Marine Protected Areas and Recreational Fishing for Kelp Bass (*Paralabrax clathratus*) in Southern California: An Economic Perspective

Photo: Brad Erisman

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Capstone Advisory Committee Final Capstone Project Signature Form

Recreational Fishing for Kelp Bass (*Paralabrax clathratus*) and Marine Protected Areas in San Diego: An Economic Perspective

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MAS Marine Biodiversity and Conservation

Capstone Project

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I sent a message to the fish:
I told them "This is what I wish."
The little fishes of the sea,
They sent an answer back to me.
The little fishes' answer was
"We cannot do it, Sir, because —"'
'I'm afraid I don't quite understand,' said Alice.
'It gets easier further on,' Humpty Dumpty replied.
'I sent to them again to say
"It will be better to obey."
The fishes answered, with a grin,
"Why, what a temper you are in!"

Lewis Carroll (Charles Lutwidge Dodgson) (1871)
Through the Looking-Glass and What Alice Found There
Macdonald, London (Chapter 6)

A note on the often-strained relationships between humans and fishes.

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ABSTRACT

The kelp bass fishery is arguably the most important recreational fishery in southern California, with more documented landings than that of any other species (excluding unidentified rockfish) in the region since 1936. However, long term declines in catch-per-unit effort over the past several decades led to progressive management of the species by the California Department of Fish and Game, most notably with the recent implementation of an extensive network of Marine Protected Areas (MPAs) spanning from Point Conception to the Mexico and United States border. Achieving a balance between ecological and socioeconomic objectives is at best challenging, and often results in a tension between protection and fishing, currently being realized by those anglers engaged in the kelp bass fishery. While the benefits of protection may be realized in the long-term, many of the costs, often economic in nature, may be incurred initially. For the kelp bass angling community in southern California, these economic costs are being felt by a current reduction in the non-market values associated with fishing for the species, including a reduction in days spent on the water, perceived increased vessel congestion, and the belief that smaller fish will be caught as a result of the MPAs. This conclusion was drawn from analysis of data that was gathered over several months via a survey distributed throughout the kelp bass angling community in southern California. Nonetheless, this devaluation may be limited to the short term, with the potential for MPAs to foster improved fishing conditions over the long-term.

INTRODUCTION

Fisheries researchers of all types like to explain, to the often bemused bystander, the many ways fish have evolved an astonishing array of adaptations, so much so that it may be challenging for them to even comprehend why any person would choose to study anything else. Nonetheless, fish are perhaps the most hunted class of animals for sport or food. Consequently, few today fail to recognize that the reconciliation of resource exploitation with biodiversity conservation presents significant challenges to current knowledge and expertise.

The relationships between humans and fishes are at times strained. Recreational fishing, commonly referred to as benign, is critically important for several reasons, including economic, social, and ecological. Despite it's significance,

the value of recreational fishing has proven exceptionally difficult to evaluate. In this paper I describe the effects of the recent implementation of the 2012 Marine Protected Areas (MPAs) under the Marine Life Protection Act (MLPA) on the economic value of the kelp bass (*Paralabrax* clathratus) fishery for anglers in southern California.

A general consensus rooted within the recreational angling community in southern California is that the implementation of the 2012 MPAs will serve to decrease the value of the kelp bass fishery in the region for the anglers (Franke, 2013). This creates a need to quantify the assumed impacts in order to facilitate deeper understanding of the economic effects of the MPAs on kelp bass anglers. I explored the effect of MPA implementation through the use of a widely distributed survey and statistical analysis of the resulting data. Such an examination is timely and relevant given the recent regulatory changes and subsequent heated debates that surround this critically important fishery. In fact, the effective management of marine fisheries depends upon having clear and well-documented information that is currently lacking for the century old kelp bass fishery (Bellquist, 2013). Such a task can be daunting, given that the form and volume of information continually increases alongside the need of fisheries managers to formulate timely and area specific management actions, such as the MPA network in southern California.

