ENVIRONMENTAL EQUIFINALITY: (RE)EXAMINING PREDICTORS OF SPECIFIC RESPONSIBLE ENVIRONMENTAL BEHAVIOURS IN AUSTRALIAN RECREATIONAL FISHING ENVIRONMENTS

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Abstract

Despite significant evidence of the effects of climate change and human degradation on natural environments, individuals, organisations and governments have had little success in reversing these impacts and rehabilitating ecosystems. This thesis explores the drivers and characteristics of individuals who participate in behaviours intended to ameliorate the destruction to natural environments, specifically in recreational fishing areas of Australia. While existing models predicting environmental behaviour apply a single, linear-based model to populations, results of this study suggest that the application of these theoretical, symmetric relationships to underlying asymmetric and equifinal relationships may contribute to the current confusion and inconsistencies in the literature and poorer than expected environmental outcomes in practice. This is revealed through the application of a novel theoretical perspective (i.e., complexity theory) and methodology (i.e., fuzzy-set qualitative comparative analysis). Results uncover the underlying complex configurational mechanisms, with multiple equifinal solutions identified as sufficient for the performance of these target stewardship behaviours. Comparing data of those who are a member of an environmental organisation and those who are not reveals distinctly different configurations that are predictive of environmental stewardship participation. Thus, these findings can inform targeted recruitment and engagement strategies for efficient use of the limited available resources to increase desired stewardship behaviours.

Keywords: Environmental behaviour, Environmental education, Environmental stewardship, Fisheries management, Fuzzy-set Qualitative Comparative Analysis, Theory of Planned Behaviour, Value Belief Norm theory

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List of Abbreviations

fsQCA	Fuzzy-set Qualitative Comparative Analysis
INUS	Insufficient but Necessary part of a condition set which is itself Unnecessary but Sufficient
PRI	Proportional Reduction in Inconsistency
QCA	Qualitative Comparative Analysis
RoN	Relevance of Necessity
SREB	Specific responsible environmental behaviour
SUIN	Sufficient but Unnecessary part of a condition set that is itself Insufficient but Necessary
TPB	Theory of Planned Behaviour
VBN	Value Belief Norm Theory

Terminology

This thesis employs the analysis technique fuzzy-set Qualitative Comparative Analysis (fsQCA), the specific terminology of which may be unfamiliar to some readers. The table below compares some common terminology of this technique with comparable quantitative terms and interpretations. Further details of the fsQCA technique are discussed in Chapter 3: Methodology.

Notational comparison of fuzzy set Qualitative Comparative Analysis (fsQCA) and conventional quantitative techniques

fsQCA Term	Comparative Quantitative Term
Sets	Variables
Set-theoretic relations	Correlations
Counterfactual analysis	Counterfactual estimation
Consistency	p-value
Coverage	r^2
Calibration	Measurement
Truth table	Beta co-efficient/ correlation matrix
Antecedent condition	Independent variable
Outcome condition (qualitative outcome)	Dependent variable
• / * = AND/ conjunction	• / * = multiplication
+ = OR/ disjunction	+ = addition
Boolean algebra	Linear algebra
Solution formula	Equation
~X, negated set membership	No equivalent[1]
Uncovers causal recipes (configurations of INUS conditions) = case based approach	Uncovers "net effects" (intercorrelations of independent variables) = variable-based approach

[1] Note: Conventional quantitative techniques are based on symmetric relationships and do not allow for asymmetry

Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: QUT Verified Signature

Date: 10/02/21

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Chapter 1: Introduction

1.1 BACKGROUND

Climate change is an undeniably important global issue, with natural environments increasingly threatened by ocean acidification, water pollution and declining levels of biodiversity due to mass extinction of species across trophic levels (Bindoff et al., 2019; de Groot & Steg, 2007, 2008; Masson-Delmotte et al., 2018). An International Panel on Climate Change (IPCC) Special Report (2018) outlining the impacts of global warming of 1.5 °C above pre-industrial levels has predicted shifts in marine species ranges, coastal resource depletion and reductions in fisheries and aquaculture productivity. These impacts will be particularly felt in nations such as Australia due to its low latitude (Masson-Delmotte et al., 2018). The report highlights the likelihood of "irreversible loss of many marine and coastal ecosystems" as a result of global warming (Masson-Delmotte et al., 2018).

Aquatic ecosystems provide benefits of far reaching and incalculable worth in terms of their ecological, economic and cultural contributions (Grizzetti, Lanzanova, Liquete, Reynaud, & Cardoso, 2016); problematically there is evidence that climate change may have impacted these ecosystems more than terrestrial ones (Arlinghaus & Cooke, 2009; Cowx, Arlinghaus, & Cooke, 2010). Furthermore, direct and indirect anthropogenic interactions with aquatic ecosystems have intensified these impacts and permanently changed the habitats of aquatic species (Danylchuk & Cooke, 2011). Fish species are now the most threatened vertebrates on Earth, with the International Union for Conservation of Nature listing more than 35% of species as either vulnerable or threatened (International Union for Conservation of Nature, 2018). As a result, impacts on society, including marine recreational activities are likely to continue to worsen (Bindoff et al., 2019).

Scientific consensus is that human behaviours are the primary cause of climate change and subsequent effects (Burrell, Evans, & Kauwe, 2020; Gills & Oosthoek, 2013; Meneganzin, 2020). The combined impacts of climate change and anthropocentric actions extend to recreational fishing areas which include oceans and coastlines, rivers, streams, lakes, dams, estuaries and their surrounds. For example, catch size and species composition have already been impacted by global warming (Bindoff et al., 2019) and some fisheries and aquaculture models predict that the impacts of global warming will result in annual global catch decreases

of 1.5 to 3 million tonnes (Masson-Delmotte et al., 2018). This will have both direct and indirect effects on a large number of people including impacts on livelihoods, food security and recreational opportunities (Barwick et al., 2014). Indeed, Danylchuk and Cooke (2011, p. 459) suggest that this environmental destruction will have "cascading negative effects on the quality of the recreational angling experience and the economic viability of the angling industry". Anthropogenic activity is also responsible for substantial decline in health of aquatic ecosystems and surrounding environments (Birch, 2017) through activities such as mechanical disruption of benthic habitats, deforestation, agriculture, heavy industry, damming, urbanisation and release of pollution (Arlinghaus & Cooke, 2009; Birch, 2017; Cowx et al., 2010; Howard, 2019).

While many of the most significant detrimental effects on fisheries typically originate outside the fishery itself, recreational fishing is also responsible for detrimental impacts on fish populations and habitats (Cowx et al., 2010). Recreational fishing is responsible for: pollution through discarded equipment such as nets, fishing line and traps (Edyvane & Penny, 2017; Leesfield, 2018); negative impacts on fish stocks through individual over extraction and cumulative take, mortality associated with catch-and-release fishing, illegal release of non-native species and artificial stocking of fish causing population imbalances (Cowx et al., 2010; Danylchuk & Cooke, 2011; Frawley, 2015); damage and pollution associated with use of boats and/or vehicles to access fishing sites and erosion of shorelines (Danylchuk & Cooke, 2011; Gregory, 2018).

Despite significant evidence of current and expected impacts on fishery ecosystems, individuals, governments and industries have had little success in reversing these impacts and rehabilitating them (Gifford, 2011). Human behaviour not only plays a significant role in environmental degradation but it is also key to reversing this damage and protecting natural ecosystems (Klöckner, 2013). As the human population continues to grow, altering destructive human behaviours and promoting positive environmental behaviours becomes more critical than ever (de Groot & Steg, 2008). This thesis explores the drivers and characteristics of individuals who participate in behaviours intended to ameliorate the destruction to natural environments, specifically in recreational fishing areas. These areas encompass both freshwater

and marine aquatic ecosystems (including estuaries) and their littoral[2], riparian[3] and terrestrial surrounds (Cowx et al., 2010).

The focus of this study is specific responsible environmental behaviour (SREB) performed within these areas, which is defined as "intentional and conscious civic behaviours that are focused on systemic causes of environmental problems and the promotion of environmental sustainability" (Alisat & Riemer, 2015, p. 14). This type of behaviour is often labelled environmental stewardship because it involves a combination of conservation, preservation, restoration and rehabilitation activities (Bramston, Pretty, & Zammit, 2010; Ridings, 2017). These behaviours differ from changing personal practices to reduce environmental impact as they are conscious, intentional and focused on creating positive impacts; and often involve particular competence (Alisat & Riemer, 2015). A key finding in the environmental behaviour literature is that these behaviours are context specific (Carmi, Arnon, & Orion, 2015; Juvan & Dolnicar, 2017; Steg & Vlek, 2009; P. C. Stern, 2000b). Therefore, an understanding of those individuals who use or have an interest in the health of fisheries ecosystems is key to understanding behaviour in this context.

1.2 STUDY CONTEXT

Recreational fishing is defined by the United Nations Food and Agriculture Organisation as "the fishing of aquatic animals (mainly fish) that does not constitute the individual's primary resource to meet basic nutrition needs and are not generally sold or otherwise traded" (2017, par. 1). A recreational *fisher* refers to an individual who engages in recreational fishing to catch fish primarily for leisure purposes, though the catch may be consumed, and is inclusive of the synonymous term angler (Copeland, Baker, Koehn, Morris, & Cowx, 2017). Recreational fishing includes a range of fishing activities and locations, with recreational fishers varying greatly in their preferences and attitudes (Fisher, 1997). Those who catch fish for subsistence or cultural reasons, and commercial fishers are not included in this group.

Recreational fishing is popular globally, with estimates of more than 10% of the adult population in developed nations participating (Arlinghaus & Cooke, 2009). This equates to approximately 220 million recreational fishers worldwide with more than 118 million in North America, Europe and Oceania alone (Arlinghaus, Tillner, & Bork, 2014; Brownscombe et al.,

[2] The zone near the shore of lakes, rivers or oceans which is often shallow areas of rivers or lakes, or between the points of high and low tide in coastal areas

[3] The zone of land that runs alongside and interfaces with estuaries, rivers, creeks, lakes or wetlands

2019). It has been estimated that globally billions of fish are caught recreationally each year (Brownscombe et al., 2019). In Australia, recreational fishing is a key leisure activity, providing substantial economic and social benefits (Barwick et al., 2014). It has been estimated that around 3.4 million Australians engage in recreational fishing each year (DAW&E, 2020)[4]. Barwick et al. (2014) have estimated that in the Murray Darling Basin alone, over 10,000 individuals are supported by employment relating to recreational fishing and that the activity contributes around $1.3 billion each year to the local economy. When considered nationally, the annual economic contribution of the Australian recreational fishing sector has been estimated at between $2.56 billion (Colquhoune, 2015) and more than $10 billion (Australian Recreational Fishing Foundation, 2013).

Recreational fisheries are fast-evolving systems based on social and ecological interactions (Brownscombe et al., 2019). The natural areas in which recreational fishing occurs are managed primarily at the State level (Pannell, Ridley, Regan, & Gale, 2004). Pannell, Roberts, Park, and Alexander (2013) found that the level to which communities and non-government actors are empowered to participate in and/or manage catchments can vary significantly. In Australia, each state's fisheries are managed under state based Acts, often falling under the purview of multiple pieces of legislation, regulation and administrative authority with limited integration (Pannell, Ridley, Regan, & Gale, 2004). Catchment management bodies exist in most States and Territories and often receive funding and support from government and non-government bodies but rely heavily on community volunteers to run. These management bodies often - and with little notice - experience changes in power, structure, responsibilities and the nature of their connection to government agencies (Pannell et al., 2004), resulting in disruption and uncertainty. This fragmentation exacerbates the impact of other threats to recreational fisheries.

The main threat to recreational fisheries is the damage and destruction of fish habitat. These threats are primarily generated outside of the fisheries through activities such as deforestation, urbanisation, disposal of waste, agricultural activities etc. (Cowx et al., 2010; Gregory, 2018). Unfortunately, recreational fishers can themselves contribute to ecosystem degradation, either directly or indirectly (Copeland et al., 2017; Danylchuk & Cooke, 2011). For example, recreational fishing has been linked to the exploitation of marine resources and

[4] It should be noted that there is no consistent collection of statistics regarding recreational fishing in Australia, with much of the current literature still using estimates from the *2000-2001 National Recreational and Indigenous Fishing Survey* (Georgeson et al., 2015).

fish stocks, and the degradation of fish habitats (Brownscombe et al., 2019; Cowx et al., 2010). Indeed, Brownscombe et al. (2019) have suggested that recreational fishing is the dominant exploiting sector of freshwater fish stock.

Many governments and non-government organisations promote the idea that recreational fishers, as users of aquatic environments, have a responsibility to perform related voluntary stewardship activities in these areas (Cowx et al., 2010; Granek et al., 2008; Grizzetti et al., 2016; Voyer, Barclay, McIlgorm, & Mazur, 2017). This has encouraged an increased focus on the role of habitat restoration activities undertaken, and sometimes directed by, recreational fishers (Copeland et al., 2017). Copeland et al. (2017) and Cowx et al. (2010) advocate exploiting this volunteer labour to achieve better environmental outcomes in recreational fishing environments. This expectation of "user maintains" the environment has also been implemented in relation to recreational boating and ameliorating the impacts of a range of marine pollutants including litter, sewage, and oil by recreational boaters (e.g. Grant-Smith, 2015; Grant-Smith & Mayes, 2017).

Ascribing responsibility for habitat stewardship to recreational fishers (a process known as responsibilisation) can create conflict with other stakeholders, and within the recreational fishing community (Brownscombe et al., 2019; Danylchuk & Cooke, 2011; Gregory, 2018). For example, successful efforts to improve these ecosystems improves fish stocks, resulting in positive economic outcomes for commercial fishers which can exacerbate tensions between recreational and commercial fishers (Boucquey, 2017; Noble, Harasti, Pittock, & Doran, 2019; Voyer et al., 2017). Despite acknowledging the various actors that impact fish habitat negatively, it is often recreational fishers who are ascribed the responsibility of habitat stewardship by State governments and NGOs (Gregory, 2018). This, coupled with a lack of understanding of individual motivations for performing habitat restoration has meant that these "user maintains" policies often fall short of achieving their goals (Gregory, 2018; Lucas, Brooks, Darnton, & Jones, 2008). A deeper understanding of what drives responsible environmental behaviours in individuals is vital for successful environmental restoration and rehabilitation efforts.

1.3 PRO-ENVIRONMENTAL BEHAVIOURS

Community concern about environmental problems is high and continues to grow (Axelrod & Lehman, 1993; Gkargkavouzi, Halkos, & Matsiori, 2019; Hawcroft & Milfont, 2010). However, while most individuals believe that immediate significant action is required

to address environmental issues, few participate in any positive environmental behaviours beyond recycling (Axelrod & Lehman, 1993; Gkargkavouzi et al., 2019; Ortega-Egea, García-de-Frutos, & Antolín-López, 2014). While the purpose of this study was to develop a model for particular environmental stewardship actions, conceptualised as specific responsible environmental behaviours (SREB), it draws upon theories and models developed in general behaviour prediction and environmental behaviour prediction. The terms environmental behaviour and pro-environmental behaviour are often used interchangeably as a broad term for general behaviours, and for specific actions (Alisat & Riemer, 2015).

Pro-environmental behaviour has proven difficult to predict using theories and traditional quantitative models, with many authors suggesting that creating a universal model to predict pro-environmental behaviour is not possible (Carmi et al., 2015; Kollmuss & Agyeman, 2002; P. C. Stern, 2000a). As such, a range of models, with different variables, from a wide variety of disciplines are promoted in the literature. Authors in various fields advocate theorising and modelling behaviours separately for individual contexts (Carmi et al., 2015), with Juvan and Dolnicar (2017) suggesting this approach is more theoretically sound as it will lead to stronger predictive models. Furthermore, it is perhaps a more practical approach which may support the development of theoretically sound and empirically grounded policy development and behaviour intervention strategies.

Although Value-Belief-Norm theory and the Theory of Planned Behaviour have emerged as the dominant theoretical basis for prediction of environmental behaviour, there are still no universally accepted antecedents or models for pro-environmental behaviour prediction (Juvan & Dolnicar, 2017; Olya & Akhshik, 2018; Schmitt, Aknin, Axsen, & Shwom, 2018). Studies that have used a single theory or concept for prediction of pro-environmental behaviours have resulted in conflicting findings (Bamberg & Möser, 2007; Gifford & Nilsson, 2014). Researchers have also typically attempted to combine and extend theories in a general context, without accounting for situational or contextual factors (Olya & Akhshik, 2018). As a result, research in environmental behaviour has failed to systematically identify the most appropriate measures for prediction, regularly generating new measures for study constructs rather than replicating empirically verified measures (Hawcroft & Milfont, 2010; Juvan & Dolnicar, 2017; Olya & Akhshik, 2018; Schmitt et al., 2018). Attempting to model the levels of complexity involved in environmental behaviour prediction has proven challenging. The problem landscape is complex and the policies and solutions to the problem are, in turn, complex. While Copeland et al. (2017) have explored habitat stewardship behaviour in recreational fishing

areas, using a multi-national sample (Ireland, UK, USA and Australia) this was limited to a single sample of recreational fishers. They found that participation was mostly in "simple" pro-environmental activities such as picking up litter, rather than more complex activities such as removing aquatic pests or weeds; and that rates of participation in pro-environmental behaviour were much lower among Australian and US fishers than Irish or UK fishers (Copeland et al., 2017). As various Australia government agencies (e.g. Catchment Management Authorities, The Department of Agriculture, Water and the Environment) and non-profit organisations (e.g. OzFish Unlimited, Recfishwest, Fish Habitat Network) advocate for a "user maintains" approach, comparing a wider sample of Australians is key to understanding whether this investment and encouragement to act is positively influencing Australian recreational fishers to engage in specific pro-environmental behaviours, and indeed whether or not recreational fishers are the correct segment of the population to be targeting in volunteer restoration efforts.

1.4 RESEARCH AIM AND APPROACH

This research has significant practical value in contributing to a deeper understanding of the serious challenges faced in enlisting volunteers in the restoration and rehabilitation of aquatic environments. The results from this research can inform nongovernment and government organisations alike in the development of initiatives and approaches aimed at increasing participation in volunteer-based environmental stewardship activities in a range of contexts. Identifying the factors that vary among individuals who do and do not participate in particular pro-environmental behaviours allows for more targeted campaigns and policy decisions, and ultimately better environmental outcomes (Juvan & Dolnicar, 2017; Wynveen, Wynveen, & Sutton, 2015). The practical contribution of a model such as that proposed in this research was recognised by Klöckner (2013, p. 1029) who suggested that:

> integrating the major models and theories into a comprehensive model that in turn could be used as a framework for identifying potentially relevant variables across behaviours and cultures is promising. It could potentially increase the impact that environmental psychology would have in the debate about mitigation of environmental problems.

This thesis responds directly to Klockner's challenge. Environmental organisations and fisheries management organisations have highlighted a lack of information regarding the profile of individuals most likely to participate in stewardship activities (Axelrod & Lehman, 1993; Copeland et al., 2017; Randle & Dolnicar, 2006). Identifying this profile (or profiles) would allow for more targeted messaging to the identified segment(s), resulting in more

efficient use of the already limited human and economic resources available to support stewardship activities (Juvan & Dolnicar, 2017; Wynveen et al., 2015).

The model presented in this thesis is more complex than any previously measured model of environmental behaviour and aims to refine the prediction of specific responsible environmental behaviours. The measures used are existing, validated construct measures from various streams of literature but the model harnesses complexity theory and embraces the complexity of pro-environmental behaviour prediction. The model in this thesis is specific to the context of fisheries habitat stewardship behaviours as specificity in prediction is essential (e.g. Bamberg, 2003; Cottrell & Graefe, 1997; de Leeuw, Valois, Ajzen, & Schmidt, 2015; Lucas et al., 2008).

As in many areas of social sciences research and behaviour prediction current approaches to pro-environmental behaviour prediction are predominantly based on symmetric theory construction and null hypothesis statistical testing (Woodside, 2017). Gigerenzer (2004) notes that null hypothesis statistical testing has been institutionalised since the 1950s, particularly in psychological and behaviour research and is often presented as the only available statistical approach to researchers. Despite theorising in behavioural sciences typically being case-based (Fiss, 2007), the research questions and/or designs employed do not reflect this and are often variable-centric. The continued use of symmetric variable-centric analysis techniques has contributed to confusion and contradictory findings in the literature. Despite the publication of thousands of research articles and multiple meta-analyses in the area of pro-environmental behaviour prediction, our understanding of this phenomena and the importance of predictive measures remains limited.

The aim of this research is:

> To identify necessary and/ or sufficient subset relations between individual, contextual, environmental and psychosocial conditions, and the performance of specific responsible environmental behaviours in Australian recreational fishing areas.

Taking a complexity theory approach and adopting a critical realism paradigm, data from this research is analysed using a statistical method known as fuzzy-set Qualitative Comparative Analysis (henceforth fsQCA), deployed using the statistical software R. fsQCA does not identify which constructs have the most predictive power, which is common with techniques such as linear regression. Rather, the technique attempts to identify combinations of conditions deemed necessary or sufficient for changes in the outcome condition (similar to dependent

variable). This approach is valuable as it allows researchers to examine the predictive validity of a range of competing antecedent conditions (similar to variables), across multiple literature streams in a sophisticated yet parsimonious, asymmetric and non-linear fashion. As the literature review presents, extant theory regarding pro-environmental behaviour is fractured across a range of disciplines and underlying theoretical models. It is complex.

Beyond the practical and theoretical contributions highlighted, this thesis makes a significant methodological contribution through its use of a methodological approach which is new to the area of environmental stewardship behaviours. The study utilises fuzzy set Qualitative Comparative Analysis (fsQCA) to explore unique combinations of behavioural antecedents in order to highlight *only* those conditions that are necessary and/or sufficient to predict behaviour. Applying this technique allows for a new approach to understanding the heterogeneity in individual's environmental behaviour that is often highlighted in the literature as a limiting factor.

1.5 THESIS OVERVIEW

Chapter 2 presents a literature review of the most commonly used theoretical models and variables for predicting pro-environmental behaviour across multiple streams of literature. It culminates in the presentation of a conceptual framework that integrates these models and variables across streams. Research questions to support the conceptual framework are also presented. Chapter 3 outlines and discusses the philosophical basis and technical aspects of fsQCA, prior to presenting the method, sample and instruments used in this study. A revised conceptual framework is then presented based on the inclusion of only valid measures, as determined by factor analysis. Chapter 4 presents the results of two distinct subsets (members of an environmental organisation, n= 89 and non-members n= 93), including analyses of necessity relationships and an overview of sufficiency findings. Chapter 5 discusses the findings in depth, with emphasis on sufficiency results. Finally, Chapter 6 discusses implications, contributions, and limitations and avenues for future research.

Chapter 2: Literature Review

Numerous authors, across many decades have generated theories and models to strengthen our understanding of human behaviour within or relating to natural environments. Despite these efforts, research has failed to deliver consensus on the most appropriate model of prediction of pro-environmental behaviours (Hawcroft & Milfont, 2010; Juvan & Dolnicar, 2017; Olya & Akhshik, 2018; M. T. Schmitt et al., 2018). This chapter integrates the extant literature from a range of disciplines including environmental education, environmental psychology, outdoor recreation behaviour, tourism, organisational citizenship behaviour for the environment and environmental volunteering.

This chapter examines the wide range of factors that have been proposed as predictors of pro-environmental behaviours, with a focus on habitat stewardship behaviours and the recreational context, specifically recreational fishing. Individual level behaviours are the key focus, as they have been widely covered in existing literature (Chawla & Cushing, 2007; Cho & Kang, 2016; Christensen, Needham, & Rowe, 2009), and align with the aims of this study. Common theories underpinning this literature are discussed, including the New Environmental Paradigm (NEP), Value Belief Norm theory (VBN), and Theory of Planned Behaviour (TPB). As this literature review will demonstrate, existing approaches are fragmented and complicated. Further work is required to integrate and synthesise existing models in order to identify only those conditions which are necessary or sufficient to produce environmental stewardship behaviours. This will allow practitioners to better focus their efforts and resources.

This chapter begins with an historical overview of environmental behaviour research before describing specific responsible environmental behaviour (SREB) and key literature streams. This is followed by discussion of 19 conditions that have emerged from these literature streams. These are grouped into four categories; individual attributes, contextual factors, environmental affinity and psychosocial aspects. Each condition is presented such that findings from the literature are discussed generally, followed by environmental and fishing specific findings where available. Finally, these conditions are integrated into a conceptual framework for the research which is presented along with research questions.

2.1 PRO-ENVIRONMENTAL BEHAVIOUR

The 1960s and 1970s saw a dramatic increase in interest in the areas of environmental awareness and environmental behaviours. Dunlap and Van Liere (1978) documented this shift in awareness, labelling it the "New Environmental Paradigm". The shift towards a New Environmental Paradigm resulted in an exponential increase in environmental behaviour research (Hines, Hungerford, & Tomera, 1987). Initial models of pro-environmental behaviour were simple, linear relationships based on the premise that increasing knowledge of the environment and the impact of behaviours on it, would shift an individual's attitudes towards the environment and this would in turn lead to enactment of pro-environmental behaviours (see **Figure 1**). Kollmuss and Agyeman (2002) noted that despite these models being quickly disproven, most NGOs still base communication and strategies on this simplistic assumption that filling an "information deficit" will result in pro-environmental behaviour performance.

Figure 1. Early Linear Model (adapted from Burgess, Harrison, Filius, and Margreet (1998); Kollmuss and Agyeman (2002))

By 1987 Hines, Hungerford and Tomera were able to identify 380 studies of environmental behaviour published since 1971. The authors completed a meta-analysis of 128 of these studies, with an aim of combining findings across research fields to inform environmental education curriculum and teaching strategy (see **Figure 2**). Their findings that 'knowledge of skills' and 'knowledge of action strategies' are key predictors of behaviour were widely adopted by education researchers and lead to general acceptance that education programs that increase knowledge of environmental issues will likely result in positive environmental behaviours (Chawla & Cushing, 2007; Cottrell & Graefe, 1997; Hungerford & Volk, 1990; Larson, Green, & Castleberry, 2009; Sia, Hungerford, & Tomera, 1986; Siemer & Knuth, 2001; Sivek & Hungerford, 1990; M. J. Stern, Powell, & Hill, 2014). This approach of increasing knowledge in order to change behaviours has also been adopted by many environmental education practitioners, and environmental behaviour change programs (Australian Association for Environmental Education, 2019; Ardoin, Bowers, Roth, & Holthuis, 2018; Ardoin, Clark, & Kelsey, 2013; Bergman, 2016; North American Association for Environmental Education, 2010; M. J. Stern et al., 2014)

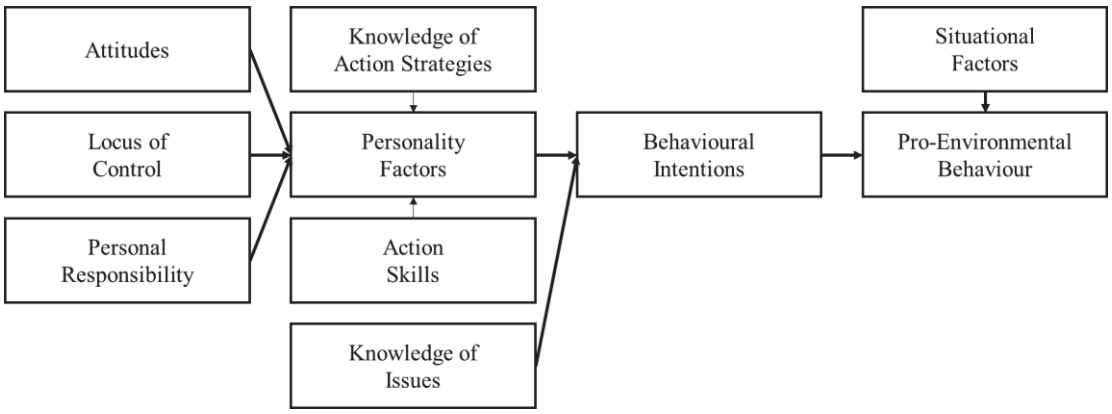

Figure 2. More complex model of pro-environmental behaviour: The Model of Responsible Environmental Behaviour (Hines et al., 1986)

Over time, focus shifted to align with models of behaviour prediction in other settings, highlighting the importance of psychosocial determinants. This focus was reflected in later meta-analyses published by Bamberg and Moser in 2007, Ocbaldiston and Schott (2012), Klöckner (2013) and Morren and Grinstein (2016). The primary theoretical frameworks that emerged were based on the Theory of Planned Behaviour (TPB: Ajzen, 1985) and the Value-Belief-Norm Theory (VBN) presented by P. C. Stern, Dietz, Abel, Guagnano & Kalof (1999) as an extension of Schwartz's Norm-Activation Theory for environmental behaviour contexts (Schwartz, 1977).

