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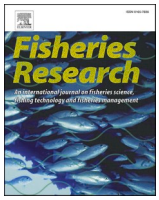

# Economic value of regional spearfishing competitions

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ABSTRACT

Large-scale surveys have been used to estimate the value of recreational fishing over large areas and time periods in the past, but there is a lack of information regarding the value of smaller event based recreational fishing activities. Using the travel-cost method, we estimate the overall value generated by two regional spearfishing competitions in eastern Australia and the adjusted value per competitor. The 2021 Bluewater Classic was valued between $32,874 and $39,492 AUD, with past values up to $100,364. The 2021 Eden 3-way Championships was valued between $102,461 and $118,747. On a per-competitor basis, the adjusted mean expenditure was between $1,090 and $1,649. Both competitions generated substantial economic activity within the towns that hosted them, as we estimated that localised expenditure constituted 60 – 71% of a competition's overall value. These estimates demonstrate the value of recreational competitions for regional areas and the importance for economic surveys to consider smaller events.

## 1. Introduction

Recreational fishing is an incredibly popular pastime, with an estimated 10.5% participation rate across the industrialized world (Arlinghaus et al., 2015). Although marine recreational catches account for slightly less than 1% of the total global marine harvest (Freire et al., 2020), they generate significant economic value (Cisneros-Montemayor and Sumaila, 2010) and can contribute both directly and indirectly towards coastal fishery declines, ecosystem-level alterations, and environmental contamination (Cooke and Cowx, 2004; Ihde et al., 2011; Lewin et al., 2019). As global appreciation for the significant impacts of recreational fishing has grown, research focusing on the socioeconomic value of recreational fishing on a national level has increased in recent years (Hyder et al., 2018; Soldo et al., 2018; Terashima et al., 2020). Both the estimated catch and economic value of recreational fisheries can be substantial, and a lack of reporting on recreational activities can lead to vast underestimations of the sector's competition with commercial and artisanal fisheries (Smith and Zeller, 2016; Babali et al., 2018). Calculating the economic value of recreational fishing activity on a national level can therefore aid policymakers in making informed decisions when balancing the social and environmental costs and benefits of competing marine resource users but some decisions require more fine-scale analyses. It is essential to assess the value of individual recreational fishing activities on a smaller regional level as recreational fishing activities vary widely in their spatial and temporal concentration, participant behaviours, and environmental impacts, The importance of within-sector valuation is supported by bioeconomic studies, which have shown that accounting for all sources of heterogeneity within the recreational sector and assessing value on a finer scale is essential for sustainable fisheries management (Johnston et al., 2010; Fenichel and Abbott, 2014).

Australia is home to around 3.36 million recreational fishers (Henry and Lyle, 2003; Hyder et al., 2018), and the nation's recreational fishing sector has an expenditure value comparable to that of commercial fisheries and aquaculture (Colquhoun, 2015; Mobsby, 2018). The state of New South Wales (NSW) makes a large contribution to these national totals, holding both the greatest number of recreational fishers and the largest estimated expenditure of any state (Henry and Lyle, 2003; Campbell and Murphy, 2005). The NSW government currently collects data on recreational fishing activities on a broad spatial and temporal scale (West et al., 2015; Murphy et al., 2020), and these methods are a cost-effective way to obtain robust estimates of catch and expenditure at

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a state-wide level. The economic value of Australia's recreational fishing sector is also estimated on a national scale by the National Recreational Fishing Survey (Henry and Lyle, 2003), which aims to capture both direct expenditure as well as flow on effects throughout the economy and the 'intangible' social, cultural, and emotional values of this practice, which can be overlooked in pure economic analyses.

While these national and state-wide surveys are thorough and ongoing, this macro approach is unable to fully capture the diversity of recreational fishing activities and understand their economic and environmental impacts on a fine spatial and temporal scale. A recent assessment of the NSW's broad-scale survey methods highlighted game fishing and fishing tournaments as research gaps in NSW's current understanding of the value and impact of recreational fishing (Lynch et al., 2020). Tournament fishing constitutes high fishing effort concentrated at a localised level, and as such have a low probability of being captured in state-wide surveys (Lynch et al., 2019). Research aiming to calculate the localised economic value of these activities is limited, but initial studies have shown that high-effort game fishing and angling trips in NSW can stimulate the economy of small regional centres and enable the transfer of wealth from cities to regional communities (Dominion Consulting Pty Ltd, 2003; Ward et al., 2012; McIlgorm and Pepperell, 2013). Further research is needed across a broad range of competitive fishing activities to better understand and manage recreational fisheries and their socioeconomic value for regional centres.