KELP BASS BIOLOGY AND ECOLOGY

Kelp bass (*Paralabrax clathratus*), also known as calico bass, are a significant component of the nearshore marine environment throughout the Southern California Bight (SCB). Historically, the species has ranged as far north as the mouth

of the Columbia River in Washington State and south to Bahia Magdalena, Baja California, Mexico. It is rare to find kelp bass north of Point Conception, as they are primarily found in waters between Baja California Norte and Point Conception, California; they are also common in the shores of the Channel Islands. The species typically inhabits shallow waters (surface to 150 feet deep) and is closely associated with high relief structure, especially kelp. Although usually associated with substrata, kelp bass will often rise into the water column, well away from structure (Love et al., 1996). While kelp bass are found swimming throughout the water column, they appear to concentrate in the water between eight and 70 feet deep (California Department of Fish and Game, 2001).

Kelp bass generally live solitary lives, only forming schools and assemblages to feed on smaller schooling fish, or to spawn. Early tag and release studies demonstrated relatively restricted movement for the majority of kelp bass on a daily and seasonal basis, with small diel home ranges and strong site fidelity, suggesting that when the fish do move it is to nearby rocky reefs or for brief distances to gather into breeding assemblages (Lowe et al., 2003). More recently, however, tagging studies in the northern portion of the Southern California Bight from Point Conception south to the northern Channel Islands indicated that the species were quite mobile, with some individuals travelling up to 50 miles. Furthermore, schools of kelp bass have been observed in the pelagic environment, suggesting that broader-scale movements occur at times, which would serve to support the theory

that MPAs may lead to spillover of kelp bass into areas still open to fishing, and thus improve fishing conditions at some point in the future (California Department of Fish and Game, 2001).

Kelp bass mature between three and four years old, or approximately 10 inches. Some individuals have been aged up to 34 years old. They are known to mature up to 28.5 inches and 14.5 pounds. Generally speaking, they are slow growing fish, and are approximately 7 or 8 years of age at the time they reach the legal size limit for harvest at 14 inches. As with most fishes, this growth is highly variable with the largest fish not necessarily being the oldest (California Department of Fish and Game, 2001).

HISTORY OF THE KELP BASS FISHERY

Kelp bass represent one of the most significant nearshore recreational species caught off of the coast of Southern California. Targeted heavily by anglers and commercial fishers since the early 1900s, the fishery has witnessed several management and biological changes over the last 100 years. In the fishery's infancy, catch statistics grouped kelp bass, and the two other *Paralabrax* species (barred sand bass and spotted bay bass) into one single "rock bass" category. Recent studies indicate that it is highly likely that kelp bass encompassed the majority of this catch category early on (California Department of Fish and Game, 2001).

Historically, sport anglers considered kelp bass a nuisance, or bycatch fish, while they were targeting more desirable game fish species. At that time, only the largest kelp bass, known throughout the fishery as "bull bass" were sought after.

During the 1920s and 1930s, the largest commercial landings of "rock bass" took place, with annual landings averaging 500,000 pounds. During and after World War II, the fishery witnessed a sharp and sudden decline in fishing activity with landings failing to just over 150,000 pounds from 1941 to 1953. Intense fishing may have served to cause a progressive decrease in the size of landed kelp bass. Conservation measures were enacted in the face of the general decline of the important natural resource. California Department of Fish and Game began comprehensive studies in 1950 that lead to a ban on commercial fishing, which made targeting the species' in California illegal (California Department of Fish and Game, 2001). Additionally, size and bag limits were enacted, with a size limit of 10.5 inches that was eventually increased to 12 inches. This size limit of 12 inches remained in effect until March 1, 2013, when the legal size limit for kelp bass was increased to 14 inches. Additionally, a total combined bag limit of 5 fish for the three Paralabrax species was implemented at the same time (Fish and Game Commission, 2012).

