

The Australian National Recreational Fishing Survey: 2000-01

David Campbell, Laurie West, Jeremy Lyle, David McGlennon, Anne Coleman, Gary Henry, and Dennis Reidⁱ

Abstract: The survey, commencing in May 2000, is the first broad based national recreational fishing survey of its kind in Australia. While primarily designed to provide biologic and fisher participant data, it provides a platform for the collection of data applicable to economic policy questions.

The survey methodology is based on a nation wide random selection of households for which base data is collected. Those in the household indicating their likely participation in fishing over the coming twelve months are invited to join the recreational fishing survey. These participating in the longitudinal survey are interviewed over the twelve months of the survey by telephone using the Kewagama Research respondent facilitation diary methodology. The offsite survey is supported with on-site creel surveys to verify participant responses throughout the duration of the survey.

Because the primary focus of the survey is the collection of biological and fishing data, it is not always possible to link economic data to a particular fishing activity, species or fishing site. The economic data is identified according to whether it is 'at home' or 'away from home' expenditure, the economic zone in which the expenditure has occurred and the proportion of expenditure attributable to recreational fishing activity. The aim in limiting the economic data in this manner is to ensure the provision of robustness data over the full range of the national survey. The economic and behavioural data to be provided by the survey will be constructive input to important to policy issues concerning the assessment and the use of fish, marine, coastal and inland water resources.

David Campbell: DCafe, dcampbell.fish@bigpond.com; Laurie West: Kewagama Research, Kewagama@dynamite.com.au; Jeremy Lyle, Tasmanian Aquaculture and Fisheries Institute, University of Tasmania, Jeremy.Lyle@itas.edu.au; David McGlennon (then South Australian Fisheries), the.mcglennons@yahoo.com; Anne.Coleman@dpif.nt.gov.au; Gary Henry, New South Wales Fisheries, henryg@fisheries.nsw.gov.au; Dennis Reid, New South Wales Fisheries, reidd@fisheries.nsw.gov.au.

Introduction

Australian fish resources support a range of commercial and recreational fishing activities of varying economic and social value. Commonwealth, State and Territory governments have a responsibility to manage these resources for the long-term prosperity and wellbeing of the community. While scientific, catch, value and fishery status data exists for commercial fisheries (eg. ABARE 1999, ABARE 2000, BRS 2000), there is no equivalent and ongoing broad based national data set for recreational fisheries. A one of exception was the study by in by PA Management Consultants (1983) that provided national estimates recreational fishing participation rates, fisher demographic information and economic impact assessment. However, there were questions in regard to the sample data not being representative to the national population, while the economic impact assessment included non-fishing elementsⁱⁱ.

A step to addressing the shortfall in recreational fisheries information was taken in 1992 with the establishment of the Australian National Recreational Fishing Working Group (NRFWG) by the Australian, New Zealand Fisheries and Aquaculture Ministerial Council. The

Working Group, which was made up of members from a range of sectoral interests, tabled two reports on issues and future directions on recreational fishing before the Ministerial Council later that same year (National Recreational Fishing Working Group 1992 a, 1992b). The reports were distributed to the wider public for comment. The public comments were revued and amalgamated by the National Recreational Fishing Steering Committee (National Recreational Fishing Steering Committee 1993), including the inclusion of the results of an unstructured survey (Lubulwa and Parameswaran 1993). This led to the establishment of a national policy statement setting out the goals and principles for a national recreational fishing policy (National Recreational Fishing Working Group 1994).

Three principles in the policy document important to the national survey are:

- *Recreational fishing should be managed as part of the total fisheries resource to ensure quality fishing, and to maintain fish stocks and their habitats for present and future generations.*

- *Recreational fishers are entitled to a fair and reasonable share of Australian fish resources taking into account long-term sustainable yields; the rights and entitlements of others; and the need to optimise community returns from available stocks.*
- *Fisheries management decisions should be based on sound information including fish biology, fishing activity, catches, and the economic and social values of recreational fishing (p3).*

Public concern with the poor quality of available data on recreational fishing has emphasised the need to ensure the need for robust and reliable data. This was important in methodology selection, survey design and the training of staff.