Spearfishing is a small but important recreational fishing sector that frequently holds competitions in regional centres along the NSW coast. Although some studies have explored catch trends in spearfishing tournaments internationally (Coll et al., 2004; Pita and Freire, 2014), the economic impacts of these tournaments (as well as recreational spearfishing generally) remain vastly unstudied (Sbragaglia et al., 2021). In common with game fishing tournaments, spearfishing competitions are likely to provide substantial economic stimulus to the communities that host them. However, such fine-scale exploration of tournament spearfishing's regional value has never been estimated anywhere in Australia (or possibly in the world, see Sbragaglia et al., 2021), although some previous fishing competition environmental accreditation schemes which have included spearfishing, for example NEATFish, have included a self-reported estimate of economic activity (Diggles et al., 2011). A detailed study into the socio-economic value of these competitions would provide valuable information for the local communities and clubs who host these competitions. Valuation of spearfishing can also complement studies into the catch, effort, and impact of spearfishers (Frisch et al., 2012; Young et al., 2014, 2015) and thereby aid policymakers in weighing up the cost and benefits of this sector when making allocation and management decisions as they balance social, economic and environmental issues.

This study aims to 1) Calculate the value of two spearfishing competitions held in regional NSW during 2021 using travel-cost valuation; 2) Use past entry data to investigate fluctuations in competition value over time, and 3) Calculate estimates of the onsite (local) expenditure per person. These aims will improve understanding of the economic impact of spearfishing competitions on the regional centres that host them. The valuations generated by this project will strengthen our understanding of the value of small-scale, event based recreational fishing and its impacts on regional communities.

## 2. Methods

### 2.1. Spearfishing competitions

Two regional spearfishing competitions in eastern Australia were selected and then attended as they represent some of the largest regional competitions in New South Wales, Australia. These were the 2021 Australian Bluewater Freediving Classic at Woolgoolga (30.109° S, 153.203° E) held on 7th – 9th May 2021 (postponed from 20 to 21 March due to flooding) and the 2021 3-Way State Titles at Eden (37.076° S, 149.885° E) on 12th and 13th of June 2021. The 3-Way State Titles were cancelled the morning of the event due to gale force wind warnings, but participants registered prior to the cancellation and most turned up prior to the cancellation so we proceeded to include the event in our analysis.

### 2.2. Data collection and survey design

Data was collected at both events using voluntary anonymous surveys of competition participants. The same survey was used at both competitions following ethics approval (UNSW HEC# HC210037) and was conducted with permission from the competition organisers. Due to the survey being conducted prior to fishing occurring at the 3-Way State Titles, some of the questions were not relevant and responses were not considered in the analysis. Surveys were conducted on tablets using the RedCap application (Harris et al., 2009, 2019) or on paper with the results transferred into the application.

The survey questions were designed based upon a previous survey used to value a birdwatching event (Callaghan et al., 2019), consultation with competition organisers and our knowledge of spearfishing. The questions spanned four main categories: Economics, Spearfishing Experience, Values and Socio-demographics, with examples shown in Table 1. The full survey questions and summarised results for all questions are available in the Supplementary Material but our main analysis concerns the economic valuation.

At the Woolgoolga Bluewater Classic, participants were surveyed at the 'weigh-in' where all competitors must register their catch if they are to be judged. We received surveys from all competitors aged 18 or over who weighed in a fish, a total of 21 surveys, one of which was removed due to being returned empty. Thirty-four people registered for the competition but 13 did not attend the weigh-in, resulting in us sampling 61.7% of competitors.

On the morning of the Eden 3-Way State Titles, safety officers met to discuss the gale-force wind forecast, and whether the competition would commence. We surveyed participants while they awaited the results of the safety meeting. We surveyed 50 competitors, receiving valid responses from all. This was 79.4% of total registered competitors.

### 2.3. Data analysis

To address our aim of estimating an economic value of each competition, we calculated the economic value using the individual travel-cost methodology, which identifies the value of recreation services that are not bought or sold. The premise of the method is that despite there being no price tag for a given recreation service (or, in our case, a specific event), the costs incurred by individuals travelling to the site provide an estimate of economic value (Špaček and Antoušková, 2013). Due to competition-specific differences in the data, first we discuss competition specific details, then describe the overall valuation methods.

