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Application of a telephone-diary methodology to estimate catch and effort in recreational fisheries: examples from Australia

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Abstract

The on-going provision of reliable information about recreational catch and effort represents a major challenge for researchers and resource managers, both methodologically and in terms of data costs. This is especially so where the spatial scales over which fisheries operate are large. Recognising the need for cost-effective approaches to provide recreational fishery data, we have developed an off-site methodology that has been applied to assess general fishing and specific (e.g. lobster and abalone) fishing activities. The survey method involves a two stage process; initial selection of a representative sample of fishers and then repeated contact with respondents throughout the survey period. The primary contact method is by telephone, with fishers initially identified through general population sampling (telephone lists) or sampling of licence-frames. Respondents are encouraged to use a simple memory-jogger diary to record key data but they are contacted frequently by survey interviewers who are responsible for recording the fishing information. Substantial detail is possible, including location, targeting, fishing methods, platform, harvest and release; information that can be linked to fishers' socio-demographic characteristics. In order to reduce potential recall biases for non-diarised data, the frequency of telephone contact is tailored to match the level of an individual's fishing activity. Response rates represent a key performance measure and have been high (80-95%) for all applications of the method. Nevertheless, the nature and impacts of non-response biases have been examined, providing important insights into the efficacy of this methodology and highlighting potential limitations of studies where response rates have been poor.

Keywords: recreational fishing, off-site survey methods, telephone survey, diary survey, non-response, recreational catch and effort

Introduction

Recreational fishing represents a significant source of fishing mortality for many species and thus reliable and on-going information about recreational catch and effort is required to support sustainable fisheries management. Unlike commercial fisheries, for which catch and effort information is typically available through mandatory reporting systems, the collection of such information from the recreational sector can represent a major methodological challenge. The sheer number of recreational fishers, the diversity of

fishing activities, modes of access and variability in participation, contribute to this challenge. Thus, surveys are necessary to achieve comprehensive coverage of recreational fishing activities where the spatial scales over which fisheries operate are large. Factors such as the scale of the survey (spatial and temporal), survey objectives (what information is required and how it will be used) and available budget need to be considered when evaluating design options. For large-scale studies, on-site survey methods may be logistically difficult and too costly to implement as the sole or primary mode of data collection. As a consequence, large-scale surveys often have some reliance on off-site survey techniques.

In this paper an off-site methodology based on a telephone-diary survey, a form of panel survey, is described. The methodology has been developed to address a broad range of policy issues including resource sharing and allocation, resource assessment and sustainability, and economic impacts (expenditure and investment), and has been applied to a range of large-scale Australia studies, including general population and licensed fishing surveys (Lyle *et al.* 2002). Consistent with the conference theme, the focus of this paper is on the provision of catch and effort information for the recreational sector, with particular attention to issues of data quality.

Telephone-diary methodology

The telephone-diary methodology involves a two stage design, an initial screening phase to gather profiling information from a sample of the population and a subsequent, intensive phase, in which respondents provide detailed catch and effort information over a period of time. In this second phase, respondents are encouraged to use a simple diary to record key fishing data and are contacted regularly by survey interviewers, who are responsible for collecting the information. The underlying design philosophy is focussed on minimizing respondent burden and maximizing response and data quality.

In practice, the primary difference between general population and licensed fishing surveys is the sampling frame. While there are significant cost and sampling efficiencies associated with a licence-frame, especially if the frame provides complete coverage (National Research Council 2006), there are few licensing systems in Australia that provide a comprehensive listing of fishers. There are, however, exceptions involving the licensing of specific fishing activities such as the taking of rock lobster, abalone and net usage, and for these fisheries licence lists have been used (e.g. McGlennon 1999, Lyle 2000, 2008, Forward and Lyle 2002, Venema *et al.* 2003, Lyle and Morton 2004, 2006, Currie *et al.* 2006). In the absence of a registry of fishers, surveys of general fishing activity such as the 2000-01 national survey (Henry and Lyle 2003) and surveys currently underway in Tasmania (authors unpubl. data) and South Australia (L. West unpubl. data), have had to sample from the general population in order to identify recreational fishers. This has been achieved by contacting households based on random sampling from telephone directories.

