Fisheries Research 208 (2018) 34–41

Contents lists available at ScienceDirect

Fisheries Research

journal homepage: www.elsevier.com/locate/fishres

Limitations of the random response technique and a call to implement the ballot box method for estimating recreational angler compliance using surveys

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ARTICLE INFO

Handled by Chennai Guest Editor

Keywords:
Noncompliance
Social desirability bias
Random response
Ballot box
Recreational fishery

ABSTRACT

Accurate estimation of the levels of non-compliance to fishing regulations is crucial in ensuring that long term sustainability goals of fisheries are met. When requesting information regarding sensitive behaviour, such as an angler's non-compliance to regulations through direct questioning methods (DQM), their responses can be influenced by social desirability bias (SDB). Literature in human dimensions research on methods for controlling this bias is limited. There has been an emerging prevalence in the use of the random response technique (RRT), which is a method aimed at reducing SDB in questions regarding sensitive behaviour, although it has never been validated against observed data in an environmental resource use context. An alternative to the RRT, the use of a ballot box method (BBM) has been successfully implemented to reduce SDB in contingent valuation studies and is introduced in this paper as a method for reducing SDB in face-to-face survey responses regarding sensitive behaviour. The RRT, BBM and a baseline DQM were compared for accuracy in obtaining honest responses from non-compliant anglers in South Africa's recreational marine based shore fishery (MBSF) who were covertly observed violating various regulations. A total of 79.6% of anglers who were interviewed using the BBM admitted to breaking the observed regulation. However, only 46.5% and 38.5% of the anglers who were interviewed using the DQM and RRT admitted to breaking the regulations. The length of the angler interview using the RRT was also significantly longer than the BBM and DQM. These results suggest that the BBM is the most accurate and practical method for reducing SDB in compliance surveys.

1. Introduction

Determining the extent of non-compliance in recreational fisheries has been a challenge that researchers and fisheries managers have approached in several different ways (Gavin et al., 2010). Routine activities by law enforcement officials are a typical measure of compliance levels. However, limited levels of enforcement allow violators to conceal evidence of their criminal behaviour rendering the data potentially unreliable (Cowles et al., 1979; Mann, 1995; Gavin et al., 2010). Covert and direct behavioural observations are another method applied to estimate the proportion of violators (Agnew, 2000; Rowcliffe et al., 2004); yet, the capital-intensive nature of this approach has reduced its feasibility for use on a broad scale (Allard and Chouinard, 1997). A less resource intensive procedure for obtaining compliance rates is through the administration of surveys. During these creel surveys, recreational anglers are subject to direct questioning on whether they have been compliant with regulations or not, while researches verbally assure them of the confidentiality of their responses in order to encourage honesty (Blank and Gavin, 2009; Bova et al., 2017; Mann, 1995; Solomon et al., 2007).

When requesting information which is subject to public disapproval in surveys, researchers must take care to ensure that the answers given by the respondent are truthful. Unfortunately, responses recorded through direct questioning methods (DQM) are most commonly subject to non-response (Blair et al., 2015) and social desirability bias (SDB) (Warner, 1965). This is due to the obvious implication that the individual is guilty of a criminal action (Warner, 1965; St. John et al., 2010; Thomas et al., 2014). Typically, due to self-preservation concerns, survey respondents will either refuse to answer or under-report socially undesirable activities and over-report those perceived as socially desirable (Sjöström and Holst, 2002). Various techniques have been developed to mitigate non-response and SDB, when requesting

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https://doi.org/10.1016/j.fishres.2018.06.017
Received 7 November 2017; Received in revised form 7 June 2018; Accepted 28 June 2018

such sensitive information by making the questions "less direct" (St. John et al., 2010; Nuno and St. John, 2014). In surveys around environmental behaviour, these primarily include and variations of the "random response technique" (Blank and Gavin, 2009; Coutts and Jann, 2011; Schill and Kline, 1995; Solomon et al., 2007; Thomas et al., 2014; Bergseth, 2017; Bergseth et al., 2017;), the "unmatched count technique" (LaBrie and Earleywine, 2000; Ahart and Sackett, 2004; Nuno and St. John, 2014), and the "nominative technique" (Droitcour Miller et al., 1983; Droitcour Miller, 1985; St. John et al., 2010). However, the latter two methods seem less popular than the former, likely due to the circumstantial, fundamental assumptions involved in the nominative technique (St. John et al., 2010) and the literature that has highlighted the limitations of the unmatched count technique, such as its inability to effectively guarantee anonymity (Glynn, 2013; Matlala et al., 2014; Arentoft et al., 2016; Tian and Tang, 2016).

Commonly applied methods for estimating angler non-compliance in recreational fisheries include direct questioning (Brouwer et al., 1997; Blank and Gavin, 2009; Bova et al., 2017) and the use of the random response technique (RRT) (Blank and Gavin, 2009; Coutts and Jann, 2011; Schill and Kline, 1995; Solomon et al., 2007). While the DQM offers the participant a verbal guarantee of confidentiality, the RRT was developed to improve on this guarantee by cloaking the participant's responses with statistical noise, thereby concealing them from the interviewer. This is meant to further reduce the potential for SDB by offering a mechanism other than a verbal guarantee that a response to a sensitive question would not be used against the respondent.

