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# Drivers of Recreational Angler Satisfaction in Port Phillip Bay, Australia

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## ABSTRACT

As a widely enjoyed pursuit, recreational fishing plays a key socio-economic role in Australia by supporting coastal businesses, especially in regional areas. Satisfaction is considered an end outcome of angling that is important in fisheries management by contributing to ongoing participation and regulatory strategies. Port Phillip Bay (PPB) in Victoria, Australia, hosts the State's largest marine recreational fishery, yet angler satisfaction has not been previously explored. We evaluated the influence of age groups, regions (5 boat ramps in Melbourne, 7 in Bellarine, and 8 in Mornington), key target species (snapper, King George whiting, calamari, and flathead), and catch rate on spatiotemporal patterns in long-term satisfaction from creel surveys conducted around PPB during 2016–2022. Angler satisfaction varied with catch per unit of effort (CPUE) and angler avidity. Satisfaction varied annually and regionally, with higher satisfaction among younger anglers, especially in the Bellarine region along the western coastline of PPB. Angler satisfaction also varied among target species, with anglers targeting calamari being generally more satisfied, although satisfaction increased for snapper when interacted with CPUE. Insights into angler behavior and key factors that influence angling satisfaction will ultimately provide a basis for formulating performance indicators to monitor and assess future angler satisfaction. More broadly, our study also provides guidance about how management interventions will impact angler satisfaction, therefore making it more likely that needs and concerns of recreational fishers are considered in decision making processes.

## 1 | Introduction

Recreational fishing is among the most popular outdoor leisure activities that provide an opportunity for human-nature connection that benefits angler well-being by combining a pleasant change of scenery with moderate physical activity, which relieves stress (Karpiński and Skrzypczak 2022), enables mental recharge, and improves physical and psychological health (Freudenberg and Arlinghaus 2009; Hunt and McManus 2016; Pita et al. 2022). Recreational fishing also contributes to local and regional economies as millions of people engage in recreational fishing globally (Pauly and Zeller 2016; Arlinghaus et al. 2019;

Freire et al. 2020). Recreational fishing generates financial on-flows derived through value adding processes such as license fees, retail activity, and hospitality with a large economic value (Cisneros-Montemayor and Sumaila 2010; McIlgorm et al. 2016; Hyder et al. 2018; Potts et al. 2020). In Australia, more than 19% of the population participates in recreational fishing, facilitated by highly effective governance policies and targeted promotional initiatives (McPhee 2017; Cooke et al. 2018; Lynch et al. 2019).

Angler satisfaction is a core element of recreational fisheries management policy and implementation strategy. Satisfaction is defined as a feeling of happiness after fulfilling a desire or

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meeting a need, and the concept of satisfaction is rooted in expectancy theory, wherein satisfaction is the difference between expectations (i.e., motivations) and the quality of experiences (Holland and Ditton 1992; Burns et al. 2003; Birdsong et al. 2021). Since the 1970s, satisfaction has attracted much attention in the field of outdoor leisure research and has been a major concept when studying recreational behavior (Floyd 1997; Vaske and Roemer 2013). In recreational fishing, satisfaction is thought to be the ultimate reward that anglers receive from their fishing experience (Arlinghaus 2006a; Birdsong et al. 2021). Thus, angler satisfaction provides a metric for measuring the efficacy of recreational fisheries management due to its influence on subsequent participation in fishing, which therefore warrants consideration whenever recreational fishing regulations are reviewed (Royce 1983; Marine et al. 2022).

Angler satisfaction can strongly affect angler behavior (Arlinghaus and Mehner 2005; van Poorten et al. 2011), and dissatisfied anglers may subsequently leave the fishery or engage in non-sustainable fishing actions (Cooke et al. 2021). Accordingly, policy makers and managers are increasingly focused on increasing understanding about angler behavioral response to policy to improve the effectiveness of management initiatives aimed at ensuring anglers remain satisfied (Hunt et al. 2013; van Poorten and Camp 2019; Birdsong et al. 2021). Overall satisfaction can be achieved by adapting policies to deliver anticipated outcomes that satisfy the main needs of all groups of fishery users and other stakeholders (Driver 1985; Beardmore et al. 2015), when the underpinning operational policy objective is to enable fishing stakeholder needs to be met while satisfying community expectations for resource sustainability and socio-economic benefit. Recent studies have also emphasized the need to explore angler preferences and behavior to inform regulatory decisions and to better understand the balance between ecological sustainability and angler satisfaction for effective management (Thomas et al. 2019; Arostegui et al. 2021).

Socio-psychological investigations into how anglers think and feel regarding fisheries resources and regulations can help to reveal behavioral characteristics relevant to management decisions (Fulton et al. 2011). This can further facilitate understanding about what satisfies anglers and how different types of anglers from different backgrounds and geographies respond to socio-ecological and fisheries changes (Hutt and Neal 2010; Hunt et al. 2012). In this respect, many catch- and non-catch related variables contribute to a satisfactory fishing trip, including catch (catch rate, size and species), fishing expenditure (travel costs, license and equipment fees), fishing site availability (distance, space and congestion), esthetics, water quality, relaxation, and facility quality (Arlinghaus and Mehner 2003; Vaske and Roemer 2013; McCormick and Porter 2014; Kainzinger et al. 2015; Hunt et al. 2019; Birdsong et al. 2022; Gundelund et al. 2022). Catch is a key determinant of angler satisfaction, and catch-related outcomes are of great importance to anglers (Gundelund et al. 2022; Johansen et al. 2022). Anglers are typically attracted by high catch rates and large fish, but the significance of such catch outcomes for satisfaction differs among target species, angler types, and other circumstantial situations (Birdsong et al. 2022). Some anglers may, however, have more general goals that focus on experiences and can be attracted