Research investigating pro-environmental behaviour has been pervasive in recent decades, resulting in publication of hundreds of articles across various fields (Morren & Grinstein, 2016). Numerous titles for this type of behaviour, performed at an individual level have been utilised including: environmental behaviour (Cho & Kang, 2016; P.C Stern et al., 1999), responsible environmental behaviour (REB), general responsible environmental behaviour (GREB) and specific responsible environmental behaviour (SREB: Cottrell & Graefe, 1997), pro-environmental behaviour (Kollmuss & Agyeman, 2002; Ocbaldiston & Schott, 2012), environmentally friendly behaviour (Ocbaldiston & Schott, 2012; Tindall, Davies, & Mauboulès, 2003), environmentally conscious behaviour (Lee, Kim, Kim, & Choi, 2014), environmentally responsible behaviour (Cheng & Wu, 2015), green behaviour (Mancha & Yoder, 2015), environmental stewardship (Bramston et al., 2010), conservation behaviour (Christensen et al., 2009; Ocbaldiston & Schott, 2012), environmental volunteering (McDougle, Greenspan, & Handy, 2011), conservation volunteering (Wilson, 2012), Organisational Citizenship Behaviour for the Environment (OCBE) which studies employees within organisations (Bergstrom, Dorfman, & Loomis, 2004), environmentally significant

behaviour (P. C. Stern, 2000a), green consumer behaviour (Lee et al., 2014), environmentally friendly consumption behaviour (Bodur & Sarigöllü, 2005), environmentally sustainable behaviour (Juvan & Dolnicar, 2017) among others. Alisat and Riemer (2015) noted that the terms environmental behaviour and pro-environmental behaviour are often used as both a generic, broad term and as a specific term for specific behaviours. This thesis uses these terms in the broad sense which, based on P. C. Stern's (2000a, p. 408) definition of environmentally significant behaviour, "captures behaviours that directly or indirectly cause environmental change, where environmental protection is a key consideration of the actor".

The Model of Responsible Environmental Behaviour proposed by Hines et al. (**Figure 2**) was extended ten years later by authors Cottrell and Graefe (1997). As shown in **Figure 3**, Cottrell and Graefe made a distinction between general and specific environmental behaviour – and related variables – by measuring both general predictors and general behaviours, and specific predictors of specific responsible environmental behaviours. They predicted that an individual who performs pro-environmental behaviour in general terms (e.g. recycling, switching products for ecological reasons and subscribing to ecological publications) is more likely to participate in specific pro-environmental actions (Cottrell & Graefe, 1997). Their study examined recreational boaters dumping boat sewage in designated stations rather than in the ocean. Based on this study Cottrell and Graefe concluded that "the more specific the indicator of behaviour, the better predictive ability that indicator has of behaviour" (1997, p. 26). The notion that specific behaviours are predicted by specific antecedents has continued to be explored throughout the literature (Juvan & Dolnicar, 2017; P. C. Stern, 2000a), while conflicting with the interests of researchers to create parsimonious, generalisable models of prediction.

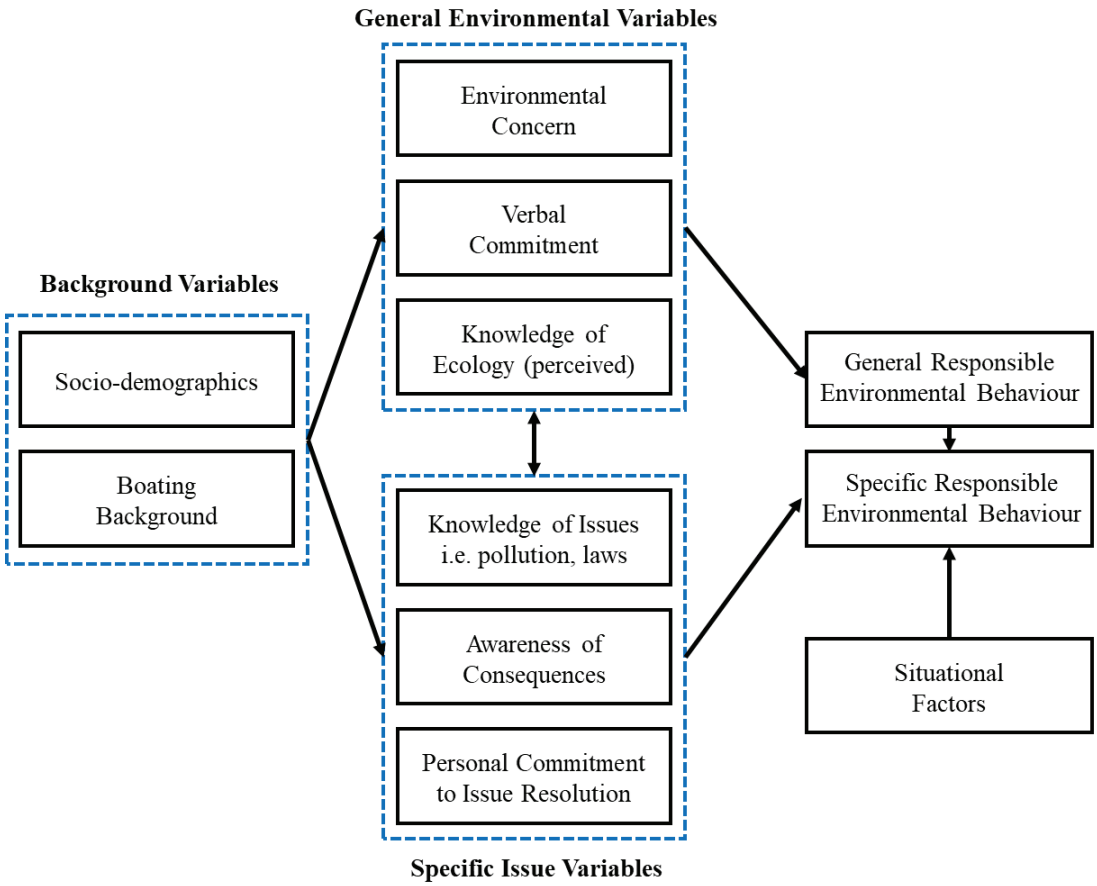

Figure 3. Conceptual Framework of Responsible Environmental Behaviour (Cottrell & Graefe, 1997)

Despite these advances in complexity, P. C. Stern (2002a) argued that a general theory of environmentally sustainable behaviour may not be attainable, due to the great variance in drivers across differing behaviours and contexts. The discussion of individual conditions in this review uncovers this heterogeneity, further supporting P. C. Stern's assertion. The usefulness, strength and direction of relationships between these antecedents and behaviours vary significantly depending on "the behaviour, the actor and the context" (Juvan & Dolnicar, 2017, p. 881). Numerous authors have also indicated that individual behaviours, or behaviour types should be theorised and modelled separately, for more accurate behaviour prediction (e.g. Carmi et al., 2015; Cheng & Wu, 2015; Juvan & Dolnicar, 2017). Therefore this research is based on a specific behaviour type which is defined as specific responsible environmental behaviour (SREB).

This research adopts Alisat and Riemer's (2015, p. 14) definition of specific responsible environmental behaviour (SREB) as "intentional and conscious civic behaviours that are focused on systemic causes of environmental problems and the promotion of environmental sustainability". This research investigates positive, voluntary habitat management and

restoration actions that may be performed by individuals visiting recreational fishing areas and are not necessarily related to recreational fishing practise. Such activities include but are not limited to: removal of non-native species, resnagging, riverbank planting, weed control, constructing artificial fish habitats, installing infrastructure such as fishways/ fish ladders or gross pollutant traps, and restoring reefs (Copeland et al., 2017; Gregory, 2018). This specific behaviour has not been previously explored, with the exception of a 2017 multinational study describing varying motivations for participation and basic demographic characteristics in a sample consisting of only recreational fishers (Copeland et al., 2017). This review of literature considers the various types of environmental behaviour while concentrating on findings most relevant to the study context by highlighting, where feasible, studies that have included Australian samples, marine or aquatic environments, recreation and leisure activities, and the most prominent theories and antecedents that have been highlighted across numerous fields.

2.2 ENVIRONMENTAL EDUCATION APPROACHES

Hines et al.'s 1987 meta-analysis attempted to bridge divisions between numerous fields and combined findings across studies in education, psychology, sociology, engineering, political science, business, forestry, and communications. Hines et al. (1987) uncovered important psycho-social relationships but also emphasised cognitive variables, particularly those concerning "knowledge of environmental problems and their consequences… [and] knowledge of how to take action on a particular environmental problem" (p. 3). They found that 'knowledge of skills' and 'knowledge of action strategies' are key predictors of behaviour were widely adopted by education researchers which lead to an acceptance that education programs that increase knowledge of environmental issues will likely result in positive environmental behaviours (Bergman, 2016; Chawla & Cushing, 2007; Cottrell & Graefe, 1997; Hungerford & Volk, 1990; L.R. Larson et al., 2009; Lincoln R. Larson, Stedman, Cooper, & Decker, 2015).

This approach of increasing knowledge in order to change behaviours has been adopted by many environmental education practitioners, and has been influential in the creation of programs by peak bodies such as the North American Association for Environmental Education's Guidelines for Environmental Education and Australia's National Environmental Education Network (Ardoin et al., 2018; Ardoin et al., 2013; Bergman, 2016; P. C. Stern et al., 2014). However, research indicates that the antecedents of action are much more complex than knowledge alone (Bolderdijk, Gorsira, Keizer, & Steg, 2013; Chawla & Cushing, 2007; Jugert

et al., 2016; Kollmuss & Agyeman, 2002; L. McDougle, Handy, Katz-Gerro, Greenspan, & Lee, 2015; Sivek & Hungerford, 1990). While there is a pervasive inclusion of knowledge measures in Environmental Education literature, most studies appropriately recognise that knowledge may be necessary for this behaviour (as an individual will not choose to perform these behaviours if they are not even aware of the environmental consequences, or of appropriate actions to take (Hines et al., 1987) but many other factors (particularly those adopted from psychology literature) play a role.

Environmental education programs have been critiqued for not placing environmental outcomes at the forefront, despite being documented as a key focus by environmental education organisations (Bergman, 2016; Zelezny, 1999). The environmental education field now tends to focus on pedagogical approaches, with primary goals such as improving academic performance or critical thinking skills in students (North American Association for Environmental Education, 2010). For example, a review of environmental education literature showed that altered environmental knowledge is a key outcome regularly measured by programs (68% of those reviewed) but changes in environmental behaviour are measured far less often (20% of those reviewed). Despite this, some reviews of programs have shown resulting increases in environmental behaviours (Ardoin et al., 2018; Bergman, 2016). Bergman (2016, p. 494) notes that while broad education programs are unlikely to result in broad behaviour performance, "enhancing knowledge and skills to address specific actions or risks can be more effective". Recent developments in environmental education have redefined the field as education for sustainability, shifting from simply informing towards developing critical and reflective thinking skills to enact change for sustainability (Tilbury, 2004).

2.3 PSYCHOLOGICAL APPROACHES TO PRO-ENVIRONMENTAL BEHAVIOURS

Social psychology variables are well adopted as key predictors of environmental behaviour (Bamberg & Möser, 2007; Christensen et al., 2009; Gifford & Nilsson, 2014). Bamberg and Schmidt (2003) acknowledged that many studies of environmental behaviour in the 1970s and 80s were exploratory, with little theoretical basis for inclusion of and relationships between constructs measured. Social psychology theories have now been well integrated in all fields exploring this phenomenon (Bamberg, Rees, & Seebauer, 2015; Goh, Ritchie, & Wang, 2017; Juvan & Dolnicar, 2017). While various psychological theories, and combinations of theories have been employed by academics investigating environmental behaviours, the core theories used are Schwartz's Norm Activation Theory (Schwartz, 1977)

and the New Ecological Paradigm presented by Dunlap & Van Liere (1978), which were combined and extended for the environmental context to generate the Value Belief Norm theory (P. C. Stern et al., 1999), and Ajzen's Theory of Planned Behaviour (Icek Ajzen, 1991; Gifford & Nilsson, 2014; Han, 2015; Wall, Devine-Wright, & Mill, 2007) which is an extension of the theory of reasoned action (Bamberg & Schmidt, 2003; Fishbein & Ajzen, 2009). Studies investigating psychological drivers of environmental behaviour have primarily focused on attitudes, values and norms of individuals as predictors (Cordano, Welcomer, Scherer, Pradenas, & Parada, 2010; de Groot & Steg, 2008; de Leeuw et al., 2015; Farrow, Grolleau, & Ibanez, 2017; Gifford & Nilsson, 2014; Mancha & Yoder, 2015; Montes, Swett, Jacobson, & Sidman, 2018; Steg, Bolderdijk, Keizer, & Perlaviciute, 2014; Steg, Perlaviciute, van der Werff, & Lurvink, 2012; Steg & Vlek, 2009; P. C. Stern et al., 1999; Ünal, Steg, & Gorsira, 2017).

Ajzen's (1985) Theory of Planned Behaviour (TPB) postulates that actual behaviour can be most precisely predicted by behavioural intention (see section 2.7.7), which in turn is determined by attitude toward behaviour (see section 2.7.1), subjective norms (see section 2.7.6) and perceived behavioural control (see section 2.7.5). The Value Belief Norm (VBN) model of environmental behaviour developed by P. C. Stern, Dietz, Abel, Guagnano & Kalof (1999) hypothesised that personal norms directly affect environmental behaviours and that these norms are formed based on ascription of responsibility, awareness of consequences and personal values. While the authors presented a model representing a causal chain they outlined that "each variable in the chain directly affects the next; each may also directly affect variables farther down the chain" (P. C. Stern et al., 1999, p. 84). While there are some similarities between the two models, each focuses on different features of behaviour (Wall et al., 2007). Because of this, a multitude of studies have compared or combined these theories and/or their predecessors in order to more accurately predict environmental behaviours (Wall et al. 2007). Steg and Vlek (2009) have proposed that TPB is a stronger predictor than VBN of behaviours that involve behavioural costs or constraints; probably due to its incorporation of more contextual factors (Klöckner & Blöbaum, 2010). Unfortunately, it is still unclear which determinates are central to behaviour prediction, and which are direct, mediated or mediating influences (Klöckner, 2013).

2.4 INDIVIDUAL ATTRIBUTES INFLUENCING PRO-ENVIRONMENTAL BEHAVIOURS

Studies of environmental behaviours typically incorporate measures of demographics. This is due to ease of measurement and evidence to suggest demographics predict pro-environmental behaviour (Cooper, Larson, Dayer, Stedman, & Decker, 2015; Cottrell & Graefe, 1997; Larson, 2010; Leonidou, Coudounaris, Kvasova, & Christodoulides, 2015; Montes et al., 2018; Theodori & Luloff, 2002). Factors including gender (female), education (high), age (young) and political views (progressive/left) have been suggested as indicators of a predisposition to higher levels of environmental concern and behaviour (e.g. Bergman, 2016; Cooper et al., 2015; Cottrell, 2003; Davidson & Stedman, 2017; de Leeuw et al., 2015; Ertz, Karakas, & Sarigöllü, 2016; Fornara, Pattitoni, Mura, & Strazzera, 2016; Kalamas, Cleveland, & Laroche, 2014; McAuliffe, Potts, Canessa, & Baily, 2014; Montes et al., 2018; Otto & Kaiser, 2014; Sánchez, López-Mosquera, & Lera-López, 2016; P. C. Stern, Kalof, Dietz, & Guagnano, 1995; van der Werff & Steg, 2016). Unfortunately, this profile description is the antithesis of an individual most likely to participate in recreational fishing (Arlinghaus et al., 2014; Magee, Voyer, McIlgorm, & Li, 2018; Young, Foale, & Bellwood, 2016). As a result of heavily skewed data in a sample consisting only of recreational fishers, Copeland et al. (2017) found that the profile of recreational fishers most likely to perform habitat management activities were in fact male, held a post-graduate degree, and were 64-81 years old. These contradictory findings regarding gender, education, age and political views are discussed in more depth in the following sections.

2.4.1 Gender

While Hines et al. (1987) were not able to find a significant gender influence in their meta-analysis, only four of the studies provided gender data. Following studies exploring environmental behaviour have regularly uncovered gender-based influences or differences. Typically, findings indicate higher levels of environmental concern and pro-environmental behaviour in females, despite females usually possessing a lower level of environmental knowledge than men (Bergman, 2016; Chawla & Cushing, 2007; Chenyang & Aaron, 2013; Gifford & Nilsson, 2014; Kalamas et al., 2014; Sánchez et al., 2016; Tanner, 1999). This is thought to occur due to women's higher levels of emotional engagement with and concern for the environment, traditional gender roles and/ or socialisation pattern influences (Chenyang & Aaron, 2013; Rauwald & Moore, 2002; Tindall et al., 2003). A higher willingness among females to change their behaviours may also contribute (Kollmuss & Agyeman, 2002).

Kalamas et al. (2014) declared that gender is one of a few consistent predictors of environmental behaviour, however others have claimed gender findings are inconsistent (Bodur & Sarigöllü, 2005; de Leeuw et al., 2015; Gifford & Nilsson, 2014). Kellert's well-known studies exploring wildlife-attitude dimensions found that females were more likely to express concern and empathy for pet animals, while males were more inclined to seek contact with nature than females (Kellert, 1976; Kellert, 1984, 2018). Males are also more inclined to interact with animals in a utilitarian or dominant manner than females (Kellert, 1976, p.539). This is consistent with the significantly larger portion of male participation in recreational fishing.

2.4.2 Education

Logically, those with a higher level of education are likely to also possess higher levels of knowledge regarding environmental issues and associated action-based knowledge, which have also been linked to environmental behaviour (as outlined in sections 2.7.3, 2.5.3 and 2.7.4) as is the goal of environmental education programs (Ardoin et al., 2018). Kellert's well-known studies of individuals' perceptions of animals and the natural environment found those with higher levels of education held naturalistic attitudes, described by a "profound attraction to wildlife and to the outdoors in general" (Kellert, 1976, p. 536). P. C. Stern (1995) indicated a higher level of education is linked to a higher level of environmental concern, which Rhead, Elliot, and Upham (2018) have linked to post-materialistic views held by this group. Higher formal levels of education have been linked to environmental behaviour in various settings including environmentally concerned consumer behaviour (Bodur & Sarigöllü, 2005), sustainable tourism behaviour (Juvan & Dolnicar, 2017) and others (Cottrell, 2003; Cottrell & Graefe, 1997; Davidson & Stedman, 2017; Hines et al., 1987; P. C. Stern et al., 1995; van der Werff & Steg, 2016).

2.4.3 Age

Similar to findings related to gender, the influence of age on performance of specific responsible environmental behaviour has produced varied results across studies (Lacroix & Gifford, 2017; McDougle et al., 2015; Ortega-Egea et al., 2014). The original meta-analysis completed by Hines et al. (1987) uncovered a weak relationship showing higher levels of environmental behaviour in younger individuals. While Otto and Kaiser (2014), and van der Werff and Steg (2016) found that participation in these behaviours increased with age, the generally accepted narrative is that a younger individual is more likely to participate in these

behaviours (Sánchez et al., 2016; Wilson, 2012). Dunlap and Van Liere (1978) claimed that low age was one of the most consistent predictors of environmentalism. Cottrell (2003) and McAuliffe et al. (2014) noted that an increase in age is correlated with a decrease in environmental concern, which was reiterated in Gifford and Nilsson's (2014) review of factors that influence pro-environmental concern and behaviour and Hawcroft and Milfont's 2010 meta-analysis of studies measuring environmental concern over 30 years. This relationship has been found among various samples including students (Bergman, 2016).

In studies more closely aligned with the context of this research Cottrell (2003) uncovered more positive and supportive attitudes towards Marine Conservation Zones in individuals of a younger age. However, Dolnicar (2010) found that environmentally sustainable behaviour actually increases with age among Australian tourists, and when studying a multinational sample of recreational fishers Copeland et al. (2017) identified higher levels of habitat restoration activity in older anglers. This inconsistency in results may be a sign of underlying non-linear relationship, for example Bodur and Sarigöllü (2005) indicated that environmentally concerned consumers are either young *or* mature. As with most identified influencing variables there is mounting evidence that prediction is context specific.

2.4.4 Political views

Several studies have also explored political ideology, stand on political issues or political views of individuals influence on environmental behaviour. Ortega-Eaga (2014) claimed this is one of the most consistent correlational measures of environmental behaviour. Most often, progressive vs conservative views are measured, with those holding more progressive/ leftist views more likely to perform these behaviours (Dunlap & Van Liere, 1978; Sánchez et al., 2016; Taniguchi & Marshall, 2018). Taniguchi and Marshall (2018, p. 173) make the connection between these political views and differing priorities regarding environmental protection and economic growth. Measures of environmental concern (see section 2.6.1) rather than behaviour have quite often also uncovered higher levels in progressives than conservatives (Cottrell, 2003; Davidson & Stedman, 2017; Hawcroft & Milfont, 2010). Additionally those holding progressive political views are more likely to join pro-environmental organisations (see section 2.6.4) (Taniguchi & Marshall, 2018, p.173). Unfortunately, while these findings are promisingly consistent, this is a more difficult construct to capture than other demographic characteristics such as age or gender (Cheng, Bynner, Wiggins, & Schoon, 2012).

2.4.5 Intersectional and Equifinal Understandings of Individual Attributes

As aptly highlighted by (Fitzgerald, 2019, p. 4) "previous research has not been able to effectively examine the complex interactions between demographic factors due to the difficulty in doing so with regression analysis". Despite this, regression-based analyses remain prominent in studies exploring environmental behaviour. The conceptual model for this research is based on hypothesised intersectional recipes, consisting of conjunctive and /or disjunctive[5] relationships among individual attributes.

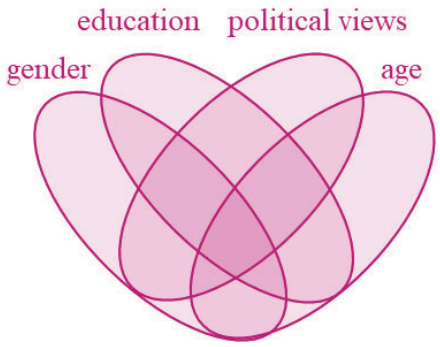

Figure 4. Individual attributes hypothesised to contribute to specific responsible environmental behaviour

2.5 CONTEXTUAL FACTORS INFLUENCING THE ADOPTION OF PRO-ENVIRONMENTAL BEHAVIOURS

Participation or involvement in outdoor recreation is difficult to operationalise due to variations in types and number of activities, hours spent participating and regularity of participation (Berns & Simpson, 2009; Van Liere & Noe, 1981). Studies focusing on environmental behaviours specifically in samples of outdoor recreationists' have identified multiple relevant influences including an individuals' level of experience in the recreation activity, their perceived skill in performing the activity, centrality of the recreation activity to their lifestyle, the areas they visit and frequency of visits (Berns & Simpson, 2009; Cooper et al., 2015; Cottrell, 2003; Cottrell & Graefe, 1997; Daigle, Hrubes, & Ajzen, 2002; Danylchuk & Cooke, 2011; McAuliffe et al., 2014; Montes et al., 2018; Thapa, 2010; Thapa & Graefe, 2003). Dunlap & Hefferman (1975) were the first to measure participation in outdoor recreation as a variable that may influence attitude, value or concern for the environment. Generally, participation in outdoor recreation activities has been linked to higher levels of environmental concern (Bodur & Sarigöllü, 2005; Rosa & Collado, 2019; Thapa & Graefe, 2003) and behaviour (Berns & Simpson, 2009) but this varies depending on the activity and associated

[5] Further explanation of set conjunction and disjunction is available in Schneider & Wagemann (2015, Ch. 2)

factors. Berns & Simpson (2009) speculated that participation in outdoor recreation mediates the relationship between environmental attitude and environmental behaviour.

The majority of these prior studies have separated participants of outdoor recreation activities into groups depending on the activity they engage in (Gifford & Nilsson, 2014). For example, when Dunlap and Hefferman (1975) categorised outdoor recreationists as appreciative or consumptive they placed all fishers in the consumptive category, regardless of their fishing practices. Others have also identified all recreational anglers within a consumptive category (Gifford & Nilsson, 2014; Thapa and Graefe, 2003). However, Kellert's (2008) biophilia hypothesis and other research suggests that individual's motivations for participating in outdoor activities are wide-ranging even within a single activity type such as fishing (Chapman, 2015; Kellert, 2008, 2016, 2018; Magee et al., 2018; Young et al., 2016) or within a particular type of fishing such as trout fishing (Berns & Simpson, 2009). Kellert (1976) categorised motivation to participate in outdoor recreation as scientistic, naturalistic, ecologistic, humanistic, moralistic, utilitarian, dominionistic and negativistic, later extended to include aesthetic, symbolic and social (Chapman, 2015; Kellert, 2008). These motivations shape how an individual participates in outdoor recreation activities which in turn indirectly influences their propensity to engage in pro-environmental behaviours (Kellert, 1976, p. 542). Some studies have confirmed anglers fall into multiple typologies, acknowledging this heterogeneity (Magee et al., 2018; Siemer & Knuth, 2001). This heterogeneity carries across to environmental behaviours in recreational fishing areas, with different groups of fishers (e.g. specialised, certain catch preference) often differing in their views and/ or participation regarding environmental management (e.g. Martin, Momtaz, Jordan & Moltschaniwskyj, 2016; McNeill, Clifton, & Harvey, 2019). Frequency of participation in outdoor recreation activities

Van Liere and Noe (1981, p. 508) first measured frequency of participation in outdoor recreation activities to reflect involvement. Frequency of participation has since been adopted as a common measure in studies of outdoor recreation activities (Berns & Simpson, 2009; Nord, Luloff, & Bridger, 1998; Thapa, 2010). In their study involving sewage dumping choices, Cottrell and Graefe (1997) measured the number of days spent boating as one measure relating to boating experience. Fishing involvement or avidity is often assessed in studies of recreational fishers using frequency and other measures (Cowx et al., 2010; Magee et al., 2018; Arlinghaus, 2014. Nature-based experiences are often associated with increased levels of pro-environmental behaviour (Rosa & Collado, 2019). Dunlap and Hefferman (1975, p. 27) found

an increase in outdoor recreation participation leads to increased concern for the natural environments visited but not necessarily increased general environmental concern.

2.5.1 Centrality to Lifestyle

In studies investigating participation in multiple outdoor recreation activities, authors have acknowledged the importance of measuring how central the activity is to an individual's life/ lifestyle, as individual attitudes and views are generally aligned with self-described importance of the measured activity (Cottrell & Graefe, 1997; Montes et al., 2018; Thapa & Graefe, 2003). Gale (1972, p. 26) pronounced that levels of attachment to an outdoor activity coincide with "commitment to protect those features of the environment which contribute directly to enjoyment of the activity". Centrality to lifestyle has been linked to environmental behaviours in studies of aquatic activities such as boating (Cottrell & Graefe, 1997; Jett, Thapa, & Swett, 2013; Montes et al., 2018), while Lee, Jan, and Huang (2015) found that engaging in recreational behaviours lead to performance of general responsible environmental behaviour among tourists.

2.5.2 Fishing Club Membership

Fishing club membership is hypothesised to influence the engagement of individuals with recreational fisheries (French, Lyle, Twardek, Cooke, & Semmens, 2019). In Copeland et al.'s (2017, p. 88) study of recreational fishers the authors found that members of a fishing club or organisation were four times more likely to undertake habitat restoration activities. Rates of club membership have been found to be as high as 40% among Australian recreational fisher samples (French et al., 2019). Connection between club or organisation membership and stewardship behaviour may be explained by the fact that strong ties to community lead to these behaviours (Cho & Kang, 2016); that perception of collective control in this setting may actually increase perceptions of individual control (Jugert et al., 2016); or that social connection plays a key role due to the collective outcomes achieved from these behaviours (Alisat & Riemer, 2015). As an increasing number of fishing organisations are now facilitating these habitat activities, determining whether membership in this type of group leads to increased behaviour is key to understanding (Barwick et al., 2014; Copeland et al., 2017; Granek et al., 2008).

2.5.3 Perceived Fishing Knowledge and Skill

Studies investigating centrality to lifestyle of outdoor recreation activities have often also measured individuals' perceived levels of knowledge and/or skill regarding the

recreational activity (Copeland et al., 2017; Cottrell & Graefe, 1997; Jett, Thapa, & Ko, 2009; Montes et al., 2018). Danylchuck & Cooke (2011) found that recreational fishers who were more advanced were focused on quality of experience while less experienced fishers focused on the quantity of catch. This suggests more skilled fishers are likely to be more concerned about health of the areas in which they fish, as this impacts the quality of the experience.

2.5.4 Intersectional and Equifinal Understandings of Contextual factors

The commonality among almost all extant literature predicting pro-environmental behaviour is the use of linear models (e.g. SEM and multiple-regression analysis). These "conventional" methods however rely on an underlying assumption of causal symmetry (Ragin, 2000, p. 164). As noted by Schmitt, Grawe, and Woodside (2017) these conventional methods may not be appropriate for the complex context of pro-environmental behaviour prediction, and what is likely an asymmetric reality.