### 2.4. Competition specific details

#### 2.4.1. Competition 1 – Bluewater Classic

One survey participant did not provide their annual income. We therefore imputed this as the mean of all other respondents at this competition. The organisers of the Bluewater Classic provided us with the post codes of all attendees at the current competition as well as five past competitions (2000, 2001, 2005, 2009 and 2015) to investigate interannual variation in value. This competition is held most years but only entry data for these years was available. Using the results from the 2021 analysis, we retrospectively valued the past competitions by using our 2021 model (discussed below) to predict values of past competitors based on the previous competition specific travel distances. This assumes that past competitions would have had similar costs to the present year. We did not control for inflation in our past estimates as we wished the values to be directly comparable to 2021. This means the values

**Table 1**
Summary of the questions asked during our survey.

| Category | Number of Questions | Example Questions | Rationale |
|---|---|---|---|
| Economics | 8 | 1. Please estimate the amount of money ($) you spent on: Meals<br>2. What is your home postcode? | These questions formed the basis of the economic assessment. |
| Spearfishing Experience | 8 | 1. How many years spearfishing experience do you have? | These questions provided insight into the previous experience of survey participants. |
| Values | 6 | 1. How important is sustainable management/ conservation of the marine environment to you? | These questions investigated the general values of survey participants and what non-economic values they believe competitions can provide. |
| Socio-demographics | 5 | 1. What is your age?<br>2. What is your highest level of education? | These questions provided insight into the demographic composition of the survey participants. |

The survey contained four broad categories and the table shows the number of questions asked in each category, example questions from each category and the rationale behind asking questions from each category. Full questions and summarised answers are provided in the Supplementary Material.

presented are the equivalent 2021 values (if a past competition was held in 2021).

#### 2.4.2. Competition 2 – 3-Way State Titles

The competition organisers of the Eden 3-Way State Titles could not provide the postcodes of each entrant but did provide each entrant's local club which we used to assign a postcode to unsurveyed competitors. This would introduce some error into the distance calculations, but this was considered minimal.

### 2.5. Valuation methods

As part of our survey, we collected the home post code of participants, and this was used to calculate the distance travelled. As all survey participants reported travelling to the competitions via car, distances and travel time were calculated using the 'gmapsdistance' package (Melo et al., 2018) in R v4.0.2 (R Core Team, 2021). This package interfaces with 'Google Maps' and returns the estimated driving distance and travel time which we then converted to a value using the standard cost of operating a motor vehicle in Australia ($0.72 per km, Australian Taxation Office, 2021). For individuals who car-pooled we divided the travel cost by the number of people in the car. To get a total travel cost of each competitor, we also added estimates of other expenditure from survey questions specifically addressing accommodation, meals, boat fuel, competition gear and other. While the incorporation of travel time in travel value estimates is common (e.g., Chae et al., 2012; Leggett et al., 2018), its inclusion is still debated (Czajkowski et al., 2019). We therefore created estimates both including and excluding a value for travel time for each individual. When included, we incorporated the value of time spent travelling to the event using the estimated travel time, valued as half of the average hourly wage rate ($34.36, ABS, 2021). The reported expenditure and distance travelled was used from all completed surveys to calculate the individual total cost. Most travel-costs analyses are now paired with or embedded within demand models (Pokki et al., 2018; Hwang et al., 2021). However, the present analysis did not use a demand model since the competitions surveyed in this study were single events and therefore there were no repeat visits.

The data from each survey was then used to estimate mean expenditure of an individual to scale up the estimate to the whole attendance of each event. The adjusted mean expenditure (travel + other costs or just other costs) of an individual was estimated based upon a regression analysis controlling for age, education, and whether an individual car-pooled. All regressions used gaussian error distributions, but the response variables were log-transformed for all Eden 3-Way State Titles models to meet the model assumptions.

To estimate values for unsurveyed participants, we produced four estimates varying in the inclusion/exclusion of travel time and whether we used distance specific valuations or simply the adjusted mean individual expenditure multiplied by the number of unsurveyed participants (Table 2). These estimates were added to the exact estimates derived from the surveyed participants to produce a total competition value.