As in any survey seeking to provide unbiased population estimates, the selection of a representative sample of the population is critical. Sample representation or coverage can be addressed in part by calibration against known demographic and/or household

characteristics (e.g. census data) but there are also potential errors associated with participation in the survey. The primary focus of this paper is such errors, namely issues related to non-response and data reporting quality, as they relate to the telephone-diary methodology.

Screening survey

Screening interviews are conducted by telephone using a structured questionnaire which is tailored to the requirements of the specific survey. The primary function of the screening interview is to collect profiling information for all household members or, for licensed-based surveys, the individual fisher, as well as establishing eligibility to participate in the follow-up diary phase. Profiling information typically includes demographics (e.g. age, gender) and previous fishing activity, including an estimate of the number of days fished within a preceding period as an indicator of 'avidity'. Diary eligibility is typically based on likelihood to fish within the diary period. The profiling information is important not only to characterize the sample population but also to examine issues relating to representation and response.

Diary survey

The telephone-diary survey differs from conventional angler diary surveys in two important ways; firstly the diary is employed more as a 'memory jogger' than a logbook and secondly, responsibility for data collection rests with survey interviewers and not diarists. Typically, diary survey response rates are low and data quality can suffer in terms of completeness, generality and consistency. Since the burden of maintaining the diary rests with the respondent, instructions may be misinterpreted and data may be incomplete or ambiguous. The need to periodically remind respondents to submit documentation creates a further problem, whereby information that has not been diarised must be collected on the basis of recall, if at all. By contrast, the telephone-diary approach effectively transfers the burden of data collection from the respondent to the survey interviewer. Data collection is undertaken by brief telephone interviews in which trained interviewers recorded details of any fishing that has occurred since the last contact. The level of fishing activity determines the frequency of such contact but, as a general rule, respondents are called at least once a month even if no fishing is planned.

After receiving the diary kit, data requirements are explained to respondents in a brief interview and the next contact arranged. Respondents are encouraged to record basic information in their diaries, such as date, location, start and finish times, and catch and release numbers (Table 1). More detailed data, such as species targets, fishing method, platform (boat or shore), water body type (river, lake, estuary, coastal, offshore, etc), and reasons for release, for each individual fishing event are collected and recorded during the telephone interview (Table 1). By maintaining regular contact, usually within a couple of weeks of any fishing activity, details of any non-diarised fishing are obtained with minimal concern in relation to recall bias. Furthermore, interviewers are able to immediately clarify ambiguities and ensure completeness of information. This in turn, provides for greater data utility, for example fishing effort can be apportioned between target fisheries, methods, fishing platform, and so on.

Table 1 Example of fishing details recorded in the diary by respondents and the expanded detail collected by the survey interviewers for each fishing event

| Parameter | Recorded in diary | Collected at interview |
|------------------|--|--|
| Date | • Date | • Date |
| Location | • Fishing location | • Fishing location • Water body type (e.g. private/public dam, river, estuary, coastal, offshore) |
| Activity | • Fishing method | • Fishing method (if relevant gear quantity) • Species targeted |
| Platform | | • Boat type (private, hire or charter) • Shore type (e.g. natural shore, man-made structure) |
| Fishing times | • Start and end times (incl. breaks) | • Start and end times (incl. breaks) |
| Catch | • Numbers kept and released (by species) | • Numbers kept and released (by species) • Reason(s) for release (by species) |

Data quality

A number of biases and other errors have the potential to impact on data quality, particularly where the information is self-reported. They include non-response, recall bias, exaggeration of catches (prestige bias), rounding of responses to numbers ending in zero or five (digit bias), behavioural shifts, and misidentification of fish species (Essig and Holliday 1991, Pollock *et al.* 1994, National Research Council 2006). A variety of validation and design elements have been employed to address these data quality issues.

Non-response bias

Some level of non-response is inevitable in any survey and must be accounted for in any responsible analysis. Non-response can introduce biases since non-respondents often differ in their characteristics to respondents (Pollock *et al.* 1994, Connelly and Brown 1996). Obviously, the higher the response rate, the lower the impact of any non-response bias on parameter estimates.