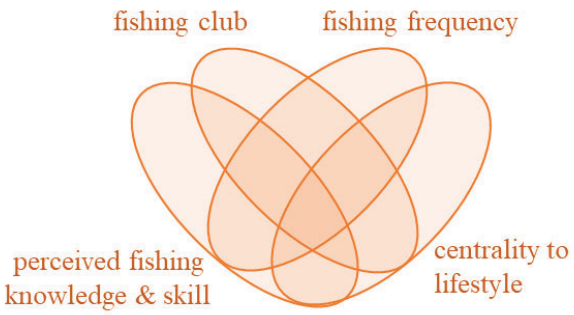

Figure 5. Recreational fishing conditions hypothesised to contribute to specific responsible environmental behaviour

2.6 ENVIRONMENTAL AFFINITIES

Environmental affinity refers to an individual's relationship with the environment. Environmental affinity constructs, for the purpose of this study, are environmental concern, general responsible environmental behaviour, values and environmental organisation membership.

2.6.1 Environmental Concern

As a result of the growing environmental movement in the 1960s and 70s, Dunlap & Van Liere (1978) documented a shifting worldview, which they termed the New Environmental Paradigm (NEP). The environmental worldview was characterised by harmonious interactions with nature and environmental predispositions (Albrecht, Bultena, Hoiberg, & Nowak, 1982; Dunlap & Van Liere, 1978). Dunlap & Van Liere (1978) claimed individuals' interest in and desire to protect natural environments was resulting in a shift towards the NEP from the

existing Dominant Social Paradigm, which was defined by desires for economic growth, materialism and anthropocentrism (LaLonde & Jackson, 2002; Rauwald & Moore, 2002).

Based on this worldview, Dunlap & Van Liere (1978) created a NEP measurement scale, designed to capture this environmental attitude or level of concern in individuals. The scale has been known interchangeably as the New Environmental Paradigm scale and the New Ecological Paradigm scale (Cordano et al., 2010; Dunlap, 2008). The scale has since been shown to be a valid and reliable measure of general feelings toward, and concern for natural environments, in numerous settings and countries (Albrecht et al., 1982; Geller & Lasley, 1985; Hawcroft & Milfont, 2010). This scale is now the most widely used tool to measure environmental concern (Bernstein, 2017; Cordano et al., 2010; Dunlap et al., 2000). Environmental concern has been shown to influence control over, attitude towards and intention to perform environmental behaviour (P. C. Stern, 1995), as well as environmental behaviour performance (Bergman, 2016; Bernstein, 2017; Hawcroft & Milfont, 2010). Rauwald & Moore (2002) found that the NEP scale was a strong predictor of support for environmental protection policy.

The use of the NEP scale to measure environmental concern has not been without criticism as some authors have argued that using such a generic measure of general environmental concern to predict specific environmental behaviours results in weak correlational relationships (Axelrod & Lehman, 1993; Bamberg & Schmidt, 2003; Carmi et al., 2015). Bamberg (2003) noted that the NEP scale may only be useful for predicting behaviours with a low cost to individuals, as there are fewer constraints on these behaviours. Others have also argued that a single measure of concern for the environment does not correspond with the complexity of environmental behaviour (Bramston et al., 2010; Kollmuss & Agyeman, 2002).

2.6.2 General Responsible Environmental Behaviour

As discussed in section 2.1, Cottrell & Graefe (1997) made the distinction between general and specific responsible environmental behaviour. The broader, more general measures of responsible environmental behaviour aim to capture a range of behaviour indicative of action in an individual's daily life (Lee et al., 2015). General responsible environmental behaviour (GREB) is often measured using multiple constructs or categories of behaviour (Alisat & Riemer, 2015; Kaiser & Wilson, 2004; P. C. Stern et al., 1999). A range of measures have been used to predict high levels of GREB in individuals (Cooper et al., 2015; Kim, Airey, & Szivas, 2011; Lee et al., 2015; Mobley, Vagias, & DeWard, 2009) and a relationship has been

uncovered between these general measures and specific actions in various recreational contexts including: the sewage dumping practises of boaters (Cottrell & Graefe, 1997); specific conservation behaviours among wildlife recreationists (Cooper et al., 2015); and some evidence of spill over effects from one behaviour to another (Evans et al., 2012).

2.6.3 Values

Schwartz (1992, p. 21) defined a value as "a desirable transsituational goal varying in importance, which serves as a guiding principle in the life of a person or other social entity". Values held regarding the environment are a subset of an individual's general values (P. C. Stern & Dietz, 1994). Individuals hold a small number of values and draw on these when faced with options or decisions as they are cognitively accessible and shape evaluation of situations (de Groot & Steg, 2008; Steg, 2016; Steg et al., 2012; Ünal et al., 2017). Because they are general and often hold constant for an individual, values are useful in predicting environmental behaviour in varying situations and circumstances (de Groot & Steg, 2007; Steg et al., 2014; P. C. Stern & Dietz, 1994). Values have been shown to play a substantial role in individual beliefs, attitudes, intentions and behaviours (de Groot & Steg, 2008; Steg & Vlek, 2009; Steg et al., 2012; P. C. Stern, 2000). Schwartz's (1992; 1987) scale of values is commonly used for studies of pro-environmental behaviour. Schwartz's values scale draws from Rokeach's (1973) values survey instrument and the Kahle's list of values (1983). The scale has been successfully used in models to predict environmental concern and environmental behaviour (Cordano et al., 2010; Dietz, Kalof, & Stern, 2002; Gifford & Nilsson, 2014; Kalamas et al., 2014; Lee et al., 2014; Steg & Vlek, 2009; P. C. Stern, 2000a; Ünal et al., 2017).

Schwartz's value theory proposed two distinct groupings of values; self-transcendent and self-enhancement values and is commonly used in studies of environmental behaviour (de Groot & Steg, 2007). In the environmental behaviour domain, self-transcendent values typically encompass altruism and biospheric values, while self-enhancement values include egoistic and, more recently (see Steg et al., 2012), hedonic values (Bramston et al., 2010; de Groot & Steg, 2007, 2008; P. C. Stern, 2000b). The self-transcendent values emphasise collective benefits to nature and others considering consequences of one's choices for others (altruistic) and nature (biospheric) (Steg, 2016). Contrarily, those with hedonic values focus on personal benefits, aiming to reduce effort and increase pleasure, while egoistic values are based on increasing personal resources (Steg, 2016). Self-transcendent values have often been used to predict environmental behaviours (McDougle et al. 2015; Steg et al., 2014: P. C. Stern et al., 1995), with biospheric values typically the most strongly related (De Groot & Steg, 2007; Steg

et al., 2014). Self enhancement values are in turn, quite often negatively correlated with this behaviour (Cordano et al., 2010; Seligman, Syme, & Gilchrist, 1994; Thøgersen & Beckmann, 1996).

2.6.4 Environmental Organisation Membership

As discussed in section 2.5.2, membership in a formal group or club may be related to higher levels of environmental behaviour. Of course, membership in an environmental organisation specifically has been linked to higher levels of positive environmental behaviour as this is quite often a key activity undertaken by these groups (Cho & Kang, 2016; McDougle et al., 2011). Alisat and Riemer (2015) note that stewardship behaviours specifically are more likely to be linked with more complex factors including contextual factors and contact with others involved in this type of behaviour, while individual attributes are more likely to be connected with personal practice behaviours (e.g. recycling).

2.6.5 Intersectional and Equifinal Understandings of Environmental Affinities

Fitzgerald (2019) is one of only a few authors to attempt to overcome the inconsistencies in existing research from a methodological standpoint. Adopting a QCA methodology Fitzgerald (2019) has shown that there are multiple distinct pathways to environmental concern. This supports the notion that pathways to environmental behaviour are also likely to be equifinal and involve multiple paradoxical configurations.

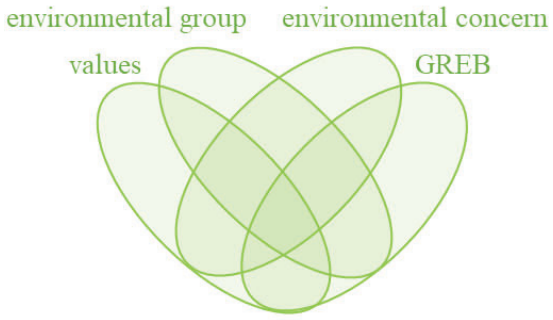

Figure 6. Environmental affinity conditions hypothesised to contribute to specific responsible environmental behaviour

2.7 PSYCHOSOCIAL ASPECTS CONTRIBUTING TO PRO-ENVIRONMENTAL BEHAVIOURS

Psychosocial aspects refer to measures related to individual psychological and interrelated factors for pro-environmental behaviour prediction. This includes measures of an individual's attitudes toward the behaviour, whether they ascribe the responsibility of

performing the behaviour to themselves, awareness of consequences of the behaviour, their perceived level of knowledge and skill surrounding the behaviour and impacts on the environment, whether they perceive they have control over performing the behaviour, norms around performing the behaviour, and whether they report intention to undertake the behaviour.

2.7.1 Attitude

Attitude is a key predictive factor in the theory of planned behaviour, as one of the three determinants of intention (Ajzen, 1991). While some studies of environmental behaviour have measured attitudes towards the environment generally, typically attitudes towards a particular behaviour are measured, as these are more closely aligned and therefore a stronger measure (Bamberg & Schmidt, 2003; Bodur & Sarigöllü, 2005; Cheng & Wu, 2015; Hines et al., 1987; Leonidou et al., 2015; Rhead et al., 2018). Attitudes are based on individual beliefs about outcomes of performing the behaviour (Carmi et al., 2015; de Leeuw et al., 2015; Montes et al., 2018; Rauwald & Moore, 2002).

2.7.2 Ascription of Responsibility

The responsibility of actions may be ascribed to another individual or group, or to oneself (Hart, 1948). Ascription of responsibility is a key component of Norm Activation Theory and Value Belief Norm Theory (Schwartz, 1977; P. C. Stern et al., 1999). Ascribing responsibility to oneself is hypothesised as key in the activation of norms based on the belief that the individual's actions may lead to desirable or undesirable consequences (P. C. Stern et al., 1999; Tanner, 1999). As discussed earlier, many government and non-government organisations promote the idea that recreational fishers, as users of fisheries, should perform voluntary stewardship activities (Cowx et al., 2010; Granek et al., 2008; Grizzetti et al., 2016; Voyer et al., 2017) and this has encouraged an increased focus on the role of recreational fishers in habitat stewardship activities (Copeland et al. 2017). Government bodies in Australia typically aim to ascribe responsibility for habitat restoration and rehabilitation to recreational fishers, and often their communication strategies are based on activating a sense of ascribed responsibility to self among recreational fishers (Gregory, 2018).

2.7.3 Awareness of Consequences

Awareness of consequences is also a key measure in Value Belief Norm theory (VBN: P. C. Stern et al., 1999). As discussed in section 2.2, knowledge is a logical pre-requisite to environmental behaviours; without being aware of the consequences of actions or inactions on the natural environment individuals would not be able to consciously make the choice to

participate in positive environmental behaviours (Bolderdijk et al., 2013; Chawla & Cushing, 2007; Gifford, 2011). Awareness of consequences is thus tightly coupled with environmental knowledge; as an individual's understanding of natural environments is strengthened, they will gain a better understanding of consequences of human behaviours within these systems (Cheng & Wu, 2015). The consequences referred to are adverse consequences, which may be to the individual and/or others and/or the environment (P. C. Stern et al., 1995). In VBN theory the authors indicated that these measures are linked to impacts on the environment - measuring an individual's understanding, or perceived understanding of the impact of certain actions on the natural environment (P. C. Stern et al., 1999).

2.7.4 Perceived Environmental Knowledge and Skill

As highlighted in the Environmental Education literature (section 2.2), it is logical that in order to behave pro-environmentally, an individual must first possess the knowledge and skill required to perform the behaviour (Hines et al. 1987). While awareness of consequences measures rely on the assumption that an individual can/will not act without pre-requisite knowledge, perceived knowledge and skill measures whether an individual believes they possess the knowledge and skill to perform the behaviour under investigation. Sia et al. (1986) found perceived skill in using environmental action strategies was a significant predictor of environmental behaviour. Measuring an individual's perceptions of skill and knowledge is key, as Alisat and Riemer (2015) highlight that lacking competency beliefs are a significant barrier to intention and action. In a study of multiple conservation organisation members Sivek and Hungerford (1990) found that perceived skill was the largest contributor to predicting environmental behaviour.

2.7.5 Perceived Behavioural Control

Perceived behavioural control was added to the Theory of Reasoned Action by Ajzen (1985) when creating the Theory of Planned Behaviour to add situational context regarding ease or difficulty performing behaviours. Perceived behavioural control is sometimes labelled personal control or self-efficacy and is a measure of an individual's assessment of their capability to perform a behaviour if they wish (Ajzen, 1991). Perceived behavioural control has consistently been linked to behaviour performance in relation to environmental actions (de Leeuw et al., 2015; Gifford, 2011; Gifford & Nilsson, 2014; Shaul & Tally, 2006). Many authors have attempted to measure and classify barriers to pro-environmental action but this is a complex task (with one study finding over 30 potential psychological barriers alone) and they

are often difficult to measure (Gifford, 2011). Perceived behavioural control acts as a proxy for control in performing behaviours and is far easier to measure (Ajzen, 2012). As this type of control is based mostly on external barriers or obstacles (as opposed to control measures such as locus of control) it is situation specific and likely to change in importance and predictive value dependent on the behaviour being measured (Ajzen, 1991, p.183).

2.7.6 Subjective (Descriptive and Injunctive) and Moral Norms

Norms were highlighted as important in both Theory of Planned Behaviour (TPB) and Value Belief Norm theory (VBN), with TPB incorporating subjective norms and VBN incorporating moral norms. VBN proposes that personal norms are rooted in values, as biospheric values lead to higher levels of EB and environmental self-identity, which strengthens personal norms (Steg et al., 2016). Moral norms measure an individual's internalisation of social norms (Bamberg & Möser, 2007; Han & Hyun, 2018). Moral norms were included in the VBN theory, with authors capturing moral obligation to perform a behaviour (P. C. Stern et al., 1999). Moral norms are an important addition to predictive models of behaviour that does not directly benefit an individual (Unal et al., 2017; Steg & Vlek, 2016).

Subjective norms capture social norms and are a combination of descriptive and injunctive norms (Montes et al., 2018). Subjective norms are founded on "perceived social pressure to perform or not to perform the behavior" (Ajzen, 1991, p. 188). Originally TPB only incorporated injunctive norms, with the descriptive norms component added by the original authors in 2010 (de Leeuw et al., 2015). Descriptive norms are based on perceptions of whether others commonly perform the behaviour (Farrow et al., 2017). Injunctive norms are based on perceptions of approval or disapproval of others (Steg & Vlek, 2009). Particularly based on others the individual perceives as important to or central in their lives, such as family and friends, or peers (de Leeuw et al., 2015; Montes et al., 2018). The norm is internalised but is based on approval seeking or judgement avoidance of others (de Leeuw et al., 2015; Carmi et al., 2015). Subjective norms have been found to be strong predictors of behaviour in various studies (Bamberg et al., 2015; Han & Hyun, 2018; Steg & Vlek, 2009; Steg 2016), with Carmi et al. (2015) and Cho and Kang (2016) noting that they are stronger predictors of behaviours that are performed in public than private due to the perceived higher visibility of the behaviour by others. Gifford & Nilsson (2014) identified that when both descriptive and injunctive norms are high, they are a strong predictor of conservation behaviours.

2.7.7 Intention

Behavioural intention is the most proximal and strongest factor influencing behaviour in Ajzen's model of planned behaviour (Ajzen, 1985; Ajzen, 1991, 2012; Howard, 2019) and was a central factor in the theory's predecessor, the theory of reasoned action (TRA). Intention was a significant predictor of behaviour in the meta-analysis conducted by Hines et al. (1987) and has been widely accepted as a key indicator of behaviour performance (Morren & Grinstein, 2016). Ajzen (2012) has noted that intention is only a strong predictor of behaviour if the behaviour is under volitional control.

As well as considerable evidence that intentions are predictive of behaviour in a range of contexts, intentions have also been shown to be predicted by attitudes, norms and perceived behavioural control (Ajzen, 2012) as modelled in the theory of planned behaviour. Intentions vary greatly between individuals due to influence of these other measures (Ajzen, 2012). Intention has been proven as a successful predictive measure in models of boater's obeying speed zones near endangered wildlife, green tourism behaviours and environmental activism behaviours (Leonidou et al., 2015; Wynveen et al., 2015).

2.7.8 Intersectional and Equifinal Understandings of Psychosocial Aspects

As with the other categories of constructs discussed in this literature review, psychosocial aspects are often measured based on their net effect on pro-environmental behaviour, causing misleading results (Olya & Akhshik, 2018). Olya and Akhshik (2018) suggest the use of fuzzy set Qualitative Comparative Analysis as a "state-of-the-art approach" to overcome this downfall and more accurately capture the complex interactions of indicators within the realm of pro-environmental behaviour prediction.

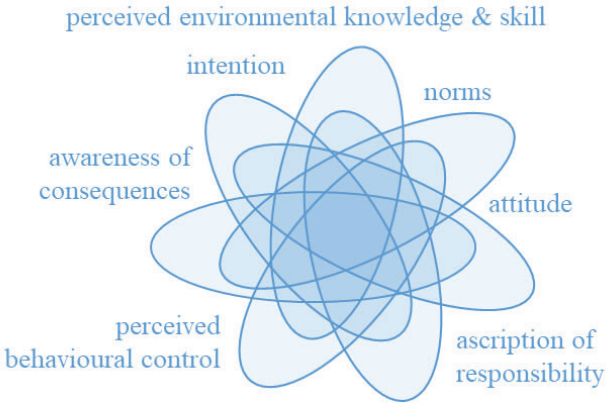

Figure 7. Psychosocial aspects hypothesised to contribute to specific responsible environmental behaviour

2.8 CONCEPTUALISING PRO-ENVIRONMENTAL BEHAVIOUR

The preceding review of literature has highlighted the various interconnected factors that have been proposed as predictive indicators of SREB. The complexity of predicting this type of behaviour is made apparent through the disagreement within and between streams of literature (Bamberg, 2003; de Leeuw et al., 2015; Lucas et al., 2008). Amplifying this complexity is the revelation that many of these factors have been indicated/ shown to have a predictive relationship with each other. Various scholars have attempted to model environmental behaviour prediction. **Figure 1**, **Figure 2** and **Figure 3** exhibited model development over time, showing development of complexity and understanding. **Figure 8** presents the composite model of pro-environmental behaviour created by Kollmuss & Agyeman (2002) which attempted to incorporate all the factors identified in their review of existing theoretical frameworks. This is a theoretical model only and has not been evaluated for predictive validity, however it does attempt to summarise the vast number of factors used in pro-environmental behaviour prediction and signifies the complexity of doing so.

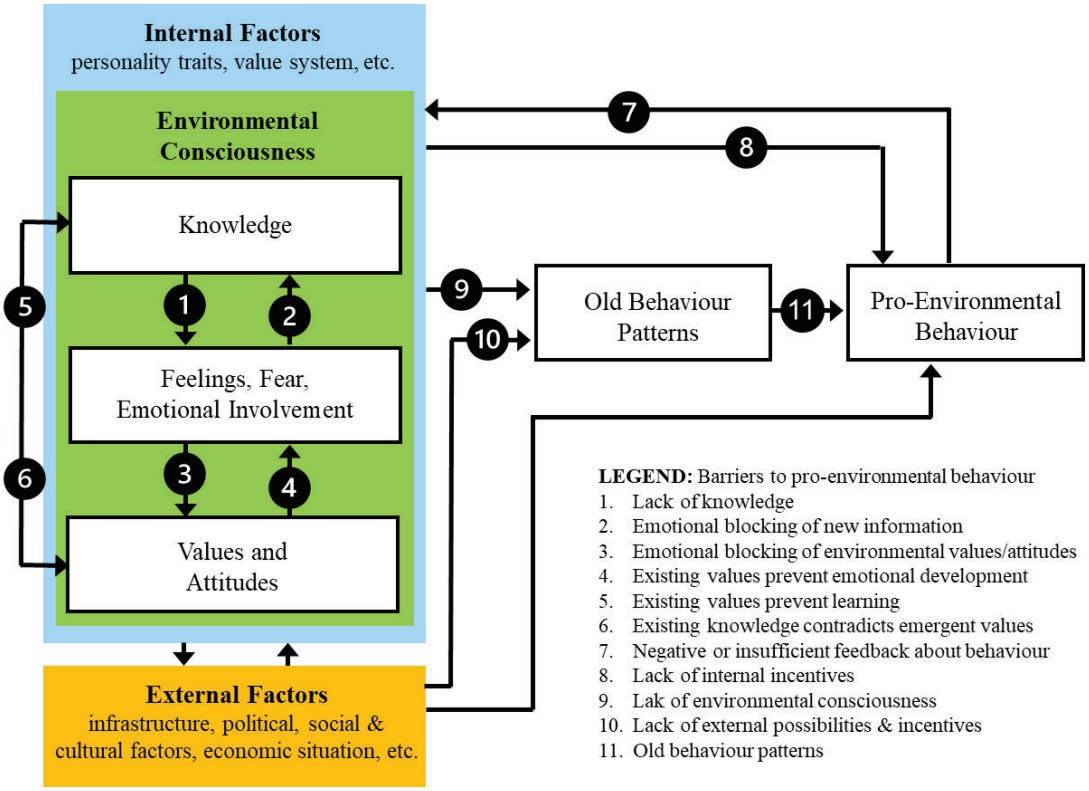

Figure 8. Composite Model of Pro-Environmental Behaviour (Kollmuss & Agyeman, 2002)

These previous models reveal the difficulty in achieving a parsimonious model of pro-environmental behaviour performance while also capturing the complexity of prediction. As stated by Gifford and Nilsson (2014, p. 151)

> the models that have been proposed, although well-intentioned, probably are too simple… Attempting to fully account for variation in environmental concern and pro-environmental behaviour is a seriously complex enterprise.

2.9 CONCEPTUAL FRAMEWORK

The proposed model for this research embraces this complexity, which used in conjunction with fsQCA aims to reduce a complex array of interrelated factors to a succinct model of necessary and sufficient factors for prediction. "One of the primary goals of the qualitative comparative approach is to allow maximum causal complexity—to avoid making simplifying assumptions about causes at the outset, as is done in most conventional statistical analyses" (Ragin, 2014, p. 105). This thesis presents a complex, integrated model of key variables highlighted throughout the preceding literature review. Seen in **Figure 9**, this model was constructed based on key constructs identified within extant literature discussing outdoor recreation, recreational fishing, behaviour prediction and environmental behaviour in order to capture a complete snapshot relevant to this research.

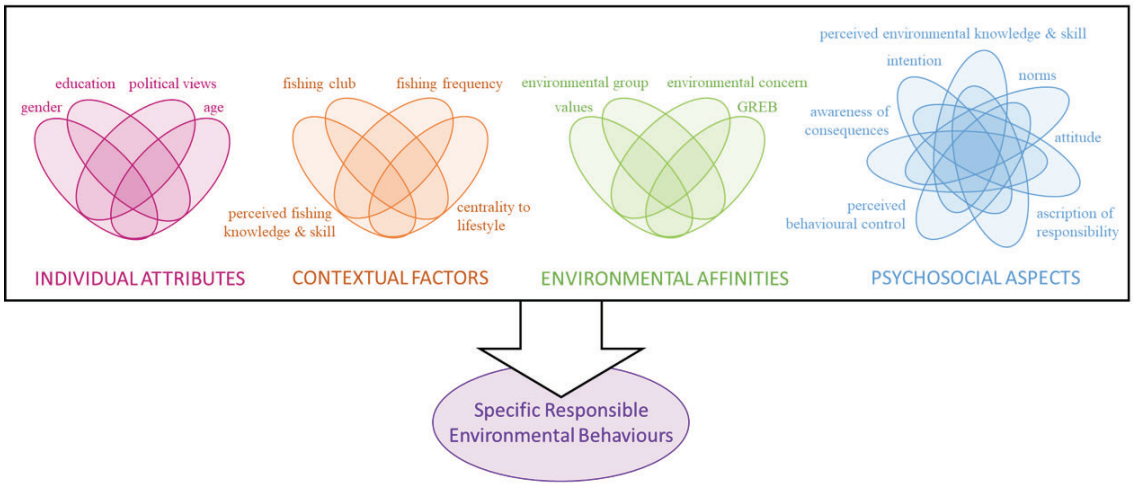

Figure 9. Conceptual model of influencing factors of specific responsible environmental behaviour

In conjunction with the hypothesised model of behaviour prediction the following research questions were proposed:

RQ1: Are there any conditions that are empirically necessary for the performance of specific responsible environmental behaviour in recreational fishing environments?

RQ2: Which, if any, theoretically possible configurations of conditions are considered sufficient for the performance of specific responsible environmental behaviour in recreational fishing environments?

The conceptual model and research questions guided the methodological approach and design of the research outlined in the following chapter. Nineteen independent variables known to predict proenvironmental behaviour are taken from the extant literature and analysed as predictive conditions via fuzzy-set Qualitative Comparative Analysis (fsQCA). Thus, this research attempts to reduce complexity in the literature by applying fsQCA to identify i) conditions that combine with other conditions in configurations that produce the outcome of interest (conjunctural causation) and ii) if many configurations are linked to the same outcome (equifinality) (Kane, Lewis, Williams, & Kahwati, 2014).

Chapter 3: Methodology

This chapter is broken into two distinct sections. The first section provides detail of the methodological approach, including epistemological, ontological and theoretical underpinnings of the research. Fuzzy set Qualitative Comparative Analysis (fsQCA) is discussed in further depth, including its relation to set theory and its unique notational system. The second section of this chapter outlines the research design, including ethical considerations, sampling design and question design. This is followed by an overview of data preparation and factor analysis, culminating in the revision of the conceptual framework for this research. Finally, methods involved in undertaking fsQCA analysis are presented.

3.1 METHODOLOGICAL APPROACH AND JUSTIFICATION

The research was undertaken within a postpositivist paradigm. Postpositivism challenges the traditional ideas of positivism i.e. that knowledge is absolute (Creswell, 2018, p.6) and instead acknowledges that research findings are "probably true" (Guba & Lincoln, 2008, p.260). Afterall, evidence is imperfect and influenced by human and social factors (Cresswell, 2018, p7). Guba and Lincoln (2008) propose that a postpositivist paradigm is well positioned for the gradual development of substantive theory through accretion of knowledge and presentation of non-falsified hypotheses. Criteria for quality in postpositivist research includes "internal and external validity, reliability, and objectivity" (Guba & Lincoln, 2008, p.261).

Due to its close alignment with postpositivism, critical realism was identified as the epistemological and ontological approach to the research. Critical realism was also being harnessed as a meta-framework for understanding the relationships between complexity and Qualitative Comparative Analysis (as described by Gerrits and Verweij, 2013). Critical realism is closely aligned with postpositivism, as a core tenet of both is that our understanding and perceptions of reality are imperfect (Guba & Lincoln, 2008). Critical realism acknowledges that events and phenomena of the world are not solely conceived by humans and the human interpretation of the world is socially constructed (Denzin & Lincoln, 2008).

A key focus of this research is its examination of environmental problems through a social lens. The research explores human behaviours, psychosocial constructs and interpretations of the world, with the end goal of impacting the physical world in a concrete, measurable way. Huckle (2004, p. 35) highlights the practicality of critical realism, stating it

is an appropriate foundation for the development of a science that "can explain how social processes as understood by the social sciences combine with ecological and biophysical processes as understood by the physical sciences". Indeed, key theorists in the field of environmental behaviour have acknowledged the inextricable links between environmental problems and human values (de Groot & Steg, 2008; P. C. Stern, 2000), and environmental action and social contexts (Taniguchi & Marshall, 2018; Steg, 2016). This is most notably portrayed in Dunlap & Van Liere's New Environmental Paradigm (1978), as discussed in section 2.6.1.

The focus of QCA analysis is to highlight the interplay of conditions, rather than isolating single variables as commonly seen in variable-based statistical analyses. QCA is therefore not only a helpful method for analysing complexity but is also complexity-informed in itself (Gerrits & Verweij, 2013). Unlike more commonly recognised methods of quantitative analysis, Qualitative Comparative Analysis does not average differences between cases in a sample. Instead it uses the heterogeneity in data to identify distinctly different configurations based on how conditions operate conjointly, known as conjunctural causation (Ragin, 2014; Gabriel et al., 2018, p. 878). Additionally, this method does not search for a single combination of conditions to predict an outcome. Instead QCA allows for multiple different configurations to predict the same outcome, known as equifinality (Fiss, 2011; Gabriel et al., 2018). QCA identifies only those conditions that are necessary and/or sufficient to predict an outcome, rather than incorporating all conditions measured (Fiss, 2011; Gabriel et al., 2018). Thus, QCA offers parsimony. In other words, it is suited to the task of analysing the conceptual framework presented herein – which includes 19 conditions. The principle of multifinality also means that conditions may have a different effect in different contexts or when assessed in combination with different conditions. This is in contrast to traditional linear analysis which is unifinal (Gerrits & Verweij, 2013, p. 175).