**Table 2**
Details of the four methods used to estimate the value of unsurveyed competitors.

| Method | Value estimation details |
|---|---|
| 1 | The adjusted mean expenditure (including travel time value) of an individual was multiplied by the number of unsurveyed competitors. |
| 2 | The adjusted mean expenditure (excluding travel time value) of an individual was multiplied by the number of unsurveyed competitors. |
| 3 | Using the distances travelled by the unsurveyed competitors to calculate the travel value (including travel time value) combined with the adjusted mean expenditure (excluding travel) for the unsurveyed participants. |
| 4 | Using the distances travelled by the unsurveyed competitors to calculate the travel value (excluding travel time value) combined with the adjusted mean expenditure (excluding travel) for the unsurveyed participants. |

Note: Distances travelled of unsurveyed competitors were supplied by the competition organisers. Adjusted mean expenditure values were calculated using a regression analysis and incorporated the "other" expenditure such as accommodation, meals etc. Full breakdown of other costs can be seen in Figure S15.

To estimate what proportion the competitors spent locally, we assumed that all costs excluding travel costs were local to the competitions. These local costs therefore include expenses such as accommodation, meals and competition gear but not travel. This is potentially a conservative estimate as some of the travel costs would have been made locally, for example fuel for the drive home from the competition.

## 3. Results

### 3.1. Sociodemographic summary

Competitors at both competitions were predominately male (95% at the Bluewater Classic and 92% at the 3-Way State Titles) and the majority did not have any children (Fig. S1). Both competitions were attended by a wide range of ages (up to 67), although over 50% of competitors were below 35 years old (Fig. S2). The distance travelled to both competitions were considerable although the median was higher for the Eden 3-Way State Titles (519 km compared to 339 km), although both competitions had competitors travel up to double this distance (Figs. 1 and 2). Competitors at the Eden 3-Way State Titles had on average completed a higher level of education with more people reporting a post-school level qualification compared to the Bluewater Classic (80% compared to 65%; Fig. S3). The distributions of incomes were higher at the Eden 3-Way State Titles although incomes at both competitions were right skewed with few individuals reporting large incomes (Fig. S4). Overall competitors at both competitions displayed high levels of engagement with the marine environment in their daily lives, with most competitors recreationally spearfishing at least once every two weeks (Fig. S5). Almost all competitors valued sustainable management extremely highly and identified the competitions as an