There are several types of non-response that can influence surveys, the most common being refusal to participate and failure to contact the selected person or household (non-contacts). Across a number of surveys using the telephone-diary method, screening survey response rates, where all substantive questions have been answered, have been high, averaging 83% for general population and 89% for licence-based sampling (Table 2). Refusals have averaged 12% in general population and just 3% in licence-based surveys, the latter reflecting greater interest of respondents in the survey topic. A rigorous approach is applied to minimise non-response from non-contacts through multiple call-backs over a period of several weeks, with non-contact rates for surveys generally ranging between 5 and 10%.

Consistently high diary uptake rates have also been achieved, averaging 90% for general population and 93% for licensed fishing surveys, with diary completion rates averaging 93% and 96% for general population and licensed fishing surveys, respectively (Table 2). The primary cause of non-response in the diary phase is typically loss of contact rather than withdrawal from the survey. Overall, by comparison with traditional angler diary surveys these survey response rates are exceptional and represent an important performance indicator as to the efficacy of the methodology.

Table 2 Screening and diary response for surveys based on the telephone-diary methodology.
NSW - New South Wales; NT - Northern Territory; QLD – Queensland; SA – South Australia; TAS – Tasmania; VIC – Victoria; WA – Western Australia. * 2000-01 national fishing survey

| State | Survey timing | Net sample | Screening survey | Diary survey | | Source |
|------------------------------------|---------------|------------|------------------|--------------|----------------|-----------------------|
| | | | Response (%) | Uptake (%) | Completion (%) | |
| General population survey | | | | | | |
| NT | 94-96 | 3776 | 86 | 90 | 98 | Coleman (1998) |
| NT | 00-01* | 1640 | 82 | 94 | 85 | Henry & Lyle (2003) |
| TAS | 00-01* | 3392 | 81 | 83 | 97 | Henry & Lyle (2003) |
| TAS | 07-08 | 4065 | 85 | 87 | in progress | Lyle (unpubl. data) |
| SA | 00-01* | 4422 | 86 | 90 | 93 | Henry & Lyle (2003) |
| SA | 07-08 | 6232 | 90 | 93 | in progress | West (unpubl. data) |
| VIC | 00-01* | 7957 | 76 | 89 | 91 | Henry & Lyle (2003) |
| NSW | 00-01* | 7797 | 81 | 92 | 91 | Henry & Lyle (2003) |
| WA | 00-01* | 4407 | 83 | 89 | 95 | Henry & Lyle (2003) |
| QLD | 00-01* | 6665 | 78 | 89 | 94 | Henry & Lyle (2003) |
| Licensed fishing activities | | | | | | |
| TAS | 96-98 | 1865 | 96 | 97 | 96 | Lyle (2000) |
| TAS | 00-01 | 526 | 92 | 96 | 98 | Forward & Lyle (2002) |
| TAS | 02-03 | 735 | 90 | 92 | 97 | Lyle & Morton (2004) |
| TAS | 04-05 | 711 | 94 | 94 | 94 | Lyle & Morton (2006) |
| TAS | 06-07 | 694 | 86 | 94 | 93 | Lyle (2008) |
| SA | 98-99 | 330 | 89 | 98 | 97 | McGlennon (1999) |
| SA | 01-02 | 2000 | 87 | 99 | 96 | Venema et al (2003) |
| SA | 04-05 | 2077 | 71 | 81 | 98 | Currie et al. (2006) |
| VIC | 06-07 | 2573 | 92 | 94 | 98 | Ryan (unpubl. data) |

Nevertheless, biases arising from non-response have been examined both through follow-up surveys and the use of profiling information. For instance, in the 2000-01 national survey we found significantly lower fishing participation rates amongst the non-response group, though interestingly the participation rate in the non-contact category was in fact slightly higher than for the response group (Fig. 1a). The net impact of adjusting for screening non-response was a reduction in the estimated national fishing participation

rate from 21.3 to 19.5%. Furthermore, those fishers within the non-response group were more likely to be less avid than fishers who responded to the survey, indicating a positive bias in terms of fishing activity within the response group (Fig. 1b). This situation was further exacerbated by higher diary uptake and completion rates amongst the more avid fishers, who have been show to contribute disproportionately more to the overall catch and effort (Fig. 1c). Profiling data, and in particular avidity, are thus important inputs in examining non-response which, if not taken in account, will bias participation, catch and effort estimates upwards. These experiences highlight the both the importance of minimising non-response in the first instance but also the need for appropriate evaluation of its influences, issues that have too often been discounted or ignored in recreational fishing surveys.

