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FISHERIES RESEARCH & DEVELOPMENT CORPORATION

NORTHERN TERRITORY DEPARTMENT OF PRIMARY INDUSTRY AND FISHERIES

The National Recreational and Indigenous Fishing Survey

The National Recreational and Indigenous Fishing Survey

Edited by G. W. Henry and J. M. Lyle

NSW FISHERIES

FISHERIES RESEARCH & DEVELOPMENT CORPORATION

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FRDC Project No. 99/158

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AUSTRALIA
Natural Heritage Trust

The National Recreational and Indigenous Fishing survey

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A Fisheries Action Program Project
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The National Recreational and Indigenous Fishing Survey

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FOREWORD

I am pleased to introduce the *National Recreational and Indigenous Fishing Survey*, a work that has been several years and many millions of dollars in the making. It is a work commissioned by the Commonwealth Government that will be a central plank in the formulation of Government policy that relates to recreational, charter, indigenous, and commercial fishing now and in the future.

This survey comes at a very important time in the management of Australia's fisheries. I have recently enjoyed the privilege of developing and releasing on behalf of the Howard Government *Looking to the Future: A Review of Commonwealth Fisheries Policy* which, among other things, identifies as a priority issue resource sharing between various sectors that access publicly owned fisheries resources managed by the Commonwealth Government.

I am pleased to record here that substantial progress has already been made on development of the resource-sharing framework. This survey will feed directly into that framework and we will see a fully transparent process to allocate rights and responsibilities to all users of Australia's publicly owned fisheries resources. These rights will convey greater access security to users other than commercial operators who already operate under a statutory regime, and with those strengthened rights will come heightened responsibility.

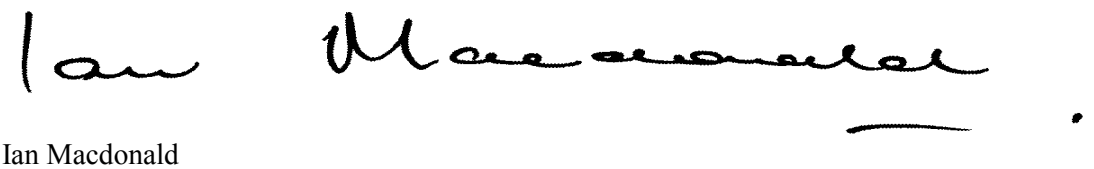
The 1994 *A National Policy for Recreational Fishing in Australia* stated that "Fisheries management decisions should be based on sound information, including fish biology, fishing activity, catches, and the economic and social values of recreational fishing." This survey will now finally allow for this to occur for the good of Australia's resources at both the State and Territories level as well as the Commonwealth level.

I am exceptionally proud that the Howard Government has been the first Government of Australia in my memory that has tackled, and continues to tackle the difficult and often unpopular fisheries management issues that have for too long been thrown into the "too hard basket." In my capacity as the Commonwealth Fisheries Minister, I am committed to pursuing this philosophy of making the right decisions early in the piece to minimise future angst and maximise conservation goals.

I believe that a mature and cooperative approach will continue to develop between, and be adopted by, all fisheries stakeholders in fisheries management in this country, be they lovers of catching, eating or conserving fish. My vision is for future generations to enjoy the same opportunities as we of this generation currently enjoy.

For many years it has only been the commercial sector of the fishing industry that has had to collect data used in the management of our nation's fisheries. With this new data on recreational and indigenous fishing that this survey has provided I am confident we can further enhance Australia's world leading fisheries management practices.

The strong support that this survey received from the Australian community is an indicator of the importance of fishing of all types to our island continent, and this support will continue to be matched by the Howard Government in the pursuit of ecologically sustainable fisheries for all Australians now and in the future.



Ian Macdonald
Minister for Fisheries, Forestry and Conservation

ACKNOWLEDGEMENTS

Many people in Australia contributed to the development and implementation of the national recreational and indigenous fishing survey. Senior research and management staff from Commonwealth and State government agencies, recreational and commercial fishing associations, environmental and indigenous groups were responsible for developing the concept, securing the funding, determining the outputs and progressing the concept to the implementation stage. The foresight, hard work and support of these people is gratefully acknowledged.

Following agreement on the methodology, a smaller team of people was formed to conduct the survey. This team recruited and trained staff, supervised the collection, collation and editing of data and managed the survey on a daily basis as an independent project within their own States/ Territories. Members of the implementation team (listed below) undertook the substantial body of work required to complete the survey. Their persistence and dedication is greatly appreciated by everyone associated with the project.

A number of people deserve special mention. Laurie West, the survey design consultant, Jeremy Lyle and David McGlennon provided intellectual rigour and attention to detail that was fundamental to the success of the project. Jeff Murphy managed the complex tasks associated with data manipulation. Their efforts are greatly appreciated by team members. Finally, the assistance of the interviewer staff and the cooperation of many thousands of recreational and indigenous fishers is gratefully acknowledged.

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NON-TECHNICAL SUMMARY

99/158	Implementation of the National Recreational and Indigenous Fishing Survey

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OBJECTIVES:
The primary objective of the national recreational and indigenous fishing survey was to collect nationally consistent and comparable fishery statistics (fish catch, fishing effort, species composition) for the non-commercial components of Australian fisheries. The survey also collected information on the number of fishers, their demographic profile, expenditure associated with fishing and the attitude and awareness of fishers to prominent fisheries management issues. The specific objectives of the project were:

- To determine the participation rate in recreational fishing nationally, by States and Territories and regionally, and profile the demographic characteristics of recreational fishers.
- To quantify catch and effort of the recreational fishing sector nationally, by States and Territories and, where appropriate, regionally.
- To collect data on expenditure by the recreational fishing sector nationally and regionally.
- To establish the attitudes and awareness of recreational fishers to management issues of relevance to their fishery.
- To quantify fishing activity by indigenous fishing communities in northern Australia.
- To quantify fishing activity by overseas visiting fishers.

NON TECHNICAL SUMMARY:
A national survey of recreational and indigenous fishing was conducted in Australia during 2000-01. The survey was a joint initiative of Commonwealth and State governments. Grants from the Natural Heritage Trust, Fisheries Research and Development Corporation, State and Territory fisheries agencies supported the project. The national survey was a multifaceted project designed to provide a range of information about non-commercial fishing in Australia. The project comprised three independent surveys, the National Recreational Fishing Survey, the Indigenous Fishing Survey of Northern Australia and the Overseas Visitor Fishing Survey. Different methodologies and analytical approaches were required for each of these surveys, reflecting their varying characteristics. A telephone/ diary survey methodology was developed to collect information on recreational fishing in Australia with non-response and behavioural biases being assessed by a suite of innovative follow-up surveys. Modified on-site survey techniques were used to collect information from indigenous fishers in northern Australia while an existing survey instrument developed by the Bureau of Tourism Research was used to obtain information on overseas visiting fishers.

An estimated 3.36 million Australian residents, aged 5 years or older, fished at least once in the 12 months prior to May 2000. This represented a national recreational fishing participation rate of 19.5%. New South Wales had the greatest number of recreational fishers (999,000) followed by Queensland (785,000) and Victoria (545,000). Almost 70% of the nation's recreational fishers resided in these three eastern States. However, the highest fishing participation rates were recorded from Northern Territory (31.6%), Tasmania (29.3%) and Western Australia (28.5%). Regional participation rates were lowest in Sydney (13.1%) and Melbourne (10.2%) but, by virtue of their population sizes, these capital cities accounted for large proportions of the fishers in each State.

An estimated 1.8 million Australian households contained at least one recreational fisher representing 24.4% of households nationally. On average, each fishing household contained 1.9 recreational fishers. Recreational fishing was more popular amongst males (2.3 million fishers) than females (1.1 million fishers) with the predominance of males involved in fishing evident across all age groups. By age group, the greatest number of fishers was in the 30-44 age bracket (644,000 males and 325,000 females), though participation rates were highest among the 5-14 age group (33% for males and 23% for females). Fishing club membership among recreational fishers was low (4.3% nationally) and the number of recreational fishing licence holders varied according to state jurisdictional arrangements. It was estimated that over 511,000 boats, with a capital value of $3.3 billion, were used for recreational fishing in the 12 months prior to May 2000.

Fishing and fishing-related expenditure activities of intending recreational fishers were monitored between May 2000 and April 2001. During this period, recreational fishers spent an estimated 20.6 million fisher days of effort, representing 23.2 million separate fishing events or 102.9 million fisher hours. New South Wales recorded the greatest effort (7.7 million events) followed by Queensland (5.8 million events) and Western Australia (3.4 million events). More than 11% of the national fishing effort (2.6 million events) occurred outside the fisher's State of residence. Patterns in interstate fishing effort indicated that New South Wales, Queensland, Northern Territory and to a lesser extent Western Australia were net importers of fishing effort, while Victoria, Australian Capital Territory and South Australia were net exporters of effort. On average, recreational fishers fished approximately 6 days over the year with just 15% of all fishers accounting for about half the total fishing effort.

Nationally, about 41% of the total fishing effort (9.5 million events) occurred in coastal waters, with estuarine waters accounting for a further 35% (8.1 million events). The level of recreational fishing directed at offshore waters was relatively low, about 4% (937,000 events). Freshwater fishing accounted for almost 20% of the national fishing effort, around 11% (2.7 million events) in rivers and 8% (1.9 million events) in lakes or dams. Fishing from the shore attracted a greater level of activity (57% of events) than fishing from a boat (43% of events). Of the boat-based fishing effort, more than 93% of fishing events were conducted from private fishing boats as opposed to charter vessels (4%) and hire boats (3%). These national trends were broadly consistent across States, but the geographical and population variations between States contributed to some differences.

Line fishing methods (bait, lure, jig, fly, setline) accounted for 19.7 million fishing events (85% of the national total). Fishing with pots and traps (7%), the use of pumps, rakes, spades and hand collection predominately for gathering bait (4%), fishing with nets (3%) and diving with spears or underwater hand collecting (1%) followed in importance.

Recreational fishers harvested approximately 136 million aquatic animals during the survey year. The harvest included 60.4 million finfish, 11.5 million small baitfish, 6.1 million crabs and lobsters, 47.7 million prawns and yabbies, 1.8 million cephalopods, 7.2 million other molluscs and 1.2 million other taxa. The prominent species/ groups in the recreational finfish harvest were whiting (8.1 million fish), flathead (7.4 million), Australian herring (6.9 million), bream (4.9

million), King George whiting (3.8 million), mullet (2.9 million), garfish (2.4 million), tailor (2.3 million), Australian salmon (1.7 million) and pink snapper (1.3 million). Two pest species, European carp and English perch, were harvested in large numbers (2.1 and 1.3 million fish, respectively). Substantial quantities of crabs (3.9 million blue swimmer and 0.8 million mud crabs), lobsters (0.7 million), prawns (18.8 million) and freshwater crayfish (7.4 million crayfish) were also harvested.

Estimated expenditure on services and items that was attributed to recreational fishing was $1.8 billion over the 12 month survey period. Regional expenditure was generally related to the size of the population and the number of fishers. New South Wales had the largest expenditure ($554 million) and Australian Capital Territory the smallest ($19 million). The national average attributable expenditure was $552 per fisher per annum, with the highest per capita expenditure in Victoria ($721) and the lowest in the Australian Capital Territory ($363). Expenditure on boats and trailers ($872 million) was the largest individual expense for fishers. Travel associated with fishing ($432 million), accommodation ($184 million) and fishing tackle ($146 million) followed in importance.

When asked about reasons for fishing, recreational fishers identified, in descending order of importance, 'to relax and unwind', 'fishing for sport', 'to be with family' and 'to be outdoors' as their primary motivations. Only a small proportion of fishers considered catching fish for food as their primary motivation for fishing.

An estimated 37,000 indigenous fishers, aged 5 years or older, living in communities in northern Australia fished at least once during the 12 months prior to July 2000. This represented a fishing participation rate of 91.7%. Indigenous fishers in northern Australia expended an estimated 420,000 fisher days of effort during the survey year, comprising 671,000 separate fishing events. Indigenous fishers harvested aquatic animals from a range of environments, but inshore waters accounted for more than half the fishing effort. Indigenous fishers used line fishing methods (53%), hand collection (26%), nets (12%) and spears (9%) as their primary fishing methods.

Indigenous fishers harvested more than 3 million aquatic animals from the waters of northern Australia. The harvest included approximately 910,000 finfish, 1.1 million shellfish, 655,000 prawns and yabbies, 181,000 crabs and lobsters, 98,000 small baitfish and 93,000 other taxa. The most prominent finfish species in the indigenous catch were mullet (182,000 fish), catfish (109,000), sea perch/ snappers (84,000), bream (71,000) and barramundi (63,000). The most prominent non-fish species were mussels, (586,000), cherabin (517,000), other bivalves (233,000), prawns (132,000), oysters (114,000) and mud crabs (108,000). A relatively small proportion of the indigenous catch (1.7%) was returned to the water. Indigenous fishers harvested a number of species groups that had protected status for non-indigenous people.

During 2001, approximately 4.6 million international visitors came to Australia. Approximately 4% of these visitors (191,000 people) engaged in fishing while they were in Australia. The largest number of visitors who fished in Australia came from United Kingdom (46,100 people), followed by Japan (23,900), United States of America (19,300) and New Zealand (14,800). All age groups were represented by the visitors who fished, though greatest numbers were in the 20-24 and 25-29 age brackets.

The project has achieved its goals regarding the collection of fishery statistics for the non-commercial components of Australian fisheries. A comprehensive fishing database has been established and survey methodologies developed, tested and proved. The project has delivered on a primary goal of the "National Policy on Recreational Fishing" and the stated objectives of Commonwealth and State fishery agencies regarding the acquisition of comprehensive and reliable data to support the management of recreational fisheries and the conservation of fishery resources.

1. BACKGROUND

1.1. Introduction

A national survey of recreational and indigenous fishing in Australia was conducted during 2000-01. The survey represents the first comprehensive national examination of the non-commercial components of Australian fisheries. The survey obtained estimates of the level of participation, fishing effort and catch by recreational and indigenous fishers. The survey also sought information on the economic activity associated with recreational fishing and the attitude of recreational and indigenous fishers to prominent management issues. These data were required at a national, state and regional level by Australian fishery agencies. The project was planned, developed and supported by Commonwealth and State governments, peak commercial and recreational fishing groups, and indigenous and environmental associations. A team of scientists from the State fisheries agencies and several external consultants implemented the project. The survey database represents the most comprehensive body of information ever collected on recreational and indigenous fishing in Australia. Fisheries statistics were gathered on a range of major issues of significance to recreational and indigenous fishing and its management. These data will be used to support the future management of recreational and indigenous fishing in Australia.

1.2. Origins of the Survey

The growing number of recreational fishers over the last few decades has raised questions about their impact on fishery resources. Recreational fishing surveys have been conducted by State fishery agencies to support the sustainable harvesting of fish stocks and to identify and accommodate a range of recreational fishing opportunities. Recreational fishing surveys were first conducted in Australia in the mid-1970's and they have grown in size and complexity ever since. Most State fishery agencies routinely conduct recreational fishing surveys as part of their core activity. However, the diversity of survey objectives and recreational fishing information required means that there is rarely a common approach to the spatial or temporal scales of these surveys or the preferred methodology. Australian fisheries research and management staff have discussed the need for a standard, comparable national survey methodology since the early 1990's. The national recreational fishing survey, therefore, had its origins in the evolution and expansion of the scope of the work already being conducted in States, and the desire to collect comprehensive national and regional recreational fishing benchmark information using a standard methodological approach. State fishery agencies also recognised the need to establish long-term recreational fishery monitoring systems of a similar standard to those for the commercial fishing sector.

More formal support for a national approach to recreational fishing research arose from the "National Policy for Recreational Fishing in Australia" that was developed by government and industry and published in December 1994. The Policy endorsed the principle that fisheries management decisions should be based on sound information including fish biology, fishing activity, catches and the economic and social values of recreational fishing. The Policy also noted that there was an urgent need to obtain accurate national information on the values of recreational fishing, and changes in these values over a period of time as all levels of government have inadequate information for managing many fish stocks of importance to recreational fishing. The Policy recommended that a national survey of recreational fishing should be undertaken on a five-yearly basis. In addition, the Policy suggested that there was also a need to identify the attitudes of recreational fishers to their sport and determine the reasons why people fish and the best means of incorporating these needs into management polices.

Finally, community support for information on the harvest of fish stocks by the non-commercial sector arose from a Federally-funded community-based natural resources program (Fishcare) that was established in 1995. Fishcare held community workshops around Australia with key stakeholders of the aquatic environment to canvass a range of natural resource and habitat issues of interest or concern to a broad cross-section of the Australian community. A common issue at these workshops was the lack of scientific information on the status of many fishery resources and the level of exploitation by non-commercial fishers. Community groups lamented the paucity of information on recreational and indigenous fishing in view of the apparent growth in the number of participants and the technical advances in fishing gear. It was acknowledged that government fishery agencies had an obligation to better understand the impact of all fishing sectors on the sustainability of fish stocks. The workshops strongly agreed with the need for a program to obtain more information on non-commercial fishing.

1.3. Development and Implementation

The national recreational and indigenous fishing survey was progressively developed through a three-phase process during the late 1990's that involved a feasibility study, a development (pilot) project and the final implementation of the survey. A survey design consultant (Kewagama Research Pty Ltd) was commissioned to review angling survey methodologies in 1998 and to recommend an appropriate survey instrument for Australian fisheries. Kewagama consolidated the output specifications of each State/ Territory, provided a literature review of potential survey methodologies (including international surveys), discussed survey methodologies in light of the output specifications and characteristics of Australian recreational fisheries and explored alternative implementation strategies. Kewagama recommended a national screening and diary instrument as the most appropriate survey technique for gathering national recreational fishery statistics. The feasibility study also provided an assessment of development and implementation costs of a national survey. Standing Committee on Fisheries and Aquaculture (SCFA) endorsed the feasibility study and approved the development of a national recreational fishing survey, along with additional components for indigenous fishing communities and international visiting fishers.

The development phase of the national recreational and indigenous fishing survey occurred during 1999-2000. The objectives of the development phase were to advance the national survey concept (as per the feasibility study), into working documents and sampling plans ready for implementation. This required the finalisation/ refinement of the output specifications, sampling design, questionnaires and other survey elements for the three major components of the survey. The survey instrument was pilot tested during 1999/2000. For the recreational component, the pilot test involved a 2-month survey in each State and Territory and a 12-month pilot in New South Wales, Tasmania and the Northern Territory. The indigenous fishing survey methodology was pilot tested within 2 communities in Queensland, Western Australia and Northern Territory. Significantly, the pilot testing provided the key survey research staff in each State and Territory with direct experience in the conduct of the various survey components and database management systems as well as refining survey procedures. The development phase allowed the final documentation and costings for the survey proper to be agreed to by the funding agencies and States. Although a complex and challenging project in many respects, the development phase achieved its stated objectives and the project team recommended that the final implementation of the national recreational and indigenous fishing survey proceed according to schedule in 2000.

1.4. Fishing Survey Literature

Recreational fishing surveys are used by fisheries agencies in many parts of the world to obtain a variety of information for management purposes. Recreational surveys may vary in their complexity and scope, but seven basic designs are commonly used to gather fishing information. These are mail surveys, telephone surveys, door-to-door surveys, diary or logbook surveys, access

point surveys, roving surveys and aerial surveys (Pollock *et al.*, 1994). The first four are regarded as off-site methods (surveys conducted away from fishing sites) and the last three are regarded as on-site methods (surveys conducted at the fishing site). Many recreational fishing surveys seek to obtain information on the fish catch (numbers or kg in some cases), fishing effort (trips, hours or days fished), catch rate (numbers or kg per hour), species diversity, size and age of fish. Surveys of the expenditure incurred by recreational fishers generally seek to assess the economic impact of recreational fishing and the flow-on benefits to regional communities, while studies of the attitude/ awareness or motivation of fishers are used to examine social and management issues. The methods used to collect data on recreational fishing are determined by the type of information required, the temporal and spatial scale of the study, the characteristics of the fishery and the resources (personnel, funds, gear) available.

Survey outcomes are reported in a broad range of media from popular fishing magazines to scientific journals. A summary of the content of scientific journals has been published in a number of recreational fishing texts that describe the current status of recreational fishing research and management. Sigler and Sigler (1990) and Kohler and Hubert (1993) provided texts on the conceptual basis of freshwater fisheries management. These texts included a history of fisheries research and management and a description of the procedures for collecting, recording and interpreting scientific data relative to fisheries management goals. In 1990, the American Fisheries Society convened an international symposium on recreational fishing that brought together over 300 people involved in research and management. The symposium drew together current survey information and focused these techniques on fishery problems. Proceedings of the symposium were published in Guthrie *et al.* (1991). A further outcome of the symposium was the publication of a manual of recreational survey techniques for practical use in fisheries management (Pollock *et al.*, 1994). This publication provides a comprehensive review of angler survey methods and has become the authoritative text on recreational survey methods. More recently, the status of recreational fisheries research and management in Europe was described in the proceedings of the European Inland Fisheries Advisory Commission symposium (Hickley and Tompkins, 1998). The most recent significant contribution to the literature on recreational fishing was the text by Pitcher and Hollingworth (2002) on the ecological, economic and social evaluation of recreational fisheries. This book arose from a selection of papers presented at an international conference on evaluating the benefits of recreational fishing held at the University of British Columbia in 1999. This text not only provides an analysis of the various approaches to valuation of recreational fishing, but an update of the management, assessment and policy making for recreational fisheries worldwide.

Different approaches to the collection of recreational fishing information are used according to the particular circumstances of the fishery and the desired outcomes. However, large-scale surveys (e.g. at national or state-wide level) commonly use off-site techniques for their lower cost and greater utility in dealing with large numbers of fishers dispersed over large geographical areas. Remote (off-site) survey techniques have been used to collect information on recreational fisheries in Britain (NRA, 1995), Canada (Dominy, 1992), England and Wales (Lyons *et al*, 2002), France (Jantzen, 1998), Germany (Steffens and Winkel, 2002), New Zealand (Teirney, 1995; Teirney *et al*., 1997), Nordic Countries (Toivonen, 2002), South Africa (Griffiths and Lamberth, 2002), Sweden (Bogelius, 1998) and the United States (Essig and Holliday, 1991; Grambsch and Fisher, 1991; Gentner and Lowther, 2002). The present survey of recreational fishing in Australia used a remote (telephone/ diary) survey technique in conjunction with a number of validation/ calibration surveys to minimise non-response and behavioural biases. Like most large-scale survey techniques, the survey instrument was constrained by the availability of resources. A justification and discussion of the methods used for the Australian national survey was provided in the feasibility study (Kewagama Research, 1998).

1.5. Literature on Australian Recreational Fishing Surveys

Recreational fishing surveys have been conducted in Australia since the mid-1970's (Tilzey 1977a, b), but the real growth in recreational fishing research occurred during the 1980's as fishery agencies recognised the need to consider estimates of harvest from all fishing groups in the management of aquatic resources. Recreational fishing survey methodology has developed to include the full range of remote, on-site and biological techniques and the scope of Australian surveys has expanded to include social, economic and motivational factors as well as traditional biological issues in fisheries management. Several hundred recreational fishing surveys have now been conducted in Australia and these surveys encompass the range and diversity of recreational fisheries. Consequently, a substantial body of quantitative information on recreational fishing now exists for a range of Australian fisheries. Unfortunately, most surveys have been limited in their objectives (e.g. collection of catch/ effort information only or collection of participation/ attitudinal only) and/ or in their temporal or spatial (single lake or estuary) scale, and this has reduced their value in helping to address broader biological, economic and social fisheries management goals and objectives on a national or state-wide basis. Short-term surveys have resolved immediate management issues, but there is a growing desire to incorporate large-scale and longer term monitoring programs, such as those in place for commercial fisheries, into the management of recreational fisheries.

The first attempt to provide national information on recreational fishing in Australia was commissioned by the Australian Recreational and Sport Fishing Confederation in the early 1980's to draw attention to the size (number of fishers) and economic impacts (expenditure associated with fishing) of the national fishing sector (P.A. Management Consultants, 1984). General population or omnibus surveys have now been conducted in all Australian States and Territories. While such surveys have provided estimates of the level of participation in recreational fishing and the demographic characteristics of recreational fishers, they do not provide estimates of catch and effort. Since the mid-1990's there have been a number of large-scale surveys directed at evaluating recreational catch and effort. They include state-wide surveys of the recreational catch in the Northern Territory (Coleman, 1998) and Queensland (Higgs, 1999; 2001), while a number of states have conducted large-scale state-wide surveys on particular fish or fisheries (Steffe *et al*., 1997; McGlennon, 1999; Sumner and Williamson, 1999; Lyle, 2000; Forward and Lyle, 2002). All states have conducted regional, single water body or fishery-specific fishing surveys in freshwater, estuarine and marine waters to resolve specific fisheries management issues. Reviews of the Australian recreational fishing survey literature can be found in McGlennon (1995), Kewagama Research (1998) and McIlgorm and Pepperell (1999).

1.6. Literature on Australian Indigenous Fishing

Accounts of indigenous fishing activities in Australia have appeared in the natural history literature since the arrival of European settlers. The official records of military officers with the first fleet (Bradley, 1786-92; Tench, 1791) provided accounts of indigenous fishing in the Sydney region. Bone and shell hooks were fabricated, while nettlebark, kurrajong and other fibrous plants were used to make fishing lines and nets (Bradley, 1786-92). Other plants were used to poison creeks and barriers were erected in areas of tidal influence. Spears and clubs were commonly used and the muttock (pronged spear) was probably the most popular implement (Tench, 1791).

A succession of naturalists and natural history writers documented the fish fauna of the new colony, including references to indigenous fishing (Cohen, 1892; de Castelnau, 1872; Oliver, 1871; Tenison-Wood, 1883; Thompson, 1893; Welsby, 1895). Early literature contains references to the skills of indigenous people in the construction and use of fishing gear, boating and water skills and the harvesting of fishery resources in coastal and inland waters (Tenison-Wood, 1883). Accounts

of indigenous fishing have been provided by Banfield (1909) and Gilmore (1986) and an overview of indigenous fishing and its supporting literature is found in Bob Dunn's (1991) history of angling in Australia. These historical accounts of indigenous fishing provide a useful description of fishing techniques, target species and aspects of the biology of Australian fish fauna, but little information on the number of fishers or the magnitude of the national, state or regional catch.

More recent indigenous fishing surveys in Australia have tended to focus on the fishing activities of individual communities and/ or regional fisheries in northern Australia (Davis, 1983; Gray and Zann, 1988; Smith, 1998; Johannes and MacFarlane, 1991 and Roberts *et al*, 1996). These qualitative studies generally describe fishing activities from personal interviews and observation rather than provide statistical assessments of the fishery. Pointer and Harris (1991) and Harris *et al* (1993, 1995) obtained detailed catch statistics that included quantitative assessments of the harvest of aquatic resources by fishing method for islands within the Torres Strait. The National Aboriginal and Torres Strait Islander Survey collected demographic data on indigenous family and culture, health, housing, education, employment, law and justice (ABS, 1994a; 1994b; 1995). Balkanu Land Council and the Queensland Fisheries Service recently sought to redress the lack of indigenous fisheries statistics in northern Queensland by establishing an indigenous subsistence fishing kit for local communities to collect relevant catch and effort data (Turner, 1998).

2. NEED FOR THE SURVEY

2.1. Fisheries Management

Fisheries legislation is the principal instrument used by governments to implement policy with regard to sustainable harvest of aquatic living resources. Fisheries management is the process whereby a government, in partnership with stakeholders, develops, implements and reviews fisheries policy and management arrangements. There are biological, economic and social objectives of fisheries management, which may vary among governments and fisheries depending on the state of fishery resources and community expectations. In fact, most management agencies are concerned with a range of management objectives and their interactions. Australian fisheries management agencies have similar goals in regard to the management of fishery resources. They seek to conserve fish stocks, manage sustainable harvesting, protect aquatic habitat and share the resource among users. A primary role of government is to ensure long-term sustainable utilisation of fisheries resources for the prosperity and well being of the community. To achieve this goal, government fishery agencies conduct scientific research to understand fish populations and implement harvesting strategies to control the impacts of fishing activity on fish stocks. Quantification of commercial, recreational and indigenous catch by species and fishing area is usually a vitally important input to assessment of the impacts of fishing and the determination of appropriate management arrangements to ensure sustainable harvesting.

2.2. Potential Impact of Recreational Fishing

A number of Australian studies have shown that recreational fishers account for a substantial proportion of the total annual catch of some fish and aquatic invertebrate species, and the sheer number of people involved in recreational fishing is forcing management agencies to divert an increasing proportion of their attention and resources from commercial to recreational fisheries issues (Ramsay, 1991). Results of creel surveys in Sydney metropolitan estuaries have shown that the estimated total recreational catch is probably larger than the reported commercial catch for some areas and species (SPCC, 1984; Henry, 1984). Recreational catches of bream and prawns are probably many times larger than the commercial catch of the same species in a number of New South Wales estuaries (Kearney, 1991). It is becoming clear that the potential impact of recreational fishing on a number of fish and aquatic invertebrate species may be greater than was previously thought. Recreational fishing effort has generally increased substantially in amount and effectiveness in recent years with inevitable declines in catch rates, particularly near major population centres (Kearney, 1991). Technological advances in fishing tackle and in position fixing and fish sounding equipment and the proliferation of information on where and how to fish in the fishing media have probably also raised the average level of competence of the recreational fishing community. As such, the impact of recreational fishers on the environment and the fish stocks may warrant more stringent assessment and management.

2.3. Assessment of Indigenous Fishing

Indigenous people are a comparatively small, but important, proportion of the total Australian population. The Australian Bureau of Statistics reported an indigenous population of about 420,000 people, representing approximately 2.2% of the Australian population, in the 2001 national census (ABS, 2002). However, indigenous people have significance beyond their numbers by virtue of their possession of one of the oldest continuous cultures in the world. There is an appreciation of the value of traditional cultures, a recognition that indigenous people are among the most disadvantaged Australians and a sharpened focus on the rights of indigenous peoples. The

government accepts a special responsibility for indigenous peoples, manifested in a range of programs and activities specifically directed at overcoming disadvantage, while retaining responsibilities for the provision of services. To understand the requirements of indigenous communities, to appreciate their traditional cultural beliefs and to deliver appropriate services, there is a substantial demand on governments for statistical data about indigenous populations. This is particularly relevant in regard to an historical and ubiquitous indigenous activity such as the harvesting of fishery resources.

A demographic profile of indigenous Australians has become available in recent years from the five-yearly national census (Australian Bureau of Statistics, 1992; 1998; 2002) and from the 1994 National Aboriginal and Torres Strait Islander Survey implemented following a recommendation of The Royal Commission into Aboriginal Deaths in Custody. However, these official sources of demographic and socio-economic information provide no insight to the overall harvest of fishery resources by indigenous Australians. The present study is an attempt to redress the lack of indigenous fishing information on a national scale by involving indigenous communities in the gathering of fisheries statistics. These data will be of value to the management of fisheries resources of importance to indigenous communities. The data will also be combined with catch data from other Australian and international visiting fishers to provide a total view of the exploitation of Australian fishery resources. Accurate statistical information is needed to assist in the formulation and monitoring of policies that will effectively address the socio-economic problems facing Australia's indigenous populations (Altman, 1992).

2.4. The Regulation of Recreational and Indigenous Fishing

Fisheries management agencies provide the government with recommendations for resource conservation and use. These recommendations may include policies and rules concerning fishing opportunity, resource allocation and harvesting strategies. Management tools available for controlling the harvest of fish are broadly classified as "input" (effort) and "output" (catch) control. Input managed fisheries are regulated by limiting the fishing effort that may be applied to the resource. There is usually no fixed upper limit on the harvest of fishery resources under input controls. Therefore, improvements in fishing technology (fish sounding and position fixing equipment, vessel size and quality etc) and numbers of fishers may negate attempts to control fishing effort and the harvest. Output control strategies set upper limits on the total catch to be taken by individual fishers (e.g. daily bag limits) or from a fishery as a whole (e.g. annual Total Allowable Catch). Output controls are more common to commercial fisheries, particularly those that have fisheries objectives that include a requirement to achieve economic efficiency.

Recreational and indigenous fishing in Australia is generally managed by a combination of input and output controls. Individual fishers are often required to adhere to daily bag and possession limits, minimum and/or maximum fish size limits, restrictions on the type, size and quantity of fishing gear and seasonal or area fishing closures. These types of restrictions have generally been implemented with the intent of controlling the impacts of recreational and indigenous fishing on fish stocks, sharing fish resources more equitably among competing users or defining responsible fishing behaviour. Recreational and indigenous fisheries statistics obtained during the current survey will provide benchmarks against which future management can be assessed as well as highlighting issues that may require management or research attention.

2.5. Fishery Management Plans

Australian fishery agencies are placing increased emphasis on ensuring that fishing activities are ecologically sustainable and that the rules governing these activities are transparent and well known by the participants and the community. This requires the development of fishery management arrangements that encompass all users of the resource including commercial,

recreational and indigenous fisheries. It also requires that the proposed management arrangements be documented in a form that provides fishers and the community with a clear statement of intent regarding the exploitation of fishery resources and adherence to sustainability principles.

2.6. Stock Assessment and Sustainability

The recreational and indigenous fishing information obtained from the current national survey will be used by management agencies for a variety of purposes. One of the most important potential uses of catch and effort information from the survey will be as an input to assessment of the impacts of fishing on stocks of key target species. Stock assessments seek to explain the factors (both fishing and non-fishing) that determine the reproductive success, distribution and abundance of fish populations and, given these circumstances, to predict the responses of fish populations to different levels of fishing pressure. Such assessments draw on a range of information sources and are subject to a wide variety of uncertainties. The type of assessment used for a particular fish stock depends on the nature of the species and fishery being studied, the value of the fishery and the cost of gathering information to facilitate the assessment. The basis for all assessments is an understanding of the key demographic processes that limit population size. These are the rates at which fish grow, reproduce and die (natural and fishing mortality), recruit and move. Biological data and fisheries statistics are used to construct models of a fishery. Such models vary substantially in complexity and sophistication. For example, the relatively simple biomass dynamic models use a time series of catch and a time series of relative abundance data to estimate changes in the biomass of the population over time. In contrast, more complex age- and length-structured models of populations incorporate more information about the biology of a species (e.g. rates of growth, natural mortality) and specifically consider multiple ages or length-classes, rather than simply the exploitable biomass.

Many types of stock assessment models explicitly acknowledge uncertainty in the process of fitting the model to historical fishery data and in providing estimates of the risk associated with alternative harvesting strategies. One of the basic requirements of most models of fish populations and fisheries is a time-series of catches (fishing-induced mortality or withdrawals) from the stock. Consequently, information on catches from all fishing sectors are of importance. Models that ignore a significant component of the total fishing-induced mortality (e.g. do not account for the recreational or indigenous component of total catch) may be biased, may result in incorrect conclusions about the status of a stock and may lead to inappropriate management arrangements for a stock or fishery. Thus, estimates of the recreational and indigenous catch (retained and discarded) of a species are fundamental to determining whether the fishing mortality by these sectors is significant compared to other sources of fishing mortality. Moreover, in cases where the recreational or indigenous harvest does represent a significant component of total fishing mortality, knowledge of their catch is fundamental to accurately representing the total catch from a fishery in models that are subsequently used to assess the status of stocks and the merits of alternative harvest strategies.

2.7. Resource Allocation between Sectors

Australian governments have generally indicated an intention to manage fisheries according to the principles of ESD, including a need to share the nation's fishery resources equitably among the various competing community sectors that use the resources. This objective, however, has been one of the more difficult to achieve because of the "common property" nature of fish resources and the lack of agreed processes for determining appropriate sharing/ allocation targets for particular resources. There are many community groups with an interest in fishery resources, fish habitat or the water that sustain fisheries. Most groups claim to have a legitimate right of access to a community resource and will use a range of biological, economic, political and social arguments to enhance their share of the resource and/or reduce the share of other users.

The greatest source of friction for recreational and indigenous fishers has been the debate with the commercial fishing sector over the ecological sustainability of each group's activities, and over the relative value to the community of commercial verses recreational/ indigenous use of fish resources. Recreational fishers often blame commercial fishers for reductions in stocks, who in turn will often deny this, and counter with the claim that the recreational take is under-estimated. Recreational fishers also claim that in many cases the social or economic value of recreational fishing for particular species or in particular areas greatly exceeds the social or economic value of commercial fishing for the same species or in the same area. Indigenous fishing issues are often completely overlooked during allocation disputes. In the absence of appropriate research and monitoring programs to provide relevant biological, fishery and socio-economic valuation information, these types of debates are insoluble.

Competition between commercial, recreational and indigenous fishers for the same fish stocks does not occur in all fisheries, and where such competition does occur their proportional share of the total catch taken by each sector is generally not clear. A compounding factor in the debate over sharing of fish resources is an inability of many recreational fishers to relate their own (perhaps small and disappointing) catch to the total recreational catch. Also, recreational fishers tend to overlook the fact that the beneficiaries of commercial fishing are not only the operators, but related businesses, regional economies and the substantial proportion of the national population who are seafood consumers.

The national recreational and indigenous fishing survey methodology can assist in the resolution of fish resource allocation disputes by providing estimates of the total recreational and indigenous catch (retained and discarded) of key species that are the subject of competition between different user groups. Such estimates can be expressed as a proportion of the combined catch of a particular resource by all fishing sectors, and will provide an indication of the significance of the recreational and indigenous sector and the appropriate level of management. Knowledge of current sectoral catch shares for each fish resource is important in helping to set or revise catch share targets, and in determining whether re-allocation is required to meet new catch share targets. Subsequent surveys to estimate total recreational and indigenous catches of key species will be necessary to determine whether actual catch shares are in line with the specified catch share targets.

2.8. Socio-economic Information

In recent years, fisheries management agencies in Australia have begun to collect a range of socio-economic information not only to help resolve resource allocation issues and improve resource management, but also to support a range of non-catch initiatives by other Commonwealth, State and local government agencies. Information on the demographic profile of fishers, motivations for fishing, attitudes to government initiatives and the economic impact of recreational fishing is now commonly gathered as part of management programs. This information can be used by Commonwealth, State and local government agencies in their regional planning and infrastructure development programs to enhance recreational fishing opportunities and promote tourism development. For example, agencies concerned with sport and recreation, boating and maritime issues, national parks and wildlife, education, tourism, planning and infrastructure development seek a range of information on the recreational sector to support their initiatives and justify budgetary allocations to community projects related, but not exclusive, to the recreational sector. Collection and distribution of profiling and economic information to other government agencies and community groups has become a role of fisheries agencies as important as some of the catch and effort data and a further justification for the conduct of the national recreational and indigenous fishing survey.

3. OBJECTIVES

The objectives of the National Recreational and Indigenous Fishing Survey were to obtain estimates of the primary fishery statistics for the non-commercial components of Australian fisheries. These fishery statistics include estimates of the number of fishers, the proportion of the Australian population that goes fishing, fishing effort, catch and the diversity of species taken by the non-commercial fishing sectors. The survey also sought information on the expenditure incurred by recreational fishers and the attitude and awareness of fishers to a range of prominent fisheries management issues. The non-commercial components of Australian fisheries were defined as the recreational sector, indigenous fishing in northern Australia and fishing undertaken by international visitors to Australia. Recreational fishing has been the subject of considerable research attention in Australia, but indigenous and overseas visiting fishers have received far less focus despite their potential to impact on aquatic resources and contribute to regional economies.

The specific project objectives of the survey were:

- To determine the participation rate in recreational fishing nationally, by States and Territories and regionally, and to profile the demographic characteristics of recreational fishers.
- To quantify catch and effort of the recreational fishing sector nationally, by States and Territories and, where appropriate, regionally.
- To collect data on expenditure by the recreational fishing sector nationally and regionally.
- To establish attitudes and awareness of recreational fishers to issues relevant to their fishery.
- To quantify fishing activity by indigenous fishing communities (where significant) in terms of participation, catch and effort and attitudes.
- To quantify fishing activity of overseas visiting fishers.

These fisheries statistics and related data were required at a national, state and regional level and should be spatially and temporally comparable. Catch information from these non-commercial sectors, when combined with the commercial catch estimates, will provide the first complete estimate of the harvest of fishery resources in Australia. These data will support the management of all fishing sectors and assist fishery resource agencies to address various stock assessment and fishery management issues. It is anticipated that the survey will provide a methodological and information baseline for future large-scale recreational and indigenous fishing surveys in Australia. The real value of the information collected during the present survey will be realised in future years as the survey is repeated and a time series of recreational and indigenous data becomes available for trend analysis.

4. SURVEY CONTEXT

4.1. Overview

The National Recreational and Indigenous Fishing Survey was developed as a multifaceted project designed to provide a range of information about non-commercial fishing in Australia. The project comprised three independent surveys, the National Recreational Fishing Survey (NRFS), the Indigenous Fishing Survey of Northern Australia (IFSNA) and the Overseas Visitor Fishing Survey (OVFS). Different methodological and analytical approaches were required for each of these surveys, reflecting their varying characteristics. Each survey itself was composed of a number of different components for the collection, analysis and validation of data. Output specifications, sample sizes, survey documentation and implementation strategies for each survey were described in detail in the development report (SDWG, 2000). The three different components were meant to encapsulate the range of non-commercial fishing in Australia. Fisheries statistics obtained from these sources, when combined with those for the commercial sector, will provide a more comprehensive view of the utilisation of living aquatic resources of Australia. Details of the sampling methodology for each component of the national recreational and indigenous fishing survey were provided in SDWG (2000) and Sections 5, 6 and 7 of the present report.

4.2. Implementation Strategies

The sampling methodology, survey outputs, statistical analyses, data management and survey documentation were specifically tailored to this survey. The concept of a national survey for the Australian recreational and indigenous fisheries needed to be developed into working documents (e.g. interviewer manuals, questionnaires, workflow plans) and sampling plans ready for implementation. Additionally, database and analytical tools were required for implementation, along with training of key personnel throughout Australia. Expertise for preparation of this material was not universally available, although more generalised expertise in recreational fisheries did exist within fishery agencies in each State and Territory. The preferred approach, therefore, was to establish a development team, involving specialist consultants, to prepare all material for the implementation of the national survey and to work closely with representatives from each State and Territory to ensure that the needs of all fishery agencies were met.

After considering various options for 'out-sourcing' project functions, staff associated with the survey recommended a largely 'in-house' approach to the management, conduct, analysis and reporting of the survey. A national project manager was appointed to co-ordinate the primary functions of the survey, including liaison with other survey management/consultant staff. Commissioning of consultants was minimised to five areas of expertise (survey design, interviewer training and management, statistics, economics and data management). The current national survey report was prepared in accordance with a structure agreed by all agencies. Relevant timing, resource inputs and budgetary issues for the implementation of the survey were presented in the development report (SDWG 2000).

4.2.1. Recreational Fishing Survey

A manager was appointed for each State fishery agency to take responsibility for the day-to-day functions within each of the seven Australian States/ Territories (New South Wales would have responsibility for the Australian Capital Territory). The State manager's responsibilities included recruitment, training and management of survey staff. Each State manager was assisted by an

office manager recruited for the various administrative, clerical, data entry and editing functions. Additional support staff was required for specific functions such as data entry at peak times.

The largest group of people to be appointed were the telephone interview staff. These people were recruited locally (to the agency concerned) and in accordance with specific criteria required for their functions within the project. About 90 interviewer positions were appointed nationally. These staff (and Office Managers) received formal training in all facets of the survey work. Working from home-based offices, interviewers conducted telephone phases of the survey, including the Screening, Diary and Attitudinal Surveys. Regular liaison/ feedback/ performance monitoring was undertaken by survey management staff. Fishery agencies in each State/Territory were responsible for all data entry and editing/tabulation of survey data. Final editing, tabulation, expansion, analysis and reporting of the survey results was the primary responsibility of an analysis team.

4.2.2. Indigenous Fishing Survey

The Northern Territory Department of Business, Industry and Resource Development (NTDBIRD) managed the indigenous fishing survey of northern Australia. Twelve community staff were appointed to conduct interviews in Western Australia, Northern Territory and Queensland. These people were recruited across northern Australia by NTDBIRD in accordance with specific criteria required for their functions within the project. They received thorough formal and 'on-the-job' training in all facets of the survey work. Several communities were assigned to their 'local' interviewer. Interviewers, with assistance from the Northern Territory State manager, were responsible for the initial approach to the communities within the sample. The interviewers then visited their local communities to obtain permission to conduct the survey and subsequent face-to-face interviews for all phases of the survey, including the screening, diary and attitudinal surveys. Survey management staff undertook regular liaison/ feedback/ performance monitoring. NTDBIRD was also responsible for all data entry and editing/tabulation of survey data. Final editing, tabulation, expansion, analysis and reporting of the survey results was the primary responsibility of an analysis team.

4.2.3. Overseas Visitor Survey

An existing survey instrument developed by the Bureau of Tourism Research was used to obtain information on overseas visitors. Relevant information was extracted from the visitor survey databases and made available for collation by the national project manager.

4.3. National Perspective of the Project

The national recreational and indigenous fishing survey was supported at the highest level of government in Australia. The Standing Committee on Fisheries and Aquaculture, the Ministerial Council on Forestry, Fisheries and Aquaculture and State fishery agencies adopted the recommendations of the National Policy on Recreational Fishing and supported the development and implementation of the survey. Ministerial fishing advisory councils, fishing associations, fishing clubs, environmental and indigenous groups and many other community groups expressed their support for the collection of fishery statistics through a range of media. State fishery agencies contributed financial and human resources. Financial grants from the Australian Natural Heritage Trust (NHT), Fisheries Research and Development Corporation (FRDC) and State fisheries agencies supported the survey. The Fisheries Action Program (FAP) of the Department of Agriculture, Fisheries and Forestry – Australia (AFFA), administered the project.

5. NATIONAL RECREATIONAL FISHING SURVEY

J.M. Lyle, G.W. Henry, L.D. West, D. Campbell, D.D. Reid and J.J. Murphy

5.1. Introduction

Recreational fishing is a popular outdoor activity in Australia. It attracts a large number of people who derive a range of benefits from the sport. For the past 25 years, community-based surveys in Australia have suggested that up to a third of the population goes fishing (McNair Anderson, 1978; P.A. Management Consultants, 1984; Sweeney and Associates, 1988; Pepperell, 1996). Each year, millions of recreational fishers use a variety of fishing techniques to harvest a diversity of aquatic species throughout Australia.

Until recently, it has generally been anticipated that recreational fishing effort would continue to increase in Australia, irrespective of demographic forecasts, since the predominant socio-economic trend was toward more outdoor leisure activities. The attention drawn to recreational fishing by programs in the national broadcast and print media has raised the level of interest in recreational fishing and lifted community expectations regarding the management and conservation of aquatic resources.

Australian fisheries management agencies apply a range of measures to protect fish habitat and conserve fish stocks. In regard to recreational fishing, most agencies conduct scientific research to understand fish populations, collect fishery statistics on the recreational sector and implement harvesting strategies to regulate fishing activity. However, the recreational fishing sector is larger and more diffuse than other fishing sectors and requires special methods to examine and understand. The financial resources necessary to develop and implement an appropriate national survey have not (until recently) been available. Consequently, there were no precise national estimates of the scale or impact of recreational fishing in Australia although a number of related sources of information suggested that these might be substantial (PA Consulting, 1992; Australian Bureau of Statistics, 1992; Kearney, 1995).

Due to their limited nature and/or the different goals of the relevant studies, these reports are thought to provide, at best, indicative estimates of national recreational fishing participation and catch. Intuitively though, the large number of recreational fishers in Australia would suggest that the recreational harvest is significant and indeed several small-scale regional surveys have indicated that, for some species and situations, recreational catches are comparable to or exceed commercial catches (Hancock, 1995). The current national survey has been developed to derive fisheries statistics and related data at national, state and regional levels to support the long-term management of recreational fishing.

5.2. Survey Overview

The design of the National Recreational Fishing Survey (NRFS) built on experiences with other large-scale recreational fishing surveys and incorporated components developed specifically to address data quality issues (Lyle *et al*. 2002). The survey was implemented in early 2000 as a series of concurrent state-wide surveys, conducted and managed in-house by each State and Territory fisheries agency, but co-ordinated nationally. Survey interviewers were specifically recruited and trained by project staff and were managed by the appropriate fisheries agency.

The primary data sources for the NRFS were a general population screening survey, a diary survey and an attitudinal survey. The major functions of the screening survey were to estimate the level of participation in recreational fishing, provide a socio-demographic profile of recreational fishers and to recruit fishers to participate in the diary survey. Fishing and fishing-related economic activity was then monitored over a 12-month period using the diary survey. At the completion of the diary period, respondent awareness and attitudes to fishing related matters were assessed in a final interview, the attitudinal survey.

Data quality issues were addressed through a series of calibration surveys designed to provide adjustments for non-response and to assess the extent of behavioural change (unexpected fishing) during the diary period. Australian Bureau of Statistics (ABS) resident population information was used to benchmark survey data for coverage and representation and to provide the basis for expansion of data to 'population' estimates. On-site (creel) surveys were also conducted in each State and Territory to assess fish identification skills of recreational fishers, determine the size distribution of common species and provide independent verification of certain recreational fishing activities.

The relationships of the various components of the NRFS are represented in Figure 5.1.

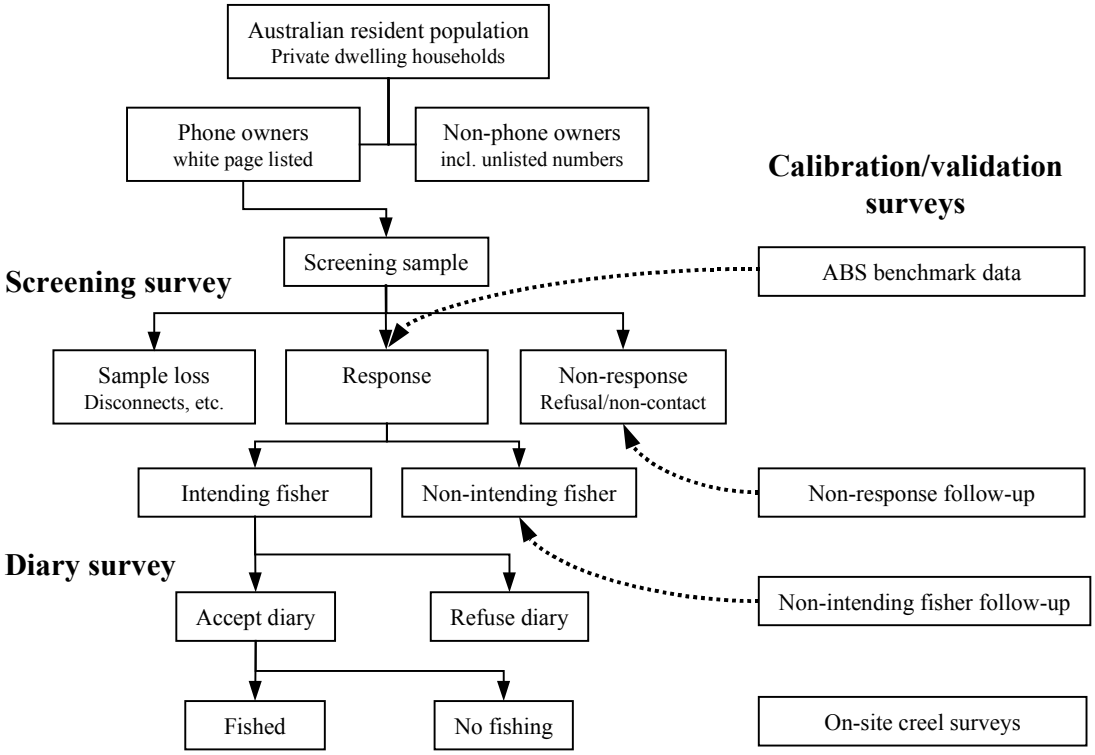

Figure 5.1. Diagrammatic representation of National Recreational Fishing Survey.

5.3. Survey Scope

The NRFS encompassed the private dwelling resident population of Australia, aged five years and older, and their recreational fishing activity. Note: residents of Australia's external territories and indigenous communities in northern Australia were excluded. The latter group was the focus of the Indigenous Fishing Survey of Northern Australia (refer section 6).

Recreational fishing was defined as the capture or attempted capture of aquatic animals in Australian waters (freshwater, estuarine, marine) other than for commercial purposes. All recreational fishing techniques and harvesting activities were included in the survey. Economic activity related to recreational fishing (expenditure and selected investment) was also within scope.

5.4. Sampling Design

The survey design for the general population sampling was based on single-stage cluster sampling (Thompson, 1992) where the household (chosen by random sampling) represented the primary sampling unit and recreational fishers within the household the secondary unit, with all fishers in the household included in the sample. Cluster designs are recommended where there is no frame listing of all elements or where a frame listing is prohibitively expensive to obtain (Schaeffer *et al.,* 1996). The major advantages of cluster sampling over simple random sampling (sub-sampling of fishers within a household) are the provision of correct weightings to both single and multiple fisher-households and a cost benefit in providing multiple fisher data through a single (screening survey) contact.

The basis for sampling households was the 'white pages' telephone directory (electronic version), which was used as a proxy for listings of private dwelling households. Available census data indicate that about 98% of the Australian population reside in private dwellings such as houses, units and apartments, as opposed to non-private dwellings such as hotels, hospitals, jails and military establishments (ABS, 1996). The use of directory lists rather than random digit dialling enabled obvious business numbers and multiple household listings to be filtered out and the sample population to be stratified into regions consistent with those used by the ABS to report statistical data. A total of 49 strata were identified for the national sample, with stratification at the Statistical Division (SD) level in all but a few instances where SD's were either amalgamated or further subdivided (Figure 5.2, Table 5.1).

Stratum sample sizes were chosen to provide general consistency in terms of the level of precision for reporting of state-wide estimates of participation, total effort and harvest (target levels were less than 5% relative standard error) (SDWG, 2000). Assumed values of regional participation rates, mean effort, catch rates and response rates, were used to model the effects of stratification and sample size on the precision of state-wide estimates.

Systematic random sampling was used in the selection of telephone numbers (and the household attached to these numbers). This approach provided a probability-sample of telephone numbers, which gave an equal probability of selection within a stratum. The sampling fraction assigned to the stratum was determined by the size of sample required to achieve the required precision (as described above). Telephone numbers for which no survey data were collected, either through non-response or sample loss, were not substituted.

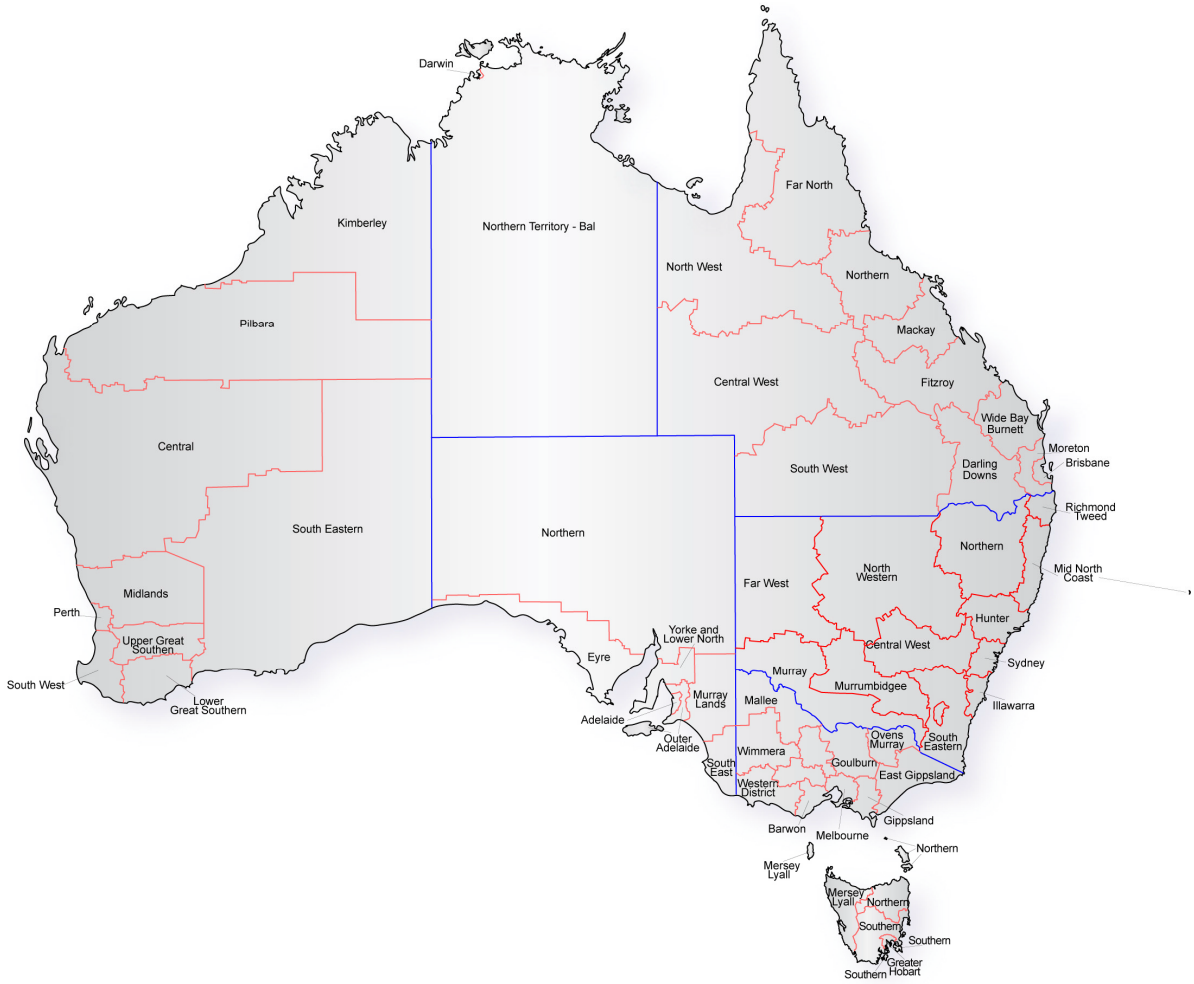

Figure 5.2. Map of Australia showing the Australian Bureau of Statistics (ABS) Statistical Divisions. (Information provided by ABS).

Table 5.1. Total numbers of private dwelling households and gross sample sizes by ABS statistical divisions and survey strata. (Information provided by ABS).