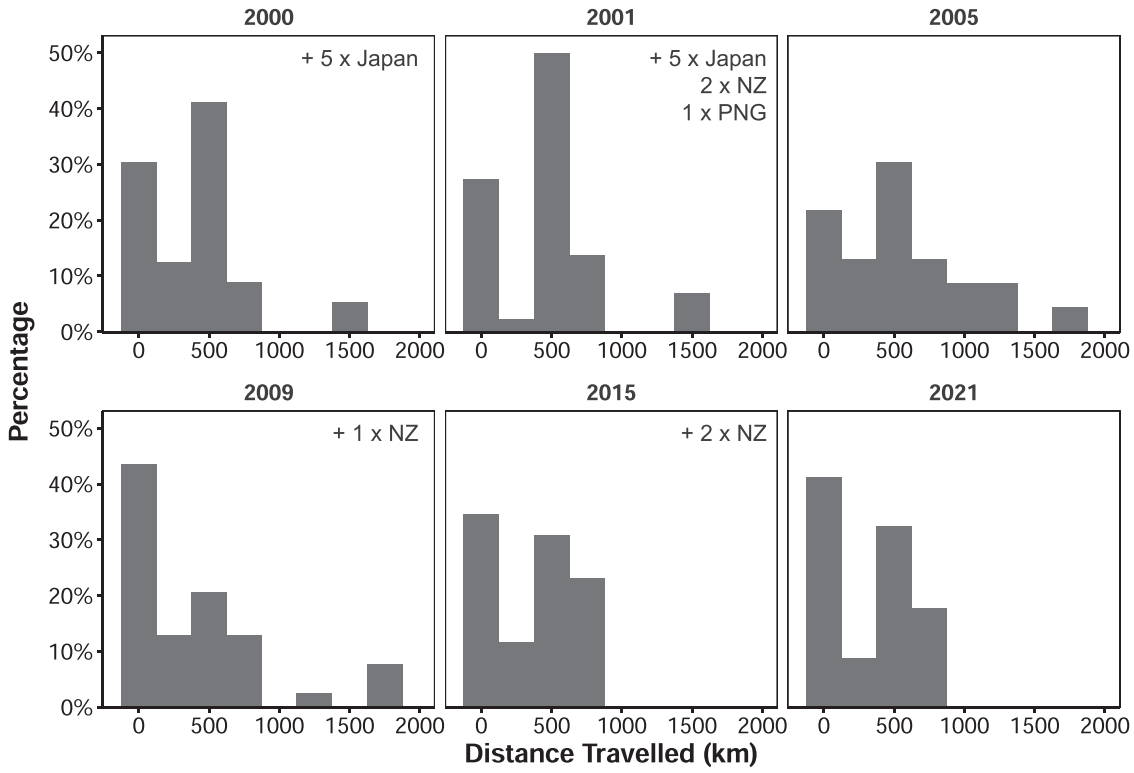


**Fig. 1.** Distances travelled by participants to the Bluewater Classic in various years. These are calculated as the driving distance between the home post codes and competition location. Note international competitors are excluded from the histograms and shown as text instead (number of competitors from each country). PNG represents Papua New Guinea and NZ represents New Zealand.

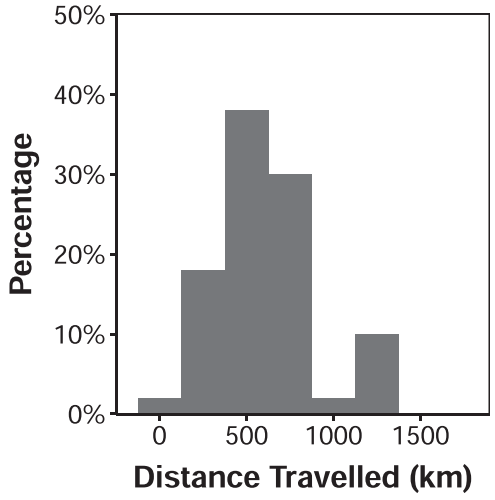


**Fig. 2.** Distances travelled by participants to the Eden 3-Way State Titles in June 2021 based upon the survey responses (n = 50). These are calculated as the driving distance between the home post codes and competition location.

important way to build community spirit and maintain social connectivity (Figs S6 and S7).

### 3.2. Economic valuations

#### 3.2.1. Bluewater Classic

The regression analysis estimated that the adjusted mean total expenditure for a competitor was $1161.52 (including travel time) or $1018.97 (excluding travel time) AUD. The adjusted mean expenditure (excluding all travel) was estimated to be $727.82 per competitor. Scaling these estimates up to all registered participants using the four travel cost variations, we estimated the value of the 2021 Bluewater classic as between $32,874 and $39,492 (Table 3). Based on the survey participants, excluding travel costs, we estimate that at least 63 – 71% percent of this was made up of expenditure local to the competition ($20,599 – $28,208).

Using the home location information of past competitors, we estimated that past competitions had large variations in value, potentially up to $100,364 in 2000 (Table 3; Fig. 3). This was largely driven by the number of competitors with 2000 having the largest number of competitors (N = 61), including several international competitors (Table S1). The value of a competition is clearly linked to the number of competitors with the highest valued competitions being those which the highest attendance, driving fluctuations over time. In all years, except 2021, the travel distance specific estimates of value provided the highest estimates of value.

#### 3.2.2. Eden 3-Way State Titles

Our regression analysis estimated that the adjusted mean total expenditure for a competitor at the Eden 3-Way State Titles was $1759.04 (including travel time) or $1537.12 (excluding travel time).

**Table 3**
Estimated values for the spearfishing competitions using the four variants of the travel cost method.

| Competition | Year | Method 1 | Method 2 | Method 3 | Method 4 |
|---|---|---|---|---|---|
| Bluewater Classic | 2000 | $70,853 | $62,157 | $100,364 | $89,124 |
| | 2001 | $58,076 | $50,949 | $86,033 | $76,182 |
| | 2005 | $26,715 | $23,436 | $30,739 | $26,003 |
| | 2009 | $46,461 | $40,759 | $47,281 | $41,431 |
| | 2015 | $32,523 | $28,531 | $34,592 | $30,114 |
| | 2021 | $39,492 | $34,645 | $36,965 | $32,874 |
| Eden 3-Way State Titles | 2021 | $118,747 | $104,724 | $103,438 | $102,461 |

Note: The details of each method are provided in Table 2.