A National Recreational Fisheries Steering Committee was formed in 1995 to assess the feasibility, direction and implementation of a national survey. Following identification of output needs, and consultant advice, the

Steering Committee recommended a national survey with *Kewagama Research*, as the principle consultant.

This paper provides a review of the methodology being used in the national survey and the possible policy issues to which the data might be applied. While biological and catch behavioural data were given prime importance in the study design, a wide range of policy relevant economic data was also included in the study design.

Methodology selection

The methodology accepted for the national survey is based on the use of telephone interviews, and follows developments from experience gained by *Kewagama Research* following the application of their methodology in the Northern Territory in 1994-96 (Coleman 1998), Tasmania in 1996-98 (Lyle 2000) and South Australia in 1998-99 (McGlennon 1999). The response rates in these three studies indicate the strength of the methodology with screening survey response rates of 86 per cent, 96 per cent and 95 per cent and respective longitudinal interview/diary uptake rates of 90 per cent, 97 per cent and 97 per cent.

Table 1: Design and Validation Methods to Ensure Data Quality

| | |
|---|--|
| Non-coverage bias | <ul style="list-style-type: none"> • Comparisons with secondary data sets (e.g. population census information) are made to assess sample representation (e.g. socio-demographics). • Behaviour (catch rates, avidity) of non-phone owners and owners of unlisted numbers are compared with directory listed respondents through creel surveys. |
| Non-response bias | <ul style="list-style-type: none"> • Survey approach results in very high response rates, thereby minimizing impacts of non-response. • Non-response follow-up is undertaken to assess possible behavioural differences. |
| Recall bias | <ul style="list-style-type: none"> • Minimized through survey design with frequent contact with respondents, low respondent burden and the use of a 'memory jogger' diary system. |
| Prestige bias | <ul style="list-style-type: none"> • Reporting accuracy is enhanced through strong rapport between respondent and interviewer, survey objectives are carefully explained to respondents and standardized neutral questioning is used. • Limited validation (zero catches and catch rates) is achieved through creel surveys (refer to figures) |
| Other response biases and behavioral 'shifts' (e.g. where intervention of the study might cause increased fishing activity) | <ul style="list-style-type: none"> • As for prestige bias • Careful respondent briefing in terms of 'normal' fishing activity, i.e. no more or less often than would have occurred in the survey period, plus neutral reinforcement by the interviewer, especially during periods of nil activity. |
| Species identification | <ul style="list-style-type: none"> • Species show cards are provided to assist respondents with species identification. • Identification skills are assessed through creel surveys. |

From Lyle, Coleman and West (2000).

The underlying design philosophy is focused on minimising respondent burden and addressing response biases and other sources of non-sample error through comprehensive field and office quality control and validation measures, as shown in table 1. Ensuring simplicity for the respondents transfers a substantial responsibility to the interviewer, who, in turn, underwent careful staff recruitment, and for whom supportive training and management are vital (Lyle, Coleman and West 2000).

While the approach used in the national survey is expensive, it has a number of strengths over alternative methodologies and has been shown to provide a representative and extensive data set. Because the approach allows the collection of all substantive data using a single methodology, many of the problems with complimentary surveys such as data compatibility links, are avoided.

Survey structure

Scope

The primary focus of the survey is to collect nationally consistent and comparable fishery statistics (fishing effort, fish catch, catch rate, species composition and size, participation), demographic information for fishers (age, gender, labour force participation), economic expenditure data and attitudinal data. Those resident in continental Australia over five years of age and likely to participate in recreational fishing in the twelve months following the screening survey are included in the survey population. The geographic distribution includes all fresh and marine waters abutting or within continental Australian.

Sampling strategy

Sample design is based on a single-stage sampling procedure with the household as the primary sample unit and each of the fishers within the household as the secondary unit. The sampling frame used for the study is the national 'white pages' telephone directory (electronic version), which is used as a proxy for a national household listing. A cluster sampling design is used to select households for the screening survey, as this provides through a single contact the correct weighting for single and multiple fisher households, in addition to multiple fisher data. Those household members identified as an 'intending fisher' are invited to take part in the second phase 12 month diary survey, including the two month supplementary survey and follow-up interview. The set of eligible fishers is selected for the longitudinal phase of the survey.

