	<0.1*			2.2
Metro South	1994	10.5	7.9	2.1	4.1	24.6
	1995	4.1	3.3	5.3	2.3	14.9
	1996	6.9	0.5*			7.4
Walpole	1994	1.5	0.1	0.4	0.6	2.6
	1995	0.2	<0.1	0.1	0+	0.3
Windy Harbour	1994	5.3	<0.1	0.1	<0.1	5.5
	1995	<0.1				<0.1

Table 30. Adjusted total catch (numbers) of Australian herring for boat based anglers from surveyed and non-surveyed sites by region, year and season. The adjusted total catch is the sum of all months sampled for each season in that year. Where there were missing values, the adjusted total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total
Albany	1994	25526	1306	2821	12319	41972
	1995	2740	2388	214	3657	8999
	1996	5261				5261
Augusta	1994	27215	0		0	27215
	1995		0		0	0
Bremer Bay	1994	4098				4098
	1995					
Bunbury	1994					
	1995					
Busselton	1994	25548	0	0	0	25548
	1995	8721	0	508	36558	45787
	1996	96820				96820
Cape Arid	1994	0			1536	1536
	1995					
Denmark	1994	0		0	189	189
	1995	0				0
Esperance	1994	19104				19104
	1995					
Hopetoun	1994	9506	990	4695	6813	22004
	1995	2605	632	248	430	3915
Mandurah	1994	71119	0	0	16840	87959
	1995	0	0	0	0	0
	1996	0				0
Metro North	1994	67628	935	948	32114	101625
	1995	302	1156	1214	935	3607
	1996	244				244
Metro South	1994	109967	24705	43756	31494	209922
	1995	39881	15025	43465	41257	139628
	1996	89947	2133*			92080
Walpole	1994	687		275	4690	5652
	1995	0	0			0
Windy Harbour	1994					
	1995					

Table 31. Adjusted total weight (tonnes) of Australian herring for boat based anglers from surveyed and non-surveyed sites by region, year and season. The adjusted total catch is the sum of all months sampled for each season in that year. Where there were missing values, the adjusted total catch was calculated over those seasons with data available (* indicates that surveys were conducted in June only for the winter season 1996. + indicates that surveys were conducted in December only for the summer season 1995).

Region	Year	Autumn	Winter	Spring	Summer	Total
Albany	1994	7.0	0.4	0.8	3.4	11.6
	1995	0.8	0.6	<0.1	1.0	2.5
	1996	1.4				1.4
Augusta	1994	3.3	0		0	3.3
	1995		0			0
Bremer Bay	1994	0.9				0.9
	1995					
Bunbury	1994					
	1995					
Busselton	1994	3.7	0	0	0	3.7
	1995	1.3	0	<0.1	5.3	6.7
	1996	14.1				14.1
Cape Arid	1994	0			0	0
	1995					
Denmark	1994	0		0	<0.1	<0.1
	1995	0				0
Esperance	1994	3.9				3.9
	1995					
Hopetoun	1994	1.4	0.1	0.6	0.9	3.0
	1995	0.4	<0.1	<0.1	<0.1+	0.5
Mandurah	1994	10.1	0	0	2.4	12.5
	1995	0	0	0	0	0
	1996	0	*			0
Metro North	1994	8.5	0.1	0.1	4.0	12.7
	1995	<0.1	0.1	0.1		0.3
	1996	<0.1	*			<0.1
Metro South	1994	13.8	3.1	5.5	4.0	26.4
	1995	5.0	1.9	5.5	5.2	17.6
	1996	11.3	0.2			11.5
Walpole	1994	<0.1		<0.1	0.5	0.6
	1995	0	0		0+	0
Windy Harbour	1994					
	1995					