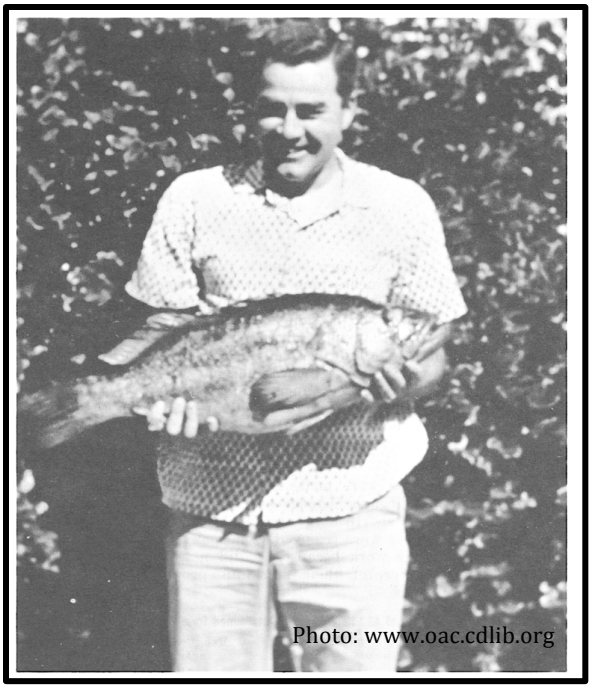


Photo: www.oac.cdlib.org

THE KELP BASS FISHERY TODAY


Photo: Lyall Bellquist

Today, California law prohibits commercial fishing for kelp bass. However, a very active recreational fishery still exists for the species. Kelp bass have consistently ranked among the top ten species or species groups caught by southern California Commercial Passenger Fishing Vessles (CPFV) anglers over the past 20 years. In terms of number of fish caught between 1939 and 2008, kelp bass ranked second, with rockfish as an aggregate ranking first (Fisheries Review, 2009). However, there has been a steady long-term decline in catch-per-unit-effort (CPUE) of the species. Sport anglers commonly use light hook-and-line tackle to target kelp bass from piers, beaches, private boats, and CPFV (California Department of Fish and Game, 2001).

Recently, California Department of Fish and Game identified over 375 marine fisheries managed by the state and prioritized them for future fishery management plans. Kelp Bass was identified as a 'high-priority' species in need of management and conservation measures that comply with the Marine Life Management Act. Effective March 1st, 2013, a 14-inch minimum was implemented for the species. Currently, Long Beach is the number one port for kelp bass catch, with 16% of total catch by number. Other major ports for kelp bass fishing include Dana Point, Mission Bay, San Diego, and Newport Beach.

THE MARINE LIFE PROTECTION ACT

On January 1st, 2012, a new and expanded network of Marine Protected Areas (MPAs) went into effect along the South Coast of California, a result of the Marine Life Protection Act (MLPA). This legislation, passed in 1999, aims to "protect California's marine natural heritage through establishing a statewide network of marine protected areas designed, created, and managed using sound science and stakeholder input" (California Department of Fish and Game, 2012). The MPAs in southern California are one component of a statewide network designed to meet the goals stated in the MLPA, including helping sustain, conserve, and protect marine life populations, including those of economic value. The South Coast region encompasses approximately 2,351 square miles of state waters from Point Conception (off the coast of Santa Barbara, California) to the United Stated – Mexico border, including the Channel Islands. This region consists of fifty MPAs and two special closures, covering approximately 356 square miles of state waters or about 15% of the south coast region, that include varying levels of protection, ranging from some areas that allow for consumptive use, to marine life reserves where both commercial and recreational take is prohibited by law (California Department of Fish and Game, 2012).

Several groups were involved in the process of developing the MPAs off the Southern California Bight. The MLPA Initiative created key bodies including a Blue Ribbon Task Force, A Master Plan Science Advisory Team, and a regional stakeholder group. Comprised of members familiar with the uses and resources in the region, the Regional Stakeholder Group aimed to reflect diverse interests. These

individuals reviewed and discussed options for MPA boundaries and level of protection as well as developed MPA alternatives, which were eventually presented to the Blue Ribbon Task Force. Additionally, many individuals on the Southern Coast Regional Stakeholder Group directly represented recreational fishing interests (California Department of Fish and Game, 2011).

All of the MPA proposals that were developed by the Regional Stakeholder Group underwent review by the Science Advisory Team, the Blue Ribbon Task Force, the Department of Fish and Game, and MLPA Initiative staff for the South Coast region. Following review, MPA proposals were amended and eventually the Blue Ribbon Task Force recommended a "preferred alternative" to the California Fish and Game Commission, responsible for making the final judgment in the MLPA decision process. Following the commission's adoption of a regional network of MPAs, those MPAs became codified in California Fish and Game regulation. Since then, this statewide network of MPAs has left many kelp bass anglers frustrated and convinced that their fishing experience is forever changed.