	Statistical Division	ABS SD Code	ABS Benchmark Aust Households	Selected Households	Survey Sample Stratum	Survey Household Sample	Comment
NSW	Sydney	5	1484163	2,999	1	2999	
	Hunter	10	229398	900	2	900	
	Illawarra	15	148998	750	3	750	
	Richmond-Tweed	20	87419	751	4	751	
	Mid North Coast	25	108015	751	5	751	
	Northern	30	130121	382	6	750	Northern + Central West
	North Western	35	53529	568	7	700	North Western + Far West
	Central West	40		368			
	South Eastern	45	73084	750	8	750	
	Murrumbidgee	50		425			
	Murray	55	99271	325	9	750	Murrumbidgee + Murray
	Far West	60		132			
	Total		**2413998**	**9,101**		**9101**	
VIC	Melbourne	5	1274784	2,935	10	2935	
	Barwon	10	95860	960	11	960	
	Western District	15	38299	810	12	810	
	Central Highlands	20	52923	910	13	910	
	Wimmera	25		307			
	Mallee	30	52212	503	14	810	Mallee + Wimmera
	Loddon-Campaspe	35	60627	910	15	910	
	Goulburn	40		617			
	Ovens-Murray	45	105053	293	16	910	Goulburn + Ovens-Murray
	East Gippsland	50		278			
	Gippsland	55	91335	532	17	810	Gippsland + East Gippsland
	Total		**1771093**	**9,055**		**9055**	
QLD	Brisbane	5	621696	1,876	18	1876	
	Moreton	10	278148	1,270	19	1270	
	Wide Bay-Burnett	15	91460	671	20	671	
	Darling Downs	20	74528	673	21	673	
	South West	25		254			
	Fitzroy	30	63537	700	23	700	
	Central West	35	25201	115	22	610	South + Central + NorthWest
	Mackay	40	46087	700	24	700	
	Northern	45	71636	700	25	700	
	Far North	50	76618	700	26	700	
	North West	55		241			
	Total		**1348911**	**7,900**		**7900**	
SA	Adelaide	5	455437	1,495	27	1495	
	Outer Adelaide	10	43476	665	28	665	
	Yorke/ Lower North	15	18250	550	29	550	
	Murray Lands	20	26297	665	30	665	
	South East	25	24359	550	31	550	
	Eyre	30	13048	500	32	500	
	Northern	35	32278	665	33	665	
	Total		**613145**	**5,090**		**5090**	
WA	Perth	5	530855	1,640	34	1640	
	South West	10	74333	655	35	655	
	Lower Great Southern	15		368			
	Upper Great Southern	20	28405	122	36	490	Upper + Lower Great Southern
	Midlands	25	19971	600	37	600	
	South Eastern	30	19742	545	38	545	
	Central	35	22002	490	39	490	
	Pilbara	40	13388	490	40	490	
	Kimberley	45	6505	490	41	490	
	Total		**715201**	**5,400**		**5400**	
TAS	Greater Hobart	5	77805	1,480	42	1480	
	Southern	10	13439	772	43	772	
	Northern	15	54409	885	44	885	
	Mersey-Lyell	20	43160	885	45	885	
	Total		**188813**	**4,022**		**4022**	
NT	Darwin	5		776			
	NT Balance (Darwin Rural)	10	38888	144	46	920	Darwin + Darwin rural
	NT Balance (Coastal)	10	7425	759	47	759	
	NT Balance (Hinterland)	10	15607	499	48	499	
	Total		**61920**	**2,178**		**2178**	
ACT	Canberra	5	120957	1,197	49	1199	Canberra + Balance
	Balance	10		2			
	Total		**120957**	**1,199**		**1199**	
	AUSTRALIA		**7234038**	**43,945**		**43945**	

5.5. Survey Components

5.5.1. National Screening Survey

A sample of approximately 44,000 Australian telephone numbers (Table 5.1) was selected for the national screening survey that was conducted in March and April 2000. Respondents were given a structured telephone interview designed to collect a range of profiling information. Demographic information, including age, gender and aboriginality, was collected for all household members. The level of participation in recreational fishing in the previous 12 months (including an estimate of the number of days fished) and the likelihood to fish in the coming 12 months were established for household members aged 5 years or older. Days fished in the previous 12 months was only used as an indicator of previous fishing 'avidity', since issues such as recall bias render such estimates imprecise (Pollock *et al.*, 1994). In addition, fishing/dive club or association membership and fishing licence status was determined for all persons, regardless of whether they had fished in the previous 12 months or not. For those households containing recreational fishers (or intending fishers), socio-economic information including labour force status (employment and job category), education and ethnicity, was also recorded for all household members aged 5 or older.

Household boat ownership was established, with each vessel characterised according to length, propulsion (jet ski, row, sail or motorised) and usage for recreational fishing during the previous 12 months. An estimate of market value along with the presence of echo sounders and Global Positioning System (GPS) were established for all vessels used for recreational fishing purposes.

All respondents with an intention to go recreational fishing in the 12 months following the screening interview (i.e. corresponding to the diary period), regardless of whether they had fished previously or not, were invited to participate in the diary survey.

5.5.2. Diary Survey

Respondents who agreed to participate in the diary survey were provided with a survey kit, comprising a covering letter (to establish survey legitimacy), a species identification booklet of the most common species/species groups relevant to their State or Territory and a fishing diary for each intending fisher within the household. The random nature of the sample at this stage was inherited from the random selection in the screening survey. The diary survey was conducted between May 2000 and April 2001, inclusive.

After receiving the diary kit, data requirements were explained to respondents in a brief telephone interview and the next contact arranged. Unlike traditional mail-back diary surveys, the diary was employed more as a "memory jogger" than a logbook, and significantly, responsibility for data collection rested with survey interviewers rather than the respondents. Regular telephone contact was maintained with diarists throughout the diary period in order to collect details of any fishing or fishing related expenditure, including kilometres travelled[1], that had occurred since the last contact. The level of fishing activity determined the frequency of such contact but, as a general rule, respondents were contacted at least once a month, even if no fishing was planned. Thus any activity not recorded in the diary could still be collected over the telephone with minimal concern about recall bias influences. In effect, this approach meant that the survey was tailored to match the level of fishing activity of the individual respondent, reducing burden and enhancing data quality and response rates.

[1] Private vehicle travel by the respondent in relation to fishing.

The use of interviewers in this manner allowed for greater detail and reporting precision than could be achieved in a self-administered diary, with interviewers being able to immediately clarify any misunderstandings or apparent reporting errors. Therefore, data consistency and completeness was ensured. Importantly, respondents were only required to record basic information in their diaries, for example start and finish times, catch and release details by species and expenditure by item category. This, in addition to more detailed information regarding target species, fishing location, fishing method, fishing platform (boat/ shore category) and water body type (lake/ dam, freshwater river, estuary, coastal or offshore marine) were collected and recorded by survey interviewers during the regular telephone contact with diarists. For water body type and specifically the delineation between marine and freshwater environments, respondent perception was ultimately relied upon, since a more objective assessment was regarded as impractical. Expenditure associated with fishing, region in which expenditure occurred and level of attribution of expenditure to recreational fishing, was also collected during telephone interviews. Level of attribution was expressed in terms of the proportion (percentage) that respondents considered the expenditure to be directly linked to the recreational fishing experience as opposed to other activities.

5.5.3. Attitudinal Survey

An attitudinal survey was conducted with diarists at the completion of the diary survey, in May/ June 2001, as the final telephone interview. This survey sought the opinion of respondents on a range of fishing related issues. A randomly selected diarist, aged 15 years or older in each diary household was asked a range of questions to assess awareness and opinions about fishing regulations, management issues, research and compliance programs and their motivation for recreational fishing. The probability of selection was, therefore, a function of the number of fishers aged 15 and older within the household.

Attitudinal surveys were customised for each State and Territory to address issues of relevance to the particular jurisdiction. In terms of nationally applied questions, key motivating factors relating to recreational fishing participation were explored.

5.5.4. Supplementary Survey Data

Supplementary economic data were collected from respondents during the 12-month diary survey and the final interview. Supplementary expenditure information for food/drink and private vehicle fuel/oil and repairs/maintenance that occurred away from home (greater than 40 km away from home) on fishing-related trips was collected for each responding household over two consecutive months during the diary survey. The diary period was divided into six two-month blocks and each responding household was randomly allocated to one of these blocks for the reporting of supplementary economic information. In effect, at any point in time during the diary survey one sixth of the responding households provided supplementary economic information. This strategy was adopted to reduce the reporting burden for respondents.

Other less obvious fishing-related expenditure such as annual registration and insurance costs for boats or trailers as well as information associated with vehicle usage (make, model and engine capacity for vehicles used on fishing trips) and seafood consumption was collected as part of the final (attitudinal) interview for diarist households.

5.5.5. Calibration Surveys

Issues of data quality were investigated through three calibration surveys conducted during the survey period, they were; (i) non-response follow-up, (ii) unexpected fishing follow-up and (iii) on-site (creel) surveys.

5.5.5.1. Non-response follow-up

Two factors, sample loss and non-response, impacted on the number of households responding to the screening survey. Sample loss arose from the inclusion of non-private dwellings (including business numbers) and disconnected telephone numbers in the sample, and had the effect of reducing the actual screening sample size. Non-response, on the other hand, has the potential to introduce biases if response and non-response groups differ in their characteristics.

There were two main causes of non-response, 'non-contact', i.e. cases where no effective contact was made with the household and thus no survey data were obtained, and 'refusals', i.e. cases where incomplete or no substantive data were obtained due to the respondent declining to take part in the survey. While benchmarking against ABS census data adjusted for demographic representation of the sample (refer section 5.7.1.1), behavioural biases (e.g. fishing participation) that can result from non-response were addressed using non-response follow-up surveys.

Non-responding households to the screening surveys were grouped according to the type of non-response (non-contact, full refusal and partial refusal) and a random sample from each category was re-surveyed using an abbreviated screening interview. For each State and Territory, samples of about 150 telephone numbers based on non-contacts, 50-80 based on full refusal and 70-130 based on part refusal at screening, were selected for non-response follow-up (total sample size of 2,095). As these interviews were conducted several months after the initial screening interview, it was necessary to confirm that the telephone number was still attached to the same household as that at the time of the screening survey. Discounting sample loss, the net non-response sample size was 1,670, with response rates of 47% for the non-contact sample[2], 69% for the full refusal sample and 88% for the part-refusal sample.

Information collected included age, gender and fishing participation (occurrence and level of activity or 'avidity' in the previous twelve months) for all household members. At the household-level this enabled the non-response group to be characterised according to fishing participation (i.e. whether at least one recreational fisher resided in the household) and 'household avidity' (a function of the level of fishing activity of the individual fishers within the household). At the person-level, the non-response group was characterised in terms of fishing participation, based on age and gender, and level of avidity for fishers.

5.5.5.2. Unexpected fishing

The primary objective of this aspect of the survey was to address the issue of fishers leaving or entering the fishery, that is 'drop-ins' and 'drop-outs'. Fishers leaving the fishery were addressed in part through the diary survey, that is diarists who fished in the previous 12 months but not during the diary period. Similarly, fishers entering the fishery were partially covered by the diary survey, measured in terms of the behaviour of persons who did not fish in the 12-months prior to the diary survey (non-fishers at screening).

In order to assess the behaviour of respondents who, at screening did not intend to go fishing during the diary period (and hence were not included in the diary survey), a stratified random sample of non-intending fisher households was re-contacted at the end of the diary period. Stratification was based on whether the household at screening contained previous fishers or not, with a higher sample take from the previous fisher household group. Approximately 250 non-fisher and 100 previous fisher households per State and Territory (total of 2,325 households) were sampled. After confirming that the sampled telephone number was attached to the same household as that at the time of screening (as per non-response follow-up), household members were asked

[2] Non-contacts accounted for a further 47% of the 'non-contact' sample.

whether they had done any recreational fishing during the diary period. Where fishing was indicated, the age, gender and an estimate of days fished (based on recall) was established. Discounting sample loss, the net sample size was 1,996 households, with response rate of 91%.

The non-intending fisher follow-up survey provided symmetry in the overall survey design, with a proportion of respondents in the diary survey actually doing no fishing whereas others reporting no intention to go fishing may have actually done some fishing.

5.5.5.3. On-site surveys

On-site (creel) surveys were conducted in each State and Territory during the diary period, with sampling effort directed at sites and during periods of greatest recreational fishing activity. In this regard the surveys were not designed to provide representative catch and catch rate information but were primarily intended to evaluate the identification skills of fishers, in terms of the level of detail required by the diary survey, and to assess the size structure of the catch. Recognising the problems with estimates of fish size and weight, diarists were only required to report catches in terms of numbers. Creel survey data were used to assess mean lengths and weights for key recreational species, the latter being applied to convert catch numbers to weights. Where necessary, size composition information was supplemented with data from previous creel surveys.

Although not a primary objective, the on-site surveys also provided an opportunity for limited independent verification of certain fishing activities where sampling coverage for both diary and on-site surveys was adequate.

5.6. Data Management

5.6.1. Database

A relational database management system (RDBMS) was developed in Microsoft Access according to the general entity relationship model described by Finney and Lyle (2000). Each State and Territory was provided with a copy of the database tailored for their specific requirements (household, fishing region and species codes) at the commencement of the survey. Each State and Territory was responsible for managing its own database during the data collection, entry and editing phases. Editing of data forms and data entry was undertaken in-house, and wherever feasible, incomplete or ambiguous forms were referred back to survey interviewers for follow-up with respondents. This process, linked to range, logic and sequencing checks in-built into the database, and coupled with thorough survey interviewer training and management systems provided for comprehensive reported-data quality checks. Individual State and Territory databases were combined at the end of the survey for national analysis and reporting.

5.6.2. Data Imputation

Imputation of missing substantive screening information (age, gender, previous fishing and likelihood to fish) was undertaken in some instances, but only where complete information was available for at least some other household members. Imputation was, therefore, applied to enable the household, and persons within the household, to be used in subsequent analyses. Imputation was applied subjectively, but with reference to the characteristics of other members of the household. Where ages were imputed they were taken as age class mid-points of those used for demographic benchmarking, gender was allocated randomly and previous fishing and likelihood was imputed with reference to the activity of other household members. In the vast majority of cases, data imputation was limited to one piece of missing substantive information, for instance the age of one household member.

The impact of imputation on data quality was considered minimal with only 0.2% of persons profiled at screening with any substantive information subject to imputation.

5.7. Data Analysis

5.7.1. Data Expansion - Screening Survey

5.7.1.1. Demographic benchmarking

Directory list sampling does not provide coverage of households without a telephone or with an unlisted number. For commercial and privacy reasons the exact proportion of Australian households with a telephone listing was unavailable. However, comparison between the number of non-business telephone listings (electronic white pages) and numbers of private dwelling households (census data) suggests a nominal 'coverage factor' of over 80% nationally.

ABS Estimated Resident Population (ERP) for June 2000 (ABS, 2001a) was used to assess sample representation and provide correct weightings for expanded population estimates. Person-based benchmarks by age and gender, and household-based benchmarks by size (number of adults and children) were developed for each of the survey strata and were then compared with screening survey results. Benchmarking did indicate some minor differences between the sample and population benchmarks within some strata (Appendix 5.1), though overall differences were considered to be within acceptable limits (E. Szoldra, ABS pers comm). Non-coverage of non-phone owners and impacts of non-response will have contributed to the differences between the characteristics of the sample and population.

A method known as integrated weighting was applied to adjust for sample representation at household and person levels by calculating weighting factors to expand sample data to population estimates (Lemaitre and Dufour, 1987). Integrated weighting considers household (size and composition) and person (age and gender) based characteristics simultaneously and seeks to maximise convergence with benchmarks at all levels, namely stratum, household and person (Appendix 5.2). By using this approach all persons in a particular household and the household itself were given the same weight, and this weight is applied when determining person and household level estimates. The application of integrated rather than simple weights[3] is more consistent with cluster sampling, since the latter can result in different weights for each person within a household and a different weight for the household itself.

5.7.1.2. Non-response adjustment

Whereas the development of integrated weights produced demographic representation for the sample, the effects of non-response may also have a behavioural aspect (e.g. in terms of fishing participation) and thus a further adjustment to the integrated weights was required. In developing such adjustments, the non-response follow-up survey data at household and person-levels were weighted in accordance with the sampling fractions (refer section 5.5.5.1) and then aggregated nationally to characterise the non-response group in terms of fishing participation rates and 'avidity' amongst fishers or fisher households. Compared to the response group, non-response analysis revealed significantly lower fishing participation rates and, amongst fishers, a bias towards lower avidity groups.

[3] Simple weights are derived by dividing benchmark population by sample size.

National non-response adjustment factors for participation were calculated as the ratio of proportions, based on the comparison of non-response and response groups. For person-based analysis, participation rates were compared by age class and gender whereas for household analysis, participation rates (i.e. whether the household contained fishers or not) was based on household size (number of residents). The second component of non-response adjustment related to avidity. Amongst fishers and fisher households, the proportional breakdown into avidity categories was compared for response and non-response groups based on nationally aggregated data. Avidity adjustment factors were calculated as the ratio of proportions of the avidity classes within the two response groups.

The national non-response adjustment factors were applied as correction factors to the integrated weights (household and person) but were made sensitive to the actual level of non-response within the particular stratum. Thus, in a stratum with half the national non-response level the adjustment effect would be halved. As noted above, non-response adjustment represented a 'behavioural' adjustment only and was applied to maintain benchmark populations.

5.7.2. Data Expansion – Diary Survey

5.7.2.1. Diary non-response adjustment

Non-response to the diary survey occurred where eligible respondents (those intending fishers) either refused to participate in the diary survey (at screening) or failed to complete the diary survey. The latter was mainly due to loss of contact (usually as a result of telephone disconnection) but did include a small proportion of respondents who refused to participate part way through the diary period. Experience revealed that once respondents accepted the diary, the vast majority fully participated for the entire diary period (refer section 5.8).

In order to correct for diary non-response, the inverse of the proportion of eligible persons/households (based on expanded data) that fully responded to the diary survey was applied as an adjustment to the non-response corrected expansion factor (section 5.7.1). That is, only information for those diarists who participated for the entire diary period was used in subsequent catch and effort and economic analyses.

Analysis of the reported behaviour of diarists confirmed a strong positive relationship between fishing activity in the diary period (number of days fished and catch) and previous avidity (reported at screening). Furthermore, diary response rates were consistently higher amongst the more avid fishers. As a consequence diary adjustments were calculated at the stratum level and categorised by avidity group. Failure to account for previous avidity in applying this adjustment would have resulted in the over-representation of the more avid (active) fishers and under-representation of the least avid group, leading to over-estimation of catch and effort.

5.7.2.2. Correction for fishers entering or leaving the fishery

Nationally about 31% of the diarists who fully participated in the survey reported no fishing activity during the survey period. In the development of the NRFS, it had been anticipated that analysis of non-intending fisher follow-up (section 5.5.5.2) and fisher behaviour (based on the Diary Survey) would be used to assess the impacts of fishers entering and leaving the fishery. However, analysis of the follow-up survey indicated that participation rate adjustments based on unexpected fishing were very unstable, due to inadequate sample sizes and therefore could exert undue influence on overall participation rates.

In the absence of robust data about the dynamics of participation in fishing, the number of persons or households (for economic information) leaving the fishery was assumed to balance the number of persons/households entering the fishery. In effect an equilibrium state was assumed. This approach for dealing with the dynamics of participation has been applied in other large-scale studies in Australia (Higgs, 1999; 2001) and overseas (Bradford, 1998).

The adjustment for participation was calculated as the inverse of the number of diarists or households that fished (expanded numbers corrected for diary non-response –section 5.7.2.1) divided by the number of fishers (persons or households) in the population (derived from the screening survey –section 5.7.1).

Adjustments were calculated at the stratum level and made sensitive to previous fishing avidity (and gender for person based estimates)[4]. Previous fishing avidity (profiled at screening) and subsequent fishing participation in the diary were strongly correlated, with lowest rates of participation amongst diarists from the lowest previous avidity group and highest amongst the highest avidity group. That is to say, less avid fishers were more likely to drop out of the fishery and not fish in the diary period. Without adjusting for avidity, disproportionate weight would have been given to the more avid fisher groups, resulting in further overestimation of catch and effort levels (refer also section 5.7.2.1).

5.7.3. Estimation Procedures

5.7.3.1. Number of fishers and fisher-households

The number of fishers/fisher-households for each sample stratum was estimated using the cluster sampling estimator given by Thompson (1992). Estimates for the State or Territory and national levels were derived by summation of the appropriate stratum estimates. Variances of the summed estimates were estimated by summation of the appropriate variance estimates (covariance terms ignored).

The primary data inputs to this analysis were the national screening survey, population census information and adjustments for screening survey non-response.

[4] A minimum number of 20 fisher diarists per stratum-avidity-gender cell was specified, where fewer diarists fished cells were collapsed until a minimum sample of 20 was achieved. Similarly for household adjustments, a minimum of 10 fisher households per stratum-avidity cell was specified, where fewer households had any diarists who fished cells were collapsed until a minimum sample of 10 was achieved.

Estimate of number of fishers in population for any stratum *h*:

Following are definitions of the terms comprising the equations:

$cf_{hi\bullet}$ = correction factor for household *i* in sample stratum *h* – mean over persons within the household. Represents behavioural non-response adjustment (fishing and avidity). *Source: Non-response follow-up survey (section 5.7.1.2).*

$\hat{NFH}_h$ = estimated number of fisher households in population. (*calculation)*

$\hat{NFP}_h$ = estimated number of fishers (aged 5 years and older) in population. (C*alculation)*

NHH_h = number of households in population. *Source: ABS ERP data (2000)*

NP_h = number of persons(aged 5 years and older) in population (estimated resident population). *Source: ABS ERP data (2000)*

nHH_h = effective number of households in sample (gross sample less sample loss and non-responding households). *Source: Screening survey*

nFH_h^* = number of fisher households in sample (corrected for non-response). *Source: Screening survey and non-response follow-up survey*

nFP_{hi} = number of fishers[5] in sample household *i* of sample stratum *h*. *Source: Screening survey (fished in previous 12 months)*

nM_h = weighted mean number of fishers per household in sample.

w_{hi} = *integrated weight* for household *i* in sample stratum *h*.

The estimator of the weighted mean number of fishers per household for stratum *h* is given by:

$$nM_h = \frac{\sum_{i=1}^{nHH_h} w_{hi} \times cf_{hi\bullet} \times nFP_{hi}}{\sum_{i=1}^{nHH_h} w_{hi}}$$

Estimated number of fishing households in stratum *h*:

$$\hat{NFH}_h = NHH_h \times \frac{nFH_h}{nHH_h}$$

This is the usual binomial estimator, with variance given by:

$$\text{var}(\hat{NFH}_h) = NHH_h^2 \times \frac{nFH_h^*}{nHH_h} \times (1 - \frac{nFH_h^*}{nHH_h}) / (nHH_h - 1)$$

[5] Fished in the 12 months prior to the Screening Survey

Estimated number of fishers in stratum *h*:

$$\hat{NFP}_h = nM_h \times NHH_h$$

The variance of this estimator is the variance estimator for a cluster sample (Thompson 1992), *viz*:

$$\text{var}(\hat{NFP}_h) = NHH_h(NHH_h - nHH_h) \times s_h{}^2 / nHH_h$$

Where for each sample stratum, s_h^2 is the weighted sample variance for the number of fishers in a household from the screening survey:

$$s_h^2 = \frac{1}{(\sum_{i=1}^{nHH_h} w_{hi} - 1)} [\sum_{i=1}^{nHH_h} w_{hi} nFP_{hi}^2 - (\sum_{i=1}^{nHH_h} w_{hi} nFP_{hi})^2 / \sum_{i=1}^{nHH_h} w_{hi}]$$

The standard error (*se*) and relative standard error (*rse*) for the estimate of number of fishers in stratum *h* are defined by:

$$se(\hat{NFP}_h) = \sqrt{\text{var}(NFP_h)}$$
$$rse(\hat{NFP}_h) = se(NFP_h) / NFP_h$$

5.7.3.2. Fishing effort

The primary data input for this analysis was the diary survey, with effort based on households in which at least one diarist fished and participated fully in the diary survey.

Fishing effort may be expressed in terms of the number of fishing events, the number of fisher-days or number of fisher-hours. The estimation method is the same for each of these measures, *viz.* for each sample stratum, estimated effort is the product of the estimated number of fisher households and the estimated weighted mean effort for all active diarist households over the full diary period:

Components of the estimator of effort are:

$\hat{E}_h$ = Estimated fishing effort (events, hours, days) by the total population of fishers for sample stratum *h*. *Source: (calculation)*.

$\hat{NFH}_h$ = Estimated number of fishing households for sample stratum *h*. *Source: (calculation) (section 5.7.3.1)*

$nEwm_h$ = sample weighted mean effort per household for sample stratum *h* over full diary period. The weightings were obtained from the integrated weighting procedure and adjusted for diary uptake and fishing participation. *Source: Diary survey calculation (section 5.7.2).*

For subsets restricted to particular water body/ fishing method combinations, the above variables are shown with the superscript r.

p_h^r = proportion of sample households in stratum *h* having a fishing event belonging to subset *r* (particular water body/fishing method combination).

Estimate of total effort for the population of fishers regardless of fishing method and water body type in a given sample stratum *h* is given by:

$$\hat{E}_h = nEwm_h \times N\hat{F}H_h$$

Variance estimate:

$$\text{var}(\hat{E}_h) = (N\hat{F}H_h)^2 \times \text{var}(nEwm_h) + (nEwm_h)^2 \times \text{var}(N\hat{F}H_h) - \text{var}(nEwm_h) \times \text{var}(N\hat{F}H_h)$$

Where var($N\hat{F}H_h$) is given in 5.2.9.1 above, and the variance of the sample weighted mean effort in sample stratum *h* is given by:

$$\text{var}(nEwm_h) = \frac{1}{nFH_h(\sum_{i=1}^{nFH_h} w_{hi} - 1)}[\sum_{i=1}^{nFH_h} w_{hi}E_{hi}^2 - (\sum_{i=1}^{nFH_h} w_{hi}E_{hi})^2 / \sum_{i=1}^{nFH_h} w_{hi}]$$

Where E_{hi} is the fishing effort for household *i* in sample stratum *h*.

For estimates of effort for subsets of the data, means and variances were conditional on households meeting the criterion for the subset. For example, for the estimation of fishing effort in freshwater for a particular substratum, the data on which estimates were based were limited to those households that recorded at least one freshwater fishing event during the diary period. The estimator of fishing effort and its variance for subsets of the data are given in the following equations:

The estimator of fishing effort for subset *r* (particular combination of water body type/fishing method) in a given sample stratum *h* is given by:

$$\hat{E}^r{}_h = nEwm_h^r \times N\hat{F}H_h^r$$

Variance estimate:

$$\text{var}(\hat{E}_h) = (N\hat{F}H_h^r)^2 \times \text{var}(nEwm_h^r) + (nEwm_h^r)^2 \times \text{var}(N\hat{F}H_h^r) - \text{var}(nEwm_h^r) \times \text{var}(N\hat{F}H_h^r)$$

Where var($N\hat{F}H^r{}_h$) is given by:

$$\text{var}(N\hat{F}H_h^r) = (p_h^r)^2 \times \text{var}(N\hat{F}H_h) + (N\hat{F}H_h)^2 \times \text{var}(p_h^r)$$

$$\textit{and } \text{var}(p_h^r) = \frac{nFH_h^r}{nFH_h} \times (1 - \frac{nFH_h^r}{nFH_h}) \times \frac{1}{nFH_h^r} = \frac{1}{nFH_h} \times (1 - \frac{nFH_h^r}{nFH_h})$$

and the variance of the sample weighted mean effort for subset *r* of sample stratum *h* is given by:

$$\text{var}(nEwm_h^r) = \frac{1}{nFH_h^r(\sum_{i=1}^{nFH_h^r} w_{hi}^r - 1)}[\sum_{i=1}^{nFH_h^r} w_{hi}^r (E_{hi}^r)^2 - (\sum_{i=1}^{nFH_h^r} w_{hi}^r E_{hi}^r)^2 / \sum_{i=1}^{nFH_h^r} w_{hi}^r]$$

5.7.3.3. Catch

Catch information, whether harvested (i.e. retained) or released (including discarded), was derived from diary survey and reported as numbers of individuals. Components of the estimator of catch are:

$\hat{C}_h$ = Estimated catch by the total population of fishers in a given stratum *h*. *Source: (calculation)*.

$N\hat{F}H_h$ = Estimated number of fishing households in a given stratum *h*. *Source: (calculation, section 5.7.3.1)*

$nCwm_h$ = weighted mean catch over the full diary period by all responding diarist-households in a given stratum *h* (excluding zero-effort households). The weightings were obtained from the integrated weighting procedure and adjusted for diary uptake and fishing participation. *Source: Diary survey, calculation.*

For subsets restricted to catches of particular species/species groups or catches from particular fishing regions, the above variables are shown with the superscript r.

p_h^r = the proportion of sample households in stratum h with at least one fish of species/species group r caught (kept or released) over the full diary year.

Estimate of total catch for the population in a given stratum *h* is given by:

$$\hat{C}_h = nCwm_h \times N\hat{F}H_h$$

Variance estimate:

$$\text{var}(\hat{C}_h) = N\hat{F}H_h^2 \times \text{var}(nCwm_h) + nCwm_h^2 \times \text{var}(N\hat{F}H_h) - \text{var}(nCwm_h) \times \text{var}(N\hat{F}H_h)$$

Where the variance of the sample weighted mean catch in sample stratum h is given by:

$$\text{var}(nCwm)_h = \frac{1}{nFH_h(\sum_{i=1}^{nFH_h} w_{hi} - 1)}[\sum_{i=1}^{nFH_h} w_{hi} C_{hi}^2 - (\sum_{i=1}^{nFH_h} w_{hi} C_{hi})^2 / \sum_{i=1}^{nFH_h} w_{hi}]$$

C_{hi} is the catch for household *i* in sample stratum *h* over the full diary period.

For estimates of effort for subsets of the data, such as a particular species or species groups, means and variances were conditional on households meeting the criterion for the subset. For example, for the estimation of catches of whiting for a particular substratum, the data on which estimates

were based were restricted to those households that recorded at least one event when a whiting was captured or released during the diary period. The estimator of catch for a particular subset (e.g. species/group) and its variance are given by the following equations:

The estimator of catch effort for subset *r* (e.g. a particular species/group) for a given sample stratum *h* is given by:

$$\hat{C}_h^r = nCwm_h^r \times N\hat{F}H_h^r$$

Variance estimate:

$$\text{var}(\hat{E}_h) = (N\hat{F}H_h^r)^2 \times \text{var}(nCwm_h^r) + (nCwm_h^r)^2 \times \text{var}(N\hat{F}H_h^r) - \text{var}(nCwm_h^r) \times \text{var}(N\hat{F}H_h^r)$$

Where var($N\hat{F}H_h^r$) is given by:

$$\text{var}(N\hat{F}H_h^r) = (p_h^r)^2 \times \text{var}(N\hat{F}H_h) + (N\hat{F}H_h)^2 \times \text{var}(p_h^r)$$

$$\textit{and } \text{var}(p_h^r) = \frac{nFH_h^r}{nFH_h} \times (1 - \frac{nFH_h^r}{nFH_h}) \times \frac{1}{nFH_h^r} = \frac{1}{nFH_h} \times (1 - \frac{nFH_h^r}{nFH_h})$$

and the variance of the sample weighted mean catch for subset *r* of sample stratum *h* is given by:

$$\text{var}(nCwm_h^r) = \frac{1}{nFH_h^r (\sum_{i=1}^{nFH_h^r} w_{hi}^r - 1)} [\sum_{i=1}^{nFH_h^r} w_{hi}^r (C_{hi}^r)^2 - (\sum_{i=1}^{nFH_h^r} w_{hi}^r C_{hi}^r)^2 / \sum_{i=1}^{nFH_h^r} w_{hi}^r]$$

Similar calculations apply to the estimation of the number of released fish.

5.7.3.4. Economic activity

Components of the estimator of total expenditure on fishing are:

$\hat{E}_h$ = Estimated total expenditure by the population of fishers in a given stratum *h*. *Source: Diary, Calculation*.

$N\hat{F}H_h$ = Estimated number of fishing households in a given stratum *h*. *Source: Calculation (section 5.7.3.1)*

$nDwm_h$ = weighted mean expenditure over the full diary period by all responding diarist-households in a given stratum *h* (excluding zero-effort households). The weightings were obtained from the integrated weighting procedure and adjusted for household diary uptake and fishing participation. *Source: Diary survey.*

Estimate of total expenditure for the population in a given stratum *h* is given by:

$$\hat{D}_h = nDwm_h \times N\hat{F}H_h$$

with variance estimate:

$$\text{var}(\hat{D}_h) = N\hat{F}H_h^2 \times \text{var}(nDwm_h) + nDwm_h^2 \times \text{var}(N\hat{F}H_h) - \text{var}(nDwm_h) \times \text{var}(N\hat{F}H_h)$$

Where the variance of the sample weighted mean expenditure in sample stratum h is given by:

$$\text{var}(nDwm)_h = \frac{1}{nFH_h(\sum_{i=1}^{nFH_h} w_{hi} - 1)}[\sum_{i=1}^{nFH_h} w_{hi} D_{hi}^2 - (\sum_{i=1}^{nFH_h} w_{hi} D_{hi})^2 / \sum_{i=1}^{nFH_h} w_{hi}]$$

D_{hi} is the total expenditure for household *i* in sample stratum *h* over the full diary period.

For estimates of expenditure for subsets of the expenditure data, such as expenditure on fishing gear, travel, boat and trailer, variance calculations used all households that were fully responding, and the above equations were also used to compute estimates and errors for these subsets of expenditure.

5.7.3.5. Attitudinal/awareness issues

Responses have been summed in accordance to the weighting factor applicable to the selected respondent (i.e. one respondent aged 15 years or older per household) and results reported as the proportion (%) of weighted sum of respondents. In this context, the expanded 'population' effectively represented 'respondent households with recreational fishers aged 15 or older' rather than 'recreational fishers aged 15 or older'.

5.8. Response Profiles

Response profiles, where the levels of response and non-response are compared, represent important indicators of data reliability in surveys. This is because response and non-response groups often differ in their characteristics and if non-response is not calibrated and/or represents a large component of the sample, significant biases can be introduced into the survey estimates (Pollock *et al.,* 1994).

An initial sample of 43,945 telephone numbers was drawn from Australian electronic white page telephone directories. However, when sample loss, that is disconnected numbers, non-private dwelling numbers (mainly businesses), fax/modem lines or holiday homes[6], was discounted the net sample was reduced to 37,243 (Table 5.2).

All primary demographic, fishing and boating information was obtained from 29,837 households (an effective response rate of 80%). Despite extensive callbacks over a period of several weeks no contact was made with 1,794 households (5% of the sample). Of the remainder, 1,351 households (4%) fully refused to participate in the survey while 4,261 (11%) provided incomplete information (partial refusal) and were excluded from subsequent analyses (Table 5.2). Response profiles to the initial survey contact were relatively consistent across the nation, with the highest response rates being achieved in South Australia.

The initial screening survey identified 21,491 persons aged 5 and older, from 10,212 households, with an intention to go fishing in the coming twelve months (Table 5.2). All such persons were eligible to participate in the diary survey and 18,370 (86%) from 9,122 (89%) households agreed to do so. Of the diarists who commenced the survey, 17,092 (93%) fully participated for the entire 12 month diary period. Diary non-response was, therefore, primarily related to uptake rather than completion, with an overall 80% (75-84% depending on State) of eligible persons completing the survey (Table 5.2). Household response rates for diary completion (at least one diarist in the household) were very high at 93% for those households that commenced the survey, equivalent to an overall response rate of 83% for eligible households.

Not all diarists reported fishing activity during the diary period, in fact only 69% of the diarists fished, providing information on over 93,000 fishing events. On a diarist household basis, 81% of the responding households included at least one active fisher.

Comparison of the response profile for this study with other fishing surveys is complicated by the fact that most other studies do not fully report issues of non-response. For instance, non-contacts are often discounted (or substituted) and partial or incomplete responses (e.g. simply establishing whether a household contained fishers or not, without determining other key profiling information) are treated as responses (or substituted). In terms of diary surveys, response rates are generally reported as diary completion rates, without taking account the proportion of eligible respondents who actually refused to accept the diary survey. Considering diary completion rates, the present survey achieved a response rate of 93% (84-96% depending on State or Territory) that is very high and comparable with other Australian studies employing the telephone/diary survey methodology (Coleman 1998; McGlennon 1999; Lyle 2000; Forward and Lyle 2002). By contrast, response rates for traditional self-administered mail-back diary surveys tend to be at best 70% but often much lower (Pollock *et al*. 1994; Bradford 1998; Higgs 1999, 2001), indicating greater potential for problems relating to non-response bias.

[6] 'Holiday homes' were treated as sample loss if they did not represent the primary residence for the household, this ensured the household only had a single chance of selection.

Table 5.2. Response analysis for the screening and diary surveys by State and Territory - based on net sample (total gross sample less sample loss).

SAMPLE (Households)	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	TOTAL
Gross Sample	9,101	9,055	7,900	5,090	5,400	4,022	2,178	1,199	43,945
Sample Loss	1,304	1,098	1,235	668	993	630	538	236	6,702
Net Sample	7,797	7,957	6,665	4,422	4,407	3,392	1,640	963	37,243
SCREENING SURVEY									
Full Response	6,316	6,028	5,183	3,785	3,638	2,755	1,351	781	29,837
Refusal (Full and Partial)	1,182	1,517	1,144	421	514	480	204	150	5,612
Non-Contacts	299	412	338	216	255	157	85	32	1,794
% Response	81.0	75.8	77.8	85.6	82.6	81.2	82.4	81.1	80.1
% Non-response	19.0	24.2	22.2	14.4	17.4	18.8	17.6	18.9	19.9
DIARY SURVEY (Households)									
Eligible Households	1,776	1,509	1,919	1,451	1,661	1,059	618	219	10,212
Diary Uptake	1,635	1,345	1,706	1,308	1,470	878	580	200	9,122
Diary Completion	1,488	1,228	1,606	1,220	1,391	850	493	173	8,449
% Uptake	92.1	89.1	88.9	90.1	88.5	82.9	93.9	91.3	89.3
% Completion	91.0	91.3	94.1	93.3	94.6	96.8	85.0	86.5	92.6
% Response (Eligibles)	83.8	81.4	83.7	84.1	83.7	80.3	79.8	79.0	82.7
Number fished	1,174	954	1,315	1,032	1,179	714	345	139	6,852
% Fished	78.9	77.7	81.9	84.6	84.8	84.0	70.0	80.3	81.1
DIARY SURVEY (Fishers)									
Eligible Fishers	3,729	2,902	4,261	2,888	3,669	2,214	1,384	444	21,491
Diary Uptake	3,327	2,418	3,480	2,578	3,136	1,765	1,279	387	18,370
Diary Completion	3,033	2,232	3,309	2,429	2,982	1,696	1,079	332	17,092
% Uptake	89.2	83.3	81.7	89.3	85.5	79.7	92.4	87.2	85.5
% Completion	91.2	92.3	95.1	94.2	95.1	96.1	84.4	85.8	93.0
% Response (Eligibles)	81.3	76.9	77.7	84.1	81.3	76.6	78.0	74.8	79.5
Number fished	2,058	1,453	2,222	1,740	2,182	1,282	577	216	11,730
% Fished	67.9	65.1	67.2	71.6	73.2	75.6	53.5	65.1	68.6
Fishing Events (no.)	16,101	11,477	17,353	14,936	18,310	10,788	3,169	1,186	93,320

5.9. Recreational Fishing Participation

The following analyses are based on information derived from the national screening survey and expanded, with non-response adjustment, to represent the resident private dwelling population of Australia. The primary purpose of this report is to provide a 'big picture' assessment of recreational participation, i.e. based primarily on analyses at the State/Territory and national levels. Subsequent reports to be produced by the participating fisheries agencies will examine data in more detail at regional scales appropriate to addressing specific resource and management issues.

5.9.1. Number of Fishers

Based on reported fishing activity in the 12 months prior to May 2000, an estimated 3.36 million Australian residents aged 5 or older fished at least once, representing a national participation rate of 19.5% (Figure 5.3, Appendix 5.3). New South Wales had the greatest number of recreational fishers (999,000) followed by Queensland (785,000) and Victoria (550,000). The high numbers of recreational fishers in New South Wales and Victoria were more a reflection of their large population sizes, since participation rates in these States were below the national average (17.1 and 12.7%, respectively). Rates of fishing participation above the national average were recorded in the Northern Territory (31.6%), Tasmania (29.3%), Western Australia (28.5%), Queensland (24.7%) and South Australia (24.1%). The participation rate for the Australian Capital Territory (19.2%) was very close to the national average.

Within each State/Territory, lowest participation rates were generally associated with the capital cities (Appendix 5.3). This pattern was particularly evident in New South Wales and Victoria, where participation rates for Sydney (13.1%) and Melbourne (10.2%) were the lowest in the nation and substantially lower than other regions within these States. Nonetheless, the large population sizes in these and the other capital cities meant that, within each State/Territory, a large proportion of the fishers resided within these urban centres.

The present survey sampled households and thus it is also possible to report on fishing participation on a household basis. An estimated 1.8 million Australian households contained at least one recreational fisher who fished in the 12 months prior to May 2000, representing 24.4% of households nationally (Figure 5.4, Appendix 5.4).

In Western Australia, Tasmania and the Northern Territory over one in three households (i.e. >33%) contained recreational fishers, compared to less than one in four (i.e. <25%) for New South Wales, the Australian Capital Territory and Victoria. The rate of household fishing participation in Queensland and South Australia was intermediate (almost 29%), and slightly above the national average. In absolute terms, New South Wales had the greatest number of recreational fishing households (528,000) followed by Queensland (388,000) and Victoria (314,000) (Figure 5.4, Appendix 5.4).

Based on numbers of fishers, there was an average of 1.9 fishers per fishing household nationally, with a range of 1.8 (Victoria) to 2.0 (Queensland) at the State/Territory level.

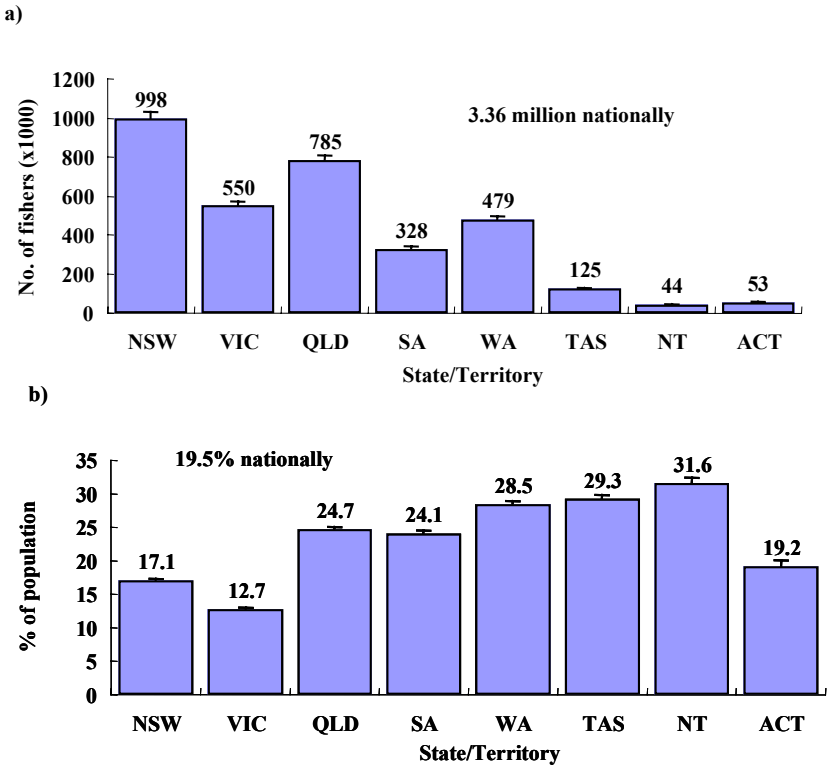

Figure 5.3. Fishing participation in the 12 months prior to May 2000 by State or Territory of residence for persons aged 5 or older: (a) Number of persons and (b) proportion of the resident population. Error bars represent one standard error.

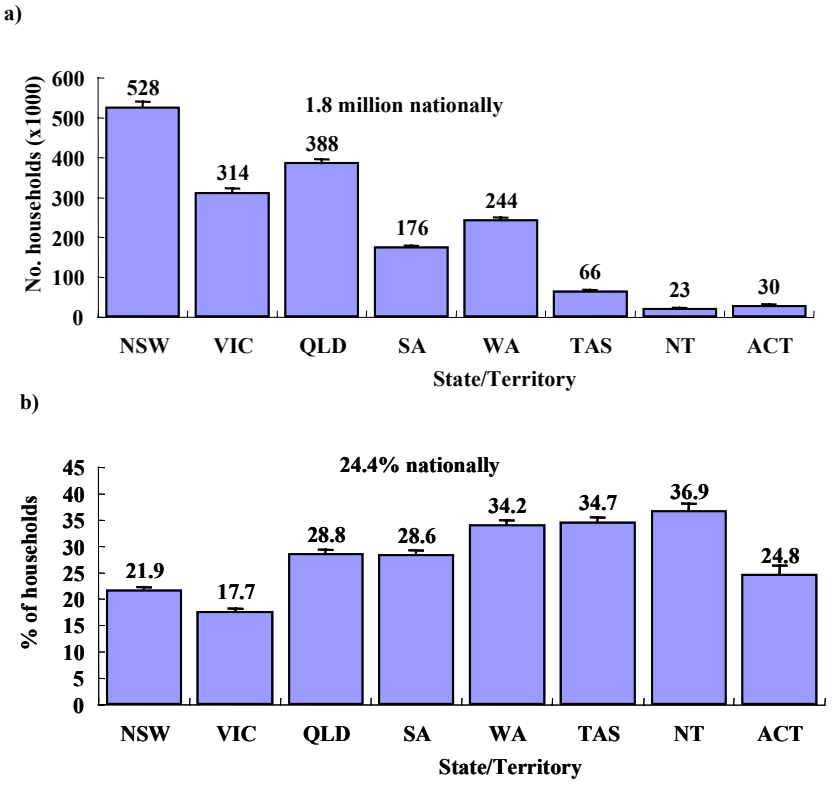

Figure 5.4. Household (private dwelling) fishing participation in the 12 months prior to May 2000 by State or Territory: (a) Number of households and (b) proportion of households within the population. Error bars represent one standard error.

5.9.2. Age and Gender

Nationally, recreational fishing was more popular with males, with over twice as many males (2.27 million) than females (1.09 million) aged 5 or older participating in recreational fishing in the 12 months prior to May 2000. This represented approximately 26.4% of the male and just 12.4% of the female resident population (Figure 5.5, Appendix 5.5). The ratio of participation rates for males and females in each of the States and Territories, apart from Victoria, was relatively consistent, ranging between 1.9-2.4 times higher for males. In Victoria, however, the participation rate amongst females was very low (just 3.6%), some six times lower than for males (22.1%), a fact that contributed significantly to the low overall participation rate for that State. The reason for the disproportionately low participation amongst females in Victorian is unclear but would appear to be an important feature of the recreational fishery in that State.

The predominance of males involved in fishing, by number and proportion of population, was evident across all age groups (Figure 5.5, Appendix 5.5). By age class, the greatest numbers of recreational fishers were in the 30-44 age group for both sexes (644,000 males and 325,000 females), although participation rates were highest amongst children in the 5-14 age class (28.5% overall or 33.4 and 23.4% for males and females, respectively). Participation rates fell slightly in the 15-29 age group (19.1% overall), increasing again in the 30-44 age bracket (22.7%), and then declined progressively in each subsequent age group, to just 3.8% (7.9% of males and 1% of females) for the 75 years plus group. This general pattern of participation by age and gender was relatively consistent for each State and Territory (Appendix 5.5).

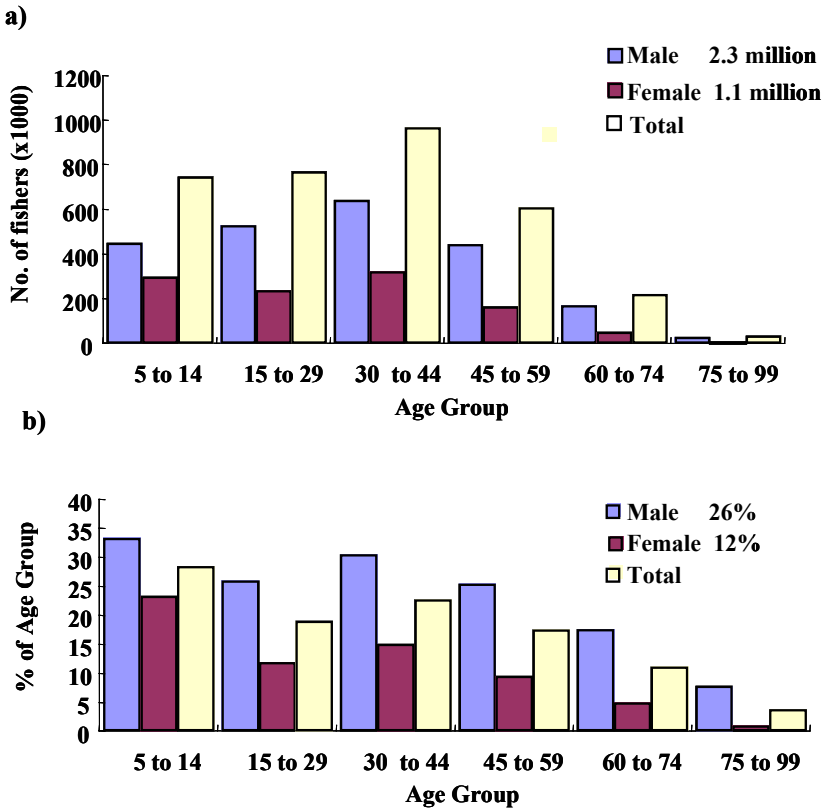

Figure 5.5. Fishing participation in the 12 months prior to May 2000 by age class and gender for Australian residents aged 5 or older: (a) Number of persons and (b) proportion of the resident population.

5.9.3. Other Characteristics

5.9.3.1. Fishing club/association membership

Fishing club/association membership for the 12 months prior to May 2000 amongst recreational fishers was low, with an estimated 143,000 members, representing about 4.3% of fishers nationally (Figure 5.6). While the level of membership was low in all States and Territories, the Northern Territory (6.8%) and Australian Capital Territory (5.6%), New South Wales (5.6%) and Victoria (5.4%) registered membership rates higher than the national average. By contrast, membership rates for the remaining States were below 3.4%, with the lowest being just 2.3% for South Australia. Fishing club membership was lower among female fishers (3%) than males (5%).

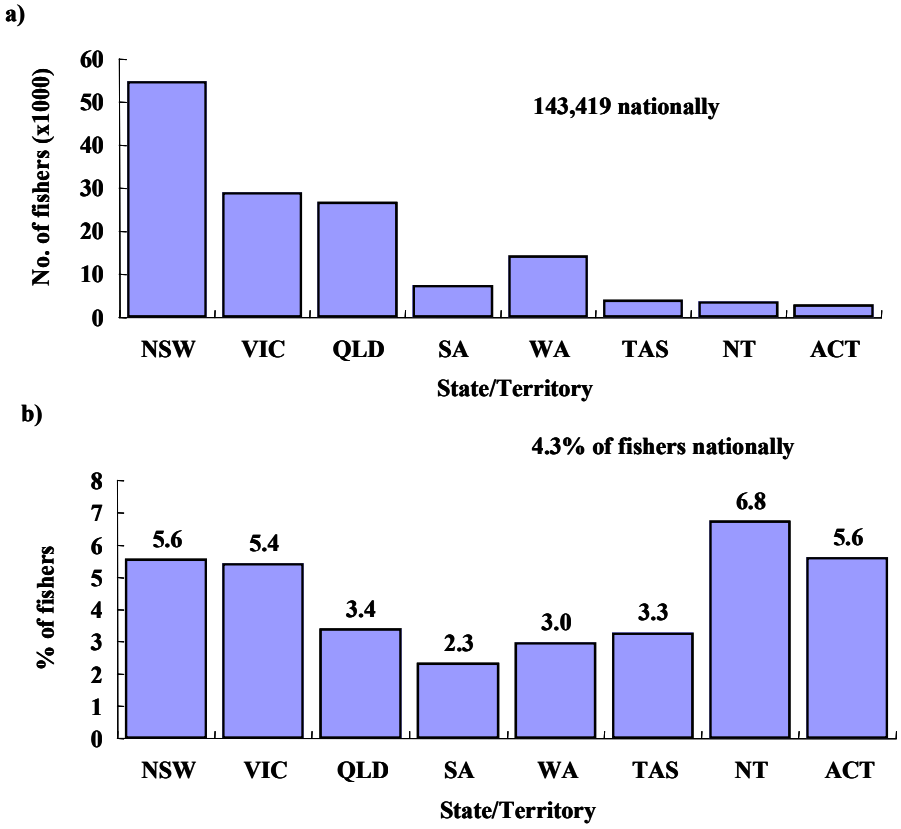

Figure 5.6. Fishing club/association membership in the 12 months prior to May 2000 by State or Territory of residence for recreational fishers aged 5 or older: (a) Number of members and (b) proportion of fishers.

5.9.3.2. Fishing licences

Approximately 445,000 Australian residents aged 5 or older held a licence for some recreational fishing activity in the 12 months prior to May 2000 (Figure 5.7). Most Australian States have some form of recreational fishing licence in place though there are many different categories of licence required and few consistent standards across the nation. Variability in the proportion of licence holders found in this survey generally reflected these management arrangements. For instance, the Victorian government introduced an all waters general fishing licence during 1999 and consequently this State had the highest number of licence holders (225,000) and the highest level of licence ownership (41% of fishers) (Figure 5.7). The disparity between the number of

licence holders and the estimated number of fishers in Victoria, however, can be explained by the fact that the licence was introduced during, rather than prior, to the 12 month period for reporting of past fishing activity. That is to say, some fishers were still yet to take out the new licence at the time of the initial screening survey. Furthermore, the Victorian licensing system has a number of exemption categories and not all fishers are required to hold licences.

Tasmanian fishers have been required to hold licences for freshwater fishing and several forms of saltwater fishing activities for many years. As a consequence the level of licence ownership was also relatively high, about 31% of fishers (Figure 5.7). In Western Australia, a licence is required for certain types of fishing and about 14% of fishers held a recreational fishing license.

In New South Wales, a freshwater fishing licence was in place at the commencement of the survey but subsequently (during the diary survey) a general fishing licence, similar to that for Victoria, was introduced. The impact of this all waters licence was not, therefore, reflected in the licensing figures, which indicated that just 8% of New South Wales fishers held licences.

Queensland has a small number of freshwater dams where an angling fee is charged and these arrangements are reflected in the low levels of licensing for residents of that State. Although the Northern Territory has no recreational licences, the survey established that a small number of Northern Territory residents did hold interstate fishing licences.

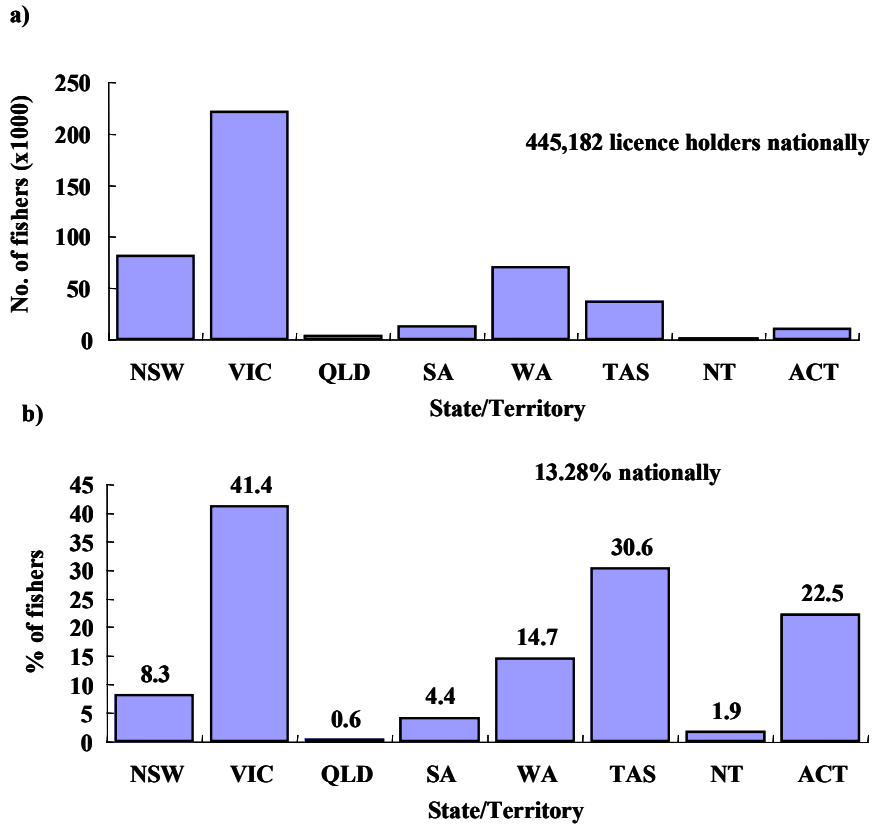

Figure 5.7. Fishing licensing status for the 12 months prior to May 2000 by State or Territory of residence for recreational fishers aged 5 or older: (a) Number of licence-holders and (b) proportion of fishers.

5.9.3.3. Boat ownership

Of the 7.2 million Australian households, an estimated 789,000 (11% of total) owned at least one recreational vessel as at April 2000. The total number of vessels (including jet skis, canoes, sailing boats, row boats and power craft) owned by Australian residents at that time was about 925,000 vessels (Table 5.3). Not unexpectedly, the level of boat ownership was higher for households containing recreational fishers, with approximately 574,000 (32%) of the 1.8 million Australian fishing households owning a boat. Not all recreational vessels are used for fishing and out of the total, over 511,000 (55%) were identified as having been used for recreational fishing in the twelve months prior to May 2000.

The largest number of boat owning households was in New South Wales, followed by Queensland and Victoria (Figure 5.8). As a proportion of the population, Tasmania and the Northern Territory had the highest boat ownership rates both within the general and fishing household populations. The lowest rate of boat ownership was recorded in the Australian Capital Territory.

As a proportion of the total number of vessels in each State or Territory, it was established that about half of the vessels in New South Wales, Victoria and South Australia had been used for fishing, compared with around 60% in Queensland, Western Australia and Tasmania and over 70% in the Northern Territory (Table 5.3).

Based on the estimated market value of the fishing boats and adjusted for the proportion of time (attribution) spent using the boat for fishing (as opposed to other boating activities), the total attributed capital value of recreational fishing vessels in 2000 in Australia was approximately $3.3 billion (Table 5.3). The value of fishing vessels in New South Wales and Queensland exceeded $750 million while the recreational fishing fleet in Victoria and Western Australia was valued in excess of $600 million.

Some characteristics of recreational fishing vessels are described below.

Vessels used for fishing ranged up to approximately 25 m in length with the majority (70% or 357,000 vessels) in the 4 to 5 m size category (Figure 5.9a). Vessels under 4 m accounted for about 15% of the recreational fleet (76,000 vessels) while a further 11% (55,000 vessels) ranged from 6 to 7 m in length. Large vessels (> 10 m) represented under 2% (8,000 vessels) of the total fleet. At the lower end of the size scale, fishing vessels were generally non-powered canoes and dinghies, while the largest vessels were more likely to be multi-purpose cruisers.

Vessels were categorised according to their primary mode of propulsion, *viz* jet skis, powered vessels, sailing vessels and paddle/row boats. While all types were used for recreational fishing, the vast majority (93%) of the recreational fishing vessels were powered (Figure 5.9b). Approximately 5% of the recreational fishing fleet were paddled vessels. Sailing boats and jet skis were of negligible significance as recreational fishing platforms.

The primary storage location of fishing boats was another feature that may be used to categorise the recreational fleet. The survey established that the majority (80%) of recreational fishing vessels were stored on trailers (trailer boats), the balance was distributed more or less equally between moorings/marinas, on the shore or carried as ‘car toppers’ (Figure 5.9c).

Depth sounding and global position fixing (GPS) electronic aids were also used to characterise the fishing fleet. These electronic devices are generally used to assist fishers in the location of fish and with navigation. Depth sounding and position fixing equipment was present on 45% (232,000 vessels) and 19% (100,000 vessels) of the recreational fishing fleet, respectively. The prevalence

of electronic aids increased with vessel size, such that for vessels in size classes 8 m or greater, about 80% had an echo sounder and 55% a GPS (Figure 5.9d,e). The presence of electronic aids in vessels under 4 m was low, about 8% for echo sounders and 2% for GPS.

Table 5.3. Details of recreational boat ownership in Australia. Number of vessels, number used for fishing and estimated market value of recreational fishing vessels by State or Territory.