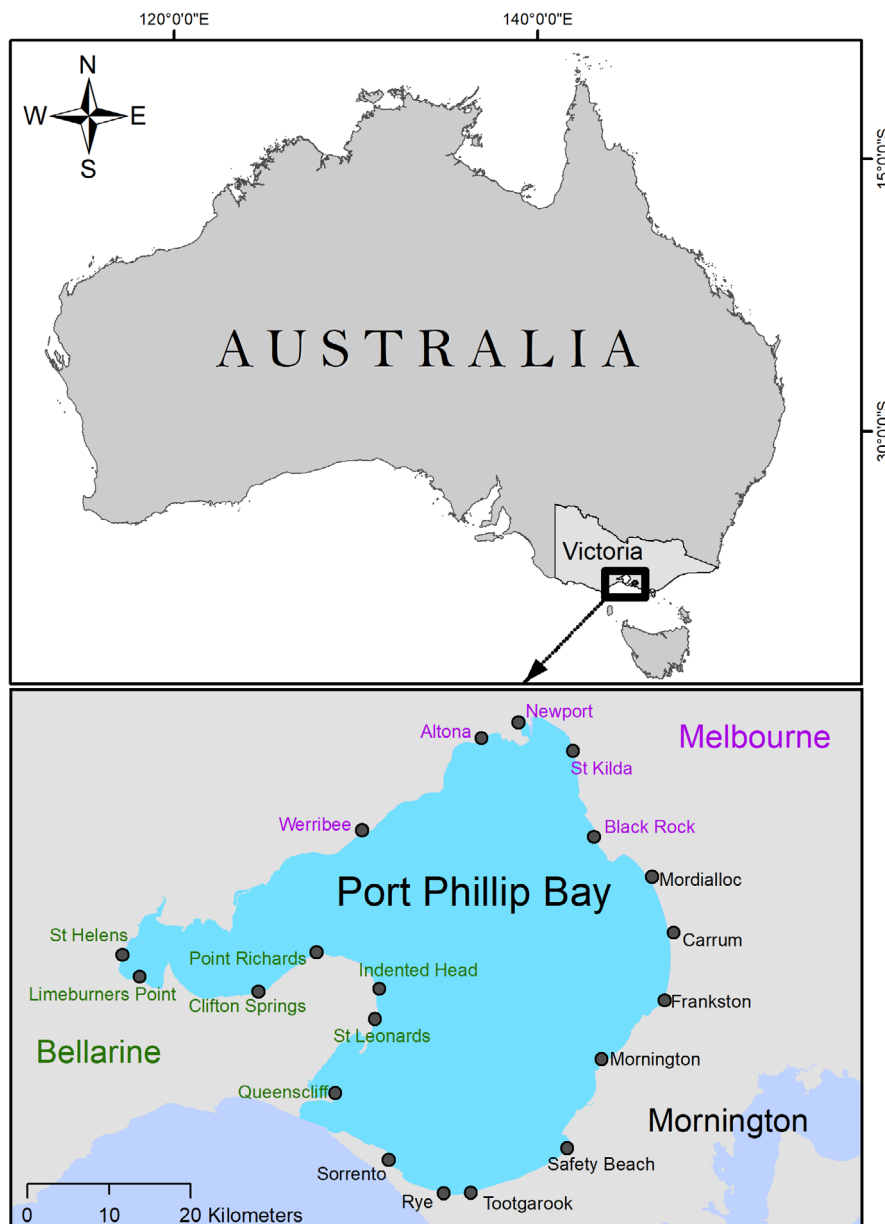
and satisfied by the quality of non-consumptive activities such as being with family and friends or enjoying nature (Vaske and Roemer 2013; Gundelund et al. 2022). Angler satisfaction also varies geographically, when distance from residence causes spatial trends in satisfaction (Hutt and Neal 2010). In addition, urban and rural anglers may differ in terms of motivations, expectations, preferences, or needs, further highlighting that regional differences in fishing practices and demographic factors can shape satisfaction (Greiner et al. 2016; Brinson and Wallmo 2017). Accordingly, fishing trip satisfaction can be influenced by multiple interacting factors, which may or may not be under the direct control of anglers or even related to the status of fish stocks (Seekell 2011; Vaske and Roemer 2013).

In the Australian state of Victoria, recreational fishing is very popular and plays an important role in both urban and regional perspectives that generate numerous tourism and economic opportunities (Sampson et al. 2014). A major marine recreational destination is Port Phillip Bay (PPB), a large marine embayment with a narrow (~3 km) entrance into Bass Strait on the central coastline of Victoria, and bordered by the Greater Melbourne area to the north, the Bellarine Peninsula to the west, and the Mornington Peninsula to the east (Figure 1). Port Phillip Bay provides an ideal environment that abounds with ecotourism attractions for local and international visitors. Fishing tourism has grown considerably with increasing participation rates and geographical extent, with some anglers traveling long distances to reach fishing destinations in PPB (Miller et al. 2015; VFA 2021; Jalali et al. 2022). Recent estimates indicated that the annual economic contribution of recreational fishing in Victoria was AUD \$2.3–2.6 billion from ~6 million fishing trips by 16%–19% of Victorians aged 18 and older (~850,000 participants) during 2018–2020 (Huang et al. 2020; VFA 2020; Moore et al. 2023). Statewide expenditure on angling by residents of the Greater Melbourne metropolitan area in 2015 was AUD \$1.7 billion, with a combined economic benefit of AUD \$32.5 million for PPB and neighboring Western Port (Huang et al. 2020). The State of Victoria has a strong history of responsive recreational fishing monitoring in PPB, although angler satisfaction has not yet been investigated. Consequently, we used long-term creel survey data for PPB to determine if angler satisfaction: (1) was associated with catch and non-catch variables, (2) varied significantly among areas within PPB and years, and (3) was influenced by management actions.

## 2 | Materials and Methods

### 2.1 | Study Area

Port Phillip Bay, located on the southern coastline in the State of Victoria, is the most densely populated catchment in Australia (Figure 1). Nearly 5 million people live in the proximity of PPB, with suburbs of Melbourne extending along its northern and eastern coastlines, and Geelong, the second largest city, located on the western shore (ABS 2021; ASGS 2021). Port Phillip Bay covers an area of 1930 km<sup>2</sup>, has a maximum depth of 24 m, an average depth of 13 m, and connects to Bass Strait through a narrow deep channel exchanging oceanic water (Holdgate et al. 2001; Sampson et al. 2014). Due to its sheltered waters, diversity of habitats, and proximity to suburban Melbourne,



**FIGURE 1** | Locations of boat-launch ramps where anglers were interviewed to determine the level of satisfaction with their angling experience in Port Phillip Bay, Victoria, Australia, during 2016–2022.

recreational fishing is extremely popular in the Bay. Although PPB supports diverse ecologically and economically important species, the main species of interest to recreational anglers are snapper (*Pagrus auratus*), southern calamari (*Sepioteuthis australis*), King George whiting (*Sillaginodes punctatus*), and sand flathead (*Platycephalus bassensis*) (Conron et al. 2020). These target species are vital to the local marine ecosystem and recreational fishery, with individual habitat preferences and spawning behavior for some species influencing angler success and satisfaction. Snapper, highly valued by anglers, are a relatively large Sparid that migrates into PPB in spring and summer to spawn (Bell et al. 2023). They mainly spawn in deeper eastern and northern waters, while shallow seagrass and coarse sediment areas are less suitable for larger snapper (Morris and Ball 2006; Hamer and Mills 2017). They are a demersal generalist predator of bivalves, crustaceans, cephalopods, and fish (Kailola et al. 1993). Southern calamari are a short-lived

cephalopod with a lifespan of < 1 year, that mature at < 6 months of age, and spawn on seagrass beds in shallow inshore waters (Triantafillos 2004; Pecl et al. 2011). Their diet is mostly shrimp and small fish (Finn and Norman 2011). King George whiting predominantly inhabit seagrass beds, which are most abundant in western and southern areas of PPB (Morris and Ball 2006). Life expectancy is over 20 years, but PPB is a nursery and the recreational fishery is dominated by 2–4 year-old sub-adults (Bell et al. 2023). Their diet is mostly benthic amphipods and small crustaceans, with polychaetes and mollusks consumed as they grow larger (Kailola et al. 1993). Flathead, particularly sand flathead, are popular with anglers and found in a diversity of habitats, including estuaries, sandy and muddy bottoms, and deeper waters (Jordan 2001; Imamura 2015). Flathead are predominantly an ambush predator that lay partially concealed in bottom sediments and consume small fish, including juvenile King George whiting, and crustaceans (Kailola et al. 1993).