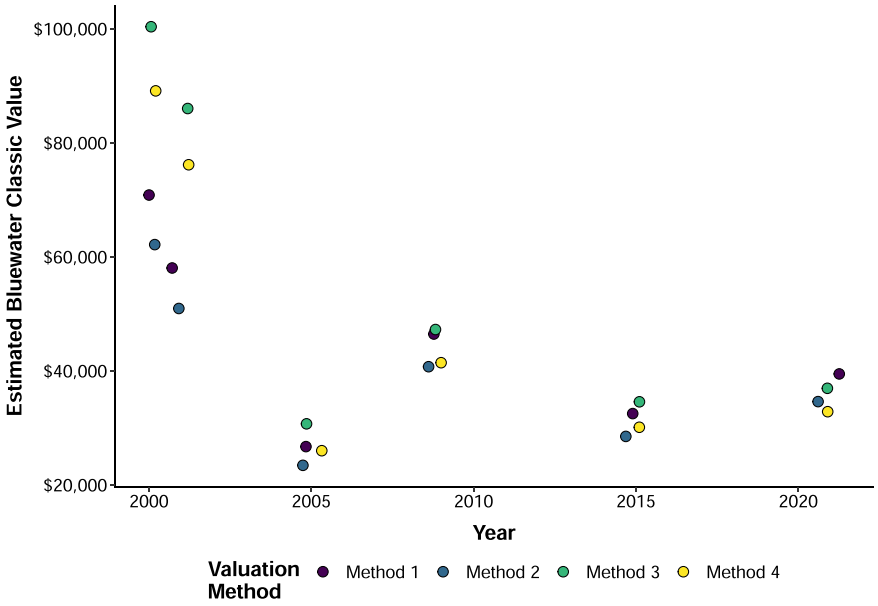


**Fig. 3.** Value of the Bluewater Classic spearfishing competition over time (2000, 2001, 2005, 2009, 2015 & 2021) using the four variants of the travel cost method. The valuation methods are detailed in Table 2. Note a small horizontal jitter was applied to the points to better see overlapping points.

The adjusted mean expenditure (excluding all travel) was estimated to be $970.51. Using the four travel cost variations we estimated the value of the Eden 3-Way State Titles as between $102,461 and $118,747 (Table 3). Based on the survey participants, by excluding travel costs and assuming all other costs were local, we estimate that at least 60 – 68% percent of this was made up of expenditure local to the competition ($61,479 - $80,748).

## 4. Discussion

The travel cost methods used in this study produced a range of non-market economic values for two regional spearfishing competitions in 2021. Economic values such as these can provide vital tools for policy-makers, as valuation enables balanced management decision-making when weighed up against the social and environmental impacts of spearfishing and other activities within the marine environment. The large differences found between the economic value of the Eden 3-Way State Titles and the Bluewater Classic, as well as differences in the value of the Bluewater Classic competition over the past 20 years, highlights the impact of participant numbers and travel distance on the value of competitions on a spatial and temporal scale as well as the natural variance in values between competitions and the need for fine scale economic information. Additionally, a large proportion of the total expenditure was found to be spent onsite. This represents a substantial economic benefit for the regional communities that hosted these competitions, with the Eden 3-Way State titles likely exerting a greater positive impact on its hosting community due to the area's socio-demography and the spending behaviours of competition attendants. Our results highlight the importance of considering the value of recreational and sport fishing at a local scale, and we recommend these methods be extended to a wider range of recreational fishing and marine activities to better understand the fine scale value differences of a heterogeneous population.

### *4.1. Spatial differences in value and regional economic benefit*

In 2021, the economic value of the Eden 3-Way State Titles was estimated to be between $102,461 and $118,747. This estimated value is approximately 3 times greater than that of the Bluewater Classic competition held in the same year (between $32,874 and $39,492). In addition to this overall difference in value, the mean expenditure per person, both including and excluding travel related costs, was also substantially higher for participants in the Eden 3-Way State Titles compared to those who attended the Bluewater Classic. The higher participation numbers and longer distances travelled by those attending the Eden largely explain the greater value of this competition overall.

Out of the total value estimated for these two competitions, approximately 60 - 70% was spent within the regional communities that hosted them. The localised economic impact of these competitions may vary due to differences in the socio-demography and economic diversity of the towns where these competitions were held (Ward et al., 2012). Eden has experienced a huge shift in industry focus from fisheries and forestry towards the tourism sector in recent years (Schweinsberg et al., 2012) and tourist expenditure supports many businesses and individuals working in the accommodation, retail, and service sectors (Tourism Research Australia, 2017). In contrast, Woolgoolga's local economy does not rely as heavily on tourism, as close to 20% of the town's workforce are employed within the agricultural sector (ABS, 2020). The higher economic value generated by the Eden competition, coupled with the stronger reliance of the local economy on tourist-focused industries and the greater number of nights spent here by competition attendants, suggest that the Eden 3-Way State Titles had a larger positive impact on its host community than the Bluewater Classic.