Allocation of the total gross sample of households to the individual States/Territories is based on the general principle of obtaining estimates of harvest and effort at comparable levels for the lowest level of geographical

aggregation for each State/Territory. For initial data selection this was assumed to be the Australian Bureau of Statistics' statistical division, or where the population size is too small at this level, a combination of statistical divisions. Estimates at differing levels may also be obtained for the regional economic zones or fishing regions, as defined in the survey.

Sampling for the *on-site creel* surveys is determined by each State/Territory to maximise the effectiveness of the data collected. Spatial and temporal stratification is undertaken within the time allocated to each State/Territory to ensure the creel data is compatible with the 12 months of survey data.

Components

There are six components to the national recreational fishing survey:

- Screening survey.
 - The screening survey is used to make initial contact to the sample households.
 - Household demographic data (age, gender, household size, labour force status, education, ethnicity/aboriginality) is collected.
 - The demographic data allows an assessment of how representative the sample is by comparison with Australian Bureau of Statistics data, and provides demographic data for fishers.
 - Data is collected on whether anybody in the household participated in recreational fishing in the last twelve months, current fishing club membership, fishing licence holder and boat ownership data, eg, length and engine, use, irrespective of participation in recreational fishing.
 - Those in the household over five years of age identified as likely to take part in recreational fishing in the next 12 months are asked to participate in the 12 month longitudinal telephone/'diary' survey and are referred to as 'diarists'.
- Telephone/'diary' survey.
 - The telephone/diary survey provides the primary data source and is the core of the national survey. While the screening survey is initiated on a household basis, telephone/diary data and subsequent finishing interview data are collected on a diarist basis.
 - A survey kit is forwarded to each participating household. This contains a covering letter, a species identification booklet and a fishing diary for each intending fisher. As data is collected from co-operators is by telephone, the diary is a memory aid.
 - Detailed fishing and fishing behavioural data (fishing region, target species, fishing method,

fishing effort including time spent and units of gear, fishing platform) is obtained. Fishing related expenditure data is collected (expenditure item, economic zone expenditure occurred in, amount attributable to fishing) as occurred during a fishing trip or as a separate event to a fishing trip.

- Participants are contacted every three to four weeks or more often as required, by the same interviewer.
- Supplementary questions.
 - Additional expenditure information is collected on a moving one-sixth sample of the households for a two-month period to provide additional expenditure coverage for the whole 12 months of the telephone/diary component.
 - This data is collected as supplementary questions in the telephone/diary survey and will collect data on all expenditure on food and drink, private vehicle fuel and oil and expenditure on vehicle repair and maintenance that occurs a distance of more than 40 kilometres by road away from home by road on a fishing related trip.
- On-site creel surveys.
 - Creel surveys are being used to assess the ability of recreational fishers to identify fish according to species and to determine the size distribution of common species (size data is not being collected in the survey). On-site and diary data are standardised where possible.
 - This data is also used to validate species recognition and to validate catch rates
- Finishing interviews at the end of the survey period.
 - Diary respondents will be asked to provide attitudinal information and including one-off expenditure information on items such as boat and fishing licences and boat insurance.
- Other data sources.
 - To minimise respondent burden and mitigate non-cooperation, income data was excluded from the survey. Australian Bureau of Statistics income data will be amalgamated with the survey data according at the level of the Australian Bureau of Statistics statistical division on the basis of the demographic and employment data collected in the screening survey. Additional economic information on vehicle running costs will be obtained from the National Motor Association.

Excepting for the creel survey and 'other data sources', all data is collected using telephone interviews. The screening and telephone/'diary' survey questionnaires were pilot tested prior to the survey.

Data links

Two types of events are accounted for in the national recreational fishing survey, these are 'fishing behavioural events' and 'expenditure events'. A fishing/behavioural event is any non-commercial harvesting or attempted harvesting of aquatic fauna and an expenditure event is any expenditure that is attributable to a recreational fishing event.

These different types of events are further split to provide increased detail and links between data variables. For example, the estimation of secondary data, such as catch by species per unit of fishing effort, can be estimated due to data splits between targeted species and fishing the fishing method used.