The RRT was conceptualized by Warner (1965) and first used in a fisheries context in surveys in the late 1980's (Lewynsky, 1986; Lewynsky and Bjornn, 1987). It rose to prominence in fisheries research after Schill and Kline (1995) used it as a viable response method for estimating non-compliance with fishing regulations in Idaho and has subsequently become the most widely used technique to obtain reliable responses from questionnaire data (Solomon et al., 2007; Blank and Gavin, 2009; St. John et al., 2010; Arias and Sutton, 2013; Thomas et al., 2014; Conteh et al., 2015; Lewis, 2015; Bova et al., 2017). Although the precise application of the technique varies amongst many of the studies, researchers typically present the respondent with a sensitive question which will be answered either honestly or with a predetermined response based on a randomizing device. The probabilities of the randomizing device are known and are used to determine whether the respondent gave the predetermined response or admitted to the sensitive behaviour (St. John et al., 2010). The various randomizing devices used in revealing undesirable resource use behavior have been a six-sided die (Schill and Kline, 1995; St. John et al., 2010; Arias and Sutton, 2013), a two-sided coin (Solomon et al., 2007; Blank and Gavin, 2009; Thomas et al., 2014; Lewis, 2015; Bova et al., 2017) and a quantitative forced alternative randomising device which contained 50 balls of orange and green colour (Conteh et al., 2015). In a variation of the die device, typically the respondent will be forced to answer "yes" to the sensitive question if the die lands on the number one, regardless of their actual response, or "no" if the die lands on the number two, or simply answer honestly if it lands on any other number. For the coin device, a variation may be to answer truthfully if the coin lands heads-up or answer an automatic "yes" if it lands on tails. Conteh et al. (2015) employed a special device that contained 50 orange and green balls with numbers on them, where if an orange ball was selected by the respondent, they answered truthfully and if a green ball was chosen, they replied with the number on that ball. The administrator does not observe the outcome of the device nor is the result ever divulged and thus the anonymity of the response and reduction of SDB is ensured. After responses are gathered using the RRT, probabilistic logic is applied to them in order to obtain estimates of the actual rate of non-compliance after the statistical noise has been removed. The specific formula used for each nuanced method of the RRT can vary in calculation.

The RRT has been lauded as the best method for obtaining less biased responses to questions regarding compliance to fisheries regulations (Schill and Kline, 1995; Solomon et al., 2007; Blank and Gavin, 2009; Lewis, 2015). Nonetheless, there is also a significant body of literature which identifies serious drawbacks to the use of the RRT (Cheng et al., 1972; Umesh and Peterson, 1991; van der Heijden et al., 2000; Gavin et al., 2010; St. John et al., 2010; Coutts and Jann, 2011; Moshagen et al., 2014; Bova et al., 2017). The most important claim of the benefits of using RRT is that it produces more valid point estimates of sensitive behavior. This has been concluded by many researchers, all of whom compared the sensitive behaviour prevalence estimates from the RRT to that estimated by other data collection modes, – predominantly the DQM (Schill and Kline, 1995; Lensvelt-Mulders et al., 2005; Solomon et al., 2007; Blank and Gavin, 2009; St. John et al., 2010; Lewis, 2015; Bergseth et al., 2017). This conclusion relies solely on the assumption that "higher estimates of non-compliance" are better (Umesh and Peterson, 1991) and not necessarily more accurate. Since the RRT has not been confirmed against a known criterion (i.e. validity of direct response), the validations of this method are "weak" and therefore the conclusion that it is a superior method cannot be drawn (Moshagen et al., 2014).

An alternative bias reduction technique, the ballot box method (BBM), has been used in the health sciences for understanding sensitive sexual behaviours (Gregson et al., 2002), but has yet to be applied in the context of estimating socially undesirable environmental behaviour. This method provides survey respondents anonymity by allowing them to respond in private by self-completing their responses to the sensitive survey questions on a secret ballot and submitting them to a locked box. The interviewer has no knowledge of what is recorded on the secret ballot and does not have access to the lock on the box, providing obscurity to the responses and limiting the potential for SDB. However, a unique control number on each ballot allows the answers to be reunited with a corresponding questionnaire that contains less sensitive questions (Gregson et al., 2002). The BBM has been used successfully to obtain estimates of sensitive sexual behaviours during an HIV prevention study (Gregson et al., 2002).

Although its application for estimating the prevalence of behaviours has been limited, it has been applied extensively as a means of reducing SDB in various contingent valuation (CV) surveys (Lewicki, 1985; Carson et al., 1996; Champ, 2003; Leggett et al., 2003; Francisco, 2015). Leggett et al. (2003) found that the use of a ballot box substantially reduced social desirability bias in CV surveys, although it did not fully eliminate it. Unfortunately, the claimed success of this method, like that of the RRT, also hinges on weak validation studies based on a "more is better" assumption when compared to direct questioning estimates (Tourangeau and Yan, 2007; Krosnick and Alwin, 1987).

The recreational marine based shore fishery (MBSF) in the Republic of South Africa (RSA), comprises approximately 350,000 anglers from varying demographics (Potts et al., unpublished data), distributed across approximately 2800 km of coastline, much of which is not easily accessible. The South African Department of Agriculture, Forestry and Fisheries (DAFF) is currently the agency tasked with providing the fishery with oversight and enforcing the regulations set forth in the Marine Living Resources Act (MLRA) of 1998. For recreational anglers, these regulations include permit requirements, size limits, bag limits, closed seasons, protected areas, prohibited species and catch methods and limits on what anglers may do with their catch (i.e. no selling). However, with a limited number of compliance staff dedicated to recreational fishing, a diffuse angling population and many inaccessible areas around the coastline, the effective enforcement of the regulations has been difficult. Unsurprisingly, many anglers perceive a generally low risk of being caught by law enforcement for fishing violations (Brouwer et al., 1997; Lamberth et al., 1997; Bova et al., 2017) and there is some evidence to suggest that these perceptions may exacerbate the lack of compliance in some areas (Bova et al., 2017). From the perspective of fisheries compliance research, the high rates of non-