	State/Territory								
	NSW	**VIC**	**QLD**	**SA**	**WA**	**TAS**	**NT**	**ACT**	**TOTAL**
No. of vessels	307,813	172,847	205,599	74,892	102,059	39,739	11,717	10,800	**925,466**
No. of used for fishing	159,300	86,575	125,150	38,713	64,047	23,111	8,590	6,103	**511,590**
% used for fishing	51.8	50.1	60.9	51.7	62.8	58.2	73.3	56.5	**55.3**
Estimated value ($million)	790	620	753	243	642	147	76	23	**3,293**

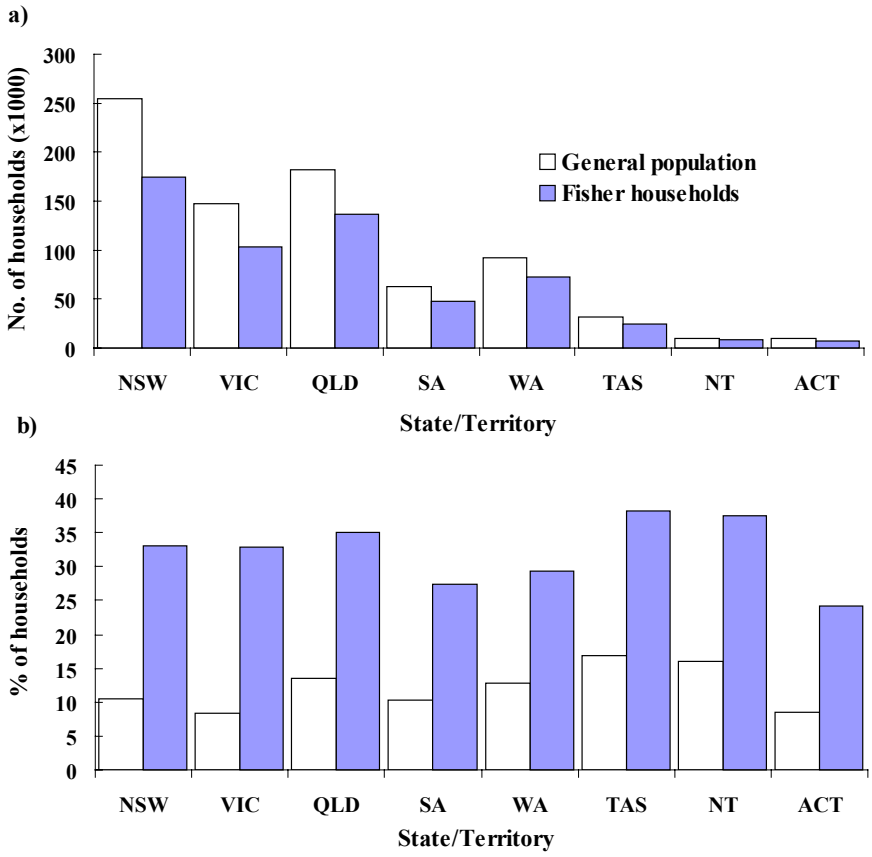

Figure 5.8. Household boat ownership for the general population and for fishing households by State or Territory: (a) Number of households and (b) proportion of the total number of households.

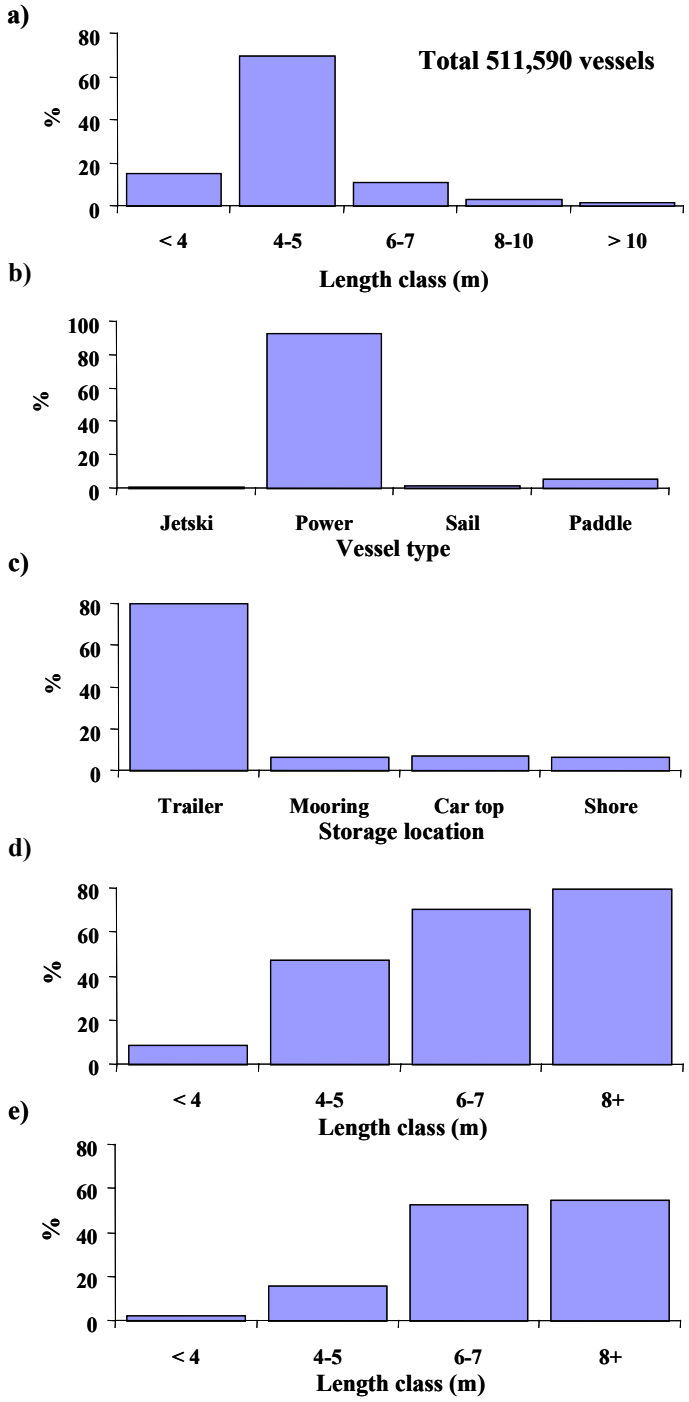

Figure 5.9. Characteristics of Australian recreational fishing boats: (a) Distribution (%) of vessels by length class; (b) distribution by propulsion category; (c) distribution (%) by storage location; (d) proportion (%) of vessels with echo sounder by length class; and (e) proportion of vessels (%) with GPS by length class.

5.10. Recreational Fishing Effort

Fishing effort is used to describe the pressure being applied to a resource by fishers and to derive (with catch data) indices of resource abundance and fishing success. The response of fish populations to variations in fishing effort is an important foundation for stock assessment and population modelling.

Fishing effort was derived from information provided by fishers during the 12-month diary survey and is presented as expanded population estimates (based on ABS estimated resident population and participation rates obtained from the screening survey). Information was collected on an 'event' basis, where an event was defined as a discrete fishing episode. Separate fishing events were recorded where there was a change in fishing region or water body type, target species and/or fishing method. In this way a day's fishing trip could comprise more than one event, for instance fishers commonly gather bait prior to fishing. Both the gathering of bait and the subsequent fishing were considered to be separate events since the effort expended in the capture of bait cannot be attributed to the capture of sport fish and vice versa. Similarly, the use of passive fishing gear, such as pots for crabs or rock lobster, whilst line fishing for finfish was recorded as separate fishing events. The delineation of fishing activity in this manner provided an ability to analyse effort (and catch) on the basis of fishing/collection method and target species/fishery. Furthermore, using this approach, three measures of effort could be defined, namely fishing days (i.e. separate days in which some form of fishing was undertaken), fishing events or hours fished.

It should be noted that for this report, person based effort has been calculated, for methods such as line fishing this is clearly appropriate, but where shared or joint activities occur, such as fishing with crab pots or using drag nets to catch prawns or bait, this can over estimate effort. For example, if three persons in a fishing party fished with pots (one or more pots) our analysis would indicate 3 person days of pot fishing, 3 person pot events and, on an hours fished basis, three times the fishing time[7]. In this instance it would be more appropriate to analyse pot effort on the basis of the number of pots fished (i.e. per pot) when reporting method based effort (and method based catch rates).

The primary purpose of this report is to provide a 'big picture' assessment of recreational fishing effort, i.e. based primarily on analyses at State/Territory and national levels. Subsequent reports will be produced by the participating fisheries agencies and will examine data at regional scales appropriate to addressing specific resource and management issues.

5.10.1. Total Effort

Australian residents aged 5 or older expended an estimated 20.6 million fisher days of effort during the period May 2000 to April 2001, representing 23.2 million separate fishing events or 102.9 million fisher hours (Appendix 5.6).

Based on where the fishing occurred (rather than State/Territory of residence), New South Wales recorded the greatest effort (6.9 million fisher days, 7.7 million events or 30.4 million fisher hours), followed by Queensland (4.6 million fisher days, 5.8 million events or 25.4 million fisher hours) and Western Australia (3.4 million fisher days, 3.4 million events or 19.7 million fisher hours) (Figure 5.10, Appendix 5.6). Recreational fishing effort was clearly concentrated on the east coast of Australia, with more than half the national total (measured either as days, events or hours) reported from New South Wales and Queensland. Reflecting the fact that many fishers undertake

[7] Note: catch information was recorded on a person basis and where joint effort occurred the catch was attributed between fishers in such a manner to avoid multiple counting.

more than one episode of fishing (i.e. fishing event) per day, this analysis of effort indicated an average of 1.12 events per fisher day nationally, ranging from 1.02 (Western Australia) to 1.24 (Queensland).

With the exception of Victoria, the relativity of effort levels across the nation generally reflected the size of the resident fisher populations (refer Figure 5.3). Fishing effort was lower than expected on the fisher population basis in Victoria and can be explained by the fact that comparatively large numbers of Victorians fish outside of the State, an observation clearly demonstrated below in the analysis of interstate fishing activity.

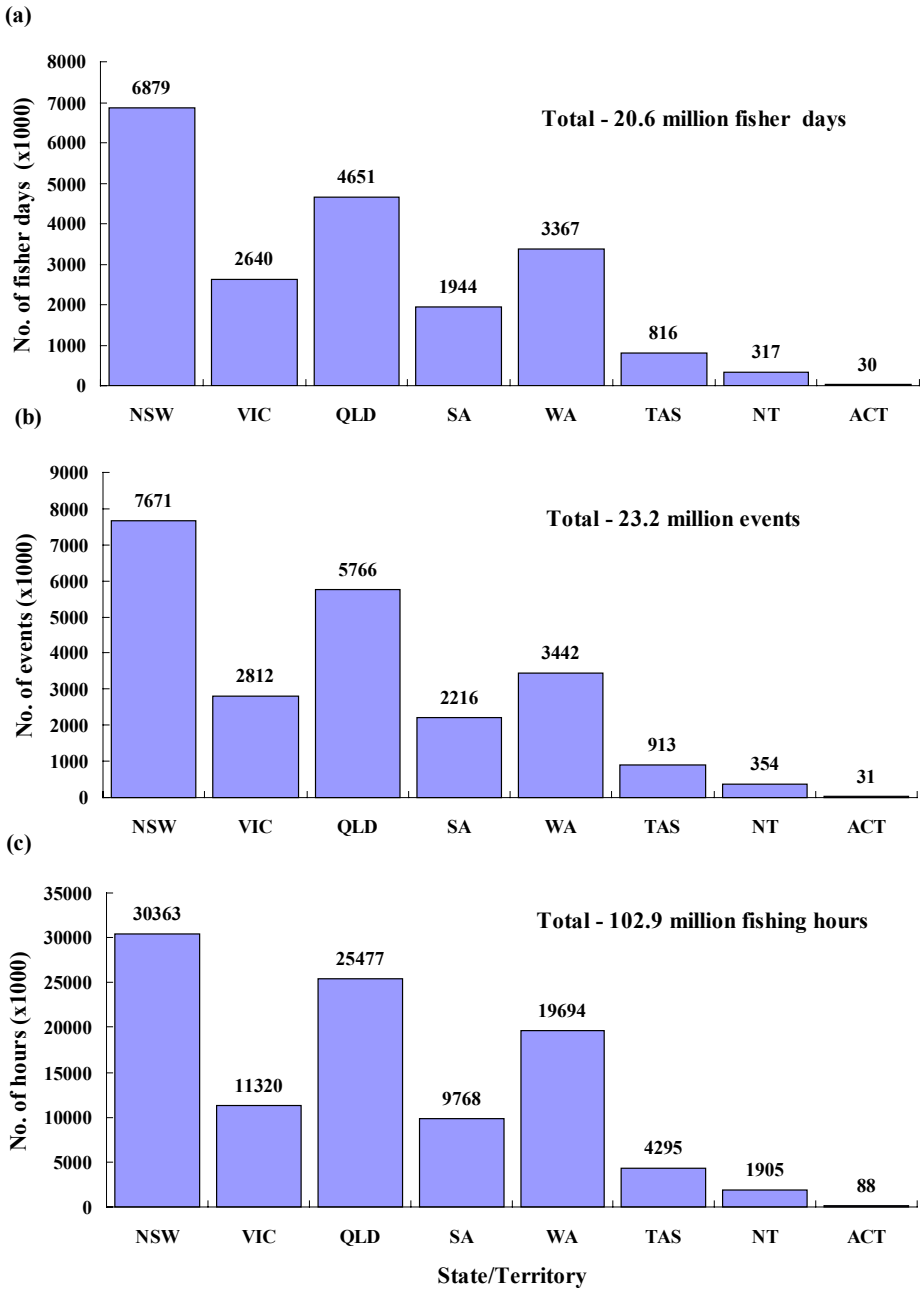

Figure 5.10. Annual fishing effort by State or Territory fished for Australian recreational fishers aged 5 or older. (a) Fisher days (b) number of fishing events, (c) hours fished.

5.10.2. Interstate Fishing Effort

A benefit of conducting the survey nationally has been the ability to monitor all fishing activity, including that which occurred outside of the State or Territory of residence[8]. Overall, an estimated 2.6 million fishing events (about 11% of the national total) occurred outside of the fisher's home State. Interstate fishing has a reciprocal aspect, with each State or Territory importing and as well as exporting effort to and from other regions of Australia.

The number of fishing events contributed to each State or Territory by interstate fishers (i.e. imported fishing effort) is presented in the columns in Appendix 5.6 and the proportion of total effort in each State or Territory that was imported is shown in Figure 5.11a. New South Wales (1.5 million events or 19% of total) and Queensland (645,000 events or 11%) imported the largest quantities of fishing effort whereas the highest proportion of imported effort occurred in the Northern Territory (135,000 events or 38%). With the exception of the Australian Capital Territory (17% imported effort), the level of imported fishing effort was below 5% for the remaining States.

The distribution of effort exported interstate by State or Territory of residence is shown by Appendix 5.6 and proportionally in Figure 5.11b. Victorians exported the largest amount of fishing effort (1.0 million events or 28% of their annual fishing effort), but residents of the Australian Capital Territory exported the highest proportion (252,000 events or 91%). Proportionally less than 10% of the fishing effort expended by residents of each of the remaining States and Territory was exported interstate.

Closer examination of the information arranged in columns and rows of Appendix 5.6 provides an insight into the dynamics of interstate fishing activity around Australia. Most of the effort exported from New South Wales was directed to Queensland and to some extent to the Northern Territory, with the bulk of the imported effort originating from Victorian, Queensland and Australian Capital Territory residents. Victoria exported relatively high levels of effort to New South Wales and Queensland in addition to Western Australia, whilst importing effort mainly from South Australian residents. As noted, Queensland imported effort primarily from New South Wales and Victorian residents, whilst exporting most effort into New South Wales and secondarily into the Northern Territory. As this analysis reveals, much of the interstate fishing activity was directed to adjacent States. In many instances this may have only involved relatively short trips that crossed jurisdictional boundaries, particularly true for residents of the Australian Capital Territory fishing in New South Wales. Other examples include Victorians fishing in New South Wales, where almost half of their exported effort (events) was directed at the Murray River while the majority (85%) of the effort by Queensland residents in New South Wales was directed at the north coast, including the Tweed and Clarence Rivers.

By considering the balance between imported and exported effort at the State or Territory level it was apparent that New South Wales, Queensland, the Northern Territory and, to a lesser extent, Western Australia were net importers of fishing effort (Figure 5.11c). By contrast, Victoria, the Australian Capital Territory and South Australia were net exporters of fishing effort. In Tasmania, imported and exported fishing effort largely balanced each other.

[8] State or Territory of residence was defined as that which applied at the time of the screening interview. For the purposes of analysis, diarists who moved interstate during the diary survey were deemed to be still residents of their former State or Territory.

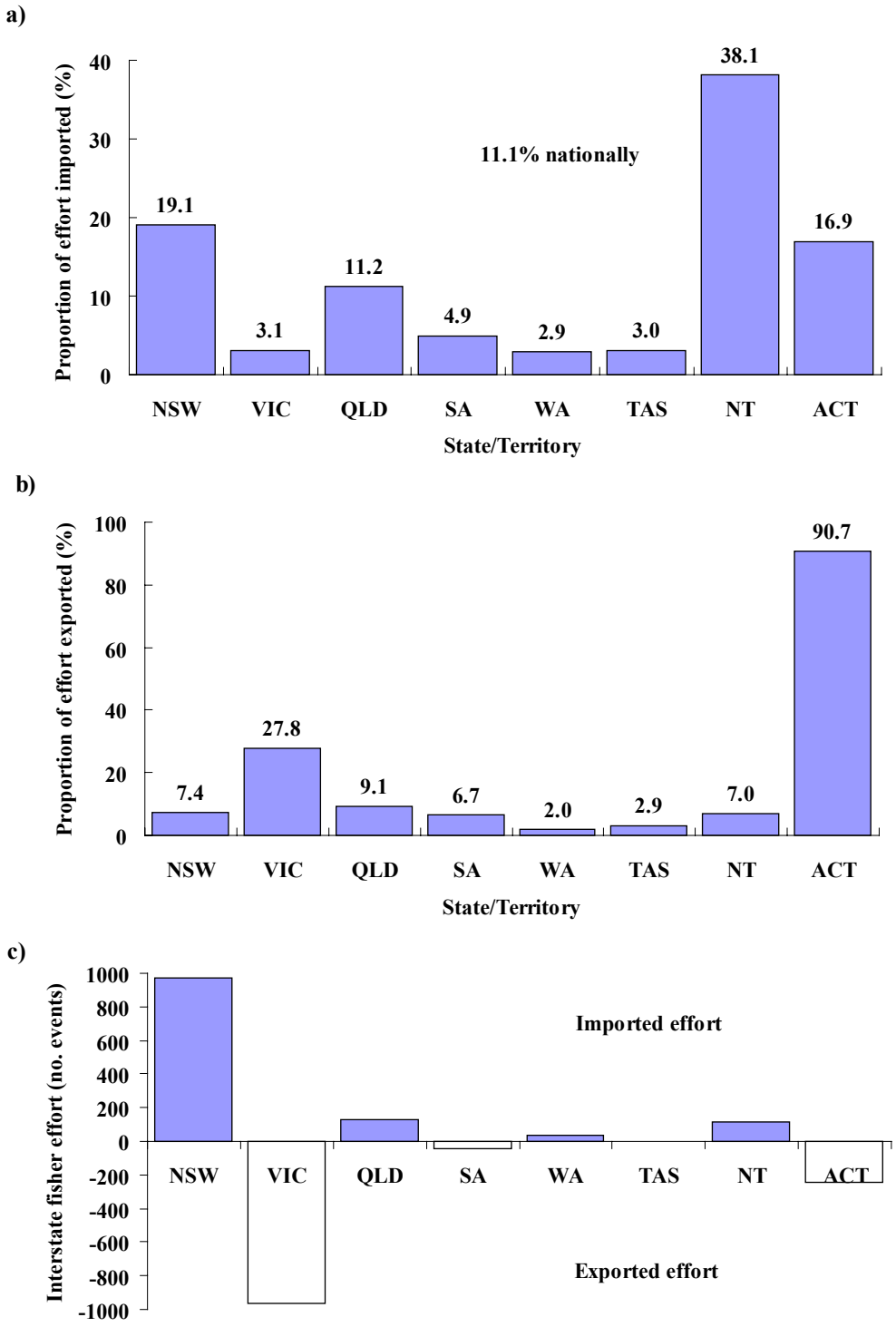

Figure 5.11. Interstate fishing activity by Australian recreational fishers age 5 or older: (a) Proportion of annual fishing effort (events) imported into each State or Territory by interstate residents, (b) proportion of annual effort (events) exported interstate by State or Territory of residence and (c) balance between imported and exported fishing effort (events x 1000) by State or Territory fished.

5.10.3. Fishing Frequency

Nationally, recreational fishers fished for an average of 6.13 days per fisher between May 2000 and April 2001 (Figure 5.12). Western Australian residents averaged the highest levels of fishing activity (6.94 days per fisher) followed by Tasmanians (6.55 days per fisher) and Victorians (6.37 days per fisher). Residents of the Northern Territory (5.02 days per fisher) and the Australian Capital Territory (4.61 days per fisher) averaged the lowest fishing activity levels.

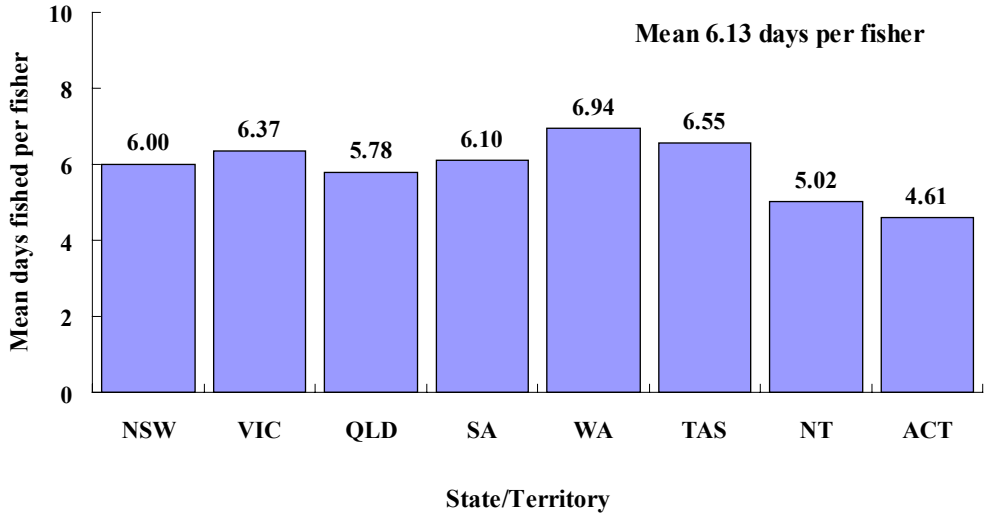

Figure 5.12. Mean annual number of days fished per recreational fisher aged 5 years or older, by State or Territory of residence.

Averages, however, fail to recognise the fact that the distribution of fishing effort (and catch) amongst recreational fishers is usually highly skewed. That is, a large number of fishers usually do relatively little fishing (and catch few fish) while, at the other extreme; relatively few fishers are very active and contribute disproportionately to the overall effort (and catch). This feature of fisher behaviour was evident for Australian recreational fishers, with about two thirds of all fishers (i.e. 2.2 million persons) fishing for 5 or less days over the 12 month survey period while just 3% of all fishers (about 101,000 persons) fished for more than 25 days (Figure 5.13).

The impact on total fishing effort of individual fishers was examined by ranking them based on their level of annual fishing effort (days fished) and then calculating the effect of progressively adding a fisher's effort to the total (Figure 5.14). At the lower end of the effort scale, about 60% of all fishers (i.e. about 2.26 million persons) accounted for less than 20% of the total effort (about 4.1 million fisher days). By contrast, at the top of the activity scale, just 15% of fishers were responsible for about half of the overall fishing effort, with the upper 3% (who each fished for greater than 25 days) also contributing about 20% of the national fishing effort. This analysis clearly highlights the potential for a relatively small proportion of the recreational fisher population to exert a substantial impact in terms of effort (and also catch), suggesting that minor shifts in the dynamics of participation (based on activity levels) at the upper end of the fishery will have significant implications on effort (and catch) levels.

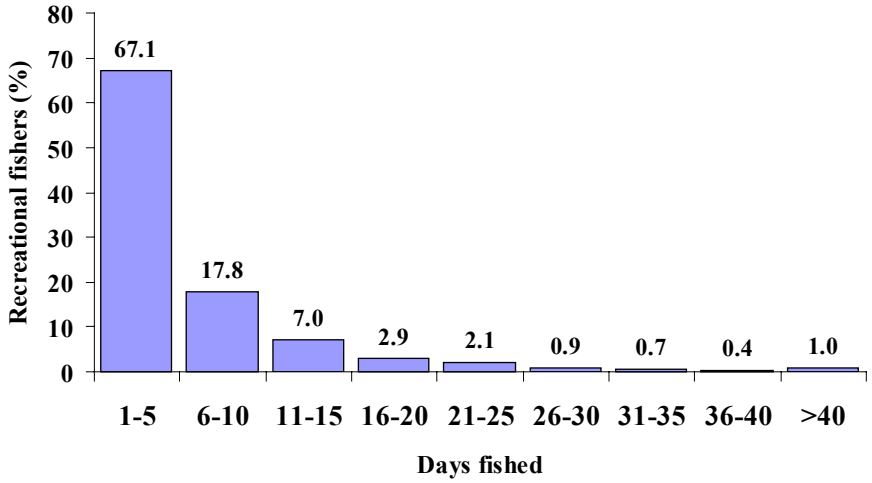

Figure 5.13. Distribution of annual fishing effort (days fished) amongst Australian recreational fishers aged 5 years or older.

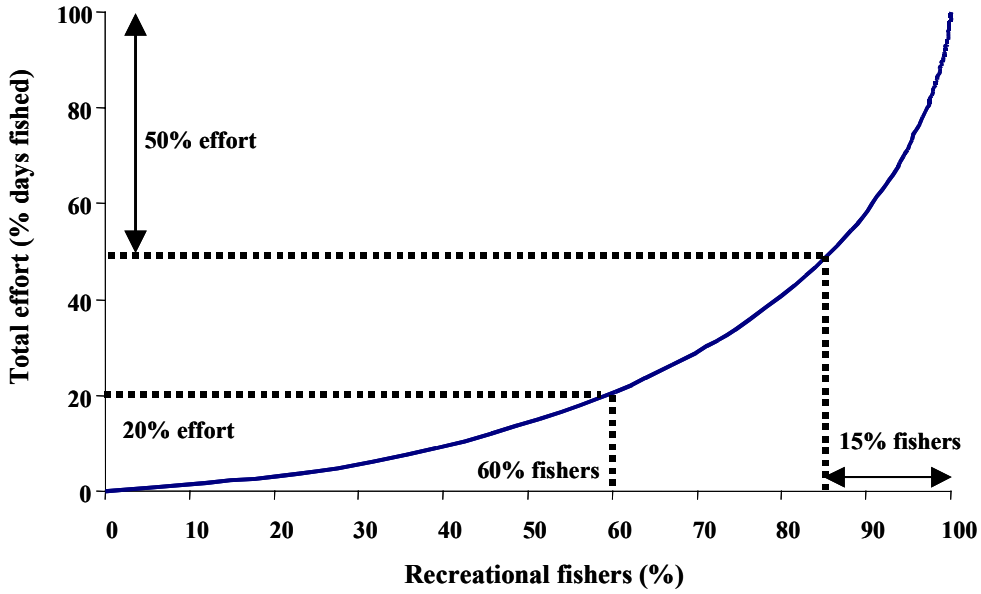

Figure 5.14. Relationship between the number of fishers and their cumulated impact in terms of fishing effort (days fished) for Australian recreational fishers aged 5 years or older.

5.10.4. Effort by Water Body Type

Five categories of water body were identified to describe the distribution of fishing activity, namely offshore (>5km from the coast), coastal (shoreline to 5km), estuarine, freshwater rivers and lakes or dams. In many instances, offshore waters also coincide with waters managed by the Commonwealth Government.

The distribution of effort (events) by water body type is summarised in Figure 5.15 and Appendix 5.7. Nationally, about 41% of the total fishing effort (9.5 million events) occurred in coastal waters, with estuarine waters accounting for a further 35% (8.1 million events). The level of recreational fishing directed at offshore waters was relatively low, about 4% (937,000 events) of the national total. Freshwater fishing accounted for almost 20% of the national fishing effort, around 11% (2.7 million events) in rivers and 8% (1.9 million events) in lakes or dams.

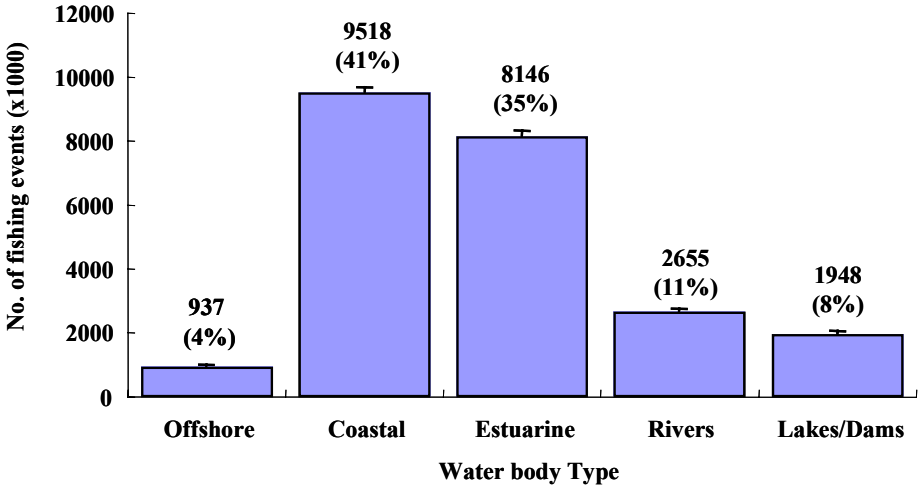

Figure 5.15. Annual recreational fishing effort (events) by water body type for Australian recreational fishers aged 5 years or older. Error bars represent one standard error.

At the State or Territory level, the relative distribution of effort between specific water body types was variable, influenced by a range of factors including geography, population distribution and access to aquatic resources (Figure 5.16, Appendix 5.7). New South Wales and Victoria have major urban population centres (Sydney, Melbourne) located adjacent to relatively large estuarine systems (Port Hacking, Botany Bay, Port Jackson, Hawkesbury, Port Phillip Bay, Western Port) and consequently a substantial proportion of the fishing effort was directed in estuarine waters. Queensland also has urban populations adjacent to large estuaries in addition to an extensive coastal fishing region bounded by the Great Barrier Reef. The bulk of the recreational fishing effort in that State was divided between the estuarine and coastal waters. The predominance of fishing in coastal waters was a feature of recreational fisheries in South Australia, Western Australia and Tasmania. These States have relatively limited estuarine systems and prominent extensions of the continental shelf adjacent to metropolitan centres. Fishing effort was more evenly distributed between river, estuarine and coastal waters in the Northern Territory while freshwater fishing, especially in lakes or dams, was the exclusive feature of fishery in the landlocked Australian Capital Territory.

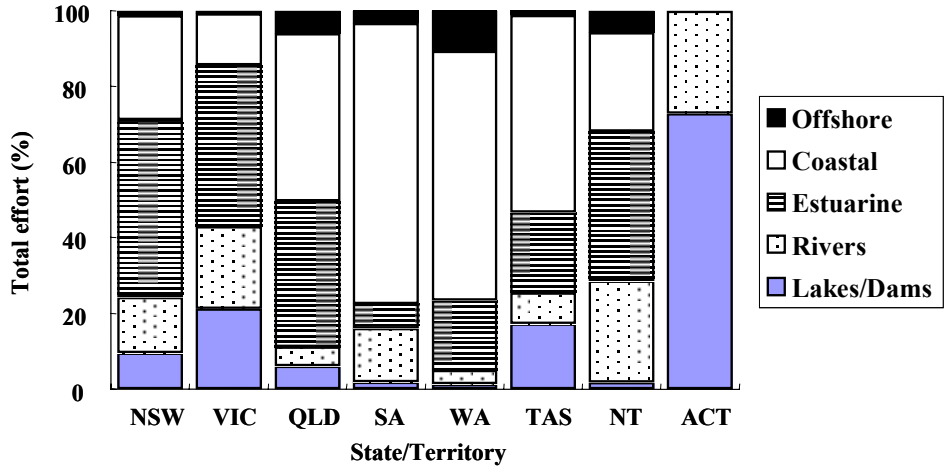

Figure 5.16. Proportion of annual fishing effort (events) for recreational fishers aged 5 years or older by water body type and State or Territory fished.

Nationally about 80% of the fishing effort (events) occurred in saltwater (offshore, coastal and estuarine waters) as opposed to 20% in freshwater (freshwater rivers, lakes and dams) (Figure 5.17, Appendix 5.7). However, at the State or Territory level it was apparent that saltwater fishing effort exceeded the national level in Queensland, South Australia and Western Australia (84-95%) and was slightly lower for New South Wales, Tasmania and the Northern Territory (71-76%). In Victoria there was greater reliance on freshwater fishing, with saltwater fishing effort representing just 57% of the total for that State.

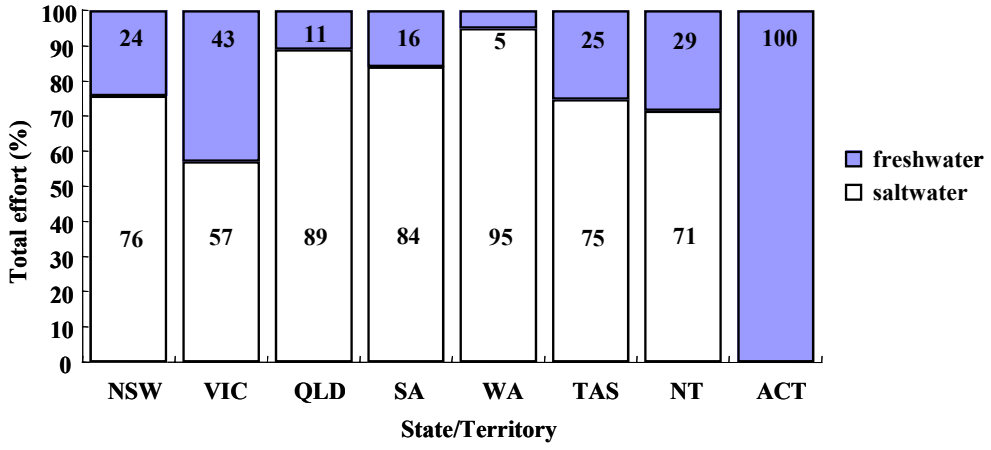

Figure 5.17. Proportion of annual fishing effort (events) in salt and freshwater by State or Territory fished for recreational fishers aged 5 or older.

5.10.5. Effort by Fishing Method

Eighteen different fishing methods were classified for the purposes of recording fishing activity and these have been grouped into five main categories for reporting purposes. The grouped categories are line fishing, fishing with pots or traps, fishing with nets, diving and other collection methods.

Line fishing (including the use of bait, artificial lures and jigs as well as set-lines) accounted for 19.7 million fishing events, that is nearly 85% of the overall annual fishing effort (Figure 5.18, Appendix 5.8). Fishing using bait was more popular than fishing with artificial lures, either solely or in combination with bait fishing. Fishing with set-lines was reported in all States and Territories but effort levels were comparatively low.

Fishing with pots and traps (including crab and lobster pots, hoop nets and fish traps) was next in order of importance, representing 1.7 million events or 7% of the total effort. Pots and traps can be categorised as 'passive' or 'active' depending on the manner in which they are operated. Passive gear, such as lobster pots, are generally baited and left unattended, the target species is attracted to the pot or trap and once inside are effectively unable to escape. Active pots or traps, which include hoop nets, require fishers to actively haul the gear to the surface to retain the target species, which are more or less free to move into and out of the trap. Passive gear was the more commonly used method (73% of pot/trap events).

Netting methods, including actively worked gear (cast nets, drag or seine and scoop or push nets) and set nets (gillnets), comprised 634,000 events, equivalent to 3% of the total effort. Cast nets and scoop or push nets were the main netting methods used, (46% and 33% of net events) followed by drag or seine nets (12%) and set-nets (9%).

Diving (using spears or underwater hand collection) contributed 266,000 events or just 1% of the overall effort. SCUBA/surface air and snorkel diving (hand collection) was the primary activity (55% of dive events) although spearfishing (36%) was also significant. Spearing fish from the surface accounted for the balance of the 'dive' effort (9%).

Other methods (including hand collection, the use of pumps, rakes and spades) accounted for 915,000 events, about 4% of the total fishing events nationally. The use of pumps, rakes or spades dominated (68%) over hand collection (31%) in this method category.

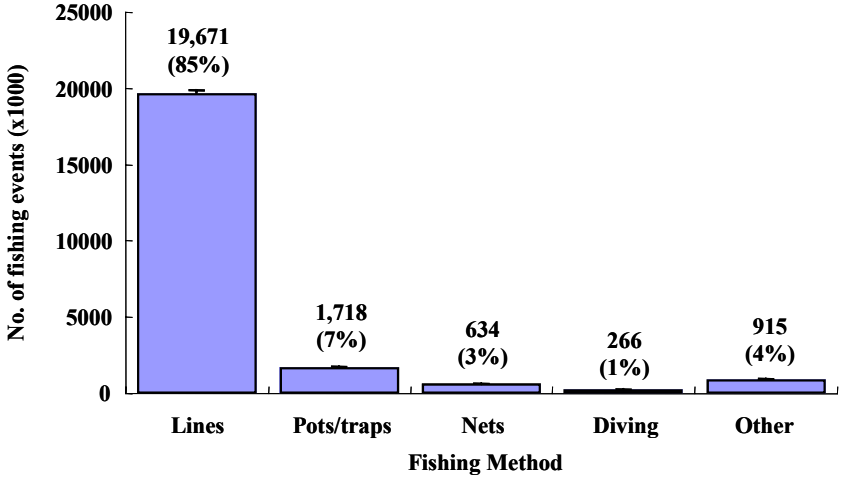

Figure 5.18. Annual fishing effort (events) by fishing method for Australian recreational fishers aged 5 or older.

The prominence of line fishing was clearly evident in all States and Territories, although alternative fishing methods were also relatively important in Western Australia and Queensland, accounting for over 20% of the total effort (Figure 5.19, Appendix 5.8).

Pot and trap usage was relatively more prominent in Western Australia, South Australia, Queensland, Northern Territory and Tasmania (7-16% of events) than in New South Wales, Victoria and the Australian Capital Territory (1-4% of events) (Figure 5.19, Appendix 5.8). Pots were commonly used to target lobsters in South Australia and Tasmania whereas they were used mainly to target crabs in Queensland and the Northern Territory. In Western Australia, passive gear was used to target lobsters whereas active gear was the primary method used to capture crabs (refer section 5.11).

The use of recreational netting methods was proportionally greater in Tasmania and Queensland (6% of events) compared to elsewhere (Figure 5.19, Appendix 5.8). In Queensland, cast nets were the dominant net method while in Tasmania the majority of the net fishing was based on gill net usage. Scoop or push nets accounted for the bulk of the net effort in New South Wales, Western Australia and Victoria.

Tasmania and Western Australia reported above average levels of dive effort (3-4%) (Figure 5.19, Appendix 5.8). In Tasmania, Western Australia, Victoria and South Australia dive (hand) collection (mainly for rock lobster and abalone) using snorkel, scuba or surface air supply accounted for the bulk of the dive effort. Spearfishing was the main dive activity in New South Wales and Queensland but was also of significance in Western Australia.

Other collection methods, especially the use of pumps, rakes or spades were particularly important in New South Wales and Queensland, largely concerned with the collection of bait species (including yabbies/nippers) (Figure 5.19, Appendix 5.8).

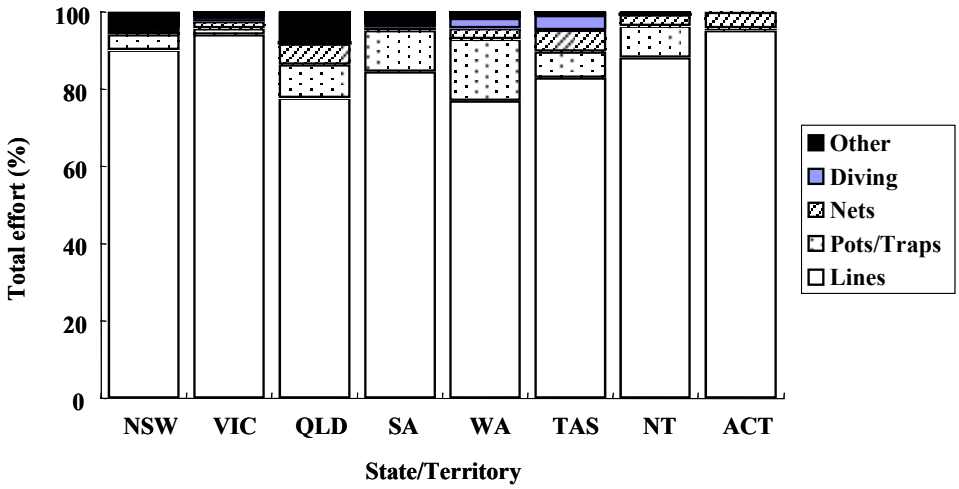

Figure 5.19. Proportion of annual fishing effort (events) by method and State or Territory fished for recreational fishers aged 5 or older.

Appendix 5.9 provides estimates of total hours fished by method and Appendix 5.10 average duration by event, based on fishing method. Nationally, line fishing accounted for over 72 million fisher hours of effort (70% of total hours fished). Line fishing events, whether using bait or artificial lures, averaged around 3.5 hours, the duration being relatively consistent across all States and Territories. In situations where a combination of bait and lure fishing occurred fishing times were slightly longer, with an average duration of over 4 hours. By contrast set-line events

averaged almost 20 hours, reflecting the fact that set lines are generally left unattended for long periods.

Pots and traps were deployed for an estimated 27 million hours, representing over 26% of the total hours fished by recreational fishers nationally (Appendix 5.9). Passive gear accounted for the bulk of the pot and trap effort in each State or Territory, with trap effort in Western Australia, Queensland, and Tasmania exceeding 30% of the total fishing duration in these States. On average, the passive gear was set for around 20 hours, reflecting the common practice of leaving the pot or traps to fish overnight (Appendix 5.10). By contrast, active gear was fished for an average of just over 4 hours per fishing event. The impact of these differences was particularly evident in South Australia, where passive and active pot or trap effort was roughly equivalent based on events (Appendix 5.8) but differed by a factor of four in terms of hours fished (Appendix 5.9).

About 1.5 million fisher hours of net effort was expended during the survey period, equating to just over 1% of the total effort (Appendix 5.9). Not unexpectedly, the active net fishing methods were generally employed for relatively short periods at a time (up to 2.5 hours on average) whereas gill or set nets were often left to fish over much longer periods (average of over 10 hours) (Appendix 5.10).

Dive effort accounted for about 582,000 hours nationally or less than 1% of the total (Appendix 5.9). Event duration for dive activity ranged from an average of 2.7 hours for spearfishing to slightly less than 2 hours for hand dive collection (Appendix 5.10).

Approximately 979,000 fisher hours was spent using alternative harvesting methods, equivalent to about 1% of the national effort (Appendix 5.9). Being largely concerned with the collection of bait, such events were, on average, of short duration, around an hour (Appendix 5.10).

The variation in deployment times for different fishing gear clearly reflects operational issues and highlights the need to consider effort by fishing method, rather than simply the total time fished on a given day. Ultimately the patterns of gear usage are influenced by a combination of regulations and availability of target species (i.e. opportunity).

5.10.6. Effort by Fishing Platform

Recreational fishing activity occurred from a range of platforms including boats (private, hire and charter) and shore (natural and man-made structures) during the survey year. Nationally, shore-based fishing attracted a greater level of activity (13.3 million events or 57% of total) than fishing from boats (9.8 million events or 43% of total) (Figure 5.20, Appendix 5.11). In all States apart from the Northern Territory, where boat fishing attracted most of the effort (70%), shore-based fishing accounted for the bulk of the fishing effort (51-62% events). In the Australian Capital Territory boat-based fishing represented a very minor component (5%) of the fishing effort.

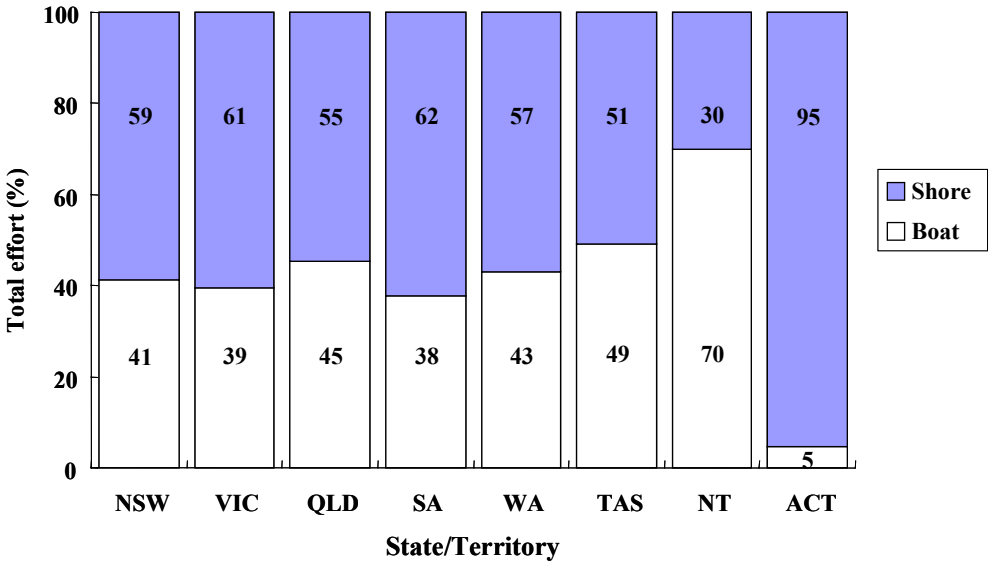

Figure 5.20. Proportion of annual fishing effort (events) by fishing platform and State or Territory fished for recreational fishers aged 5 or older.

The distribution of boat and shore-based fishing effort between salt and freshwater is presented in Figure 5.21. Boat-based fishing in Western Australia was almost entirely (98%) conducted in saltwater. A very high proportion (86-90%) of the boat fishing effort in Queensland, South Australia and Tasmania was also directed in saltwater. In the Northern Territory, New South Wales and Victoria less than 80% of the boat fishing effort was saltwater based, indicating a comparatively higher involvement in freshwater fishing using boats in these regions than elsewhere in Australia.

Like boat effort, shore-based fishing was mainly directed at saltwater environments though compared to boat fishing, shore fishing effort was comparatively higher in freshwater in Tasmania, South Australia and Western Australia. Victoria was the exception and shore-based freshwater fishing effort (events) exceeded boat-based effort. For obvious reasons, all boat and shore-based fishing in the Australian Capital Territory was undertaken in freshwater.

In the context of this survey, fishing vessels were defined as private, charter and hire boats. By definition, charter boats are generally large vessels under the command of a captain or fishing guide and designed to carry a number of passengers. Hire boats tend to be smaller vessels under the command of fishers who are generally permitted to use these boats in sheltered waters.

Not unexpectedly, privately owned fishing boats were by far the most popular boat-based platform used by recreational fishers, accounting for 9.2 million events or 93% of the total boat-based effort (Figure 5.22). An estimated 364,000 fishing events (3.7% of total) were conducted from charter vessels while 328,000 fishing events (3.3% of total) occurred from hire boats. These figures provide an indication of the relative size of the recreational charter and hire boat fisheries (based on patronage by Australian residents). By State or Territory, the highest proportion of hire and charter effort (17%) occurred in the Northern Territory followed by Queensland (9%) and New South Wales (8%). At the other extreme, charter and hire boat effort contributed just 1% of the boat-based effort for Tasmania and no hire or charter fishing was reported from the Australian Capital Territory.

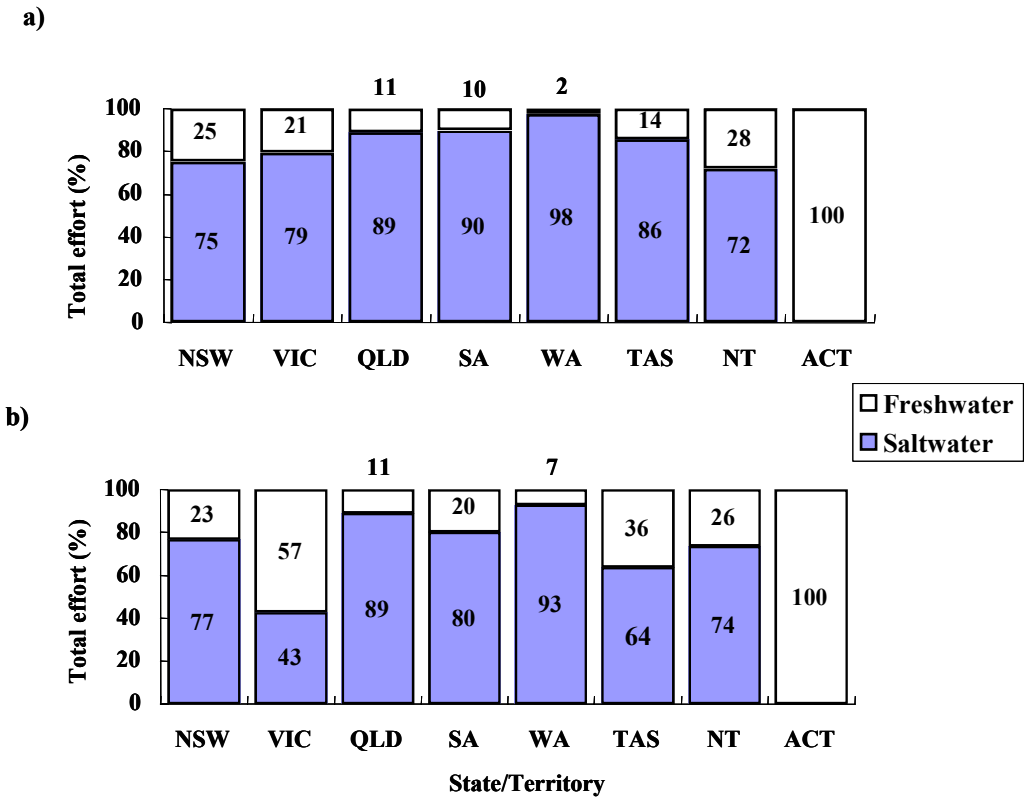

Figure 5.21. Proportion of annual fishing effort (events) by water type and State or Territory fished for recreational fishers aged 5 or older: (a) Boat-based and (b) shore-based effort.

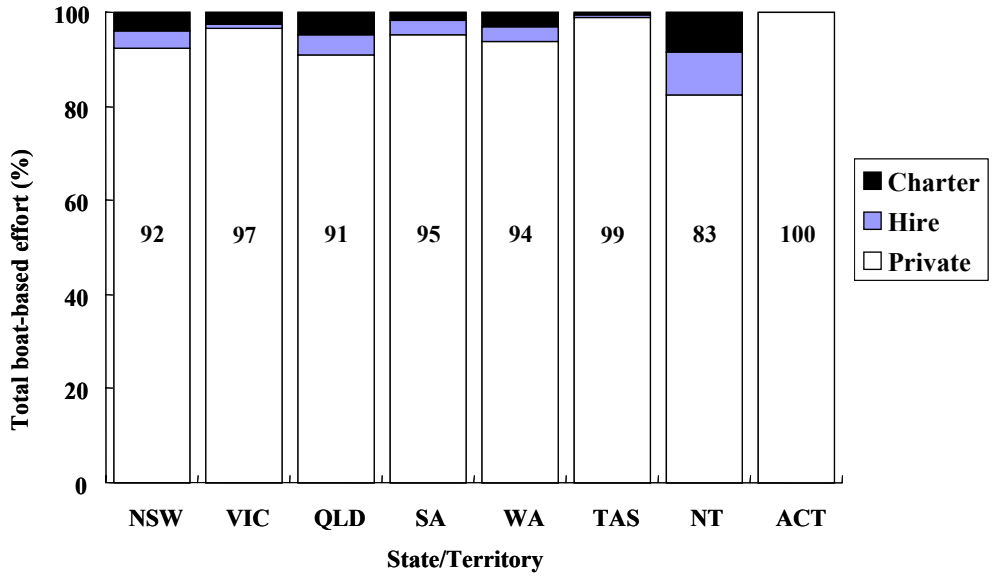

Figure 5.22. Proportion of annual boat fishing effort (events) by vessel type and State or Territory fished for recreational fishers aged 5 or older.

5.11. Recreational Catch

Australia has a long coastline and substantial landmass, providing a broad range of aquatic habitats and a diversity of aquatic life, much of which is accessible to commercial and recreational fishers. These aquatic animals have a variety of form and function and are composed of many taxonomic groups. In this survey respondent perception was ultimately relied upon for catch identification, with respondents referred to the species identification booklet when uncertainties arose. Although excellent reporting precision can be achieved at the species level in some instances (confirmed through on-site surveys), species groupings were required where fishers could not reasonably delineate particular species, even using identification booklets. For example, icon species such as barramundi were readily recognisable whereas identification to species level for flathead was less certain, even though flathead could be readily distinguished from other groups of fish.

For the purpose of high level reporting, catches have been grouped into seven categories according to taxonomy, primary method of capture and how they are utilised. The groups are finfish, small baitfish, crabs and lobsters, prawns and yabbies, cephalopods, other molluscs and other (miscellaneous) taxa. At the next level, organisms were arranged according to species or family groupings (e.g. bream, flathead, whiting) to allow the reporting of catch data on the key species groups. Listings of taxa that comprise each of these groupings are provided in Appendix 5.12.

Catches were generally reported as numbers of individuals and have been expanded using estimates of fishing participation obtained from the screening survey. In some instances, respondents occasionally reported small and generally abundant species (e.g. small baitfish, prawns, pippis) in units of weight or volume. These catches were later converted to numbers using agreed number to weight or volume conversions[9].

The provision of catch estimates for the key recreational species or species groups at national, state and regional levels represents a major output of this survey. The primary purpose of this report, however, is to provide a 'big picture' assessment of recreational catches, i.e. based primarily on analyses at the State/Territory and national levels. Subsequent reports to be produced by the participating fisheries agencies will examine data in more detail at regional scales appropriate to addressing specific resource and management issues.

5.11.1. Total Harvest

In recreational fisheries, catches can be split into retained or harvested and released or discarded components. The harvested portion may be used for a range of purposes including consumption or bait, whereas fish may be released because of regulation (e.g. size and/or bag limits), ethical reasons, undesirability of the species, and so on.

In the 12 months between May 2000 and April 2001, Australian recreational fishers harvested an estimated 60.4 million finfish, 11.5 million small baitfish, 6.1 million crabs and lobsters, 47.7 million prawns and yabbies, 1.8 million cephalopods, 7.2 million other molluscs, and 1.2 million other taxa (Figure 5.23, Appendix 5.13). This high level compilation of the recreational harvest combined animals of widely differing sizes, methods of capture and purpose of use and consequently, little can be inferred apart from a very broad characterisation of the recreational harvest.

[9] These conversion factors were either assessed directly using field observation or 'best guess' estimates.

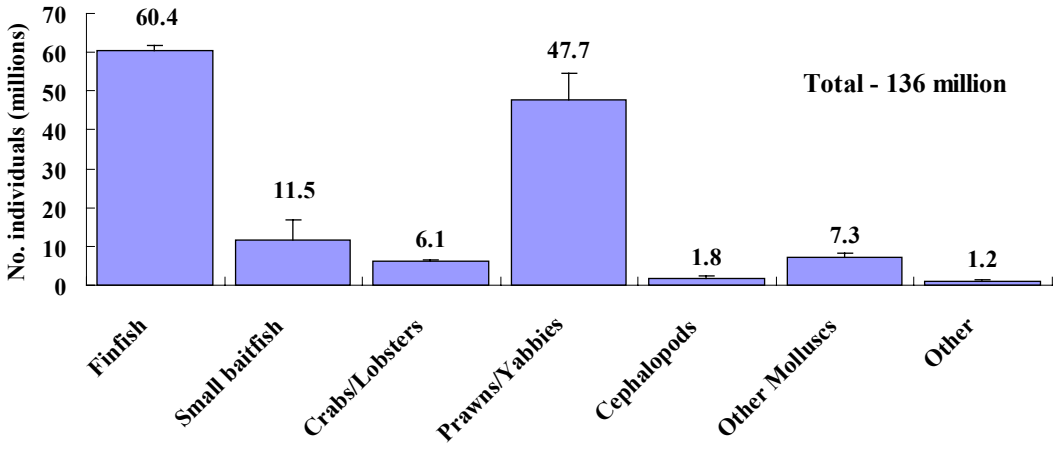

Figure 5.23. Harvest (numbers of organisms) taken by Australian recreational fishers aged 5 or older for the major taxonomic groups. Error bars represent one standard error.

5.11.2. Harvest of Key Species

Harvest estimates for selected key species are provided by State and Territory in Table 5.4, by water body type in Table 5.5 and by method in Table 5.6. In defining what constitute key species groups, consideration was given to levels of harvest, spatial distribution of the fisheries, management significance and status as targeted or 'icon' recreational species. A more comprehensive summary (including standard errors) for the main species groups is provided in Appendix 5.13.

It should be noted, however, that if no catch was reported it does not necessarily mean that the catch was zero but rather that no catches were reported by survey participants, implying that catches were either very rare or possibly nil.

5.11.2.1. Finfish

Of the marine finfish harvested, whiting (fam. Sillaginidae) including King George whiting (*Sillaginodes punctata*), followed by flathead (fam. Platycephalidae), Australian herring and Australian salmon (*Arripis* spp.), bream (fam. Sparidae), mullet (fam. Mugilidae), garfish (fam. Hemiramphidae), tailor (*Pomatomus saltatrix*), and pink snapper (*Pagrus auratus*) dominated the catch nationally based on numbers (Table 5.4, Appendix 5.13). A wide diversity of other species was also reported, some widely distributed or others, such as dhufish (*Glaucosoma herbaicum*), restricted to a single State.

European carp (*Cyprinus carpio*), redfin (*Perca fluviatilis*), golden perch (*Macquaria ambigua*) and trout/salmon (fam. Salmonidae) dominated the harvest of freshwater finfish, taken in numbers comparable to several of the major marine species (Table 5.4). Interestingly, of these, only golden perch is endemic to Australia, with European carp and redfin generally considered pest or noxious species. These two latter species clearly have successfully adapted to their new environment and now represent substantial components of the recreational harvest. Other introduced species were also reported but none were prominent components of the recreational catch. By contrast, catches of several other native fish were of significance, including Australian bass (*Macquaria*

novemaculeata), various freshwater perch species (fam. Percicthydae), Murray cod (*Maccullochella peeli*) and, in northern Australia, barramundi (*Lates calcarifer*)[10]. Since commercial fishing has been restricted or excluded from many inland areas of Australia, these survey data potentially represent the most accurate source of fishery information to monitor the distribution and abundance of native and introduced species.

A variety of small baitfish, including herring, pilchards, whitebait and unspecified small (juvenile) fish, were also taken by recreational fishers, generally for use as bait but in some instances for food (e.g. whitebait). Although sometimes harvested in large numbers, by weight or volume catches tended to be small.

While recreational fishers are permitted to use a range of fishing techniques, the vast majority of the finfish catch was taken with line methods (Table 5.6). In some Australian States recreational fishers are permitted to use nets (haul nets, gillnets, cast nets) and such arrangements were apparent in the harvest data when method is considered.

More detailed descriptions of the fisheries for selected fish species/species groups are presented below and reference should also be made to Figure 5.24, Tables 5.4-5.6 and Appendix 5.13.

Whiting (other than King George whiting)

Recreational fishers harvest a range of whiting species, distributed throughout tropical and temperate inshore waters of Australia. Numerically, whiting were the most abundant of all finfish harvested, 8.1 million fish or over 13% of the national finfish harvest, with catches reported in all States and the Northern Territory. Catches in three States, namely Queensland, Western Australia and New South Wales, collectively comprised about 94% of the national whiting harvest, with about 46% taken in Queensland (primarily sand whiting *Sillago ciliata* and winter whiting *S. maculata*). Nationally, 60% of the whiting were taken from coastal waters, with a further 35% from estuaries. The catch from offshore waters represented just 5% of the harvest. When method is considered, it was apparent that the vast majority (99%) was captured by line fishing and that over two thirds were taken whilst boat fishing.

In terms of contributions to state-wide harvests, whiting were the dominant finfish taken in Queensland (31% of State total) and the second and third most important groups in Western Australia (20% of State total) and New South Wales (12% of State total), respectively.

Flathead

Flathead represented the second most numerous finfish group harvested, estimated at about 7.4 million fish or 12% of the total finfish harvest. Catches were concentrated in Victoria (45%), New South Wales (30%) and Tasmania (19%). From other studies, several species of flathead are known to be represented in the recreational catch, with sand flathead (*Platycephalus bassensis*) particularly important in Victoria and Tasmania, dusky flathead (*P. fuscus*) in New South Wales and Victoria and tiger flathead (*Neoplatycephalus richardsoni)* regularly caught off all three States. The majority of the flathead (57%) were taken from estuaries, with a further 40% from coastal waters and just 3% from offshore. Line fishing methods accounted for over 99% of the harvest, with the vast majority (90%) taken whilst boat fishing.