Complexity theory, like QCA is based upon the principles of conjunctural causation, multifinality, equifinality and asymmetry (Gerrits & Verweij, 2013). QCA has the capacity to analyse complex causation (Ragin, 2008, 25) and the complexity of reality described by critical realism and complexity theory (Gerrits & Verweij, 2013). In this way, the research questions, paradigm and contribution are aligned, given policy intervention often occurs in the context of complex causality (Blackman, 2013).

3.1.1 Fuzzy-set Qualitative Comparative Analysis: A Methodological Approach

In order to adequately answer the research questions and tackle the conceptual framework, the application of the comparative analysis technique fuzzy-set Qualitative Comparative Analysis (fsQCA) was required. QCA was developed by Charles Ragin in 1987 to bridge case based and traditional quantitative approaches to research, harnessing the best of both approaches (Ragin, 2014). QCA in its original form is sometimes referred to as crisp-set Qualitative Comparative Analysis (csQCA), as membership in sets was measured as 1 "full membership" or 0 "full non-membership". Ragin later developed fuzzy-set Qualitative Comparative Analysis (fsQCCA) which allows membership on a scale between 0 and 1 (Ragin, 2000, 2008). As an approach and analysis technique, fsQCA relies on set theory, complexity theory, formal logic, and Boolean and fuzzy algebra. QCA is said to closely align with postpositivism and critical realism. As aptly noted by Schneider & Wagemann (2010, p. 2) "QCA is not just another (computer-based) data-analysis technique. In order to do justice to its underlying epistemology, it needs to also be understood – and applied – as a research approach in a broad sense".

In his key work *The Comparative Method* published in 1987 and re-released in 2014, Ragin described a "synthetic strategy" that incorporates "the best features of the case-oriented approach with the best features of the variable-oriented approach" (Ragin, 2014, p. 84). Ragin suggests QCA does not diminish either the complexity of causation or the variation in social phenomena. In this way, QCA is a mid-point of complexity and generality (Ragin, 2014). Readers should note that the mathematical underpinning of QCA is Boolean, as opposed to linear algebra. The focus of statistical studies is breadth, where researchers infer characteristics of populations from samples (Cooper 2011, p. 142). Conversely, case studies focus on depth and detail and the interrelations of conditions in a small sample of events or outcomes. QCA combines breadth and depth to assess which conditions are related to a particular outcome (Rihoux & Ragin, 2009; Rihoux & Marx, 2013; Ragin, 2008).

Schneider & Eggert (2014) acknowledge that QCA is a better choice for analysis "when the links are complex", as has been shown in the preceding literature review. They indicate the suitability of QCA analysis for answering the research questions of this study due to the complex, configurational links between data that are expected, based on the complexity and intertwined nature of conditions uncovered in the literature review. Schneider & Wagemann (2010, p.3) note the aims of QCA include testing existing hypotheses and theories and

developing new theoretical arguments – demonstrating the suitability of QCA as an approach and analysis technique for this research.

3.1.2 Set theory

QCA is a set theoretic approach and sets are key to the methodology. Duşa (2019) describes sets as a category/ collection of objects that share a common property. Based on existing theory, membership in sets is conceptualised and then applied to the data through a process known as calibration (see section 3.5.1 for further discussion) (Gabriel, Campbell, Djurdjevic, Johnson, & Rosen, 2018; Ragin & Pennings, 2005). "A fuzzy set can be seen as a continuous variable that has been purposefully calibrated to indicate [the] degree of membership in a well-defined and specified set" (Ragin, 2008, p. 30). Investigating set relations instead of linear relationships is based on the idea that social sciences relations are often based on explicit connections that are set-theoretic relations rather than correlations (Ragin, 2014). This demonstrates the link to complexity as set-relations are asymmetric and "complexity focuses on intricate causal patterns that progress non-linearly" (Gerrits & Verweij, 2013, p. 168).

QCA investigates relationships of necessity and sufficiency. These relationships are represented by set relations in the form of supersets and subsets. fsQCA asks "what conditions—alone or in combination with other conditions—are necessary or sufficient to produce an outcome" (Kane et al., 2014, p. 202). A relationship of sufficiency is represented with a superset relation where Y is a superset of X, while a necessity relationship involves X being a superset of Y (Fiss, 2007; Kane et al., 2014; Ragin, 2013). Accordingly, a sufficiency relation indicates that X is a subset of Y and a necessity relation indicates that Y is a subset of X (Ragin, 2008). **Figure 10** visualises these two types of relationship.

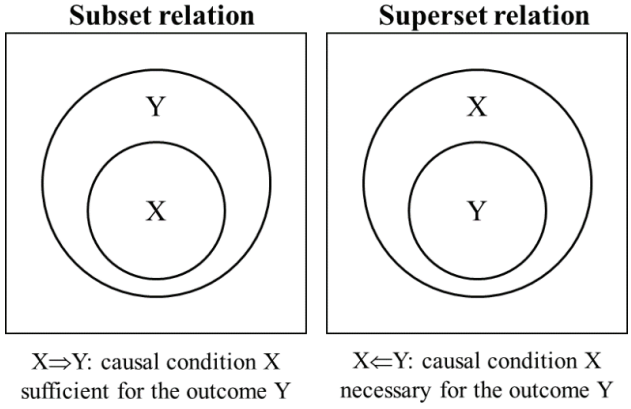

Figure 10. Subset and superset relations

3.1.3 Notational systems

QCA borrows terminology and operational notation from other mathematical logics and principals. To aid readers, Table 1 summarises QCA terminology and the closest quantitative equivalent or comparisons.

Table 1. Notational comparison of fsQCA and conventional quantitative techniques

fsQCA Term	Comparative Quantitative Term
Sets	Variables
Set-theoretic relations	Correlations
Counterfactual analysis	Counterfactual estimation
Consistency	p-value
Coverage	r^2
Calibration	Measurement
Truth table	Beta co-efficient/ correlation matrix
Antecedent condition	Independent variable
Outcome condition (qualitative outcome)	Dependent variable
• / * = AND/ conjunction	• / * = multiplication
+ = OR/ disjunction	+ = addition
Boolean algebra	Linear algebra
Solution formula	Equation
~X, negated set membership	No equivalent[6]
Uncovers causal recipes (configurations of INUS conditions)= case based approach	Uncovers "net effects" (intercorrelations of independent variables) = variable-based approach

Sources: Ragin (2008); Schneider and Wagemann (2012); Woodside (2017, p. 13)

This thesis uses capitalised condition names for outcome conditions (e.g. X) and ~ to indicate the absence of or negation of an outcome condition (e.g. ~X). Set intersection, or the conjunction of two or more condition sets (logical AND) is indicated with an asterisk. Set union, the disjunction of two or more condition sets (logical OR) is indicated with +[7]. These conventions were taken from Schneider and Wagemann (2010, p. 18).

3.2 RESEARCH DESIGN

A structured questionnaire was deployed via the online platform Qualtrics. A self-administered survey was deemed appropriate for the research due to the versatility and

[6] Note: Conventional quantitative techniques are based on symmetric relationships and do not allow for asymmetry

[7] See Ragin (2008, p. 36-37) for a detailed explanation of set intersection and union

efficiency of this approach. Surveys allow for vast geographic coverage, prompt collection of data and the use of more complex instruments than face-to-face or phone interviewing (Cooper, 2011). Walter (2013, p. 131) and Ornstein (2013, p. 118) highlight an additional benefit of self-administered surveys in that participants complete the questionnaire at their own pace, allowing them to more carefully consider questions before responding and easily revise details if necessary. Self-administered questionnaires are less prone to issues such as order effects (Ornstein, 2013, p. 181), interviewer influence or biases (Walter, 2013) and social pressure (Cooper, 2011, p. 251) than surveys administered in other ways.

The descriptive nature of this study, combined with budget and time constraints lead to the collection of cross-sectional data. "Cross-sectional studies are carried out once and represent a snapshot of one point in time" (Cooper, 2011, p. 142). A cross-sectional design was also appropriate given the traits, attitudes and behaviours measured are considered durable over time. As suggested by Ornstein (2013, p. 46) a draft of the survey was reviewed by two senior researchers and an industry professional. Minor revisions were made to increase both construct and face validity based on feedback from the reviewers. Participants may misinterpret items within a self-report instrument (Creswell, 2009). To prevent this from occurring, the survey was distributed to a small pilot sample. Comments were provided regarding question comprehension, meaning and understanding.

Abridged existing scales were used where possible, although slight modification of scales occurred in some instances to more accurately capture the construct in the study context. Screening questions were incorporated at the beginning of the survey to qualify participants and reduce response error (Cooper, 2011) but also comply with ethical considerations regarding the age of participants. The sequence in which questions were presented was carefully considered to avoid potential semantic order effects or serial order effects (Ornstein, 2013). Where possible general environmental views and self-report behaviours were captured prior to SREB participation and proximal determinants. Demographic information was captured in the final section of the survey, as this information is generally easier for participants to recall than attitudinal views, thus reducing cognitive effort (Ornstein, 2013). A number of items were reverse coded in order to avoid straightlining effects (Walter, 2013).

Some argue that research measuring human behaviour should be designed around observation of behaviour, as opposed to self-reported behaviour (Kormos & Gifford, 2014). However self-reported measures are common in the extant literature.
The anonymity associated with self-administered surveys allows for more honest responses,

reducing social desirability bias (Cooper, 2011). Furthermore, observing individuals in recreational fishing environments would be prohibitively challenging in terms of cost and ethical compliance.

3.2.1 Ethical considerations

Ethical clearance for the research was granted by The Queensland University of Technology Ethics Committee and it was conducted while upholding the values of justice, beneficence and respect for participants. The research was confirmed to be low risk, defined by Walter (2013, p. 76) as "research where the only foreseeable risk to respondents is one of discomfort". Babbie (2016) indicates that revealing attitudes and personal characteristics can make a participant uncomfortable. While this survey did not capture deviant behaviours, various questions capturing concepts such as political views, level of education and attitudes may have led to discomfort (Babbie, 2016; Earl, 2015). In order to ease participant concern and discomfort, anonymity was assured (Walter, 2013, p. 82) through measures such as distributing the survey via an anonymous link and not recording participant IP addresses. Participants were also advised that only the initial screening questions required a response and all others could be skipped if answering would cause discomfort.

Other ethical considerations included the amount assigned to the prize draw and collection of identifying information. Five vouchers for $50 each were offered in recognition for participants' contributions. $50 was in line with social norms, striking a balance between compensation for one's time and the coercion associated with larger rewards (Walter, 2013). A completion window of six weeks was selected to give participants ample opportunity to consider their participation and seek clarification if required. The participant group was not identified as vulnerable. As the survey was distributed via individuals in a position of power relative to organisation members, the name of organisations that individuals belonged to was not recorded. Walter (2013) advises that the most effective way to ensure anonymity is to not collect identifying data. Identifying information was required in order to complete the prize draw, however it was stored securely and not linked to the survey responses.

3.2.2 Sampling Design

Cooper (2011) outlined the five core elements of a sampling design: target population, parameters of interest, sampling frame, sampling method and sample size. This section discusses the sample with respect to each of these elements.

Ragin (2008) notes that QCA methods involve selecting participants based on the expectation of displaying the outcome condition. This is in contrast to traditional quantitative methods, which often aim for a representative sample. The target population for this study was therefore defined as "*individuals aged 16 or older, who live in Australia and participate in recreational fishing and/or environmental conservation activities*". A cut-off of 16 years of age was selected in consultation with the university's ethics department so that participants could exercise their capacity to consent (as per Chapter 2.2 of the National Statement on Ethical Conduct in Human Research), whilst also capturing a broad range of ages, given the extant literature indicates youth are more likely to perform volunteering (Gil-Lacruz, Marcuello-Servós, & Saz-Gil, 2016) and pro-environmental behaviours (Grønhøj & Thøgersen, 2017). A national sample was chosen as previous studies have found that predictors of environmental behaviour vary in different cultural settings (Cordano et al., 2010). Furthermore, the political and regulatory landscape of recreational fishing in Australia is unique. The parameter of interest was self-reported performance of fish habitat management and restoration actions in the 12 months prior to completing the survey. This was captured with a nominal measure (yes/no).

Capturing data from these two populations allows for comparing and contrasting of outcome recipes (while reducing the issue of limited diversity in the sample). The selection of recreational fishing participants is appropriate as they are often the target of programs designed to increase stewardship behaviours, while the selection of participants who participate in environmental conservation activities ensures the outcome is captured. The sampling frame was constructed by compiling a list of publicly available email addresses or web-based contact forms for Australian recreational fishing clubs and relevant environmental or habitat management organisations. As no email address directories are available, this was the most suitable way to access these individuals. While a comprehensive search was completed to locate appropriate organisations and contact details, it was limited to the publicly available information uncovered by the primary researcher. A list of organisations contacted is available in Appendix A.

A non-probability sampling method was adopted, given the sampling frame and need for national coverage (Cooper, 2011). This involved judgment and snowball sampling. "Judgement sampling occurs when a researcher selects sample members who conform to some criterion" (Cooper, 2011, p. 385). Primary contacts for organisations that conformed to the sampling frame were selected in a purposeful way, followed by a snowball strategy, whereby

these individuals were invited to distribute the survey to their members, and in turn their members were then invited to distribute to others who fit the sampling frame. A similar sampling technique was successfully employed by Tranter (1995) to access individuals in environmental organisations in Tasmania, Australia. Recruiting via these organisations skews the sample towards individuals who are a member of an organisation. However, requesting that these individuals distribute to others in their network acts to counterbalance this limitation. A recent study involving recreational fishers found that more than half of the respondents did not belong to a fishing organisation, despite deployment of the survey through these channels (Copeland et al. 2017). Non-probability sampling is complimentary with the methodological approach of the study. Generalising "what is" is the goal of positivists, while QCA methodology employs purposive sampling for the outcome condition, with the goal of drawing conclusions that may translate to other contexts, or generalising "what could be" (Cooper, 2011; Ragin, 2013).

A sample of 150 participants was deemed sufficient to ensure variability and validity of responses, while being attainable and ethical, given constraints surrounding recruitment channels. Unlike correlation-based techniques, fsQCA does not require a large sample size to ensure robust application. Thus, a power analysis to determine appropriate sample size was unnecessary. FsQCA has been appropriately applied in studies with anywhere from 10 to 2,400 cases (Gabriel et al., 2018). In order to maximise participation rates, participants received multiple reminders after the initial invitation and an offer to enter a prize draw after survey completion. Both strategies have been suggested to increase response rates (Cooper, 2011; Ornstein, 2013).

Although researchers such as Walter (2013) and Cooper (2011) warn that using the Internet to distribute surveys may exclude or under-represent low income individuals it was determined that an Internet based survey was appropriate for this study as it employed non-probability sampling. Moreover, previous studies have found a positive correlation between recreational fishing, pro-environmental behaviours and income.

3.2.3 Question design

The questionnaire incorporated a combination of existing and modified scale items, measuring the conditions outlined in the conceptual framework. Well-established, validated and reliable instruments were chosen. All items were monotone, avoiding extreme or suggestive language. None of the items were likely to induce anxiety of social desirability bias

(Cooper, 2011). Response scales were retained where possible. The scales used to operationalise each condition are briefly discussed in the following sections. The full survey instrument is provided in Appendix B.

Outcome Condition: Specific Responsible Environmental Behaviour (SREB)

SREB was measured with a single item adapted from (Wynveen & Sutton, 2017). The measure was based on participants' self-reported behaviour during the twelve months prior to taking the survey. Participants were first provided with a definition/ examples of SREB activities: "Fish habitat management and restoration actions can involve a range of activities including: removing non-native species; resnagging, riverbank planting, restoring reefs; removing rubbish; weed control; constructing artificial habitats, fish hotels, fish friendly marine infrastructure; installing fishways/ fish ladders/ fish steps, installing gross pollutant traps, removing barriers in waterways etc. The following questions relate to fish habitat management and restoration actions:" This was followed by a single item to measure SREB, "Have you performed these environmental behaviours in the past 12 months" (yes/no). Use of a single item to measure SREB is common (Cho & Kang, 2016; P. C. Stern et al., 1999). Research suggests that single item measures are often preferable for constructs that address a concrete or binary attribute as was the case here. The use of self-reported behaviours is common in the extant literature exploring environmental behaviour (Hines et al., 1987; Schultz & Zelezny, 1999).

Causal Conditions

The tables below summarise the measures used for each condition across the four categories measured: Individual Attributes (Table 2), Contextual Factors (Table 3), Environmental Affinities (Table 4) and Psychosocial Aspects (Table 5):

Table 2. Individual attributes items

Condition	Measures
Gender	Single item "what gender do you identify as?". Three response options provided (male, female, X) in-line with QUT Ethics guidelines
Education	Following Ornstein (2013) highest level of education was captured using a single item based on the Australian Standard Classification of Education (ABS, 2001). For ease of completion some levels were combined, reducing choices to six options.
Age	A single, open-ended question "how old are you today?" was used to capture the participants' age at the time of taking the survey. This allowed for ratio data that represents "actual amounts" (Cooper, 2011, p. 277).

Condition	Measures
Political views	Three items from a political attitudes scale were used (ABS, 2001; Curtice, Clery, Perry, Phillips, & Rahim, 2019; Evans & Heath, 1995). Items included the statements: "Government should redistribute income from the better off to those who are less well off", "Big business benefits owners at the expense of workers", and "There is one law for the rich and one law for the poor". Responses were measured on a 5-point Likert scale, anchored at strongly (dis)agree.

Table 3. Contextual factors items

Condition	Measures
Frequency of Participation	Participants were asked how often they had engaged in recreational fishing over the past 12 months. This timeframe was utilised due to its prevalence in outdoor recreation (e.g. Daigle et al., 2002) and recreational fishing studies (e.g. Magee et al., 2018).
Centrality to Lifestyle	This was a measure of how central recreational fishing is to the individual's lifestyle. It was measured using a modified scale fromSutton (2003) and Montes et al. (2018). Items included statements such as "fishing and fishing related activities are one of the most enjoyable things I do". Responses were measured on a 5-point Likert scale, anchored at strongly (dis)agree.
Fishing Club Membership	This was measured using a single item with a binary yes/no response option as is common in the literature (Copeland et al., 2017).
Perceived Knowledge and Skill (Fishing)	This was measured with a scale adapted from Montes et al. (2018). Respondents rated agreement on a Likert scale for three items, such as, "I have an in-depth knowledge of fishing rules and regulations".

Table 4. Environmental affinities items

Condition	Measures
Environmental Concern	Measured using the most recent version available (Bernstein, 2017) of the established New Environmental Paradigm Scale (Dunlap & van Liere, 1978, 2000). Items measured on a 5-point Likert scale. Statements included, "Nature would be at harmony if human beings would leave it alone". This instrument included reverse coded items as indicated with an (r) in Appendix B.
General responsible environmental behaviour (GREB)	Participants were asked "which of the following have you done in the last twelve months (select all that apply)" and then indicated their participation in a list of seven activities related to "general environmental issues": The items selected were based on the environmental action scale (Alisat & Riemer, 2015).
Values	Measured using value orientations for environmentally significant behaviour (de Groot & Steg, 2008). Consistent with Value Belief Norm Theory, egoistic, altruistic and biospheric values (P. C. Stern et al., 1999) and hedonistic values (Steg et al., 2012) were measured. Respondents were asked "How important are the

Condition	Measures
	following to you in the way you live your life?" with responses recorded on a 5-point Likert scale, anchored at "opposed to my principles" and "extremely important/ central to my life".
Environmental Organisation Membership	Following Leonidou et al. (2015) and P. C. Stern et al. (1999) measured using a single-yes / no response to "Are you a member of any group whose aim is to preserve or protect the environment?".

Table 5. Psychosocial aspects items

Condition	Measures
Attitude	Participants' attitudes towards SREB were measured via three statements, on a 5-point Likert scale, indicating their agreement that the activity would be enjoyable, important, or worthwhile. This is based on the highly utilised measure of attitude in Theory of Planned Behaviour applications (Ajzen 1991; Ajzen 2005; Fishbein & Ajzen, 2009). Attitudes as per the TPB have been measured in a number of studies of environmental behaviour (Bamberg, 2003; Zhang, Geng, & Sun, 2017). Following recommendations from Kollmuss and Agyeman (2002), Axelrod and Lehman (1993) and Carmi et al. (2015) attitude was measured toward the specific behaviour that is the focus of the study (SREB).
Awareness of Consequences	These items measured participants' level of awareness of threats to fish habitat by modifying existing measures (Han, Jae, & Hwang, 2016; P. C. Stern et al., 1999; P. C. Stern et al., 1995). Participants were asked questions such as "what do you believe are the impacts of the following on fish habitats?". Four response options were provided; "positive", "neutral", "negative" and "I don't know". Items listed were a combination of recognised threats to fish habitat and recognised actions that improve fish habitat compiled from Gregory (2018) and Copeland (2017). The inclusion of the option "I don't know" in the response scale is recommended by Cooper (2011) as removing this option and forcing a response from participants who are unsure of the answer would reduce reliability of the responses. A composite condition was computed.
Perceived Knowledge and Skill (PKS)	PKS relates to performing the responsible environmental behaviours and was adapted from studies by Montes et al. (2018). Four items were measured on a Likert scale.
Perceived Behavioural Control (PBC)	PBC is a variable from the Theory of Planned Behaviour (Ajzen, 1991). PBC items have been altered to suit various contexts, including studies of environmental behaviour (e.g. Mancha & Yoder, 2015; Olya & Akhshik, 2018). As with attitude measures, authors advise PBC is measured to the same level of specificity as the measured behaviour (Carmi et al., 2015). This study measured PBC with items adapted from Han (2015) including "I am confident I can undertake these types of activities" and "my participation in these types of activities is up to me", using a 5 point Likert response scale.

Condition	Measures
Subjective Norms	This study measured both the descriptive aspects ("People who are important to me undertake these activities") and injunctive aspects ("People who are important to me disapprove of those who undertake these activities") of subjective norm (Ajzen, 1991; de Leeuw et al., 2015; Ho, Liao, & Rosenthal, 2015). Measures of moral norms included "I feel an obligation to undertake these types of activities". All items measuring norms referred to the outcome condition (SREB) which had been introduced and described to participants following Han and Hyun (2018) and Mancha and Yoder (2015).
Ascription of Responsibility	Ascription was measured with a single, reverse-scored item (Wynveen et al., 2015) "My contribution to environmental damage in fish habitats is negligible" (Jakovcevic & Steg, 2013; Wynveen et al., 2015).
Intention	The TPB (Ajzen, 1991) suggests that intentions to perform a behaviour precede observable behaviour. Intentions were measured with a single item from the literature (Ajzen, 1991; Fishbein & Ajzen, 2009). Participants were asked, "Do you intend to perform any fish habitat management and restoration actions in the next twelve months". This item was presented with examples of SREB. Specificity to the outcome behaviour was important, as highlighted by Carmi et al. (2015) and de Leeuw et al. (2015).

3.3 DATA PREPARATION AND FACTOR ANALYSIS

Prior to running Fuzzy-set Qualitative Comparative Analysis (fsQCA), the data was cleaned, and a factor analysis performed. Details of this procedure are provided in this section along with descriptive statistics. As a result of the factor analysis, a revised conceptual model is presented, followed by a discussion of the QCA procedure and the Results chapter. As such, the descriptive statistics and factor analysis are to be considered as preparation for QCA.

3.3.1 Data Preparation

The data was prepared using SPSS v25.0.0.1. A total of 206 Australians elected to participate in the study. Visual inspection concluded that 24 respondent's provided incomplete data or did not provide a response to measure the outcome variable. These cases were removed from any subsequent analysis, using listwise deletion as suggested by Tabachnick (1996). Thus, the final sample included data from 182 individuals (78.57% male, M age = 52.36, SD = 15.15). The sample was spread throughout Australia, as depicted in **Figure 11**. The majority of respondents had completed education following secondary schooling, with the highest level of education completed being a certificate or diploma for 31.3% of the sample, a bachelor's degree for 20.9% and postgraduate education for 30.2% (three respondents did not advise their level of education).

Figure 11. Geographical distribution of survey respondents

Reverse coded items were recoded to ensure correlations with other variables were accurate, while retaining distributional characteristics (Hair, 2014; Tabachnick, 1996). While not all measures were normally distributed, deviations from normality were not deemed problematic due to the robust nature of factor analysis (Allen, 2019). Data was also deemed satisfactory for factor analysis due to the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (0.78) and Bartlett's Test of Sphericity results (Chi-square 2089.471. df=190, sig=0.00). The correlation matrix revealed many of the bivariate correlations between variables were greater than 0.3, also indicating suitability for factor analysis (Allen, 2019, p. 238). Further assumptions of factor analysis as outlined by Allen (2019, p. 238) were confirmed.

3.3.2 Factor Analysis

Schneider & Wagemann (2010, p. 5) advise the use of techniques such as factor analysis in conjunction with fsQCA analysis, for individual level data. Exploratory factor analysis was undertaken using SPSS v25.0.0.1 (IBM Corp., 2017), following the procedures outlined by Yong and Pearce (2013) and Hair (2014). To investigate the underlying structure, all measured items suitable for factor analysis (i.e. excluding aggregate score measures and nominal measures such as gender) were subjected to principal axis factoring with Promax rotation (Kappa 4), as the review of literature indicates factors are correlated (as is often the case with social science research) (Allen, 2019). This process revealed that orthogonal rotation was appropriate, thus reduction of items was performed through completion of Principal

Components Analysis with varimax rotation. Five factors (with eigenvalues exceeding 1) were identified and are presented in **Table 6**. In total, these factors accounted for approximately 72.36% of the variance in the questionnaire data. These 5 factors were used to create summated scales from average scores.

Table 6. Varimax Rotated Factor Structure of Questionnaire Items

Item	Loadings				
	Factor 1[a]	Factor 2[b]	Factor 3[c]	Factor 4[d]	Factor 5[e]
I have a strong knowledge of fish species	.91				
I have a strong knowledge of fish habitat	.90				
I have a strong knowledge of how to restore and preserve fish habitats	.82				
I have a high level of skill in restoring and preserving fish habitats	.75				
I have a strong knowledge of waterways	.73				
Fishing and fishing related activities are one of the most enjoyable things I do		.95			
Fishing is very important to me		.95			
In the past twelve months how often have you gone fishing?		.90			
I consider myself an expert recreational fisher		.79			
Almost everything we do in modern life is harmful to nature			.84		
Nature would be at harmony if human beings would leave it alone			.80		
We are approaching the maximum number of people the earth can support			.75		
We will experience a major ecological catastrophe if society continues on its present course			.69		
Technology causes more environmental problems than it solves			.61		
Involvement in these types of activities would be worthwhile				.92	
Involvement in these types of activities would be important				.90	
Involvement in these types of activities would be enjoyable				.82	
Big business benefits owners at the expense of workers					.90
There is one law for the rich and one law for the poor					.88
Government should redistribute income from the better off to those who are less well off					.88

Note: a= "perceived knowledge and skill" α= .88, b= "centrality to lifestyle" α=.93, c= "environmental concern" α=.80, d= "attitude" α=.84 e= "political views" α=.87. Factor loadings <.3 have been suppressed.

3.4 REVISED CONCEPTUAL FRAMEWORK

As a result of the factor analysis, the conceptual framework was revised to reflect only the psychometrically appropriate measures. This progression is shown in Figure 12 and Figure 13, with Figure 12 showing the original conceptual model and Figure 13 the revised conceptual model. Fishing frequency was included as a measure of centrality to lifestyle, while perceived fishing knowledge and skill was no longer included. The individual attributes and contextual factors were collapsed, to include measures of age, gender, education, political views, centrality of fishing to lifestyle and fishing organisation membership. Measures of norms and perceived behavioural control were also removed. Conditions excluded from the new model are not reported in subsequent analysis.