Splits between fishing events occur in the diary survey when there are changes in the:

- fishing region: occur on a geographic basis and are usually defined according to the boundaries of a particular catchment;
- fishing sub region, occur according to the characteristics of the fishing region such as whether offshore, inshore, eustary, ... ;
- fish species being target; and
- fishing method used.

Expenditure events may be collected independently of or in association with recreational fishing events. Expenditure is entered as a separate event if there is no associated fishing event, as might occur with a lunchtime purchase of a fishing lure, but is included with a fishing event when it occurs on a trip involving recreational fishing. In such cases, expenditure data might be entered on the last event sheet of the day or weekend, or, depending on the nature of the trip, expenditure might be pooled over several days and included on the last event sheet for that period - as long as the period did not go into a new calendar month, in which case expenditure would be pooled to the last event sheet for the month.

Splits in economic events occur:

- according to economic zones, while analogous to the fishing region, may contain one or more fishing regions. The economic zones are made up of an amalgam of Australian Bureau of Statistics statistical units;
- when the timing of a fishing trip extends into the next calendar month; and
- if it is food/drink, fuel/oil, or vehicle repairs collected as supplementary questions in the telephone/diary survey. In which case it is collected on the basis of family expenditure, rather than diarist expenditure:

- . according to whether it is 40 kilometres or less by road away from home (home expenditure), or
- . according to whether it is in excess of 40 kilometres by road away from home (away expenditure).

Direct links do exist between expenditure data and the items and services purchased, the economic zone it occurred in, the home area of the recreational fisher and the fisher's socio-demographic-income characteristics. In addition, that proportion of expenditure attributable to participation in recreational fishing is identified. In addition, and depending on the nature of the fishing trip and the economic characteristics of the item on which expenditure occurred, it might be possible to *assume* a causative link between expenditure and recreational fishing behaviour. For instance, all fishing in the New South Wales Southern Alps is likely to be trout fishing, regardless of the sub-region (lake or stream) or fishing method used (bait or lure). However, it was not possible to obtain explanative links between different forms of fishing behaviour and fishing expenditure without placing an excess burden on respondents and possibly affecting data quality.

Behavioural events can be located according to the fishing region in which they occurred and aggregated up to larger aggregations of Australian Bureau of Statistics statistical units. Economic expenditure can be expanded according to the economic zone in which they occurred, while behavioural events and economic expenditure can be expanded to the State or Territory in which they occurred and eventually to the national level. The national survey will provide a national set of comparable recreational fishing behavioural patterns that may be examined according to species targeted, species caught, fishing effort, location, the characteristics of recreational fishing participants and their fishing behaviour.

The decision was made to not explicitly collect data to estimate the unit value recreational fishers might place on fish caught. The reasons for this decision are discussed in attachment A.

Attribution of expenditure

Recreational fishing as a form of recreation, occurs as a result of an individual's desire to experience other places, other people and other behaviour or deeds. In most instances it occurs as a tourist activity involving the consumption of commodity and environmental services by people who travel to destinations away from their normal place of accommodation or workⁱⁱⁱ (Corcoran, Allcock, Frost and Johnston, 1998). A trip including recreational fishing might involve an individual or a group and it might be for the sole purpose of recreational fishing or for a range of recreational activities in addition

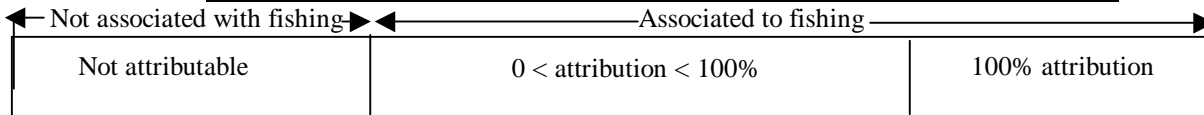
to fishing. These additional activities could include visiting relatives, touring, walking, boating, swimming, socialising, camping and sightseeing. Alternatively, the trip might involve work related activities in addition to recreational fishing.