THE ANGLER'S RESPONSE

The overwhelming message from local kelp bass anglers in response to the implementation of the 2012 MPAs is that "fifty percent of our best calico (kelp bass) fishing grounds were lost to the reserves" (Franke, 2013). During hundreds of hours speaking with kelp bass anglers throughout southern California while on fishing vessels, at various fishing shows and tournaments, and at local fishing association meetings, this message was reiterated to me on a regular basis. In an attempt to further understand where this belief stemmed from, I contacted the California

Department of Fish and Game requesting geographic information system (GIS) shape files of various kelp bass habitats including kelp cover and rocky reef for the past several years. This information allowed me to compose a map in ArcView GIS software to determine the percentage of prime kelp bass habitat no longer available to anglers due to MPAs.

Following (Figure 1) is the resulting map demonstrating 2011 kelp cover estimates provided by the California Department of Fish and Game, as well as the entire network of Marine Protected Areas in the Southern California Bight enacted January 1st, 2012. Kelp cover was selected as it is considered prime habitat for kelp bass, and the 2011 kelp cover was selected, as it was the last year anglers were able to fish throughout the majority of the habitat prior to the implementation of the MPAs in 2012.

Kelp coverage residing within MPA is observable on the map and appears to be significantly less than 50% (as stated by the anglers), but still may serve to explain some of the frustration across the kelp bass angling community regarding the loss of prime kelp bass fishing grounds.