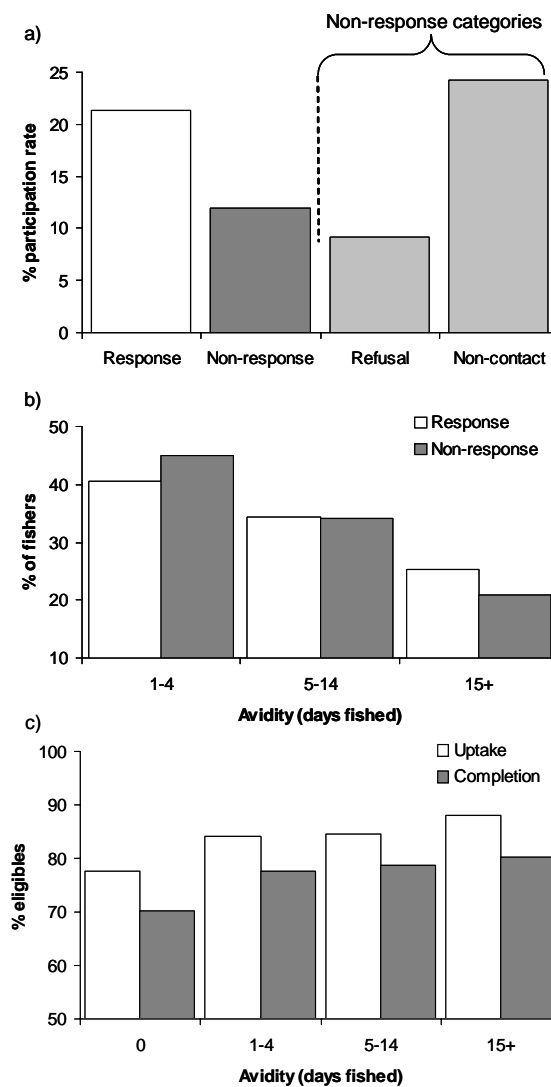


Fig. 1 a) Fishing participation rates based on screening response and non-response follow-up, with refusal and non-contact categories of non-response distinguished; b) relative avidity amongst fishers in the response and non-response follow-up samples; c) diary uptake and completion rates for eligible fishers based on previous avidity, note avidity “0” refers to eligible persons who did not fish in the year prior to survey (based on 2000-01 national fishing survey data).

Recall bias

Recall or memory bias is a complex issue that is influenced not only by the length of the recall period but by the frequency of participation (Fisher *et al.* 1991, Tarrant and Manfredo 1993, Tarrant *et al.* 1993, Connelly and Brown 1995). The use of the diary in conjunction with regular contact with respondents represents an important strategy to reduce recall bias effects. Ideally fishing details are recorded soon after the activity has been completed but, in any case, respondents are contacted routinely within a few weeks of activity such that details of any non-diarised fishing are obtained with minimal concern in relation to recall bias. Based on experience, between 75-85% of all fishing events are typically reported as diarised by respondents.

Prestige and digit bias

By design, reporting accuracy is optimised by a range of measures that rely on the rapport that exists between the respondent and interviewer. Put simply, the respondent is brought into the survey process in terms of understanding objectives and, for example, that poor or zero catches are common and very important to the study. Comparisons between diary and concurrent creel surveys have shown strong alignment between catch rates and catch distributions (e.g. Fig. 2). Digit bias is, to some extent, linked to prestige bias in that catches may be inflated through the effects of rounding up. Survey results have revealed limited evidence of digit bias effects on catch reporting.