To advocate all economic activity or expenditure on a recreational trips involving recreational fishing would result in an overestimate of the economic impact and the relative importance of recreational fishing relative to other recreational activities. To overcome this, a qualifying coefficient or weighting to estimate that proportion of expenditure *attributable* to recreational fishing is obtained.

The level of attribution will differ depending on the characteristics of the activity in which the item or service is an input. Some items, such as fishing rods and lures, are 100 per cent attributed to recreational fishing, while other inputs, such as a boat or dingy, might be used for recreational fishing in one instance, while being used for water skiing in another instance. While all these examples involve capital cost items, expenditure can still be an input to joint outputs even when expenditure is a marginal cost item. For instance, accommodation and fuel costs may be inputs to a trip that involved a round of golf as well as recreational fishing. In addition, even if expenditure on an item, such as a fishing rod, is wholly attributable to recreational fishing, use of that item may, over time, be used in a number of recreational fishing events at different times in which the species targeted or caught may also differ.

With expenditure for items or services that are joint inputs and not 100 per cent attributable to recreational fishing, diarists are asked to identify the proportion of *their* expenditure that they attribute to recreational fishing. It is carefully explained to respondents that all activities by all people associated with the expenditure are taken into account in making this assessment. Attribution, in this case, is on the basis of the respondent's assessment of their own expenditure and the use made by everybody on that trip of the goods purchased. It was considered that a behaviourally based assessment of attribution would provide a more consistent measure than one based on expected outcomes, even though expenditure decisions normally occur on the basis of expected benefits.

The relative attribution relationship is shown in figure 1, where 'Not attributable' includes expenditure on items such as golf, '0 < attribution < 100%' is for items that are linked to or are a an 'imperfect compliment' to the fishing activity, and '100% attribution', while linked are fully attributable to recreational fishing and are a 'pure compliment' with catching fish.

Figure1: Relative Relationship of Expenditure Between Linkage and Attribution**Table 2: Source, Type and Policy Relevance of Economic Data a**

| | Expenditure items | Economic characteristics | Attribution | Policy | | |
|-------------------------|--------------------|--------------------------|-------------|----------------------|------------------|--------------|
| | | | | Regional expenditure | | Fishing gear |
| | | | | Home expenditure | Away expenditure | |
| Screening survey | Fishing gear owned | Capital | 1 | | | X |
| | boats owned | capital | <1 | | | X |
| Primary survey | rods | capital | 1 | X | X | X |
| | reels | capital | 1 | X | X | X |
| | other tackle | capital | 1 | X | X | X |
| | bait/burley | variable | 1 | X | X | X |
| | ice | variable | ≤1 | X | X | |
| | publications | annual | 1 | X | X | X |
| | boat purch'd | capital | ≤1 | X | X | |
| | bt maint'nce | annual | ≤1 | X | X | |
| | bt insurance | annual | ≤1 | X | | |
| | bt mooring | annual | ≤1 | X | X | |
| | bt fuel/oil | variable | ≤1 | X | X | |
| | boat hire | variable | ≤1 | X | X | |
| | boat charter | variable | ≤1 | X | X | |
| | trailer | capital | ≤1 | X | X | |
| | trl maint'nce | annual | ≤1 | X | X | |
| | trl ins/reg | annual | ≤1 | X | | |
| | car hire/ch | variable | ≤1 | X | X | |
| | car kms | variable | ≤1 | | | |
| | other travel | ? | ≤1 | ? | ? | |
| | accomdtn | variable | ≤1 | | X | |
| | fees-club | annual | ≤1 | X | | X |
| | fees-competition | variable | | | X | |
| | fees-licence | annual | ≤1 | X | X | X |
| contributions | ? | ≤1 | X | X | X | |
| clothing | capital | | | X | X | |
| books/maps | capital | ≤1 | X | X | | |
| other access | variable | ≤1 | | X | | |
| Supplementary questions | food | variable | | | X | |
| | drink | variable | | | X | |
| | fuel/oil | variable | | | X | |
| Finishing' interviews | Car | capital | ≤1 | | | |
| | Licence/s | annual | ≤1, | | | |
| | Insurance/s | annual | ≤1 | | | |
| NRMA | car travel cost | variable | ≤1 | | | |
| ABS | income | annual | | | | |

a. The actual economic data to be included in the data set and the source of data is still to be finalised.