At the State level, flathead represented the primary species group harvested in New South Wales (15% of State total), Victoria (31% of State total) and Tasmania (53% of State total).

[10] Barramundi occur in fresh and saltwater depending on life history stage.

Australian herring

Australian herring catches were largely restricted to Western Australia and South Australia, these States contributing 56% and 43%, respectively, of the total harvest of about 6.8 million fish. Within each of these States, this species was the major finfish species harvested, accounting for 37% of the Western Australian and 27% of the South Australian finfish harvests.

Australian herring were almost exclusively taken on hook and line, with the vast majority (92%) caught in coastal waters and just 5% in estuarine and 3% in offshore waters. Shore-based fishing was especially important for Australian herring, with about two thirds of the total harvest taken from the shore and one third from boat based fishing.

Bream

Moderate to high catches of bream were reported from all States and the Northern Territory, with an estimated annual harvest of 4.8 million fish, or about 8% of the finfish harvest. Previous surveys have established that the two main species of bream caught by recreational fishers are the yellowfin bream (*Acanthopagrus australis*), distributed from Queensland to Victoria on the east coast, and the black bream (*A. butcheri*) found from New South Wales through to Western Australia, including Tasmania. In tropical Australia, the northern bream (*A. berda*) was likely to have been the primary species harvested. Tarwine (*Rhadbdosargus sarba*) have also been grouped with the bream species due to similarities in appearance and the likelihood that fishers may have misidentified the two groups.

Fisheries in New South Wales (43% of the total) and Queensland (35%) were particularly prominent, with Victoria (10%) and Western Australia (9%) of secondary importance. Bream catches were reported primarily from estuarine (55%) and coastal (44%) waters, with negligible quantities from offshore. Line fishing accounted for the vast majority (99%) of the catch, with roughly equal numbers taken by boat and shore fishing.

Within both New South Wales and Queensland, bream represented the second most abundant finfish group (contributing 15% and 14%, respectively, of total harvests). Bream represented between 1-5% of the harvest in the other States and Northern Territory.

King George whiting

The estimated annual harvest of King George whiting was about 3.8 million fish, representing about 6% of the overall finfish harvest. It is possible, however, that some King George whiting were misreported as other whiting species, and vice versa.

Catches were highest in South Australia (62% of national total) followed by Victoria (27%) and Western Australia (11%), with only minor catches reported from New South Wales. King George whiting were primarily taken from inshore coastal waters (64% of the harvest), with estuaries (26%) and offshore waters (10%) making up the balance. The species was almost exclusively captured using line fishing methods, primarily from boats (91% of harvest).

King George whiting was the second most abundant finfish species retained by recreational fishers in both South Australia and Victoria, representing 21% and 10% of the total finfish numbers respectively, and accounted for about 4% of the finfish harvest in Western Australia.

Mullet

There are a number of species of mullet known to be taken regularly by recreational fishers, including yellow eye mullet (*Aldrichetta forsteri*) and sea mullet (*Mugil cephalus*).

The survey produced an annual harvest estimate of approximately 2.9 million mullet, equivalent to about 5% of the total finfish harvest. Mullet were reported from all States and the Northern Territory, with catches in Queensland (32% of total), South Australia (27%) and New South Wales (15%) the most significant. Victorian and Western Australian harvest levels were intermediate (9-10%) while the contributions from Tasmania and Northern Territory were relatively low (3%). Mullet were mainly caught in estuarine (49%) and coastal (47%) waters, with a very small proportion taken from freshwater. Unlike many of the other finfish, line fishing accounted for just over half (54%) of the harvest while nets (39%) and fish traps (6%) were also relatively important methods. The significance of these alternative methods highlights, to some extent, the role of mullet as a bait species (i.e. net and trap fishing is generally associated with bait gathering). The majority of harvest (70%) was taken from shore based fishing activities.

In Queensland and the Northern Territory, mullet were the third most numerous finfish harvested by recreational fishers, representing 8% and 14%, respectively, of the annual finfish harvest in these regions. Mullet comprised 7% of the South Australian finfish harvest and between 2-4% of the harvest in the remaining States.

Garfish

Garfish were taken in all States and the Northern Territory, with a total estimated harvest of 2.4 million fish or 4% of the national finfish harvest. Catches from South Australia clearly dominated (62% of the total), with New South Wales, Western Australian and Victorian catches of secondary importance (10-12% of the total). There are a number of species of garfish, the southern sea garfish (*Hyporhamphus melanochir*) probably the most significant (especially in South Australia) followed by the river garfish (*H. regularis*).

The majority of the garfish catch, around 72%, was taken in coastal waters, estuary fishing produced about 23% and offshore fishing just 5% of the annual harvest. Line fishing methods accounted for 95% and nets about 5% of the harvest. About 70% of the garfish were caught from boats, compared to 30% from shore-based fishing.

Garfish was ranked as the third most abundant species taken in South Australia (14% of total numbers). The species accounted for between 2-3% of the finfish harvest in New South Wales, Western Australia and Victoria.

Tailor

Nationally about 2.3 million tailor were harvested (4% of finfish harvest), of which most were taken from New South Wales (44%), followed by Queensland (28%) and Western Australia (25%). The species was also reported from Victoria, Tasmania and, in very low numbers, from South Australia. Tailor were taken almost exclusively using line fishing methods, the majority caught in coastal waters (78%) and, to a lesser extent estuarine waters (21%). Offshore catches were very low (1%). Catches taken whilst fishing from the shore, as opposed to boat fishing, dominated (about 70%) the overall harvest.

In New South Wales tailor accounted for 7% of the finfish harvest, in Queensland 5% and Western Australia, where the species was the third most abundant finfish, 6%. In the other States, the proportion of the finfish harvest represented by tailor was below 1%.

Australian salmon

The national harvest of Australian salmon was assessed to be about 1.7 million fish or 3% of the finfish total. Catches were widely distributed but with production concentrated in South Australia (42% of national total), Victoria (31%) and Tasmania (18%). New South Wales (6%) and Western

Australia (2%) were of secondary importance. Line fishing accounted for the vast majority (99%) of the catch, with a very minor net component (1%). The catch was derived largely from coastal (76%) and estuarine waters (22%). Only small quantities (2%) were taken from offshore waters. The majority of the harvest (60%) was caught whilst fishing from the shore.

In Tasmania, Australian salmon represented the second most common finfish harvested (12% of State total). The species also represented a significant component of the finfish harvest in South Australia (7%) and Victoria (6%) but was a relatively minor component in New South Wales and Western Australia (<1%).

Pink snapper

An estimated 1.3 million pink snapper were harvested nationally, the species representing about 2% of the total finfish harvest. Catches were highest in Victoria (37% of total), followed by New South Wales (26%), Queensland (18%), Western Australia (10%) and South Australia (9%). The harvest reported from Tasmania was very low. Pink snapper were taken almost exclusively by line fishing, with catches from coastal (44%) and estuarine (30%) waters dominating. Unlike many other finfish, there was a significant offshore component to the catch (26%). Boat-based fishing accounted for the vast majority (95%) of the harvest.

As a proportion of the finfish harvest for each State, the species ranged from about 5% in Victoria to 2% in each of New South Wales and Queensland and 1% in both South Australia and Western Australia.

European carp

European carp have a wide distribution throughout the inland waters of New South Wales (including the Australian Capital Territory), Victoria, South Australia and extending into southern Queensland. Numerically the species was the dominant freshwater species harvested, around 2.1 million fish, accounting for about 3% of the total harvest of finfish. Harvest levels were highest in New South Wales (56% of total), with significant catches also taken in South Australia (23%) and Victoria (16%). Almost all of the catch was taken using lines, with rivers contributing 81% of the total and dams and lakes the remaining 19%. About 60% of the total harvest was taken whilst fishing from the shore.

At the State level, carp accounted for 8% of the New South Wales, 4% of the South Australian and 3% of the Victorian finfish harvests. Although catches of carp in the Australian Capital Territory were low in the context of the national fishery, the species was the most commonly retained fish (67% of the annual finfish harvest).

Redfin perch

As evidenced by distribution of recreational catches, redfin perch have established populations throughout the inland waters of southern Australia, including Tasmania. Overall, an estimated 1.3 million fish were harvested, the majority (73%) from Victorian waters. Catches from New South Wales contributed a further 19% while harvests from South Australia, Western Australia and Tasmania accounted for between 1-4% of the total. Redfin were exclusively taken on lines but, unlike carp, were mainly caught in lakes and dams (85%) as opposed to rivers (15%). Roughly equal quantities of redfin were taken from boat and shore based fishing activities.

In Victoria and the Australian Capital Territory, redfin was the third most abundant species harvested, accounting for 10% of the finfish harvest in both regions. In New South Wales the species represented about 2% of the harvest while in the other States it accounted for less than 1% of the catch.

Golden perch

An estimated 1.0 million golden perch were harvested by recreational fishers, equivalent to about 2% of total finfish harvest. Just over half (52%) were taken in New South Wales, with progressively lower harvest levels in Queensland (25%), Victoria (13%) and South Australia (8%). Small quantities (<1%) were also reported from the Australian Capital Territory and Western Australia. Golden perch were taken exclusively by line fishing, with the majority caught in rivers (60%) and the balance in lakes or dams (40%). Boat-based fishing accounted for slightly more than half of the total harvest.

In New South Wales, golden perch contributed 4% of the finfish harvest while in the Australian Capital Territory it was the second most abundant species harvested, accounting for 16% of the total finfish. In Queensland, Victoria and South Australia the species represented between 1-2% of the finfish harvest.

Trout/salmon

Trout, in particular brown trout (*Salmo trutta*) and rainbow trout (*Oncorhynchus mykiss*) were introduced into Australia specifically as sport fish and now support fisheries throughout south-eastern Australia, including Tasmania. Atlantic salmon (*S. salar)* have also been introduced, mainly for aquaculture (Tasmania), however, escapees from fish farms and introductions into inland waters mean that salmon are also taken by recreational fishers.

The overall harvest of trout/salmon was about 0.8 million fish, 45% of which were taken in Victoria, 30% in New South Wales and 26% in Tasmania. Minor quantities were also reported from Western Australia, South Australia and the Australian Capital Territory. The vast majority (99%) were taken by line fishing although a minor component was taken in nets. Catches were greatest in lakes and dams (64%)[11], followed by rivers (33%). A small proportion (3%) were also caught in saltwater, mainly sea run trout and salmon, some of which were taken using gillnets (Tasmania). Overall, the majority of the salmon/trout harvest (62%) was taken from shore-based fishing activities.

Trout/salmon were the third most commonly harvested finfish in Tasmania, representing 8% of total finfish numbers. In the Australian Capital Territory, Victoria and New South Wales, trout catches accounted for 7%, 4% and 2%, respectively of the finfish harvested.

Barramundi

Even though overall harvest of barramundi was relatively low by comparison to many other species, about 0.2 million fish, it has icon status as a sport fish in northern Australia. The harvest was highest in the Northern Territory (49% of the total) followed by Queensland (40%) and Western Australia (10%). Barramundi were captured in both fresh and saltwater; 49% from estuarine, 10% from coastal waters, 36% from rivers and 3% from lakes or dams. Boat-based fishing accounted for 72% of the harvest while the balance (28%) was taken from shore-based fishing activities.

The species represented a particularly significant component of the finfish harvest in the Northern Territory (16%, second to sea perch/snappers) but was of minor importance (<1%) in terms of numbers in Queensland and Western Australia.

[11] Note: 5% of the harvest was from privately owned waters, such as farm dams or private fisheries.

5.11.2.2. Non-fish

Recreational fishers harvested a wide diversity of non-fish species. Squid/cuttlefish, blue swimmer crabs (*Portunus pelagicus*), mud crabs (*Scylla* spp), lobsters and abalone were dominant among the larger non-fish species (Table 5.4, Appendix 5.13). Smaller organisms such as prawns, yabbies, crayfish, bivalve molluscs (especially mussels and pippis) and worms were also harvested in large numbers.

Fishing pots and traps were the main methods used to harvest crabs, lobsters and freshwater yabbies, underwater hand collection was also important in the harvest of lobsters and abalone while nets were the dominant method used to capture prawns (Table 5.6).

More detailed descriptions of the fisheries for selected fish species/species groups are presented below and reference should also be made to Figure 5.24, Tables 5.4-5.6 and Appendix 5.13.

Squid/cuttlefish

Nationally, recreational fishers harvested about 1.7 million squid, the majority (61%) of which were taken in South Australia (primarily southern calamary *Sepioteuthis australis*). Significant catches were also taken in Western Australia (13%), Victoria (12%) and New South Wales (9%) while moderate harvest levels were taken in Queensland (4%) and Tasmania (3%).

Line fishing (mainly lures or jigs) was by far the main capture method (98% of numbers), with nets and spears accounting for most of the balance. Almost two thirds of the harvest was taken whilst boat fishing. Squid/cuttlefish were primarily caught in coastal waters (77%) and to a lesser extent in estuaries (16%) and offshore waters (7%).

Blue swimmer crab

Blue swimmer crabs represented the most numerous of the crabs taken by recreational fishers, with a national harvest of approximately 3.9 million crabs. Harvest levels were greatest in Western Australia (57% of total), followed by South Australia (29%), New South Wales (11%) and Queensland (4%) in importance.

The majority of the harvest was taken using pots or traps (78%) with hand collection, nets, and line fishing accounting the bulk of the remainder. Just over half (52%) of the blue swimmer crabs were captured in estuarine waters, coastal waters contributed a further 46% and there was only a very minor (2%) offshore harvest component. Boat fishing activities accounted for the majority of the crabs harvested (77%).

Mud crab

Mud crabs occur in tropical and subtropical waters and the pattern of the recreational harvest reflects this distribution. A total of about 0.8 million mud crabs were harvested, the greatest quantity taken in Queensland (71%), with Western Australia (12%), the Northern Territory (10%) and New South Wales (6%) of secondary importance.

Pots and traps were the primary capture method for mud crabs, accounting for 92% of the catch. A relatively small component of the catch was taken using lines and hand collection (using hooks or gaffs). Based on harvest proportion, boats represented main fishing platform used to capture mud crabs (74%), with the fishery concentrated in estuarine (74% of the harvest) and to a lesser extent inshore coastal waters (24%).

Lobsters

Recreational fishers harvest a variety of marine lobster species. Species include the western rock lobster (*Panulirus cygnus*), the dominant species in Western Australia, southern rock lobster (*Jasus edwardsii*), the dominant species in South Australia, Victoria and Tasmania, eastern rock lobster (*J. verreauxi*), the main species in New South Wales, and the ornate lobster (*P. ornatus*) from tropical Australia. The majority of the approximately 0.7 million lobster harvested were taken in Western Australia (59%), with catches from South Australia (17%), Tasmania (13%) and Victoria (7%) of secondary importance. Comparatively minor quantities were taken in Queensland (3%) and New South Wales (2%), with a negligible take from the Northern Territory.

Pots were the main method used to catch lobsters (67%) with dive collection also important (32%). Catches were largely restricted to coastal waters (90%), the offshore harvest component was comparatively low (10%). The vast majority of the lobster harvest (92%) was taken using a boat as the fishing platform.

Abalone

Nationally, about 0.4 million abalone were harvested, with the fishery concentrated in Western Australia (56%) and Tasmania (28%). Of secondary importance were fisheries in New South Wales (9%), South Australia (5%) and Victoria (3%). Several species of abalone are harvested, they include roes abalone (*Haliotis roei*), blacklip abalone (*H. rubra*), greenlip abalone (*H. laevigata*) and brownlip abalone (*H. conicopora*). Roes abalone accounted for the vast majority (about 90% of numbers) of the Western Australian harvest whereas blacklip abalone dominated the Tasmanian catch.

Virtually all of the abalone harvested (99%) were taken from inshore coastal waters with dive collection accounting for about 68% and hand collection (wading) the balance (32%). Hand collection was primarily used to gather roes abalone in Western Australia. Fishers operating from the shore accounted for the bulk (72%) of the abalone harvest.

Prawns

Significant recreational fisheries for prawns (various species) exist in Australia, in particular in New South Wales and Queensland, with prawns either consumed or used for bait. Nationally, an estimated 18.8 million prawns were harvested by recreational fishers, over half (59%) of which were reported from New South Wales. Catches in Queensland (29%) were of secondary importance while levels of harvest in Victoria and Western Australia were low, but significant (5-6%). In addition about 1.2 million *macrobrachium* were harvested, the majority (86%) reported from South Australia.

Prawns were primarily harvested from estuarine waters (83%) and to a lesser extent inshore coastal waters (9%) and rivers (6%). By contrast, *macrobrachium* were mostly taken from rivers (94%), reflecting their distribution in freshwater habitats. Nets represented the dominant fishing methods for prawns (93% of the catch) whereas traps were the main method for *macrobrachium* (82%). Fishing from boats was more important for prawns in general (60% harvest) whereas most of the *macrobrachium* (73%) were derived from shore-based fishing activity.

Freshwater crayfish

A variety of freshwater crayfish, including gilgie (*Cherax quinqecarinatus*), koonac (*C. preissii*), marron (*C. tenimanus*), red claw (*C. quadricarinatus*) and yabbies (*C. destructor*), are known to be targeted by recreational fishers. The annual harvest of freshwater crayfish was estimated at about 7.4 million individuals, with highest catches in Queensland (31%), New South Wales (26%) and Victoria (25%). Fisheries in Western Australia and South Australia were of secondary importance

(8-9% of total harvest). Harvest levels in the Australian Capital Territory, Northern Territory and Tasmania were very minor in the context of the overall fishery.

The majority of the catch (62%) was taken from lakes or dams, with rivers accounting for the balance. Traps represented the primary fishing method (accounting for about 81% of the harvest) followed by nets (8%) and lines (8%). Fishing from the shore, as opposed to boats, produced the bulk of the harvest (72%).

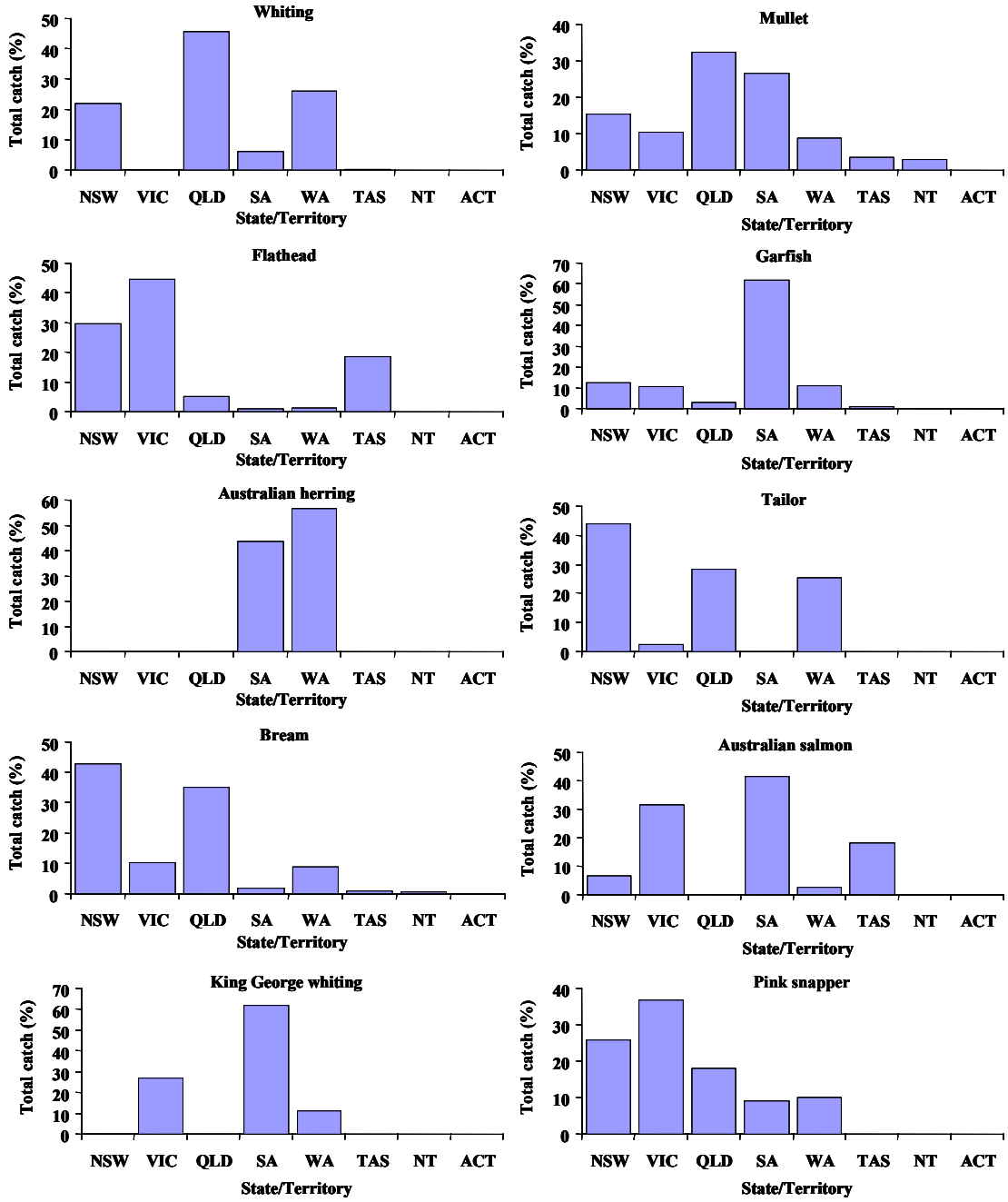

Figure 5.24. Relative distribution of the annual recreational harvest (based on numbers) by State and Territory fished for key recreational species.

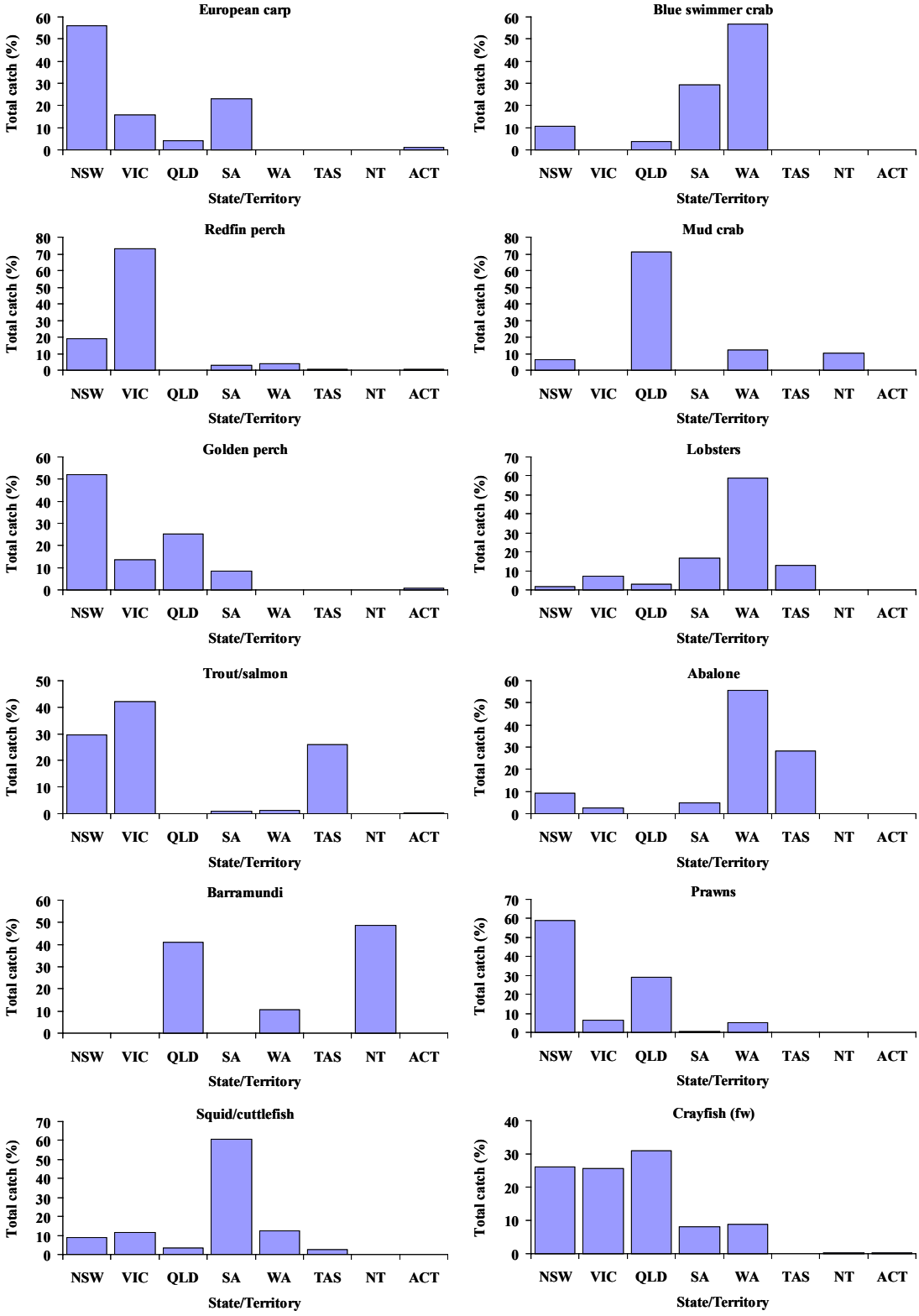
European carp
Blue swimmer crab
Redfin perch
Mud crab
Golden perch
Lobsters
Trout/salmon
Abalone
Barramundi
Prawns
Squid/cuttlefish
Crayfish (fw)
Total catch (%)
NSW VIC QLD SA WA TAS NT ACT
State/Territory

Fig 5.24. (cont)

Table 5.4. Estimated annual harvest (numbers) taken by Australian recreational fishers, aged 5 or older, for key species by State and Territory fished.

Species/ species group	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Total
Whiting	1,791,276	4,997	3,704,448	499,432	2,126,680	12,215	2,069		8,141,117
Flathead	2,217,059	3,316,071	380,947	72,105	79,061	1,377,350	1,467		7,444,060
Australian herring		11,354		2,973,402	3,873,411				6,858,166
Bream	2,082,149	506,704	1,684,719	81,088	424,242	45,396	20,625		4,844,924
King George whiting		975,349		2,238,071	408,209				3,621,629
Mullet	445,036	301,848	944,555	775,361	258,676	99,130	86,287		2,910,892
Garfish	302,297	255,199	69,889	1,511,250	275,295	19,549	4,788		2,438,267
Tailor	1,010,943	57,428	651,069	151	587,041	1,721			2,308,352
Australian salmon	110,988	541,852		715,768	41,695	314,221			1,724,524
Pink snapper	334,191	474,879	232,354	115,798	130,251	352			1,287,826
Trevally	250,087	107,241	151,714	80,620	363,710	23,770	17,988		995,131
Leatherjackets	385,594	166,378	5,371	155,168	34,420	20,090			767,022
Wrasse/tuskfish/gropers	149,636	120,689	165,906	64,672	192,238	22,792	14,789		730,723
Luderick	622,511	33,273	1,995	3,563		1,879			663,221
Sea perch/snappers	20,765		405,265		68,825		160,959		655,814
Emperors	3,345		438,518		199,374		12,195		653,432
Pike	31,461	257,795	50,149	185,947	60,864	10,481	11,419		608,117
Grunters/trumpeters	4,581		221,467	268,366	68,534		21,836		584,783
Blue mackerel	427,062	7,057	8,997	45,044	78,631	2,528			569,319
Scads/mackerel	218,237		94,437	2,679	125,746	33,571			474,670
Mackerels	25,725		339,445		85,208		21,292		471,671
Cod (various)	16,265	12,158	185,603	13,675	55,525	66,829	19,924		369,980
Dart	115,287		231,084		11,818				358,189
Catfish	94,222	7,436	210,615	2,480	27,460		3,736		345,950
Mulloway/jewfish	136,852	5,421	73,243	27,004	62,928		18,012		323,459
Coral trout			270,713		38,975		9,939		319,627
Morwong	186,572	4,688	17,541	5,527	27,462	38,291			280,081
Flatfish	99,915	37,572	45,251	2,994	14,663	71,160			271,555
Tuna/bonitos	140,747		41,153	1,576	28,857	12,737	7,280		232,350
Red emperor	172		204,076		18,010		6,342		228,600

Table 5.4. (cont)

Species/ species group	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Total
Sharks/rays	30,093	89,423	35,899	30,722	24,432	9,808	7,942		228,320
Sweep	92,678	26,324	524	57,864	28,944	633			206,966
Threadfin salmon			103,278		44,724		36,899		184,901
Kingfish/ Samson fish	90,001	375	5,121	6,160	10,890	1,505			114,053
Rock-cod/gropers	2,457		14,155	198	90,861	504	102		108,277
Dhufish					102,848				102,848
European carp	1,168,881	328,189	80,227	483,310		0		23,940	2,084,548
Redfin perch	244,596	949,351		40,410	47,384	9,316		3,454	1,294,511
Golden perch	542,107	142,276	261,688	86,732	1,258			5,846	1,039,907
Trout/salmon	244,470	345,894		6,871	10,246	214,582		2,495	824,558
Australian bass/perch	93,150	74,931	97,789	8,530	5,059	51	1,100		280,612
Barramundi			88,155		22,570		105,131		215,857
Murray cod	93,973	11,943	158	2,278					108,352
Other finfish	532,398	388,012	469,612	252,340	285,261	169,995	46,608		2,144,226
Squid/cuttlefish	154,627	199,202	61,255	1,047,904	216,850	44,438	264		1,724,540
Blue swimmer crab	412,883		140,242	1,139,795	2,211,466		671		3,905,057
Mud crab	51,724		585,502		100,289		82,371		819,886
Lobsters	10,569	51,228	19,652	113,679	403,833	86,976	494		686,431
Abalone	35,233	10,355		17,780	214,351	108,495			386,214
Prawns	11,074,232	1,188,236	5,461,783	101,547	943,458	9,646	9,731		18,788,633
Macrobrachium/cherabin	20,292			1,065,271	130,473		15,424		1,231,459
Yabbies/nippers (sw)	3,033,392	370,036	16,671,929		7,578				20,082,936
Crayfish (fw)	1,938,164	1,887,942	2,300,453	593,113	645,465	1,422	15,391	19,936	7,401,886

Table 5.5. Estimated annual harvest (numbers) taken by Australian recreational fishers, aged 5 or older, for key species by water body type.

Species/ species group	Offshore	Coastal	Estuary	River	Lakes/ dams	Total
Whiting	417,974	4,888,875	2,834,268			8,141,117
Flathead	211,401	2,953,551	4,279,108			7,444,060
Australian herring	227,583	6,280,965	349,618			6,858,166
Bream	33,073	2,129,735	2,678,547	3,568		4,844,924
King George whiting	369,628	2,304,527	947,474			3,621,629
Mullet	5,535	1,367,195	1,415,043	118,324	4,795	2,910,892
Garfish	136,467	1,748,832	551,620		1,348	2,438,267
Tailor	13,240	1,804,398	490,713			2,308,352
Australian salmon	33,928	1,317,539	373,057			1,724,524
Pink snapper	341,606	559,598	386,621			1,287,826
Trevally	148,379	616,746	230,006			995,131
Leatherjackets	44,590	376,722	345,710			767,022
Wrasse/tuskfish/gropers	226,083	413,128	91,511			730,723
Luderick	205	281,200	381,816			663,221
Sea perch/snappers	329,353	194,491	130,209	1,762		655,814
Emperors	462,054	185,634	5,745			653,432
Pike	43,966	290,008	274,144			608,117
Grunters/trumpeters	22,340	357,002	135,486	50,326	19,630	584,783
Blue mackerel	47,179	472,673	49,468			569,319
Scads/mackerel	49,689	306,758	118,223			474,670
Mackerels	120,916	325,801	24,954			471,671
Cod (various)	91,990	144,564	108,984	21,584	2,857	369,980
Dart	5,415	336,860	15,914			358,189
Catfish	2,032	33,305	135,182	97,620	77,812	345,950
Mulloway/jewfish	55,251	184,653	83,555			323,459
Coral trout	270,684	46,993	1,950			319,627
Morwong	70,935	195,935	13,211			280,081
Flatfish	1,600	139,540	130,416			271,555
Tuna/bonitos	74,714	147,317	10,319			232,350
Red emperor	68,242	159,134	1,224			228,600
Sharks/rays	22,765	115,085	90,304	167		228,320
Sweep	10,184	174,800	21,982			206,966
Threadfin salmon	11,960	76,301	95,764	877		184,901
Kingfish/ Samson fish	19,202	78,840	16,012			114,053
Rock-cod/gropers	70,112	31,190	6,975			108,277
Dhufish	84,466	18,327	55			102,848
European carp			10,151	1,685,222	389,175	2,084,548
Redfin perch				191,216	1,103,295	1,294,511
Golden perch				626,584	413,323	1,039,907
Trout/salmon		12,962	8,628	271,707	531,262	824,558
Australian bass/perch			15,764	137,353	127,495	280,612
Barramundi	977	23,337	105,770	78,328	7,446	215,857
Murray cod				98,674	9,678	108,352
Other finfish	297,787	1,120,577	346,882	95,121	283,859	2,144,226

Table 5.5. (cont)

Species/ species group	Offshore	Coastal	Estuary	River	Lakes/dams	Total
Squid/cuttlefish	113,010	1,331,220	280,309			1,724,540
Blue swimmer crab	82,172	1,791,663	2,031,222			3,905,057
Mud crab	1,686	201,975	611,202	5,023		819,886
Lobsters	69,925	615,845	661			686,431
Abalone	1,998	383,882	334			386,214
Prawns		1,699,417	15,603,812	1,178,178	307,227	18,788,633
Macrobrachium/cherabin			52,033	1,161,784	17,643	1,231,459
Yabbies/nippers (sw)		7,061,771	13,021,166			20,082,936
Crayfish (fw)				2,839,509	4,562,378	7,401,886

Table 5.6. Estimated annual harvest (numbers) taken by Australian recreational fishers, aged 5 or older, for key species by method. Boat-based proportion of the total harvest is indicated.

Species/ species group	Line	Pots/traps	Nets	Dive	Other	Total	% boat caught
Whiting	8,087,790		40,891	12,436		8,141,117	67.5
Flathead	7,406,969	523	12,836	22,808	924	7,444,060	90.5
Australian herring	6,832,685	468	17,316	7,698		6,858,166	34.2
Bream	4,785,507	1,745	26,187	31,484		4,844,924	51.4
King George whiting	3,612,798	949	620	7,261		3,621,629	91.1
Mullet	1,582,484	174,947	1,148,158	5,303		2,910,892	30.0
Garfish	2,310,946	2,340	113,487	8,897	2,597	2,438,267	69.2
Tailor	2,303,474		4,877			2,308,352	26.7
Australian salmon	1,705,900	109	16,577	1,938		1,724,524	40.5
Pink snapper	1,287,451	36		339		1,287,826	94.6
Trevally	983,849		6,401	4,881		995,131	61.2
Leatherjackets	683,649	8,099	13,362	61,912		767,022	74.3
Wrasse/tuskfish/gropers	707,009	313	8,923	14,479		730,723	82.3
Luderick	632,767		269	30,186		663,221	24.5
Sea perch/snappers	653,061	79	1,171	1,503		655,814	91.1
Emperors	652,852	98		482		653,432	95.4
Pike	606,239	51	1,389	438		608,117	88.5
Grunters/trumpeters	579,053	1,400	2,704	1,626		584,783	65.8
Blue mackerel	569,319					569,319	67.8
Scads/mackerel	461,662	140	12,843	25		474,670	58.0
Mackerels	471,268		254	149		471,671	91.3
Cod (various)	353,998	3,028	7,554	5,399		369,980	79.7
Dart	358,189					358,189	7.6
Catfish	337,275	1,194	1,939	5,543		345,950	51.0
Mulloway/jewfish	317,871	1,207	2,073	2,308		323,459	56.9
Coral trout	308,159			11,469		319,627	98.9
Morwong	233,470	67	19,170	27,375		280,081	90.2
Flatfish	161,591		14,182	95,783		271,555	59.2
Tuna/bonitos	232,350					232,350	91.1
Red emperor	228,562			38		228,600	99.8
Sharks/rays	222,855	327	2,411	2,727		228,320	74.2
Sweep	197,715			9,251		206,966	78.8
Threadfin salmon	183,720	128	370	682		184,901	76.0
Kingfish/ Samson fish	113,102		16	935		114,053	90.5
Rock-cod/gropers	106,356		146	1,775		108,277	94.4
Dhufish	98,623			4,225		102,848	99.8

Table 5.6. (cont)

Species/ species group	Line	Pots/traps	Nets	Dive	Other	Total	% boat caught
European carp	2,056,376	10,401	4,314	292	13,166	2,084,548	39.3
Redfin perch	1,294,511					1,294,511	53.3
Golden perch	1,039,670	50	102	85		1,039,907	57.2
Trout/salmon	816,564		7,964	31		824,558	37.6
Australian bass/perch	266,966	2,737	10,910			280,612	44.2
Barramundi	215,256	117	29	455		215,857	72.4
Murray cod	106,456	1,896				108,352	64.9
Other finfish	1,945,054	38,377	85,474	53,879	21,441	2,144,226	65.5
Squid/cuttlefish	1,689,148	4,428	13,666	9,493	7,805	1,724,540	65.1
Blue swimmer crab	141,491	3,055,529	295,805	46,983	365,250	3,905,057	76.8
Mud crab	49,065	750,586	1,793	1,206	17,235	819,886	74.4
Lobsters	5,699	458,874	215	220,812	831	686,431	92.4
Abalone	1,319		25	261,378	123,492	386,214	27.8
Prawns	105,251	1,158,259	17,482,618	7,433	35,073	18,788,633	60.9
Macrobrachium/cherabin	20,081	1,012,429	198,125	147	677	1,231,459	27.4
Yabbies/nippers (sw)		25,185	173,500		19,884,251	20,082,936	7.0
Crayfish (fw)	555,694	6,010,192	593,697		242,303	7,401,886	28.0

5.11.3. Release Rates

Recreational fishers release or discard fish for a variety of reasons, these include fisheries regulation (size limits, bag limits or closed seasons), poor eating quality, damage (due to capture, including predation), catch and release fishing and/or for ethical reasons. The influence of these factors will vary between individual fishers and species but information on the released component of the catch has relevance as a measure of fishing success (i.e. whether any fish were caught or not), the need for and effectiveness of catch regulations (size and bag limits) and potential issues relating to post-release survival.

In order to examine the significance of the released component of the catch for key recreational species, numbers of released individuals have been compared with the retained component (Table 5.7, Appendix 5.14). This analysis clearly demonstrated that significant numbers of fish caught by recreational fishers were not retained with, for example, over 18 million flathead, bream and whiting released nationally. The actual proportion of the catch released varied substantially between species, though three categories can be distinguished, namely species for which release rates were high (61-100%), medium (31-60%) or low (0-30%) (Table 5.7, Appendix 5.14).

Species for which release rates were in the high category included salt and freshwater finfish such as sharks/rays, Murray cod, Australian bass/perch, catfish, barramundi, red emperor, pink snapper, bream, cod and wrasse/tuskfish/gropers. It is likely that many of the sharks/rays, catfish and wrasse were released because of perceived poor eating qualities, while size-related factors (primarily occurrence of undersized individuals) were likely to have been important for the remaining species. A wide variety of fish occupied the medium rate of release category, including the marine species such as sea perches/snappers, emperors, mulloway/jewfish, flathead, trevally, tailor, mackerels, whiting, Australian salmon, and luderick. Freshwater species in this category included trout/salmon, golden perch and redfin perch. Species for which rates of release were low included King George whiting, Australian herring, garfish and European carp. Interestingly, even though many Australians do not favour the eating qualities of the latter species, carp were rarely

released, largely reflecting the noxious status of the species and the fact that in some States it is an offence to release the species (back) into waterways.

Amongst the non-fish, high release rates were recorded for mud crabs, medium levels for lobsters and blue swimmer crabs and low levels for abalone, squid/cuttlefish, prawns and freshwater yabbies. Size limits and restrictions on the harvesting of female lobsters and crabs no doubt have some impact on the quantities released.

Table 5.7. Estimated annual harvest and released/discarded catch (numbers) taken by Australian recreational fishers, aged 5 or older, for selected species. Released proportion of the catch is indicated.

Species/ species group	Harvest	Released/discarded	Total catch	% released
Sharks/rays	228,320	1,024,408	1,252,728	81.8
Catfish	345,950	1,024,400	1,370,351	74.8
Grunters/trumpeters	584,783	1,311,569	1,896,352	69.2
Red emperor	228,600	487,685	716,284	68.1
Pink snapper	1,287,826	2,535,955	3,823,780	66.3
Bream	4,844,924	8,201,492	13,046,416	62.9
Cod (various)	369,980	608,115	978,095	62.2
Wrasse/tuskfish/gropers	730,723	1,179,060	1,909,783	61.7
Dart	358,189	511,497	869,686	58.8
Kingfish/ Samson fish	114,053	137,079	251,132	54.6
Sea perch/snappers	655,814	718,458	1,374,272	52.3
Emperors	653,432	682,717	1,336,149	51.1
Sweep	206,966	189,228	396,195	47.8
Mulloway/jewfish	323,459	276,567	600,026	46.1
Leatherjackets	767,022	647,255	1,414,276	45.8
Flathead	7,444,060	6,017,507	13,461,567	44.7
Rock-cod/gropers	108,277	71,530	179,807	39.8
Flatfish	271,555	173,423	444,978	39.0
Threadfin salmon	184,901	117,857	302,758	38.9
Trevally	995,131	632,387	1,627,518	38.9
Tailor	2,308,352	1,410,814	3,719,166	37.9
Mackerels	470,215	270,045	740,260	36.5
Dhufish	102,848	56,884	159,733	35.6
Coral trout	318,171	173,249	491,420	35.3
Scads/mackerel	474,670	250,198	724,868	34.5
Whiting	8,141,117	4,238,624	12,379,741	34.2
Tuna/bonitos	232,350	120,879	353,229	34.2
Australian salmon	1,724,524	875,106	2,599,630	33.7
Luderick	663,221	333,072	996,293	33.4
King George whiting	3,621,629	1,277,542	4,899,170	26.1
Mullet	2,910,892	963,040	3,873,932	24.9
Morwong	280,081	75,294	355,375	21.2
Blue mackerel	569,319	151,495	720,814	21.0
Pike	608,117	126,356	734,473	17.2
Australian herring	6,858,166	1,385,584	8,243,750	16.8
Garfish	2,438,267	339,589	2,777,856	12.2
Murray cod	108,352	374,932	483,284	77.6
Australian bass/perch	280,612	869,571	1,150,183	75.6
Barramundi	215,857	545,816	761,673	71.7
Trout/salmon	824,558	868,297	1,692,856	51.3
Golden perch	1,039,907	817,853	1,857,760	44.0
Redfin perch	1,294,511	968,985	2,263,496	42.8
European carp	2,084,548	269,421	2,353,970	11.4
Mud crab	819,886	1,759,843	2,579,729	68.2
Lobsters	686,431	658,781	1,345,212	49.0
Blue swimmer crab	3,905,057	2,703,920	6,608,977	40.9
Squid/cuttlefish	1,724,540	67,536	1,792,076	3.8

5.11.4. Harvest Weights

Catch information reported during the diary survey was based on numbers rather than weight or size (length) since these latter parameters tend to be less reliably estimated when self-reported by recreational fishers. However, the weight of the recreational harvest of some species is of particular interest to resource managers, scientists, the broader fishing community (commercial and recreational) and other stakeholder groups with an interest in the aquatic environment. Commercial production is generally reported in terms of weight and thus to permit comparisons between sectors for species that are caught by both sectors it is desirable to report recreational harvest of some species as weights.

It is possible to approximate recreational harvest weights for a given species by multiplying numbers caught by the average weight of each harvested individual. However, achieving accuracy and precision in determining average individual weight for a species is complex because fish populations tend to exhibit structuring based on size (and age) over a range of temporal and spatial scales. For example, for many marine fish species, smaller individuals are located inshore whereas larger individuals move offshore into deeper water, so the location of fishing may influence the size of fish caught. Similarly, time of year can influence not only catch rates but also the size of fish available to fishers. There are issues of gear selectivity, skill and personal ethics of individual fishers that will also affect the sizes of fish captured and retained. Ideally all of these factors should be taken into account when calculating average individual weight estimates. As this is rarely the case in large-scale studies, and was beyond the scope of the limited on-site surveys undertaken as part of this national survey, the simple application of an average individual weight will introduce a degree of uncertainty to the harvest (weight) estimates for a given species. Furthermore, in this national survey related species were generally grouped together for reporting purposes, thereby further confounding the notion of a simple average individual weight for all the species in a group. For these reasons it is necessary to view harvest weights for particular species or species groups as indicative rather than absolute point estimates of recreational fishery production.

On-site creel surveys conducted during the present survey, results of previous studies (where necessary and appropriate) and information from alternative sources, such as commercial size composition information, have been used to estimate the mean size of fish retained by recreational fishers (Appendix 5.15). Where lengths were available, length/ weight relationships have been used to derive mean weights and these have been applied to harvest numbers (Table 5.4) to derive catch weights of the recreational catch (Table 5.8).

Whilst there is uncertainty about the precision of the weights reported in Table 5.8 and only selected species or species groups are presented, these data suggest that for the period May 2000 to April 2001, the total recreational harvest of finfish was in excess of 27,000 tonnes nationally, with at least a further 3,000 tonnes of non-fish species also taken. Finfish production for the selected species in Table 5.8 was greatest in Queensland (over 8,100 tonnes) followed by New South Wales (6,600 tonnes), Western Australia (4,800 tonnes) and South Australia (3,300 tonnes). Non-fish catches were high in Western Australia (1,000 tonnes), South Australia (900 tonnes) and Queensland (800 tonnes). Catches of several species groups exceeded 1,000 tonnes nationally, including whiting, flathead, bream, Australian salmon, pink snapper, emperors, mackerels, tunas/bonitos, sharks/rays, European carp and blue swimmer crabs.

The conversion of harvest numbers to weight had a profound impact on the relative importance of the various species groups. For instance, by weight flathead (2,300 tonnes), mackerels (1,800 tonnes) and bream (1,700 tonnes) comprised the top three finfish species. Other species for which consideration of weight resulted in marked increases in significance included pink snapper (1,400 tonnes), tuna/bonitos (1,300 tonnes), sharks/rays (1,200 tonnes), emperors (1,000 tonnes), red

emperor (1,000 tonnes), mulloway/jewfish (900 tonnes), barramundi (700 tonnes) and coral trout (700 tonnes). By contrast, weights resulted in reduced rankings for species such as whiting (1,200 tonnes), King George whiting (900 tonnes), Australian herring (800 tonnes), tailor (600 tonnes), mullet (500 tonnes), redfin perch (300 tonnes) and garfish (200 tonnes). Catches of the latter group were, however, still substantial.

The provision of harvest weights for selected species enables comparison to be made with commercial production levels of the same species and has relevance for stock assessment and management, including issues relating to resource sharing and allocation. This survey has clearly established that, for a wide range of species, recreational catches are significant, and in some instances may be equivalent to or exceed commercial production. This aspect will be expanded upon in subsequent survey reports to be produced by the participating fisheries agencies.

Table 5.8. Estimated annual harvest (kilograms) taken by Australian recreational fishers, aged 5 or older, for selected species by State or Territory fished.

Species/species group	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	Total
Whiting	394,081	1,099	444,534	104,881	225,428	1,307	331		1,171,661
Flathead	886,824	596,893	419,042	18,964	43,088	360,866	734		2,326,409
Australian herring		1,135		297,340	522,910				821,386
Bream	728,752	202,682	561,011	31,949	144,667	29,008	8,250		1,706,319
King George whiting		214,577		606,517	105,726				926,820
Mullet	151,312	60,370	94,456	82,964	64,410	26,765	17,257		497,534
Garfish	22,672	25,520	5,242	132,990	45,148	2,346	359		234,277
Tailor	252,736	14,357	162,767		187,266	430			617,556
Australian salmon	221,976	270,926		372,199	136,301	111,234			1,112,636
Pink snapper	116,967	332,415	309,031	370,554	292,023	950			1,421,940
Trevally	87,530	37,534	235,157	18,301	249,141	5,396	26,982		660,041
Leatherjackets	107,966	49,913	1,504	40,189	23,061	8,799			231,432
Wrasse/tuskfish/gropers	52,373	84,482	308,585	22,635	305,851	13,424	14,789		802,139
Luderick	280,130	13,309	898	1,603		846			296,786
Sea perch/snappers	18,481		360,686		47,765		144,863		571,794
Emperors	5,988		784,947		237,853		7,317		1,036,105
Mackerels	128,625		1,160,902		360,259		138,852		1,788,638
Cod (various)	8,133	2,432	386,054	6,838	79,345	31,343	19,924		534,069
Catfish	94,222	7,436	296,967	2,480	27,460		3,736		432,301
Mulloway/jewfish	273,704	10,842	84,229	90,193	359,696		156,704		975,370
Coral trout			549,547		108,234		8,483		666,264
Morwong	139,929	3,516	13,156	11,054	94,085	45,298			307,038
Tuna/bonitos	844,482		243,626	28,368	143,910	45,356	21,840		1,327,582
Red emperor			908,138		66,367		9,513		984,018
Kingfish/Samson fish	180,002	750	13,110	61,600	98,642	3,010			357,113
Dhufish					577,800				577,800
European carp	876,661	246,142	60,170	273,553				17,955	1,474,481
Redfin perch	61,149	237,338		10,103	16,584	2,329		864	328,366
Golden perch	325,264	85,366	316,642	91,069				3,508	821,848
Trout/salmon	122,235	172,947		3,436	4,611	156,645		1,248	461,121
Australian bass/perch	46,575	37,466	68,452						152,493
Barramundi			230,085		78,995		367,959		677,039
Murray cod	93,973	27,469		22,780					144,222
Squid/cuttlefish	65,716	89,641	26,033	423,353	76,331	26,663			707,737
Blue swimmer crab	154,831		46,701	389,810	493,157				1,084,499
Mud crab	30,000		585,502		134,488		65,897		815,886
Lobsters	7,398	61,474	13,756	95,490	201,917	73,060			453,095
Abalone	10,570	3,107		8,588	30,223	52,078			104,565
Prawns	110,742	11,882	54,618	1,015	16,039		97		194,394
Crayfish (fw)	77,527	75,518	92,018	23,725	37,437		616	797	307,637

5.12. Expenditure by Recreational Fishers

Expenditure information was collected during the diary and supplementary surveys (refer section 5.5.4) for a wide range of items and services related to recreational fishing activity. This information, whether used independently or in conjunction with socio-demographic and fisher behavioural data, may be used to assess a wide range of public policy issues and questions. Information presented in this report, however has been confined to an analysis of economic activity for certain items and services and, importantly, does not in itself represent a measure of valuation of recreational fishing. A separate and more detailed economic report will be made available at a later date.

5.12.1. The Nature of the Expenditure Data

In providing expenditure information, respondents identified the item or service provided, the price paid, when the expenditure occurred and where the expenditure occurred, defined in terms of economic zones within or outside the respondent's state of residence. Apart from private vehicle travel, dollar values were collected for items or services. For practical reasons, distance travelled was employed for private vehicle travel and a rate of $0.50 per kilometre applied to cover vehicle running costs. Consequently, vehicle travel costs cannot be readily defined in terms of where the 'expenditure' occurred.

Reported expenditure by recreational fishers (household basis) included items and services that may not have been wholly 'consumed' during the reference period (e.g. capital expenditure on a fishing reel used over many years). Conversely, certain items and services that were 'consumed' during the survey period, but purchased prior to this, were routinely excluded.

In collecting expenditure data, it was not possible to maintain an explicit link between the expenditure and fishing events. However, implicit links may be established between expenditure and classes of fishing events. Explicit links exist with the respondent's socio-economic characteristics including age, gender, ethnicity, employment and home location, and location of expenditure on an item or service and time of year in which the expenditure occurred.

The introduction of a supplementary survey was designed to minimise the respondent's reporting burden and was applied on a random basis to each respondent household for a two-month period during the diary survey. The supplementary survey was used to obtain additional expenditure data on food and drink and vehicle expenses (fuel, oil, repairs and maintenance) for fishing related activities that occurred 'away from home'. For this purpose, away from home expenditure was defined as expenditure that was incurred on a fishing-related trip more than 40 kilometres by road from home. A detailed analysis of away from home expenditure relating to food and drink and vehicle expenses will be undertaken in a subsequent economic report.

Items excluded from the economic analysis include motor vehicle purchases, real estate purchases and communication costs (telephone, postage and internet).

5.12.2. Attribution of Expenditure

Respondents were asked to provide an estimate of the proportion of their expenditure *associated* with fishing that they thought to be *attributable* to recreational fishing – as against any other activity incurred on the fishing trip or any other future use to be made of the item or service purchased. Attribution of expenditure relates to the recreational choice and the use made of the expenditure item or service, as assessed by the respondent. For those expenditure items and services with no association with recreational fishing, such as golf green fees, no data was collected

(Figure 5.25). For those expenditure items and services wholly or partly associated with recreational fishing, such as fishing gear and transport, respondents were asked to provide an estimate of that proportion of the associated expenditure they attributed to recreational fishing.

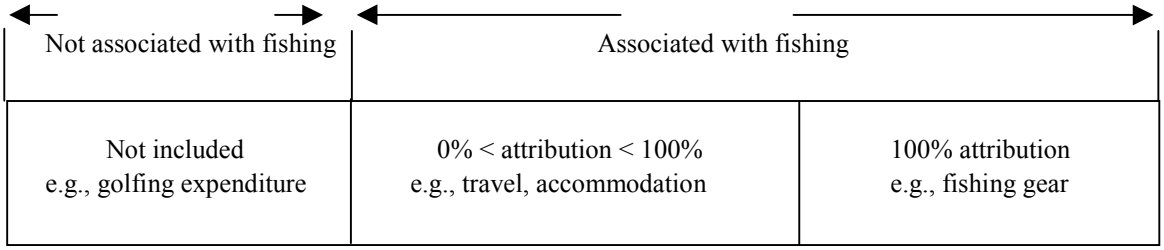

Figure 5.25. Relationship between associated and attributable expenditure.

Recreational fishing is a form of activity involving the consumption of commodity and environmental services by people who travel to destinations away from their normal place of accommodation or work (Corcoran *et al*, 1998). A recreational trip that includes fishing might involve an individual or a group and it might be for the sole purpose of recreational fishing or for a range of other activities in addition to recreational fishing such as visiting friends and relatives, touring, walking, boating, swimming, camping, sightseeing and work. As well as trip expenses, other items or services purchased before or during a trip might provide input to a range of activities in addition to recreational fishing. While some items, such as fishing rods and lures, were given a 100% attribution to recreational fishing, other items, such as a boat, could be used for activities in addition to fishing, such as water skiing. Therefore levels of attribution may differ depending on the characteristics of the activity in which the item or service was used.

With this in mind, diarists were asked to provide an estimate of the proportion of their expenditure they would attribute to participation in recreational fishing. This estimated value was then used as a proportional coefficient or weighting to provide an estimate of the amount of associated expenditure to be attributed to (or explained by the respondent's participation in) recreational fishing. At the time of the interview, it was carefully explained to respondents that all activities by all people benefiting from their expenditure was to be taken into accounted in making this assessment. Attribution, in this case, was on the basis of the respondent's assessment of their own expenditure and the use made for recreational fishing, of the items and services purchased, by everybody on that trip.

However, some uncertainties exist in the use of attribution data. A difficulty in the collection of attribution data within the context of a fishing survey is that respondents are likely to be more aware of recreational fishing than of other activities. Thus there is potential for respondents to provide a higher level of attribution to recreational fishing than would occur in an activity neutral context. The effect of such non-sampling error is unknown.

5.12.3. Economic Characteristics

The economic characteristics of the expenditure data will affect how the data can be used and the policy inferences that might be drawn. Expenditure on items, such as bait, berley, fuel, and services such as fishing guides and accommodation, are variable inputs to recreational fishing, because the amount used varies in line with fishing effort or the length of the fishing trip in distance from home and duration. Other expenditure items, such as fishing gear, boats, boat trailers, camping gear and annual fees and licences are constant or fixed regardless of the amount

of fishing effort. Accordingly, the amount of expenditure incurred on such items/services cannot be explained by or attributed to a particular fishing trip and are fixed capital costs.

However, the variable/fixed dichotomy is not this simple. For example, if a fisher hires or leases rather than buys a capital item, such as a boat, diving equipment or camping gear, the amount of expenditure varies according to the level of fishing effort or number of days the item is hired. Expenditure in these instances is a variable cost. In addition, the concept of 'user cost' (Keynes, 1936), which is a measure of the wear-and-tear from the use of piece of a fixed capital item, is used when estimating vehicle cost. That is, vehicle costs involve variable cost inputs such as fuel, oil and repairs and the fixed costs of the vehicle, licences, insurance and holding cost (interest on capital). Vehicle travel expenditure data presented here was estimated on the basis of kilometres travelled multiplied by $0.50, where the kilometre charge includes an allowance for wear-and-tear (user cost) on the basis of distance travelled.

5.12.4. Attributable Expenditure by State/ Territory of Residence

Estimated total attributable expenditure (excluding food and drink and certain vehicle expenses, refer section 5.12.1) by Australian recreational fishers between May 2000 and April 2001 was $1.86 billion (Table 5.9, Appendix 5.16). Expenditure patterns were generally related to fisher population size, with New South Wales residents accounting for about 30% of the fisher population and 30% of the national expenditure attributed to fishing (Table 5.9). Victoria (21%), Western Australia (18%) and Queensland (17%) followed in the proportion of national expenditure attributed to recreational fishers. On average, Australian recreational fishers spent $552 per fisher per annum with the highest average expenditure by residents of Victoria ($721) followed by Western Australia ($706) and Northern Territory ($608) (Table 5.9). Average expenditure levels below the national average emerged in South Australia ($452), Tasmania ($416), Queensland ($407) and the Australian Capital Territory ($362).

In terms of intra-state distribution, it emerged that most attributable expenditure (except for Queensland and Tasmania) was by residents in the capital cities, rather than persons living outside the capitals. In Queensland, it was estimated that 56% of attributable expenditure referred to residents outside of Brisbane, while in Tasmania 61% of the attributable expenditure was by residents outside of Hobart. At the other extreme, 83% of attributable expenditure by Northern Territory residents was by Darwin residents (Table 5.10), while Western Australia and Victoria, at 68 and 67%, had the next highest levels of capital city expenditure.

For Australia as a whole, 58% of attributable fishing expenditure was by fishers living within the capital cities. This compares with the 53% of the total population of recreational fishers who reside in these capital cities and indicates disproportionately higher expenditure by capital city verses non-capital city residents. This difference may be due to a number of factors, including fewer recreational choices within the urban centres and differences in regional catch rates that contribute to capital city-based fishers travelling to regional locations to fish.

Table 5.9. Estimated total and average attributable fishing expenditure by State and Territory of residence for recreational fishers aged 5 years or older. (rse – relative standard error).

State/Territory	Attributable expenditure $M	Proportion of national expenditure %	Number of fishers	Proportion of national participation %	Average Fisher Expenditure $	Ranking
NSW	554.204	30	998,501	30	555	4
(rse)	(11.9%)					
VIC	396.27	21	549,803	16	721	1
(rse)	(9.5%)					
QLD	319.57	17	785,045	23	407	7
(rse)	(7.3%)					
SA	148.48	8	328,227	10	452	5
(rse)	(9.5%)					
WA	338.38	18	479,425	14	706	2
(rse)	(13.4%)					
TAS	51.83	3	124,590	4	416	6
(rse)	(9.6%)					
NT	26.70	2	43,932	1	608	3
(rse)	(12.9%)					
ACT	19.36	1	53,467	2	362	8
(rse)	(16.8%)					
Total	**1,854.80**	**100**	**3,362,990**	**100**	**552**	
(rse)	**(5.0%)**					

Table 5.10. Regional attributable fishing expenditure by State or Territory of residence for recreational fishers.