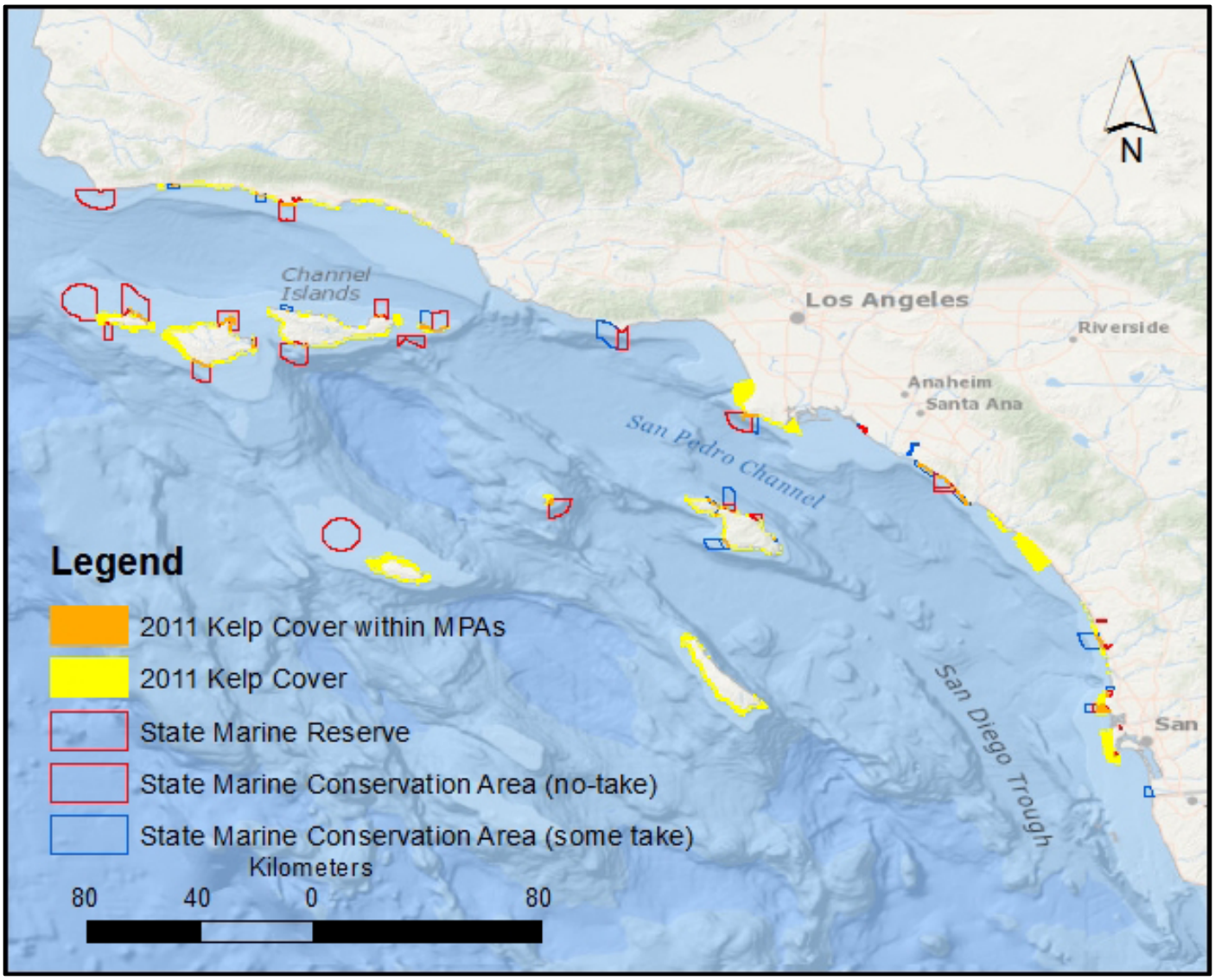


Figure 1. MPAs and Kelp Cover

METHODS

This project, and subsequent human dimensions survey design, maintained a social science approach, outlined in the literature and widely practiced by environmental agencies attempting to identify recreational angler's values, interests, and behaviors. The survey targeted recreational anglers who fish for kelp bass in southern California that use personal vessels, charter/sport boats, or kayaks as their primary vessel to fish from.

The survey design drew from those generated by the National Marine Fisheries Service (NMFS). The Marine Recreational Fisheries Statistics Survey (MRFSS) has been used to obtain statistics about marine recreational fisheries since 1979 by NMFS. It is well understood that it is considerably more difficult to collect data on recreational saltwater anglers than on commercial fishing operations. Anglers took an estimated four million marine fishing trips in 2011 to fish for marine fish in California, and forty-nine percent of those trips originated in San Diego, Orange, and Los Angeles counties (Fisheries Forum Report, 2012). These anglers do not land their catches at specific points where dealers are present, as do commercial anglers, making it difficult to precisely monitor the amount and characteristics of catch. Furthermore, some anglers travel extensive distances for the opportunity to fish, and may only fish occasionally throughout the year, making such individuals difficult to encounter in surveys. Others, who reside within several miles of the ocean, are significantly more likely to be intercepted with a survey. And, finally, surveys of anglers depend strongly on the anglers' recall and willingness to volunteer valid and truthful information (National Research Council, 2006).

To combat the above-mentioned problems associated with conducting recreational surveys, NMFS requested the National Research Council (NRC) of the National Academy of Sciences to assemble a committee to review recreational fisheries survey methods and provide recommendations for improvements. One of the main recommendations made by the committee was that survey creators and distributors make efforts to engage various anglers' associations, and to recognize and stress the importance of using local and traditional knowledge, capacity, and

local communities in knowledge and data gathering (National Research Council, 2002).

Following NRC guidance, I dedicated the last 10 months to immersing myself in the local kelp bass fishing industry in San Diego and throughout southern California in a variety of ways, ranging from representing Scripps at large fishing shows in Long Beach and Del Mar, to regularly fishing for kelp bass on chartered and private boats out of San Diego. Through this process, I developed ongoing relationships with numerous members of the local kelp bass fishery, which ensured the widespread distribution of my survey, as well as the accumulation of traditional and local knowledge of the fishery and a high survey response level. My extensive networking and engagement in the fishery has been largely due to my involvement in the Coastal Angler Tagging Cooperative project based out of Scripps, led by Dr. Brice Semmens (on my advisory committee) and PhD candidate Lyall Bellquist, who are currently working directly with the recreational fishing community, the California Department of Fish and Game, and the San Diego Oceans Foundation to implement an assessment of Paralabrax (including kelp bass) populations, vital rates, and movement patterns (Bellquist, 2013). Furthermore, I have attended numerous meetings of local recreational fishing organizations, including the San Diego Rod and Reed Club and the San Diego Anglers Fishing Club, which facilitated connecting with local anglers, and I have personally interviewed multiple industry representatives including Ken Franke (the President of Sportfishing Association of California), Buzz Brizzendine (Owner and Operator of the F/V Prowler), and Louis Almeida (Vice President of San Diego Anglers). I have developed lasting relationships with numerous California Department of Fish and Game and NOAA

representatives deeply involved in the kelp bass fishery, including Marty Golden, Charles Villafana, and Erica Jarvis.

This extensive networking and relationship building has allowed me to gain an in-depth knowledge and understanding of the attitudes surrounding the kelp bass fishery as it relates to the MPAs. The trust I have gained across the fishing community greatly contributed to the success in fielding my survey.