## 2.2 | Survey and Data

Boat-based recreational fishing surveys were conducted annually in PPB at 20 highly used boat ramps around its coastline (Figure 1). Based on geography, urbanicity, marine topography, habitat, and angler behavior (target species, in particular), boat ramps were grouped into Melbourne, Bellarine, and Mornington as three distinct demographic and environmental regions that differ in their influence on angler behavior, including choices about where and when to fish (Jalali et al. 2022). Each region included multiple boat ramps commonly used by anglers, with five ramps in Melbourne, seven in Bellarine, and eight in Mornington (Figure 1). Creel surveys were conducted when anglers returned from fishing, mostly on weekends and peak fishing days (e.g., public holidays) over a 6-month period from November to April, mainly to monitor harvest rates of key recreationally important species (Ryan and Conron 2019). A bus-route survey design followed broadly accepted methodology to minimize bias (Chen and Woolcock 1999). During interviews, anglers were asked to provide feedback on how satisfied they were with their daily fishing trip. Anglers also provided information about their completed trips, including target species, landings, fishing effort, age, postcode, and number of days fished per year. Angler avidity was categorized as occasional (< 5 days fished in PPB in the preceding 12 months), regular (5–10 days fished), and avid anglers (> 15 days fished). Creel survey data were obtained for Australian July–June fiscal years from 2016–2017 to 2021–2022.

Incomplete interviews and interviews with clear inconsistencies were excluded from analysis. Most trips (~85%) targeted four species (snapper, southern calamari, King George whiting, and flathead), and few fishing trips targeted other species, so data were filtered for these four target species, which resulted in 4060 fishing trips. Sand flathead and southern bluespotted flathead (*Platycephalus speculator*), were combined as ‘flathead’ because the two species were often caught concurrently, and most anglers did not differentiate between the two species. Catch per angler trip (CPUE) was calculated by dividing the number of each species caught by the number of hours of angling effort (number of anglers multiplied by the number of hours spent fishing). CPUE was categorized as Virtually No Catch if  $CPUE \leq 0.1$  fish/h, Single Fish Caught if  $CPUE = 0.1$ –1 fish/h, and More Than One Fish Caught if  $CPUE > 1$  fish/h.

## 2.3 | Statistical and Spatial Analyses

Angler satisfaction was measured using a 1 to 5-point Likert scale with 1 = very dissatisfied, 2 = quite dissatisfied, 3 = quite satisfied, and 4 = very satisfied. A score of five was used for responses of ‘unsure’, as a measure of uncertainty rather than neutrality, which were excluded from analysis to avoid potential response bias.

Because the response variable, satisfaction, was ordinal, logistic regression was used to test the effects of predictor variables for target species, year, region, avidity, age, and CPUE. Logistic regression models that describe relationships between an ordinal response variable and one or more predictor variables are

conceptually similar to binary logistic regression models (McCullagh 1980; Harrell 2015). Satisfaction was treated as an ordinal (categorical) response variable in the model, with target species as a factor with levels for each of four species (snapper, calamari, King George whiting, or flathead), year with levels for each of six fiscal years (2016–2017 to 2021–2022), region with levels for each of three regions (Melbourne, Mornington, or Bellarine), age with levels for each of four age groups (< 18, 18–49, 50–69, or  $\geq 70$  years old), and avidity with levels for each of three classes of angling avidity (occasional, regular, or avid angler). CPUE was included as a continuous variable in the model.

Logical 2-way and 3-way interaction terms were included in models to test variation in satisfaction across the range of predictor variables and their interactions. To find the best-fitting model, backward stepwise elimination based on Akaike information criteria (AIC) was used to consider all independent variables (Akaike 1998). Beginning with a full model, least significant terms were eliminated, starting with 3-way interactions, then 2-way interactions, and last for main effects. When 2-way or 3-way interactions were significant, main effects were retained in the model. Model assumptions were evaluated using residual plots and the best model among all models evaluated was based on the lowest AIC score. Regression tests assumed a 5% level of significance. Analysis of deviance was tabulated including Wald chi-square tests required for measuring model significance. Statistical analyses were in R version 4.0.3, R Core Team (2021), using the *clm* function in the ordinal package for ordinal logistic regression (Christensen 2022), and *olsrr*, *ggffects*, *MASS*, and *ggplot2* for model selection, prediction, and plotting (Wickham 2016; Hebbali 2022).

To identify spatial patterns in angler satisfaction, the number of anglers and their satisfaction ratings from each residential postcode were spatially joined into postcode polygons using ArcGIS software (version 10.7, ESRI), and the percentage (%) of each satisfaction level was calculated for each postcode. Using a spatial selection query, postcode polygons with at least three anglers interviewed were selected for spatial analysis. Next, Moran's I statistic using Euclidean distance was used to test for spatial autocorrelation in the percentage of each satisfaction level within distance bands to indicate an appropriate distance threshold for spatial clustering at 95% confidence. Next, a significant peak distance threshold for each satisfaction level was used in spatial clustering analysis using the local Getis-Ord Gi statistic to map satisfaction clusters or hotspot areas (Jalali et al. 2015) that represented areas of high or low satisfaction at 90%, 95%, and 99% confidence. Last, satisfaction ratings were categorized into two groups of satisfied anglers (combining very satisfied and quite satisfied ratings) and dissatisfied anglers (combining quite dissatisfied and very dissatisfied ratings) to represent the overall percentage (%) of satisfied anglers for each postcode.

## 3 | Results

The response rate of anglers for participation in creel surveys was 95%, prior to the exclusion of unsure cases. Most anglers (91%) interviewed were 18–69 years old. Only 11% of fishing trips sampled included one or more female anglers. Almost 63% of anglers stated that they were very satisfied or quite satisfied

**TABLE 1** | Proportion (%) of angler satisfaction levels and distribution (%) of anglers among regions in Port Phillip Bay, Australia, based on angler trip records combined across four key species (snapper, calamari, King George whiting, flathead) and six years (2016–2017 to 2021–2022).