Past studies have acknowledged the significant economic benefits of a broader range of recreational fishing activities for regional areas in NSW (Dominion Consulting Pty Ltd, 2003; Ward et al., 2012), Australia (Murphy, 2002; Pascoe et al., 2014), and internationally (Pendleton and Rooke, 2006; Kauppila and Karjalainen, 2012), but often overlook the fine-scale impacts of this value for individual communities. Both Eden and Woolgoolga have very low levels of access to economic resources relative to the rest of the state (ABS, 2018). Regional events such as spearfishing competitions are therefore likely to play an important role in facilitating expenditure within these low-income communities. Local communities may benefit even further from the tourism brought in by spearfishing communities through marketing initiatives, including complementary events or festivals, targeted restaurant menus, or an emphasis on marine and fishing recreation in destination branding (Hall, 2021). Events such as spearfishing competitions also provide valuable exposure for volunteer organisations with opportunities for education and fundraising. At many spearfishing tournaments, the fish

captured are donated to a community auction which raises money for a local cause – often raising over $1000. As an example, the local Marine Rescue organisation was heavily involved in the Bluewater Classic and used the opportunity as a fundraiser to support their activities.

### 4.2. Temporal differences in value

By estimating the Bluewater Classic's value for past competitions using participant data from previous years, our results also display the ways that value changes in relation to attendance numbers and demographics on a temporal scale. The economic value of the Bluewater Classic has fluctuated over time due to differences in attendance numbers and the distance travelled by competitors. Despite the potential negative impacts of COVID-19, rescheduling, and inclement weather in 2021, the value of the 2021 competition was still higher than some previous years (2015 and 2005). However, the greatest differences in value were seen between the 2000–01 competitions and all subsequent years. The presence of international and interstate participants who travelled more than 1000 km in 2000–01 was likely a contributing factor in the significantly higher value of competitions held in these years. When excluding international competitors, the number of attendees is relatively stable over time although travel distances do vary. While 2010 information was not available in this study, the NEATFish environmental accreditation program (Diggles et al., 2011), assessed the 2010 Bluewater Classic (4/5 stars overall), with the self-reported value of the competition ($10,000 – $49,999; B. Diggles unpublished data) aligning with that estimated in our study for similar years. This was a similar value to that self-reported in the Australian Pacific Coast Spearfishing Championships 2013 NEATFish assessment (B. Diggles unpublished data).

The presence of international participants may have impacted the accuracy of the travel cost estimates in several ways. First, although there is anecdotal evidence that international participants travelled to the region solely for the purpose of attending this spearfishing competition, these participant's trips to Australia may have served a multitude of other purposes. International participant's total travel cost may therefore not be applicable as an indicator of their willingness to pay for this specific spearfishing opportunity alone. Second, our application of the travel cost method relied on the assumption that competitors travelled to the site by car and may have over or underestimated the fuel costs associated with aeroplane travel. We accounted for these issues by providing more conservative valuation estimates that exclude distance travelled (methods one and two). However these methods may undervalue the economic contributions of long-distance travellers when applied to larger competitions or inversely overvalue local competitors. Other studies have accounted for fuel and time costs across a wide range of transportation when applying travel cost methods to recreational activities (Rolfe et al., 2011), and similar methods should be used in future studies when participants travel from a range of distances.

### 4.3. Limitations

The timing of these competitions, specifically in relation to COVID-19 and conflicting events, may have had a substantial impact on the numbers and travel distances of competition attendants in 2021. Travel restrictions were in place for residents of metropolitan Melbourne during June 2021 (resulting from an outbreak of the COVID-19 Delta variant), effectively preventing Melbourne residents from travelling to NSW for the Eden 3-Way State Titles. Participants from Melbourne have made up a significant proportion of competition attendants in past years, and the Eden competition's value may have been much higher without the impacts of these travel restrictions (Spennemann and Whitsed, 2021). The COVID-19 pandemic may have also had a psychological influence over potential participant's willingness to travel in 2021 and thereby impacted attendance numbers at both competitions. Studies into the pandemic's influence on the tourist psyche suggest that, even after outbreaks have passed, deep rooted protection motivations triggered by the pandemic can promote caution in tourist behaviours (Kock et al., 2020; Zheng et al., 2021).