State or Territory of residence	Attributable expenditure $M			% Capital City
	Total	Capital City	Outside capital	
NSW	554.20	314.52	239.68	57
VIC	396.27	266.57	129.70	67
QLD	319.57	139.92	179,64	44
SA	148.48	83.98	64.50	57
WA	338.38	229.55	108.83	68
TAS	51.83	20.21	31.63	39
NT	26.70	22.13	4.57	83
ACT.	19.36	19.36	NA	
Total	**1,854.80**	**1,076.89**	**777.92**	**58**

5.12.5. Attributable Expenditure by Item/ Service Category

Australian recreational fishers reported expenditure on more than 45 categories of goods and services (Appendix 5.16). These expenditure items were grouped into ten main categories (Table 5.11). Boats/ trailers represented the largest expenditure category, at $940 million this category constituted over half of the total attributable expenditure by recreational fishers (Table 5.11). A third of the attributable expenditure on boats/ trailers was by New South Wales residents, while Western Australian residents had the highest expenditure per fisher ($418) followed by the Northern Territory ($370).

Travel associated with fishing ($395 million) was the second highest expenditure grouping reported by recreational fishers. About 95% of all travel expenditure referred to private vehicle travel (as discussed in section 5.12.3) (Appendix 5.16). At $108 million, the highest level of travel expenditure was by New South Wales residents, with the highest levels of expenditure per fisher of $177 and $172 being for Victoria and the Australian Capital Territory, respectively. Expenditure on fishing gear ranked third at $183 million, which when added to bait/berley, provides an estimate of direct fishing expenditure of $223 million nationally (Table 5.11).

Table 5.11. Attributable fishing expenditure by item/ service grouping for recreational fishers aged 5 or older and by State or Territory of residence.

	Attributable expenditure $M								
Item Category	**NSW**	**VIC**	**QLD**	**SA**	**WA**	**TAS**	**NT**	**ACT**	**Total**
Accommodation	17.74	13.02	6.26	2.93	8.35	0.69	0.23	1.13	50.33
Camping gear	36.23	30.38	21.38	13.61	26.68	3.27	0.52	1.88	133.97
Bait/Berley	11.98	8.33	8.21	3.77	6.98	0.36	0.37	0.56	40.58
Boat /Trailer	303.90	158.64	160.58	72.61	200.61	24.35	16.29	2.97	939.97
Clothing	6.51	9.47	4.57	1.78	1.58	1.01	0.12	0.50	25.60
Dive Gear	0.65	0.01	0.80	0.53	3.20	0.53	0.00	0.00	5.72
Fees & Licences	8.72	8.25	2.74	1.01	3.20	1.60	0.91	0.51	26.93
Fishing Gear	56.71	34.39	39.88	11.15	30.95	5.13	2.22	2.47	182.88
Travel	107.52	97.45	64.54	40.15	55.62	14.69	5.84	9.21	395.01
Other	4.23	36.34	10.60	0.94	1.20	0.18	0.20	0.14	53.83
Total	**554.20**	**396.27**	**319.57**	**148.48**	**338.38**	**51.86**	**26.70**	**19.36**	**1,854.83**

5.12.6. Interpretation and Use of Expenditure Data

Care needs to be taken in interpreting the values in Table 5.11 as they refer to grouped data and consideration must be given to ensure that the use made of the data is consistent with the policy question being considered. While such aggregated information is a useful indicator of economic activity, it does not provide an estimate of fish value, particularly given that recreational fishers are likely to derive enjoyment in recreational fishing from a number of factors in addition to fish catch.

The data collected in this survey indicate that a large proportion of the Australian population participated in recreational fishing over the survey period. It is also apparent that recreational fishing involves the delivery of a broad range of items and services by the private and public sectors. While many of these items and services are provided through the market, a very wide range of items and services are provided outside of the market. These include the provision of roads and boat ramps by local and state jurisdictions, as well as those items and services that flow from the environment (including fish and fish habitat) that are enjoyed by fishers. The public sector, on behalf of those involved in recreational fishing (and on behalf of those having alternative interests in the environmental and other resources), is also involved in setting up and maintaining the institutional basis in which all of this is managed. Such issues are relevant from local council level to the level of international agreements over migratory fish stocks. The private provision of items and services also has a wide operational scale extending from part time single operator to multi-national operations.

Table 5.12 shows the economic activity associated with recreational fishing according to the types of inputs used by recreational fishers to the economic sector of the community by which they are provided, the likely policy issue and the application of current survey data to these issues. A number of methodologies might be used in assessing these data, ranging from the descriptive to

more complex modelling as discussed by Blamey (2002). One shortcoming in the NRFS data set, however, is that there is no information on the factors affecting a fisher's choice of a particular fishing location. Given the complexity of factors affecting fisher satisfaction (see section 5.13), such considerations are likely to be important to models used in estimating the unit value of fish taken by recreational fishers.

Table 5.12. Application of current survey data to policy issues.

Inputs to recreational fishing according to sector	Attribution %	Market (expenditure)/Non-market provided	Policy issues	Relevant non-expenditure data
Private sector Capital inputs eg fishing gear boat & camping gear Variable inputs e.g. bait, fishing gear fuel, ice Services fishing guide accommodation	 100 ≤100 ≤100 100 ≤100 100 ≤100	 Provided through the market. Expenditure and quantity data collected.	 Investment in the provision of items and services as per the major items and services and the location of fisher activity.	Behavioural data including fish species targeted & caught, type of fishing, location, distance travelled can be used independently or combined with expenditure data to assess the economic characteristics of publicly provided non-market economic supplied items and services
Public sector Capital inputs e.g. fish population environment, roads, & boat ramps Variable inputs Services e.g. safety, rescue, weather reports, institutional structure (manage- ment/licences)	 100 ≤100 ≤100 ≤100 ≤100 ≤100 ≤100	 Not provided through the market. Some quantity data collected. –Partly market/expenditure data	Questions of competing use of resources. Impact of spillover effects of recreational fishing on the environment and other activities and the impact of spillover effects of other activities on recreational fishing. The public provision of infrastructure and services. Efficient charging for the provision of infrastructure and services.	

5.13. Fisher Attitudes and Awareness

The opinions of fishers in relation to a range of fishing related issues were assessed at the completion of the diary survey. Attitudinal surveys were customised for each State and Territory to address issues of relevance to the particular jurisdiction, with a range of questions to assess awareness and opinions about fishing regulations, management issues, research and compliance programs. As these surveys were specific to each jurisdiction, results will be presented in subsequent reports to be prepared by the participating agencies. In terms of nationally applied questions, key motivating factors relating to recreational fishing participation were explored and are discussed here.

5.13.1. Fisher Motivation

Recreational fisheries management entails not only the conservation of fish stocks and habitat but also the provision of fishing opportunities. For example, an objective of the New South Wales Fisheries Management Act is "to promote quality recreational fishing opportunities". To achieve this objective it is necessary to understand what recreational fishers seek in a fishing experience. Knowledge of the key motivating factors may provide insight into their aspirations and expectations regarding fisheries management. Certainly, by ignoring such issues management agencies run the risk of alienating a significant constituency and contributing to the failure of management regulations based on the cooperation of recreational fishers.

Recreational fishers frequently express strong opinions regarding the management of fish stocks and the sustainability of aquatic resources, though they generally acknowledge that fishing involves much more than just catching fish. Past research on the motivation of fishers (Fedler and Ditton, 1994) has suggested that factors related to fishers' psychological state, the physical environment, social interactions and resource status are among the primary motives for fishing. These issues were examined in the present study.

Recreational fishers were asked to rate eight factors according to their importance (very, quite, not very or not at all important) as reasons or motives for fishing. These factors were (1) "to relax or unwind", (2) "to be outdoors, in the fresh air, to enjoy nature", (3) "to be on your own, to get away from people", (4) "to spend time with family", (5) "to spend time with friends", (6) "to compete in fishing tournaments", (7) "for the enjoyment or sport of catching fish", and (8) "to catch fresh fish for food". If unclear from these responses, respondents were then asked to rate which of the eight factors was the main reason they went fishing.

To relax or unwind and to be outdoors were identified as important factors (i.e. 'very important' or 'quite important') by the vast majority (>90%) of recreational fishers[12] (Table 5.13). Fishing for the enjoyment or sport of catching fish was also rated as being important for the majority of fishers (82%), as was to be with friends (73%) and family (69%) and catching of fish for food (61%). Less than half of the respondents (42%) identified to get away from people (for solitude) as important and only a very small proportion of fishers (5%) considered competing in fishing tournaments was an important motive for fishing. As recreational fishing clubs are the primary focus of fishing competition activities, these findings are not unexpected given the low level of club membership amongst fishers (section 5.9.3.1). Responses by State/Territory are tabulated in Appendix 5.17.

[12] In the context of this analysis, the expanded 'population' effectively represented 'respondent households with recreational fishers aged 15 or older' rather than recreational fishers aged 15 or older (refer section 5.7.3.5).

This analysis clearly highlighted the importance of perceived psychological, environmental and social benefits, along with sporting aspects, as motives for fishing. The latter, in particular, has been downplayed by some fishing groups and individuals in the past, however, these results confirm the value of the sporting aspect as a key reason for fishing in Australia. The importance of fish for food was also apparent, though overall it was secondary to the above motivations.

Table 5.13. Importance of factors to do with recreational fishing motivation (% of respondents) based on nationally aggregated data.

	Importance rating				
Motivation	Very	**Quite**	**Not Very**	**Not At All**	**Unsure**
Relax and Unwind	63	27	8	2	0
To be Outdoors	58	33	7	2	0
For Solitude	19	23	35	24	0
To be with Family	39	30	19	13	0
To be with Friends	32	41	17	10	0
Fishing competitions	2	3	11	84	0
Fish for Sport	48	34	12	5	0
Fish for Food	33	28	25	14	0

The greatest proportion of recreational fishers (37%) identified 'to relax and unwind' as their primary reason for recreational fishing. Other main reasons for fishing ranked as follows; fishing for sport (18%), to be with family (15%) and to be outdoors in the open air (13%) (Figure 5.26, Table 5.14). Only a small proportion of fishers (8%) considered catching fish for food as their primary motivation for fishing. The remaining factors were relatively less important, though to be with friends (5%) is clearly linked to fishing with family.

At the State/Territory level minor differences emerged in the order of importance assigned the top motivational factors (Table 5.14). For instance, fishers in New South Wales, Victoria and the Australian Capital Territory rated to relax and unwind as most important (40-43%), followed by fishing for sport (15-27%) and to be outdoors (15%). In Queensland, South Australia, Western Australia and Tasmania, in addition to relax and unwind (28-39%) and fish for sport (15-18%), to be with family (16-20%) was amongst the top three reasons for fishing. In the Northern Territory to be outdoors in the open air was the highest rated factor (32%), followed by to relax and unwind (29%) and to be with family (11%). Interestingly, in the Northern Territory fishing for sport (9%) was rated behind fishing with friends (10%).

This survey has identified that non-catch-related motives rated higher than catch-related motives for fishing. To relax or unwind has little to do with the management of aquatic resources. It relates more to the need to get away from daily routine, work and/or the pressures of modern society. Natural environment-related reasons were also rated highly by Australian fishers and social motives dealt with the desire to interact with other people. Resource-related motives were rated highly, the challenge or sport of fishing was the second highest motive at a national level, but the capture of fish for food rated poorly. Presumably, the expectation of fishing success was

important, but the harvest aspect of fishing was clearly not the major motive identified for most Australian recreational fishers. These data make the connections between fisheries and environmental protection abundantly clear from a constituency perspective.

This analysis considered recreational fishers from a collective viewpoint but it should be recognised that they are a heterogeneous group and the concept of an average fisher does not exist (Shafer, 1969). Although these data contribute to a better understanding of the behaviour of Australian recreational fishers, the likelihood of different response patterns from different sub-groups of fishers (club fishers, boat/shore fishers, specific fishing methods and/or target species) and different circumstances need to be considered in the development of fisher programs and services by management agencies.

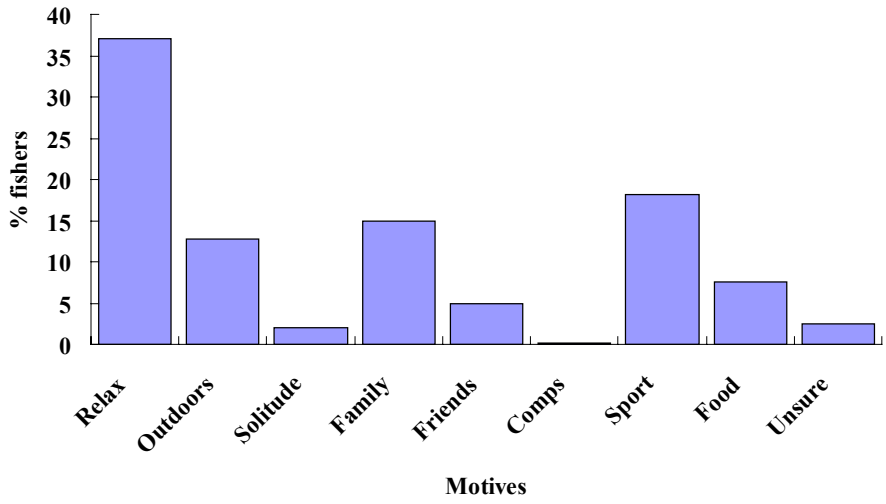

Figure 5.26. Primary motivation for recreational fishing as identified by Australian recreational fishers (% respondents).

Table 5.14. Primary reason for recreational fishing (% of respondents) by State or Territory of residence.

	% respondents								
Motivation	**NSW**	**VIC**	**QLD**	**SA**	**WA**	**TAS**	**NT**	**ACT**	**Total**
Relax and Unwind	40	43	39	32	28	31	29	41	37
To be Outdoors	15	15	9	10	11	13	32	15	13
For Solitude	1	1	3	3	3	2	4	2	2
To be with Family	13	12	16	17	20	19	11	9	15
To be with Friends	4	7	3	9	6	3	10	2	5
Competitions	0	0	0	0	0	0	0	0	0
Fish for Sport	21	15	18	15	18	16	9	27	18
Fish for Food	5	6	9	12	11	8	2	3	8
Unsure	2	1	4	2	3	7	4	1	3

6. INDIGENOUS FISHING SURVEY OF NORTHERN AUSTRALIA

A.P.M. Coleman, G.W. Henry, D.D. Reid and J.J. Murphy

6.1. Introduction

Indigenous people were the first owners and managers of Australia's fishery resources. To this day, many indigenous communities maintain an active interest in the conservation, management and use of these resources. Fish, crustaceans and molluscs are of major nutritional, economic and cultural importance for coastal indigenous people. Indeed, the Australian landscape is a product of their economic modes of subsistence, and is important in both cultural and religious terms (Lane and Dale, 1995). Fishing is important to a healthy diet and lifestyle, and allows communities and families to retain their independence. The importance of fishery resources for some coastal communities is revealed in large measure by the dietary patterns of these communities and numerous middens found along the shores of our principal rivers and bays. Seafoods have been shown to contribute between 30 and 40 percent of calorific intake in a coastal outstation community in the Northern Territory (Meehan, 1982) and seafood consumption by Torres Strait Islanders has been ranked among the highest in the world (Johannes and MacFarlane, 1991). Australian indigenous people have particularly strong relationships to land and natural resources and much to gain from the sustainable use of these resources.

6.1.1. Traditional Estates and Responsibilities

For indigenous people, fishing is not only important for food and nutrition, but also for ceremonial occasions, exchange, trade and barter. Fishing is an invaluable component of their cultural lifestyle and is connected to the traditional responsibilities of land management and kinship. Many indigenous people express a strong and continuing sense of belonging to, and responsibility for, regions and resources they consider to be their traditional estates (Resource Assessment Commission, 1993). Anthropological research shows that distinct maritime cultures continue to exist among some indigenous communities (Chase and Sutton, 1981) and records dating back to early this century describe instances of a system of indigenous property rights relating to reefs and seas (Cordell, 1992). The sense of custodianship extends to fishery resources within the sea as well as land and many groups of indigenous people consider areas in the sea as integral parts of their traditional country.

"Country" may relate to an indigenous person's cultural or spiritual place of origin. Therefore, it may refer to more than just a geographical area and include all the values, places, resources, stories and cultural obligations for the area (Smyth, 1994; Langton *et al*. no date). The origins of islands, reefs and other features are also contained in creation beliefs, as are geographical features on the land (Smyth 1993). For coastal Aboriginal people 'country' can also include the sea, which is seen as inseparable from the land (Smyth, 1994). Traditionally, individual Aboriginal people are associated with at least one totemic animal (Tindale and Lindsay, 1963). However, the relationship between the person and the animal may vary. Some may be able to eat the animal at certain times whilst others may not eat the animal at all (Bennett, 1983). Certain members of the community may also place taboos on what may be taken at other times for other reasons (E. Mulholland – pers. com.). Modern fishing technology, availability of a wider trading market, restriction of

access to land resources and the effect of economic downturns within communities have intensified indigenous reliance on fish and fishing (Chapman, 1996).

6.1.2. Social Value

The value of food collecting, hunting and fishing is seen as important in maintaining the social cohesion of indigenous communities (Walsh, 1992). Social networks are reinforced through the customary sharing of gathered food (Caughley *et al*., 1996). Hunting is also used as an important educational tool for teaching younger people Aboriginal law through the expression of knowledge and reinforcement of spiritual beliefs (Collins, 1996). Caughley *et al*. (1996) suggests that without food gathering social networks would be disrupted. Some resources are harvested for community celebrations. In New Mapoon (Queensland), 17% of hunts were conducted to provide food for community feasts (Roberts *et al.*, 1996) and these hunts tended to involve more people who hunted cooperatively. Dugongs form a very important part of ceremonies in East Arnhem Land in the Northern Territory (Green, 1988) but this can differ from community to community (E. Mulholland pers. com.).

6.1.3. Traditional Management of Fish Stocks

For centuries, indigenous peoples have managed their fisheries by looking after their country. They followed laws about who could fish where, which fish to take at different times of the year, and how many to take in different seasons. Indigenous fishing activities are the distillation of thousands of years of experience and are a unique mixture of experimentation, mythology and concentrated lore (Dunn, 1991). Even with the benefit of 200 years hindsight, we are not much closer to understanding fisheries management. Recreational fishers have been lamenting the dwindling fish populations for years, yet conservation and fisheries management techniques adopted in comparatively recent times by white Australians are essentially little different to those practised by indigenous Australians up until the late nineteenth century (Dunn, 1991). Local tribes established fish and wildlife sanctuaries where hunting and fishing could only take place in alternate seasons (Gilmore, 1986). Indigenous people were able to predict future fish abundance from the prevailing environmental conditions (Welsby, 1895). Unfortunately, much of this traditional knowledge has been lost or disregarded and indigenous people were rarely involved in the management of fishery resources during the past century.

6.1.4. Current Indigenous Fisheries Management

Modern fishing laws generally do not distinguish between indigenous fishing and recreational or commercial fishing. Indigenous fishers are generally required to conduct their fishing activities according to the rules in place for the broader recreational and commercial fishing communities. As such, indigenous fishers are required to adhere to the relevant bag and size limits, closed areas and seasons, licences and restrictions on fishing gear and methods in force throughout Australia. However, most governments now recognise that traditional, cultural and community fishing activities have become increasingly impacted by modern fisheries laws. Current fisheries legislation, in many cases, is simply not appropriate for traditional and cultural resource use. Governments are considering regulatory strategies which can be developed to ensure sustainability, equitable sharing, promote viable industries, and at the same time, accommodate indigenous heritage, culture, traditions and community values. Most governments have begun a process of consultation with indigenous community leaders to develop more appropriate fishing laws and management arrangements for indigenous Australians. While the indigenous population of Australia is small, a relatively high proportion of the people in indigenous communities are involved in fishing. Fishing strategies are being developed to recognise indigenous opportunities and rights and to incorporate traditional activities into plans for the sustainable integrated management of the nation's natural resources.

6.2. Survey Design Issues

The design of the indigenous fishing survey of northern Australia was based on experiences from other large-scale surveys, but with new components designed to address specific data collection needs. The indigenous fishing survey was also designed to be compatible with the national recreational fishing survey. For the coastal areas of northern Australia, where indigenous communities comprise a relatively large proportion of the total population, the collection of indigenous fishery information was considered crucial to regional assessments of non-commercial fishing activity. For example, indigenous peoples represent approximately 24% of the overall population of the Northern Territory, but the proportion of indigenous people may be as high as 95% in localised regions along the coast (ABS, 1996).

The telephone/ diary survey methods developed for gathering national fisheries statistics on recreational fishing were not appropriate for the indigenous communities in northern Australia. The relatively low proportion of home phone ownership in indigenous communities would translate to substantial under-representation of fishing activity through a national telephone survey. Indigenous communities have further characteristics relating to personal/household mobility, language barriers and sensitivities to data gathering by government agencies that may reduce the effectiveness of phone survey techniques.

Accordingly, a separate 'face-to-face' interview survey module was developed for collecting data 'on-site' from indigenous communities in northern Australia. Whereas, the scope and data elements for this indigenous survey were comparable to the recreational fishing survey, the sampling strategy was modified to reflect the different social, cultural and economic characteristics of remote communities. A modified 'creel survey' methodology was developed and refined following a substantial review of available literature, consultation with indigenous people and the results of a pilot study. However, pilot testing, discussions with indigenous groups and experience gained by the Australian Bureau of Statistics (ABS) suggested that conventional telephone survey definitions and methods were appropriate for indigenous people living in urban areas (where comparatively high phone ownership rates are believed to exist). Therefore, the National Recreational Fishing Survey provided Australia-wide coverage of indigenous people living in urban areas.

A full description of the indigenous fishing survey methodology was provided in the development report (Coleman, 2000). The report discusses specific cultural aspects of remote indigenous communities, their understanding of aquatic resource ownership and use and the political sensitivities associated with contacting indigenous people. It also provided a summary of the various survey methods used in other Australian and international surveys of indigenous groups and the value of data available from these studies. Particular sensitivities of the relevant indigenous groups and suggested techniques for overcoming these were discussed before the proposed methodology was outlined. The report also discussed output specifications, sampling design and methodologies for a survey of non-commercial fishing activity by persons living in remote indigenous communities.

6.3. Survey Scope

The IFSNA collected fishery statistics from indigenous people, aged 5 years and older, living in coastal communities across the top of Australia from Broome in Western Australia to Cairns in Queensland[13] (Figure 6.1). Residents of these communities were out of scope of the NRFS and therefore results of the NRFS and IFSNA can be considered additive in terms of describing non-commercial fishing activity in Australia. Fishing was defined as the capture or attempted capture

[13] Note: residents of the Torres Strait Islands were not included

of aquatic organisms (not plants) in Australian waters (freshwater, estuarine, marine), other than for commercial purposes. All fishing techniques and harvesting activities were included in the survey.

6.4. Sample Design

The design for the indigenous fishing survey was based on a stratified sampling design. Stratification of indigenous communities in northern Australia was based on ABS statistical regions (Aboriginal and Torres Strait Islander Commission Regions), population size of the community, sub-region/location (i.e. inland, coastal or urban) and the presence/absence of community outstations. Within the study area there are 144 communities, representing an indigenous population of 40,708 persons aged 5 and older, of which 46 communities were selected.

Within each selected community, dwellings were initially stratified (from community-sourced information during the 'background' survey) in a hierarchical fashion in terms of (i) boat ownership, (ii) fisher dwelling (non-boat owning), (iii) non-fisher dwelling and (iv) vacant. Random selections were then made from each of these strata, with up to 86 dwellings per community selected (representing between 16 and 100 % of dwellings), the actual number dependent mainly upon the size of the community and operational considerations. To provide statistical strength in the data, boat owning and fisher dwellings were sampled at higher rates than non-fisher and vacant dwellings. In this way, higher proportions of boat owner and fisher dwellings were sampled. Once dwelling selections were made the sample was fixed for the remaining survey period, even if the dwelling proved to be wrongly assigned to a stratum during the background survey, or changed between the background and screening surveys.

For all survey components (including the catch and effort phase), data was collected from all residents and visitors (aged 5 years or more) of the selected dwellings on the basis of their presence (staying) at the dwelling at the time of interview. This approach enabled the dynamic nature of indigenous populations to be accounted for, hence, the inclusion in the design strategy of a separate stratum of 'non-fisher' and vacant dwellings to enable coverage of fishers/etc. who might move around during the survey - either within or across communities.

The primary data sources for the IFSNA were a background survey, screening survey, a 12-month catch and effort survey and an attitudinal survey. Following the background and screening surveys, each community was enumerated on a bi-monthly basis (based on moon phase) for a 12-month period to collect catch and effort data. Communities across the survey area were systematically allocated an 'odd' or 'even' monthly visit with the visit week randomly selected within the month based on moon phase. The survey was implemented in July 2000 as a separate component of the broader national survey and managed in-house by the Fisheries Group, Northern Territory Department of Business, Industry and Resource Development (NTDBIRD). ABS population information was used to benchmark survey data for coverage and representation and to provide the basis for expansion of data to indigenous population estimates.

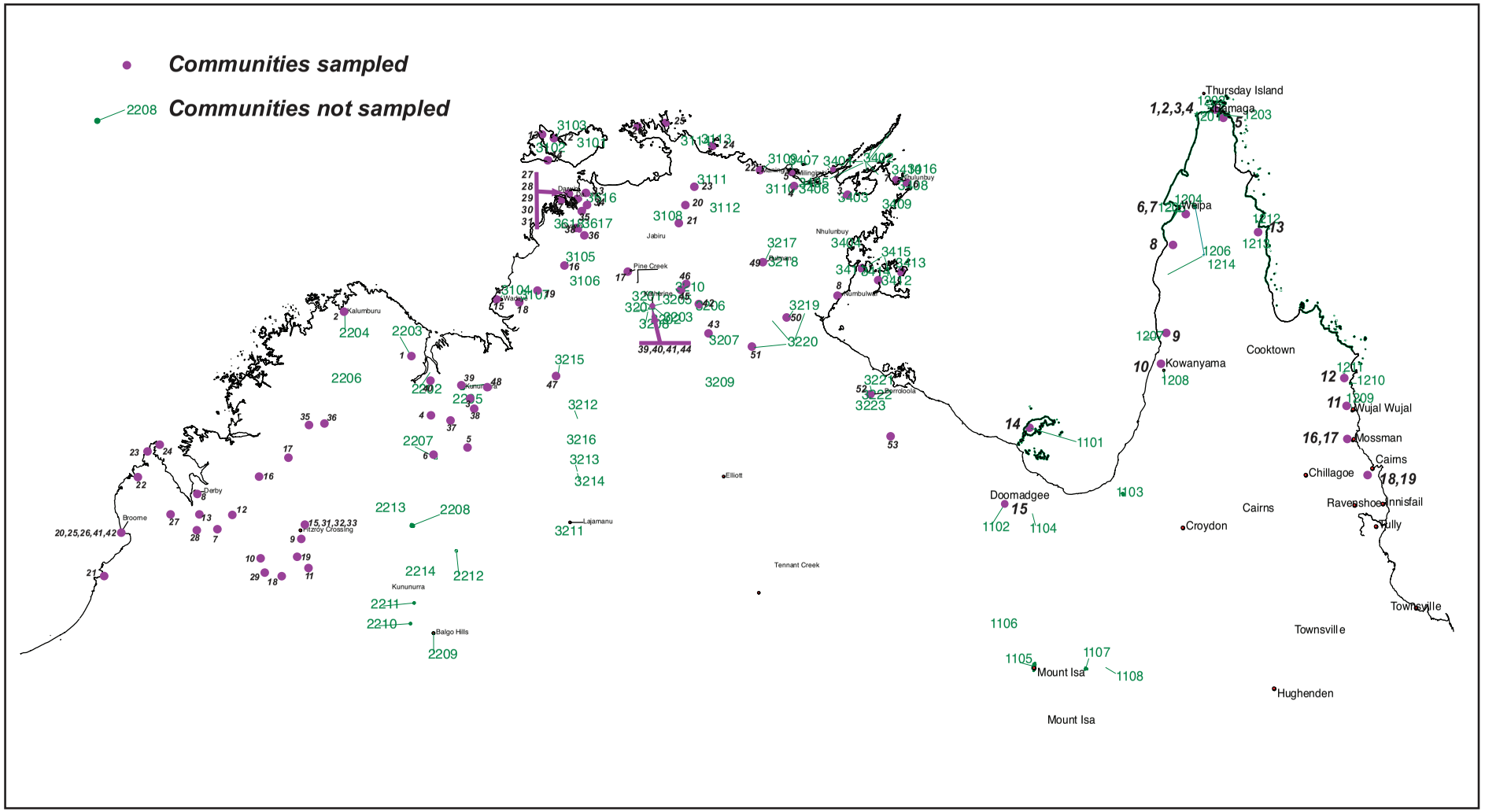

Figure 6.1. Map showing locations of indigenous communities throughout the study region in northern Australia.

6.5. Survey Components

6.5.1. Background Survey

A range of background information was collected from each indigenous community prior to the commencement of the survey proper. Information on the structure of the community (number and type of dwelling, size of resident population, telephone ownership), the stability of the resident population and likely people movements, the level of boat and vehicle ownership, relevant authorities and access protocols were necessary to facilitate the ensuing sampling program. Formal permission to conduct the background and fishing surveys was requested from the relevant authority (community council/ traditional owners) for each community. The requirements and process of the survey were explained and the relevant authority was asked to identify a local person to assist interview staff contact people in the community and outstations as appropriate. Background surveys commenced in April 2000 with a sample of 46 communities (13 communities in Western Australia, 22 in Northern Territory and 11 in Queensland) (Table 6.1).

A most important component of the background survey involved mapping of the selected community to allow the sample of dwellings to be selected. Interviewers either obtained a map of the community, or developed their own map, showing all habitable 'dwellings'. With the aid of a guide, all dwellings were listed as either boat owning, non-boat owning or vacant. Non-boat owning dwellings were further stratified into fishing or non-fishing dwellings. The sample of dwellings was randomly selected from each stratum within the community prior to the screening survey taking place. Information from the background survey was used to finalise the sampling frame, contingency plans and any other information applicable to conducting the survey in each community.

6.5.2. Screening Survey

The major objectives of the screening survey were to estimate the level of participation in fishing, provide a socio-demographic profile of fishers and to introduce the catch and effort survey. The screening survey involved residents and visitors from 1,239 dwellings (305 in Western Australia, 539 in Northern Territory and 395 in Queensland) within 44 of the 46 selected communities. The screening survey occurred as soon as possible following the background survey and most screening surveys were completed by July 2000. However, due to delays in the process of obtaining permission in some communities, the final screening survey was not completed until November 2000. All households were given a structured face-to-face interview designed to collect a range of profiling information. Age and gender were collected for all people staying/living at the dwelling at the time of interview. The level of participation in fishing in the previous 12 months, and the likelihood to fish in the coming 12 months, were also established for household members aged 5 years or older.

The screening survey also collected information on boat and vehicle ownership. Boat ownership was further characterised according to length, propulsion (row, sail or motorised) and usage for fishing during the previous 12 months. Boats used for fishing were further categorised according to the presence of echo sounder and Global Positioning Systems (GPS). Unlike the national recreational fishing survey, the current market value of fishing boats was not established. All respondents regardless of their intention to go fishing in the 12 months following interview (i.e. during the catch and effort survey period), or whether they had fished previously or not, were invited to participate in the catch and effort survey.

Table 6.1. Indigenous communities in northern Australia that participated in the survey.

Community Name	State	Area	Estimated Population	Estimated No. Dwellings
Gununa	QLD	Coast	809	155
Injinoo	QLD	Coast	376	73
Naprunum	QLD	Coast	673	161
Kowanyama	QLD	Coast	753	135
Wujal Wujal	QLD	Coast	219	64
Lockhart River	QLD	Coast	271	82
Seisa	QLD	Coast	110	26
Bamaga	QLD	Coast	638	149
Yarrabah	QLD	Coast	1,973	345
Mona Mona	QLD	Inland	185	43
Chinaman's Creek	QLD	Urban	80	20
La Grange/Bidyadanga	WA	Coast	483	79
Beagle Bay	WA	Coast	277	52
One Arm Point	WA	Coast	295	58
Kalumburu	WA	Coast	289	43
Junjuwa	WA	Inland	305	64
Looma	WA	Inland	276	52
Dobnun	WA	Inland	40	8
Yungungora	WA	Inland	239	31
Djugerari (cherrabun)	WA	Inland	63	16
Mirima	WA	Inland	280	70
Warmun	WA	Inland	288	49
Mallingbar	WA	Urban	100	25
Morgans Camp	WA	Urban	60	15
Knuckeys Lagoon	NT	Coast	18	7
Belyeun	NT	Coast	269	75
Nguiu	NT	Coast	1,210	223
Wadeye	NT	Coast	1,379	24
Warruwi	NT	Coast	356	53
Gapuwiyak	NT	Coast	599	64
Milingimbi	NT	Coast	918	90
Gumatj Association	NT	Coast	150	18
Umbakumba	NT	Coast	215	52
Acacia Larrakia	NT	Inland	54	14
Nauiyu (Daly River)	NT	Inland	309	66
Oenpelli	NT	Inland	1,074	148
Kalano/Miali Brumby	NT	Inland	185	28
Binjari	NT	Inland	181	30
Barunga	NT	Inland	410	77
Timber Creek	NT	Inland	420	85
Ngukurr	NT	Inland	844	91
Kulaluk	NT	Urban	87	22
Minmirama	NT	Urban	61	15
Bagot	NT	Urban	240	44
Total			**18,061**	**3,041**

6.5.3. Catch and Effort Survey

The catch and effort survey was conducted for each community for a 12 month period between June 2000 and November 2001, inclusive. Dwellings were re-visited throughout the survey period at two monthly intervals (i.e. 6 times during the survey year). Respondents for each dwelling were identified at the beginning of each interview. This included all indigenous people (aged 5 or more), staying at the dwelling at the time of interview (i.e. including visitors to the dwelling and excluding residents who were away). Catch and effort data for the previous seven days was collected on a recall basis for each respondent within the dwelling. Detailed information such as species targeted (if any), fishing location, fishing platform (boat and boat category or shore and shore category), fishing method, water body type (freshwater, marine, estuary, offshore, etc) and catch and release details by species were collected and recorded by survey interviewers during the face-to-face interview. Unlike the recreational survey, detailed information about fishing start and finishing times or expenditure details was not asked.

6.5.4. Attitudinal Survey

At the completion of the catch and effort survey, respondent attitudes to several fishing-related matters were assessed in a final interview. These interviews were simple and could collect information either on a household or personal basis. General questions on fishing, the environment and the survey were asked. The same questions were asked in all communities across the three States/Territory.

6.6. Data Management

A relational database management system was developed in Microsoft Access, following the general entity relationship model described by Finney and Lyle (2000) for the recreational fishing survey. The Fisheries Group (NTDBIRD) was responsible for managing the database. Editing of data forms and data entry was undertaken in-house, and wherever feasible, incomplete or ambiguous forms were referred back to survey interviewers for follow-up with respondents. This process, linked to range, logic and sequencing checks in-built into the database, and coupled with thorough survey interviewer training and management systems provided for comprehensive reported-data quality checks.

6.7. Data Analysis

6.7.1. Data Expansion – Screening Survey

Population data for the number of indigenous persons and dwellings were obtained from the ABS 2001 'Census of Population and Housing', and provided estimates as at 30 June 2001. The data were not available in standard Census publications, but were provided by ABS Client Services, Darwin on the basis of Indigenous Location (ILOC), which in most cases aligned with a defined indigenous community. In a small number of cases, an ILOC did not align with a single community. In these cases, data from appropriate Collection Districts (CDs) were combined to provide an estimate of population (persons, dwellings) for the community. No population data were available for person-based benchmarks by age and gender, or for dwelling-based benchmarks by size (number of adults and children) as used in the recreational fishing survey.

6.7.2. Data expansion – Catch and Effort Survey

Catches were recorded for each household in the diary survey on six occasions over the sample period, with each sampling occasion covering activity over the previous seven days. The total catch by stratum (region (coastal/inland/urban) was estimated by calculating the product of the catch by each diary-household over the six sampling occasions, and the three expansion factors f1, f2, f3 (defined below), then summing over all households within the stratum. The same principle was used to obtain estimates for individual taxa.

Similarly, fishing effort (by method) was recorded for each household in the diary survey on six occasions over the sample period, with each sampling occasion covering activity over the previous seven days. The total effort by stratum was estimated by calculating the product of the effort by each diary-household over the six sampling occasions, and the three expansion factors f1, f2, f3 (defined below), then summing over all households within the stratum.

6.7.3. Estimation Procedures

6.7.3.1. Number of Dwellings

The number of fishing dwellings in the population for each stratum (coastal/ inland/ urban) was estimated by the stratum proportion of fishing dwellings in the screening sample (i.e. the sample participation rate), multiplied by the stratum total number of dwellings in the population. The estimates for each state/territory were obtained by calculating the weighted sum of strata.

$$\hat{NHF}_h = \frac{nHF_h}{nHH_h} \times NHH_h$$

The participation rate of dwellings for each stratum h is given by:

$$P\_HH\hat{P}R_h = \frac{nHF_h}{nHH_h} = \frac{\hat{NHF}_h}{NHH_h}$$

6.7.3.2. Number of Persons

The number of fishers in the population for each stratum (coastal/ inland/ urban) was estimated by the stratum proportion of persons in the screening sample who reported that they had fished in the 12 months prior to the screening sample, multiplied by the stratum total number of persons in the population. The estimates for each state/territory were obtained by calculating the weighted sum of strata.

$$\hat{NPF}_h = \frac{nPF_h}{nP_h} \times NP_h$$

The participation rate of persons for each stratum h is given by:

$$P\_\hat{P}R_h = \frac{nPF_h}{nP_h} = \frac{\hat{NPF}_h}{NP_h}$$

Where:

NHF_h = Estimated number of fisher dwellings in stratum h, which is defined as a region (coastal/ inland/ urban) within a particular state/territory.

NHH_h = Number of dwellings in stratum h

nHF_h = Sample number of fisher dwellings in stratum h.

nHH_h = Sample number of dwellings in stratum h.

NPF_h = Estimated number of persons in stratum h who fished in the 12 months period prior to screening survey

NP_h = Number of persons in the population for stratum h.

nPF_h = Sample number of fishers in stratum h.

nP_h = Sample number of persons in stratum h.

6.7.3.3. Catch and effort

The components which make up the overall expansion factors for the estimation of catch and effort are defined as follows:

f1: Region (Coastal/inland/urban community).

This component is a weighting factor to expand from the sampled (diary) dwellings to the universe of dwellings within each stratum (i.e. state and region within that state). Defined as the inverse of the sampling fraction, i.e. the total number of dwellings in a stratum divided by the number of dwellings in sampled communities for that stratum.

$$f1_h = \frac{NHH_h}{ndHH_h}$$

Where

NHH_h = is defined above, and

$ndHH_h$ = is the number of dwellings in the diary sample for stratum h.

f2: Adjustment for Boat-ownership and Fishing/Non-fishing dwellings.

To adjust for over-sampling of boat-owning dwellings and under-sampling of non-fishing dwellings. This was estimated by calculating for each regional stratum h, the proportion in a category ($Pcat_h$ -e.g. Boat-owning dwellings) from the screening survey and dividing this by the proportion in that category for the diary sample ($pCat_h$).

$$f2_h = \frac{PCat_h}{pCat_h}$$

f3: Expansion factor for partial temporal coverage of sampled communities:

Each sampled community was scheduled to be visited by interviewers on six occasions, with a diary period of seven days being covered for each interview.

$$f3_i = \frac{365}{7 \times nsamples_i}$$

Where n $samples_i$ is the number of sampling occasions for dwellings within community i.

6.7.3.4. Catch Estimates

The estimator of catch C for stratum h (region (coastal/inland/urban) within a state/territory) is given by summing the product of catches for the full survey period over all diary dwellings within a sample stratum h, and the three expansion factors:

$$\hat{C}_h = \sum_i C_{hi} \times f1_h \times f2_h \times f3_i$$

The weighted sums of strata provided the estimates of catch for each state/territory.

6.7.3.5. Effort Estimates

The estimator of fishing effort E for stratum h (region (coastal/inland/urban) within a state/territory) is given by:

$$\hat{E}_h = \sum_i E_{hi} \times f1_h \times f2_h \times f3_i$$

The weighted sums of strata provided the estimates of total effort for each state/territory.

6.8. Response Profiles

The indigenous fishing survey represented particular challenges in terms of fieldwork logistics. Many remote communities were only accessible by four-wheel drive vehicle and some were only accessible by boat. Cyclones and flooding also impacted on the sampling work and on a number of occasions, communities were closed for funerals or ceremonial purposes. However, once field staff were able to contact indigenous communities in the study region their response to the survey was excellent. Forty-six indigenous communities were invited to participate in the survey and 44 communities remained in the survey for the full 12 month period (Table 6.2). Permission to conduct the survey was not obtained from two communities in the Northern Territory.

These 44 communities contained approximately 18,000 people living in about 3,000 dwellings. Approximately 1,200 dwellings were selected for the survey and more than 900 dwellings (containing about 5,100 people) fully responded for the survey period (Table 6.2). Of the 264 data collection periods scheduled for the survey (44 communities x 6 collection periods), 253 were successfully completed. Incomplete sampling periods were due to the community being closed, either for logistical or cultural reasons. The participating communities provided fishing information on 10,272 fishing events conducted in a range of water body types, using a variety of methods across the top end of Australia from Broome to Cairns.

Table 6.2. Number of fully responding indigenous communities, dwellings and persons sampled in each State/ Territory.

State	Stratum	Communities	Dwellings	Persons
Queensland	Coast	9	238	1,067
	Inland	1	17	66
	Urban	1	4	14
	Total	11	259	1,147
Western Australia	Coast	4	109	541
	Inland	7	110	583
	Urban	2	10	45
	Total	13	229	1,169
Northern Territory	Coast	9	221	1,566
	Inland	8	161	1,083
	Urban	3	39	132
	Total	20	421	2,781
Combined	Coast	22	568	3,174
	Inland	16	288	1,732
	Urban	6	53	191
	Total	**44**	**909**	**5,097**

6.9. Indigenous Fishing Participation

Indigenous fishing participation was based on information derived from the screening survey and expanded to represent the indigenous population living in communities in northern Australia. The primary purpose of this report is to provide a 'big picture' assessment of fishing effort by indigenous people living in communities within the study region. A subsequent report will examine data at smaller regional scales.

6.9.1. Number of Fishers

Based on reported fishing activity, an estimated 37,300 indigenous persons (aged 5 years or older and living in communities in northern Australia), fished at least once during the survey year (Figure 6.2a). This represented a regional fishing participation rate of 91.7% of the surveyed population (Figure 6.2b). In the study region, which included all coastal areas of the Northern Territory but only parts of Queensland and Western Australia, participation rates were generally similar, ranging between 89 and 93% (Figure 6.2). The greatest number of fishers (20,700) resided in the Northern Territory followed by northern Queensland (10,600) and northern Western Australia (5.900). Generally, within each region, participation was highest in coastal communities and lowest in urban environments.

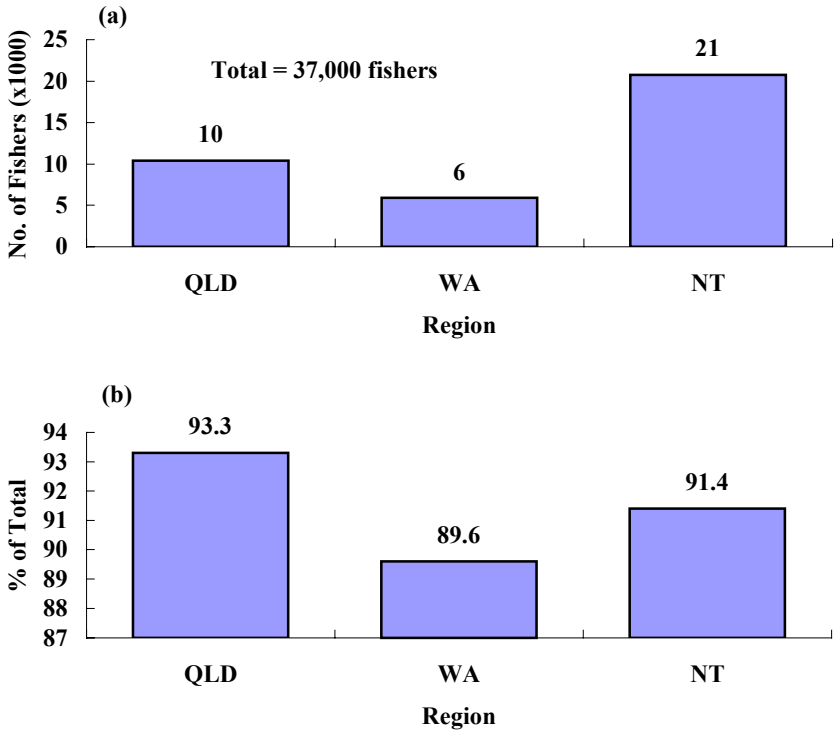

Figure 6.2. Fishing participation by region, for indigenous fishers, aged 5 or older and living in communities in northern Australia (a) number of people, (b) proportion of the population.

6.10. Indigenous Fishing Effort

Fishing effort was derived from information provided by indigenous fishers during the 12-month catch and effort survey and is presented as expanded estimates for the indigenous population living in communities in northern Australia. Information was collected on an 'event' basis, where an event was defined as a discrete fishing episode. Separate fishing events were recorded where there was a change in fishing region or water body type, target species and/or fishing method. In this way a day's fishing could comprise more than one event. For instance if fishers gathered shellfish before going line fishing, both the gathering of shellfish and subsequent line fishing were considered to be separate events since the effort expended in the collection of shellfish cannot be attributed to the capture of fish and vice versa. The delineation of fishing activity in this manner provides an ability to analyse effort (and catch) on the basis of fishing/collection method and target species/fishery. Furthermore, using this approach, two measures of effort could be defined, namely fishing days (i.e. separate days in which some form of fishing was undertaken) or fishing events. The primary purpose of this report is to provide a 'big picture' assessment of fishing effort for indigenous people living within the study region. A subsequent report will examine data in more detail and at smaller regional scales.

6.10.1. Total Effort

Indigenous fishers residing in communities in the study region undertook an estimated 671,000 fishing events during the survey year (Figure 6.3a, Appendix 6.1). This level of fishing effort represented approximately 420,000 fisher days (Figure 6.3b) and 136,000 dwelling fishing days (Figure 6.3c). Overall this represented an average of 11.2 days fishing per person per year, or by region, 10.0, 11.4 and 11.8 days fishing, respectively, for indigenous fishers from northern Western Australia, Queensland and the Northern Territory. Within the study region, over 65% of the effort occurred in the Northern Territory, followed by 21% in northern Queensland and 14% in northern Western Australia (Figure 6.3a).

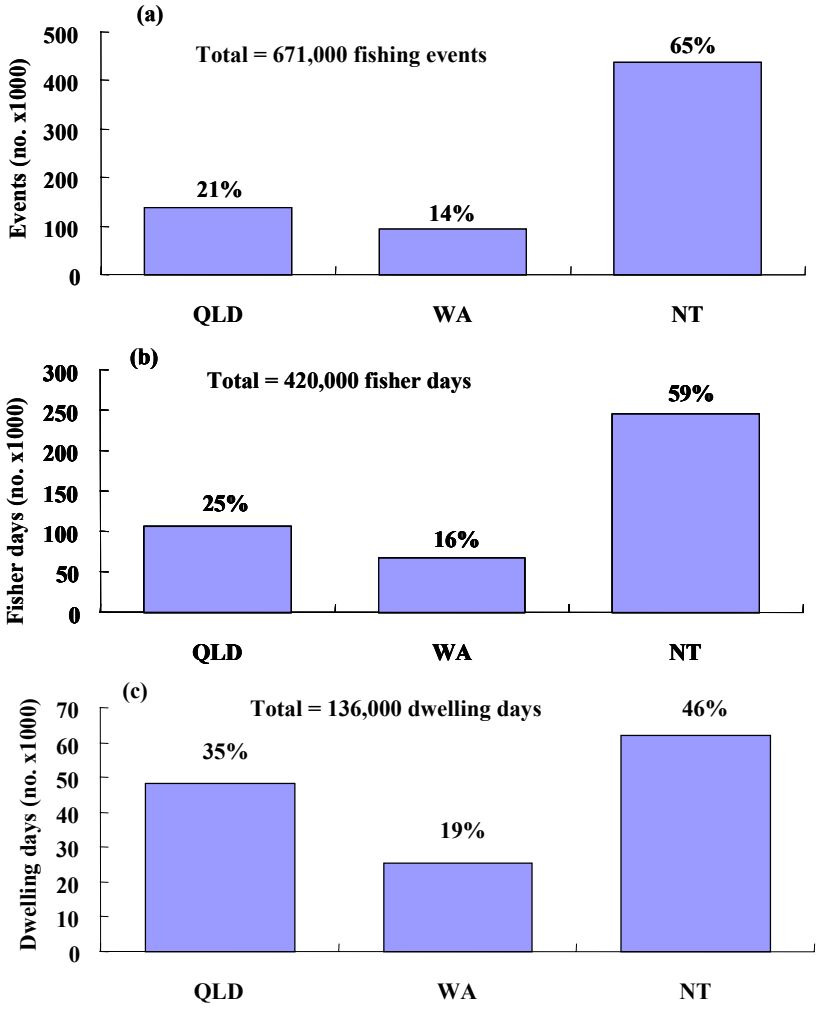

Figure 6.3. Annual fishing effort, expressed as (a) fishing events, (b) fishing days and (c) dwelling fishing days by region for indigenous fishers, aged 5 or older, living in communities in northern Australia.

6.10.2. Effort by Water Type

Indigenous fishers from within the study region harvested aquatic resources from a range of water body types including offshore waters (more than 5km from the coastline), inshore waters (less than 5km from the coastline), estuaries, freshwater rivers and freshwater lakes and dams. The major portion of indigenous fishing effort (370,000 events) was expended in inshore waters (Figure 6.4, Appendix 6.2). Similar levels of fishing effort were expended in estuarine (103,000 events) and freshwater rivers (127,000 events). Fishing in offshore waters was relatively limited (9,000 events).

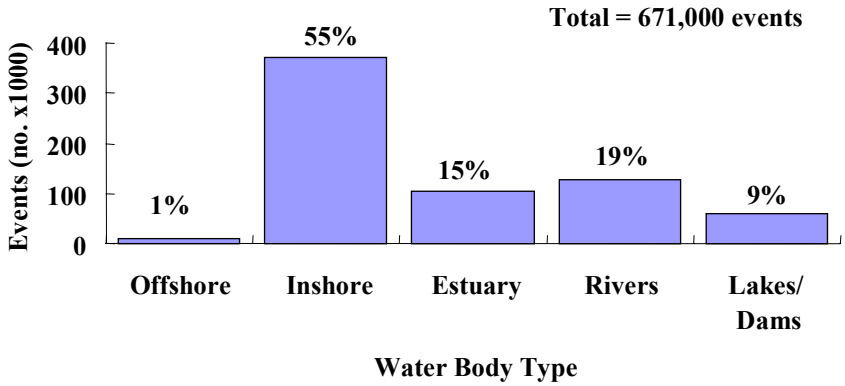

Figure 6.4. Annual fishing effort (events) by water type for indigenous fishers, aged 5 years or older, living in communities in northern Australia.

Quite different patterns in fishing effort were apparent regionally (Figure 6.5). In northern Queensland, indigenous fishers reported proportionally higher offshore and coastal fishing effort and proportionally lower activity in rivers and dams compared to the other regions surveyed. In northern Western Australia, the highest level of fishing effort occurred in rivers with proportionally lower activity in coastal and inshore regions. In the Northern Territory, indigenous fishers reported higher inshore effort, proportionally less fishing effort in coastal areas rivers and dams and, as in Western Australia, negligible fishing effort occurred offshore.

Indigenous fishers reported higher levels of fishing effort from saltwater (483,000 events 72% of total) than freshwater (188,000 events 28% of total) (Figure 6.6, Appendix 6.5). However, there were substantial differences in the pattern of fishing effort between regions, the proportion of saltwater-based fishing effort varied from 45% in Western Australia to 90% in Queensland.

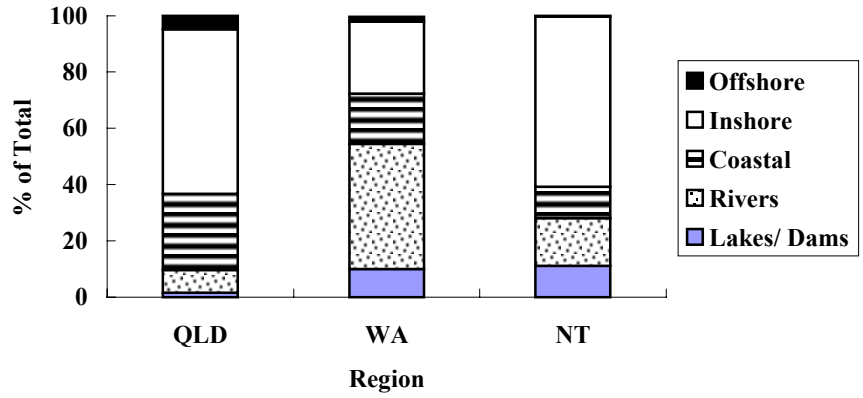

Figure 6.5. Proportion of annual fishing effort (events) by water type for indigenous fishers, aged 5 years and older, living in communities in northern Australia.

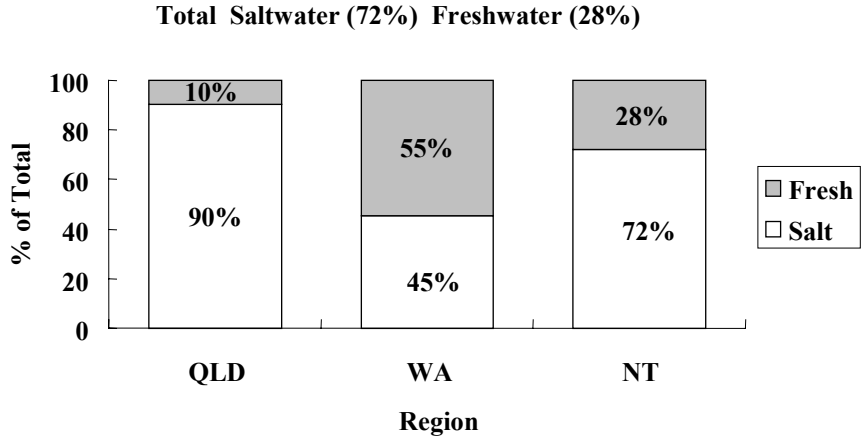

Figure 6.6. Proportion of annual fishing effort (events), in salt and freshwater by region for indigenous fishers, aged 5 years or older, living in communities in northern Australia.

6.10.3. Effort by Fishing Method

Fishing methods for indigenous fishing were classified into the same categories as employed for recreational fishing (section 5.10.5) and have been grouped into five main categories for reporting purposes (Figure 6.7). Line fishing was the most commonly used fishing method by indigenous people, comprising approximately 53% of the total fishing effort (over 355,000 fishing events). Bait was used much more frequently than lures, accounting for 88% of all line fishing events (Appendix 6.3). Hand collection was next in importance, representing approximately 26% of the total fishing effort, while effort levels for spears and nets were also important. Cast nets were the main net type used (9.8% of all fishing events) and surface spearing the main spearing method (8.7% of all fishing events) (Appendix 6.3).

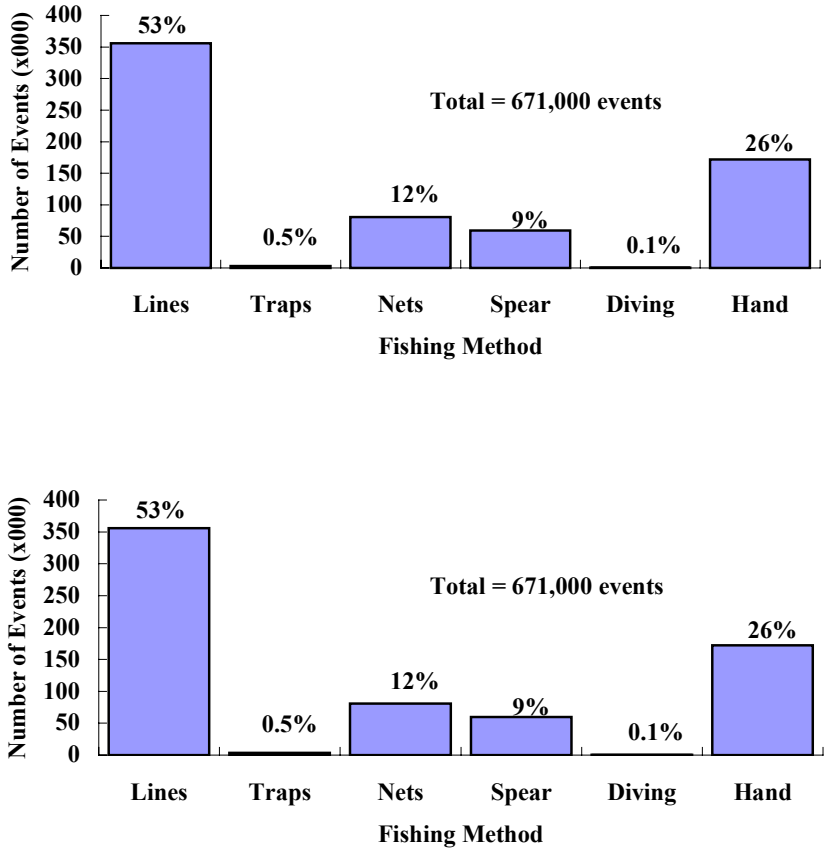

Figure 6.7. Annual fishing effort (events) by fishing method for indigenous fishers, aged 5 years or older, living in communities in northern Australia.

Although indigenous and recreational fishers use a similar variety of fishing methods, the patterns of use of these methods differ substantially. Proportionally, indigenous fishers used line fishing methods less frequently and hand collection and spearing methods more often than recreational fishers (section 5.10.5).

The relative importance of the various fishing methods used by indigenous fishers also differed regionally (Figure 6.8, Appendix 6.3). Line fishing was used proportionally less frequently whilst hand collection methods were more commonly employed by indigenous fishers in the Northern Territory than the other two States. In Western Australia, the use of nets was more common than in Queensland or Northern Territory, whilst spearing was used less frequently.

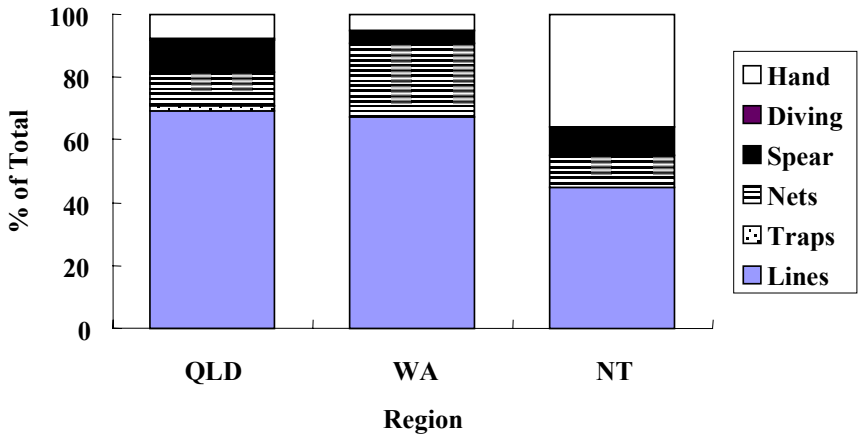

Figure 6.8. Proportion of annual fishing effort (events), by method and region for indigenous fishers, aged 5 years or older, living in communities in northern Australia.

6.10.4. Effort by Fishing Platform

Indigenous fishing effort was only classified into boat or shore fishing (unlike the recreational fishing survey, see section 5.10.6). Approximately 90% of fishing effort (606,000 events) occurred from the shore and 10% (66,000 events) from boats (Figure 6.9, Appendix 6.4). Northern Territory and Western Australia reported similar patterns in fishing effort by platform, but indigenous fishers in Queensland reported relatively high levels of boat fishing effort (Figure 6.9).