Region	Proportion (%) and number (No.) of anglers in each satisfaction level										Distribution (%) of anglers by region
	Very dissatisfied		Not quite satisfied		Quite satisfied		Very satisfied		Unsure		
	%	No.	%	No.	%	No.	%	No.	%	No.	
Bellarine	6.7	76	19.4	220	37.9	430	35.7	405	0.4	4	27.3
Melbourne	22.0	341	18.8	291	27.0	417	29.1	450	3.1	48	37.2
Mornington	9.1	135	27.5	406	36.3	536	25.0	369	2.0	30	35.5
Overall	13.3	552	22.1	917	33.3	1383	29.3	1224	2.0	82	100

with their fishing trip. Anglers launching from boat ramps in the Bellarine region had the highest satisfaction, with 73% being either quite or very satisfied, compared to 56% in Melbourne and 61% in Mornington (Table 1). In contrast, Melbourne anglers had the highest proportion of very dissatisfied respondents (22%) and the highest percentage of unsure responses (3%). Responses coded as unsure that were excluded from analysis were a small proportion of total responses (Table 1).

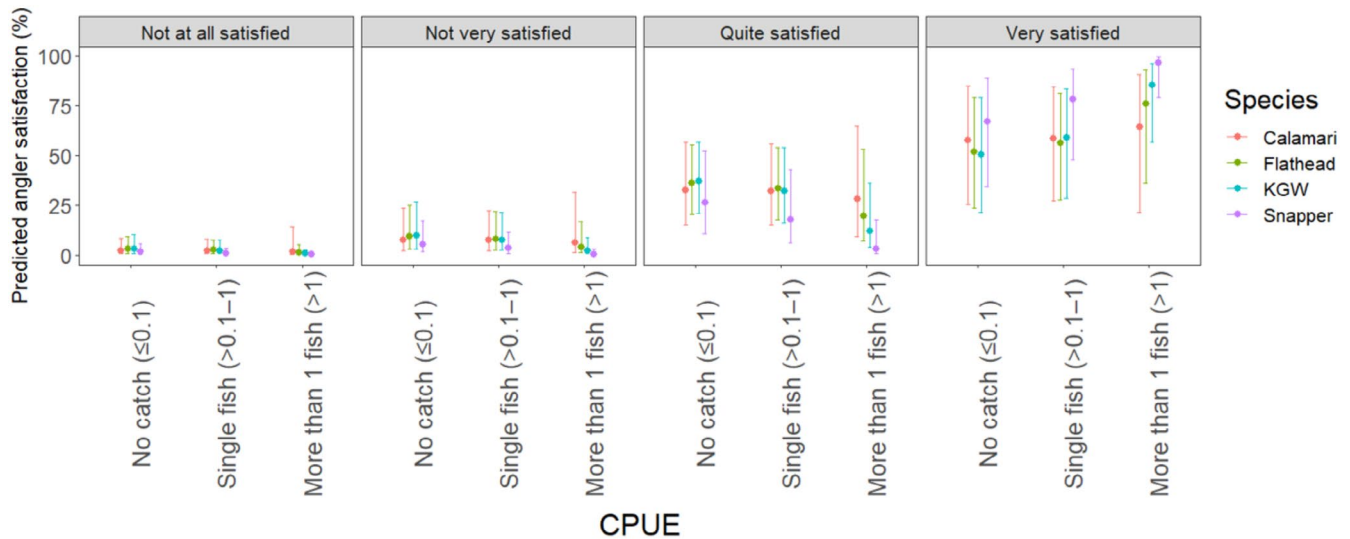
Angler satisfaction was significantly associated with target species, year, region, avidity, age, and CPUE (Table 2). Satisfaction categories each showed variability among target species, with snapper having the highest percentages of predicted angler satisfaction for each of the three levels of CPUE in the ‘very satisfied’ category (Figure 2). Calamari showed the highest percentages of predicted angler satisfaction for the remaining three categories, although differences were relatively small among species for the lower two categories (Figure 2). In contrast, King George whiting were associated with lower satisfaction. Catch per unit effort (CPUE) was significantly related to angler satisfaction, with higher CPUE generally leading to higher satisfaction, although CPUE should be considered in conjunction with target species because CPUE was not directly related among species that varied in relative abundance (Figure 2). Occasional and younger anglers launching in the Bellarine region were more satisfied (Figure 3). Anglers launching at Melbourne and Mornington boat ramps had lower satisfaction than those launching at Bellarine. Satisfaction generally increased annually (Figure 4).

Multiple 2-way and 3-way interactions among predictors were significantly related to angler satisfaction. For all species, satisfaction was positively related to CPUE, but the effect was most pronounced for snapper (Figure 1). Satisfaction of calamari and flathead anglers was unrelated to CPUE, although higher catch rates of King George whiting and flathead were associated with higher proportions of very satisfied anglers, and lower CPUE for these two species were associated with higher proportions of anglers who were ‘not very satisfied’ or ‘quite satisfied’ (Figure 2). Satisfaction varied significantly among regions, but was influenced by CPUE, with anglers in Mornington and Melbourne being more sensitive to lower catch rates than elsewhere. Avidity was related to satisfaction, with less experienced anglers being more satisfied, while avid anglers, particularly those from Melbourne and Mornington, being less satisfied (Figure 3). The effect of avidity was amplified by CPUE, with increasingly

**TABLE 2** | Analysis of deviance for the best-fitting ordinal logistic model describing angler satisfaction in relation to four target fish species, year, region, angler avidity, age, and catch/h (CPUE) in Port Phillip Bay, Australia, during 2016–2022 ( $p$ -value = approximate significance level; Wald Chi-sq = Wald chi-square statistic; Asterisks (\*) indicate interactions among predictor variables).

Variables	Wald Chi-sq	$p$
Species	232	<0.001
Year	45	<0.001
Region	40	<0.001
Avidity	15	<0.001
Age	29	<0.001
CPUE	411	<0.001
Species*Region	38	<0.001
Species*CPUE	108	<0.001
Year*Region	24	0.006
Year*Avidity	21	0.010
Region*Avidity	17	<0.001
Region*CPUE	45	<0.001
Species*Year*CPUE	72	<0.001
Species*Region*Avidity	44	<0.001
Species*Region*CPUE	52	<0.001
Year*Region*Avidity	46	<0.001
Year*Region*CPUE	34	<0.001
Year*Avidity*CPUE	38	<0.001
Region*Avidity*Age	38	<0.001

avid anglers having higher catch-related expectations that led to greater dissatisfaction when CPUE was low. Overall satisfaction generally increased through time, but at different rates for different species, regions, and avidity (Figure 4). For example, satisfaction increased over time among most anglers, but avid and regular anglers launching from Melbourne were less satisfied. Further, older, avid anglers that launched from Melbourne and Mornington were less satisfied, a trend that was exacerbated by



**FIGURE 2** | Angler satisfaction (%) in relation to catch/h (CPUE) of four target fish species in Port Phillip Bay, Victoria, Australia, during 2016–2022.

low CPUE. Last, differing abundance of target species over time and among regions influenced satisfaction differently among angler groups.