Expenditure on capital items during the twelve months of the survey can be assumed to represent annual expenditure on capital items. However, this cannot be used to indicate the actual fishing capital held by fishers; although resale value of boats owned is collected for all families in the screening survey. Such partitioning allows the attribution of expenditure between recreational fishing and other events. Of itself, it does not allow expenditure to be partitioned between different fishing events.

Policy Issues

Two sets of policy questions for which economic data is being collected, and can be related to the data on fishing behaviour are:

- How much is spent on fishing items. This provides information of the size of the industry involved in the manufacture and supply of those items that are directly used in recreational fishing.
- Expenditure by recreational fishers that can be attributed to recreational fishing. This data can be used to provide an indication of the level of economic activity in an area that has occurred as a result of recreational fishing (table 2).

The data results from the NRFS might be used to directly assess current and future or alternative fishery management options as a primary data for derived data such as catch effort, regional expenditure and marginal value estimates.

A number of possible policy issues, expected National Recreational Fishing Survey data and possible methodological procedures in which such data might be used is provided in table 3. Policy options may relate to broad policies issues including the monitoring of fishery management performance, impact of fish resource use on national and regional productivity and distributional outcomes. Alternatively, such data may apply to more specific resource use policy questions such as stock protection or enhancement including questions of improved water quality, protection and enhancement of breeding and spawning areas, and stocking of local water ways. Survey data might also be relevant to questions regarding the provision of ancillary services including road improvements, the provision of access including boat ramps, and the provision of accommodation including camp and caravan parks.

Table 3: **Applicability of Data to Policy Issues**

| Policy issues | Data provided |
|--|--|
| Resource allocation <ul style="list-style-type: none"> • Optimal allocation of fish resources between competing uses (commercial, recreational, conservation, indigenous and commodity). • Allocation of fish habitat between competing uses • National and regional productivity • Economic impact assessment | <ul style="list-style-type: none"> • Hedonic pricing data may be available for some fish species or fishing sites depending on fisher behaviour. • Data for economic impact assessment will be provided at the level of the defined economic region. <ul style="list-style-type: none"> ○ Both these data sets can be used in national and regional productivity assessment, while providing information for resource allocation between competing uses. |
| Resource access to waterways and fish resources | Access and use data, such as: <ul style="list-style-type: none"> • Regional data regarding use of a particular fishing region • Fishing sub region data providing information on the sort of conditions. fished in; eg, offshore or from a stream bank. • Type of fishing carried out. |
| Participation and distributional effects | Home location, fishing location and species data, socio-demographic-economic data, and expenditure data can all be applied. |
| Optimal resource use in time | Catch and catch effort data |

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Background

- Unlike that for commercial fishing a data shortfall exists for recreational fishing
- The 1992 decision by the Australian, New Zealand Fisheries and Aquaculture Ministerial Council to set up a working group to examine
- A series of public papers that were distributed for public comment and input
- Publication of a national policy statement in 1994

Outcomes

- Three of the needs identified in the national policy
 - Recreational fishing should be managed as part of the total fisheries resource to ensure quality fishing, and to maintain fish stocks and their habitats for present and future generations.
 - Recreational fishers are entitled to a fair and reasonable share of Australian fish resources taking into account long-term sustainable yields; the rights and entitlements of others; and the need to optimise community returns from available stocks.
 - Fisheries management decisions should be based on sound information including fish biology, fishing activity, catches, and the economic and social values of recreational fishing (p3).
- Performance standard identified in the national Policy
 - *A robust and reliable data set.*

Methodology selection

- *Kewagama Research* were chosen to provide the methodological support for the national survey
 - Use of telephone interviews supported with 'reminder' diaries;
 - Designed on minimising respondent burden;
 - Be shown in previous studies to provide high (>90%) participation rates over the duration of the survey.

Survey structure

- Scope: To collect nationally consistent and complete fishery statistics, fisher demographic information, expenditure data and attitudinal data from those over five years of age within continental Australia.