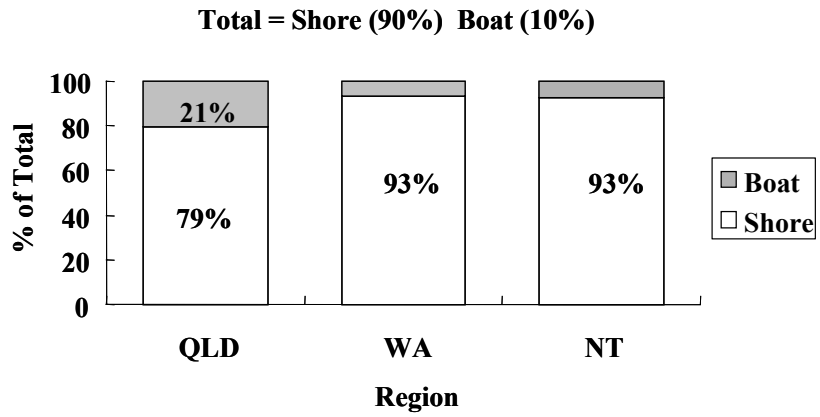

Figure 6.9. Proportion of annual fishing effort (events), by platform (boat/ shore) and region for indigenous fishers, aged 5 years or older, living in communities in northern Australia.

6.11. Indigenous Catch

Estimates of catch were derived from the information provided by residents in selected dwellings/ Estimates of catch were derived from the information provided by residents in selected dwellings/ communities during field interviews as part of the catch and effort survey. Catches were generally reported as numbers of individuals. The catch (retained and released) of aquatic resources by indigenous fishers was reported in a similar manner to the recreational survey (see section 5.11). Indigenous catch was reported at two levels to accommodate the diversity of species and the problems associated with fish identification and the range of common names for the same species. High level groupings were finfish, small baitfish, crabs and lobsters, prawns and yabbies, shellfish (e.g. mussels) and miscellaneous taxa. At the lower level, organisms were arranged according to species or species groupings (e.g. mullet, shark) to allow reporting of catch data on the key indigenous fish groups. Listings of taxa that comprise each of these groupings are provided in Appendix 5.12.

6.11.1. Total Harvest

Indigenous fishers in northern Australia harvested (caught and retained) approximately 900,000 finfish, 1.1 million molluscs, 660,000 prawns and yabbies, 180,000 crabs and lobsters and smaller numbers of other miscellaneous species during the survey year (Figure 6.10, Appendix 6.6). Since negligible quantities of seafood (54,700 aquatic animals or 1.7% of the total catch numbers) were not retained, the following description of the indigenous catch has been limited to the harvested (caught and kept) component only.

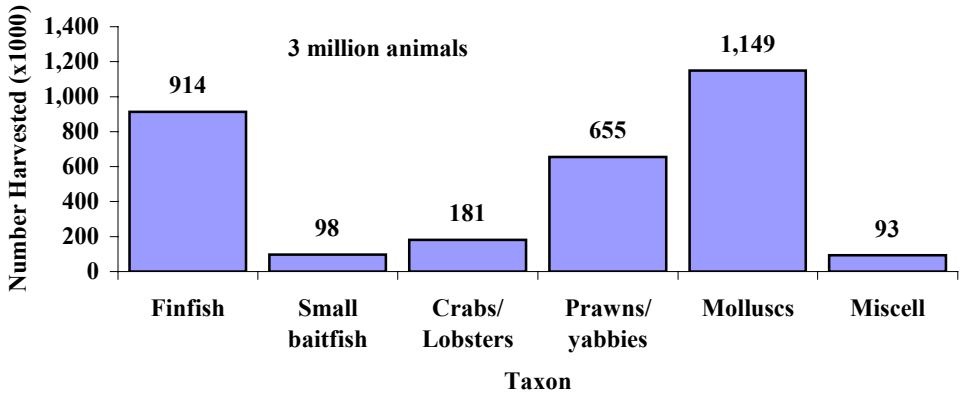

Figure 6.10. Annual harvest (numbers) by high level groupings for indigenous fishers, aged 5 years or older, living in communities in northern Australia.

6.11.2. Harvest of Key Species

The annual harvest of key species or species groups by indigenous fishers from the study region is provided in by State/ Territory (Table 6.3), water body (Table 6.4) and method (Table 6.5). A more comprehensive summary is presented in Appendix 6.7.

The most prominent finfish species/ groups (by number) in the indigenous harvest were mullet, catfish, perch/ snappers, bream and barramundi (Table 6.3). In excess of 50,000 fish of each species/ group were harvested by indigenous fishers in the study region.

The largest proportion (by number) of the total indigenous finfish catch was taken in the Northern Territory (40% of total indigenous finfish), followed by Queensland (38%) and West Australia (22%) (Appendix 6.7). This may be anticipated since the Northern Territory had a larger population of the indigenous fishers in the survey area.

The indigenous harvest of finfish (900,000 fish) from northern Australia was relatively small by comparison with the national recreational harvest of 56 million fish. However, regionally, the catch is more important, for instance within the Northern Territory the indigenous harvest of finfish from the northern region was over half of the recreational fishing harvest for the whole of the Territory.

The most prominent non-fish species/ groups (by number) in the indigenous catch were mussels, *macrobrachium*/ cherabin, mud crabs, prawns and oysters (Table 6.3). In excess of 100,000 animals of each non-fish species/ groups were harvested by indigenous fishers.

Indigenous fishers also harvested a range of species that are prohibited for non-indigenous Australians (Appendix 6.7). These species included reptiles (crocodiles, turtles) and mammals (dugong). It was estimated that indigenous fishers harvested about 390 crocodile, 1,600 dugong, 6,000 saltwater turtle, 14,000 freshwater turtle and 40,000 turtle eggs during the survey year. Dugong were taken in all States/ Territory with largest numbers (1,300 dugong) being reported from Queensland while crocodile catches were only reported from Western Australia. Indigenous fishers harvested turtle and turtle eggs from all regions, with the largest numbers being reported from the Northern Territory (Appendix 6.7).

Estimates of the indigenous catch by water body type (Table 6.4) suggest that the main part of the catch was taken from inshore and coastal waters. This may be anticipated since the highest level of fishing effort (events) occurred in these waters and the prominent species/ groups are known to be distributed in large numbers in inshore and coastal waters. Inshore and coastal waters are generally regarded as locations of greatest productivity and diversity and these waters have the additional advantage for indigenous fishers of being more accessible to traditional fishing methods.

Indigenous fishers in the study region used a range of fishing methods to harvest aquatic resources, but the major portion of the catch was taken by line, net and spear fishing methods (Table 6.5). The proportion of the harvest taken by these methods was generally more evenly spread than for non-indigenous fishers. The particular method chosen for fishing may result from the behaviour of target species, vulnerability to the fishing method and the skill of the fisher.

More detailed descriptions of the fisheries for selected fish species/ species groups are presented below.

Mullet

Mullet were the most abundant finfish species taken by indigenous fishers in northern Australia (Table 6.3). The estimated harvest of mullet (182,000 fish) was almost twice as much as the next most abundant finfish species. Mullet were taken throughout the study region with the largest catches from the Northern Territory (46% of total), followed by northern Queensland (38%) and northern Western Australia (16%). The bulk of the indigenous catch of mullet (78% of total) was taken from inshore waters (Table 6.4). Smaller numbers were taken from coastal waters (18%) and rivers (4%). Fishing nets were the primary method for harvesting mullet (Table 6.5). Relatively small numbers of mullet were taken by fishing lines and spears.

Catfish

Catfish are a widely distributed family of fishes with species that inhabit marine and freshwater environments throughout the world. Catfish were the second most prominent species harvested by indigenous fishers, with an annual harvest of approximately 110,000 fish (Table 6.3). More than half the catfish were taken from Northern Territory (56% of total), while roughly similar numbers taken from northern regions of both Western Australia (25%) and Queensland (19%) (Table 6.3). Catfish were taken in substantial numbers from both marine and freshwater environments. The largest proportion of the harvest was derived from freshwater rivers (47% of total), with catches from coastal (23% of total), inshore (20% of total) and lakes/dams (11% of total) following in importance (Table 6.4). The vast majority (90%) of the catfish were harvested by line fishing methods (Table 6.5).

Sea perch/ snappers

Sea perch/ snappers constituted a number of tropical, near shore species from the family Lutjanidae. Approximately 84,000 sea perch/ snappers were harvested by indigenous fishers in northern Australia (Table 6.3). The harvest of sea perch/ snappers occurred throughout the study region with the highest proportion taken from northern Queensland (45% of total). Lesser quantities were taken from the Northern Territory (33%) and northern Western Australia (22%). Sea perch/ snappers are predominately marine species and this was reflected in the water body type. The bulk of the catch was taken from inshore waters (66% of total). Similar numbers of sea perch/ snappers were taken from coastal (18%) and offshore waters (16%). Sea perch/ snappers were not reported from freshwater environments (Table 6.4). Virtually all (95%) of the sea perch/ snapper were taken by line fishing methods (Table 6.5).

Bream

Bream (Family Sparidae) is another broadly distributed, near shore family of fish with popular appeal among all fishing sectors. Several species of bream are endemic to Australia and two species occur in large numbers in northern Australia. The estimated annual harvest of bream by indigenous fishers in northern Australia was 70,000 fish (Table 6.3). Most of the harvest occurred in Queensland (62% of total), with lesser numbers being harvested from Northern Territory (25%) and Western Australia (13%). Bream are predominantly distributed in coastal waters around Australia and their range was reflected in the catch. Similar numbers of bream were harvested by indigenous fishers from coastal (49% of total) and inshore waters (47% of total) (Table 6.4). Practically the entire bream catch (94% of total) was taken by line fishing methods (Table 6.5).

Barramundi

Barramundi (*Lates calcarifer*) are widely distributed in estuarine and freshwater environments of northern Australia where they are sought after by commercial, recreational and indigenous fishers. Barramundi are arguably the most popular fish species in northern Australia. The estimated annual barramundi harvest by indigenous fishers in northern Australia was 63,200 fish (Table 6.3). The major portion of the indigenous barramundi catch was taken from Northern Territory (70% of total) with smaller numbers from Western Australia (21%) and Queensland (9%). Barramundi move between fresh and saltwater during various stages of their life cycle and this distribution was apparent in their harvest location. Barramundi recorded the broadest range of harvest locations (all water body types) of the prominent species in the indigenous catch. The largest number of fish was harvested from freshwater rivers (47% of total) (Table 6.4). Similar numbers of barramundi were harvested from inshore waters (14% of total), coastal waters (15%) and lakes/ dams (21%). The majority of the indigenous barramundi catch (86%) was taken by line fishing methods (Table 6.5), although significant numbers (10% of total) were also taken by spearing methods.

Mud crabs

Mud crabs are widely distributed throughout northern Australia where they inhabit sheltered estuarine waters and the tidal reaches of rivers. Extensive commercial and recreational fisheries exist for mud crabs and they also proved to be an important component of the indigenous catch. The estimated harvest of mud crabs by indigenous fishers in northern Australia was 108,000 crabs (Table 6.3). Mud crabs were harvested from inshore (66% of total) and coastal waters (34%) (Table 6.4). The major portion of the mud crab harvest was taken by hand collection methods (58% of total) and spears (27%) (Table 6.5).

6.11.3. Species Diversity of the Indigenous Catch

The present surveys have indicated that recreational and indigenous fishers harvest a wide variety of finfish species common to the waters of northern Australian. Based on overall catch composition, however, indigenous fishers demonstrated a greater reliance on non-fish species (crabs, shellfish) than recreational fishers. Species targets of indigenous fishers also extended to include some species that are prohibited for non-indigenous Australians, these included reptiles (crocodiles, turtles) and mammals (dugong) (Appendix 6.7). Both groups used similar fishing methods (lines, traps, nets etc) although a greater proportion of the indigenous catch was taken using spears and hand collection methods.

6.11.4. Further Analyses and Reporting

A great wealth of information on indigenous fishing activities has been collected through the current survey, this report represents an overview of these data. The indigenous fishing database will be the subject of further and more detailed analyses and reporting to be undertaken by the Northern Territory Department of Business, Industry and Resource Development.

Table 6.3. Estimated annual harvest (numbers) for key species taken by indigenous fishers, aged 5 years or older, living in communities in northern Australia by survey region.

Species/ species group	QLD	WA	NT	Total
Mullet	68,573	30,415	83,277	182,265
Catfish	21,738	26,920	60,831	109,489
Sea perch/snappers	38,200	18,645	27,588	84,434
Bream	44,205	9,387	17,876	71,469
Barramundi	5,745	13,318	44,134	63,197
Grunters/trumpeters	15,116	33,938	8,195	57,249
Trevally	21,494	10,369	8,241	40,104
Threadfin salmon	11,950	8,980	8,565	29,495
Wrasse/tuskfish/gropers	9,181	11,301	8,778	29,260
Garfish	26,169			26,169
Whiting	19,879	5,450	770	26,099
Cod (various)	11,679	2,748	4,254	18,681
Sharks/rays	3,819	2,011	12,464	18,294
Australian bass/ freshwater perch	612	1,205	12,789	14,606
Emperors	9,268	3,417	612	13,297
Coral trout	7,004	79	792	7,875
Rock-cod/gropers		4,530		4,530
Red emperor	1,207	90	3,210	4,508
Mackerels	2,382	424	1,416	4,222
Butterfish	2,189	1,072		3,261
Flathead	2,384	168		2,552
Tuna/bonitos		335	1,420	1,755
Pike	972	148	467	1,586
Redfish	795	543		1,338
Other Finfish	21,842	12,684	63,619	98,145
Herring/pilchards	3,545	2,866		6,411
Small baitfish	71,012	5,085	15,314	91,411
Blue swimmer crab	882	592	646	2,119
Crabs (other)	2,345	9,668	44,146	56,159
Lobsters	12,903		1,321	14,224
Mud crab	12,874	9,015	86,573	108,462
Crayfish (freshwater)	2,276		4,220	6,496
Macrobrachium/cherabin		512,413	4,101	516,514
Prawns (saltwater)	131,158	395	880	132,432
Bivalves (other)		17,264	215,586	232,850
Mussels	3,499	1,834	581,126	586,459
Oysters	34,615	22,995	56,389	113,999
Pippi/ Goolwa cockle	71,607			71,607
Crocodile		388		388
Dugong	1,293	30	296	1,619
Turtle eggs	3,976	1,051	37,282	42,309
Turtle - longneck	1,214	289	2,454	3,957
Turtle - saltwater unspec.	3,851	979	1,624	6,455
Turtle - freshwater unspec.	3,243	1,496	9,765	14,504
Worms, mangrove			14,361	14,361

Table 6.4. Estimated annual harvest (numbers) for key species taken by indigenous fishers, aged 5 years or older, living in communities in northern Australia, by water body type.

Species/ species group	Offshore	Inshore	Coastal	Rivers	Lakes/Dam	Total
Mullet		141,620	32,796	7,353	496	182,265
Catfish		21,865	24,657	51,094	11,873	109,489
Sea perch/snappers	13,219	55,620	15,595			84,434
Bream	1,232	33,909	35,604		723	71,469
Barramundi	1,213	9,032	9,740	29,944	13,268	63,197
Grunters/trumpeters	256	3,453	9,091	44,208	241	57,249
Trevally	2,794	22,286	15,024			40,104
Threadfin salmon	138	16,697	12,661			29,495
Wrasse/tuskfish/gropers	4,405	22,449	2,337	69		29,260
Garfish		11,512	14,657			26,169
Whiting		20,854	5,245			26,099
Cod (various)	2,603	9,846	6,232			18,681
Sharks/rays	421	9,763	5,508	2,602		18,294
Australian bass/perch				12,142	2,464	14,606
Emperors	4,186	7,927	1,184			13,297
Coral trout	3,477	4,318	80			7,875
Rock-cod/gropers		4,530				4,530
Red emperor	1,246	3,262				4,508
Mackerels	1,224	2,692	306			4,222
Butterfish		1,642	1,619			3,261
Flathead	80	1,895	577			2,552
Tuna/bonitos	1,420	276	59			1,755
Pike	80	1,334	173			1,586
Redfish	844	444	49			1,338
Herring/pilchards		4,856	1,555			6,411
Small baitfish	969	35,829	31,923	14,420	8,270	91,411
Blue swimmer crab		1,881	239			2,119
Crabs (other)		49,633	5,838	689		56,159
Lobsters	10,633	3,592				14,224
Mud crab	233	71,081	37,147			108,462
Crayfish (freshwater)				6,496		6,496
Macrobrachium/cherabin		777		278,492	237,245	516,514
Prawns (saltwater)		87,385	44,634		414	132,432
Bivalves (other)		176,591	56,259			232,850
Mussels		332,602	252,178	1,679		586,459
Oysters		91,591	22,408			113,999
Pippi/ Goolwa cockle		71,607	0			71,607
Crocodile			99	289		388
Dugong	650	969				1,619
Turtle eggs		40,366	1,943			42,309
Turtle - longneck				2,992	965	3,957
Turtle - saltwater	2,959	3,011	484			6,455
Turtle - freshwater				9,851	4,652	14,504
Worms - mangrove		9,699	4,662			14,361

Table 6.5. Estimated annual harvest (numbers) for key species taken by indigenous fishers, aged 5 years or older, living in communities in northern Australia by fishing method.

Species/ species group	Line	Pots/Traps	Nets	Spears	Diving	Hand	Total
Mullet	12,918		158,053	10,571		723	182,265
Catfish	98,361		7,387	3,741			109,489
Sea perch/snappers	79,873		2,454	2,106			84,434
Bream	67,451		3,338	679			71,469
Barramundi	54,186		2,600	6,410			63,197
Grunters/trumpeters	54,097		3,153				57,249
Trevally	36,259		2,131	1,713			40,104
Threadfin salmon	24,144		4,252	1,100			29,495
Wrasse/tuskfish/gropers	28,454			805			29,260
Garfish	16,798		9,371				26,169
Whiting	11,096		14,685	318			26,099
Cod (various)	17,475		477	729			18,681
Sharks/rays	9,004	47	2,009	7,233			18,294
Australian bass/perch	10,051	2,068	2,239	248			14,606
Emperors	13,297						13,297
Coral trout	6,890		80	905			7,875
Rock-cod/gropers			4,530				4,530
Red emperor	4,269		239				4,508
Mackerels	4,079		48	95			4,222
Butterfish	2,555		705				3,261
Flathead	1,400		834	318			2,552
Tuna/bonitos	1,755						1,755
Pike	1,178		361	47			1,586
Redfish	1,338						1,338
Herring/pilchards			6,411				6,411
Small baitfish	18,716	1,090	71,260			345	91,411
Blue swimmer crab			159	78		1,883	2,119
Crabs (other)	239	976	3,209	175		51,561	56,159
Lobsters				3,187	11,038		14,224
Mud crab	7,744	4,753	3,417	29,345		63,203	108,462
Crayfish (freshwater)	3,944	2,276				276	6,496
Macrobrachium/cherabin	5,508	2,218	507,597			1,191	516,514
Prawns (saltwater)	395		131,572	466			132,432
Bivalves (other)						232,850	232,850
Mussels						586,459	586,459
Oysters						113,999	113,999
Pippi/ Goolwa cockle						71,607	71,607
Crocodile	388						388
Dugong				1,619			1,619
Turtle eggs						42,309	42,309
Turtle - longneck	2,528	194		477		758	3,957
Turtle - saltwater	178			6,227		49	6,455
Turtle - freshwater	11,617			1,991		896	14,504
Worms - mangrove						14,361	14,361

7. OVERSEAS VISITOR FISHING SURVEY

G.W. Henry

7.1. Overview

Over the past decade, international tourism in Australia has experienced rapid growth (ABS, 2001a). More than 4.8 million people visited Australia last year and tourism has become an industry of significant value to the national economy. International visitors consumed a total of $12.8 billion in goods and services in Australia during 2000, which ranked the tourism industry among the nation's major export earners. The contribution of tourism products (11.2% of total exports) is now comparable with traditional exports of primary products such as food and live animals (14.1%), coal (8.4%) and petroleum and gas (5.1%) (ABS, 2002b). Tourism has also influenced the employment prospects of many Australians. In 2000-01, tourism directly employed 513,000 persons, representing 6% of the total workforce. In recognition of the value of the industry, State and local governments have implemented policies and initiatives to market tourism products to the international community. This support for the tourism industry by all levels of government and industry is likely to see a rise in the number of tourists visiting Australia in future years.

Overseas visitors come to Australia for a variety of reasons including holidays, business, conventions, visiting family and friends, employment, education and other reasons. Over half (55%) of all overseas visitors to Australia nominated a holiday as their main purpose of visit. While in Australia, visitors participate in a range of sports and activities including the water-related activities of swimming, surfing, diving, sailing and fishing. During the last decade, 2-3% of overseas visitors participated in fishing during their stay in Australia. Australia has a number of outstanding fisheries that may attract recreational fishers from other parts of the world. The black marlin fishery off Cairns that occurs during spring each year is a popular and lucrative industry involving boats, holidays, charter guides and tackle industry people. Barramundi fishing in the Northern Territory and trout fishing in Tasmania have world class reputations that attract overseas fishers each year. Apart from these icon fish species, Australia has a number of features of the environment and fisheries that may attract visitors or make fishing pleasurable. The low level of pollution, small population size, pristine environment, relatively healthy fish stocks, diversity of fish species and fishing opportunities may be seen by some overseas visiting fishers as contributing to their travelling experience.

While the number of overseas visitors who fish in Australia may be relatively small compared to the resident recreational fishing population, the economic activity generated by this group in regard to particular icon fisheries may well be substantial. In view of the survey goals of gathering fisheries statistics on all components of the non-commercial fishing sector, some consideration of the overseas visiting fishers must be made to ensure the survey results contribute to the integrated fisheries management being developed for natural resource management in Australia. Currently, there is no information available to provide estimates of the size, importance or likely impact of overseas visiting fishers on Australian aquatic resources. The goal of the current study was to describe and quantify fishing activity by overseas visiting fishers in terms of participation and to infer their likely impact on aquatic resources.

7.2. Methods

Surveying fishing activity of overseas visitors represents different methodological challenges to resident recreational fishers or indigenous fishers. Visiting fishers are relatively few in number and (presumably) undertake their fishing activity over widespread areas throughout Australia. International airport terminals, however, represent a common gathering point for overseas visitors and, after considerable review, sampling for visiting fishers as they depart Australia through international airport terminals was considered to be the most appropriate technique for gathering fishing information. Fortuitously, the methodological instrument, resources and sampling framework to collect information from international visitors currently exists and is being used by the Australian Bureau of Tourism Research (BTR).

BTR is a joint state and federal government agency that collects, analyses and disseminates information about the Australian tourism industry to the general public, government and industry. BTR has commissioned AC Nielsen Research to conduct an ongoing quarterly International Visitor Survey (IVS) at Australian international airport terminals. Each year, approximately 20,000 short-term visitors (duration of stay less than 12 months), aged 15 years or older, are interviewed at international airports (Sydney, Melbourne, Brisbane, Cairns, Perth, Adelaide, Darwin) as they depart from Australia. The interviews include questions on recreational activities (including fishing) that visitors have participated in during their stay, along with various tourism-related data (length of stay, States/Territories visited etc) and profiling information (country of origin, age, gender etc).

The IVS is the most comprehensive source of information available on visitors travelling to Australia and it offered the most cost-effective approach to the collection of information on recreational fishing by visiting fishers. The total number of interviews conducted with residents of each country or region is distributed among airports by selecting monthly samples of departing flights and visitors on those flights to achieve acceptable sample sizes in various categories. In developing the current project it had been intended to include supplementary questioning relating to recreational fishing, including main regions fished, days fished and target species and, for key species, catch estimates, in the IVS. However, inclusion of additional fishing questions proved cost-prohibitive and, as a consequence, information on recreational fishing was limited to standard IVS data outputs. Such results are weighted to data on international visitor numbers over the period, provided by the Commonwealth Department of Immigration and Multicultural Affairs with the assistance of the Australian Bureau of Statistics. BTR/Nielsen agreed to prepare relevant tabulations of expanded data and provide these data in an electronic format for the use in the current project.

7.3. Results

Information on the number of visiting fishers to Australia was provided by BTR along with demographic profiling information. Data were provided covering a four year period (1998 to 2001) but it should be noted that the sequence of data collection was interrupted by a six month period while the Department of Immigration, Multicultural and Indigenous Affairs implemented an automated scanning process to speed up access to arrivals data from passenger cards. Consequently, the survey obtained information on visiting fishers for three complete years (1998, 1999, 2001) before, during and after the implementation of other components of the NRIFS.

7.3.1. Numbers of Visitors to Australia

Annual numbers of visitors to Australia have grown steadily from about 900,000 in the early 1980's to more than 4.6 million in 2001 (Table 7.1) (BTR, 2000). International visitors arrived from more than 40 countries, although four countries (New Zealand, Japan, the United Kingdom and the United States of America) have consistently accounted for over half of the short-term visitors in recent years (Table 7.1). The main purposes of trips to Australia were for a holiday (55%), to visit friends or relatives (19%), for business (11%) or for other reasons such as education, convention, exhibitions and employment. While the annual visitor numbers show an increasing trend, there are no strong seasonal patterns in visitor arrivals throughout the year (BTR, 2000).

New South Wales was the most popular State for all categories of international visitors with 38% of all visitor nights spent in New South Wales compared with 22% for Queensland and 18% for Victoria. The five main regions visited in 1999 were Sydney, Melbourne, Gold Coast, North Queensland and Brisbane (BTR, 2000).

Table 7.1. Estimated number of overseas visitors, aged 15 years and older, to Australia during 1998, 1999 and 2001, by country of origin. (Information provided by the Bureau of Tourism Research).

	Visitors to Australia		
Country of Origin	**1998**	**1999**	**2001**
New Zealand	640,500	660,800	718,761
Japan	704,400	662,500	615,463
United Kingdom	448,400	508,900	663,607
Other Europe	343,700	388,500	432,839
USA	353,200	392,500	410,897
Singapore	215,600	234,100	255,559
Germany	123,500	140,000	147,692
Hong Kong	130,400	127,900	142,605
Malaysia	101,800	126,500	132,617
Taiwan	135,100	133,600	90,280
Korea	62,300	100,100	170,036
China	73,300	87,500	165,995
Other Asia	92,300	101,800	111,091
Indonesia	82,600	82,400	89,000
Canada	68,100	75,200	99,187
Thailand	44,600	55,700	67,440
Other Countries	239,200	265,100	266,927
Total	**3,859,000**	**4,143,100**	**4,579,995**

7.3.2. Annual Number of Visiting Fishers by Country of Origin

During 2001 about 191,000 overseas visitors engaged in fishing activities while visiting Australia (Table 7.2). Although the number of visiting fishers has risen in line with the growth in overseas visitor numbers since 1998 (Table 7.2), the proportion of visitors who participated in fishing in 2001 was about 4.2% of total visitors, compared with 4.3% in 1998 and 4.6% in 1999 (Table 7.3).

In terms of absolute numbers, the highest participation in recreational fishing in Australia during 2001 was by visitors from the United Kingdom (46,100 persons) followed by Japan (23,900), the United States (19,300) and New Zealand (14,800) (Table 7.2). Based on participation rates in 2001

a different pattern emerged, with the highest rate for Taiwan (7.65%), followed by the United Kingdom (6.95%), Thailand (5.82%) and Hong Kong (5.31%). For comparative purposes, numbers and participation rates by country of origin for 1998 and 1999 are also presented in Tables 7.2 and 7.3.

Table 7.2. Estimated numbers of overseas visitors, aged 15 years and older, who fished in Australia during 1998, 1999 and 2001, by country of origin. (Information provided by the Bureau of Tourism Research).

Country of Origin	Visitors who fished		
	1998	1999	2001
United Kingdom	34,005	39,165	46,088
Japan	23,722	23,634	23,939
Other Europe	14,464	22,672	19,540
New Zealand	20,588	20,122	14,775
USA	10,578	16,185	19,323
Singapore	10,133	7,527	8,717
Taiwan	6,515	8,150	6,908
Hong Kong	6,187	7,771	7,572
Germany	4,458	6,134	4,596
Korea	4,260	5,595	3,991
Malaysia	4,832	4,002	4,693
Other Asia	4,508	6,294	2,651
Canada	3,447	4,510	5,200
Indonesia	3,660	4,849	3,845
China	2,856	4,048	2,889
Thailand	1,746	1,549	3,924
Other Countries	10,829	7,654	12,480
Total	**166,788**	**189,861**	**191,131**

Table 7.3. Percentage of overseas visitors, 15 years of age and older, who fished in Australia, during 1998, 1999 and 2001, by country of origin. (Information provided by the Bureau of Tourism Research).

Country of Origin	Participation rate (%)		
	1998	1999	2001
United Kingdom	7.58	7.70	6.95
Taiwan	4.82	6.10	7.65
Canada	5.06	6.00	5.24
Hong Kong	4.74	6.08	5.31
Korea	6.84	5.59	2.35
Indonesia	4.43	5.88	4.32
Other Europe	4.21	5.84	4.51
Other Asia	4.88	6.18	2.39
Thailand	3.91	2.78	5.82
USA	2.99	4.12	4.70
Malaysia	4.75	3.16	3.54
Singapore	4.70	3.22	3.41
Germany	3.61	4.38	3.11
Japan	3.37	3.57	3.89
China	3.90	4.63	1.74
New Zealand	3.21	3.05	2.06
Other Countries	4.53	2.89	4.68
Total	**4.32**	**4.58**	**4.17**

7.3.3. Age and Gender of Fishers

All age groups, from 15 to over 70 years of age, were represented by visiting fishers, though greatest numbers were in the 20-24 and 25-29 age groups, about 35,000 and 30,000 persons, respectively (Figure 7.1). Each of the age groups from 30 years and onwards were represented by about half these numbers. Of the visitors who fished, approximately 63% were male as compared to 38% for females.

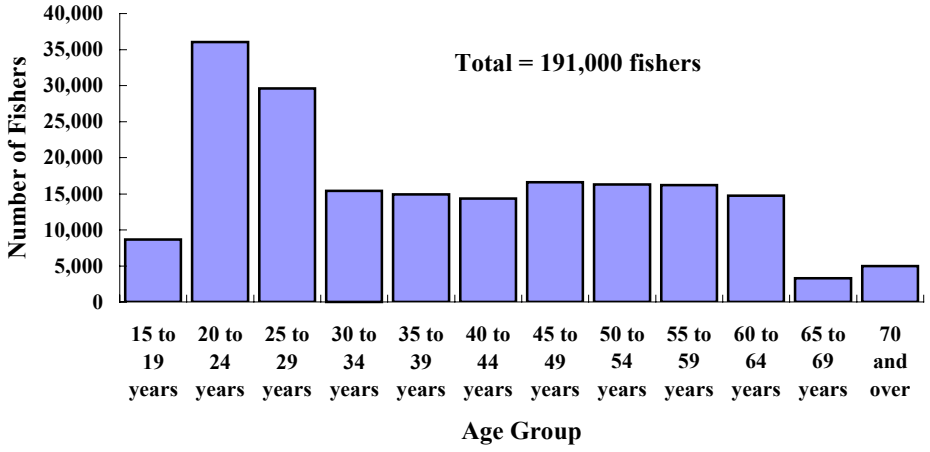

Figure 7.1. Numbers by age class of overseas visitors who fished in Australia during 2001. (Information provided by the Bureau of Tourism Research).

7.3.4. Conclusion

By comparison with the resident recreational fisher population, the numbers of overseas visitors who fished in Australia during 2001 was relatively low. Unfortunately no information about regions fished, effort (days or trips), catch or fishing related expenditure was collected and therefore the impacts of fishing activities by overseas visitors could not be assessed.

8. BENEFITS

The National Recreational and Indigenous Fishing Survey has provided a wealth of benefits for the conservation of aquatic resources and the management of fisheries in Australia. The survey represents the first comprehensive assessment of non-commercial fishing, including the number and distribution of participants, their demographic characteristics, levels of fishing effort and catches. Such information provides resource managers, researchers, fishers and the general community with an appropriate and realistic appraisal of the size of the non-commercial fishery and its potential impact on fishery resources. Baseline economic assessments have also been provided, together with the capability for more detailed analyses of the survey database. The national survey therefore provides important benchmarking information for non-commercial fishing in Australia.

By conducting the survey nationally, directly comparable information has been collected across all jurisdictions, enabling assessments on a variety of regional scales. Such analyses may be relevant for marine species that have wide distributions or for inland fisheries based on catchments that cross state boundaries. Furthermore, there are benefits in assessing the levels of effort and economic activity that are imported or exported between the states. This study has clearly demonstrated that such impacts can be significant and may not be readily evaluated in state-wide surveys that are limited in scope to the fishing activity of residents.

The fishery statistics (catch, fishing effort, species composition) generated from the national survey provide some indication of the status of fish populations and the quality of recreational fishing at a variety of spatial scales. Catch and catch rates represent indices of fishing success and are the focus of interest by recreational and commercial sectors since they are closely related to their outputs of sport and profit. If collected over the long-term, such data may also provide a method of tracking the health of fish stocks on a national, state or regional basis. Australian fishery agencies have maintained catch and effort databases for the commercial fishing sector for decades and have expressed the desirability of establishing similar data for the recreational sector. A whole-of-fishery approach to resource management will clearly enhance the management and conservation of our aquatic resources. Furthermore, quantification of the harvest share for the various sectors is important to the consideration of issues relating to resource assessment and allocation.

Fisheries agencies implement management regulations (bag and size limits, closed areas and seasons, restrictions on gear) to limit fishing activity and control the harvest of fish. Ideally such regulatory control measures and harvest strategies should be implemented on the basis of objective evidence of their effect, or at least with monitoring programs to quantify the outcomes. Information from the national survey has the potential to assist management agencies in determining the need for additional management controls as well as the relevance of current regulatory controls.

The national survey also indirectly provided an opportunity for fishery agencies to communicate broadly with recreational and indigenous fishers and the general community. Client involvement in fisheries management issues is regarded as an important part of the modern resource management agenda. During the national survey, contact was made with over 30,000 households (including indigenous communities), which is likely to have raised the level of awareness of fishery management and research initiatives. Indeed, fisheries research staff remained in contact with more than 20,000 fishers over a 12 month period, culminating in an attitudinal survey where client opinion was assessed for a range of issues. Nowadays, management actions are scrutinised by a broad cross-section of the community that interpret scientific data and management regulations in relation to their own interests. It is essential, therefore, that fisheries agencies understand the expectations of client groups, while involved in negotiating biological and population outcomes for the management of aquatic resources.

9. FURTHER DEVELOPMENTS

The National Recreational and Indigenous Fishing Survey was developed over a number of years by a group of specialists in the fields of recreational fishing surveys, fisheries management, survey design and statistical analyses. A number of international experts in recreational survey design were also consulted prior to and during the development of the methodology. A thorough literature survey was conducted to assess the range of survey methodologies and to select the most appropriate technique for Australian conditions. The chosen method was pilot tested at a number of locations in Australia during 1999. Similar large-scale survey techniques were implemented with success in the Northern Territory (Coleman, 1997), South Australia (McGlennon, 2000) and Tasmania (Lyle, 2000) prior to the implementation of the current survey. These desktop and field exercises have led to the development of a robust survey instrument that is recognised internationally.

While some refinement of the methods of analysis occurred at the end of the project, the essence of the data collection process was implemented as designed. Validation and calibration exercises were conducted during the course of the survey to confirm data quality. Non-response and behavioural biases in survey data that have been the subject of speculation and assumption in previous surveys were examined in detail in the current survey. These innovative design aspects have provided important insights into a number of fundamental issues relating to recreational surveys. The quality of data obtained from the national survey and the success of validation exercises have provided research staff with confidence that the national survey could be repeated in the future with only minor adjustments or improvements necessary.

A full set of survey documentation including interviewer manuals, questionnaires, data collection forms, diaries, fish identification booklets and survey maps are available. Training programs for survey staff have been developed. A national database using off-the-shelf software (Microsoft ACCESS) has been developed. Key components of the survey instrument require only limited further development and, therefore, cost savings would be envisaged if the survey was repeated.

As it is anticipated that the survey, in part of full, will be repeated, the real value of the present study lies not only with the first comprehensive description of non-commercial fishing activity in Australia, but as a baseline or benchmark against which future developments can be assessed. It is generally recognised that long term monitoring of catches, effort and participation represent important inputs into fisheries resource management. Long-term monitoring programs have been in place for the commercial sector for decades (logbooks), however, any development of on-going monitoring programs for the recreational and indigenous sectors will ultimately be dependent upon the ability to secure funding.

The level of funding provided by the Commonwealth to support the current survey represents short-term assistance, granted mainly to develop and undertake an initial survey. Now that this phase has been completed it would seem appropriate that the States/ Territories accept a greater share in terms of the costs of monitoring their recreational fisheries. Several states already have some cost-recovery programs relevant to recreational fisheries, either through licensing or boat registration fees. Some of the revenue raised through such programs is generally available to support research and as such there is a need to develop a strategic view to the assessment of recreational fishing activity at state-wide and even national levels.

The current project has provided a wealth of information about non-commercial fishing activity in Australia and the present report represents only a first cut ‘big picture’ analysis of the data. Further reports are in progress, including individual State/ Territory recreational fishing reports, a more comprehensive economic analysis and a detailed evaluation of indigenous fishing activity. Significantly the data set will also continue to be used extensively by resource managers, researchers and the general community in the future to address a variety of specific resource based issues as they arise.

10. CONCLUSIONS

10.1. National Survey Overview

- The National Recreational and Indigenous Fishing Survey (NRIFS), a multifaceted project designed to provide a range of information about non-commercial fishing in Australia, was successfully conducted during 2000-01.
- The primary objective of the NRIFS was to collect nationally consistent and comparable fishery statistics (numbers of fishers, fish catch, fishing effort, species composition, economic and social data) for the non-commercial components of Australian fisheries.
- The NRIFS was comprised of three independent surveys, the National Recreational Fishing Survey (NRFS), the Indigenous Fishing Survey of Northern Australia (IFSNA) and the Overseas Visitor Fishing Survey (OVFS). Reflecting their varying characteristics, different methodological and analytical approaches were required for each of these surveys.

10.2. National Recreational Fishing Survey (NRFS)

10.2.1. Participation in Recreational Fishing

- In the twelve months prior to May 2000, an estimated 3.36 million Australians, aged 5 years or older, went recreational fishing at least once, representing a national recreational fishing participation rate of 19.5%.
- An estimated 1.8 million Australian households contained at least one recreational fisher, representing 24.4% of households nationally.
- New South Wales had the highest number of recreational fishers (999,000) followed by Queensland (785,000) and Victoria (550,000). But the highest participation rates were recorded from Northern Territory (31.6%), Tasmania (29.3%) and Western Australia (28.5%).
- Regional participation rates were lowest in urban centres, e.g. Sydney (13.1%) and Melbourne (10.2%), but by virtue of their large populations, urban centres contained large numbers of fishers, often dominating the fisher populations at the State or Territory levels.
- Based on numbers of fishers, there was an average of 1.9 fishers per fishing household nationally, with a range of 1.8 (Victoria) to 2.0 (Queensland).
- Recreational fishing was more popular with males (2.3 million fishers) than females (1.1 million fishers) and distinct patterns in the age structure of fishers were observed.
- The 30-44 age group contained the highest number of recreational fishers (644,000 males and 325,000 females), although participation rates were highest among the 5-14 age group (33% for males and 23% for females).
- In Australia, more than 511,000 boats with a capital value of $3.3 billion were used for recreational fishing in the 12 months prior to May 2000.
- Australian recreational fishing boats were most commonly engine powered, between 4-5 metres in length and kept on a trailer. About half the vessels were equipped with a depth sounder and about 20% had GPS, though the likelihood of electronic aids being present increased with vessel size.

10.2.2. Recreational Fishing Effort

- Recreational fishing effort, catch and fishing related expenditure was monitored for intending fishers over a twelve month period, from May 2000 to April 2001.
- During the survey period, Australians fished for an estimated 20.6 million fisher days of effort. This fishing activity was comprised of 23.2 million separate fishing events or 102.9 million fisher hours of effort.
- New South Wales recorded the greatest effort (6.9 million fisher days, 7.7 million events or 30.4 million fisher hours), followed by Queensland (4.6 million fisher days, 5.8 million events or 25.4 million fisher hours) and Western Australia (3.4 million fisher days, 3.4 million events or 19.7 million fisher hours).
- Recreational fishing effort was clearly concentrated on the east coast of Australia, with more than half the national total (measured either as days, events or hours) reported from New South Wales and Queensland alone.
- An estimated 2.6 million fishing events (about 11% of the national total) occurred outside of the fisher's home State. Interstate fishing had a reciprocal aspect, with each State or Territory importing as well as exporting effort to and from other regions of Australia.
- New South Wales, Queensland, the Northern Territory and, to a lesser extent, Western Australia were net importers of fishing effort. By contrast, Victoria, the Australian Capital Territory and South Australia were net exporters of fishing effort. In Tasmania, imported and exported fishing effort largely balanced each other.
- Nationally, individual recreational fishers fished for an average of just over 6 days during the survey period.
- Recreational fishing in coastal waters attracted 41% of fishing effort. Fishing in estuarine waters (35%), freshwater rivers (11%), freshwater lakes and dams (8%) and offshore waters (4%) followed in importance.
- Nationally, about 80% of the fishing effort (events) occurred in saltwater (offshore, coastal and estuarine waters) as opposed to 20% in freshwater (freshwater rivers, lakes and dams).
- Shore-based fishing attracted a greater level of activity (13.3 million events or 57% of total) than fishing from boats (9.8 million events or 43% of total).
- Fishing from privately-owned boats accounting for 9.2 million events or 93% of the total boat-based effort. An estimated 364,000 fishing events (3.7% of total) were conducted from charter vessels while 328,000 fishing events (3.3% of total) occurred from hire boats.
- Line fishing (including the use of bait, artificial lures and jigs as well as set-lines) accounted for 19.7 million fishing events, i.e. nearly 85% of the overall annual fishing effort. Fishing with pots and traps (7%), harvesting bait with pumps, rakes and spades (4%), fishing with nets (3%) and diving with spears or hand collecting (1%) followed in importance.
- Line fishing events, whether using bait or artificial lures, averaged around 3.5 hours, but the fishing times varied widely with the different fishing techniques.

10.2.3. Recreational Fish Catch

- Australian recreational fishers harvested an estimated 60.4 million finfish, 11.5 million small baitfish, 6.1 million crabs and lobsters, 47.7 million prawns and yabbies, 1.8 million cephalopods, 7.2 million other molluscs, and 1.2 million other taxa during the survey period.
- Of the marine finfish harvested, whiting (fam. Sillaginidae), including King George whiting (*Sillaginodes punctata*), followed by flathead (fam. Platycephalidae), Australian herring and Australian salmon (*Arripis* spp.), bream (fam. Sparidae), mullet (fam. Mugilidae), garfish

(fam. Hemiramphidae), tailor (*Pomatomus saltatrix*), and pink snapper (*Pagrus auratus*) dominated the catch nationally based on numbers.

- European carp (*Cyprinus carpio*), redfin (*Perca fluviatilis*), golden perch (*Macquaria ambigua*) and trout/salmon (fam. Salmonidae) dominated the harvest of freshwater finfish, taken in numbers comparable to several of the major marine species.
- A wide diversity of non-fish species was harvested, primarily for use as bait or food. Squid/cuttlefish, blue swimmer crabs (*Portunus pelagicus*), mud crabs (*Scylla* spp), lobsters and abalone were dominant among the larger non-fish species. Smaller organisms such as prawns, yabbies, crayfish, bivalve molluscs (especially mussels and pippis) and worms were also harvested in large numbers.
- Significant numbers of fish caught by recreational fishers were not retained. For example, over 18 million flathead, bream and whiting were released nationally. Species for which release rates were in the high category included salt and freshwater finfish such as sharks/rays, Murray cod, Australian bass/perch, catfish, barramundi, red emperor, pink snapper, bream, cod and wrasse/tuskfish/gropers.
- Catch information reported during the survey was based on numbers rather than weight, however the approximate harvest weights for selected species or species groups were obtained by multiplying estimated total numbers caught and retained by the average weight of the harvested individual. For a variety of reasons, achieving accuracy and precision in determining weight was difficult. Nevertheless, these data suggest that the total annual recreational harvest of finfish was in excess of 27,000 tonnes nationally, with at least a further 3,000 tonnes of non-fish species also taken.
- Estimated total catches of several species groups exceeded 1,000 tonnes nationally. They include whiting, flathead, bream, Australian salmon, pink snapper, emperors, mackerels, tunas/bonitos, sharks/rays, European carp and blue swimmer crabs.

10.2.4. Expenditure by Recreational Fishers

- Recreational fishers in Australia spent an estimated $1.8 billion on fishing related items during the survey year.
- Expenditure was generally related to the size of the population and the number of fishers. New South Wales had the largest expenditure ($554 million) and Australian Capital Territory the smallest ($19 million).
- Australian recreational fishers reported more than 45 different expenditure items. Expenditure on boats and trailers ($940 million) was the largest individual expense for fishers. Travel associated with fishing ($395 million) and fishing gear ($182 million) followed in importance.
- The average expenditure was $552 per fisher per annum with Victoria being the highest at $721 and the Australian Capital Territory, at $363, the lowest.

10.2.5. Motivation for recreational fishing

- Australian recreational fishers identified ‘to relax and unwind’ (37% of respondents), ‘fishing for sport’ (18%), ‘to be with family’ (15%) and ‘to be outdoors’ (13%) as their primary motives for fishing. Only a small proportion of fishers (8%) considered catching fish for food as their primary motivation.

10.3. Indigenous Fishing Survey of Northern Australia (IFSNA)

- The survey of indigenous fishing in northern Australia collected fishery statistics from 44 communities distributed across the top end of Australia from Broome to Cairns.

10.3.1. Participation in fishing by indigenous people

- Indigenous people in northern Australia had a high level of participation in fishing. More than 37,000 people, representing 91.7% of indigenous people, aged 5 years or older, living in communities in northern Australia participated in fishing during the survey year.
- The Northern Territory had the highest number of indigenous fishers living in communities (20,700), followed by Queensland (10,400) and Western Australia (6,000). However, the highest fishing participation rate (93%) was reported from Queensland.

10.3.2. Indigenous fishing effort

- Indigenous fishers in northern Australia expended an estimated 420,000 fisher days of effort during the survey year, representing 671,000 separate fishing events. Almost two thirds of the fishing effort (439,000 events) occurred in the Northern Territory region while the Queensland and Western Australia regions reported 21% (138,000 events) and 14% (95,000 events) of the effort, respectively.
- Indigenous fishers harvested aquatic animals from a range of environments, but inshore waters (370,000 events) accounted for more than half the fishing effort. Fishing in freshwater rivers (127,000 events), estuaries (104,000 events) and lakes and dams (61,000 events) followed in importance. Different patterns in water body usage were apparent between State and Territory regions.
- More fishing effort occurred in saltwater (483,000 events, 72%) than in freshwater (188,000 events, 18%). Fishing from the shore (606,000 events or 90% of the total) dominated indigenous fishing.
- Indigenous fishers in northern Australia used line fishing methods (53%), hand collecting (26%), nets (12%) and spears (9%) as their primary fishing methods.

10.3.3. Indigenous fish catch

- Indigenous fishers harvested more than 3 million aquatic animals from the waters of northern Australia. The harvest included 900,000 finfish, 1.1 million shellfish, 660,000 prawns and yabbies, 180,000 crabs and lobsters and smaller numbers of other taxa.
- The most prominent finfish species/ groups (by number) in the indigenous catch were mullet (182,000 fish), catfish (109,000), sea perch/ snappers (84,000), bream (71,000) and barramundi (63,000).
- The Northern Territory region recorded the largest proportion (by number) of the total indigenous finfish catch (40% of total) followed by the Queensland (38%) and West Australia regions (22%).
- The most prominent non-fish species/ groups (by number) in the indigenous catch were mussels, *macrobrachium*/ cherabin, mud crabs, prawns and oysters.
- A relatively small proportion of the indigenous catch (1.7%) was returned to the water.
- Indigenous fishers harvested a number of species groups that were out-of-scope or protected from non-indigenous fishers.

10.4. Overseas Visitor Fishing Survey (OVFS)

- Approximately 4.6 million international visitors came to Australia during 2001.
- Approximately 191,000 of these visitors (4%) engaged in fishing while they were in Australia.
- The largest number of visitors who fished in Australia came from United Kingdom (46,100). Japan (23,900), USA (19,300) and New Zealand (14,800) followed in importance.
- All age groups were represented by the visitors who fished, though greatest numbers were in the 20-24 and 25-29 age brackets.
- No information on the levels of fishing effort, catch or fishing related-expenditure in Australia was collected for international visitors.

10.5. Conclusions

- The project has established a substantial database on recreational and indigenous fishing in Australia, representing the first comprehensive description of these sectors. As such these data will provide an invaluable baseline against which future developments may be evaluated. In order to fully realise the value of the data, however, it is highly desirable that the surveys are periodically repeated.
- Exceptional response rates and the quantity and detail of data obtained confirm the efficacy of the survey methodologies as vehicles for the study of the non-commercial fisheries at national, state and regional levels.
- Government, industry and community groups will use the information obtained from the current study for a variety of biological, social, economic and political purposes. Fisheries agencies will use the biological knowledge to assess the status of key fish stocks and the relevance of fisheries management regulations. Fishing, environmental and community groups will use indices of fishing success to support perceptions of stock abundance. Inevitably, a broad range of groups will use the information in relation to issues of access and resource allocation and, as such, these discussions may now occur with some quantitative understanding of the issues.
- The project has delivered on the primary goal of the "National Policy on Recreational Fishing" regarding the establishment of an information base at national and regional levels to meet the needs of recreational fisheries management. The project has also achieved the objective of Commonwealth and State fishery agencies regarding the collection of scientific data to support the management of recreational fishing within various Australian jurisdictions.
- While the project has been a success by any measure, the real value of the data will become apparent in future years as further research projects are completed and long-term trends in recreational fisheries statistics become available.

11. REFERENCES

Altman, J.C. (1992) Statistics about indigenous Australians: Needs, problems, options and implications. In: Altman, J.C. (Editor) *National Survey of Indigenous Australians: Options and Implications*. Centre for Aboriginal Economic Policy Research, Australian National University, Canberra.

ABS (1992) 1991 Census: Australia's Aboriginal and Torres Strait Islander Population. Report No. 2740.0. Australian Bureau of Statistics, Canberra.

ABS (1994) Home production of selected foodstuffs, Australia, year ended April 1992. Australian Bureau of Statistics, Catalogue No. 7110.0

ABS (1996) 1994 National Aboriginal and Torres Strait Islander Survey. Report No. 4190.0. Australian Bureau of Statistics, Canberra.

ABS (1997) Results of the 1996 National Census. Australian Bureau of Statistics, Sydney.

ABS (1998) 1996 Census: Australia's Aboriginal and Torres Strait Islander Population. Report No. 2034.0. Australian Bureau of Statistics, Canberra.

ABS (2001a) Demography working paper 2001/7 – Statistical requirements for overseas arrivals and departures data at September 2001. Australian Bureau of Statistics, Sydney.

ABS (2001b) Estimated resident population (ERP) data for 2000. Australian Bureau of Statistics, Canberra.

ABS (2002a) 2001 Census: Australia's Aboriginal and Torres Strait Islander Population. Report No. 4713.0. Australian Bureau of Statistics, Canberra.

ABS (2002b) Tourism: International inbound tourism – Characteristics. Australian Bureau of Statistics, Canberra.

ABS (2002c) Tourism: Feature article – International tourism and its worth to Australia. Australian Bureau of Statistics, Canberra.

Banfield, E.J. (1909) Blacks as fishermen: expedients, devices, stratagems. *Royal Geographical Society of Australasia*, Brisbane.

Bennett, D.H. (1983) Some aspects of aboriginal and non-aboriginal notions of responsibility to non-human animals. *Journal of the Australian Institute of Aboriginal Studies*, pp 19-25.

Blamey, R. (2002) The recreational sector. In: Hundloe, T.J. (Editor) *Valuing Fisheries: An Economic Framework*. University of Queensland Press, St Lucia.

Bockstael, N.E. and McConnell, K.E. (1981) Theory and estimation of the household production function for wildlife recreation. *Journal of Environmental Economics and Management*, **8**(2), 199-214.

Bogelius, A. (1998) National survey of recreational fisheries in Sweden. In: Hickley, P. and H. Tompkins (Editors) *Recreational fisheries: social, economic and management aspects*. Fishing News Books, London.

Bradford, E. (1998) National marine recreational fishing 1996: Scaling the diary survey results to give the total recreational harvest. NZ National Institute of Water and Atmospheric Research (NIWA) Technical Report 17.

Bradley, W. (1786-92) Journal of Lieutenant William Bradley on board H.M.S. Sirius. State Library of NSW (Mitchell library).

BTR (2000) International visitors in Australia, 1999. Bureau of Tourism Research, Canberra.

Caughley, J., Bomford, M. and McNee, A. (1996) Use of wildlife by indigenous Australians: Issues and concepts. In: Bomford and Caughley (Editors) *Sustainable use of wildlife by aboriginal peoples and Torres Strait Islanders*. Australian Government Publishing Service, Canberra.

Chapman, D. (1996) Importance of fish and fisheries to aboriginal communities. Paper presented at the Second World Fisheries Congress, Brisbane.

Chase, A. and Sutton, P. (1981) Hunters and gatherers in a rich environment: Aboriginal coastal exploitation in Cape York Peninsula. In: Keast, Crocker and Christian (Editors) *Biogeography and ecology in Australia*. Junk and Co, The Hague.

Cohen, P. (1892) The marine fish and fisheries of New South Wales; past and present in their commercial aspect. Government Printer, Sydney.

Coleman, A.P.M. (1998) Fishcount: A survey of recreational fishing in the Northern Territory. Fishery Report No. 43. Northern Territory Department of Primary Industry and Fisheries.

Coleman, A.P.M. (2000) Indigenous survey component. In: *SDWG: Development of the National Recreational and Indigenous Fishing Survey*. Final Report to the Fisheries Research and Development Corporation Project No. 98/169.

Collins, A.J. (1976) Inland angling in New South Wales. New South Wales State Fisheries, *Research Bulletin* No. 14.

Corcoran, K., Allcock, A., Frost, T. and Johnston, L. (1999) Valuing Tourism: Methods and Techniques, Bureau of Tourism Research, Occasional Paper no. 28, Canberra.

Cordell, J. (1992) Managing sea country: tenure and sustainability of Aboriginal and Torres Strait Islander Marine Resources. Consultancy report for ESD Working Group on Fisheries, ESD Fisheries Working Group, Canberra.

Dargin, P. (1976) Aboriginal fisheries of the Darling-Barwon Rivers. Brewarrina Historical Society, Brewarrina.

De Castelnau, Count F. (1872) Essay on the ichthyology of Port Jackson. *Proceedings of the Linnean Society of New South Wales*. **3**:347.

Dominy, L. (1992) A Canadian perspective on recreational fisheries, pp 9-13. In: S. Dovers (Editor) *Australian Recreational Fishing: Policies for Resource Management*. Proceedings of the National Conference, 23-25 October 1991. Issues in Water Management No 7, Australian National University in association with the Australian Recreational and Sports Fishing Confederation.

Dunn, B. (1991) *Angling in Australia: Its history and writings*. David Ell Press Pty Ltd, Sydney.

Edwards, G.B. (1991) A USA perspective on problems and policies. In: S. Dovers (Editor). *Australian Recreational Fishing: Policies for Resource Management*. Proceedings of the National Conference, Australian National University, Canberra.

Essig, R.J. and Holliday, M.C. (1991) Development of a recreational fishing survey: The marine recreational fishery statistics survey case study. *American Fisheries Society Symposium* **12**: 245-54.

Fedler, A.J and Ditton, R.B. (1994) Understanding angler motivations in fisheries management. *Fisheries* **19**(4): 6-13.

Finney, K. and Lyle, J.M. (2000) Data management strategy for the national recreational and indigenous fishing survey. In: *SDWG: Development of the National Recreational and Indigenous Fishing Survey*. Final Report to the Fisheries Research and Development Corporation Project No. 98/169.

Fisheries Inquiry Commission (1880) Report of the Royal Commission to inquire into and report upon the actual state and prospect of the fisheries of this colony. Government Printer, Sydney.

Forward J. and Lyle J.M. (2002) A survey of the 2000/01 Tasmanian recreational rock lobster fishery and options for future assessment. Final report to the Marine Recreational Fishery Council. Tasmanian Aquaculture and Fisheries Institute, University of Tasmania.

Gentner, B. and Lowther, A. (2002) Evaluating marine sport fisheries in the USA. In: Pitcher, T.J. and Hollingworth, C.E. (Editors). *Recreational Fisheries: Ecological, Economic and Social Evaluation*. pp186-206. Blackwell Science, Oxford, UK.

Gilmore, M (1986) *Old days Old ways*: A book of recollections new edition, Sydney.

Grambsch, A.E. and Fisher, W.L. (1991) Improving surveys: Lessons from the National Survey. *Amer. Fish. Soc. Symposium* **12**: 5-12.

Green, N. (1988) Aboriginal affiliations with the sea in Western Australia. In: Gray and Zann (Editors) *Traditional knowledge of the marine environment in Northern Australia*. pp 19-29. Great Barrier Reef Marine Park Authority, Townsville.

Griffiths, M.H. and Lamberth, S.J. (2002) Evaluating the marine recreational fishery in South Africa. In: Pitcher, T.J. and Hollingworth, C.E. (Editors) *Recreational Fisheries: Ecological, Economic and Social Evaluation*. pp227-51. Blackwell Science, Oxford, UK.

Guthrie, D., Hoenig, J.M., Holliday, M., Jones, C.M., Mills, M.J., Moberly, S.A., Pollock, K.H. and D.R. Talhelm (Editors) (1991) Creel and angling surveys in fisheries management. *American Fisheries Society Symposium* **12**.

Handcock, D.A. (Editor) (1995) *Recreational fishing: what's the catch?* Australian Society for Fish Biology Workshop Proceedings, Canberra August 1994. Australian Society for Fish Biology, Canberra.

Henry, G.W. (1984) Commercial and recreational fishing in the Sydney estuary. *Fishery Bulletin* No.1. Dept. Agri., NSW.

Hickley, P. and Tompkins, H. (Editors) (1998) *Recreational Fisheries: Social, Economic and Management Aspects*. Fishing News Books, Blackwell Scientific Publications, Oxford, UK.

Higgs, J.B. (1999) Experimental catch estimates for Queensland residents. RFISH Technical Report No. 2. Results from the 1997 diary round. Queensland Fisheries Management Authority.

Higgs, J.B. (2001) Catch estimates for Queensland residents. RFISH Technical Report No. 3. Results from the 1999 diary round. Queensland Fisheries Service.

Hundloe, T.J. (Editor) (2002) Valuing Fisheries: An Economic Framework. University of Queensland Press, St Lucia, QLD.

Jantzen, J.-M. (1998) A national survey on freshwater fishing in France. In: Hickley, P. and H. Tompkins (Editors) *Recreational fisheries: social, economic and management aspects*. Fishing News Books.

Johannes, R.E. and MacFarlane, J.W. (1991) Traditional fishing in the Torres Strait Islands. CSIRO Division of Fisheries, Hobart.

Kaufmann, B. (1996) Economic efficiency and the allocation of fisheries resources between the commercial and recreational sectors. Discussion paper prepared for Australian Fisheries Management Authority, Canberra.

Kearney, R.E. (1991) Sustaining fisheries resources: The research/management interface. In: S. Dover (Editor). *Australian Recreational Fishing: Policies for Resource Management*. Proceedings of the National Conference. Australian National University, Canberra.

Kearney, R.E. (1995) Keynote address: Recreational fishing: What's the catch. In: Handcock, D.A. (Editor) *Recreational fishing: What's the catch?* Australian Society for Fish Biology Workshop Proceedings, Canberra, 30-31 August 1994. ASFB, Canberra

Kearney R.E. (2002) Recreational fishing: Value is in the eye of the beholder. In: Pitcher, T.J. and Hollingworth, C.E (Editors) *Recreational Fisheries: Ecological, Economic and Social Evaluation*. pp17-33. Blackwell Science, Oxford, UK.

Kewagama Research. (1998) National recreational fishing survey – Feasibility study. Report to Department of Primary Industries and Energy, Canberra.

Keynes, J. M. (1936) The General Theory of Employment Interest and Money, Macmillan Press Ltd, London.

Kohler, C.C. and Hubert, W.A. (Editors) (1993) Inland fisheries management in North America. *American Fisheries Society*, Bethesda, Maryland.

Lane, M. and A. Dale. (1995) Project assessment in Australian Indigenous domains: The case for reform. *Australian Journal of Environmental Management.* **2**, 30-39.