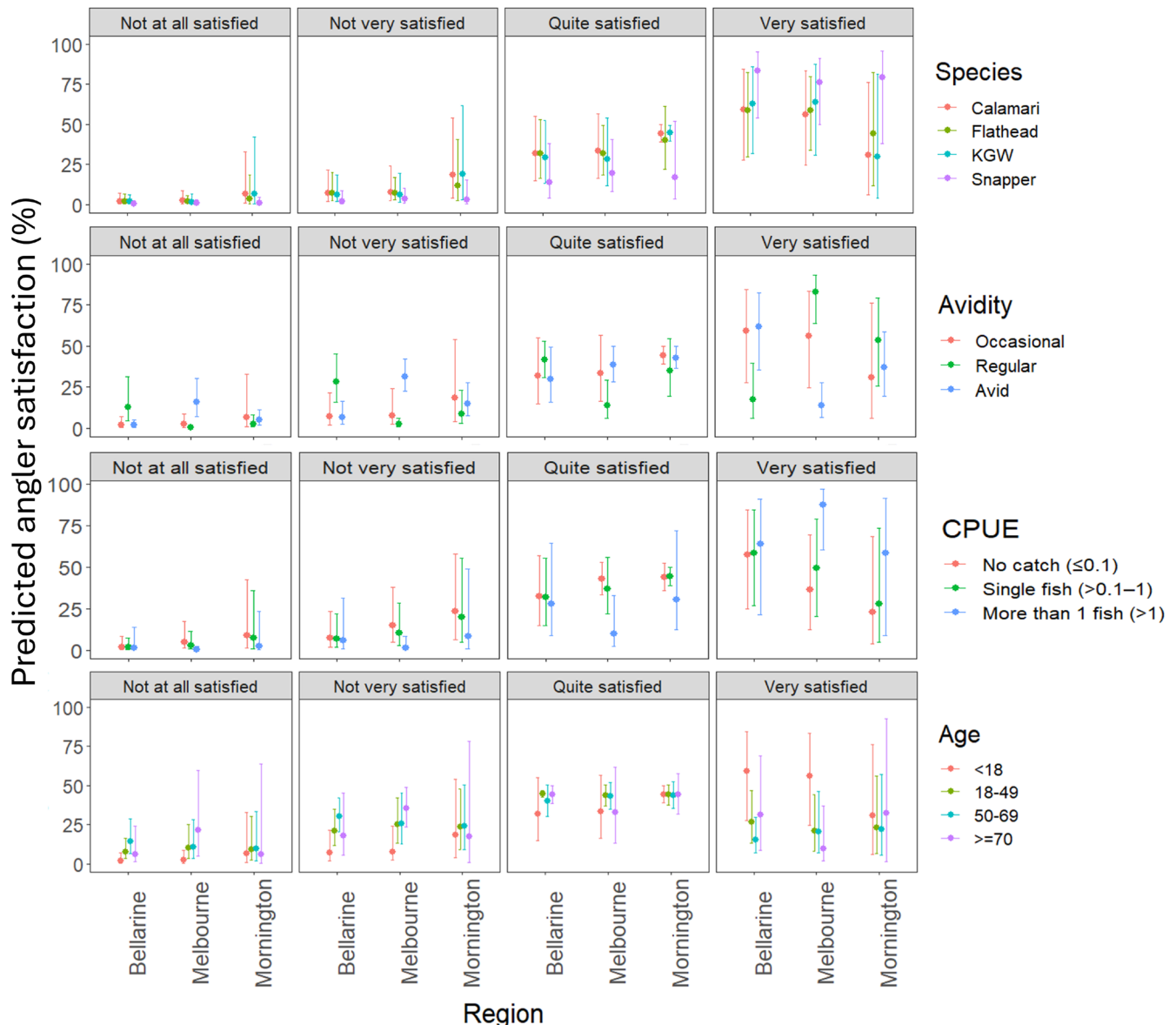
Satisfaction (%) differed among postcode areas in PPB (Figure 5A). Furthermore, anglers from postcode areas on the western side of PPB (Bellarine region) were generally more satisfied than those from farther north and east (Figure 5B). In contrast, anglers who were from the west-northwest and southeast Melbourne metropolitan areas were less satisfied (Figure 5B).

#### 4 | Discussion

We found strong and positive effects of catch rate on angler satisfaction, and the interaction between catch rate and other factors such as target species and region, which is consistent with a primary goal of many anglers, for whom catch is the ultimate reward. Thus, satisfaction increases when anglers catch large fish or have high catch rates, although the direct relationship varies depending on angler avidity, fishing location, target species (present study), and other factors (Birdsong et al. 2022; Gundelund et al. 2022). We found, for example, that satisfaction increased with catch rate, especially for snapper, and satisfaction was consistently high with calamari or flathead within the same ranges of catch rates, which illustrates how catching one species may be more important for driving angler satisfaction than other species (Beardmore et al. 2011, 2015). In our study, the interaction of target species with catch rate was a far more reliable predictor than these factors were individually because catch-related expectations differed markedly between snapper and the other three species. As a target species, snapper are highly valued by anglers, and angler satisfaction with the snapper fishery varies spatiotemporally (Hamer and Mills 2017). Snapper is relatively less abundant, so capturing one snapper per hour may elicit a higher level of satisfaction than capturing many more King George whiting or flathead per hour. However, some anglers prioritize non-catch-related factors that stem from being on the water while fishing (Arlinghaus 2006a; Skrzypczak

and Karpiński 2020; Gundelund et al. 2022), a common response during creel surveys in PPB (current study, unpublished data). Nonetheless, the thrill of catching fish is what drives many anglers, and the strong influence of CPUE in our study suggests catch-related factors have the greatest influence on anglers irrespective of other motives to go fishing. This finding aligns with previous research indicating that recreational catch outcomes can strongly shape angler behaviors (Bade et al. 2022). While our results indicate that CPUE had a strong influence on satisfaction, non-catch-related factors not measured in our study, such as facility conditions, water quality, and crowding, significantly affect angler satisfaction (Cabanellas-Reboredo et al. 2014; Hunt et al. 2019; Birdsong et al. 2021). Such factors should be considered when interpreting the relative influence of CPUE on satisfaction, because inclusion of such variables may have provided a more comprehensive understanding of drivers of angler satisfaction.