- Sample design: a single-stage sampling procedure as the primary sample unit with each fisher in the household as the secondary unit
 - 'white pages' telephone directory was used as the sampling frame

Survey Components

- Screening survey
- Telephone / 'diary' survey
- Supplementary questions
- On-site creel surveys
- Finishing interviews at the end of the survey period
- Other data sources

Events & data links

- Two types of events:
 - Fishing/fishing behavioural events
 - Economic events

These events may be collected together during a recreational trip involving recreational fishing or independently.

- Splits occur in the 'diary' survey for fishing events when there are changes in:
 - The fishing region (catchment)
 - Fishing sub region (offshore/stream, lake...)
 - Fish species targeted &
 - Fishing method used
- Splits occur in the economic events for the 'diary' survey when:
 - There is a change in economic zones
 - When the timing of the fishing trip extends into another calendar month
 - For food & drink expenditure, whether it is in the 'at home' or is 'away from home'

Aside from timing, there is no direct link between economic events and fishing behavioural events.

Economic data/expenditure attribution

Recreational fishing occurs on a recreational trip involving that can involve a number of people and can involve activities in addition to fishing. Therefore:

- Expenditure, such as golf, not associated with fishing. Non of this expenditure data is collected
- Expenditure such as travel, accommodation and fishing gear, that is associated to varying degrees. All of this data is collected; *but*
 - Respondents are asked to designate the proportion attributable to fishing; eg:

Table 3: **Applicability of Data to Policy Issues**

| Policy issues | Data provided |
|--|--|
| Resource allocation <ul style="list-style-type: none"> • Optimal allocation of fish resources between competing uses (commercial, recreational, conservation, indigenous and commodity). • Allocation of fish habitat between competing uses • National and regional productivity • Economic impact assessment | <ul style="list-style-type: none"> • Data for economic impact assessment will be provided at the level of the defined economic region. <ul style="list-style-type: none"> ○ Both these data sets can be used in national and regional productivity assessment, while providing information for resource allocation between competing uses. • It is possible that hedonic pricing data may be available for some fish species or fishing sites depending on fisher behaviour. |
| Resource access to waterways and fish resources | Access and use data, such as: <ul style="list-style-type: none"> • Regional data regarding use of a particular fishing region • Fishing sub region data providing information on the sort of conditions fished in; eg. offshore or from a stream bank. • Type of fishing carried out. |
| Participation and distributional effects | Home location, fishing location and species data, socio-demographic-economic data, and expenditure data can all be applied. |
| Optimal resource use in time | Catch and catch effort data, assuming additional surveys |

Table 1: **Design and Validation Methods to Ensure Data Quality**

| | |
|---|--|
| Non-coverage bias | <ul style="list-style-type: none"> • Comparisons with secondary data sets (e.g. population census information) are made to assess sample representation (e.g. socio-demographics). • Behaviour (catch rates, avidity) of non-phone owners and owners of unlisted numbers are compared with directory listed respondents through creel surveys. |
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| Recall bias | <ul style="list-style-type: none"> • Minimized through survey design with frequent contact with respondents, low respondent burden and the use of a 'memory jogger' diary system. |
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| Other response biases and behavioral 'shifts' (e.g. where intervention of the study might cause increased fishing activity) | <ul style="list-style-type: none"> • As for prestige bias • Careful respondent briefing in terms of 'normal' fishing activity, i.e. no more or less often than would have occurred in the survey period, plus neutral reinforcement by the interviewer, especially during periods of nil activity. |
| Species identification | <ul style="list-style-type: none"> • Species show cards are provided to assist respondents with species identification. • Identification skills are assessed through creel surveys. |

ⁱ This study is part of a larger project on non-commercial use of fish resources that includes indigenous use by Aborigines and Torres Strait Islanders and international tourists. Acknowledgement is given to the input from recreational fishers and the State, Territory and National fishery jurisdictions who were involved in the respective working groups.

ⁱⁱ Other national studies that do not have the same broad base include those by the Australian Bureau of Statistics (1992 and 1999), the Bureau of Tourism Research (1999) and the study by PA Consulting (1992). The 1992 ABS

ⁱⁱⁱ Recognising, that for some, recreational fishing can be carried out within their normal place of accommodation or work.