Langton, M., Epworth, D. and Sinnamon, V. (no date) Indigenous social, economic and cultural issues in land, water and biodiversity conservation. A scoping paper for WWF Australia (Vol 1), Centre for Indigenous Natural and Cultural Resource Management, NT University.

Lemaitre and Dufour. (1987) An integrated method for weighting persons and families. In: *Survey Methodology* Vol. 13 No.2 pp 199-207 Statistics Canada.

Lyle, J.M. (2000) Assessment of the licensed recreational fishery of Tasmania (Phase 2). Final report to the FRDC, Project 1996/161, 102pp.

Lyle, J.M., Coleman, A.P.M., West, L., Campbell, D., and Henry, G.W. (2002) New large-scale methods for evaluating sport fisheries. In: Pitcher, T.J. and Hollingworth, C.E. (Editors). *Recreational Fisheries: Ecological, Economic and Social Evaluation*. pp207-26. Blackwell Science, Oxford, UK.

Lyons, J., Hickley, P. and Glendhill, S. (2002) An evaluation of recreational fishing in England and Wales. In: Pitcher, T.J. and Hollingworth, C.E. (Editors). *Recreational Fisheries: Ecological, Economic and Social Evaluation*. pp144-55. Blackwell Science, Oxford, UK.

McGlennon, D. (1995) A review of recreational surveys in Australia. In: Hancock, D.A. (Editor) *Recreational fishing: What's the catch?* Australian Society for Fish Biology Workshop Proceedings, Canberra, 30-31 August 1994. Australian Society for Fish Biology, Canberra

McGlennon, D. (1999) Survey of the licensed recreational rock lobster fishery in South Australia 1998/99. SARDI Final Report 20p.

McGlennon, D. and Kinloch, M.A. (1997) Resource allocation in the South Australia marine scalefish fishery. Final Report to Fisheries Research and Development Corporation, Project 93/249, 107 p.

McIlgorm, A. and Pepperell, J.G. (1999) A national review of the recreational fishing sector. Report to Agriculture, Fisheries and Forestry–Australia. Dominion Consulting, Sydney.

McNair, Anderson and Associates. (1978) A survey of recreational fishing in New South Wales. Report prepared for the New South Wales State Fisheries.

Meehan, B. (1982) Shell bed to shell midden. Australian Institute of Aboriginal Studies, Canberra.

National Recreational Fisheries Working Group (1994) Recreational fishing in Australia: A National Policy. Dept. Primary Industries and Energy, Canberra.

National Rivers Authority (1995) National angling survey 1994. NRA Fisheries Technical Report 5, Bristol.

Oliver, A. (1871) The fisheries of New South Wales. Government Printer, Sydney.

PA Consulting (1992) National seafood consumption study: Summary report. Prepared for Fisheries Research and Development Corporation.

PA Management Consultants (1984) National survey of participation in recreational fishing. Report to the Australian Recreational Fishing Confederation, No 1.

Pepperell, J.G. (1996) Recreational fishing in New South Wales, April 1995 to April 1996. Survey conducted by Quadrant Research Services for New South Wales Fisheries.

Pitcher, T.J. and Hollingworth, C.E. (Editors) (2002) Recreational Fisheries: Ecological, Economic and Social Evaluation. Blackwell Science, Oxford, UK.

Pollock, K.H., Jones, C.M. and T.L. Brown (1994) Angler survey methods and their applications in fisheries management. *American Fisheries Society Special Publication* **25**.

QFMA (1999) Recreational fishing in Queensland – a survey of Queensland residents. Report prepared for the Queensland Fisheries Management Authority by Roy Morgan Research.

Ramsay, M. (1991) Recreational fishing and fisheries: The Australian situation. In: S. Dovers (Editor) *Australian Recreational Fishing: Policies for Resource Management*. Proceedings of the National Conference. ANU Canberra.

Ramsay-Smith, W. (1930) Myths and legends of the Australian Aboriginals. London, UK.

Resource Assessment Commission (1993) Coastal Zone Inquiry. Australian Government Publishing Service.

Roberts, A., Klomp, N. and Birckhead, J. (1996) Monitoring marine and terrestial hunting in an aboriginal community in north Queensland. In: Bomford and Caughley (Editors) *Sustainable use of wildlife by aboriginal peoples and Torres Strait Islanders*. Australian Government Publishing Service, Canberra.

Schaeffer, R.L., Mendenhall, W. and R.L. Ott (1996) *Elementary survey sampling*, fifth edition. Duxbury press, Belmont California.

Schuele, M., Rose, R. and Treadwell, R. (1997) Valuing recreational fishing. ABARE report prepared for the Department of Primary Industries and Energy, Canberra.

Shafer, E.L. Jr. (1969) The average camper who doesn't exist. US Northeast Forest Experiment Station, Research Publ. NE-142, Upper Darby, PA.

Sigler, W.F. and Sigler, J.W. (1990) *Recreational fisheries: Management, theory and application*. University of Nevada Press, Reno, USA.

Smith, W.R. (1930) Myths and legends of the Australian aboriginals, London.

Smyth, D. (1993) *A Voice in all Places: Aboriginal and Torres Strait Islander Interests in Australian Coastal Zone*. Report to the Coastal Zone Inquiry.

Smyth, D. (1994) *Understanding Country: The Importance of Land and Sea in Aboriginal and Torres Strait Islander Societies*. Council for aboriginal Reconciliation, Australian Government Publishing Service, Canberra.

SPCC (1984) Recreational fishing in Botany Bay. Report prepared by NSW Fisheries for the State Pollution Control Commission. BBS No 24.

Steffe, A.S., Murphy, J.J., Chapman, D.J., Tarlington, B.E., Gordon, G.N.G. and Grinberg, A. (1997) An assessment of the impact of offshore recreational fishing in New South Wales on the management of commercial fisheries. Final report to Fisheries Research and Development Corporation, Project 94/053.

Steffens, W. and Winkel, M. (2002) Evaluating recreational fishing in Germany. In: Pitcher, T.J. and Hollingworth, C.E. (Editors). *Recreational Fisheries: Ecological, Economic and Social Evaluation*. pp130-6. Blackwell Science, Oxford, UK.

Sumner, N.R. and Williamson, P.C. (1999) A 12-month survey of coastal recreational boat fishing between Augusta and Kalbarri on the west coast of Western Australia during 1996-97. Fisheries Research Report No. 117. WA Fisheries.

Survey Development Working Group. (2000) Development of the National Recreational and Indigenous Fishing Survey. Final Report to the Fisheries Research and Development Corporation Project No. 98/169.

Taylor, J. (1998) Measuring short-term population mobility among indigenous Australians: Options and implications. *Australian Geographer* **29**(1): 125-37.

Teirney, L.D. (1995) Determining the recreational share of New Zealand's marine harvest. In: Handcock, D.A. (Editor) *Recreational fishing: What's the catch?* Australian Society for Fish Biology Workshop Proceedings, Canberra, 30-31 August 1994. Australian Society for Fish Biology, Canberra

Teirney, L.D., Kilner, A.R., Millar, A.R., Bradford, E. and Bell, J.D. (1997) Estimates of recreational harvest from 1991-92 to 1993-94. New Zealand Assessment Research Document 97/15.

Tench, W. (1791) Journal of Captain Watkin Tench, 1788-1791, Officer and historian with the first fleet. Mitchell Library.

Tenison-Wood, Rev. J.E. (1883) Fish and fisheries of New South Wales. Government Printer, Sydney.

Thompson, L.G. (1893) History of the fisheries of New South Wales with a sketch of the laws by which they have been reegulated. Government Printer, Sydney.

Thompson, S.K. (1992) *Sampling*. Wiley, New York.

Tilzey, R.D.J. (1977a) A creel survey of the Lake Eucumbene, New South Wales, trout fishery. I. Catch composition and catch per effort. Internal report of the NSW Fisheries.

Tilzey, R.D.J. (1977b) A creel survey of the Lake Eucumbene, New South Wales, trout fishery. II. Estimation of total angling effort, catch and economic value. NSW Fisheries Internal report.

Tindale, N.B. and Lindsay, H.A. (1963) *Aboriginal Australians*. Jacaranda Press, Brisbane.

Toivonen, A-L. (2002) A survey of the economic value of Nordic recreational fisheries. In: Pitcher, T.J. and Hollingworth, C.E. (Editors) *Recreational Fisheries: Ecological, Economic and Social Evaluation*. pp137-43. Blackwell Science, Oxford, UK.

Turner, C. (1998) Indigenous subsistence fishing survey kit. Balkanu Cape York Development Centre, Cairns.

Van der Elst, R.P. (1994) Strategies for data collection in marine recreational and commercial linefisheries of South Africa. In: Handcock, D.A. (Editor) *Recreational fishing: What's the catch?* Proceedings of the Australian Society for Fish Biology Recreational Fishing Workshop, Canberra, 30-31 August 1994.

Walsh, F.J. (1992) The relevance of some aspects of aboriginal subsistence activities to the management of National Parks; with reference to the Martu People of the Western Desert. In: Birckhead, De Lacy and Smith (Editors) *Aboriginal Involvement in Parks and Protected Areas*. Aboriginal Studies Press, Canberra.

Weithman, A.S. (1991) Telephone survey preferred in collecting angler data statewide. *Amer. Fish. Soc. Symposium* **12**: 271-280.

Welsby, T. (1895) Schnappering, Brisbane.

12. APPENDICES

Appendix 5.1. Chi-square significance tests comparing survey sample against ABS benchmark population data (bold values indicate significant differences).

State/	Survey				Males							Females					Total
Territory	Stratum	0-4	5-14	15-29	30-44	45-59	60-74	75+	0-4	5-14	15-29	30-44	45-59	60-74	75+	Males	Females
NSW	1	**11.55**	4.19	3.00	0.46	0.57	**8.54**	**12.41**	0.89	2.07	0.42	0.65	1.08	**6.07**	0.10	40.73	11.28
	2	0.22	0.05	**11.38**	0.10	0.14	**5.34**	2.69	0.09	**5.38**	0.85	0.50	0.17	**3.96**	0.13	19.93	11.08
	3	0.71	0.91	2.14	0.27	1.44	0.46	0.38	0.01	0.53	0.54	0.29	1.23	1.08	0.57	6.33	4.25
	4	0.75	0.95	3.28	0.51	3.75	2.01	0.54	0.88	4.53	0.31	0.05	**4.80**	2.21	2.19	11.80	14.98
	5	**8.12**	3.45	3.80	0.03	1.36	2.60	0.00	0.34	0.29	**4.22**	0.05	0.74	0.10	0.32	19.37	6.06
	6	4.02	0.34	4.49	0.06	0.03	**9.06**	0.03	**7.89**	0.01	0.91	0.09	0.25	12.89	0.00	18.03	22.05
	7	2.97	0.50	0.24	0.81	1.00	1.87	4.72	0.35	0.03	3.61	0.22	0.23	2.35	0.35	12.11	7.13
	8	**4.30**	0.03	0.11	0.03	0.06	2.92	0.01	3.27	0.06	1.33	0.11	0.36	**5.34**	0.57	7.46	11.03
	9	1.28	0.03	0.01	0.04	2.88	0.53	0.38	5.82	2.21	1.07	0.00	0.12	**6.12**	2.19	5.15	17.53
VIC	10	**8.41**	0.00	0.95	0.22	4.87	5.42	3.37	2.97	0.63	2.15	0.03	1.94	0.01	**3.95**	23.23	11.68
	11	**6.21**	0.17	9.59	0.34	0.07	0.21	0.07	0.40	0.76	0.23	0.70	0.05	2.49	1.23	16.67	5.85
	12	0.61	1.19	2.55	2.42	1.75	1.20	0.00	5.74	2.82	0.02	2.91	3.83	0.24	0.44	9.72	16.00
	13	0.90	2.06	0.00	0.01	0.00	0.41	2.78	0.56	0.67	0.05	0.04	0.14	4.37	2.96	6.17	8.77
	14	**7.28**	0.00	0.33	0.44	0.02	2.98	0.00	0.24	0.43	0.39	6.05	0.16	0.90	1.43	11.05	9.61
	15	**11.06**	0.90	0.74	3.83	3.24	2.07	2.21	**6.75**	0.92	2.23	0.76	0.53	3.21	**4.94**	24.05	19.35
	16	**6.05**	3.02	1.08	0.82	0.46	9.23	14.74	2.55	0.89	0.65	0.23	0.27	0.72	**13.32**	35.41	18.64
	17	1.72	0.23	2.84	0.51	0.01	4.45	0.18	0.12	0.05	3.32	1.32	0.19	1.58	0.63	9.94	7.21
QLD	18	**8.43**	11.73	**5.66**	0.01	1.08	0.02	0.27	0.59	1.47	3.69	0.00	1.46	2.34	1.47	27.21	11.03
	19	2.72	3.69	0.73	0.02	1.81	**11.15**	0.22	7.00	1.78	3.02	2.21	0.76	**9.40**	0.28	20.33	24.46
	20	0.53	2.11	0.03	0.04	3.88	4.32	0.05	4.53	4.37	**5.64**	0.00	1.56	**6.01**	0.11	10.96	22.22
	21	1.42	0.23	1.21	0.03	0.05	4.44	3.18	0.04	0.13	4.19	0.04	4.96	0.68	1.28	10.56	11.33
	22	0.03	0.68	1.02	0.00	0.35	0.41	0.19	0.07	6.81	0.03	0.00	0.98	0.12	0.04	2.69	8.06
	23	0.05	0.95	1.38	0.13	1.41	0.94	2.63	0.00	0.88	0.01	0.01	0.08	3.05	1.67	7.49	5.69
	24	0.00	0.16	0.05	0.42	0.02	4.53	2.88	0.23	0.00	2.14	0.05	0.49	3.02	0.40	8.06	6.34
	25	3.18	0.01	0.29	0.08	0.33	3.96	0.00	**5.66**	1.42	1.49	0.31	0.31	3.20	0.42	7.86	12.82
	26	**4.08**	**3.80**	0.44	0.66	0.77	1.69	0.13	0.40	3.03	1.36	0.20	0.57	**10.44**	0.22	11.56	16.22
SA	27	4.38	**7.77**	0.61	1.22	0.33	9.45	10.66	0.02	2.41	0.32	0.39	0.08	**4.71**	**5.38**	34.42	13.29
	28	**8.66**	0.14	0.01	0.01	0.52	1.12	**3.80**	0.01	1.00	0.01	0.20	1.26	1.27	1.90	14.26	5.63
	29	0.44	0.64	3.66	2.63	0.86	6.42	1.56	3.64	3.71	0.99	0.67	0.05	**19.70**	0.52	16.21	29.29
	30	**3.23**	0.02	1.91	0.93	0.52	2.13	**7.27**	0.15	1.61	2.50	0.02	2.17	**9.21**	1.03	16.01	16.67
	31	0.02	0.42	2.58	0.16	0.00	1.60	0.04	0.35	0.93	2.07	0.08	0.34	1.28	10.44	4.82	15.50
	32	0.16	1.73	1.32	3.69	1.03	13.79	8.06	0.92	0.71	1.26	0.02	0.11	**18.46**	2.96	29.78	24.43
	33	**7.34**	3.11	5.00	0.03	0.58	0.80	1.16	6.58	0.00	2.83	0.29	0.26	2.30	**6.21**	18.02	18.46
	34	13.71	0.99	0.69	0.13	0.06	12.53	1.42	3.13	0.10	**10.91**	0.36	0.20	**14.07**	0.00	29.52	28.78
	35	0.32	0.91	4.34	0.12	1.37	**7.67**	0.33	2.90	0.01	**7.06**	2.88	1.31	**17.48**	1.03	15.05	32.67
WA	36	0.14	0.24	2.58	1.94	0.00	0.31	0.03	0.07	0.74	0.44	2.27	0.16	0.44	2.25	5.23	6.37
	37	**5.89**	0.15	0.90	1.25	0.14	1.22	0.00	1.12	0.49	1.24	0.19	0.09	**4.74**	0.19	9.56	8.06
	38	**16.21**	0.11	4.97	0.02	2.79	3.59	0.29	0.27	0.00	**4.48**	2.28	2.72	**10.00**	2.36	27.97	22.12
	39	0.98	0.99	**7.35**	4.17	0.49	0.10	1.46	2.86	1.38	**7.45**	0.91	2.84	0.15	0.41	15.55	15.98
	40	2.61	0.94	0.61	1.53	0.01	0.66	1.72	0.04	0.03	2.22	0.28	0.11	0.51	2.38	8.08	5.58
	41	0.00	1.92	3.37	0.36	1.40	0.52	0.86	1.23	1.09	0.01	0.75	0.57	1.08	1.60	8.42	6.32
TAS	42	0.07	0.42	0.01	1.83	1.13	4.98	0.01	5.52	0.00	**6.31**	1.41	5.74	3.66	1.14	8.44	23.79
	43	0.23	0.18	5.53	0.73	1.28	0.22	0.21	0.16	0.03	**14.18**	2.75	1.19	0.73	0.17	8.37	19.22
	44	**15.70**	**4.71**	0.26	0.35	0.21	2.45	0.01	2.52	0.30	**7.94**	0.05	0.06	0.82	1.42	23.68	13.11
	45	0.41	0.09	4.56	3.26	0.05	0.01	0.72	1.81	2.33	**5.28**	3.01	0.13	0.48	2.43	9.10	15.47
NT	46	**5.63**	0.09	5.94	0.08	**6.66**	2.60	0.09	1.38	0.02	**11.33**	**3.16**	0.59	8.75	**4.71**	21.09	29.94
	47	1.73	**10.78**	**11.54**	1.43	0.09	1.48	0.13	8.08	**26.29**	**10.61**	3.03	0.38	0.02	0.03	27.18	48.44
	48																
ACT	49	0.24	0.98	**6.08**	**4.46**	0.01	3.83	0.94	0.10	0.27	1.74	0.14	1.17	5.38	0.06	1063.21	1085.79

Appendix 5.2. Description of the procedure used to develop household and person integrated weights.

THE DETERMINATION OF INTEGRATED WEIGHTS

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Background

Integrated weighting is a method under which a single set of weights is used to make both person and household estimates. That is, all persons in a particular household are given the same weight, and this weight is used for person level estimates, and the household itself is given the same weight for household level estimates. This method utilises benchmarks at the person and household level by ensuring that the weights are consistent with the benchmarks at all levels. For further details on integrated weighting see Lemaitre and Dufour "An Integrated Method for Weighting Persons and Families" in *Survey Methodology* December 1987 Vol. 13 No.2 pp 199-207 Statistics Canada.

Method

In order to calculate the integrated weights, a SAS program called GREGWT was used. The inputs required by GREGWT is listed below:

Inputs

1. Unit level dataset with an initial weight for each unit (GREGWT tries to keep the integrated weight as close as possible to this initial weight).
2. Benchmark datasets .
3. Group variable (GREGWT ensures that each unit with the same group variable value has the same final weight).
4. Upper and Lower bounds for the final weight. These can be different for each unit.

GREGWT works by creating a vector for each group (in this case household) which has one component for each benchmark class. For example, a household may contribute:

0 to "Single person households"
1 to "Three + adults, no children households"
0 to "Persons aged 0-4"
2 to "Persons aged 25-34"
1 to "Persons aged 75+".

Then GREGWT uses an iterative process to adjust the initial weight of the groups (households) so that the weighted sum of the sampled groups sums to the benchmarks. It does this while minimising the *generalised least-squares function:*

$$F^{GLS} = \sum_{i=1}^{n} \frac{(w_i - a_i)^2}{a_i}$$

Where n = no. of groups (households) in the sample;
a_i = initial weight of group i;
w_i = final weight of group i.

GREGWT does this while ensuring that the new weights fall within the upper and lower bound restrictions

$$L_i \le w_i \le U_i$$

GREGWT then assigns this new weight to all units in the group (persons in the household).

Inputs Used in NRFS calculations

1) The unit level dataset was the person usable sample file with the initial weights being the selection weights based on the telephone listings from which the selections were made.

$$a_{hi} = \frac{N_h}{n_h}$$

where a_{hi} = the selection weight of household *i* in stratum *h;*
N_h = count of dwellings on telephone listings in stratum *h;*
n_h = number of sampled units in stratum *h.*

It has been recognised that there are coverage problems with the telephone listings. However, since these weights are being adjusted anyway, these initial weights do not need to be perfect.

2) Benchmarks:

The benchmarks used were modified 2000 Estimated Resident Population data with adjustments made to account for Indigenous Survey figures (i.e., relevant to selected northern Australian strata). Some benchmark classes were, however, collapsed to ensure that GREGWT could converge, details are presented below:

Person Benchmark Classes:

Geographic Region:	Stratum
Sex:	Male / Female
Age:	0-4, 5-14, 15-29, 30-44, 45-59, 60-74, 75+

In most strata there were 2 x 7 age/sex classes.

Exceptions:
In strata 40, 41 and 47 only used 6 age classes were used: 0-4, 5-14, 15-29, 30-44, 45-59, 60+. So in these strata there were 2 x 6 classes.

In stratum 38, male and female classes were collapsed in the 0-4 age group, resulting in 2 x 6 + 1 classes.

Household Benchmark Classes:

Geographic Region:	Capital City / Rest of State
Household Size:	1 adult no children, 1 adult + children,
	2 adults no children, 2 adults + children,
	3+ adults no children, 3+ adults + children.

So in most states there were 2 x 6 household size classes.

Exceptions:
In NT and ACT there was no Capital City /Rest of State split, so household benchmarks in these states were at a state-wide level.

In NT, only 4 household size classes were used: 1 adult no children, 1 adult + children, 2+ adults no children, 2+ adults + children

The actual benchmark class values were calculated by simply collapsing the classes as described above.

3) Group: As has already been stated. The group used was the household, so each person in the same household was given the same weight.

4) Upper and Lower bounds: The restrictions used on the new weights were different in each state. They consisted of a lower and upper percentage such that the new weight could not be greater than the upper percentage of the selection interval or less than the lower percentage of the selection interval. The values of these bounds are shown in the table below:

State	**Lower**	**Upper**
NSW	60%	350%
Victoria	60%	580%
Queensland	60%	380%
South Australia	60%	350%
Western Australia	50%	400%
Tasmania	50%	380%
Northern Territory	25%	800%
ACT	25%	380%

In the case of the Northern Territory, the restrictions appear very wide, however, the only units that required a weight increase of 800% had initial selection weights of 16. As such, the final weight was not considered unacceptably high so as to cause problems.

Appendix 5.3. Estimated number of persons and proportion of the Australian resident population aged 5 or older who fished recreationally in the 12 months prior to May 2000 by State or Territory of residence, Statistical Division and sample stratum.

se is standard error, rse is relative standard error.

State/Region	Sample Stratum	Recreational fishers Number	se	rse	Participation rate (%)	se
NSW						
Sydney	1	482,739	*29,868*	*6.2*	13.1	*0.8*
Hunter	2	131,348	*9,521*	*7.2*	25.2	*1.8*
Illawarra	3	73,686	*6,287*	*8.5*	20.9	*1.8*
Richmond/ Tweed	4	49,995	*3,432*	*6.9*	26.0	*1.8*
Mid North Coast	5	74,441	*5,468*	*7.3*	29.9	*2.2*
Northern & Central West	6	62,894	*5,750*	*9.1*	20.5	*1.9*
North West & Far West	7	28,404	*2,706*	*9.5*	22.7	*2.2*
South Eastern	8	49,264	*3,732*	*7.6*	30.1	*2.3*
Murray & Murrumbidgee	9	45,729	*4,064*	*8.9*	19.9	*1.8*
Total NSW		**998,501**	***33,686***	*3.4*	**17.1**	***0.6***
VIC						
Melbourne	10	321,051	*22,641*	*7.1*	10.2	*0.7*
Barwon	11	33,905	*2,965*	*8.7*	15.0	*1.3*
Western District	12	18,858	*1,586*	*8.4*	21.4	*1.8*
Central Highlands	13	18,912	*1,769*	*9.4*	15.3	*1.4*
Mallee and Wimmera	14	30,705	*2,303*	*7.5*	24.5	*1.8*
Loddon	15	27,173	*2,371*	*8.7*	18.6	*1.6*
Goulburn & Ovens-Murray	16	50,678	*4,276*	*8.4*	20.3	*1.7*
Gippsland & East Gippsland	17	48,521	*3,820*	*7.9*	22.9	*1.8*
Total VIC		**549,803**	***23,892***	*4.3*	**12.7**	***0.5***
QLD						
Brisbane	18	332,340	*19,756*	*5.9*	22.6	*1.3*
Moreton	19	142,913	*10,132*	*7.1*	22.6	*1.6*
Wide Bay & Burnett	20	59,576	*4,949*	*8.3*	27.9	*2.3*
Darling Downs	21	38,729	*3,803*	*9.8*	21.7	*2.1*
North West, Central West, South West	22	13,160	*1,294*	*9.8*	23.1	*2.3*
Fitzroy	23	54,535	*3,917*	*7.2*	34.1	*2.5*
Mackay	24	37,278	*2,618*	*7.0*	33.2	*2.3*
Northern	25	52,471	*3,872*	*7.4*	30.0	*2.2*
Far North	26	54,043	*4,418*	*8.2*	30.1	*2.5*
Total QLD		**785,045**	***24,295***	***3.1***	**24.7**	***0.8***
SA						
Adelaide	27	202,772	*13,184*	*6.5*	20.3	*1.3*
Outer Adelaide	28	30,243	*2,356*	*7.8*	30.0	*2.3*
York & Lower North	29	14,758	*1,055*	*7.1*	36.5	*2.6*
Murray Lands	30	23,037	*1,442*	*6.3*	37.2	*2.3*
South East	31	19,201	*1,431*	*7.5*	34.0	*2.6*
Eyre	32	14,433	*816*	*5.7*	48.1	*2.7*
Northern	33	23,784	*1,688*	*7.1*	32.6	*2.3*
Total SA		**328,227**	***13,716***	*4.2*	**24.1**	***1.0***

Appendix 5.3. (cont)

State/Region	Sample Stratum	Recreational fishers Number	se	rse	Participation rate (%)	se
WA						
Perth	34	301,949	*16,361*	*5.4*	24.1	*1.3*
South West	35	79,502	*4,714*	*5.9*	46.8	*2.8*
Upper & Lower Great Southern	36	22,721	*1,833*	*8.1*	35.7	*2.9*
Midlands	37	13,760	*1,179*	*8.6*	29.5	*2.5*
South Eastern	38	16,800	*1,347*	*8.0*	34.1	*2.7*
Central	39	19,973	*1,496*	*7.5*	39.0	*2.9*
Pilbara	40	16,205	*1,152*	*7.1*	47.5	*3.4*
Kimberley	41	8,515	*521*	*6.1*	52.7	*3.2*
Total WA		**479,425**	***17,330***	*3.6*	**28.5**	***1.0***
TAS						
Hobart	42	50,105	*2,680*	*5.3*	28.5	*1.5*
Southern	43	12,125	*720*	*5.9*	38.4	*2.3*
Northern	44	35,554	*2,496*	*7.0*	29.6	*2.1*
Mersey & Lyell	45	26,807	*1,823*	*6.8*	27.3	*1.9*
Total TAS		**124,590**	***4,154***	*3.3*	**29.3**	***1.0***
NT						
Darwin	46	31,818	*1,905*	*6.0*	37.3	*2.2*
Coast	47	7,249	*389*	*5.4*	45.2	*2.4*
Hinterland	48	4,865	*689*	*14.2*	12.8	*1.8*
Total NT		**43,932**	***2,063***	*4.7*	**31.6**	***1.5***
ACT	49	53,467	*4,104*	*7.7*	**19.2**	***1.5***
Total AUSTRALIA		**3,362,990**	***53,129***	*1.6*	**19.5**	***0.3***

Appendix 5.4. Estimated number of households and the proportion of Australian private dwelling households that contained persons who fished recreationally in the 12 months prior to May 2000 by State or Territory, Statistical Division and sample stratum.

se is standard error, rse is relative standard error.

State/Region	Sample Stratum	Fisher households Number	se	rse	Proportion of private dwelling households (%)	se
NSW						
Sydney	1	255,528	*13,061*	*5.1*	17.2	*0.9*
Hunter	2	69,758	*4,106*	*5.9*	30.4	*1.8*
Illawarra	3	40,368	*2,846*	*7.1*	27.1	*1.9*
Richmond/ Tweed	4	28,899	*1,678*	*5.8*	33.1	*1.9*
Mid North Coast	5	38,003	*2,214*	*5.8*	35.2	*2.1*
Northern & Central West	6	34,038	*2,485*	*7.3*	26.2	*1.9*
North West & Far West	7	14,048	*1,055*	*7.5*	26.2	*2.0*
South Eastern	8	23,417	*1,476*	*6.3*	32.0	*2.0*
Murray & Murrumbidgee	9	24,156	*1,807*	*7.5*	24.3	*1.8*
Total NSW		**528,215**	***14,697***	***2.8***	**21.9**	***0.6***
VIC						
Melbourne	10	186,671	*10,963*	*5.9*	14.6	*0.9*
Barwon	11	20,920	*1,553*	*7.4*	21.8	*1.6*
Western District	12	10,493	*697*	*6.6*	27.4	*1.8*
Central Highlands	13	10,900	*847*	*7.8*	20.6	*1.6*
Mallee and Wimmera	14	16,493	*997*	*6.0*	31.6	*1.9*
Loddon	15	14,082	*1,025*	*7.3*	23.2	*1.7*
Goulburn & Ovens-Murray	16	26,602	*1,817*	*6.8*	25.3	*1.7*
Gippsland & East Gippsland	17	27,467	*1,754*	*6.4*	30.1	*1.9*
Total VIC		**313,628**	***11,499***	***3.7***	**17.7**	***0.6***
QLD						
Brisbane	18	163,088	*7,936*	*4.9*	25.8	*1.3*
Moreton	19	73,278	*4,311*	*5.9*	26.4	*1.6*
Wide Bay & Burnett	20	30,449	*1,994*	*6.5*	33.3	*2.2*
Darling Downs	21	19,649	*1,550*	*7.9*	26.4	*2.1*
North West, Central West, South West	22	6,859	*557*	*8.1*	27.2	*2.2*
Fitzroy	23	23,932	*1,411*	*5.9*	37.7	*2.2*
Mackay	24	18,160	*1,032*	*5.7*	39.4	*2.2*
Northern	25	26,985	*1,612*	*6.0*	37.7	*2.3*
Far North	26	25,672	*1,701*	*6.6*	33.5	*2.2*
Total QLD		**388,072**	***8,537***	***2.2***	**28.8**	***0.6***
SA						
Adelaide	27	111,992	*6,012*	*5.4*	24.6	*1.3*
Outer Adelaide	28	15,093	*939*	*6.2*	34.7	*2.2*
York & Lower North	29	7,992	*443*	*5.5*	43.8	*2.4*
Murray Lands	30	11,353	*584*	*5.1*	43.2	*2.2*
South East	31	9,635	*577*	*6.0*	39.6	*2.4*
Eyre	32	7,596	*325*	*4.3*	58.2	*2.5*
Northern	33	11,920	*697*	*5.8*	36.9	*2.2*
Total SA		**175,581**	***6,203***	***3.5***	**28.6**	***1.0***

Appendix 5.4. (cont)

State/Region	Sample Stratum	Fisher households Number	se	rse	Proportion of private dwelling households (%)	se
WA						
Perth	34	159,478	*7,167*	*4.5*	30.0	*1.4*
South West	35	36,857	*1,725*	*4.7*	49.6	*2.3*
Upper & Lower Great Southern	36	11,260	*747*	*6.6*	39.6	*2.6*
Midlands	37	6,809	*465*	*6.8*	34.1	*2.3*
South Eastern	38	8,112	*527*	*6.5*	41.1	*2.7*
Central	39	10,175	*601*	*5.9*	46.3	*2.7*
Pilbara	40	7,413	*398*	*5.4*	55.4	*3.0*
Kimberley	41	4,149	*183*	*4.4*	63.8	*2.8*
Total WA		**244,254**	***7,480***	***3.1***	**34.2**	***1.0***
TAS						
Hobart	42	26,249	*1,152*	*4.4*	33.7	*1.5*
Southern	43	5,963	*292*	*4.9*	44.4	*2.2*
Northern	44	18,079	*1,050*	*5.8*	33.2	*1.9*
Mersey & Lyell	45	15,250	*829*	*5.4*	35.3	*1.9*
Total TAS		**65,540**	***1,789***	***2.7***	**34.7**	***0.9***
NT						
Darwin	46	16,125	*793*	*4.9*	41.5	*2.0*
Coast	47	4,089	*174*	*4.3*	55.1	*2.3*
Hinterland	48	2,649	*331*	*12.5*	17.0	*2.1*
Total NT		**22,862**	***877***	***3.8***	**36.9**	***1.4***
ACT	49	**29,951**	***1,875***	***6.3***	**24.8**	***1.6***
Total AUSTRALIA		**1,768,103**	***18,081***	***1.0***	**24.4**	***0.3***

Appendix 5.5. Number of recreational fishers and proportion of the resident population by age class and gender and State or Territory of residence.

State/Territory	Age class	Males	% pop	Females	% pop	Total	% pop
NSW	5 to 14	137,498	30.6	91,508	21.4	229,006	26.1
	15 to 29	120,636	17.8	44,050	6.6	164,686	12.3
	30 to 44	214,517	30.0	93,881	13.0	308,398	21.4
	45 to 59	162,221	27.8	50,733	8.8	212,954	18.3
	60 to 74	57,975	17.1	13,392	3.7	71,367	10.2
	75 plus	11,196	8.7	894	0.5	12,090	3.8
	Total	**704,043**	**24.3**	**294,457**	**10.0**	**998,501**	**17.1**
VIC	5 to 14	90,932	27.8	18,710	6.0	109,643	17.2
	15 to 29	72,442	14.1	14,034	2.8	86,476	8.5
	30 to 44	153,429	29.0	23,162	4.3	176,592	16.5
	45 to 59	110,739	26.2	16,678	3.9	127,417	14.9
	60 to 74	39,881	16.1	6,071	2.3	45,952	9.0
	75 plus	3,435	3.7	289	0.2	3,724	1.6
	Total	**470,859**	**22.1**	**78,944**	**3.6**	**549,803**	**12.7**
QLD	5 to 14	86,773	33.9	72,534	29.9	159,307	32.0
	15 to 29	112,647	29.9	48,515	13.0	161,162	21.5
	30 to 44	160,582	42.0	86,371	21.8	246,953	31.7
	45 to 59	112,146	34.5	46,600	14.5	158,747	24.6
	60 to 74	43,689	24.8	12,162	6.8	55,851	15.7
	75 plus	2,418	3.8	609	0.7	3,026	2.0
	Total	**518,254**	**32.8**	**266,791**	**16.7**	**785,045**	**24.7**
SA	5 to 14	45,158	44.5	28,146	29.2	73,304	37.1
	15 to 29	44,956	29.8	23,140	15.8	68,096	22.9
	30 to 44	71,555	44.2	28,311	17.2	99,866	30.6
	45 to 59	46,448	33.7	16,287	11.5	62,735	22.5
	60 to 74	18,894	22.4	2,568	2.8	21,462	12.3
	75 plus	1,663	4.8	1,102	2.2	2,765	3.3
	Total	**228,673**	**34.1**	**99,554**	**14.5**	**328,227**	**24.1**
WA	5 to 14	56,113	41.2	43,868	34.0	99,981	37.7
	15 to 29	66,163	32.4	34,373	17.2	100,536	24.9
	30 to 44	98,410	47.3	52,905	24.9	151,316	35.9
	45 to 59	68,239	39.9	24,549	14.6	92,788	27.4
	60 to 74	23,750	26.8	8,475	9.3	32,225	17.9
	75 plus	1,359	4.5	1,220	2.8	2,579	3.5
	Total	**314,034**	**37.4**	**165,391**	**19.6**	**479,425**	**28.5**
TAS	5 to 14	17,291	49.8	10,735	32.5	28,026	41.4
	15 to 29	16,119	35.2	10,486	22.8	26,605	29.0
	30 to 44	24,342	49.8	10,625	20.6	34,966	34.8
	45 to 59	18,453	42.3	7,140	16.3	25,593	29.2
	60 plus	7,705	29.4	960	3.5	8,665	16.1
	Total	**84,644**	**42.5**	**39,946**	**19.8**	**124,590**	**31.0**
NT	5 to 14	5,040	36.3	2,976	27.2	8,016	32.3
	15 to 29	7,039	34.9	2,820	15.7	9,859	25.8
	30 to 44	11,264	51.4	4,371	22.9	15,636	38.2
	45 to 59	6,797	44.9	2,095	18.7	8,892	33.8
	60 plus	1,455	28.7	74	1.9	1,529	17.1
	Total	**31,596**	**41.5**	**12,336**	**19.6**	**43,932**	**31.6**

Appendix 5.5. (cont)

State/Territory	Age class	Males	% pop	Females	% pop	Total	% pop
ACT	5 to 14	7,929	36.2	5,365	25.4	13,294	30.9
	15 to 29	8,660	23.6	5,411	15.3	14,071	19.5
	30 to 44	9,870	28.9	5,710	15.7	15,580	22.1
	45 to 59	7,353	25.5	1,186	4.0	8,539	14.6
	60 plus	1,518	9.7	465	2.6	1,983	5.9
	Total	**35,330**	**25.7**	**18,138**	**12.9**	**53,467**	**19.2**
AUSTRALIA	5 to 14	449,190	33.4	298,315	23.4	747,505	28.5
	15 to 29	530,472	26.0	240,134	12.0	770,606	19.1
	30 to 44	641,666	30.5	324,250	15.1	965,916	22.7
	45 to 59	442,979	25.5	167,273	9.6	610,252	17.6
	60 to 74	172,025	17.6	51,243	5.0	223,268	11.1
	75 plus	29,036	7.9	5,060	1.0	34,096	3.8
	Total	**2,265,368**	**26.4**	**1,086,275**	**12.4**	**3,351,643**	**19.5**

Appendix 5.6. Annual fishing effort, expressed as fisher days, fishing events and fisher hours, by State or Territory of residence and State or Territory fished for Australian recreational fishers aged 5 or older se is standard error, rse is relative standard error.

State/Territory	State/Territory fished								Interstate	
of residence	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	total	TOTAL
FISHER DAYS										
NSW	5,585,059	21,886	309,899	13,581	18,773	1,799	31,713	4,952	402,602	**5,987,661**
VIC	700,688	2,562,570	115,851	34,964	51,943	13,132	28,128		944,706	**3,507,275**
QLD	351,568	17,533	4,109,702	14,679	16,660	1,512	27,050		429,001	**4,538,704**
SA	22,848	26,451	67,351	1,861,637	3,395	1,335	19,369	337	141,085	**2,002,723**
WA	9,056	1,115	26,395	12,759	3,260,343	5,777	10,376		65,478	**3,325,820**
TAS	5,167	6,526	6,240	1,886	3,837	791,257	773		24,429	**815,685**
NT	1,200	1,114	4,404	4,115	11,176	132	198,256		22,141	**220,397**
ACT	203,012	3,056	10,689	830	817	1,460	1,590	25,202	221,453	**246,656**
Interstate total	1,293,540	77,680	540,828	82,813	106,601	25,146	118,999	5,289	2,250,895	
State total	**6,878,599**	**2,640,250**	**4,650,531**	**1,944,450**	**3,366,943**	**816,402**	**317,255**	**30,491**		**20,644,921**
% national total	33.3	12.8	22.5	9.4	16.3	4.0	1.5	0.1		**100.0**
FISHING EVENTS										
NSW	6,208,830	23,989	382,786	20,295	19,417	3,164	38,279	4,952	492,883	**6,701,713**
VIC	769,498	2,723,878	142,350	43,811	51,442	13,640	29,376		1,050,118	**3,773,995**
QLD	420,280	23,349	5,120,226	19,770	17,737	1,512	32,167		514,814	**5,635,041**
SA	24,853	27,640	71,589	2,108,483	3,499	1,426	21,350	337	150,694	**2,259,177**
WA	9,056	1,479	25,689	15,781	3,340,467	5,777	11,008		68,790	**3,409,256**
TAS	5,610	7,312	6,499	2,169	3,837	885,108	1,002		26,429	**911,537**
NT	1,200	1,187	4,927	4,404	4,726	132	218,917		16,577	**235,494**
ACT	231,556	3,056	11,595	1,328	817	1,930	1,809	26,001	252,091	**278,091**
Interstate total	1,462,053	88,013	645,435	107,558	101,475	27,581	134,992	5,289	2,572,395	
State total	**7,670,883**	**2,811,891**	**5,765,661**	**2,216,041**	**3,441,941**	**912,689**	**353,909**	**31,290**		**23,204,305**
se	*213,512*	*114,938*	*149,354*	*80,329*	*122,896*	*39,494*	*8,881*	*11,484*		***303,207***
rse	*2.8*	*4.1*	*2.6*	*3.6*	*3.6*	*4.3*	*2.5*	*36.6*		***1.3***
% national total	33.1	12.1	24.8	9.6	14.8	3.9	1.5	0.1		**100.0**

Appendix 5.6. (cont)

State/Territory of residence	State/Territory fished								Interstate total	TOTAL
	NSW	VIC	QLD	SA	WA	TAS	NT	ACT		
FISHER HOURS										
NSW	22,712,041	87,959	1,277,755	69,951	97,535	12,036	170,504	10,737	1,726,478	**24,438,519**
VIC	4,590,937	10,934,221	718,952	254,231	622,723	85,430	171,880		6,444,154	**17,378,375**
QLD	1,872,452	52,748	22,897,263	58,660	42,416	2,232	217,995		2,246,502	**25,143,765**
SA	204,832	193,005	232,494	9,307,735	10,558	5,214	97,841	800	744,744	**10,052,479**
WA	27,030	4,448	286,821	47,207	18,877,411	14,399	49,419		429,325	**19,306,736**
TAS	20,247	30,107	18,967	10,069	13,118	4,172,111	4,575		97,083	**4,269,194**
NT	3,586	4,127	13,835	14,452	27,346	148	1,181,812		63,493	**1,245,306**
ACT	931,658	13,261	31,217	5,642	3,347	3,489	10,542	76,567	999,157	**1,075,724**
Interstate total	7,650,742	385,656	2,580,042	460,212	817,043	122,947	722,756	11,537	12,750,935	
State total	**30,362,783**	**11,319,877**	**25,477,305**	**9,767,947**	**19,694,454**	**4,295,058**	**1,904,568**	**88,104**		**102,910,097**
% national total	29.5	11.0	24.8	9.5	19.1	4.2	1.9	0.1		**100.0**

Appendix 5.7. Annual fishing effort (fishing events) by water body type and State or Territory fished for Australian recreational fishers aged 5 or older.

se is standard error

	State/Territory fished								
Water body	**NSW**	**VIC**	**QLD**	**SA**	**WA**	**TAS**	**NT**	**ACT**	**TOTAL**
Offshore									
No. of events	101,480	21,138	344,845	73,715	365,700	10,081	20,407		937,367
se	*32,176*	*20,714*	*31,478*	*12,199*	*29,954*	*7,461*	*2,454*		*59,691*
% of State Total	1.3	0.8	6.0	3.3	10.6	1.1	5.8		4.0
Coastal									
No. of events	2,108,276	380,883	2,547,953	1,643,362	2,271,168	476,442	92,367		9,520,452
se	*91,461*	*34,383*	*86,148*	*70,787*	*92,692*	*25,232*	*3,976*		*176,703*
% of State Total	27.5	13.5	44.2	74.2	66.0	52.2	26.1		41.0
Estuarine									
No. of events	3,606,708	1,204,237	2,232,759	142,010	651,229	195,028	139,896		8,171,867
se	*143,094*	*67,662*	*84,751*	*18,624*	*32,749*	*12,389*	*5,083*		*183,944*
% of State Total	47.0	42.8	38.7	6.4	18.9	21.4	39.5		35.2
Rivers									
No. of events	1,119,358	610,008	293,461	316,043	111,301	74,194	95,314	8,489	2,628,167
se	*69,286*	*40,183*	*32,490*	*30,063*	*22,178*	*8,261*	*4,482*	*4,077*	*94,717*
% of State Total	14.6	21.7	5.1	14.3	3.2%	8.1	26.9	27.1	11.3
Lakes/ Dams									
No. of events	735,060	595,625	346,642	40,911	42,544	156,944	5,925	22,801	1,946,452
se	*84,411*	*49,052*	*39,223*	*13,951*	*19,376*	*14,026*	*2,157*	*5,176*	*108,769*
% of State Total	9.6	21.2	6.0	1.8	1.2	17.2	1.7	72.9	8.4
Total									
No. of events	7,670,883	2,811,891	5,765,661	2,216,041	3,441,941	912,689	353,909	31,290	23,204,305
se	*213,512*	*114,938*	*149,354*	*80,329*	*122,896*	*39,494*	*8,881*	*11,484*	*303,207*
% of State Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Appendix 5.8. Annual fishing effort (events) by fishing method and State or Territory fished for Australian recreational fishers aged 5 or older.

se standard error, rse relative standard error

	State/Territory fished								
Method	**NSW**	**VIC**	**QLD**	**SA**	**WA**	**TAS**	**NT**	**ACT**	**TOTAL**
LINE									
Bait	5,746,073	2,085,513	3,686,887	1,393,074	2,330,684	464,577	140,661	20,151	**15,867,619**
Lure/jig/fly	715,607	335,570	513,051	180,595	164,508	224,343	137,841	6,444	**2,277,961**
Bait & lure	393,334	221,485	274,861	293,951	157,967	66,595	34,387	3,016	**1,445,596**
Set-line	63,254	3,113	5,991	4,238	1,899	2,012	147	166	**80,820**
Total	**6,918,268**	**2,645,681**	**4,480,790**	**1,871,858**	**2,655,059**	**757,527**	**313,036**	**29,777**	**19,671,996**
se	*145,854*	*89,047*	*93,950*	*59,781*	*79,458*	*23,740*	*5,069*	*6,343*	***220,332***
rse	2.1	3.3	2.1	3.2	3.0	3.1	1.6	21.3	**1.1**
% of State total	90.2	94.1	77.7	84.5	77.1	83.0	88.5	95.2	**84.8**
POTS & TRAPS									
Pot/trap - passive	283,775	35,752	490,044	120,619	237,875	60,376	24,097	201	**1,252,740**
Pot/trap - active	17,233	12,279	7,836	116,692	305,541	913	4,751		**465,245**
Total	**301,008**	**48,030**	**497,881**	**237,311**	**543,416**	**61,289**	**28,848**	**201**	**1,717,984**
se	*15,010*	*4,776*	*16,126*	*13,601*	*24,136*	*5,488*	*1,808*		***36,181***
rse	5.0	9.9	3.2	5.7	4.4	9.0	6.3	0.0	**2.1**
% of State total	3.9	1.7	8.6	10.7	15.8	6.7	8.2	0.6	**7.4**
NETS									
Cast net	2,636	37	266,944	118	13,298	509	9,159		**292,701**
Drag/seine net	8,283	15,901	33,530	540	13,718	3,441	239	361	**76,013**
Gill net	822	1,015	158	1,513	8,291	42,319	63		**54,181**
Scoop/push net	73,052	34,613	16,735	15,595	64,507	5,159	734	951	**211,345**
Total	**84,792**	**51,566**	**317,367**	**17,766**	**99,814**	**51,428**	**10,195**	**1,312**	**634,240**
se	*9,174*	*5,336*	*14,750*	*2,119*	*5,813*	*4,200*	*839*	*1,278*	***19,709***
rse	10.8	10.3	4.6	11.9	5.8	8.2	8.2	97.4	**3.1**
% of State total	1.1	1.8	5.5	0.8	2.9	5.6	2.9	4.2	**2.7**
DIVING									
Spearfishing	58,408	4,240	9,637	649	20,788	1,152	88		**94,961**
Surface spear	731	3,014	3,564	1,571	5,741	9,984	334		**24,939**
SCUBA/surface air		15,987	163	10,148	43,394	17,397	97		**87,187**
Snorkel	18,731	7,344	1,215	8,282	15,230	6,643	6		**57,449**
SCUBA & snorkel				85	1,213				**1,298**
Total	**77,870**	**30,585**	**14,578**	**20,734**	**86,366**	**35,176**	**525**		**265,834**
se	*11,001*	*4,431*	*2,300*	*2,937*	*6,305*	*2,690*	*170*		***14,199***
rse	14.1	14.5	15.8	14.2	7.3	7.6	32.4		**5.3**
% of State total	1.0	1.1	0.3	0.9	2.5	3.9	0.1		**1.1**
OTHER									
Pump/ rake/ spade	157,865	18,894	380,856	45,670	16,594	1,579	184		**621,642**
Hand collection	130,924	17,133	74,190	22,701	28,325	5,689	1,122		**280,084**
Other	156				12,369				**12,525**
Total	**288,945**	**36,028**	**455,045**	**68,371**	**57,287**	**7,268**	**1,305**	**0**	**914,250**
se	*17,305*	*5,620*	*18,261*	*4,818*	*4,778*	*948*	*216*		***26,674***
rse	6.0	15.6	4.0	7.0	8.3	13.0	10.6	0.0	**2.9**
% of State total	3.8	1.3	7.9	3.1	1.7	0.8	0.4	0.0	**3.9**

Appendix 5.9. Annual fishing effort (fisher hours) by fishing method and State or Territory fished for Australian recreational fishers aged 5 or older.

	State/Territory fished								
Method	**NSW**	**VIC**	**QLD**	**SA**	**WA**	**TAS**	**NT**	**ACT**	**TOTAL**
LINE									
Bait	20,204,734	8,655,416	13,669,636	5,335,285	7,122,844	1,421,066	617,999	51,258	**57,078,240**
Lure/jig/fly	2,535,252	1,002,530	1,713,317	449,053	478,264	749,464	755,806	14,436	**7,698,121**
Bait & lure	1,813,820	955,001	1,234,153	1,175,325	588,691	232,136	217,493	8,889	**6,225,509**
Set-line	1,302,028	33,397	115,342	57,086	14,381	7,054	15,803	11,703	**1,556,795**
Total	**25,855,834**	**10,646,345**	**16,732,448**	**7,016,749**	**8,204,180**	**2,409,720**	**1,607,102**	**86,287**	**72,558,665**
% of State total	85.2	94.0	65.7	71.8	41.7	56.1	84.4	97.9	**70.5**
POTS & TRAPS									
Pot/trap - passive	3,581,640	391,368	7,916,842	2,018,293	9,817,240	1,294,628	255,058	403	**25,275,472**
Pot/ trap - active	158,554	50,306	26,658	523,529	1,174,775	4,824	28,900		**1,967,545**
Total	**3,740,194**	**441,674**	**7,943,500**	**2,541,821**	**10,992,014**	**1,299,452**	**283,958**	**403**	**27,243,017**
% of State total	12.3	3.9	31.2	26.0	55.8	30.3	14.9	0.5	**26.5**
NETS									
Cast net	6,390	37	310,980	59	22,893	584	8,013		**348,956**
Drag/seine net	24,918	20,192	43,370	3,512	25,073	4,572	359	60	**122,056**
Gill net	3,580	3,684	2,373	7,347	25,622	502,581	253		**545,440**
Scoop/push net	226,590	90,093	32,261	37,523	130,619	13,373	1,004	1,355	**532,818**
Total	**261,479**	**114,005**	**388,984**	**48,441**	**204,207**	**521,110**	**9,629**	**1,415**	**1,549,270**
% of State total	0.9	1.0	1.5	0.5	1.0	12.1	0.5	1.6	**1.5**
DIVING									
Spearfishing	143,452	11,775	37,110	1,762	61,546	1,939	276		**257,860**
Surface spear	1,462	9,670	8,121	3,790	12,127	21,467	1,123		**57,762**
SCUBA/surface air		39,776	163	17,691	71,102	25,728	116		**154,576**
Snorkel	36,055	15,713	1,510	20,194	24,809	11,303	11		**109,596**
SCUBA & snorkel				212	2,320				**2,532**
Total	**180,969**	**76,935**	**46,904**	**43,650**	**171,904**	**60,438**	**1,526**		**582,326**
% of State total	0.6	0.7	0.2	0.4	0.9	1.4	0.1		**0.6**
OTHER									
Pump/ rake/ spade	137,755	26,353	295,601	94,500	37,927	1,096	321		**593,553**
Hand collection	186,083	14,566	69,867	22,786	47,444	3,242	2,032		**346,020**
Other	468				36,779				**37,247**
Total	**324,307**	**40,919**	**365,468**	**117,286**	**122,149**	**4,338**	**2,353**		**976,820**
% of State total	1.1	0.4	1.4	1.2	0.6	0.1	0.1		**0.9**

Appendix 5.10. Mean duration (hours) of recreational fishing events by method and by State or Territory.

	State/Territory fished								
Method	**NSW**	**VIC**	**QLD**	**SA**	**WA**	**TAS**	**NT**	**ACT**	**TOTAL**
LINE									
Bait	3.52	4.15	3.71	3.83	3.06	3.06	4.40	2.54	3.60
Lure/jig/fly	3.54	2.99	3.34	2.49	2.91	3.34	5.48	2.24	3.38
Bait & lure	4.61	4.31	4.49	4.00	3.73	3.49	6.32	2.95	4.31
Set-line	20.58	10.73	19.25	13.47	7.57	3.51	107.87	70.50	19.26
POTS & TRAPS									
Pot/trap - passive	12.62	10.95	16.16	16.73	41.27	21.44	10.58	2.00	20.18
Pot/ trap - active	9.20	4.10	3.40	4.49	3.84	5.28	6.08		4.23
NETS									
Cast net	2.42	1.00	1.16	0.50	1.72	1.15	0.87		1.19
Drag/seine net	3.01	1.27	1.29	6.50	1.83	1.33	1.50	0.17	1.61
Gill net	4.36	3.63	15.00	4.86	3.09	11.88	4.00		10.07
Scoop/push net	3.10	2.60	1.93	2.41	2.02	2.59	1.37	1.42	2.52
DIVING									
Spearfishing	2.46	2.78	3.85	2.72	2.96	1.68	3.12		2.72
Surface spear	2.00	3.21	2.28	2.41	2.11	2.15	3.36		2.32
SCUBA/surface air		2.49	1.00	1.74	1.64	1.48	1.20		1.77
Snorkel	1.92	2.14	1.24	2.44	1.63	1.70	2.00		1.91
SCUBA & snorkel				2.50	1.91				1.95
OTHER									
Pump/ rake/ spade	0.87	1.39	0.78	2.07	2.29	0.69	1.75		0.95
Hand collection	1.42	0.85	0.94	1.00	1.67	0.57	1.81		1.24
Other	3.00				2.97		3.00		2.98

Appendix 5.11. Recreational fishing effort by fishing platform and State or Territory fished for Australian recreational fishers aged 5 or older.

	State/Territory fished								
Platform	**NSW**	**VIC**	**QLD**	**SA**	**WA**	**TAS**	**NT**	**ACT**	**TOTAL**
BOAT									
No. events	3,120,093	1,098,277	2,613,731	832,349	1,476,471	446,608	238,772	1,507	9,827,807
% total	40.7	39.1	45.3	37.6	42.9	48.9	67.5	4.8	42.4
SHORE									
No. events	4,502,291	1,703,002	3,141,674	1,381,315	1,964,839	464,975	106,890	29,783	13,294,769
% total	58.7	60.6	54.5	62.3	57.1	50.9	30.2	95.2	57.3
BOTH									
No. events	48,499	10,611	10,256	2,377	632	1,106	8,248		81,729
% total	0.6	0.4	0.2	0.1	0.0	0.1	2.3	0.0	0.4
TOTAL EVENTS	**7,670,883**	**2,811,891**	**5,765,661**	**2,216,041**	**3,441,941**	**912,689**	**353,909**	**31,290**	**23,204,305**

Appendix 5.12. Common and scientific names of species taken by recreational fishers and groupings (high level and key species groupings) used for analysis and reporting.