Our findings highlighted the role of fishing location as a driver of angler satisfaction, likely because different areas offered different types of fishing experiences, and certain areas were likely known to have a higher abundance of specific species. For example, north-eastern areas of PPB generally offer greater opportunities for snapper, whereas the western side supports King George whiting and calamari due to a greater abundance of sea-grass and reef habitats (Morris and Ball 2006). Lower satisfaction toward snapper in the Melbourne and Mornington regions, particularly when catch rates were lower, could be attributed to heightened expectations in these regions with a greater chance of disappointment, as previous research suggested that unmet expectations can reduce satisfaction (Arlinghaus 2006b). A significant portion of snapper populations spawn in the vicinity of these regions, so anglers there might have higher expectations when targeting this species (Wilson 1986; Hamer and Mills 2017). As a result, anglers, especially avid anglers, might feel dissatisfied if their expectations are not met, likely due to their more specific expectations and strong reactions to unmet goals (Oh et al. 2005; Beardmore et al. 2015; Marine et al. 2022). In contrast, satisfaction for snapper was higher in the Bellarine



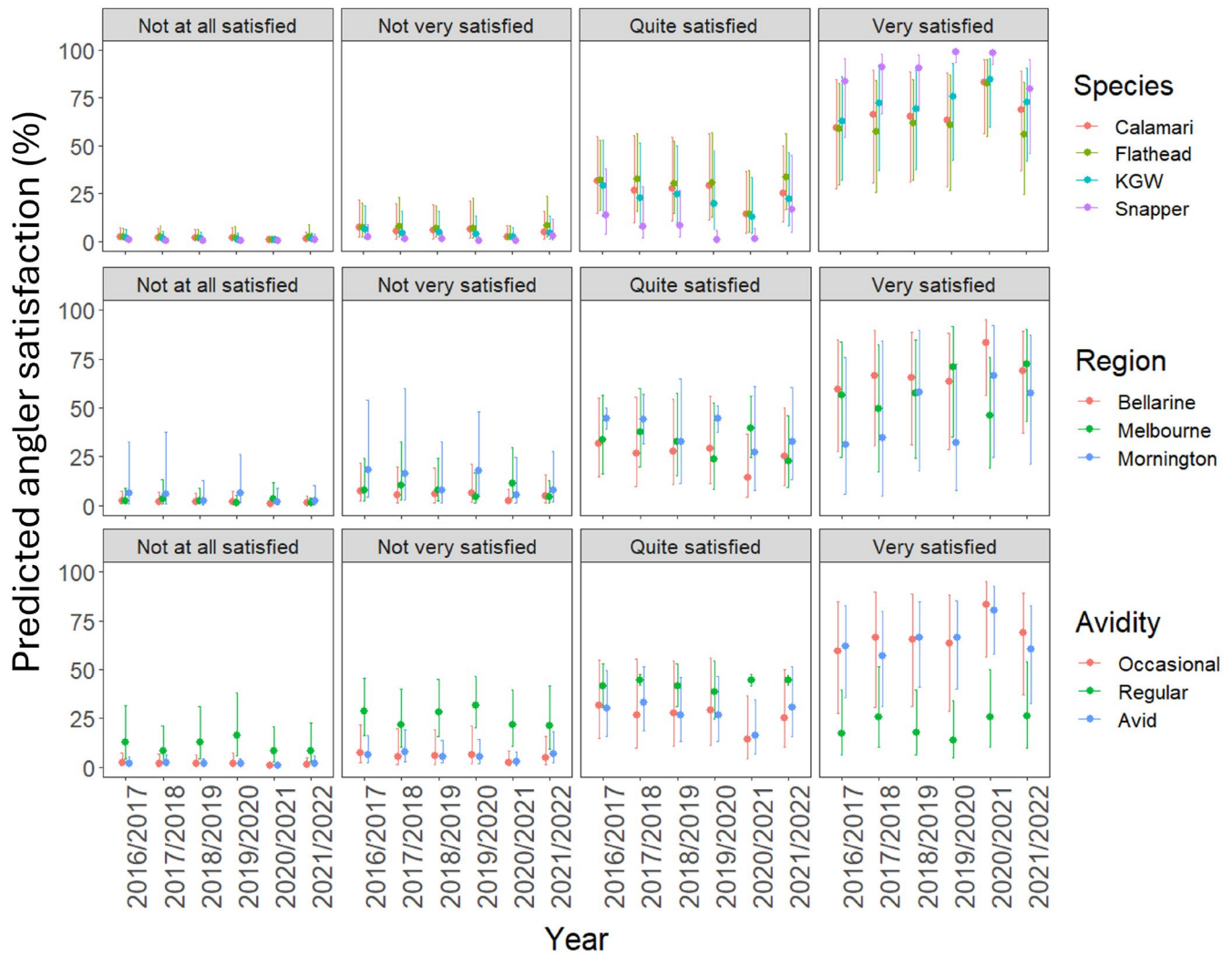
**FIGURE 3** | Angler satisfaction (%) in three regions, in relation to four target species, three levels of angler avidity, three catch rates (catch/h = CPUE), and four age ranges in Port Phillip Bay, Victoria, Australia, during 2016–2022.

region even though actual CPUE was lower, but expectations are likely lower due to the snapper populations being less abundant in this region (Wilson 1986; Morris and Ball 2006; Hamer and Mills 2017). Congestion of participants at some locations also likely plays a role (Dabrowska et al. 2017; Hunt et al. 2019; Birdsong et al. 2021), with far higher fishing effort indicative of a greater density of anglers in the north and east of PPB than in the southern area (Bellarine), because angler satisfaction can decline when increasing numbers of other anglers are encountered.

Regional variation in angler satisfaction was further supported by spatial trends among angler residence, with anglers residing in the Bellarine region being more satisfied than those from other regions. Interpretation of spatial variability in satisfaction is complex and can be influenced by angler socio-economic circumstances, such as income and education (Hutt and Neal 2010; Brinson and Wallmo 2017). Individuals living in economically

disadvantaged areas may face financial constraints that limit their ability to fish (Arlinghaus et al. 2015), thereby affecting their satisfaction. For example, angler satisfaction differed geographically with respect to distance from residence (Hutt and Neal 2010) and region (Gordoa et al. 2019). Most anglers surveyed lived within 50 km of PPB, but the impact of travel distance on satisfaction was not investigated because anglers were not asked how far they traveled to fish. Nevertheless, anglers traveled farther on water to target snapper in PPB than other species in a recent study that modeled travel distance (Jalali et al. 2022). Those who traveled farther and hence expended more time and money may be highly motivated by the prospect of catching their target species. Satisfaction of such anglers, when successful, can be high, and expectations of these anglers likely differ from those who prefer or are only able to fish nearer to shore.