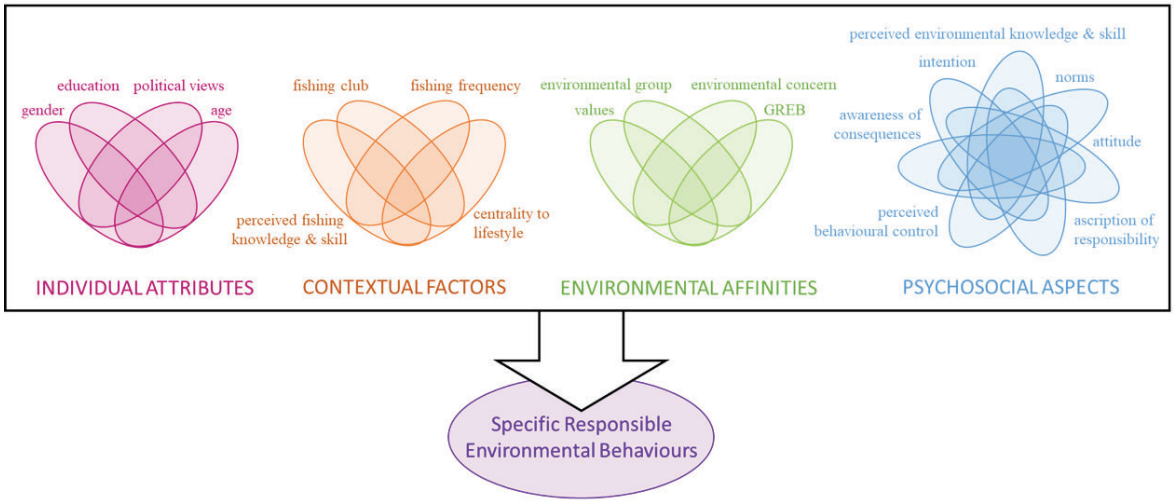

Figure 12. Conceptual model of influencing factors of specific responsible environmental behaviour

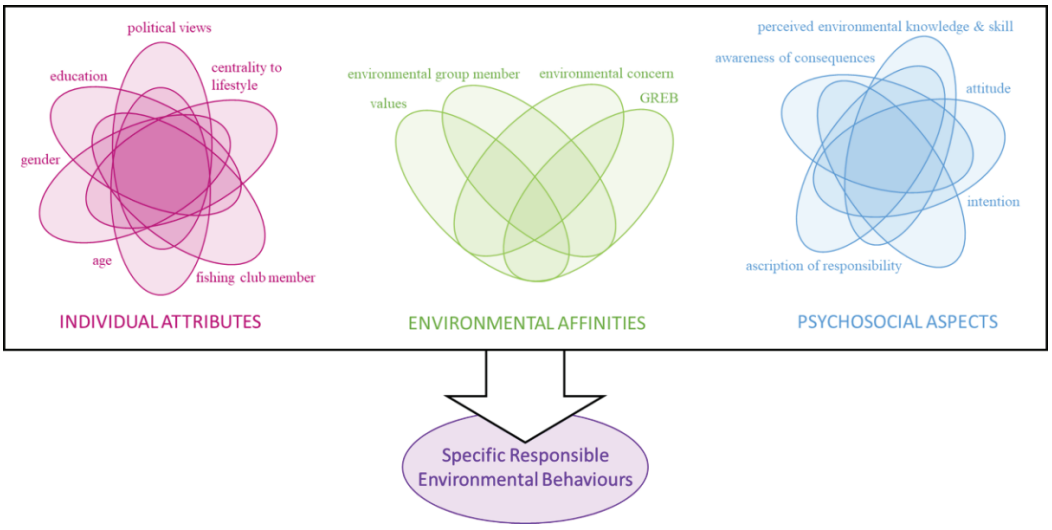

Figure 13. Revised conceptual model of influencing factors of specific responsible environmental behaviours

3.5 METHODS

While there are multiple software programs available for QCA analysis, this study employed the QCA package (Duşa, 2019) and the complimentary package admisc (Dusa, 2019) within the statistical analysis program R (R Studio, version 3.6.1; R Core Team, 2019). This selection was based on the requirement for a program that could handle the complexity of analysis for this study and that the package has been verified to produce output consistent with or better than other available software options (Thiem & Duşa, 2013). A limitation of this software selection is that the package does not allow for missing data, therefore predictive replacement was necessary prior to analysis (Schneider, 2018; Tabachnick, 1996, p. 63). Data imputation was completed following guidelines outlined by Tabachnick (1996, p. 63) and performed using the R package TestDataImputation (Dai, Wang, & Svetina, 2019). Data imputation followed the procedures of Fiss (2011, p. 406) where missing values were imputed based on information from all measures (apart from those cases that were missing an outcome value where these cases were deleted listwise). All other data manipulation required (recoding variables, creating data sets, binding calibrated conditions into data frames etc.) was completed using the dplyr package (Wickham, François, Henry, & Müller, 2019).

Procedures for all steps in the fsQCA analysis were completed as per the procedures and R code outlined by Dusa (2007, 2019). QCA analysis involves multiple steps, mainly calibration procedures, necessity analysis, and sufficiency analysis. These procedures are discussed in detail by numerous authors (e.g. Ragin, 2008; 2014; Schneider & Wagemann, 2012). A brief overview of these procedures follows.

3.5.1 Calibration

The process of fuzzy set calibration involves the assignment of qualitative anchors indicating the point of full-membership (1), full non-membership (0) and maximum ambiguity (0.5) within a set and then transforming recorded measures into a calibrated set (Ragin, 2000, p. 153). For this study the direct assignment method of calibration was selected as the most appropriate (Dusa, 2019; Ragin, 2008). Transformation of data into a set is typically characterised by an adjective label (e.g. highly educated) rather than a noun or abstract noun typically used for variables (e.g. education). An increasingly common practice (criticised by leaders in the field) is to calibrate sets based around the mean or median of the collected data (e.g. Woodside, 2017) but this does not distinguish between relevant and irrelevant variation (Ragin & Fiss, 2017). Following suggestions by Ragin (2008) and Ragin and Pennings (2005)

selection of the qualitative anchors for calibration (full membership, full non-membership, and the cross-over point, or point of maximum ambiguity) were selected based on theoretical reasoning rather than properties of the data. The data set was only considered when selecting the exact calibration mid-point, with a slight adjustment made if necessary, to ensure cases were not excluded from being displayed in the truth tables produced in later stages of the analysis. Where relevant, multiple sets were calibrated from the same variable (as in Ragin & Fiss, 2017) in order to adequately capture variation and to maximise explanatory power of solutions. For example, the measure of age was transformed into a set of "high age" and a set of "low age". This is depicted in **Figure 14** which shows the calibrated data vs the raw data scores for both high and low age. The thresholds of full membership, point of maximum ambiguity and threshold of non-membership are seen, which correspond to the scores given in **Table 7** for AGELOW and AGEHIGH.

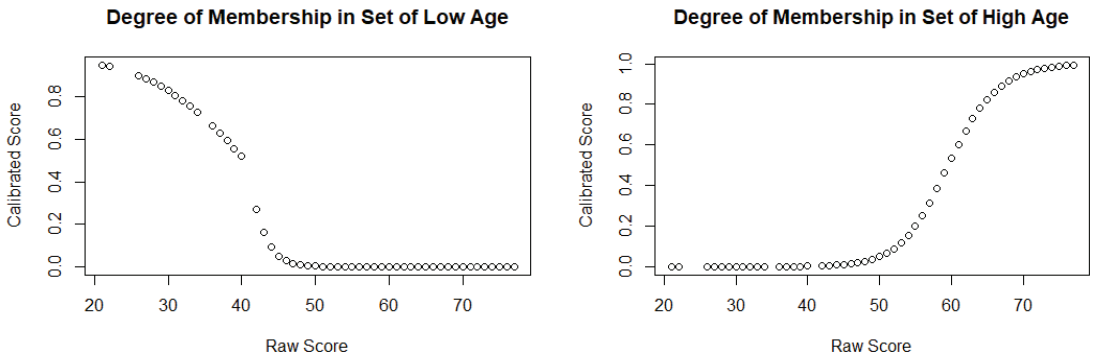

Figure 14. Dual calibration of age measures

Table 7, **Table 8** and **Table 9** present the calibration scores used for each condition measured. Each row shows the label used for the condition, the description of its membership, as well as the thresholds for full membership and full non-membership and point of maximum ambiguity. For conditions calibrated as crisp rather than fuzzy sets (e.g. FEMALE), there is no cross-over figure as crisp sets entail only full membership (1) or full non-membership (0).

Table 7 contains nine calibrated conditions associated with individual attributes (four of which are dual calibrations). Consistent with the revised conceptual model these centre on gender, level of education attained, age, political views, and involvement in recreational fishing.

Table 7. Individual Attributes Calibrated Conditions

Condition label	Condition description	Threshold for full membership	Cross-over	Threshold for full non-membership
FEMALE	The set of individuals who identify as female	Identified as female	N/A crisp set	Did not identify as female
EDUHIGH	Set of highly educated people	Highest level of education completed was a bachelor's degree (5)	4.5	Highest level of education completed was secondary school (3)
EDULOW	Set of low educated people	Highest level of education completed was primary school (2)	2.5	Highest level of education completed was secondary school (3)
AGELOW	Set of young individuals	Age at time of completing survey was 21	30.5	Age at time of completing survey was 40
AGEHIGH	Set of older individuals	Age at time of survey was 70	59.5	Age at time of completing survey was 50
PVLEFT	Set of individuals with politically progressive views	Summated average score of 4.5 on political views scale	4.1	Summated average score of 3.1 on political views scale
PVRIGHT	Set of individuals with politically conservative views	Summated average score of 1.5 on political views scale	1.9	Summated average score of 2.9 on political views scale
CTLHIGH	Set of individuals for whom fishing is central to their life	Summated average score of 3.5 on centrality of fishing to lifestyle scale	3.2	Summated average score of 3 on centrality of fishing to lifestyle scale
CTLLOW	Set of individuals for whom fishing is not central to their life	Summated average score of 1.5 on centrality of fishing to lifestyle scale	2.4	Summated average score of 3 on centrality of fishing to lifestyle scale

Table 8 also contains nine calibrated conditions however these are associated with environmental affinities and only two conditions are dual calibrated. As in the revised conceptual model these conditions include concern for the environment, levels of general responsible environmental behaviour, membership in an environmental organisation, and measures of values including altruistic, biospheric, hedonic and egoistic.

Table 8. Environmental Affinities Calibrated Conditions

Condition label	Condition description	Threshold for full membership	Cross-over	Threshold for full non-membership
CONHIGH	Set of individuals who demonstrate a high level of concern for the natural environment and its protection	Summated average score of 4.6 on NEP scale	4.1	Summated average score of 3 on NEP scale
CONLOW	Set of individuals who demonstrate a low level of concern for the natural environment and its protection	Summated average score of 2.1 on NEP scale	2.6	Summated average score of 3 on NEP scale
GREBHIGH	Set of individuals who have performed a wide range of general responsible	Participation in 6 of 7 measured general environmental	4.5	Participation in 3 of 7 measured general environmental behaviours in the previous 12 months

Condition label	Condition description	Threshold for full membership	Cross-over	Threshold for full non-membership
	environmental behaviours in the previous 12 months	behaviours in the previous 12 months		
GREBLOW	Set of individuals who have performed limited general responsible environmental behaviours in the previous 12 months	Participation in 1 of 7 measured general environmental behaviours in the previous 12 months	2.5	Participation in 3 of 7 measured general environmental behaviours in the previous 12 months
ALTRU	Set of individuals for whom altruistic values are core	Measured 4.5 on Likert scale measuring altruistic values	4.1	Measured 3 on Likert scale measuring altruistic values
BIOSPH	Set of individuals for whom biospheric values are core	Measured 4.5 on Likert scale measuring biospheric values	4.1	Measured 3 on Likert scale measuring altruistic values
EGOIS	Set of individuals for whom egoistic values are core	Measured 4.5 on Likert scale measuring egoistic values	4.1	Measured 3 on Likert scale measuring altruistic values
HEDON	Set of individuals for whom hedonic values are core	Measured 4.5 on Likert scale measuring hedonic values	4.1	Measured 3 on Likert scale measuring altruistic values
ENVORG	Set of individuals who belong to an environmental organisation	Identified as a current member of an environmental organisation	N/A crisp set	Did not identify as a current member of an environmental organisation

Table 9 contains the psychosocial aspects reflected in the revised conceptual model. This includes eight calibrated conditions, three of which are dual calibrated. Psychosocial aspects include attitude toward the behaviour, awareness of consequences, perceived levels of knowledge and skill in performing the behaviour, whether an individual ascribes responsibility for performing the behaviour to themselves, and intent to perform the behaviour.

Table 9. Psychosocial Apects Calibrated Conditions

Condition label	Condition description	Threshold for full membership	Cross-over	Threshold for full non-membership
ATTPOS	Set of individuals who indicated a positive attitude towards performing fish habitat management and restoration activities	Summated average score of 4.5 on attitude scale	4.1	Summated average score of 3 on attitude scale
ATTNEG	Set of individuals who indicated a negative attitude towards performing fish habitat management and restoration activities	Summated average score of 2.5 on attitude scale	2.7	Summated average score of 3 on attitude scale
ACHIGH	Set of individuals who demonstrated a high level of awareness of consequences of actions in fish habitats	Score of 13 out of 15 correct responses	11.5	Score of 10 out of 15 correct responses
ACLOW	Set of individuals who demonstrated a low level of awareness of consequences of actions in fish habitats	Score of 2 out of 15 correct responses	4.5	Score of 6 out of 15 correct responses
PKSHIGH	Set of individuals who indicated a perceived high level of environmental knowledge and skill	Summated average score of 4.5 on perceived environmental knowledge and skill scale	3.5	Summated average score of 3 on perceived environmental knowledge and skill scale
PKSLOW	Set of individuals who indicated a perceived low level of environmental knowledge and skill	Summated average score of 1.5 on perceived environmental knowledge and skill scale	2.5	Summated average score of 3 on perceived environmental knowledge and skill scale
ARES	Set of individuals who ascribed personal responsibility for SREB	Measured 4.5 on Likert scale measuring ascription of responsibility	4.1	Measured 3 on Likert scale measuring ascription of responsibility
INTENT	Set of individuals who indicated intent to perform fish habitat and management and restoration activities in the next 12 months	Indicated intent to perform fish habitat and management and restoration activities in the next 12 months	N/A crisp set	Did not indicate intent to perform fish habitat management and restoration activities in the next 12 months

3.6 FSQCA ANALYSIS PROCEDURES

3.6.1 Comparing Environmental Organisation Members and Non-Members

Schneider & Wagemann (2010, p. 5) suggest that the selection of cases for individual-level data should be selected to represent different known paths to the outcome. While this increases the number of cases that lead to the outcome it also reduces the phenomenon of limited diversity which leads to logical remainders (see Schneider & Wagemann, 2012, Chapter 6 for a discussion of limited diversity and remainders). Another benefit is the ability to compare the two groups to see which conditions are shared and therefore more universally sufficient for the outcome. Therefore, this study employed a method that collected data from two target samples: those who are members of an environmental organisation and those who identify as recreational fishers, as these groups are known to participate in SREB in recreational fishing environments.

Data analysis was undertaken by splitting the data into two subsets: Subset One: those who are a member of an environmental organisation and Subset Two: those who are not a member of an environmental organisation. This process allows for clearer representation and easier interpretation of the output but is also based on continued findings suggesting significant differences across many of the scales used for this study between those who are members of an environmental organisation and those who are not (e.g. Asah & Blahna, 2013; Bernstein, 2017; Dunlap, Van Liere, Mertig, & Jones, 2000; Hines et al., 1987; McDougle et al., 2015). The process of splitting data into subsets when employing fsQCA has been demonstrated in Fiss (2011) and Ragin and Fiss (2017). Following calibration of measures, fsQCA procedures to determine necessary and sufficient conditions were carried out for each of the two subsets of data. Sensitivity analyses were conducted to ensure the validity of findings. This was followed by procedures to test for necessity and sufficiency which are summarised in the following sections.

3.6.2 Necessity

Analyses of necessity (necessary cause must be present for the outcome in question to occur (Ragin, 2014, p. 91)) were conducted prior to construction of truth tables and sufficiency analysis, as recommended by Rihoux and Ragin (2009), and Schneider and Wagemann (2010). While inductively there were no expected necessary conditions, a deductive check was completed for necessary conditions in the presence and absence of the outcome (Dusa, 2019). Ragin (2014) suggests there should not be a clear-cut threshold for consistency of necessity or

sufficiency, and the context of each study may lead to differing appropriate thresholds[8]. Despite the absence of a hard cut-off value, generally a threshold of 0.90 for consistency of necessity relations is acceptable (Schneider & Wagemann, 2012; Gabriel et al., 2018; Ragin 2008). In this study, examinations of necessity relations at 0.8, 0.9 and 0.95 consistency thresholds were undertaken to examine differences in solutions and determine the correct threshold to apply. For each solution, relevance of necessity and coverage measures were examined and produced, along with graphical output of the necessity relation prior to confirming importance and validity of necessary relationships.

3.6.3 Sufficiency

Analysis of sufficiency (whether the cause in question always produces the outcome in question (Ragin, 2014, p. 92)) involved multiple steps. For each identified category of conditions, a truth table was constructed from the data. Truth tables originate from formal logic and represent the "2^k logically possible combinations, where k is the number of attributes under consideration" (Fiss, 2007, p. 402) and summarises the "property space" of these attributes from the data (Fiss, 2011). Truth tables were examined for limited diversity and distribution of cases across rows. A frequency threshold of 1 was applied, based on observations and to ensure at least 80% of all cases were retained as recommended by Ragin (2008).

Minimisation was completed using the QCA package, selecting the consistency cubes algorithm described by Dusa (2018). The Enhanced standard analysis procedure (described in depth by Schneider & Wagemann, 2012; 2013) was employed over the Standard Analysis procedure (Ragin, 2014; 2008). The enhanced standard analysis is an extension of standard QCA analysis that accounts for untenable assumptions[9]. As with consistency of necessity measures, thresholds for consistency of sufficiency are dependent on setting but a generally accepted threshold is 0.80 (Misangyi et al., 2016; Ragin, 2008; Misangyi & Acharya, 2014; Ragin, 2008; Ragin, 2014; Dusa, 2019). As with the analysis of necessity relations, multiple consistency thresholds were applied and the solutions compared, along with examining the truth table for "natural breaks" in consistency scores. This examination was paired with

[8] Indeed, an overreliance on universal thresholds for p-values in null hypothesis statistical testing has contributed to significant concerns surrounding the credibility of many published claims (Goodman, 2016).
[9] Untenable assumptions are a subset of difficult counterfactuals including incoherent counterfactuals (counterfactuals contradicting necessity statements and/or contradictory simplifying assumptions) and implausible counterfactuals (logical impossibilities). See Schneider & Wagemann (2013, Ch. 8) for a discussion or Dusa (2019, Ch. 8) for worked examples of Enhanced Standard Analysis.

consideration of measures of proportional reduction in inconsistency (PRI), to ensure claims of sufficiency relations were robust (Schneider & Wagemann, 2010, 2012).

3.7 SUMMARY

This chapter has outlined the methodological approach, design of the research and methods undertaken. The following chapter outlines the findings which are a result of application of this methodological approach, design and method, using the revised conceptual model presented in section 3.4.

Chapter 4: Findings

This chapter presents the results of fsQCA analysis procedures completed after calibration. First, necessity relationships are presented across each subset, for those who are a member of an environmental organisation, followed by those who are not. This presentation of results also includes further interpretation and discussion of necessity findings. Second, sufficiency findings are summarised with an example of solution output for a single category of conditions for a single subset (Psychosocial aspects in subset one: members of an environmental organisation). This output includes a Truth table and the three minimisation solutions (complex/ conservative, intermediate and parsimonious) as an exhibit of those constructed for each category of conditions, for each subset of data. Finally, a ConCov table is presented which summarises all necessary and intermediate sufficiency solutions across the three categories, for each subset.

4.1 ANALYSIS OF NECESSITY

A condition (or disjunction of conditions) is deemed necessary when the presence of the outcome condition is only attained with the presence of this condition (Fiss, 2007, 2011; Schneider & Eggert, 2014); in other words, the outcome is a subset of the condition (Dusa, 2019). Uncovering necessity relations in this research would indicate that SREB does not occur without the presence of this necessary condition (or set of conditions). Alternatively, this means that the necessary condition (or set) is always present (or in fuzzy sets, almost always present) when SREB occurs (Braumoeller & Goertz, 2000). Rather than correlational relationship that implies a higher level of these conditions leads to a higher level of SREB, a necessity relationship indicates the minimum level of conditions (or a set of conditions) is necessary for SREB to occur.

The QCA Package in R allows for analysis of necessity with a simple command. This was completed for all three groups of conditions (individual attributes, environmental affinities and psychosocial aspects), for both subsets of the data (members of an environmental organisation and those who are not members of an environmental organisation). Several criteria need to be applied during the search for necessary conditions to confirm validity of the output: empirical consistency, empirical relevance, and conceptual meaningfulness (Schneider, 2018). Prior to making claims of necessity, output was examined to confirm appropriate measures of

solution consistency, solution coverage, relevance of necessity, presence of deviant cases and consideration of empirical and theoretical relevance (Schneider, 2018; Dusa, 2019). Details of this for each subset follow.

4.1.1 Subset One: Members of an environmental organisation

Table 10. summarises the recipes identified by the software as necessary for SREB for those who are members of an environmental organisation, with a consistency threshold of 0.8 and a RoN threshold of 0.5 applied. Three disjunctive (set union/ OR) recipes were identified as necessary for performance of SREB for members of an environmental organisation. Levels of consistency indicate the "degree to which instances of the outcome agree in displaying the causal condition thought to be necessary, while coverage assesses the relevance of the necessary condition—the degree to which instances of the condition are paired with instances of the outcome" (Ragin, 2008, p. 45).

Table 10. Necessity relationships for members of an environmental organisation (subset one) n=89

Necessary Conditions	Consistency	Coverage	Relevance of Necessity
FEMALE+EDUHIGH	0.803	0.763	0.587
EDUHIGH+~FISHORG	0.803	0.756	0.570
AGELOW+~CTLHIGH+~FISHORG	0.801	0.741	0.544

Note. EDUHIGH= highly educated, ~FISHORG= not a member of a fishing organisation, AGELOW= young, ~CTLHIGH= fishing is not highly central to lifestyle

Inclusion/ consistency cut-off: 0.8, RoN cut-off: 0.5

Claiming disjunctions as necessary conditions should be done with caution, as unions of sets increase the size with every condition added to the disjunction; so adding conditions in union will almost always lead to a necessity relationship at some point[10]. Disjunctions of conditions are only deemed necessary if they form a higher order concept, defining a factor which is necessary for the outcome (Schneider, 2018). Trivial necessary conditions occur either when the condition(s) set is far greater in size than the outcome set, or when there is little to no evidence of the negated condition set to the point that the condition set is constant or almost constant. Necessity coverage scores indicate the proportion of cases that fit the necessity relationship, while also highlighting the first form of trivialness if present (Ragin, 2006). Relevance of necessity is a measure to ensure the second form of trivialness is not present. A low RoN score indicates this form of trivialness and invalidates claims of necessity (Schneider

[10] An explanation of fuzzy-set operations is available in Ragin (2008 p. 36-37)

& Wagemann, 2012). The lack of clear factor or higher order concept, a relatively low inclusion/consistency measure, a relatively low coverage measure and low RoN score invalidate the claim of necessity for these three disjunctions.

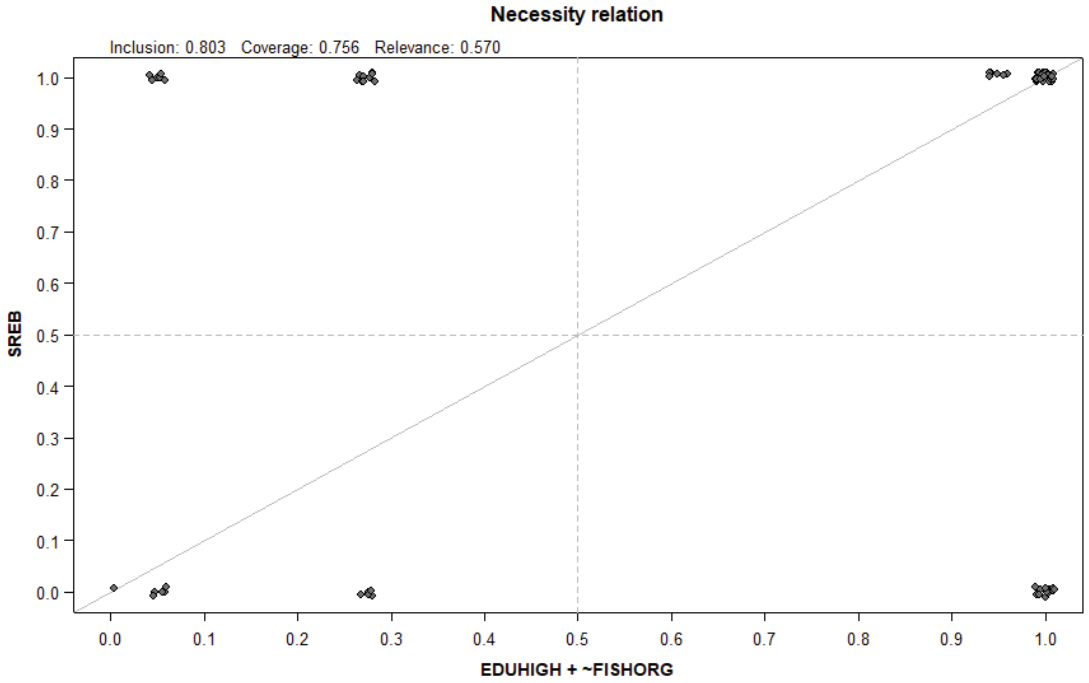

Figure 15. Necessity relation for subset one: members of an environmental organisation

Additional to checking inclusion, coverage and relevance figures, graphical output was examined to identify any deviant cases consistency (Schneider, 2018). For example, **Figure 15** shows a number of cases in the top left quadrant of the graph, indicating a number of deviant cases consistency in kind (the outcome is present in the absence of the identified recipe, invalidating the claim that the outcome only occurs in the presence of X). Cases in the upper right quadrant support the necessity relationship, as both the outcome and disjunctive recipe are present; while those cases above the diagonal line are deviant cases consistency in degree, as the outcome membership being greater than the disjunction membership violates the superset relationship of necessity. The examination of measures and graphical output indicates that the output in **Table 10** does not represent valid necessary relationships. Graphical output of all three relationships presented similar inconsistencies with a necessity relationship.

4.1.2 Subset Two: Not members of an environmental organisation

Table 11 summarises the recipes identified by the software as necessary for SREB for those who are not members of an environmental organisation, with a consistency threshold of 0.8 and a RoN threshold of 0.5 applied. Two recipes were initially identified as necessary for

performance of SREB for those who are not members of an environmental organisation. One solution is a single necessary condition (INTENT), while the second is a conjunctive (set intersection/ AND) recipe (~ARES*INTENT). For those who are not members of an environmental organisation, intent is a perfectly consistent necessary condition for SREB. Rather than implying that as soon as there is the negation of ascribed responsibility and intent that SREB will occur, the second relationship in this table indicates that the intersection of the absence of ascribed responsibility and presence of intent is a minimum requirement for SREB to occur. There are instances of both intent and negated ascription occurring for individuals, without SREB being performed but SREB is only performed when these conditions are met (with a consistency of 0.979).

Intent is a perfect necessary condition, with an inclusion/ consistency score of 1.00. While Intent is necessary for SREB alone, the intersection of ~ARES and SREB is also necessary. In this conjunctive recipe, negated ascription of responsibility (~ARES) is a SUIN condition. A SUIN condition is 'a *sufficient* but *unnecessary* part of a factor that is *insufficient* but *necessary* for an outcome' (Mackie, 1965, p. 247).

Table 11. Necessity relationships for non-members of an environmental organisation (subset two) n=93

Necessary Conditions	Consistency	Coverage	Relevance of Necessity
INTENT	1.00	0.789	0.824
~ARES*INTENT	0.979	0.799	0.840

Note. INTENT= intention, ~ARES= does not ascribe responsibility for performing the behaviour to themselves.

Inclusion/ consistency cut-off: 0.8, RoN cut-off: 0.5

Figure 16 and **Figure 17** compare these two necessity relationships. Neither figure shows cases in the upper left quadrant, however Figure 16 shows a small cluster of deviant cases consistency in degree (cases above the diagonal line), as indicated by the slightly lower inclusion score. Both of these necessity recipes are deemed not trivial as there are numerous cases in the bottom left quadrant of each graph (Goertz, 2006).