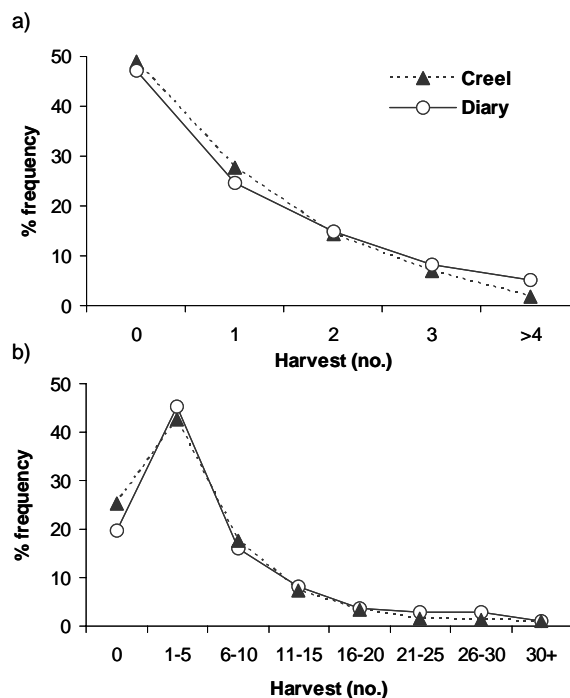


Fig. 2 Comparison between creel and telephone-diary survey catch distributions for a) rock lobster and b) recreational gillnet (based on Lyle 2000).

Behavioural shifts

Involvement in a survey has the potential to condition respondent behaviour. This can occur through sensitisation, where respondents may be prompted to go fishing more often, or on the other hand experience fatigue, where they may actually go fishing (or report activity) less often, or withdraw from the survey all together (Connelly and Brown 1996). While such behavioural shifts are difficult to quantify, respondents are routinely briefed in terms of not going fishing any more or less often than they would normally do within the survey period. This aspect is neutrally reinforced throughout the survey by interviewers, especially during periods of nil or low activity.

Species identification and fish sizes

Some studies have suggested that recreational fishers cannot reliably identify species and incorrectly estimate weights and lengths (Essig and Holliday 1991). Clearly, as diary information is self-reported it is important that respondents correctly identify their catch. To assist with this, respondents are provided with show cards of the main species (or species groups) and interviewers routinely refer respondents to these cards where uncertainties in fish identification arise. Identification skills of fishers, in terms of the level of detail required by the diary survey, are typically evaluated through concurrent creel surveys. Although excellent reporting precision can often be achieved at the species level, species groupings are sometimes required, namely where fishers cannot reasonably delineate particular species, even using show cards.

Recognising the problems with estimating fish size and weight, diarists are routinely only required to report catch numbers. Creel surveys and/or a sub-group of reliable diarists, who also measure their catch, are used to assess mean lengths and weights, the latter being applied to convert catch numbers into weights.

Summary

The success of the telephone-diary methodology in achieving high response rates and data reporting quality is ultimately dependent on a comprehensive respondent management process involving highly-trained survey interviewers. Interviewers are, in effect, able to personalise the survey to match the behaviour of individual respondents, yet at the same time ensure consistency in data collection. This clearly places considerable responsibilities on the interviewer and thus the processes of interviewer recruitment and training, along with on-going interviewer management, represent critical elements to overall survey success.

The telephone-diary methodology not only represents a cost-effective means for conducting large-scale recreational fishing surveys, but it has the advantage of collecting all substantive data using a single methodology and therefore, problems with complemented surveys, such as data comparability links, are effectively avoided. Additional data utility is also possible because of the connections between fisher

behaviour and their socio-demographic characteristics as well as the inclusion of activities such as shore-based and night-time fishing that are often difficult to assess in on-site surveys (Pollock *et al.* 1994).

Based on our experiences in Australia, the telephone-diary methodology has widespread potential in recreational fisheries research, in particular in countries with high telephone ownership rates. However, the increasing trend towards personal mobile telephone ownership will create future challenges in ensuring representative sample coverage, especially in the absence of licence frames.

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