Anglers may have different preferences when choosing a fishing location related to scenery and overall atmosphere



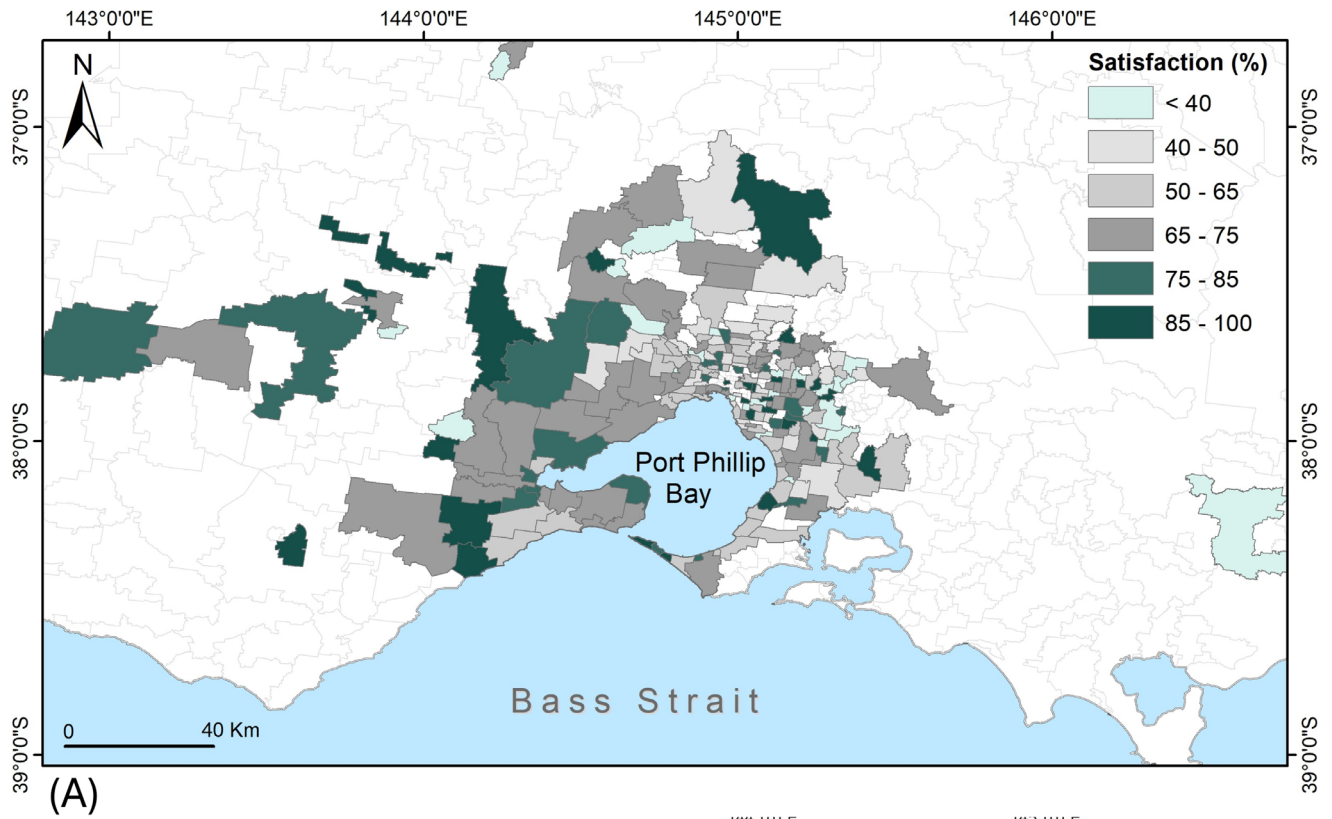
**FIGURE 4** | Angler satisfaction (%) in four fiscal years, in relation to four target fish species, three regions, and three levels of angler avidity in Port Phillip Bay, Victoria, Australia, during 2016–2022.

(Cabanelas-Reboredo et al. 2014; Hunt et al. 2019). Some may prefer quiet, secluded spots, whereas others may enjoy the social aspect of fishing in more crowded areas (Beardmore et al. 2015; Hunt et al. 2019; Birdsong et al. 2021). Other factors such as access to amenities may also impact angler satisfaction (Hunt 2005). Fishing pressure and congestion may be factors that explain variation in satisfaction given that if a fishing location, or launching facilities used to access a particular fishing location, are overcrowded, it can become more difficult to access and/or catch fish, leading to frustration and dissatisfaction among anglers (Hunt et al. 2012; Kainzinger et al. 2015; Birdsong et al. 2021). These factors potentially explain the lower satisfaction observed in the Melbourne and Mornington regions that have higher population densities. However, the influence of region and fishing location on angler satisfaction is complex and multifaceted, and we may not expect anglers to be similarly satisfied even with the same fishing trip outcomes within the same region, potentially due to factors unable to be assessed in the present study.

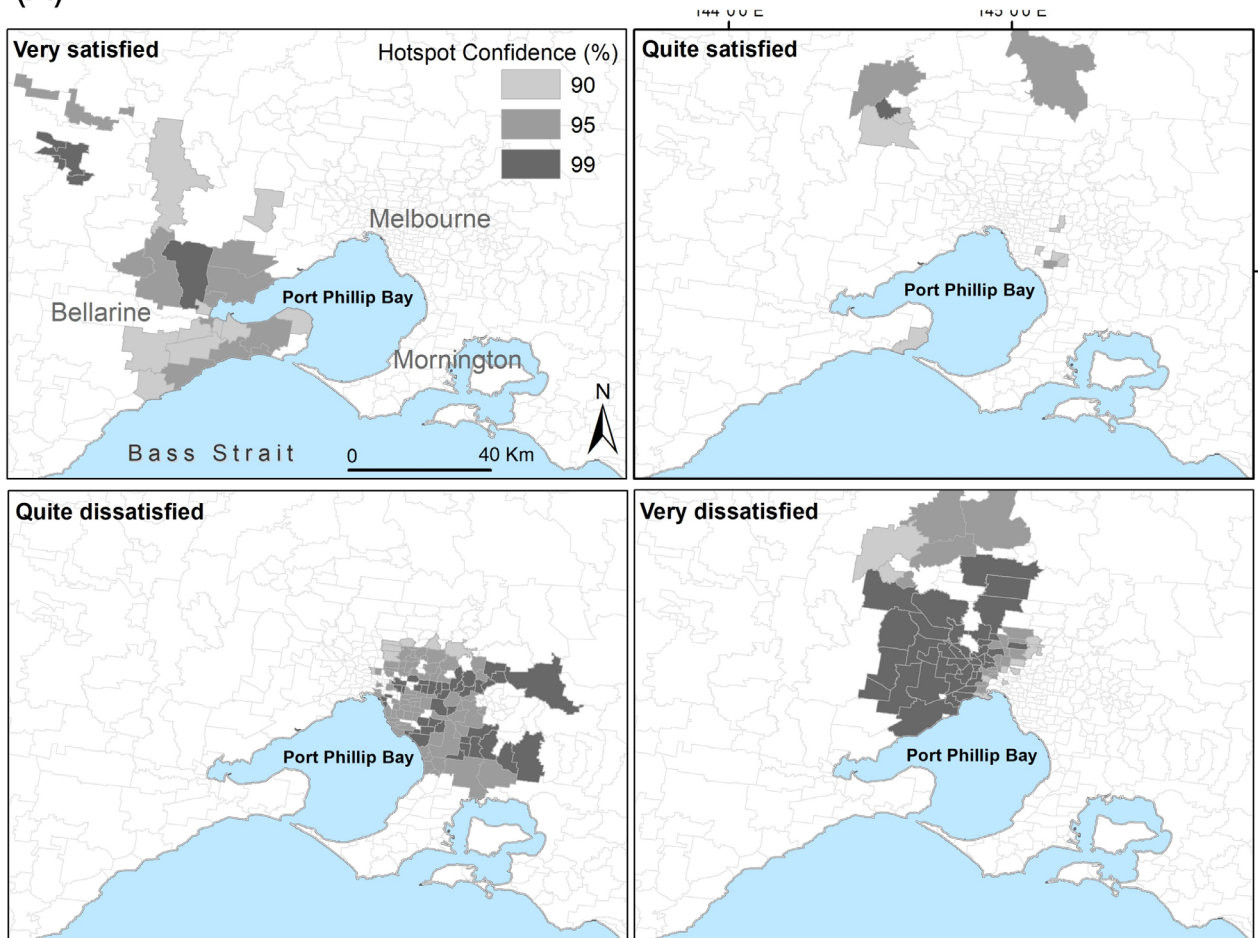
Age and its interactions with other factors also played a significant role in angler satisfaction in our study, with younger anglers being more satisfied than older anglers, especially when