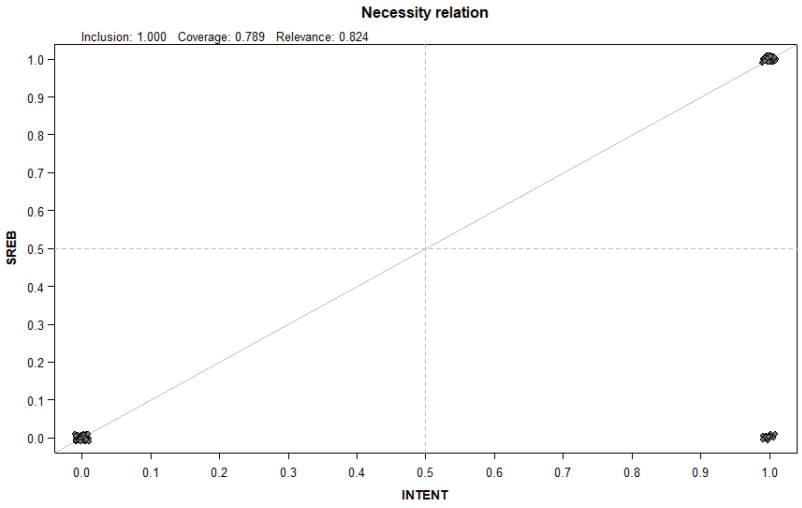

Figure 16. Necessity relation for subset two: not members of an environmental organisation

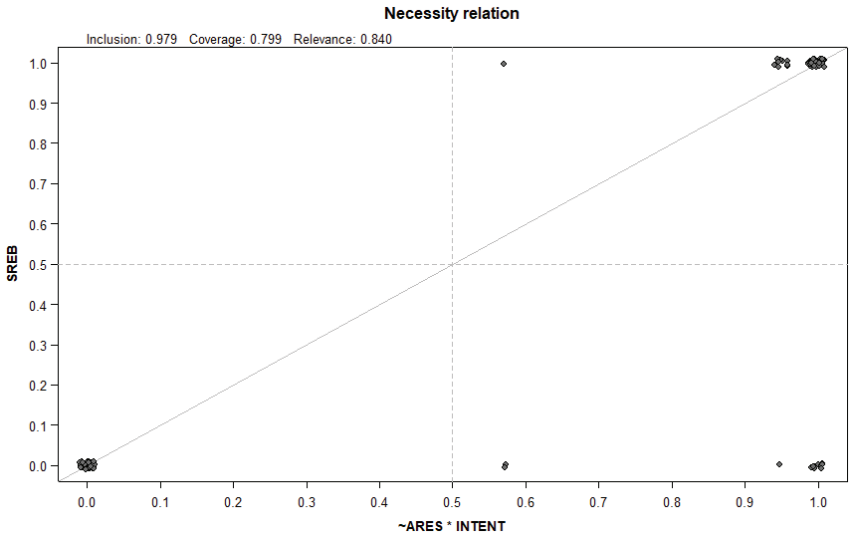

Figure 17. Necessity relation for subset two: not members of an environmental organisation

4.2 ANALYSIS OF SUFFICIENCY

A condition (or union or disjunction of conditions) is deemed sufficient when the presence of the causal condition always results in the presence of the outcome condition (Fiss, 2011; Schneider, & Eggert, 2014), in other words the causal condition is a subset of the outcome condition (Dusa, 2019). The analysis of sufficiency involves construction of a truth table, followed by logical minimisation using counterfactual analysis which results in three solutions: complex/ conservative, parsimonious and intermediate. A truth table and these three solutions were produced for each of the three sections of the revised conceptual model (individual attributes, environmental affinity and psychosocial aspects), across each of the sample subsets (members of an environmental organisation and those who are not members of

an environmental organisation). An example of the findings (with all output available upon request) is shown below to illustrate this process in **Table 12**, **Figure 18**, **Figure 19** and **Figure 20**.

Each solution was plotted to check for deviant cases consistency in kind (in sufficiency relations this is cases where the causal condition(s) is present but the outcome is not; found in the bottom right corner), deviant cases consistency in degree (in sufficiency relations this occurs when the membership in the causal condition is higher than the membership in the outcome condition) and deviant cases coverage (when the outcome is present in the absence of the causal condition; seen in the top left corner). The PRI and inclusion scores are very similar as the enhanced standard analysis procedure was employed, which reduces or eliminates the occurrence of trivial or irrelevant cases.

Table 12: Truth Table: Psychosocial factors for environmental group members

Row	ATTPOS	ACHIGH	ARES	PKSHIGH	INTENT	PKSLOW	OUT	n	incl	PRI
36	1	0	0	0	1	1	1	4	0.998	0.988
52	1	1	0	0	1	1	1	1	0.998	0.988
4	0	0	0	0	1	1	1	1	0.993	0.993
59	1	1	1	0	1	0	1	3	0.979	0.979
43	1	0	1	0	1	0	1	1	0.965	0.965
47	1	0	1	1	1	0	1	1	0.962	0.962
23	0	1	0	1	1	0	1	10	0.949	0.949
19	0	1	0	0	1	0	1	3	0.933	0.933
51	1	1	0	0	1	0	1	4	0.929	0.929
63	1	1	1	1	1	0	1	3	0.927	0.927
3	0	0	0	0	1	0	1	3	0.924	0.924
35	1	0	0	0	1	0	1	4	0.890	0.890
39	1	0	0	1	1	0	1	13	0.880	0.880
55	1	1	0	1	1	0	1	16	0.851	0.851
7	0	0	0	1	1	0	0	6	0.785	0.785
2	0	0	0	0	0	1	0	1	0.759	0.759
1	0	0	0	0	0	0	0	1	0.090	0.090
13	0	0	1	1	0	0	0	4	0.001	0.001
37	1	0	0	1	0	0	0	2	0.000	0.000
17	0	1	0	0	0	0	0	2	0.000	0.000
21	0	1	0	1	0	0	0	1	0.000	0.000
26	0	1	1	0	0	1	0	1	0.000	0.000
49	1	1	0	0	0	0	0	1	0.000	0.000
53	1	1	0	1	0	0	0	3	0.000	0.000

OUT: output value — n: number of cases in configuration
incl: sufficiency inclusion score — PRI: proportional reduction in inconsistency

M1: ATTPOS*INTENT*~PKSLOW + ATTPOS*~ARES*~PKSHIGH*INTENT + ~ACHIGH*~ARES*~PKSHIGH*INTENT + ACHIGH*~ARES*INTENT*~PKSLOW => SREB

		inclS	PRI	covS	covU
1	ATTPOS*INTENT*~PKSLOW	0.897	0.897	0.692	0.307
2	ATTPOS*~ARES*~PKSHIGH*INTENT	0.932	0.932	0.266	0.014
3	~ACHIGH*~ARES*~PKSHIGH*INTENT	0.917	0.917	0.179	0.023
4	ACHIGH*~ARES*INTENT*~PKSLOW	0.902	0.902	0.418	0.102
M1		0.913	0.913	0.863	

inclS: inclusion/consistency for the solution PRI: proportional reduction in inconsistency
covS: coverage for the solution covU: unique coverage for the solution

Figure 18. Complex/ conservative solution for psychosocial factors for environmental group members

M1: ATTPOS*INTENT + ACHIGH*INTENT + ~PKSHIGH*INTENT => SREB

		inclS	PRI	covS	covU
1	ATTPOS*INTENT	0.906	0.906	0.760	0.184
2	ACHIGH*INTENT	0.915	0.915	0.560	0.091
3	~PKSHIGH*INTENT	0.951	0.951	0.939	0.032
M1		0.916	0.916	0.904	

inclS: inclusion/consistency for the solution PRI: proportional reduction in inconsistency
covS: coverage for the solution covU: unique coverage for the solution

Figure 19. Parsimonious solution for psychosocial factors for environmental group members

M1: ATTPOS*INTENT + ~PKSHIGH*INTENT + ACHIGH*INTENT*~PKSLOW => SREB

		inclS	PRI	covS	covU
1	ATTPOS*INTENT	0.906	0.906	0.760	0.184
2	~PKSHIGH*INTENT	0.951	0.951	0.393	0.039
3	ACHIGH*INTENT*~PKSLOW	0.912	0.912	0.537	0.091
M1		0.916	0.916	0.904	

inclS: inclusion/consistency for the solution PRI: proportional reduction in inconsistency
covS: coverage for the solution covU: unique coverage for the solution

Figure 20. Intermediate solution for psychosocial factors for environmental group members

Set-theoretic consistency is an indication of the proportion of cases for which SREB is present among a set of cases that share a combination of conditions. Conversely, coverage is an indication of empirical relevance or importance. It does not imply better performance in terms of SREB performance but is an indication of being more prevalent (Ragin, 2008).

Not all three solution formulas are used extensively for substantive interpretation (Schneider & Wagemann, 2010). The parsimonious and conservative/ complex solution are steps in the process to calculate the intermediate solution. The parsimonious and conservative/complex solutions were still considered in interpreting the intermediate solution. This thesis presents the intermediate solution only, in line with recommendations by Ragin (2008, p. 175)[11]. **Figure 21** presents an example of a branching diagram which shows the multiple sufficiency recipes for the outcome SREB (Rubinson, 2019).

[11] All solution output available upon request

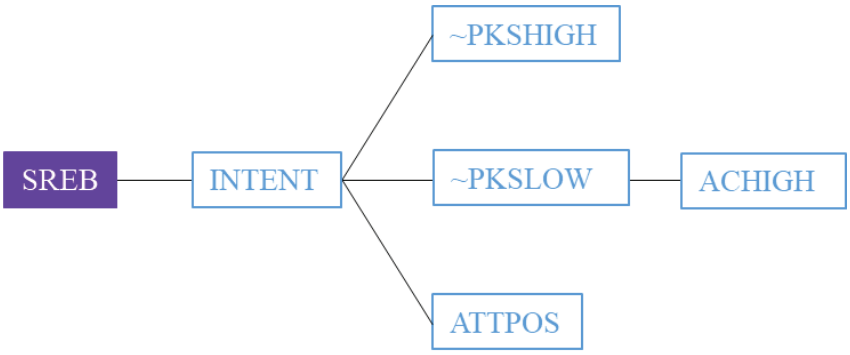

Figure 21. Intermediate solution for psychosocial factors for environmental group members

Each branch represents a single recipe which is sufficient for the outcome. The solution therefore consists of:

1. Individuals who do not have a positive attitude toward performing the behaviour AND do not have a negative attitude toward performing the behaviour AND do not perceive their level of knowledge or skill in performing the behaviour is high AND report intention to perform the behaviour; OR
2. Individuals who do not have a negative attitude toward performing the behaviour AND perceive their level of knowledge or skill in performing the behaviour is low AND report intention to perform the behaviour; OR
3. Individuals who do not have a negative attitude toward performing the behaviour AND perceive their level of knowledge or skill in performing the behaviour is high AND have a high awareness of consequences of the behaviour AND report intention to perform the behaviour

The resulting intermediate solution recipes for all categories of conditions are presented in

Table 13 (subset one) and **Table 14** (subset two). This summarises the final results of fsQCA analysis for this research across two tables, showing both necessary and (intermediate) sufficient solutions. These tables are a simplified version of the CONCOV table presented by (Rubinson, 2019).

Table 13. Simplified Concov table for Subset One: environmental organisation members (intermediate solutions)

Sufficient conditions	Recipe	Consistency/ Inclusion	PRI	Raw coverage	Unique coverage
Individual attributes	EDUHIGH*CTLHIGH*AGELOW*FISHORG +	.97	.97	.03	.01
	CTLHIGH*AGELOW*~PVRIGHT*FISHORG +	.96	.96	.03	.01
	~FEMALE*EDUHIGH*~AGELOW*PVRIGHT*~FISHORG +	.86	.86	.07	.07
	FEMALE*~EDUHIGH*~CTLHIGH*~PVRIGHT*~FISHORG +	.93	.93	.02	.02
	FEMALE*~EDUHIGH*CTLHIGH*~PVRIGHT*FISHORG +	.99	.99	.04	.04
	FEMALE*~CTLHIGH*PVLEFT*~PVRIGHT*~FISHORG +	.94	.94	.08	.07
	~FEMALE*EDUHIGH*CTLHIGH*~PVLEFT*~PVRIGHT*FISHORG	.87	.87	.08	.07
Solution		.92	.92	.3	-
Environmental affinities	CONHIGH*GREBHIGH*ALTRU*~EGOIS*~HEDON +	.85	.85	.24	.13
	CONLOW*GREBHIGH*ALTRU*~EGOIS*~HEDON +	.99	.99	.02	.02
	CONHIGH*`CONLOW*GREBHIGH*ALTRU*~BIOSPH*~EGOIS	.93	.93	.12	.02
Solution		.87	.87	.28	-
Psychosocial aspects	ATTPOS*INTENT	.91	.91	.76	.18
	~PKSHIGH*INTENT	.95	.95	.40	.04
	ACHIGH*INTENT*~PKSLOW	.91	.91	.54	.09
Solution		.92	.92	.90	-

Inclusion/ consistency cut-off: 0.90, PRI cut-off: 0.50

Table 14. Simplified Concov table for Subset Two: not members of environmental organisation (intermediate solutions)

Necessary conditions	**Recipe**	**Consistency/ Inclusion**	**RoN**	**Raw coverage**	**Unique coverage**
	INTENT	1.00	.82	.79	
	~ARES*INTENT	.98	.84	.80	

Sufficient conditions	**Recipe**	**Consistency/ Inclusion**	**PRI**	**Raw coverage**	**Unique coverage**
Individual attributes	FEMALE*CTLHIGH*~PVRIGHT*FISHORG	.99	.99	.04	-
Solution		.99	.99	.04	-
Environmental affinities	GREBHIGH*CONLOW*~EGOIS	.83	.83	.07	-
Solution		.83	.83	.07	-
Psychosocial aspects	~ATTNEG*PKSLOW*INTENT +	.92	.92	.08	.02
	~ATTPOS*~ATTNEG*~PKSHIGH*INTENT +	.83	.83	.18	.10
	~ATTNEG*ACHIGH*PKSHIGH*INTENT	.98	.98	.24	.21
Solution		.90	.90	.41	-

Necessity: Inclusion/ consistency cut-off: 0.80, RoN cut-off: 0.50,

Sufficiency: Inclusion/ consistency cut-off: 0.90, PRI cut-off: 0.50

4.3 SUMMARY

These results directly address the two research questions posed in section 2.9. Empirically necessary conditions for the performance of SREB in recreational fishing environments of Australia (RQ1) are seen in Table 14 which summarises the results for those who are not members of an environmental organisation. The sections of Table 13 and Table 14 which show the sufficiency recipes show which of the theoretically possible configurations of conditions are sufficient for the performance of SREB in recreational fishing environments of Australia (RQ2). Further interpretation of these findings is discussed in the following chapter.

Chapter 5: Discussion

The previous chapter identified the uncovered necessity relationships and sufficiency relationships for both subsets of the data and discussed necessity relationships in more depth. The primary focus of this chapter therefore is the discussion of sufficiency relationships. This chapter first presents a discussion of sufficiency relationships and how to interpret them in the context of this study. This is followed by a summary of the intermediate sufficiency solutions of all three categories (individual attributes, environmental affinities and psychosocial aspects), for both subsets. Each of these solutions is presented with a verbal understanding, then represented visually with a branching diagram, followed by a discussion of recipe coverage. Finally, each element measured and its presence, absence or negation in solution terms is discussed.

5.1 INTRODUCING INUS CONDITIONS

As the methodological approach used embraces complexity and configurations, a key consideration when examining and interpreting results is that the recipe solution should be considered as a whole. The presence or absence of a single condition in a single solution recipe should not be over-interpreted as it is the interplay with other conditions in the recipe that explains the outcome (Ragin, 2008, p. 13). While the discussion of this thesis does include the examination of each construct in isolation, this is done to compare these findings with that of the extant literature, and is done with the acknowledgement that no single condition was found to be sufficient for the presence of the outcome condition. Instead, all solution recipes are made up of conjunctions of INUS conditions. INUS conditions are those which are an "**I**nsufficient but **N**ecessary part of a condition [set] which is itself **U**nnecessary but **S**ufficient" for the result (Mackie, 1965, p. 247).

5.2 INDIVIDUAL ATTRIBUTES

Individual attributes captured a range of demographic and contextual factors relevant to this research. The most relevant constructs for environmental behaviour prediction and/or recreational fishing contexts were selected for the original conceptual framework. Following factor analysis, the individual attributes and contextual factors were collapsed and now include measures of age, gender, education, political views, centrality of fishing to lifestyle and fishing organisation membership.

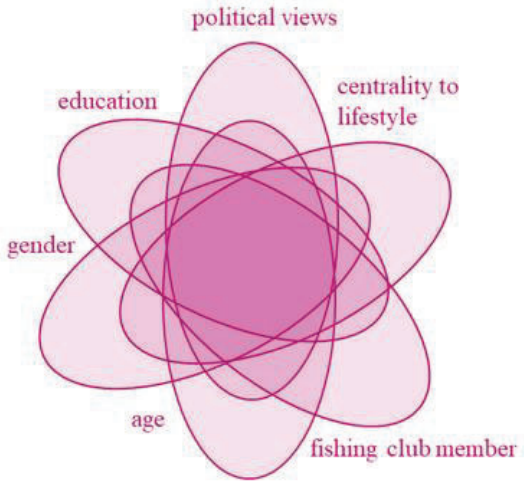

Figure 22. Individual attributes

In this category there were many more recipe solutions for subset one (members of an environmental organisation) than subset two (not members of an environmental organisation).

There are seven total solutions for environmental organisation members. Solutions have a range of individual attributes present, absent or negated. These recipes consist of[12]:

1. Young AND highly educated AND member of a fishing organisation AND fishing is highly central to their lifestyle; OR[13]
2. Young AND not conservative AND member of a fishing organisation AND fishing is highly central to their lifestyle; OR
3. Not young AND not female AND highly educated AND conservative AND not a member of a fishing organisation; OR
4. Female AND not highly educated AND not conservative AND not a member of a fishing organisation AND fishing is not highly central to her lifestyle; OR
5. Female AND not highly educated AND not conservative AND member of a fishing organisation AND fishing is highly central to her lifestyle; OR
6. Progressive AND not conservative AND female AND not a member of a fishing organisation AND fishing is not highly central to her lifestyle; OR

[12] Recipes in descending order of consistency measure
[13] Logical AND indicates set intersection/ conjunction while logical OR indicates set union or disjunction. Its is the configuration of all the conditions linked with AND that creates the solution set, while the use of OR reminds us that there are multiple unique configurations that predict the outcome

7. Male AND not highly educated AND doesn't hold strong conservative views AND doesn't hold strong progressive views AND member of a fishing organisation AND fishing is highly central to his lifestyle

These recipes are also presented visually as seven branches in **Figure 23** [14]:

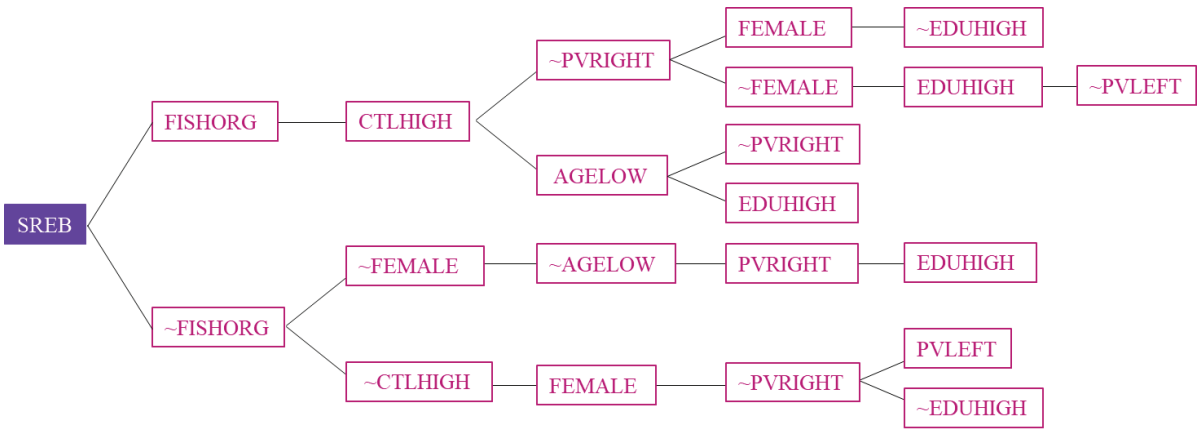

Figure 23. Branching diagram showing recipe solution of sufficient individual attributes for performance of specific responsible environmental behaviour, Subset One

When examining individual attributes, it appears that there are a dispersed range of individuals in environmental organisations who participate in SREB, with sufficiency recipes containing sets of individuals who are female, not female; highly educated, not highly educated; young, not young; progressive, conservative, centred political views; fishing is central to their lifestyle, fishing is not central to their lifestyle; and are a member of a fishing organisation, are not a member of a fishing organisation. Unlike linear models based on net-effects, fsQCA embraces asymmetry and accounts for scenarios where the absence of an identified INUS condition does not necessarily lead to an absence of the outcome. As seen in **Table 14** some of these recipes have a higher level of coverage (more individuals are a member of this set than of other solution sets). Three recipes have a higher coverage score than others (however they are still quite low at only 7% unique coverage):

3: ~FEMALE*EDUHIGH*~AGELOW*PVRIGHT*~FISHORG (raw cov. 0.07, unique cov. 0.07);

7: FEMALE*~CTLHIGH*PVLEFT*~PVRIGHT*~FISHORG (raw cov. 0.08, unique cov. 0.07) and

[14] Note: recipes are ordered for ease of interpretation rather than based on inclusion scores

8: ~FEMALE*EDUHIGH*CTLHIGH*~PVLEFT*~PVRIGHT*FISHORG (raw cov. 0.08, unique cov. 0.07).

There are no common conditions across all three of these recipes, in fact they are quite contradictory to each other, suggesting multiple, contrasting profiles of individuals within environmental organisations that are likely to participate in SREB. This is further support for the validity of equifinal behaviour prediction in this context.

In contrast to the solution recipes in Subset One, the only attribute profile of individuals who are not members of an environmental organisation and participate in SREB is those who are a female AND a member of a fishing organisation AND fishing is highly central to her lifestyle AND holds political views that are not conservative. While there was only one recipe solution for individual attributes for subset two, this single recipe was very simple, as seen in **Figure 24** below:

Figure 24. Branching diagram showing recipe solution of sufficient individual attributes for performance of specific responsible environmental behaviour, Subset Two

The coverage score of this recipe is low (0.04) indicating only a very small proportion of individuals in this sample are members of the outcome set. While a single recipe solution for this subset means it is easier to target a single profile, the low coverage score indicates that there is only a small number of individuals within this subset to target.

Randle & Dolnicar (2015) have called for a "more scientific approach" (p. 33) to recruitment campaigns for attracting environmental volunteers. They suggest adoption of techniques often used in the private sector including market segmentation and targeted advertising. For practitioners and organisations hoping to encourage SREB in individuals, these results suggest recruitment efforts would be best spent on those who are members of an environmental organisation and/or politically non-conservative females who are a member of a fishing organisation, and likely an actively involved member, as fishing is central to their lifestyle.

As mentioned previously, it is important to note that INUS conditions are only sufficient in configuration with other conditions, however the following discussion analyses findings for the individual conditions measured in light of the existing literature.

5.2.1 Gender

Subset one results include sufficient solutions that do not include gender, some that include females and some that include males (~FEMALE[15]). There is general consensus in extant literature that females are more likely to participate in environmental behaviour and that males are more likely to participate in recreational fishing (Kellert, 1976). The results of this study offer some support for this. Despite a disproportionately high number of male respondents in this research, 3 of 7 sufficiency recipes for subset one and the only sufficiency recipe for subset two contained FEMALE as an INUS condition. However, rather than the simple assumption of net effects models, results indicate that there are also scenarios where gender is not a contributing factor, and others where being male is predictive of performing SREB.

Those who were not members of an environmental organisation only included females who would be quite active in the fishing community (high centrality to lifestyle and member of fishing organisation). Cho and Kang (2016) suggest it is the more extensive social ties possessed by women that contribute to their higher levels of behaviour of this type. Perhaps the membership in environmental organisations that create social ties linked to environmental restoration that increase participation of individuals who are not female.

The results of this study suggest that there are more sufficient pathways to performing that behaviour for females but that there are configurations where gender is not relevant, and other configurations where being not female is sufficient.

5.2.2 Education

Being highly educated is part of the intermediate sufficiency solution for three of seven recipes in the environmental group members, whereas negated high education was present in two of seven recipes. When added to the model, low education was not present in any sufficiency recipes. Education level does not feature in the solution for those who are not members of an environmental organisation. This indicates rather than a linear correlational relationship suggesting that for each increase in education level there is an increased chance of, or level of involvement in pro-environmental behaviour performance, there is a sufficient education level in certain configurations that is a component of the sufficiency recipe for the

[15] Note: no respondents selected the option “x” for their gender so any individual who are not members of the set FEMALE are members of the set MALE

outcome (as the threshold for full non membership in the set of highly educated people was completion of secondary school).

5.2.3 Age

Age featured in only three sufficiency recipes of seven among members of environmental organisations. Both young (twice) and not-young (once) sets were included in these recipes. Age did not feature in the recipe for those who are not members of an environmental organisation. This further supports the inconsistencies of age as a linear predictor of pro-environmental behaviour uncovered in the literature review and the notion that these relationships are non-linear. Bodur and Sarigöllü (2005) noted a U-shaped relationship where there are higher levels of participation in both young and old adults and less in middle age. Dual calibration analyses in this study did not result in any recipes indicating "middle-aged" individuals (~AGEHIGH*~AGELOW) participate, further supporting this notion.

5.2.4 Political Views

For members of an environmental organisation, sufficiency recipes included the negation of conservative political views in 5 of 7 recipes. However, one of these 5 recipes also included progressive political views, while another one of these 5 recipes included negated progressive views (indicating centred views in this recipe). Only one of 7 recipes indicated conservative political views were an INUS condition, while the final 7th recipe did not feature political views. The negation of conservative political views was an INUS condition for those who were not members of an environmental organisation. This indicates a connection of political views to behaviours such as SREB. The high frequency of negated conservative views somewhat aligns with the existing notion that it is those who hold progressive political views that possess higher levels of environmental concern and are more likely to perform SREB. However, more recipes feature the negation of conservative views rather than the presence of progressive views. For these configurations it is only important *not* to hold strong conservative views, but the individual does not possess strong progressive views either. This variation in presence and absence of differing views is further support for non-linear, equifinal relationships.

5.2.5 Centrality of fishing to lifestyle

While 4 of 7 recipes for environmental organisation members included the set of individuals for whom fishing is central to their lifestyle, another two recipes included the negation of this set, while the final recipe did not include centrality. High centrality is also an

INUS condition in the only sufficiency recipe for individuals who are not members of an environmental organisation. There may be differing motivations and reasons for involvement in this specific set of pro-environmental behaviours (Asah & Blahna, 2013). Volunteering is often stimulated by a personal connection (McDougle et al., 2011; Seng & White, 2007), so it is logical that for some individuals it is their involvement in fishing which is linked to their participation. Others, who are not members of the set for whom fishing is highly central to their lifestyle are likely driven by different motivations, linked to their involvement in an environmental organisation.

5.2.6 Fishing organisation membership

Organisational membership in a fishing group and centrality to lifestyle appear to be closely linked conditions. The 4 recipes for environmental organisation members that included the set of individuals for whom fishing is central to their lifestyle also included fishing organisation membership. Not being a member of a fishing organisation was an INUS condition for the other 3 of 7 recipes for environmental organisation members. This indicates that within the subset of individuals who are members of an environmental organisation there are both those that have a high level of interest in fishing (high centrality and members of a fishing organisation) and those with little interest in fishing (negated fishing organisation membership and/or negated centrality) who participate in SREB. On the other hand, for those who are not members of an environmental organisation the only sufficiency recipe contains both fishing organisation membership and high centrality of fishing to lifestyle as INUS conditions, further supporting the importance of personal interest and connection to the issue.

5.3 ENVIRONMENTAL AFFINITIES

Measures of environmental affinity included measures related to the natural environment more broadly, as a typically more distal measure of specific responsible environmental behaviour. This includes measures of an individual's values, their level of concern for the environment, and whether they perform general responsible environmental behaviours (GREB). The measure of environmental group or organisation membership from this group of measures was used to create the two subsets of data.