Alongside the influence of a global pandemic, other changes to the 2021 Bluewater Classic's date may also have impacted attendance numbers at this competition. Communication with the spearfishing community indicated that firstly the competition being postponed due to poor weather, then being held over the Australian Mother's Day weekend (9 May) reduced people's willingness to travel for the competition (D. Cruz *pers comm.*). The resulting higher proportion of local competitors in the Bluewater Classic could also explain the lower adjusted mean expenditure per person, as residents would be expected to spend almost nothing on accommodation and reduced amounts on meals. A variety of other site-specific factors, such as predicted adverse ocean conditions and reported low abundances of target species in the lead up to the competition, may have impacted the perceived quality of fishing experience at the Bluewater Classic and negatively affected attendance. The present study is also limited by the focus on economic value. As recognised in the national survey there are many 'intangible' values that should be incorporated into any management decisions (Henry and Lyle, 2003).

### 4.4. Future research and conclusion

Travel cost analysis is used more frequently than any other valuation method in studies exploring non-market values of recreational fishing in Australia (Coglan et al., 2021), and has long been implemented in case studies exploring recreational economic value throughout the world (Samples and Bishop, 1985; Pokki et al., 2018; Terashima et al., 2020). However, travel cost valuation alone cannot explain how different environmental and societal factors contribute to estimates of economic value, nor how changes in these factors may impact the value of fishing activities or trips in the future. Many respondents in this study reported that they had observed ecosystem changes over the years, including decreases in fish numbers and size as well as increases in the abundance of sharks and urchins. Past studies have shown that spearfishers can develop a deep understanding of the environment and detect changes even in non-target species, as spearfishing requires participants to spend a great deal of time underwater observing the marine ecosystem (Sbragaglia et al., 2021). However, is difficult to verify these observations with current scientific literature as respondents did not give any indication of the timescale of these changes or leave any species-specific comments (although the population expansion of the urchin *Centrostephanus rodgersii* along Australia's SE coastline is well-established and may support some responses, see Ling et al., 2009, 2018). Similarly, we cannot understand the ways that these potential environmental changes may have impacted 2021 competition attendance and value, or how it could alter the value of future competitions. Future studies could incorporate other survey questions and valuation strategies as well as travel cost methods to assess how these and other changes - whether real or perceived – may impact and influence a competition's value over time. This could involve the implementation of contingency valuation and random utility maximisation (RUM), as these approaches have been used alongside travel cost methods to explore a wide variety of factors that influence the value of recreational activities in other studies (Parsons et al., 2013; Leggett et al., 2018; He and Poe, 2021).

Around half of the spearfishers surveyed reported that they attend between 10 and 15 spearfishing competitions each year, which suggests that the total economic value generated by spearfishing competitions annually is likely to be substantial. While our findings provide good estimates of the economic value of the two spearfishing competitions surveyed, these results are not indicative of the value of every spearfishing competition in NSW. Future studies should aim to value a wider range of spearfishing competitions and other recreational activities in marine environments, such as game fishing (Ward et al., 2012) and diving/snorkelling (Binney, 2009), to better understand their economic

value and balance the needs of different user groups. The current study also did not assess fundraising for local community activities and possibly represents a source of underestimation in terms of the value of these competitions. To fully assess this, it would be necessary to extend the survey beyond the travel cost method applied to only the participants.

This case study successfully shed light onto the value of the previously overlooked spearfishing sector in NSW and highlights a method that can be adapted to other small-scale events within the diverse marine resource sector. The economic values calculated can provide key information for regulators weighing up the costs and benefits of allocation both between recreational and commercial sectors, as well as across the vast diversity of recreational fishing activities within the sector itself.

## CRediT authorship contribution statement

**Hayden T. Schilling:** Conceptualisation, Investigation, Writing – original draft, Formal analysis. **Indiana J. Riley:** Writing – original draf. **Aaron C. Puckeridge:** Conceptualisation, Investigation, Writing – review & editing. **Alexandra Milne-Muller:** Investigation, Writing – review & editing. **Corey T. Callaghan:** Conceptualisation, Writing – review & editing.

## Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Aaron Puckeridge is a member of the spearfishing community and the Australian Underwater Federation (AUF). Aaron Puckeridge registered in both surveyed competitions and competed in the Bluewater Classic. The other authors have no declarations of interest.

## Data Availability

Raw data can only be provided if an appropriate ethics approval is provided to the corresponding author. Summary data of all survey questions is in the Supplementary Material.

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## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.fishres.2022.106289.

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