catch rates were lower for occasional anglers, which suggests that younger anglers have different expectations and motivations for fishing than older anglers (Aas 1996; McCormick and Porter 2014). Younger anglers may have fewer preconceived notions about what makes a successful fishing trip and may be more easily pleased by the simple act of being outdoors and engaging in the activity (Aas 1996; McCormick and Porter 2014). On the other hand, older anglers may have higher expectations for their fishing experience, based on years of experience and knowledge about the activity, or be influenced by other factors such as external pressures or responsibilities (McCormick and Porter 2014). Moreover, older anglers may have a specific idea about what constitutes a successful fishing trip, such as catching a certain type or size of fish from a particular location or a productive spot, and they may become disappointed if they do not meet these expectations (Scott and Shafer 2001). Older anglers may also have fished for many years so they feel nostalgic for what they recall fishing used to be like, when anglers were fewer and catch rates were higher (Floyd 1997; Scott and Shafer 2001; Kyle et al. 2007; Birdsong et al. 2021).

Angler avidity, as an indicator of commitment to fishing, and its interaction with other factors, also influenced angler



(A)



(B)

**FIGURE 5** | Percentage angler satisfaction ( $\geq 3$  anglers interviewed) in residential postcodes (A) for satisfaction levels at 90%, 95%, and 99% confidence (B) across all species and years in Port Phillip Bay, Victoria, Australia, during 2016–2022.

satisfaction in our study. Differences we observed among angler types could be due to avid anglers being more invested in fishing, with higher expectations (Oh et al. 2005). They may spend more time and money on gear, travel to remote locations, and engage in more specialized or challenging types of fishing (Oh et al. 2005; Marine et al. 2022). As a result, avid anglers could be more likely to succeed in fishing if they are able to catch their target species or achieve a personal goal (Beardmore et al. 2015). In contrast, casual or occasional anglers may have lower expectations or be less invested in the activity. They may be more likely to prioritize social or relaxation aspects of the fishing experience, rather than focusing on specific catches or achievements. Nevertheless, Beardmore et al. (2015) found that casual anglers could derive more satisfaction from landing a larger fish than avid anglers because it was a less common occurrence for them, but they were prone to be less satisfied if they had traveled long distances or invested more in a trip and their expectations were not realized.

We found that angler satisfaction generally increased through the years, with relatively lower satisfaction in early years that was likely linked to conflict between commercial and recreational fishers in PPB (Green et al. 2015), and which reflected a perception that excessive commercial netting led to a decline in recreational catches, particularly King George whiting (King and O'Meara 2019). In 2018, as part of the Victorian Government's commitment to a staged removal of commercial netting in Corio Bay, 43 PPB commercial fishers were offered financial exit packages in exchange for relinquishing their licenses (King and O'Meara 2019). By 2022, all commercial net fishing had been phased out. Unfortunately, angler survey data for satisfaction were not available prior to 2016 for use in our modeling, but none of the explanatory variables we explored can explain the increasing temporal trend in satisfaction, so we assume that the conflict over commercial netting was responsible. Even small reductions in commercial net fishing, such as spatial closures (to support recreational fishers), have led to higher angler satisfaction (Marine et al. 2022). This implies that the implementation of fishing regulations or closure of areas may lead to temporal variation in higher or lower angler satisfaction, which could be important to fisheries managers when developing and implementing policy because it is closely tied to the success of management strategies. In addition, some observed patterns in angler behavior and satisfaction may have been influenced by the COVID-19 pandemic, as in previous studies that documented shifts in angling participation and patterns during this period (Gundelund and Skov 2021; Howarth et al. 2021; Pita et al. 2021; Britton et al. 2023).

Our study indicated that angler satisfaction was complex and multifaceted, shaped by a wide range of factors, and is to some degree beyond the direct control of anglers, fisheries managers, or the influence of fish stock status. An understanding of factors affecting angler satisfaction, such as species-specific expectations, catch success, and regional differences in perceived quality, can improve angler experience and inform fisheries managers and policymakers to develop more effective, socially responsive management strategies.

Impetus for this study was a management policy initiative to remove commercial netting from PPB to improve its amenity for

recreational anglers. Our approach to measuring angler satisfaction enables managers to potentially gauge the effectiveness of this kind of change in policy. Indeed, measures of satisfaction can provide more timely feedback than costlier direct measures of catch and abundance, affected by lags in population-level responses among target fish species. In addition to determining responses to management changes, if appropriate questions were to be included in creel surveys, then satisfaction measures could also have the potential to be used by fisheries managers to make decisions about the provision of infrastructure, such as where to establish or improve boat launching facilities, fishing platforms, and interpretive signage. Increasing interest in habitat improvement and re-stocking of marine bays and inlets can be directed more strategically when there is a better understanding of what motivates and satisfies anglers. In essence, measuring satisfaction provides a means for evaluating the effects of implementing management changes and identifying the needs of anglers when formulating future management policy initiatives. Moreover, in systems where popular target species like snapper, KGW, or other large-bodied fish are unevenly distributed, managers could also use this insight to develop spatial management plans or education campaigns to align angler expectations with ecological realities. These approaches are applicable not only in Australia but in any nation managing high-demand recreational fisheries facing pressures from urbanization, resource limitation, or shifting social values. By aligning management practices with angler values and expectations, particularly in diverse socio-economic and ecological settings, managers can ensure that fishing remains a popular and rewarding recreational activity for generations to come.

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#### Ethics Statement

Although the study involved conducting a structured questionnaire with anglers, participation was voluntary and did not include the collection of any personal or private information. This meant that ethics approval was not required.

#### Conflicts of Interest

The authors declare no conflicts of interest.

#### Data Availability Statement

The data underlying this article will be shared on reasonable request to the corresponding author.

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