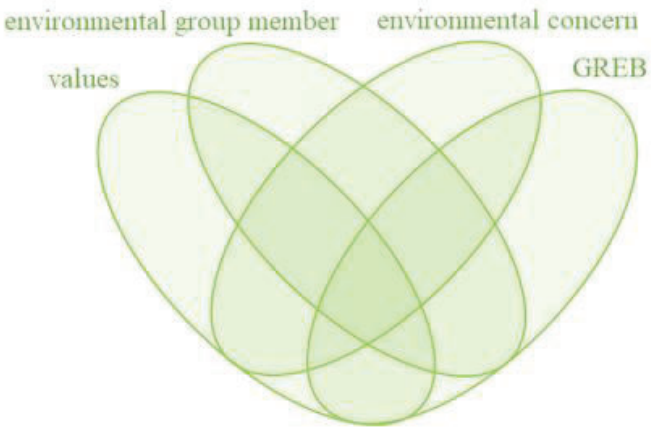

Figure 25. Environmental Affinities

As seen with individual attributes, there are more configurations that predict the outcome condition for those who are members of an environmental organisation than those who are not. For environmental organisation members there are three configurations of environmental affinities that lead to the outcome, while the non-members only presented one solution. There are three total solutions for environmental organisation members. Recipes consist of :

1. Individuals who often perform general responsible environmental behaviours AND possess altruistic values AND do not possess egoistic values AND do not possess hedonic values AND have a high level of concern for the environment
2. Individuals who often perform general responsible environmental behaviours AND possess altruistic values AND do not possess egoistic values AND do not possess hedonic values AND have a low level of concern for the environment
3. Individuals who often perform general responsible environmental behaviours AND possess altruistic values AND do not possess egoistic values AND do not possess biospheric values AND have a high level of concern for the environment AND do not have a low level of concern for the environment)

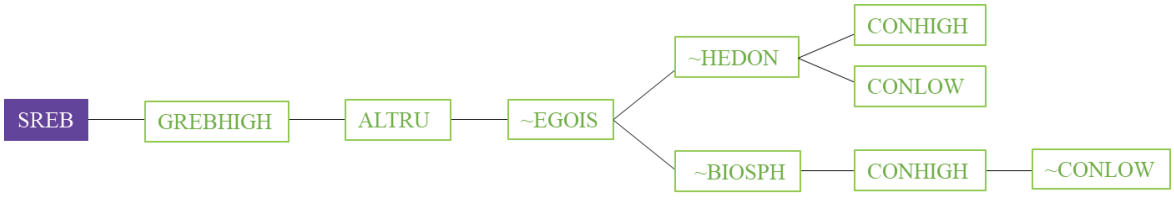

Figure 26. Branching diagram showing recipe solution of sufficient environmental affinities for performance of specific responsible environmental behaviour, Subset One

Of these three recipes, one has a much greater level of coverage than the others: (Recipe 1) CONHIGH*GREBHIGH*ALTRU*~EGOIS*~HEDON (raw cov. 0.24, unique cov. 0.13) therefore representing more of the sample than other solutions with lower coverage. For these three recipes the presence of altruistic values, the absence of egoistic values and the presence of high levels of general responsible environmental behaviour are all common. This indicates that appealing to altruistic motivations of others may be an effective recruitment strategy.

Compared to the recipe solutions in subset one which include the conjunction of multiple value sets, the recipe solution for non-members is quite simple, with only one negated value (egoistic). The single recipe solution for those who are not members of an environmental organisation is those individuals who often perform general responsible environmental behaviours AND do not possess egoistic values AND have a low level of concern for the environment.

Figure 27. Branching diagram showing recipe solution of sufficient environmental affinities for performance of specific responsible environmental behaviour, Subset One

5.3.1 Environmental Concern

High levels of concern for the environment were present in two of three sufficiency recipes for those who are members of an environmental organisation (with the negation of low levels of concern also in one of these recipes). Interestingly, the third recipe included a low level of environmental concern. Typically the literature indicates that those who are members of an environmental organisation possess higher levels of environmental concern (Bernstein, 2017; Hawcroft & Milfont, 2010). However, despite sensitivity analyses for the calibration of the concern condition, varying the thresholds for membership in this set did not alter the resultant recipes. The second subset (individuals who are not members of environmental organisations) included low levels of concern in the only sufficient recipe, which were again robust to sensitivity analyses.

These varying configurations of high concern, low concern and negated low concern indicate that a measure of general concern for the environment or support for the New Environmental Paradigm is not solely sufficient for predicting this specific behaviour type and is only sufficient in certain contexts, in conjunction with other conditions.

5.3.2 General Responsible Environmental Behaviour

General responsible environmental behaviour was an INUS condition in all the sufficiency recipes, across both subsets of data. As indicated in the research by Cottrell and Graefe (1997), it appears to be the same mechanisms that drive SREB that drive GREB. This indicates that those individuals who act in other pro-environmental ways may be enticed to perform specific measures as measured in this research. Unfortunately, effectively identifying and targeting these individuals is not always simple.

5.3.3 Values

The literature review revealed that altruistic and biospheric values are typically predictors of environmental concern and environmental behaviour (e.g. Karp, 1996; Nilsson, Borgstede, & Biel, 2004; Steg et al., 2014; L. Steg & de Groot, 2012; P. C. Stern et al., 1995), although the relations are typically weak and moderating and mediating variables such as personal norms and beliefs are often needed to satisfactorily predict behaviour from values (Gifford & Nilsson, 2014; Nordlund & Garvill, 2003).

Surprisingly these results did not indicate that biospheric values are sufficient for SREB performance. Instead it was altruistic values that were present in all recipes for environmental group members, and the absence of egoistic values across all recipes for both subsets (members and non-members of environmental organisations) that was part of the sufficiency recipes. Unexpectedly, one recipe of the environmental group members included the intersection of high concern for the environment, the absence of low concern for the environment and the absence of biospheric values. While extant literature commonly associates environmental group membership with high levels of concern for the environment (e.g. Bernstein, 2017; Hawcroft & Milfont, 2010), this is coupled with the assumption that biospheric values are associated with environmental group membership and concern for the environment. The presence of altruistic values and/ or the absence of egoistic values in all recipe solutions indicate that it may actually be a concern for others through the implication of direct and indirect effects of ecosystem destruction on them, which is key to driving SREB performance. The prominence of altruistic rather than biospheric values may indicate that motivations are based on activation of concern for others, rather than for the environment.

Steg et al. (2012) proposed the addition of self-enhancement value of hedonism for pro-environmental behaviour prediction. Negated hedonic values are an INUS condition in 2 of the

3 recipes for subset one. This is particularly relevant as the behaviours measured in this research are ones which require a sacrifice of effort and reduced comfort.

5.4 PSYCHOSOCIAL ASPECTS

Measures of psychosocial aspects included measures related to individual psychological and interrelated factors, as typically more proximal measures of the outcome condition. This included measures of an individual's attitudes toward the behaviour, their perceived level of knowledge and skill surrounding the behaviour, awareness of consequences of the behaviour, whether they ascribe the responsibility of performing the behaviour to themselves, and whether they report intention to undertake the behaviour.

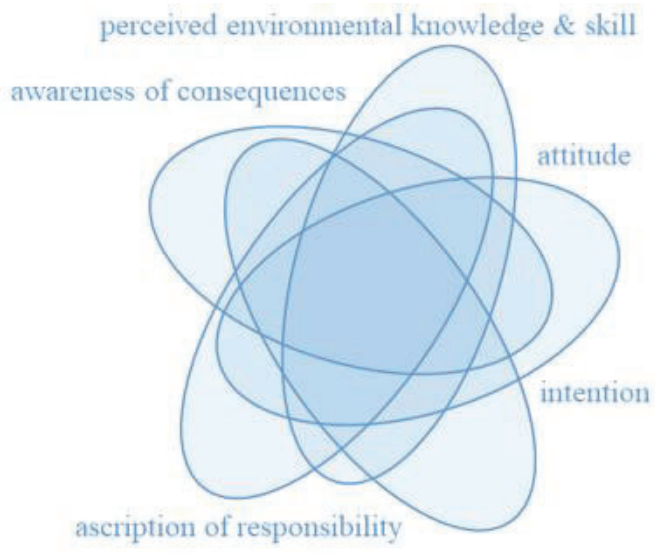

Figure 28. Psychosocial aspects

Unlike solutions for the other categories of conditions, there are the same number of sufficient recipes for psychosocial aspects across the two subsets of data.

There are three total solutions for environmental organisation members, consisting of simple recipes of two or three conditions. Recipes consist of:

1. Individuals who have a positive attitude toward performing the behaviour AND report intention to perform it; OR
2. Individuals who do not perceive their level of knowledge or skill in performing the behaviour is high AND report intention to perform the behaviour; OR

3. Individuals who do not perceive their level of knowledge or skill in performing the behaviour is low AND have a high awareness of consequences AND report intention to perform the behaviour

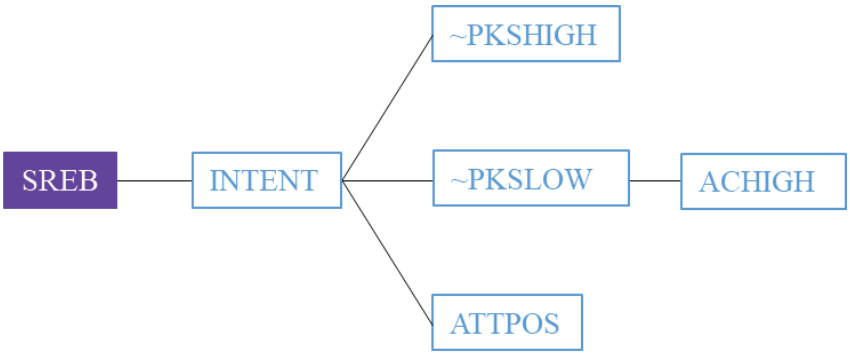

Figure 29. Intermediate solution of psychosocial factors for environmental organisation members

Of the three recipes, recipe one has much greater coverage levels than the others: ATTPOS*INTENT (raw cov. 0.76, unique cov. 0.18), in fact the highest raw coverage and unique coverage of any recipe solution across both subsets. All three of the recipes share INTENT as an INUS condition, indicating its importance in behaviour prediction.

The three recipe solutions for those who are not members of an environmental organisation include:

1. Individuals who do not have a negative attitude toward performing the behaviour AND perceive their level of knowledge or skill in performing the behaviour is low AND report intention to perform the behaviour; OR

2. Individuals who do not have a positive attitude toward performing the behaviour AND do not have a negative attitude toward performing the behaviour AND do not perceive their level of knowledge or skill in performing the behaviour is high AND report intention to perform the behaviour; OR

3. Individuals who do not have a negative attitude toward performing the behaviour AND perceive their level of knowledge or skill in performing the behaviour is high AND have a high awareness of consequences of the behaviour AND report intention to perform the behaviour

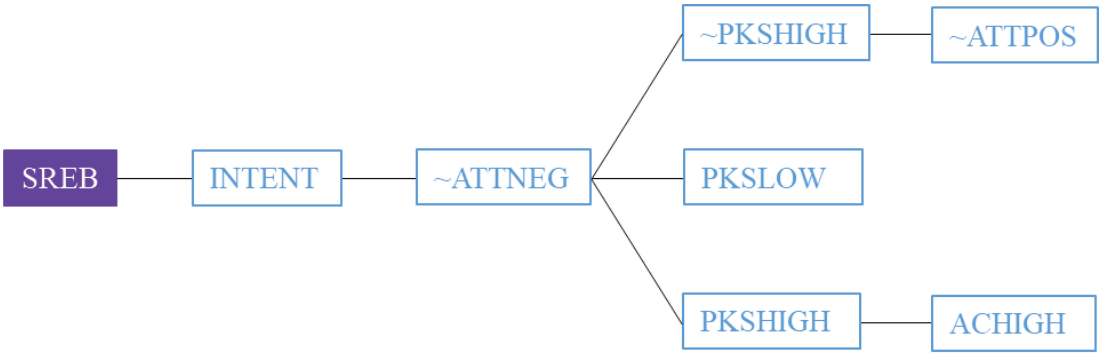

Figure 30. Intermediate solution for psychosocial factors for subset two: not members of an environmental organisation

One of these recipes has a higher unique coverage than the others: (Recipe 3) ~ATTNEG*ACHIGH*PKSHIGH*INTENT (raw cov. 0.24, unique cov. 0.21).

Each of the conditions is discussed further below.

5.4.1 Attitude

Attitude only features in one sufficiency recipe for subset one, however the high raw and unique coverage score of ATTPOS*INTENT relative to other recipes indicates more individuals are a member of this set than others.

The first sufficiency recipe for environmental organisation members does not include attitude. However, one sufficiency recipe for those who are not members of an environmental organisation includes negated positive attitude, in conjunction with negated high levels of perceived knowledge and skill, and presence of intent. This indicates that this group does not perceive themselves to possess a high level of knowledge or skill in undertaking the activity, nor do they have a positive attitude towards undertaking the activity (perceive it as worthwhile, important and enjoyable) but they still possess intention and perform the behaviour. Negated positive attitude toward the behaviour is present in one of the solutions for subset two. With the dual calibrated condition (negative attitude toward the behaviour) added, negated negative attitude was present in all solutions for those who were not members of an environmental organisation but not present for those who are members of environmental organisations.

5.4.2 Ascription of Responsibility

Despite commonly accepted hypotheses that a feeling of personal responsibility is predictive of environmental concern and/or behaviour (Kaiser, Ranney, Hartig, & Bowler, 1999; Kuhlemeier, Van Den Bergh, & Lagerweij, 1999), ascription of responsibility was not an identified sufficient condition in any recipes for either subset. Adding to this is the negated

ascription of responsibility (~ARES) as a SUIN condition for subset two. The lack of ascribed responsibility may be linked to the public ownership of waterways in Australia (Copeland et al., 2017), or an indicator of the denial or misunderstanding of the contribution of recreational fishing to environmental degradation (Dedual et al., 2013).

While the level of damage caused by recreational fishing is less than that of farmers, developers and large-scale industry, and on-par with commercial fishing, policy often ascribes rehabilitation of these areas to recreational fishers (Gregory 2018). In fact, scientific evidence supports the idea that damage cannot be attributed to a single stakeholder group. So, despite policies and campaigns aimed at mobilisation of recreational fishers through responsibilisation, this group is unlikely to embrace this idea. Instead it is a specific subset of fishers in this study that were likely to engage in the behaviour. As indicated by necessity of ~ARES this is unlikely due to feelings of personal responsibility and rather due to the activation of other values or motivations.

5.4.3 Awareness of Consequences

Extant literature exploring awareness of consequences tends to measure linear relationships and describe these relationships as linear or as necessary relationships (i.e. that more awareness leads to more behaviour performance, or that the behaviour will not be performed without the presence of awareness of consequences (Bolderdijk et al., 2013; Chawla & Cushing, 2007; Gifford, 2011; Lee, Hochman, Prince, & Ariely, 2016; P. C. Stern et al., 1999). High awareness of consequences is only present in one of three recipes for each subset. In both of these recipes this is in conjunction with INTENT and either ~PKSLOW or PKSHIGH. This suggests that the perception of knowledge and skills related to the behaviour is somewhat aligned with actual measures of knowledge of consequences.

5.4.4 Perceived Environmental Knowledge and Skill

Results for subset one contained one recipe of three with negated high perceived environmental knowledge and skill (~PKSHIGH), and one other recipe of three with negated low perceived levels of environmental knowledge and skill (~PKSLOW). The group that indicated they perceive they do not possess a high level of knowledge and skill in performing SREB was in conjunction with INTENT. This indicates a willingness to be involved in stewardship activity despite a lack of development of these skills. It is possible that there is an anchoring effect for those who are members of an environmental organisation as their perception of their knowledge and skill may be influenced by regular interaction with others

who are quite knowledgeable and experienced in these activities (Kahneman & Tversky, 1973). Similarly, to environmental organisation members, recipes for those who are not members of an environmental organisation included mixed results for perceived environmental knowledge and skill. One recipe contains ~PKSHIGH, another PKSLOW and another PKSHIGH. This indicates that the emphasis placed on educating stakeholders about stewardship behaviours may not be required in order for individuals to act.

5.4.5 Intention

Intention is an INUS condition in all three recipes for both subsets of data. The prevalence of intention indicates its importance as a predictor of pro-environmental behaviour and supports existing research using theory of planned behaviour. As a particularly proximal construct, it is not surprising that INTENT is present in all sufficiency recipes and also appears as a necessary recipe and SUIN condition for those who are not members of an environmental organisation. As with other more abstract constructs however, INTENT is difficult to capture and target in individuals, so this result provides less practical value than, for example, those identified individual attributes.

5.5 SUMMARY

The preceding discussion has highlighted the results for each subset of data in relation to each category of condition, and each individual condition measured. There are clear similarities and differences between the two subsets of data (members and non-members of environmental organisations). These results are both aligned with but also contradictory to the conceptual model presented in **Figure 31**.

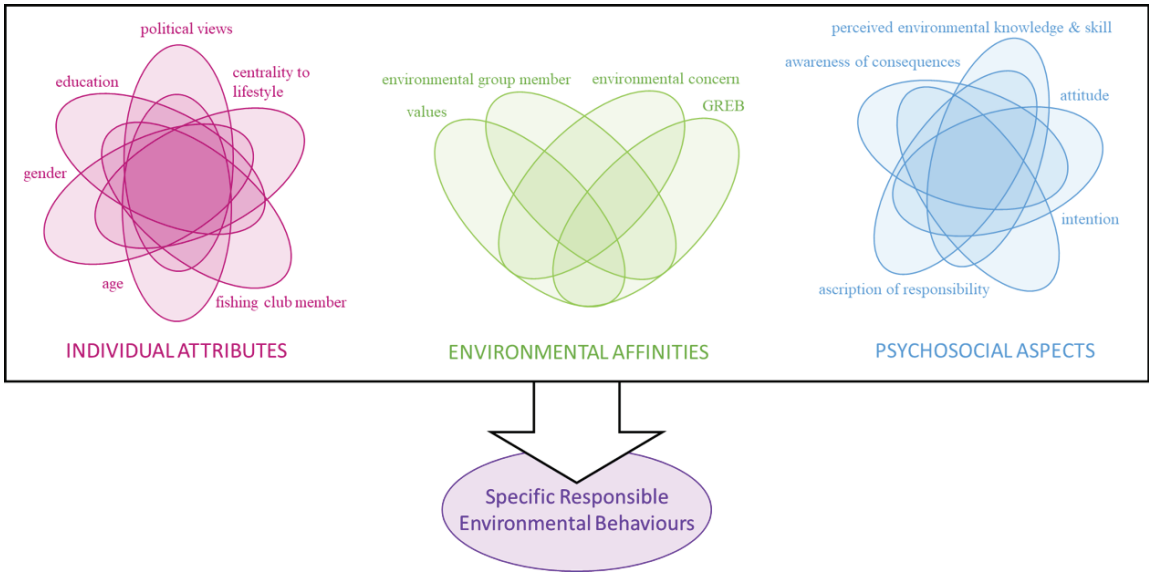

Figure 31. Conceptual Model of specific responsible environmental behaviours

Figure 31 presents a revised model which is a summary of the relevant identified sufficient conditions for those who are members of an environmental organisation.

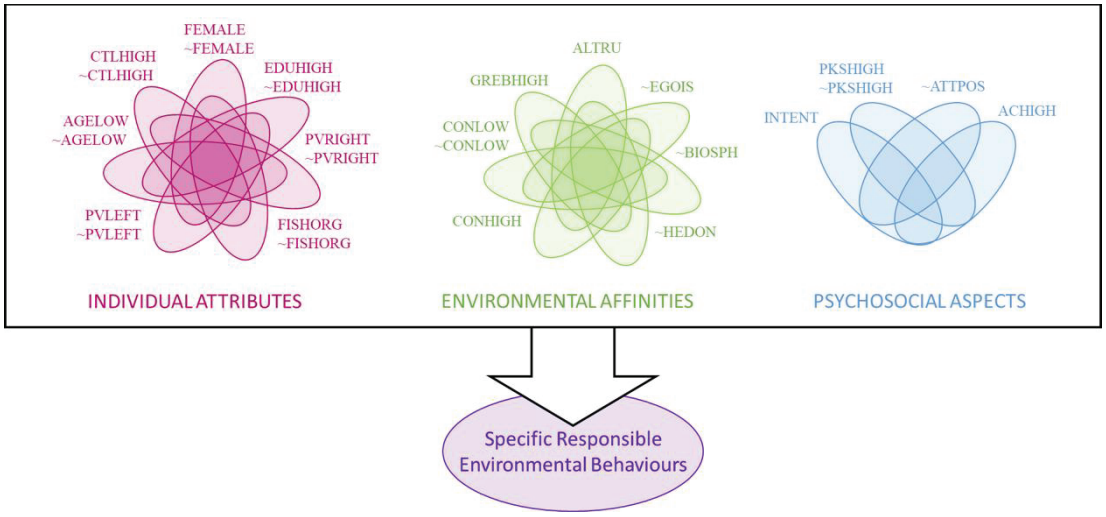

Figure 32. Influencing Factors of specific responsible environmental behaviour for members of an environmental organisation

Figure 32 presents a revised model which is a summary of the relevant identified necessary and sufficient conditions for those who are not members of an environmental organisation.

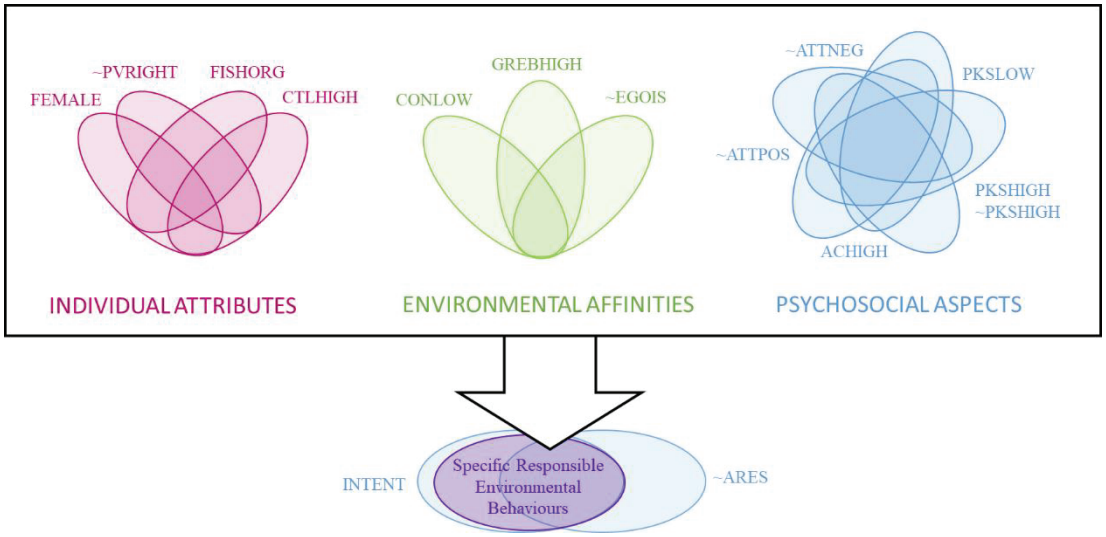

Figure 33. Influencing Factors of specific responsible environmental behaviour for those who are not members of an environmental organisation

These models directly answer the research questions posed in section 2.9 as they summarise the identified conditions which are necessary and conditions which are sufficient for performance of SREB in Australian recreational fishing environments.

Chapter 6: Conclusions

This thesis focused upon the configurations of attributes of individuals who participate in habitat stewardship actions in recreational fishing environments in Australia. The aim of this research was *"to identify necessary and/ or sufficient subset relations between individual, contextual, environmental and psychosocial conditions, and the performance of specific responsible environmental behaviours in Australian recreational fishing areas."* The purpose of the research was to overcome the inadequacies of current models and methods of pro-environmental behaviour prediction. This was done in order to simplify existing predictive models and provide practical support for organisations wishing to increase performance of these behaviours for effective environmental restoration and rehabilitation. The application of fuzzy set Qualitative Comparative Analysis (fsQCA) as a methodological approach and analytical technique allowed for the isolation of key conditions that are necessary or sufficient for specific responsible environmental behaviours in Australian recreational fishing environments.

Two research questions were answered. The research adapted complexity theory, critical realism and fsQCA to successfully answer these research questions and achieve the research aim. The first research question sought to identify psychosocial or contextual conditions that are empirically *necessary* for the performance of specific responsible environmental behaviour in recreational fishing environments. The second research question sought to identify configurations of psychosocial or contextual conditions that are considered *sufficient* for the performance of specific responsible environmental behaviour in recreational fishing environments. Wall et al. (2007) called for a synthesis of differing theoretical approaches to pro-environmental behaviour prediction. The conceptual model in this study has synthesised multiple common theoretical models and analysed its predictive capability using a unique analytical technique. This allowed for the successful identification of necessary and sufficient conditions for the outcome, for two subsets of the sample.

The following sections summarise key findings of this research, along with the implications of these findings for policy and practice, theoretical contributions, and practical implications. Finally, limitations of the research design are discussed, with recommendations for future research.

6.1 KEY FINDINGS

Ragin (2008) noted that conventional data analysis techniques (e.g. regression) are highly adopted due to their perceived rigor, however this rigor is specific to the analysis of "net-effects" of "independent" variables. In chapter 10 of Redesigning Social Inquiry (2008) Ragin outlines the limitations of this "net-effects thinking". Despite being pervasive in social sciences research, the practicality of adopting these traditional techniques in almost all social sciences research is limited. Indeed, Ragin (2008, p. 177) states:

> [It] is not that conventional analytic techniques are flawed—in fact, they are powerful and rigorous. Rather, the argument is that they are not well suited for analyzing causal complexity. Indeed, the assessment of net effects requires that the researcher assume that causation is uncomplicated.

This research has adopted a configurational, rather than correlational, approach to understanding predictors of stewardship behaviours in recreational fishing environments. In doing so it has embraced the complexities often ignored in studies utilising traditional modelling techniques. The adoption of a case-based rather than variable based approach has enhanced the understanding of the context in which individual conditions are of importance.

Existing predictors of an individual's pro-environmental behaviour have been investigated using a novel theoretical perspective and methodological approach. Fuzzy set Qualitative Comparative Analysis allowed for the isolation of key conditions that are necessary or sufficient for SREB in Australian recreational fishing environments. The conceptual model developed in this research aimed to bring together models and predictors from the extant literature. Some conditions presented in the conceptual model were able to be eliminated, as they were found to be not relevant in this context (e.g. age for individuals who are not members of environmental organisations). Most extant studies of environmental behaviour prediction have applied a single, linear-based model to populations of interest and aimed to uncover variables key to environmental behaviour prediction based on their net-effects. Results support the notion that application of linear models to such complex phenomena are often ineffective due to underlying complex configurational, asymmetric and equifinal relationships, hence persistent attempts to generate predictive models based on linear relationships contributes to the confusion and inconsistencies in the field.

Results of this study uncovered the underlying complex configurational mechanisms involved in responsible environmental behaviour prediction. Multiple equifinal solutions were

identified as sufficient for the performance of these target behaviours. Comparing data of those who are a member of an environmental organisation and those who are not revealed distinctly different configurations that are predictive of this behaviour. Thus, these findings can inform targeted recruitment and engagement strategies for efficient use of the limited available resources, for organisations and governing bodies hoping to increase these behaviours among individuals (Randle & Dolnicar, 2006). The lack of necessary solutions for those who are a member of an environmental organisation, coupled with the various sufficiency pathways supports the notion that efforts and resources may be best spent on those who are members of an environmental organisation.

Research question one aimed to identify conditions that are empirically necessary for the performance of specific responsible environmental behaviour in recreational fishing environments. Necessity relationships are based on causal conditions which must be present for the behaviour to occur. For the individuals in subset one, members of environmental organisations, there were no identified necessary conditions. However, by definition, being an environmental organisation member, who was over 16 years old and lived in Australia at the time of participation is the necessary conjunctive recipe because scope conditions are necessary by their nature. Subset two scope conditions include not being a member of an environmental organisation, being over 16 years old and living in Australia. This however was combined with two necessary recipes of measured conditions. Intent was present in both recipes, as a single necessary condition but also in conjunction with the negation of ascribed responsibility to oneself. This was unexpected, as the presence of ascribed responsibility is typically thought to play a role in inducing pro-environmental behaviour among individuals (Gregory, 2018; P.C. Stern et al., 1999). This further highlights the conflict between policies that ascribe responsibility to recreational fishers when it is unlikely that these individuals ascribe responsibility to themselves.

Research question two uncovered the theoretically possible configurations of conditions that are considered sufficient for the performance of specific responsible environmental behaviour in recreational fishing environments. These sufficiency relationships are based on combinations of conditions that always (or with high consistency) lead to the habitat stewardship behaviours measured. The resultant recipes for sufficiency are complex and indicate a wide range of intersecting conditions. The complexity of sufficiency recipes is further explanation of inconsistent findings in the extant literature in that the constructs often claimed to be important predictors of SREB are in fact likely to be INUS conditions and only

sufficient in conjunction with the presence and/or absence of multiple other INUS conditions. No measured construct was solely sufficient for the outcome. For both subsets the coverage measures of the sufficiency recipes of psychosocial aspects (the most proximal measures) were the highest of the three categories. This indicates that they are better measures as they are seen in a higher portion of individuals performing SREB. As with existing models of behaviour prediction however they are often the hardest to capture and target in individuals.

While results of this research are not generalisable to all contexts, this research has built upon the work of a few others who have aimed to overcome the deficiencies of "traditional" methods of pro-environmental behaviour prediction (e.g. Dolnicar & Grün, 2008; Fitzgerald, 2019; Olya & Akhshik, 2018). It is further support for the application of complimentary analytical techniques such as fsQCA in such complex contexts. The research contributes to building a better understanding of factors that are predictive of specific responsible environmental behaviours and the underlying patterns of these relationships.

6.2 THEORETICAL CONTRIBUTIONS

Despite approximately 50 years of research attempting to predict environmental behaviour there are persistent inconsistencies and confusion. Rather than reducing the complexity of this phenomena, existing models have increased it. Consistently employing inappropriate research questions and/or methodologies to investigate pro-environmental behaviour has led to insufficient attempts to resolve the complexity of this issue. A complimentary approach is required to progress our understanding of pro-environmental behaviour. This thesis has employed an alternative approach in order to answer alternate research questions and uncover configurational relationships.