High level grouping	Key species grouping	Common name	Taxon
FINFISH	Australian bass/perch (freshwater)	Bass – Australian	*Macquaria novemaculeata*
		Cod – freshwater	Percicthydae
		Perch – estuary	*Macquaria colonorum*
		Perch – Macquarie	*Macquaria australasia*
		Perch – silver	*Bidyanus bidyanus*
		Perch (fw) – other	Percicthydae
		Perch (fw) – unspecified	Percicthydae
		Trout cod	*Maccullochella maquarienis*
	Australian herring	Herring – Australian/ tommy ruff	*Arripis georgianus*
	Australian salmon	Salmon – Australian east/ west	*Arripis trutta & A. truttaceus*
	Barracouta	Barracouta/ couta/ snoek	*Thyrsites atun*
	Barramundi	Barramundi	*Lates calcarifer*
	Blue mackerel	Mackerel – blue/ slimy	*Scomber australasicus*
	Bream	Bream – black/ northern/ pikey	*Acanthopagrus berda*
		Bream – black/ southern/ golden/ silver	*Acanthopagrus butcheri*
		Bream – eastern yellowfin/ silver	*Acanthopagrus australis*
		Bream – other	Sparidae
		Bream – unspecified	Sparidae
		Bream – western yellowfin	*Acanthopagrus latus*
		Tarwhine/ silver bream	*Rhabdosargus sarba*
	Butterfish	Butterfish – unspecified	Scatophagidae
		Butterfish – western	*Pentapodus vitta*
	Catfish	Catfish – estuary	*Cnidoglanis macrocephalus*
		Catfish – freshwater	*Tandanus tandanus*
		Catfish – other	Plotosidae
		Catfish – saltwater/ eel-tailed	Plotosidae
		Catfish – saltwater/ fork-tailed	Ariidae
		Catfish – unspecified	Plotosidae
	Coral trout	Coral trout – unspecified	Serranidae
		Coronation trout	*Variola louti*
	Dart	Dart/ swallowtail	*Trachinotus* spp.
	Dhufish	Dhufish/ jewfish	*Glaucosoma hebraicum*
	Drummer	Drummer – other	*Kyphosus* spp.
		Drummer – silver/ buffalo bream	*Kyphosus sydneyanus*
		Drummer – unspecified	*Kyphosus* spp.
		Rock blackfish	*Girella elevata*
	Eels	Eel – conger	*Conger* spp.
		Eel – other	Anguillidae
		Eel – unspecified	Anguillidae

Appendix 5.12. (cont)

High level grouping	Key species grouping	Common name	Taxon
FINFISH	Emperors	Bream - coral/sea	Lethrinidae
		Emperor - blue spotted	*Lethrinus punctulatus*
		Emperor - blue-lined/ black snapper	Lethrinidae
		Emperor - grass sweetlip	*Lethrinus fletus*
		Emperor - grass/ tricky	*Lethrinus laticaudis*
		Emperor – other	Lethrinidae
		Emperor - red throat/ sweetlip	*Lethrinus miniatus*
		Emperor – spangled	*Lethrinus nebulosus*
		Emperor – unspecified	Lethrinidae
		Emperor - yellow tailed	*Lethrinus atkinsoni*
	European carp	Carp	*Cyprinus carpio*
	Flatfish	Flounder/ sole/ flatfish - unspecified	Bothidae & Pleuronectidae
	Flathead	Flathead - bar tailed	*Platycephalus endrachtensis*
		Flathead - blue spot	*Platycephalus caeruleopunctatus*
		Flathead - dusky	*Platycephalus fuscus*
		Flathead - other	Platycephalidae
		Flathead - sand	*Platycephalus bassensis*
		Flathead - tiger	*Neoplatycephalus richardsoni*
		Flathead - unspecified	Platycephalidae
	Garfish	Garfish - other	Hemiramphidae
		Garfish - southern	*Hyporhamphus melanochir*
		Garfish - unspecified	Hemiramphidae
	Golden perch	Perch - golden/ yellowbelly/ callop	*Macquaria ambigua*
	Grunters/trumpeters	Grunter - sooty	*Hephaestus fuliginosus*
		Perch - spangled/ spangled grunter	*Leiopotherapon unicolor*
		Trumpeter - grunters/ javelin fish	Teraponidae
		Trumpeter - other	Teraponidae
		Trumpeter - shitty	*Pelates octolineatus*
		Trumpeter - unspecified	Teraponidae
	King George whiting	Whiting - king george/ spotted whitey	*Sillaginodes punctata*
	Leatherjackets	Leatherjacket	Monacanthidae
	Luderick	Luderick/ blackfish	*Girella tricuspidata*
	Mackerels	Mackerel - broad barred	*Scomberomorus semifasciatus*
		Mackerel - narrow barred/ spanish	*Scomberomorus commerson*
		Mackerel - Queensland school	*Scomberomorus queenslandicus*
		Mackerel - shark	*Grammatorcynus bicarinatus*
		Mackerel - spotted	*Scomberomorus munroi*
		Mackerel - unspecified	Scombridae
		Mackerel -other	Scombridae
		Wahoo	*Acanthocybium solandri*

Appendix 5.12. (cont)

High level grouping	Key species grouping	Common name	Taxon
FINFISH	Morwong	Morwong - banded	*Cheilodactylus spectabilis*
		Morwong - blue	*Nemadactylus douglasii*
		Morwong - dusky	*Dactylophora nigricans*
		Morwong - jackass	*Nemadactylus macropterus*
		Morwong - other	Cheilodactylidae
		Morwong - red	*Cheilodactylus fuscus*
		Morwong - unspecified	Cheilodactylidae
		Perch - magpie	*Cheilodactylus nigripes*
		Snapper - queen/ queenies	*Nemadactylus valenciennesi*
	Mullet	Mullet - other	Mugilidae
		Mullet - sea	*Mugil cephalus*
		Mullet - unspecified	Mugilidae
		Mullet - yelloweye/ pilch	*Aldrichetta forsteri*
	Mulloway/jewfish	Jewfish - other	Scianidae
		Jewfish - unspecified	Scianidae
		Jewfish/ spotted croaker/ spotted jew/ black jew	*Protonibea diacanthus*
		Mulloway/ jewfish/ kingfish	*Argyrosomus japonicus*
		Teraglin/ jewfish	*Atractoscion aequidens*
	Murray cod	Cod - murray/ murray perch	*Maccullochella peeli*
	Pike	Barracuda/ striped sea pike	*Sphyraena barracuda*
		Pike - long finned	*Dinolestes lewini*
		Pike - unspecified	Sphyraenidae & Dinolestidae
		Snook/ shortfinned pike	*Sphyreana novaehollandiae*
	Red emperor	Emperor - red	*Lutjanus sebae*
	Red mullet	Mullet - red/ goatfish	Mullidae
	Redfin perch	Perch - redfin/ english	*Perca fluviatilis*
	Redfish	Redfish/ nannygai	*Centroberyx affinis*
		Snapper - red	*Centroberyx gerrardi*
	Rock-cod/gropers	Cod - black tipped	*Epinephelus fasciatus*
		Cod - breaksea/ black-arse	*Epinephelides armatus*
		Cod - chinaman/ charlie court	*Epinephelus rivulatus*
		Cod - estuary/ greasy	*Epinephelus coioides*
		Cod - maori	*Epinephelus undulatostriatus*
		Hapuku	*Polyprion* spp.
		Harlequin fish	*Othos dentex*
		Rockcod - rankins/ white blotched	*Epinephelus multinotatus*
		Rockcod - tomato	*Cephalopholis sonnerati*
		Wirrah - western	*Acanthistius serratus*
	Scads/mackerel	Mackerel - jack/ horse	*Trachus declivis*
		Yellowtail/ scad	*Trachurus novaezelandiae*
	Scorpionfish/gurnard	Cod - red rock/ red scorpion/ coral perch	*Scorpaena cardinalis*
		Gurnard	Triglidae
		Perch - ocean / red gurnard/ coral cod	*Helicolenus* spp.
		Scorpaenidae	Scorpaenidae

Appendix 5.12. (cont)

High level grouping	Key species grouping	Common name	Taxon
FINFISH	Sea perch/snappers	Bass - Red	*Lutjanus bohar*
		Chinaman fish	*Symphorus nematophorus*
		Hussar	*Lutjanus adetii*
		Jobfish	Lutjanidae
		Nannygai/ redfish/ scarlet sea perch	*Lutjanus malabaricus*
		Snapper - golden/ fingermark	*Lutjanus johnii*
		Snapper - mangrove jack	*Lutjanus argentimaculatus*
		Snapper - other	Lutjanidae
		Snapper - red/ redfish/ scarlet perch/ saddle	*Lutjanus* spp.
		Snapper - russels/ moses perch/ fingermark	*Lutjanus russelli*
		Snapper - stripey seaperch/ spanish flag	*Lutjanus carponotatus*
		Snapper - unspecified	Lutjanidae
	Sharks/rays	Ray - shovelnose	*Aptychotrema vincentiana*
		Rays/skates - other	Several Families (incl. Rhinobatidae, Dasyatidae)
		Rays/skates - unspecified	Several Families (incl Rhinobatidae, Dasyatidae)
		Shark - blue	*Prionace glauca*
		Shark - bronze whaler	*Carcharhinus brachyurus*
		Shark - dogfish/ spurdogs	*Squalus* & *Centrophorus*
		Shark - draftboard/swell	*Cephaloscyllium laticeps*
		Shark - gummy	*Mustelus antarcticus*
		Shark - hammerhead	Sphyrnidae
		Shark - mako/ blue pointer	*Isurus oxyrinchus*
		Shark - other	Several Families
		Shark - port jackson	*Heterodontus portusjacksoni*
		Shark - saw	*Pristiophorus* spp.
		Shark - school	*Galeorhinus galeus*
		Shark - tiger	*Galeocerdo cuvier*
		Shark - unspecified	Several Families
		Shark - whaler	*Carcharhinu*s spp.
		Shark - wobbegong/ carpet shark	*Orectolobus* spp.
	Pink snapper	Snapper - southern/ squire	*Pagrus auratus*
	Sweep	Sweep - banded	*Scorpis georgianus*
		Sweep - other	*Scorpis* spp.
		Sweep - sea	*Scorpis aequipinnis*
		Sweep - unspecified	*Scorpis* spp.
	Tailor	Tailor/ chopper/ jumbo	*Pomatomus saltatrix*
	Threadfin salmon	Salmon - blue	*Eleutheronema tetradactylum*
		Salmon - northern threadfin/ bluenose	*Polydactylus plebius*
		Salmon - other	*Polydactylus* or *Arripis*
		Salmon - unspecified	*Polydactylus* or *Arripis*

Appendix 5.12. (cont)

High level grouping	Key species grouping	Common name	Taxon
FINFISH	Trevally	Trevally - giant/ turrum	*Caranx ignobilis*
		Trevally - gold spotted	*Carangoides fulvoguttatus*
		Trevally – golden	*Gnathanodon speciosus*
		Trevally – other	Carangidae
		Trevally - silver/ skipjack	*Pseudocaranx dentex*
		Trevally – unspecified	Carangidae
	Trout/salmon	Salmon - atlantic	*Salmo salar*
		Salmon - chinook	*Oncoryhnchus* spp.
		Trout - brown	*Salmo trutta*
		Trout - other	Salmonidae
		Trout - rainbow	*Oncoryhnchus mykiss*
		Trout - unspecified	Salmonidae
	Tuna/bonitos	Tuna - albacore	*Thunnus alalunga*
		Tuna - bonitos/ horse mackerel	*Sarda* spp.
		Tuna - mackerel	*Euthynnus affinis*
		Tuna - northern bluefin/ longtail	*Thunnus tonggol*
		Tuna - other	Scombridae
		Tuna - skipjack/ striped	*Katsuwonis pelamis*
		Tuna - southern bluefin	*Thunnus maccoyii*
		Tuna - unspecified	Scombridae
		Tuna - yellowfin	*Thunnus albacares*
	Whiting	Whiting - diver/ winter/ trumpeter	*Sillago maculata*
		Whiting – other	Sillaginidae
		Whiting - sand/ summer	*Sillago ciliata*
		Whiting – silver	*Sillago bassensis*
		Whiting -unspecified	Sillaginidae
		Whiting - yellowfin/ western sand	*Sillago schomburgkii*
	Wrasse/tuskfish/gropers	Foxfish – western	*Bodianus frenchii*
		Groper - baldchin/ blue bone	*Choerodon rubescens*
		Groper - eastern blue	*Achoerodus viridis*
		Groper – other	Labridae
		Groper – unspecified	Labridae
		Groper - western blue	*Achoerodus gouldii*
		Pigfish	*Bodianus* spp.
		Tuskfish – blackspot	*Choerodon schoenleinii*
		Tuskfish/ parrotfish – unspecified	Labridae
		Wrasse - brown spotted/ rock cod	*Pseudolabrus parilus*
		Wrasse – maori	Labridae
		Wrasse – other	Labridae
		Wrasse – unspecified	Labridae
	Kingfish/ Samson fish	Amberjack	*Seriola dumerili*
		Kingfish - yellowtail/ kingy/ hoodlam	*Seriola lalandi*
		Samson fish	*Seriola hippos*

Appendix 5.12. (cont)

High level grouping	Key species grouping	Common name	Taxon
FINFISH	Other	Archer fish	Toxotidae
		Bass - sand	*Psammoperca waigiensis*
		Blackfish - river	*Gadopsis marmoratus*
		Boarfish	Pentacerotidae
		Bonefish	*Albula neoguinaica*
		Bony bream	*Nematalosa erebi*
		Bream - butter	*Monodactylus argenteus*
		Bream - threadfin	*Nemipterus bathybius*
		Bullseye	Pempheridídae
		Cardinal fish	*Apogonidae*
		Clown fish	Pomacentridae
		Cobia/ black kingfish	*Rachycentron canadum*
		Cowfish	Ostraciidae
		Dolphin fish/ mahi mahi/ dorado	*Coryphaena hippurus*
		Dory	Zeidae
		Elephant fish/ elephant shark	*Callorinchus milii*
		Finfish - ID unknown	Several Families
		Fish - other	Several Families
		Fusilier	Caesionidae
		Gemfish	*Rexea solandri*
		Globefish/ porcupine fish	*Diodon nicthemerus*
		Knifejaw	*Oplegnathus woodwardi*
		Latchet	*Pterygotrigla polyommata*
		Ling	Aphyonidae, Bythitidae, Ophidiidae
		Lizardfish/ grinners	Synodontidae
		Long Tom	Belonidae
		Marblefish	*Aplodactylus* sp.
		Marlin - black	*Makaira indica*
		Marlin - blue	*Makaira mazara*
		Marlin - striped	*Tetrapturus audax*
		Marlin - unspecified	Istiophoridae
		Milkfish	*Chanos chanos*
		Moonfish/ batfish	*Zabidius novaemaculatus*
		Old Wife	*Enoplosus armatus*
		Perch - (marine) other	Lutjanidae & Caesonidae
		Perch - (marine) unspecified	Lutjanidae & Caesonidae
		Perch - pearl	*Glaucosoma scapulare*
		Queenfish	*Scomberoides* spp.
		Rainbow fish	*Pseudomugilidae* spp.
		Rainbow runner	*Elegatis bipunnulata*
		Remora	*Remora remora*
		Roach	*Rutilus rutilus*
		Sailfish - indo pacific	*Istiophorus platypterus*
		Saratoga	*Scleropages jardinii*
		Seaperch	*Ellerkeldia* spp.
		Sergeant baker	*Aulopus purpurissatus*
		Silverbiddy/ silverbelly/ roach	*Gerres* spp.

Appendix 5.12. (cont)

High level grouping	Key species grouping	Common name	Taxon
FINFISH	Other	Squirrel fish	Holocentridae
		Stargazer	Uranoscopidae
		Surgeon fish - unspecified	*Prionurus* spp.
		Sweetlips - painted/ slatey bream	*Diagramma pictum*
		Tarpon/ ox-eye herring	*Megalops cyprinoides*
		Tench	*Tinca tinca*
		Tilapia	*Tilapia mariae & Oreochromis mossambicus*
		Toads/ pufferfish/ boxfish/ blowfish	Several Families
		Trevalla - blue eye / deep sea trevalla	*Hyperoglyphe antarctica*
		Trumpeter - bastard	*Latridopsis forsteri*
		Trumpeter - striped	*Latris lineata*
		Tupong	*Pseudaphritis urvilli*
		Warehou - blue/ snotty/ haddock	*Seriolella brama*
		Warehou - other	Centrolophidae
		Warehou - silver/ spotted	*Seriolella punctata*
		Warehou - unspecified	Centrolophidae
		Western blue devil fish	*Paraplesiops meleagris*
		Whiting - grass/ stranger/ weedy	*Haletta semifasciata*
SMALL BAITFISH	Small baitfish	Small baitfish	Several Families
		Whitebait	*Lavettia & Galaxias* spp.
	Herring/pilchards	Herring - other	Clupeidae
		Herring - unspecified	Clupeidae
		Pilchard	Clupeidae
CRABS & LOBSTERS	Blue swimmer crab	Crab - blue swimmer/ sand	*Portunus pelagicus*
	Mud crab	Crab - mud	*Scylla* spp
	Lobsters	Lobster - eastern rock	*Jasus verreauxi*
		Lobster - other	Palinuridae
		Lobster - southern rock	*Jasus edwardsii*
		Lobster - tropical/ ornate	*Panulirus ornatus*
		Lobster - unspecified	Palinuridae
		Lobster - western rock	*Panulirus cygnus*
	Crabs (other)	Crab - other	Brachyura
		Crab - sand	Brachyura
		Crab - unspecified	Brachyura
		Crabs - hermit	Brachyura
PRAWNS & YABBIES	Macrobrachium/cherabin	Macrobrachium/ cherabin	*Macrobrachium rosenbergii*
	Murray crayfish	Murray crayfish	*Euastacus armatus*
	Prawns (freshwater)	Shrimps - freshwater	Kakaducarididae
	Prawns (saltwater)	Prawns	Penaeidea
	Yabbies/nippers (saltwater)	Yabbies/ nippers/ bass yabbies	*Callianassa australiensis*
	Crayfish (freshwater)	Gilgie	*Cherax quinquecarinatus*
		Koonac	*Cherax preissii*
		Marron	*Cherax tenimanus*
		Red claw	*Cherax quadricarinatus*
		Yabbies	*Cherax* spp.

Appendix 5.12. (cont)

High level grouping	Key species grouping	Common name	Taxon
CEPHALO-PODS	Squid/cuttlefish	Calamari - southern	*Sepioteuthis australis*
		Cuttlefish	Spirulidae
		Squid - arrow	*Nototodarus gouldi*
		Squid - other	Teuthoidea
		Squid - unspecified	Teuthoidea
	Octopus	Octopus	*Octopus* spp.
OTHER MOLLUSCS	Abalone	Abalone - blacklip	*Haliotis rubra*
		Abalone - brownlip	*Haliotis conicopora*
		Abalone - greenlip	*Haliotis laevigata*
		Abalone - unspecified	Haliotidae
		Abalone -roes	*Haliotis roei*
	Mussels	Mussel - blue	*Mytilus edulis*
		Mussels - mud	Mytilidae
		Mussels - other	Mytilidae
		Mussels - unspec.	Mytilidae
	Other	Longbums	*Telescopium telescopium*
		Shells - other	Mollusca
		Shells - Unknown	Mollusca
		Shells - unspecified	Mollusca
	Oysters	Oysters	Ostreidae & Pteriidae
	Pippi/ Goolwa cockle	Cockles - Goolwa	*Donax deltoides*
		Pippi	*Donax deltoides*
	Razorfish	Razorfish	*Pinna bicolor*
	Scallops	Scallops	Pectinidae
	Bivalves (other)	Clams - unspec.	Mollusca
		Cockles	*Anadara & Katelysia* spp.
		Cockles - mud	*Katelysia* sp.
		Cockles - unspecified	Mollusca
		Surf clams	*Dosinia* spp.
OTHER TAXA	Other	Cunjuvoi	*Pyura stolonifera*
		Non-fish - ID unknwon	Non-fish - ID unknown
		Non-fish - other	Non-fish - other
		Sea urchins	Echinoidea
		Trepang/ beche de mer	Holothuriidae/Stichopodidae
	Worms	Worms - beach	Phylum Annelida
		Worms - blood	Phylum Annelida
		Worms - mangrove	Phylum Annelida
		Worms - other	Phylum Annelida
		Worms - sand	Phylum Annelida
		Worms - unspecified	Phylum Annelida

Appendix 5.13. Estimated annual harvest (numbers) taken by recreational fishers, aged 5 or older, by species group and by State or Territory fished.

se is standard error, values indicated in bold represent relative standard errors of greater than 0.4.

Species group		NSW	VIC	QLD	SA	WA	TAS	NT	ACT	TOTAL
FINFISH										
Australian bass/perch	No.	93,150	74,931	97,789	8,530	5,059	<1,000	1,100		280,612
	se	*9,956*	***74,322***	*16,874*	***3,627***	*1,733*				*76,966*
Australian herring	No.		11,354		2,973,402	3,873,411				6,858,166
	se		***6,458***		*318,820*	*339,084*				*465,474*
Australian salmon	No.	110,988	541,852		715,768	41,695	314,221			1,724,524
	se	*14,228*	*85,492*		*86,057*	*7,745*	*80,639*			*146,560*
Barracouta	No.	<1,000	108,895	<1,000	2,411	<1,000	28,287	<1,000		140,499
	se		*35,157*		***985***		*5,852*			*35,655*
Barramundi	No.			88,155		22,570		105,131		215,857
	se			*11,160*		*5,551*		*9,403*		*15,613*
Blue mackerel	No.	427,062	7,057	8,997	45,044	78,631	2,528			569,319
	se	*138,970*	***5,144***	*2,572*	*17,394*	*17,377*	***1,601***			*141,254*
Bream	No.	2,082,149	506,704	1,684,719	81,088	424,242	45,396	20,625		4,844,924
	se	*259,180*	*95,468*	*136,246*	*16,777*	*60,287*	*10,283*	*2,706*		*314,453*
Butterfish	No.	<1,000		15,920	<1,000	123,884	<1,000			140,362
	se			*4,511*		*44,302*				*44,532*
Catfish	No.	94,222	7,436	210,615	2,480	27,460		3,736		345,950
	se	*18,649*	***4,561***	*42,949*	***5,107***	*4,681*		*584*		*47,556*
Cod (various)	No.	16,265	12,158	185,603	13,675	55,525	66,829	19,924		369,980
	se	***50,808***	*3,569*	*15,432*	***10,338***	*6,555*	*17,008*	*3,207*		*57,286*
Coral trout	No.			270,713		38,975		9,939		319,627
	se			*26,186*		*8,712*		*1,403*		*27,632*
Dart	No.	115,287		231,084		11,818				358,189
	se	*19,241*		*42,212*		*3,526*				*46,524*

Appendix 5.13. (cont)

Species group		NSW	VIC	QLD	SA	WA	TAS	NT	ACT	TOTAL
Dhufish	No.					102,848				102,848
	se					*13,949*				*13,949*
Drummer	No.	83,158		<1,000	<1,000	6,408				90,726
	se	*22,437*				***4,963***				*22,988*
Eels	No.	5,350	147,254	7,766	<1,000	1,664	8,239			170,654
	se	***2,377***	*49,056*	*2,728*		*370*	*1,749*			*49,223*
Emperors	No.	3,345		438,518		199,374		12,195		653,432
	se	***2,154***		*73,679*		*27,630*		*4,175*		*78,829*
European carp	No.	1,168,881	328,189	80,227	483,310				23,940	2,084,548
	se	*117,070*	*65,290*	*18,117*	*66,724*				*7,270*	*151,001*
Flatfish	No.	99,915	37,572	45,251	2,994	14,663	71,160			271,555
	se	*13,928*	***37,357***	*6,548*	*647*	*2,645*	*12,336*			*42,332*
Flathead	No.	2,217,059	3,316,071	380,947	72,105	79,061	1,377,350	1,467		7,444,060
	se	*247,909*	*658,108*	*35,315*	*9,785*	*8,762*	*153,964*	*263*		*720,895*
Garfish	No.	302,297	255,199	69,889	1,511,250	275,295	19,549	4,788		2,438,267
	se	***183,103***	*75,558*	*20,342*	*167,024*	*43,692*	*3,208*	***2,629***		*263,577*
Golden perch	No.	542,107	142,276	261,688	86,732	1,258			5,846	1,039,907
	se	*48,561*	***68,197***	*37,588*	*12,086*				***2,534***	*92,598*
Grunters/trumpeters	No.	4,581		221,467	268,366	68,534		21,836		584,783
	se	***5,066***		*25,399*	*50,613*	*18,164*		*3,964*		*59,817*
King George whiting	No.		975,349		2,238,071	408,209				3,621,629
	se		*173,254*		*202,607*	*73,984*				*276,659*
Leatherjackets	No.	385,594	166,378	5,371	155,168	34,420	20,090			767,022
	se	*106,807*	*53,187*	*1,315*	*19,369*	*10,679*	*5,930*			*121,502*
Luderick	No.	622,511	33,273	1,995	3,563		1,879			663,221
	se	*212,910*	*7,179*	***1,095***	***2,085***		***1,033***			*213,046*
Mackerels	No.	25,725		339,445		85,208		21,292		471,671
	se	***15,263***		*53,827*		*12,618*		*2,475*		*57,408*

Appendix 5.13. (cont)

Species group		NSW	VIC	QLD	SA	WA	TAS	NT	ACT	TOTAL
Morwong	No.	186,572	4,688	17,541	5,527	27,462	38,291			280,081
	se	*34,708*		*5,470*	*1,002*	*4,704*	***22,913***			*42,222*
Mullet	No.	445,036	301,848	944,555	775,361	258,676	99,130	86,287		2,910,892
	se	*111,266*	*78,893*	*130,223*	*109,063*	*61,842*	*28,337*	*10,870*		*228,478*
Mulloway/jewfish	No.	136,852	5,421	73,243	27,004	62,928		18,012		323,459
	se	*21,678*	***2,997***	*13,392*	*5,156*	*14,921*		*2,823*		*30,256*
Murray cod	No.	93,973	11,943	<1,000	2,278					108,352
	se	*6,842*	*3,336*		***1,362***					*7,733*
Other	No.	238,361	100,557	443,287	87,634	120,493	96,589	46,506		1,133,427
	se	*32,232*	*19,318*	*48,091*	*17,037*	*18,117*	*18,228*	*7,319*		*68,812*
Pike	No.	31,461	257,795	50,149	185,947	60,864	10,481	11,419		608,117
	se	*9,196*	*82,758*	***31,739***	*34,482*	*13,862*	*2,322*	*1,666*		*96,592*
Red emperor	No.	<1,000		204,076		18,010		6,342		228,600
	se			*69,320*		*4,710*		*984*		*69,487*
Red mullet	No.	5,185	25,051	<1,000	113,077	2,149				145,601
	se	***2,380***	***41,145***		*29,535*	***1,140***				*50,717*
Redfin perch	No.	244,596	949,351		40,410	47,384	9,316		3,454	1,294,511
	se	*46,454*	*193,285*		*12,318*	***23,605***	***6,692***		***2,053***	*200,686*
Redfish	No.	104,578	<1,000		45,310	26,722				176,846
	se	*21,464*			*9,236*	*6,164*				*24,167*
Rock-cod/gropers	No.	2,457		14,155	<1,000	90,861	<1,000	<1,000		108,277
	se	***1,418***		***10,541***		*11,837*				*15,914*
Scads/mackerel	No.	218,237		94,437	2,679	125,746	33,571			474,670
	se	*51,551*		*33,225*	***1,270***	*27,478*	***18,487***			*69,713*
Scorpionfish/gurnard	No.	95,416	6,020	1,869	2,674	3,564	36,569			146,112
	se	*22,924*	***2,970***	***1,059***	*883*	*1,137*	*11,814*			*26,021*
Sea perch/snappers	No.	20,765		405,265		68,825		160,959		655,814
	se	*4,254*		*45,129*		*10,290*		*24,345*		*52,472*
Sharks/rays	No.	30,093	89,423	35,899	30,722	24,432	9,808	7,942		228,320
	se	*6,617*	*20,585*	*8,095*	*8,428*	*3,260*	*3,917*	*1,391*		*25,140*

Appendix 5.13. (cont)

Species group		NSW	VIC	QLD	SA	WA	TAS	NT	ACT	TOTAL
Pink snapper	No.	334,191	474,879	232,354	115,798	130,251	<1,000			1,287,826
	se	*43,344*	*103,762*	*63,052*	*25,067*	*21,557*	*91*			*133,093*
Sweep	No.	92,678	26,324	<1,000	57,864	28,944	<1,000			206,966
	se	*17,355*	***12,958***		*16,430*	*6,986*				*28,069*
Tailor	No.	1,010,943	57,428	651,069	<1,000	587,041	1,721			2,308,352
	se	*171,827*	*17,821*	*98,600*		*60,572*	***805***			*207,927*
Threadfin salmon	No.			103,278		44,724		36,899		184,901
	se			*17,196*		*7,980*		*5,186*		*19,654*
Trevally	No.	250,087	107,241	151,714	80,620	363,710	23,770	17,988		995,131
	se	*32,958*	*26,361*	*15,511*	*18,292*	*42,253*	*3,746*	*1,508*		*64,482*
Trout/salmon	No.	244,470	345,894		6,871	10,246	214,582		2,495	824,558
	se	*27,320*	*50,345*		*3,965*	*2,979*	*25,725*		*681*	*62,991*
Tuna/bonitos	No.	140,747		41,153	1,576	28,857	12,737	7,280		232,350
	se	*40,211*		*7,079*	***636***	*5,229*	***5,382***	*1,393*		*41,541*
Whiting	No.	1,791,276	4,997	3,704,448	499,432	2,126,680	12,215	2,069		8,141,117
	se	*448,367*	***2,532***	*566,122*	*161,608*	*261,548*	*2,552*	*469*		*784,898*
Wrasse/tuskfish/gropers	No.	149,636	120,689	165,906	64,672	192,238	22,792	14,789		730,723
	se	*23,649*	*33,958*	*30,046*	*20,435*	*20,257*	*4,741*	*1,432*		*58,887*
Kingfish/Samson fish	No.	90,001	<1,000	5,121	6,160	10,890	1,505			114,053
	se	***38,472***		***2,468***	***3,814***	*2,984*	***883***			*38,864*
Total finfish	No.	14,357,783	9,562,106	11,987,131	10,817,157	10,442,286	2,580,457	638,730	35,735	60,421,387
	se	*800,687*	*700,699*	*617,807*	*480,896*	*425,031*	*188,898*	*32,409*	*8,260*	*1,400,885*
SMALL BAITFISH										
Herring/pilchards	No.	78,847	<1,000	688,950		2,471		<1,000		770,804
	se	***36,792***		*165,493*		***1,335***				*169,539*
Small baitfish	No.	201,111	786,563	1,124,507	1,227	29,626	8,496,037	76,306		10,715,376
	se	*73,400*	*217,524*	*171,831*		*10,358*	***5,347,204***	*21,967*		*5,354,943*
Total baitfish	No.	279,957	786,636	1,813,457	1,227	32,097	8,496,037	76,769		11,486,181
	se	*76,272*	*215,753*	*237,218*		*10,114*	***5,347,204***	*21,842*		***5,357,407***

Appendix 5.13 (cont)

Species group		NSW	VIC	QLD	SA	WA	TAS	NT	ACT	TOTAL
CRABS & LOBSTERS										
Blue swimmer crab	No.	412,883		140,242	1,139,795	2,211,466		<1,000		3,905,057
	se	*113,652*		*31,716*	*148,346*	*220,047*				*290,431*
Crabs (other)	No.	34,742	23,412	483,655	116,110	44,352	6,707	<1,000		709,869
	se	*9,165*	***17,790***	***517,118***	*26,793*	***19,465***	***6,251***	***459***		*518,601*
Lobsters	No.	10,569	51,228	19,652	113,679	403,833	86,976	<1,000		686,431
	se	*3,641*	***20,513***	*6,021*	*34,509*	*69,321*	*11,847*	*191*		*81,283*
Mud crab	No.	51,724		585,502		100,289		82,371		819,886
	se	*12,427*		*53,067*		*16,159*		*10,525*		*57,813*
Total crabs & lobsters	No.	509,918	74,640	1,229,051	1,369,584	2,759,941	93,683	84,426		6,121,243
	se	*108,443*	***30,591***	*461,365*	*156,044*	*219,802*	*12,365*	*10,328*		*546,329*
PRAWNS & YABBIES										
Crayfish (fw)	No.	1,938,164	1,887,942	2,300,453	593,113	645,465	1,422	15,391	19,936	7,401,886
	se	*247,123*	*489,538*	*594,428*	*132,355*	*131,968*	***924***	*2,956*	***10,816***	*830,134*
Macrobrachium/cherabin	No.	20,292			1,065,271	130,473		15,424		1,231,459
	se				*263,783*	*42,930*		***9,169***		*267,410*
Murray crayfish	No.	128,941	34,704							163,646
	se	*15,940*	*13,361*							*20,799*
Prawns (freshwater)	No.	590,950	1,118,514	520,959	90,740					2,321,164
	se	*93,870*	*317,431*	*205,847*						*389,804*
Prawns (saltwater)	No.	10,483,282	69,721	4,940,824	10,807	943,458	9,646	9,731		16,467,469
	se	***7,548,722***		*742,012*		*304,208*	*1,163*	*2,940*		*7,591,201*
Yabbies/nippers (saltw)	No.	3,033,392	370,036	16,671,929		7,578				20,082,936
	se	*445,452*	***171,353***	*2,354,456*						*2,402,343*
Total prawns & yabbies	No.	16,195,022	3,480,918	24,434,165	1,759,931	1,726,974	11,068	40,546	19,936	47,668,561
	se	*6,271,183*	*618,692*	*2,468,542*	*290,441*	*312,597*	***5,325***	*9,025*	***10,816***	*6,781,336*
CEPHALOPODS										
Octopus	No.	10,129	2,092		<1,000	25,586	<1,000			39,412
	se	***5,034***	***895***		*195*	*8,549*				*9,967*

Appendix 5.13 (cont)

Species group		NSW	VIC	QLD	SA	WA	TAS	NT	ACT	TOTAL
Squid/cuttlefish	No.	154,627	199,202	61,255	1,047,904	216,850	44,438	<1,000		1,724,540
	se	*54,521*	*63,342*	*14,839*	***435,903***	*51,997*	*7,450*			*447,186*
Total cephalopods	No.	164,756	201,295	61,255	1,048,718	242,436	45,230	<1,000		1,763,952
	se	*54,903*	*64,752*	*15,304*	***434,033***	*52,079*	*7,758*			*445,644*
OTHER MOLLUSCS										
Abalone	No.	35,233	10,355		17,780	214,351	108,495			386,214
	se	***15,851***	*4,090*		*4,994*	*51,686*	*20,525*			*58,186*
Bivalves (other)	No.	102,224			300,645	9,771	9,502	2,305		424,447
	se	*30,307*			*105,391*	***8,286***		*774*		*109,978*
Mussels	No.	7,191	615,798		14,664	687,086	77,330	6,582		1,408,650
	se		***534,405***		*5,604*	*205,836*	*28,362*	*547*		*573,405*
Other	No.	5,565		1,658	5,120		18,968	1,349		32,659
	se				*1,266*		*7,290*			*7,399*
Oysters	No.	51,303		66,865	<1,000	5,218	14,312	1,176		139,548
	se	***27,944***		*12,415*		*941*	***5,779***	***661***		*31,144*
Pippi/ Goolwa cockle	No.	1,076,765	638,401	985,758	1,474,859			<1,000		4,176,224
	se	*169,937*	***262,026***	*313,102*	***982,506***					*1,077,445*
Razorfish	No.				470,564	1,833				472,397
	se				*134,412*					*134,412*
Scallops	No.		83,290		59,231	69,026				211,547
	se				*21,874*					*21,874*
Total molluscs	No.	1,278,282	1,347,844	1,054,280	2,343,537	987,285	228,607	11,853		7,251,687
	se	*180,401*	***581,306***	*293,973*	*773,692*	*233,684*	*47,991*	*3,367*		*1,054,706*
OTHER TAXA										
Other	No.	38,631		12,064	<1,000	<1,000	2,193	<1,000		53,671
	se	***22,190***		***13,232***			***1,022***			*25,856*
Worms	No.	285,633	427,250	200,399	60,543	155,887	10,592			1,140,304
	se	*72,697*	***250,504***	*79,443*	*16,473*	***125,237***	*2,944*			*300,520*
Total other	No.	324,264	427,250	212,463	60,645	155,935	12,785	<1,000		1,193,975
	se	*75,912*	***250,504***	*82,136*	*20,642*	***146,279***	***5,392***			*311,631*

Appendix 5.14. Estimated annual harvest and released/discarded catch (numbers) taken by Australian recreational fishers, aged 5 or older. The released proportion of the total catch is indicated.

Species group	Harvest	Released/discarded	Total catch	% released
FINFISH				
Australian bass/perch	280,612	869,571	1,150,183	75.6
Australian herring	6,858,166	1,385,584	8,243,750	16.8
Australian salmon	1,724,524	875,106	2,599,630	33.7
Barracouta	140,499	50,144	190,643	26.3
Barramundi	215,857	545,816	761,673	71.7
Blue mackerel	569,319	151,495	720,814	21.0
Bream	4,844,924	8,201,492	13,046,416	62.9
Butterfish	140,362	108,010	248,372	43.5
Catfish	345,950	1,024,400	1,370,351	74.8
Cod (various)	369,980	608,115	978,095	62.2
Coral trout	319,627	173,249	492,876	35.2
Dart	358,189	511,497	869,686	58.8
Dhufish	102,848	56,884	159,733	35.6
Drummer	90,726	36,034	126,759	28.4
Eels	170,654	134,576	305,229	44.1
Emperors	653,432	682,717	1,336,149	51.1
European carp	2,084,548	269,421	2,353,970	11.4
Flatfish	271,555	173,423	444,978	39.0
Flathead	7,444,060	6,017,507	13,461,567	44.7
Garfish	2,438,267	339,589	2,777,856	12.2
Golden perch	1,039,907	817,853	1,857,760	44.0
Grunters/trumpeters	584,783	1,311,569	1,896,352	69.2
King George whiting	3,621,629	1,277,542	4,899,170	26.1
Leatherjackets	767,022	647,255	1,414,276	45.8
Luderick	663,221	333,072	996,293	33.4
Mackerels	471,671	270,773	742,444	36.5
Morwong	280,081	75,294	355,375	21.2
Mullet	2,910,892	963,040	3,873,932	24.9
Mulloway/jewfish	323,459	276,567	600,026	46.1
Murray cod	108,352	374,932	483,284	77.6
Other	1,133,427	2,969,030	4,102,457	72.4
Pike	608,117	126,356	734,473	17.2
Red emperor	228,600	487,685	716,284	68.1
Red mullet	145,601	84,658	230,259	36.8
Redfin perch	1,294,511	968,985	2,263,496	42.8
Redfish	176,846	195,583	372,429	52.5
Rock-cod/gropers	108,277	71,530	179,807	39.8
Scads/mackerel	474,670	250,198	724,868	34.5
Scorpionfish/gurnard	146,112	394,677	540,788	73.0
Sea perch/snappers	655,814	718,458	1,374,272	52.3
Sharks/rays	228,320	1,024,408	1,252,728	81.8
Pink snapper	1,287,826	2,535,955	3,823,780	66.3
Sweep	206,966	189,228	396,195	47.8
Tailor	2,308,352	1,410,814	3,719,166	37.9
Threadfin salmon	184,901	117,857	302,758	38.9
Trevally	995,131	632,387	1,627,518	38.9

Appendix 5.14. (cont)

Species group	Harvest	Released/discarded	Total catch	% released
Trout/salmon	824,558	868,297	1,692,856	51.3
Tuna/bonitos	232,350	120,879	353,229	34.2
Whiting	8,141,117	4,238,624	12,379,741	34.2
Wrasse/tuskfish/gropers	730,723	1,179,060	1,909,783	61.7
Yellowtail kingfish	114,053	137,079	251,132	54.6
Total	60,421,387	47,284,274	107,705,660	43.9
SMALL BAITFISH				
Herring/pilchards	770,804	109,377	880,181	12.4
Small baitfish	10,715,376	592,798	11,308,174	5.2
Total	11,486,181	702,175	12,188,355	5.8
CRABS & LOBSTERS				
Blue swimmer crab	3,905,057	2,703,920	6,608,977	40.9
Crabs (other)	709,869	253,521	963,389	26.3
Lobsters	686,431	658,781	1,345,212	49.0
Mud crab	819,886	1,759,843	2,579,729	68.2
Total	6,121,243	5,376,065	11,497,308	46.8
PRAWNS & YABBIES				
Crayfish (fw)	7,401,886	1,794,114	9,196,000	19.5
Macrobrachium/cherabin	1,231,459	207,299	1,438,758	14.4
Murray crayfish	163,646	387,402	551,047	70.3
Prawns (fw)	2,321,164	160,782	2,481,947	6.5
Prawns (sw)	16,467,469	531,748	16,999,217	3.1
Yabbies/nippers (sw)	20,082,936	2,421,639	22,504,575	10.8
Total	47,668,561	5,502,983	53,171,544	10.3
CEPHALOPODS				
Octopus	39,412	28,477	67,890	41.9
Squid/cuttlefish	1,724,540	67,536	1,792,076	3.8
Total	1,763,952	96,013	1,859,965	5.2
OTHER MOLLUSCS				
Abalone	386,214	68,063	454,277	15.0
Bivalves (other)	424,447	527	424,975	0.1
Mussels	1,408,650	8,553	1,417,203	0.6
Other	32,659	0	32,659	0.0
Oysters	139,548	0	139,548	0.0
Pippi/ Goolwa cockle	4,176,224	607,241	4,783,465	12.7
Razorfish	472,397	2,802	475,199	0.6
Scallops	211,547	17,420	228,967	7.6
Total	7,251,687	704,606	7,956,294	8.9
OTHER TAXA				
Other	53,671	30,717	84,388	36.4
Worms	1,140,304	24,375	1,164,679	2.1
Total	1,193,975	55,092	1,249,067	4.4

Appendix 5.15. Estimated mean weights (kg) for key recreational species in Australia by State or Territory.

[A] limited empirical data, 'best-guess' estimate; [B] estimate based on commercial catch data.

Species	NSW	VIC	QLD	SA	WA	TAS	NT	ACT
Whiting	0.220	0.220 [A]	0.120	0.210	0.106	0.107	0.160 [A]	
Flathead	0.400	0.180	1.100	0.263	0.545	0.262	0.500 [A]	
Australian herring		0.100 [A]		0.100	0.135			
Bream	0.350	0.400	0.333	0.394	0.341	0.639	0.400	
King George whiting		0.220		0.271	0.259			
Mullet	0.340	0.200 [A]	0.100 [A]	0.107	0.249	0.270	0.200 [A]	
Garfish	0.075	0.100	0.075	0.088	0.164	0.120 [A]	0.075 [A]	
Tailor	0.250	0.250 [A]	0.250		0.319	0.250 [A]		
Australian salmon	2.000	0.500		0.520 [A]	3.269	0.354		
Pink snapper	0.350	0.700	1.330	3.200 [B]	2.242	2.700		
Trevally	0.350	0.350 [A]	1.550	0.227	0.685	0.227 [A]	1.500	
Leatherjackets	0.280	0.300 [A]	0.280 [A]	0.259	0.670	0.438		
Wrasse/tuskfish/gropers	0.350	0.700 [A]	1.860	0.350 [A]	1.591	0.589	1.000 [A]	
Luderick	0.450	0.400 [A]	0.450 [A]	0.450 [A]		0.450 [A]		
Sea perch/snappers	0.890 [A]		0.890		0.694		0.900	
Emperors	1.790 [A]		1.790		1.193		0.600	
Mackerels	5.000		3.420		4.228		7.000	
Cod (various)	0.500	0.200 [A]	2.080	0.500 [A]	1.429	0.469	1.000 [A]	
Catfish	1.000 [A]	1.000 [A]	1.410	1.000 [A]	1.000 [A]		1.000 [A]	
Mulloway/jewfish	2.000	2.000 [A]	1.150	3.340	5.716		8.700 [B]	
Coral trout			2.030		2.777		1.000 [A]	
Morwong	0.750	0.750 [A]	0.750 [A]	2.000 [A]	3.426	1.183		
Tuna/bonitos	6.000		5.920	18.000 [A]	4.987	3.561	3.000 [A]	
Red emperor			4.450		3.685		1.500 [A]	
Kingfish/Samson fish	2.000	2.000 [A]	2.560	10.000 [A]	9.058	2.000 [A]		
Dhufish					5.618			
European carp	0.750 [A]	0.750 [A]	0.750 [A]	0.566				0.750 [A]
Redfin perch	0.250 [A]	0.250 [A]		0.250 [A]	0.350	0.250 [A]		0.250 [A]
Golden perch	0.600 [A]	0.600 [A]	1.210	1.050				0.600 [A]
Trout/salmon	0.500 [A]	0.500 [A]		0.500 [A]	0.450	0.730		0.500 [A]
Australian bass/perch	0.500 [A]	0.500 [A]	0.700					
Barramundi			2.610		3.500 [A]		3.500	
Murray cod	1.000 [A]	2.300 [A]		10.000 [B]				
Squid/cuttlefish	0.425	0.450 [A]	0.425 [A]	0.404	0.352	0.600		
Blue swimmer crab	0.375		0.333 [A]	0.342	0.223			
Mud crab	0.580		1.000		1.341		0.800	
Lobsters	0.700 [B]	1.200 [A]	0.700 [A]	0.840	0.500	0.840 [B]		
Abalone	0.300	0.300 [A]		0.483 [B]	0.141	0.480 [B]		
Prawns	0.010	0.010 [A]	0.010 [A]	0.010 [A]	0.017		0.010 [A]	
Crayfish (fw)	0.040	0.040 [A]	0.040 [A]	0.040 [A]	0.058		0.040 [A]	0.040 [A]

Appendix 5.16. Estimated annual attributed expenditure ($) by item type and by State or Territory of residence for recreational fishers aged 5 or older.

Based on $0.50 per kilometer charge; NEC – not elsewhere classified; se is standard error; rse is relative standard error

ITEM	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	TOTAL
Accommodation	17,736,337	13,015,854	6,264,933	2,925,587	8,346,290	687,322	230,819	1,126,545	50,333,687
Airfares	3,780,784	9,323,954	692,779	687,569	1,287,615	163,693	240,853	116,889	16,294,137
Bait/berley	11,983,530	8,334,935	8,214,433	3,768,280	6,983,608	361,347	367,832	562,748	40,576,712
Boat ramp fees	87,282	533,172	80,545	288,814	359,349	1,350	26,780	11,345	1,388,636
Boat/ trailer - insurance	12,769,662	8,943,950	8,726,820	4,764,621	10,511,670	2,021,936	815,933	250,858	48,805,450
Boat/ trailer - registration fees	10,272,408	5,711,687	14,576,570	4,135,223	5,625,816	1,245,643	287,124	280,796	42,135,266
Boat-capital	194,995,610	78,084,769	89,741,121	49,483,438	116,785,585	11,476,795	9,823,624	1,126,131	551,517,074
Boat-charter	21,256,505	4,734,189	3,635,426	1,289,937	3,723,576	224,748	414,275	246,392	35,525,047
Boat-fuel/oil	13,233,927	11,858,019	11,350,385	4,451,249	19,794,166	2,160,012	1,749,079	388,036	64,984,873
Boat-hire	5,345,368	10,717,750	2,019,354	349,284	1,369,731	65,492	578,072	267,273	20,712,324
Boat-maintenance	38,983,437	25,514,606	21,988,781	4,473,226	29,663,591	3,492,937	1,631,336	362,531	126,110,446
Boat-mooring fees	1,172,448	1,101,681	2,865,231	643,481	2,126,614	118,919	5,649		8,034,023
Books/magazines	1,190,389	1,066,714	926,716	510,215	570,698	105,093	21,306	51,184	4,442,314
Camping gear - hire		1,282			4,321	14,757			20,359
Camp gear - maintenance	2,206,727	2,155,199	791,260	394,540	6,201,075	143,631	9,895	309,352	12,211,679
Camp gear - registration/ insurance	3,906,214	2,921,271	1,511,795	812,346	1,236,972	233,090		101,203	10,722,890
Camp gear -capital	30,121,433	25,303,625	19,078,796	12,410,349	19,238,770	2,883,304	511,953	1,469,868	111,018,099
Car-capital	10,579,984	11,618,163	2,282,515	569,150	9,570,963	1,044,148	48,652	465,793	36,179,368
Car-hire	307,363	526,081	13,958	28,053	324,624				1,200,080
Car expenses#	103,287,001	87,345,958	62,918,484	39,102,549	53,784,084	14,432,461	5,590,590	9,091,923	375,553,050
Clothing/ apparel	6,509,109	9,467,691	4,573,848	1,782,065	1,584,164	1,066,161	121,183	496,977	25,601,198
Dive - air fills				38,861	200,680	35,738	346		275,624
Dive equipment - capital	649,951	6,651	796,304	160,006	2,995,602	461,881	1,392		5,071,787
Dive equipment - hire				61,550	7,476	26,274			95,300
Dive equipment - maintenance				266,344		8,444			274,788
Fees-club	918,131	567,481	578,059	500,661	953,676	77,726	67,894	41,483	3,705,111
Fees-fishing competition	366,976	220,765	685,763	91,224	353,578	29,702	747,625		2,495,633

Appendix 5.16. (cont)

ITEM	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	TOTAL
Fees-fishing licence	4,783,173	4,482,315	768,446	305,338	1,409,919	1,352,601	18,648	348,349	13,468,790
Fuel - other (not boat or car)			14,830	731	38,567	8,027	157		62,313
Ice	255,809	106,687	562,834	101,495	497,470	2,356	83,886	14,609	1,625,145
Information costs - other	20,497		20,348	101,418	6,944	25,025	1,362	42,742	218,336
Other access costs	271,478	2,677,353	246,474	61,654	280,456	73,058	46,100	37,954	3,694,528
Other travel costs	147,005	254,643	911,213	332,526	223,427	90,454	7,468		1,966,735
Other expenditure (NEC)	2,700,028	34,723,492	8,940,178	1,300	17,443	11,620	33,311	9,832	46,437,206
Other equipment (NEC) - capital	65,169	441,541	136,159	222,394	73,255	25,611	62,005	17,033	1,043,167
Other equipment (NEC) - hire					703				703
Other equipment (NEC) - maintenance			1,902			622			2,524
Other govt. Licence fees (boat drivers, radio)	2,383,001	297,632	457,341	54,487	202,837	64,768	28,065	83,146	3,571,277
Safety gear (NEC) - life jackets, flares	905,308	1,655,637	2,309,978	1,422,142	1,950,029	3,178,246	288,718	28,525	11,738,583
Tackle - hire	586		1,655	2,615	1,132,322				1,137,177
Tackle-capital	36,662,231	13,702,882	29,040,107	8,202,283	15,760,712	3,023,281	1,372,587	1,472,483	109,236,564
Tackle-maintenance	809,311	1,040,985	1,066,224	235,170	1,025,816	48,654	162,697	62,658	4,451,514
Tackle-terminal	8,657,706	8,023,513	7,489,497	2,138,409	3,460,320	981,302	634,409	464,421	31,849,577
Trailer-capital	2,768,428	1,997,630	1,654,425	604,915	7,378,193	222,766	377,425	2,806	15,006,587
Trailer-maintenance	2,114,126	7,788,292	1,632,816	708,886	1,318,773	143,465	294,647	6,885	14,007,892
Total	**554,204,435**	**396,268,047**	**319,568,305**	**148,484,385**	**338,381,480**	**51,834,458**	**26,703,695**	**19,358,773**	**1,854,803,576**
se	66,103,715	37,549,299	23,463,189	14,061,748	45,215,059	4,966,010	3,457,329	3,244,819	92,840,992
rse	11.9%	9.5%	7.3%	9.5%	13.4%	9.6%	12.9%	16.7%	5.0%

Appendix 5.17. Importance ratings for reasons to do with recreational fishing motivation (% of respondents) by State or Territory of residence.

Motivation/importance	NSW	VIC	QLD	SA	WA	TAS	NT	ACT	TOTAL
Relax and Unwind									
Very Important	65.8	66.6	61.5	55.8	60.3	51.7	62.7	61.3	62.6
Quite Important	25.2	28.5	22.8	30.6	31.1	35.6	31.2	31.8	27.2
Not Very Important	7.9	4.6	10.6	10.5	7.0	10.3	4.9	5.2	8.0
Not at all Important	1.1	0.3	5.2	3.0	1.4	2.4	0.8	1.7	2.2
Unsure	0.0	0.0	0.0	0.1	0.2	0.0	0.4	0.0	0.0
To be Outdoors									
Very Important	62.9	60.3	51.9	51.5	59.2	57.6	65.4	67.4	58.2
Quite Important	30.5	33.1	33.2	38.1	34.5	35.1	31.1	28.6	33.1
Not Very Important	6.0	5.1	9.7	7.0	5.2	6.5	2.9	4.0	6.6
Not at all Important	0.6	1.4	5.2	3.3	1.1	0.8	0.2	0.0	2.1
Unsure	0.0	0.0	0.0	0.1	0.0	0.0	0.4	0.0	0.0
For Solitude									
Very Important	15.7	20.8	20.6	19.5	18.9	14.6	15.6	18.5	18.6
Quite Important	24.9	23.9	16.7	22.9	24.8	24.3	27.6	22.4	22.6
Not Very Important	44.1	35.0	17.4	34.1	42.6	38.9	36.3	46.0	34.9
Not at all Important	15.1	20.2	45.3	23.4	13.6	22.3	20.0	13.1	23.8
Unsure	0.3	0.1	0.0	0.1	0.0	0.0	0.5	0.0	0.1
To be with Family									
Very Important	36.3	38.2	38.1	38.8	44.1	39.6	31.1	44.4	38.6
Quite Important	32.6	32.0	25.9	25.7	28.0	31.5	29.5	27.8	29.5
Not Very Important	24.7	20.2	10.6	18.3	17.7	20.1	29.1	22.6	18.9
Not at all Important	6.0	9.6	25.4	16.7	10.1	8.7	10.3	5.2	12.9
Unsure	0.4	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.2
To be with Friends									
Very Important	31.6	38.2	27.1	33.6	34.8	24.9	24.1	44.7	32.3
Quite Important	44.6	39.0	36.2	41.1	44.8	41.7	52.3	29.8	41.1
Not Very Important	19.6	14.8	14.4	15.9	15.9	25.5	20.9	20.5	16.9
Not at all Important	4.1	8.1	22.3	9.3	4.5	7.8	2.6	5.0	9.7
Unsure	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Competitions									
Very Important	1.9	1.6	1.9	1.4	0.8	1.1	1.1	3.7	1.6
Quite Important	4.2	4.4	2.3	2.3	3.5	1.9	4.6	1.1	3.4
Not Very Important	16.1	10.6	3.1	10.6	12.1	10.8	21.6	17.3	10.9
Not at all Important	77.1	83.4	92.8	85.3	83.1	86.1	71.9	77.9	83.7
Unsure	0.7	0.1	0.0	0.4	0.5	0.1	0.8	0.0	0.3
Fish for Sport									
Very Important	49.9	49.9	50.2	41.8	46.9	37.2	29.5	52.0	48.0
Quite Important	31.7	37.4	29.6	40.4	36.4	40.9	45.4	29.0	34.3
Not Very Important	13.8	8.8	10.7	12.8	13.2	15.5	16.9	15.2	12.1
Not at all Important	3.8	3.9	9.6	4.9	3.4	6.3	7.6	3.8	5.3
Unsure	0.8	0.0	0.0	0.1	0.1	0.1	0.6	0.0	0.3
Fish for Food									
Very Important	29.2	29.7	35.4	32.1	44.6	26.1	20.3	24.6	32.8
Quite Important	25.6	27.5	26.1	31.7	32.4	34.9	28.9	31.7	28.1
Not Very Important	34.4	31.2	13.2	24.1	16.9	30.9	30.5	27.9	25.3
Not at all Important	10.3	11.7	25.4	12.1	6.1	8.1	19.7	15.8	13.7
Unsure	0.5	0.0	0.0	0.1	0.0	0.0	0.5	0.0	0.2

Appendix 6.1. Annual fishing effort, expressed as household fishing days, person fishing days and person fishing events for indigenous fishers, aged 5 years or older, in northern Australia by State or Territory.

Fishing effort	QLD	WA	NT	TOTAL
Person Events	137,570	94,983	438,620	671,174
%	20.5	14.2	65.3	100.0
Person Days	106,792	67,103	245,698	419,592
%	25.4	16.0	58.6	100.0
Household Days	48,229	25,410	61,935	135,574
%	35.6	18.7	45.7	100.0

Appendix 6.2. Annual fishing effort (fishing events) by water body type for indigenous fishers, aged 5 years or older, in northern Australia by State or Territory.

	Effort (no. events				
Water body type	QLD	WA	NT	TOTAL	%
Offshore	6,550	1,566	1,183	9,300	1.4
%	4.8	1.6	0.3	1.4	
Inshore	80,466	24,399	265,303	370,167	55.2
%	58.5	25.7	60.5	55.2	
Coastal	37,270	17,002	49,193	103,464	15.4
%	27.1	17.9	11.2	15.4	
Rivers	11,060	42,138	74,135	127,333	19.0
%	8.0	44.4	16.9	19.0	
Lakes/Dams	2,224	9,879	48,807	60,909	9.1
%	1.6	10.4	11.1	9.1	
Total	**137,570**	**94,983**	**438,620**	**671,174**	
%	100.0	100.0	100.0	100.0	

Appendix 6.3. Annual fishing effort (fishing events) by fishing method for indigenous fishers, aged 5 years or older, in northern Australia by State or Territory.

	Effort (no events)				
Method	**QLD**	**WA**	**NT**	**TOTAL**	**%**
Lines - bait	82,423	61,640	168,861	312,925	46.6
Lines - lure/jig/fly	11,532	977	12,197	24,707	3.7
Lines - both	1,179	1,123	15,306	17,608	2.6
Lines - set (passive)	318			318	0.0
Total	**95,453**	**63,740**	**196,365**	**355,557**	**53.0**
%	69.4	67.1	44.8	53.0	
Pot/trap - pass	2,375		1,060	3,435	0.5
%	1.7	0.0	0.2	0.5	
Net - cast	6,152	20,472	38,962	65,586	9.8
Net - drag/seine	6,715	1,117	4,350	12,181	1.8
Net - gill/set	1,314	937	233	2,484	0.4
Net - scoop/push	398			398	0.1
Total	**14,578**	**22,526**	**43,545**	**80,649**	**12.0**
%	10.6	23.7	9.9	12.0	
Spearfishing - diving	526	367		893	0.1
Other spearfishing - surface	13,604	3,482	41,224	58,311	8.7
Total	**14,131**	**3,849**	**41,224**	**59,204**	**8.8**
%	10.3	4.1	9.4	8.8	
Other diving - scuba/surf/air	194			194	0.0
Other diving - snorkel	207			207	0.0
Total	**401**	**0**	**0**	**401**	**0.1**
%	0.3	0.0	0.0	0.1	
Pump/rake/spade	370	2,144	46,412	48,926	7.3
Other hand collecting	10,262	2,725	107,008	119,995	17.9
Other			3,007	3,007	0.4
Total	**10,632**	**4,869**	**156,427**	**171,928**	**25.6**
%	7.7	5.1	35.7	25.6	
GRAND TOTAL	**137,570**	**94,983**	**438,620**	**671,174**	
%	100.0	100.0	100.0	100.0	

Appendix 6.4. Annual fishing effort (fishing events) by fishing platform (boat/ shore) for indigenous fishers, aged 5 years or older, in northern Australia by State or Territory.

	Effort (no. events)			
Fishing platform	**QLD**	**WA**	**NT**	**TOTAL**
Boat	28,298	6,319	30,980	65,597
%	20.6	6.7	7.1	9.8
Shore	109,272	88,665	407,640	605,576
%	79.4	93.3	92.9	90.2
Total	**137,570**	**94,983**	**438,620**	**671,174**
%	100.0	100.0	100.0	100.0

Appendix 6.5. Annual fishing effort (fishing events) by fresh or saltwater for indigenous fishers, aged 5 years or older, in northern Australia by State or Territory.

	Effort (no. events)			
Water type	**QLD**	**WA**	**NT**	**TOTAL**
Freshwater	13,284	52,017	122,941	188,242
%	9.7	54.8	28.0	28.0
Saltwater	124,286	42,966	315,679	482,932
%	90.3	45.2	72.0	72.0
Total	**137,570**	**94,983**	**438,620**	**671,174**
%	100.0	100.0	100.0	100.0

Appendix 6.6. Annual harvest (numbers) of aquatic organisms by indigenous fishers, aged 5 years or older, in northern Australia by State or Territory.

	Harvest (numbers)			
High level grouping	**QLD**	**WA**	**NT**	**Total**
Finfish	346,404	198,178	369,298	913,880
Small baitfish	74,557	7,951	15,314	97,822
Crabs & Lobsters	29,004	19,274	132,686	180,965
Prawns & yabbies	133,434	512,808	9,200	655,442
Molluscs (shells)	122,844	46,730	979,872	1,149,446
Miscellaneous taxa	15,267	4,378	73,615	93,260
Total	**721,511**	**789,320**	**1,579,984**	**3,090,815**

Appendix 6.7 Annual harvest (numbers) of key species/ species groups by indigenous fishers, aged 5 years or older, in northern Australia by State or Territory.

	Harvest (numbers)			
Species/ species group	**QLD**	**WA**	**NT**	**Total**
Mullet	68,573	30,415	83,277	182,265
Catfish	21,738	26,920	60,831	109,489
Sea perch/snappers	38,200	18,645	27,588	84,434
Bream	44,205	9,387	17,876	71,469
Barramundi	5,745	13,318	44,134	63,197
Grunters/trumpeters	15,116	33,938	8,195	57,249
Trevally	21,494	10,369	8,241	40,104
Threadfin salmon	11,950	8,980	8,565	29,495
Wrasse/tuskfish/gropers	9,181	11,301	8,778	29,260
Garfish	26,169			26,169
Whiting	19,879	5,450	770	26,099
Cod (various)	11,679	2,748	4,254	18,681
Sharks/rays	3,819	2,011	12,464	18,294
Australian bass/perch	612	1,205	12,789	14,606
Emperors	9,268	3,417	612	13,297
Coral trout	7,004	79	792	7,875
Rock-cod/gropers		4,530		4,530
Red emperor	1,207	90	3,210	4,508
Mackerels	2,382	424	1,416	4,222
Butterfish	2,189	1,072		3,261
Flathead	2,384	168	0	2,552
Tuna/bonitos		335	1,420	1,755
Pike	972	148	467	1,586
Redfish	795	543		1,338
Mulloway/jewfish	366		568	934
Eels	869			869
Pink snapper	726			726
Leatherjackets	176	543		719
Australian salmon		641		641
Dart	207			207
Yellowtail kingfish		148		148
Blue mackerel		132		132
Tailor	97			97
Luderick	80			80
Scads/mackerel		72		72
Other	19,321	11,148	63,051	93,520
Finfish Total	**346,404**	**198,178**	**369,298**	**913,880**

Appendix 6.7. (Cont.)

Species/ species group	Harvest (numbers) QLD	WA	NT	TOTAL
Herring/pilchards	3,545	2,866		6,411
Small baitfish	71,012	5,085	15,314	91,411
Small Baitfish Total	**74,557**	**7,951**	**15,314**	**97,822**
Blue swimmer crab	882	592	646	2,119
Crabs (other)	2,345	9,668	44,146	56,159
Lobsters	12,903		1,321	14,224
Mud crab	12,874	9,015	86,573	108,462
Crabs/ Lobsters Total	**29,004**	**19,274**	**132,686**	**180,965**
Crayfish (freshwater)	2,276		4,220	6,496
Macrobrachium/cherabin		512,413	4,101	516,514
Prawns (saltwater)	131,158	395	880	132,432
Prawns/ Yabbies Total	**133,434**	**512,808**	**9,200**	**655,442**
Bivalves (other)		17,264	215,586	232,850
Mussels	3,499	1,834	581,126	586,459
Oysters	34,615	22,995	56,389	113,999
Pippi/ Goolwa cockle	71,607			71,607
Other	13,124	4,637	126,770	144,531
Shellfish Total	**122,844**	**46,730**	**979,872**	**1,149,446**
Crocodile	0	388	0	388
Dugong	1,293	30	296	1,619
Turtle eggs	3,976	1,051	37,282	42,309
Turtle - longneck	1,214	289	2,454	3,957
Turtle - saltwater unspec.	3,851	979	1,624	6,455
Turtle - shortneck		96	896	992
Turtle - freshwater unspec.	3,243	1,496	9,765	14,504
Non-fish - other	1,690	49	6,937	8,675
Worms, mangrove	0	0	14,361	14,361
Miscellaneous Total	**15,267**	**4,378**	**73,615**	**93,260**

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