Complex causality has been referred to throughout the extant literature, but linear models have almost always still been applied to pro-environmental behaviour prediction (LaLonde & Jackson, 2002). The proposed model for this research was more complex than any previously proposed model of environmental behaviour and aimed to refine the prediction of specific responsible environmental behaviours. The model is specific to the context of recreational fisher's habitat restoration behaviours as specificity in prediction is important. Despite this, the model will ideally be modified and utilised in a range of contexts to predict various other specific responsible environmental behaviours, with the use of fsQCA.

Other studies exploring heterogeneity in samples with different statistical techniques have found, for example, support for different profiles of: environmental consumerism (Bodur

& Sari 2005); behaviour types performed (Dolnicar & Grun 2008); concerns and attitudes which are predictive of environmental behaviour (Rhead et al., 2018) and different behaviours of the same individual across contexts (Dolnicar & Grun 2008). The results of this study include multiple recipes and the indication of multiple pathways to the outcome rather than the single most predictive like in linear models. They allow for highlighting of commonalities between recipes, examination of most prevalent configurations through coverage scores and comparison of differing configurations, and identify the critical and non-essential elements in current behaviour prediction models.

This research examined a specific set of responsible environmental behaviours. Measuring behaviour too narrowly may be of little theoretical or practical significance. Fishbein and Ajzen (2009) and Carmi et al. (2015) warn against predicting a behaviour that is too specific, to a point of not being generalisable or practical. The use of a group of stewardship behaviours, captured as specific responsible environmental behaviours (SREB) and relevant to recreational fishing areas provides proximal measures of a group of related behaviours, while achieving high levels of utility.

Traditional models assume symmetric, correlational relationships. Set theory allows for asymmetry and configurations – a condition can be present in a sufficiency recipe relationship but absent in another recipe, in a different configuration. This supports the idea that the causes leading to SREB are not simply mirrored in the causes leading to an absence of SREB, as assumed in traditional models. While checks for necessary and sufficient conditions for the negation of the outcome (~SREB) were explored to confirm the validity of results, a discussion of the negation of SREB is not in the scope of this research. The practical relevance of identifying the conditions necessary or sufficient for the absence of SREB performance holds far less practical value than those of the presence of SREB.

6.3 IMPLICATIONS FOR POLICY & PRACTICE

The findings also have several practical implications for organisations seeking to identify individuals likely to participate in habitat stewardship, or seeking to increase habitat stewardship rates of participation. This research contributes to a deeper understanding of the serious challenges faced in restoration of aquatic environments. The results may be used by industry, NGOs and government organisations in a range of fishing contexts to provide practical guidance for policy and strategy. Identifying the factors that vary among individuals who do and do not participate in these behaviours allows for more targeted future research,

campaigns and policy decisions, and ultimately better environmental outcomes. While the core focus of this work has been ecological benefit, there are numerous social and economic benefits. Recreational fishing benefits fishers socially and psychologically, and the economic and social values of fisheries is often overlooked or poorly defined (Cowx, 2010). Fishing licences alone generate $13 million revenue in a single State (NSW) of Australia (Dedual et al., 2013). However, there are also multiple supporting industries which are closely linked with recreational fisheries.

The diversity of individuals identified in this research may at first seem to generate more confusion, however for the public sector and NGOs the findings are promising. Rather than typical findings in linear modelling of a single, very specific profile (young, female, left-leaning political views etc.) this research suggests there are a wide range of individuals participating, likely with a range of motivations and connections to the issue. Randle & Dolnicar (2015) highlighted the value of understanding multiple profiles, as this allows for the adoption of market segmentation strategies to encourage voluntary environmental activity. Specifically, targeting or funding existing environmental groups or group members is a promising strategy. Results for subset two do provide a very specific subset of individuals to target that indicates that investment in existing fishing organisations or members exclusively may be beneficial but only if it is specific and targeted. For example, providing a platform for females within the fishing community (whose involvement has often been downplayed) may encourage further development of SREB performance.

Granek et al. (2008) claimed that recreational fishing is valuable for conservation as fishers have a vested interest in preservation of the resource they rely on. The authors cited evidence of direct and indirect conservation practices such as direct stocking of fish and the indirect impact of fishing licence money or performance of habitat stewardship. In Australia however fishing licences are only required in some states and this research (and others e.g. Copeland et al., 2017) suggests only a small portion of recreational fishers in Australia participate in SREB. The current approach of recruitment targeting recreational fishers is ineffective and this leads to recreational fishing having a larger negative impact than the positive impacts of stewardship behaviours by these groups (Cowx et al., 2010). Unexpected findings, contrary to the literature, such as the negation or absence of ascribed responsibility and the prevalence of altruistic rather than biospheric values indicate that participation is motivated by internal mechanisms, rather than the “top-down” approach of responsibility commonly employed by government and non-government organisations.

While the findings are preliminary and future studies are required, they suggest that an appropriate strategy may be to invest significant resources in the establishment of and/or existing environmental organisations in order to generate further stewardship activity. For recreational fishers who are not members of environmental organisations, efforts would be best realised if the focus is on the reduction of harmful practices or the uptake of more positive alternative behaviours while participating in recreational fishing. Alisat and Riemer (2015) noted that behaviours such as those measured in this study are distinct because of the relative difficulty and effort involved (as opposed to simple activities such as curbside recycling). They argued that only "very committed environmental activists" engage in behaviours of this type.

6.4 LIMITATIONS AND RECOMMENDATIONS FOR FUTURE RESEARCH

Some limitations of the research design are recognised. Due to the sampling technique, a response rate was not able to be calculated and therefore a measure of non-response bias was also unobtainable. Additionally, only self-reported behaviours were measured (rather than a true measure of behaviour performance) but this is common practice in the research field. Not all measures included in the original conceptual model were able to be incorporated in the analysis, as they were found to not be psychometrically appropriate. As with all survey research this is a result of a trade-off between survey length and robustness of measures. The results of the research are specific to Australian recreational fishers over 16; however, the methodology should be transferable to other contexts. There are likely differences in the uncovered profiles, in an Australian sample compared to other industrialised nations, due to differing contextual factors (Pannell et al., 2004; Randle & Dolnicar, 2006). Finally, by grouping memberships of various environmental organisations and fishing organisations together in a single measure this implies homogeneity between these groups when in reality there are various environmental organisations with differing goals and activities, and various types of fishing and fishing organisations. While this is acknowledged, accounting for this heterogeneity would further increase the complexity of an already very complex model.

In this research a lower threshold of consistency was applied due to the use of fuzzy-set causal conditions and a crisp-set outcome conditions. For the fuzzy-set conditions it is easier to be a subset of a crisp outcome than a superset as it is much easier for conditions to satisfy a consistency measure of <1 for sufficiency (subset) than it is to qualify for necessity (superset) which would require full set membership to be equal to the outcome (and can't be greater than it). This led to a number of deviant cases consistency in degree as an outcome of the research

design. Future studies would overcome this by measuring SREB participation across multiple conditions and/ or as fuzzy rather than crisp sets. As in Fiss (2011) different sets may be used to measure different levels of performance (based on performance in organisations: average performance, high performance and very high performance) so it may be possible to generate an understanding of the typology of those most likely to perform SREB on a regular basis.

Despite fsQCA not being subject to violation of statistical principles when too many variables are included in a model, Schneider and Wagemann (2010) suggest restricting the number of conditions to a moderate level (as the inclusion of many constructs produces highly complex results and increases the problem of limited diversity, thus producing a high number of logical remainders). This work has done that by incorporating only a selection of possible constructs, with a focus on those most common to environmental behaviour prediction and/or specific to the context. Still, results are complex. Future studies may use higher-order concepts/ macro-variables to reduce these problems[16] (while also recognising that the use of macro variables actually reduces the heterogeneity in a sample, thus potentially increasing logical remainders, so a trade-off is required). Many studies rely on self-reported intentions only as a proxy for actual environmental behaviours (Wynveen et al., 2015). Future studies could measure actual behaviour but this is prohibitive, logistically and economically.

6.5 CONCLUSION

The aim of this research was "to identify necessary and/ or sufficient subset relations between individual, contextual, environmental and psychosocial conditions, and the performance of specific responsible environmental behaviours in Australian recreational fishing areas." In identifying these conditions, the research has questioned the widespread use of conventional analytic techniques to analyse questions of causal complexity. Results support that this conventional application is ineffective in prediction of environmental stewardship behaviours due to the complexity and nature of the relationships being modelled. Additionally, results have uncovered the presence of equifinality, with multiple solutions identified as sufficient for the performance of specific responsible environmental behaviour in Australian recreational fisheries, and contrasting solutions for those who are and are not a member of an environmental organisation. The findings of this research support the application of different analytic techniques for similarly complex phenomena. Specific to this application they can also

[16] while also recognising that the use of macro variables actually reduces the heterogeneity in a sample thus potentially increasing logical remainders so a trade-off is required

be used to inform recruitment and engagement strategies for more efficient use of limited available resources to increase desired stewardship behaviours.

The two questions posed in this research aimed to identify both the conditions that are necessary and the conditions that are sufficient for the performance of specific responsible environmental behaviours in recreational fishing environments. Multiple necessary and sufficient recipes of conditions were identified for both those who are members of an environmental organisation and those who are not. While the results are complex, they do highlight that there are various segments of the population who perform these behaviours, allowing for more specific targeting of groups who may become involved. The results highlight the need for practitioners and policy makers to rethink the assumption that recreational fishers should be a primary target of campaigns to increase environmental stewardship behaviours in these environments, and instead consider leveraging the resources of existing environmental groups. Targeting individual recreational fishers or fishing organisations may not be the most efficient allocation of resources to effect positive environmental change. Rather, fishing organisations seeking to involve members in environmental stewardship may wish to partner with environmental organisations to achieve these goals.

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Appendices

Appendix A: Clubs for survey distribution

OzFish Australia
Amateur Fishermen's Association of NSW
Heads Hotel Fishing Club
Penrith Panthers Fishing Club
Sunfish QLD
BlueFin Fishing Club
Brisbane Deaf Anglers Club
City Hall Amateur Anglers Club Incorporated
Mallard & Claret Fly Fishing Club
Pine Rivers Services Fishing Club
EcoFishers Australia
Anglers Alliance Tasmania
Amateur Fishermen's Association of the Northern Territory
Recreational Fishing Alliance of NSW
RecFishWest
TARFish
ACT Flyfishers Club
Canberra Game Fishing Club
Echuca and Moama Sport Fishing Club
Greenwells Fly Fishing Club
Amateur Fishing Club – Lake Cathis
Ashford Anglers Club
Australian National Sportfishing Association
Avalon Beach RSL Fishing Club
Bass Sydney Fishing Club Inc.
Batemans Bay Game Fishing Club
Bermagui Sportfishing Club Inc.
Botany Bay Sport Fishing Club
Broken Bay Game Fishing Club
Campbelltown City Sportfishing Club
Davistown RSL Amateur Fishing Club
Eden Amateur Fishing Club
Elanora Hotel Fishing Club
Glenorie Amateur Fishing Club
Gosford RSL Fishing Club
Hornsby Angling and Casting Club
Illawarra Fly Fishers Club
Jannali Inn Social Fishing Club
Jervis Bay Game Fishing Club
Maroubra Amateur Fishing Association
Merimbula Big Game & Lakes Angling Club
Mid North Coast Fly Rodders
Moorebank Fishing Club
Newcastle Flyrodders
Newport Arms Fishing Club
NSW Fishing Clubs Association
NSW Council of Freshwater Anglers
Port Macquarie Panthers Anglers Club
Port Macquarie Game Fishing Club
Sea Bees Fishing Club
Shellharbour Game Fishing Club
South Sydney Amateur Fishing Association
St George & Sutherland Shire Anglers Club
Sydney Flyrodders' Club
Sydney Metropolitan Division of NSW Fishing Clubs' Association
Tacking Point Tavern Fishing Club
Toongabbie RSL Fishing Club
Warilla Bowls Fishing Club
Woronora River RSL & Citizens Club
Darwin Flyrodders
Darwin Game Fishing Club
Darwin Prison Officers Fishing Club
Arana Leagues Fishing Club
Baptist Church Fishing Club
Blue Water Sportfishing Club Townsville
Burleigh Heads Amateur Fishing Club
Cairns Bluewater Game Fishing Club
Cairns Flyfishers Inc.
Cairns Sportfishing Club
Gladstone Sportfishing Club
Grand Wivenhoe Social Fishing Club
Grand Wivenhoe Social Fishing Club
Hervey Bay Game Fishing Club
Innisfail Game Fishing Club
Mackay Game Fishing Club
Mt Isa Fish Stocking Group
Racecourse Light Gear Fishing Club
Riverview Deep Sea Fishing Club
Sherwood Services Fishing Club
Waterpark Lightgear Fishing Club
Adelaide Sportfishing Club
SA Division of Australian Anglers Association
Copper Coast Angling Club

SAFWAA South Australian Freshwater Anglers Association
South Coast Angling Club
Steel City Sport Fishing Club
War Veterans Fishing Group
Western Districts Angling & Game Fishing Club
Devonport Fly Fishing Club
Fly Fishers Club of Tasmania
Frequent Fly Rodders
Game Fishing Association of Tasmania
Game Fishing Club of Northern Tasmania
Latrobe Sportfishing Club
Wynyard Angling Club
South Sydney Amateur Fishing Association
Broome Fishing Club
Denmark Boating and Angling Club
Drifters Deep Sea Angling Club
Esperance Surfcasters Club
Exmouth Game Fishing Club
Geraldton Game Fishing Club
Hillarys Yacht Club – Game Fishing
Mangles Bay Fishing Club
Naturaliste Game and Sport Fishing Club
Nickol Bay Sport Fishing Club
Nor-west Game Fishing Club
Offshore Angling Club of Western Australia
Quinns Rocks Fishing Club
South Suburban Angling Club
Surf Casting and Angling Club
Swan Yacht Club
Warnbro Church of Christ Fishing Club
West Australian Trout & Freshwater Angling Association Inc.
West Coast Angling Club Inc.
Albert Park Yachting & Angling Club
Australian Anglers Association (Victorian Division)
Australian National Sportfishing Association (Vic Branch)
Ballarat Blue Water Gamefishing Club
Ballarat Fly Fishers Club
Bass Strait Game Fishing Club
Beaumaris Motor Yacht Squadron Angling Section
Bendigo & District Fly Fisher Inc.
Boronia Sport Fishing Club
Brotherhood of St. Laurence Fishing Club
Camperdown Angling Club
Cardinia Fly Fishers
Carrum Sports Club Anglers

Castaways Angling Club
Churchill Angling Club
Clayton Fishing Club
Clayton RSL Angling Club
Clunes Angling Club
Coastal Anglers
Cobaw Fishing Club
Corinella Boating & Angling Club
Council of Victorian Fly Fishing Clubs
Dargo Angling Club
Dederang & District Angling Club
Donvale Sport Fishing Club Inc.
Edithvale RSL Angling Club
Elwood Angling Club Inc
Epping RSL Angling Club
Essendon Fish Preservation Society & Anglers Club
Geelong & District Angling Club & Fish Preservation Society
Geelong Flyfishing Club
Globe Hotel Angling Club
Goulburn Valley Association of Angling Clubs
Greensborough & District Angling Club
Hobsons Bay Sports & Game Fishing Club
Keysborough Angling Club
Kyabram Angling Club Inc.
Latrobe Valley Game Fishing Club
Lorne Aquatic & Angling Club
Maryborough Angling Club
Melton Sportfishing Club
Mitcham Angling Club
Modewarre & District Anglers Club
Montmorency RSL Angling Club
Oakdale Angling Club
Pakenham Angling Club
Preston Angling Club
Red Tag Fly Fishers Club Inc
Reel Time Fishing Club
Rhyll Phillip Island Angling Club
Sandringham Anglers Club
Sands Angling Club
Seymour Fly Fishing Club
Smokies Angling Club
Snapper Point Angling Club
South Gippsland Game Fishing Club Inc.
Southern Fly Fishers
St. Albans Angling Club
Sunshine Fly Fishing Club
Terang Angling Club
Tirelines Angling Club
Toorak Angling Club & Fish Protection Society

Undera Angling Club
Upwey Fish Angling Fish Club
Venus Bay Angling Club
Victoria Police Angling Club Inc.
Victorian Sport & Game Fishing Club
Wangaratta Fly Fishing Club Inc
Warrnambool Fly Fishers Club
Watsonia RSL Anglers Club
Waverley & District Anglers
Werribee South Fishing Club
Westernport Angling Club Inc.
Williamstown & Newport Anglers Club
Williamstown Sport & Game Club
Wimmera Offshore Sport & Game Fishing Club
Yarra Valley Fly Fishers Inc.
Yinnar Angling Club
Queensland Water & Land Carers
Queensland Conservation
Australian Marine Conservation Society
Wildlife Preservation Society of Queensland
The Environment Institute of Australia & New Zealand
Australian Land Groundwater Association
SEQ Catchments Ltd
Great Barrier Reef Foundation
Healthy Waterways Ltd
Ginninderra Catchment Group
Southern ACT Catchment Group
Molonglo Catchment Group
Bayside Creeks Catchment Group
Bulimba Creek Catchment Coordinating Committee
Kedron Brook Catchment Branch
Moggill Creek Catchment Group
Norman Creek Catchment Coordinating Committee
Pullen Pullen Catchments Group Inc
Oxley Creek Catchment Association

Save Our Waterways Now Inc
Wolston & Centenary Catchments
Fitzroy Basin Association
Wimmera Catchment Management Authority
VicWater
Corangamite Catchment Management Authority
East Gippsland Catchment Management Authority
Glenelg Hopkins Catchment Management Authority
Goulburn Broken Catchment Management Authority
North Central Catchment Management Authority
North East Catchment Management Authority
Wheatbelt Natural Resource Management Incorporated
Perth Region Natural Resource Management
Peel-Harvey Catchment Council
South West Catchments Council
South Coast Natural Resource Management
Rangelands Natural Resource Management
Yarra Yarra Catchment Management Group
Moore Catchment Council
Territory Natural Resource Management
OceanWatch Australia
Southern Gulf Natural Resource Management
Queensland Murray-Darling Committee
Healthy Land and Water
Australian Marine Conservation Society

Appendix B: Survey instrument

Note. Not all survey items were used in the analysis

Please confirm you currently live in Australia and are at least 16 years old - **only individuals who live in Australia and are 16 or older should complete this survey**

- ☐ I currently live in Australia
- ☐ I confirm I am aged 16 or older

Fishing Background
This section involves questions about your fishing experience:

In the past twelve months how often have you gone fishing?

- ○ Once a week or more frequently
- ○ Once every 2-4 weeks
- ○ Once every 2-4 months
- ○ Once or twice a year
- ○ Less than once a year
- ○ I do not participate in fishing

Where do you **most often** fish?

- ○ Freshwater river or stream
- ○ Freshwater impoundment or dam
- ○ Freshwater natural lake or pond
- ○ Estuary
- ○ Coastal shore or beach
- ○ Rocky headlands
- ○ Inshore marine boat fishing (less than 3 nautical miles from shore)
- ○ Offshore marine boat fishing (more than 3 nautical miles from shore)

Please indicate your level of agreement with the following statements:

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I consider myself an expert recreational fisher	○	○	○	○	○
Fishing and fishing related activities are one of the most enjoyable things I do	○	○	○	○	○
Fishing is very important to me	○	○	○	○	○
Most of my friends are in some way connected with fishing	○	○	○	○	○
I have an in-depth knowledge of fishing rules and regulations	○	○	○	○	○
I have a strong knowledge of waterways	○	○	○	○	○
I have a strong knowledge of fish habitat	○	○	○	○	○
I have a strong knowledge of fish species	○	○	○	○	○
I have a strong knowledge of how to restore and preserve fish habitats	○	○	○	○	○
I have a high level of skill in restoring and preserving fish habitats	○	○	○	○	○

Knowledge
This section involves questions regarding where you obtain information about fishing and environmental issues:

Where do you get information about fishing and/or environmental issues? (Select all that apply)

	Fishing information	Environmental issue information
Fishing blogs or websites	☐	☐
Government websites	☐	☐
Other government sources	☐	☐
Fishing clubs	☐	☐
Environmental groups	☐	☐
Fishing magazines	☐	☐
Local bait and tackle shop	☐	☐
Family/ friends	☐	☐
Other fishers	☐	☐
TV shows/ radio	☐	☐
Newspapers	☐	☐
Social Media	☐	☐
I don't seek this type of information	☐	☐

What do you believe are the impacts of the following on fish habitats?

	Positive	Neutral	Negative	I Don't Know
Installing fishways/ fish ladders/ fish steps	○	○	○	○
Creating dams and weirs	○	○	○	○
Constructing artificial habitats (e.g. artificial reefs, fish hotels)	○	○	○	○
Sewage discharges from boats or sewers	○	○	○	○
Planting along riverbanks	○	○	○	○
Removing debris	○	○	○	○
Removing rubbish	○	○	○	○
Treating storm water runoff	○	○	○	○
Removing exotic (non-native) species	○	○	○	○
Climate change	○	○	○	○
Urban and rural development	○	○	○	○
Pesticides	○	○	○	○
Livestock grazing near waterways	○	○	○	○
Block and chain moorings	○	○	○	○
Creating pools, riffles, snags	○	○	○	○

Actions
This section involves questions regarding participation in environmental activities

Which of the following have you done in the last 12 months? (Select all that apply)

	Recreational fishing	General environmental issues
Educated myself about... (e.g. through TV, media, internet etc.)	☐	☐
Participated in an educational event related to...	☐	☐
Organised an educational event related to...	☐	☐
Talked with other people about... (e.g. spouse, parents, children, friends)	☐	☐
Shared posts on social media about...	☐	☐
Communicated with a politician and/or government official about...	☐	☐
Consciously made time for...	☐	☐

Fish habitat management and restoration actions can involve a range of activities including:
-Removing non-native species
-Resnagging, riverbank planting, restoring reefs
-Removing rubbish
-Stopping things you do while fishing that damage the environment
-Weed control
-Constructing artificial habitats, fish hotels, fish friendly marine infrastructure
-Installing fishways/ fish ladders/ fish steps, installing gross pollutant traps, removing barriers in waterways etc.

The following questions relate to fish habitat management and restoration actions:

	Yes	No
Have you performed any fish habitat management and restoration actions in the last 12 months?	○	○
Do you intend to perform any fish habitat management and restoration actions in the next 12 months?	○	○

Please indicate your level of agreement with the following statements regarding fish habitat management and restoration actions:

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I usually prefer to lead these types of activities	○	○	○	○	○
I usually prefer to organise these types of activities	○	○	○	○	○
I usually prefer to participate in but not organise or lead these types of activities	○	○	○	○	○

In regard to fish habitat management and restoration actions please indicate your level of agreement with the following statements:

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I am confident that I can undertake these types of activities	○	○	○	○	○
My participation in these types of activities is up to me	○	○	○	○	○
These types of activities help to reduce the harm of recreational fishing on natural habitats	○	○	○	○	○
These types of activities help to minimise environmental degradation in fish habitats	○	○	○	○	○
I feel an obligation to undertake these types of activities	○	○	○	○	○
Regardless of what other people do, because of my own values/principles I feel that I should undertake these types of activities	○	○	○	○	○
Other recreational fishers undertake these types of activities	○	○	○	○	○
Other recreational fishers approve of those who do not undertake these types of activities	○	○	○	○	○
People who are important to me (e.g., family and friends) undertake these types of activities	○	○	○	○	○
People who are important to me (family and friends) disapprove of those who do not undertake these types of activities	○	○	○	○	○
People whose opinions I value undertake these types of activities	○	○	○	○	○
Involvement in these types of activities would be enjoyable	○	○	○	○	○
Involvement in these types of activities would be important	○	○	○	○	○
Involvement in these types of activities would be worthwhile	○	○	○	○	○

Please indicate why you participate in fishing and/or why you participate in fish habitat management and restoration actions (Select all that apply):

	Why you Fish:	Why you participate in activities that restore or protect fish habitats:
To get away from the daily routine	☐	☐
For physical exercise	☐	☐
To be outdoors	☐	☐
To experience nature	☐	☐
To spend time alone	☐	☐
To be with my friends or family	☐	☐
For the challenge or sport of fishing and the experience of the catch	☐	☐
To catch fish for eating	☐	☐
To catch a trophy fish	☐	☐
To develop my skills	☐	☐
To test my equipment	☐	☐
To increase fish numbers so there are more to catch	☐	☐
To improve the habitat of fish	☐	☐

To learn new things	☐	☐
To be a part of my club / organisation's activities	☐	☐
To meet a social obligation/ its the right thing to do	☐	☐
To make a contribution/ give something back	☐	☐
To set an example	☐	☐
To follow an example	☐	☐
I don't participate in this type of activity	☐	☐

Responsibility
This section involves questions regarding who has responsibility for fish habitat management and restoration

Please indicate your level of agreement with the following statements:

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
My contribution to environmental damage in fish habitats is negligible	○	○	○	○	○
Every recreational fisher must take responsibility for improving the health of fish habitats	○	○	○	○	○
Government authorities have a greater responsibility than recreational fishers for improving the health of fish habitats	○	○	○	○	○
Fishing clubs have a greater responsibility than recreational fishers for improving the health of fish habitats	○	○	○	○	○
Commercial fishers have a greater responsibility than recreational fishers for improving the health of fish habitats	○	○	○	○	○
Land-based activities (farmers, developers and industry) have a greater responsibility than recreational fishers for improving the health of fish habitats	○	○	○	○	○
Environmental groups have a greater responsibility than recreational fishers for improving the health of fish habitats	○	○	○	○	○
Local communities have a greater responsibility than recreational fishers for improving the health of fish habitats	○	○	○	○	○
Government should redistribute income from the better off to those who are less well off	○	○	○	○	○
Big business benefits owners at the expense of workers	○	○	○	○	○
There is one law for the rich and one law for the poor	○	○	○	○	○

In your opinion, how important are each of the following in solving environmental problems in fish habitats?

	Extremely important	Important	Neutral	Not important	Not at all important/ no impact
People making small changes in their daily lives	○	○	○	○	○
People working together in small groups	○	○	○	○	○
Locally focused actions	○	○	○	○	○
State based laws and regulations	○	○	○	○	○
National laws and policies	○	○	○	○	○
International agreements	○	○	○	○	○

Values

These are more general questions as we are interested in understanding why different types of people fish and how likely they are to participate in fish habitat management and restoration

How important are the following to you in the way you live your life?

	Opposed to my principles	Not important	Neutral	Important	Extremely important/ Central to my life
Enjoying life	○	○	○	○	○
Personal wealth	○	○	○	○	○
Equality	○	○	○	○	○
Protecting the environment	○	○	○	○	○

Please indicate your level of agreement with the following statements:

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
I prefer to stay in a modern campground than an isolated area where there might be wild animals around	○	○	○	○	○
I care more about the wellbeing of individual animals than I do about species population levels	○	○	○	○	○
I have owned pets that were as dear to me as another person	○	○	○	○	○
Zoos should provide more natural conditions for their animals even if this means much higher entrance fees	○	○	○	○	○
I have little interest in learning about the taxonomic classification of animals	○	○	○	○	○
I approve of building on wetlands that non-endangered wildlife use if the wetlands are needed for housing development	○	○	○	○	○
I admire someone who works hard to catch a big trophy fish like a Marlin	○	○	○	○	○
I enjoy opportunities to view animals in their natural environment	○	○	○	○	○
It is important to me that animals are killed humanely	○	○	○	○	○

Please indicate your level of agreement with the following statements:

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Nature would be at harmony if human beings would leave it alone	○	○	○	○	○
Almost everything we do in modern life is harmful to nature	○	○	○	○	○
The earth has limited resources	○	○	○	○	○
We are approaching the maximum number of people the earth can support	○	○	○	○	○
We will experience a major ecological catastrophe if society continues on its present course	○	○	○	○	○
Technology causes more environmental problems than it solves	○	○	○	○	○
Environmental problems will eventually be solved through better technology	○	○	○	○	○
Actions taken by individuals can solve environmental problems	○	○	○	○	○

Demographics
This section involves questions regarding basic demographic characteristics

	Yes	No
Are you a member of a fishing club or organisation?	○	○
Are you a member of any group whose main aim is to preserve or protect the environment?	○	○

Are these the same organisation?

○ Yes

○ No

What gender do you identify as?

- ○ Male
- ○ Female
- ○ X

How old are you today?

_____

What is the level of the highest qualification you have **completed**?

- ○ Did not complete primary schooling
- ○ Primary school
- ○ Secondary school
- ○ Certificate level/ diploma / advanced diploma
- ○ Bachelor degree
- ○ Postgraduate study

What is the postcode of the address where you usually live?

_____

Is there anything you'd like to say about fish habitat that hasn't been captured yet?

_____