Survey Design:

Relationship building and informal interviews with recreational anglers provided valuable background information, personal anecdotes, and opinions regarding the kelp bass fishery and the MPAs that are not yet published in literature. This information served to guide the survey design.

Twenty-four survey questions were developed, which focused on identifying the values and opinions held by recreational kelp bass anglers regarding the fishery and the implementation of MPAs in southern California in 2012. Questions were based on both stated preference and revealed preference information. Topics covered included, but were not limited to, basic demographic information, the value individual anglers place on the kelp bass fishing experience, opinions regarding the current status of the kelp bass stocks, individual catch and fishing rates prior to 2012 and during the 2012 fishing season, specific reasons for variations in catch or numbers of days spent fishing since the implementation of the MPAs, opinions on congestion and crowding on fishing grounds, projections for future fishing activity, and likelihood of compliance with MPA regulations. Many questions included multiple-choice answers and/or a ranking scale. Several questions included an

"other" option where anglers could describe answers not included in the list. Seven questions included simple "yes" or "no" selections.

The members of my capstone committee and Lyall Bellquist (Coastal Angler Tagging Cooperative) reviewed initial drafts of the survey and provided valuable feedback and suggested revisions. Once improvements were completed, the survey was reviewed by two local kelp bass anglers to ensure the clarity of the questions to the intended audience. The survey was then submitted to the UCSD Human Research Protections Program for review. In turn, the survey and project was considered to "not meet the criteria for human subjects research, and (did) not require review by the HRPP IRB. Under federal guidelines, studies requiring IRB review must meet the following definition: research - systematic investigation, including research development, testing and evaluation, designed to develop or contribute to generalized knowledge" (Myers, 2013). Lastly, the final version of the survey was printed for in-person distribution and data collection at various fishing shows and fishing events.

Data Collection:

Surveys were distributed over 11 days at three different events in southern California from the Coastal Angler Tagging Cooperative Booth, including the Fred Hall Fishing Show in Long Beach (March 5, 2013 – March 9, 2013), the Fred Hall Fishing Show in Del Mar (March 27, 2013 – March 30, 2013), and the Port of San Diego's Day at the Docks (April 21, 2013). A total of 225 surveys were collected in-person from individual recreational kelp bass anglers. A small proportion of the surveys were distributed from the San Diego Anglers Association booth at the same events. Each participant provided verbal or informed consent and was made aware

that the survey was anonymous and would be used for an academic research project by a graduate student at Scripps Institution of Oceanography, UCSD. Participants were able to choose whether or not to answer each individual question, but I did request that they complete the entire survey. In total, 7 anglers declined the opportunity to take the survey.

Data Collection Discussion:

I attribute the high survey response rate to a number of factors. I consider my involvement in the Coastal Angler Tagging Cooperative project, and subsequently handing the survey out at their booth, as being critical to the success of the survey and the project as a whole. In addition to lending credibility to the survey and my project, and facilitating relationship building with countless anglers, this method was highly effective as the booth served to initially select the survey target population of kelp bass anglers since the project focuses on tagging the three *Paralabrax* species, including kelp bass. The same benefits were realized by having the survey available to fill out at the San Diego Anglers booth and the Rod and Reel Club booth. Once anglers were informed on the details of the tagging project, they were asked to fill out the survey for a related project (mine). Additionally, distributing the survey at the booth eased angler's fears that I worked for Department of Fish and Game. Furthermore, the printed length of the survey was a single page double-sided, none of the questions were complicated, and language familiar to kelp bass anglers was employed. For example, the name familiar to anglers, "calico bass," was used rather than "kelp bass", the name conventionally used by scientists. On average, it took participants 2 – 3 minutes to complete the survey in full. I suspect that the survey length could have been shortened to one

page, rather than double-sided, but do not feel that would have lead to additional surveys being completed. A reason for shortening the survey would be to curb the amount of data I received, as the volume was so great, and my time so limited, that much of it remains un-analyzed at this point.

Sampling Bias:

As with all surveys, minimizing bias was a central goal while fielding my recreational fishing survey. A difficulty with achieving this objective is that the nature of recreational fishing makes it challenging to avoid sampling bias. Formidable challenges exist due to the diversity of fishing sites and numerous modes available to kelp bass anglers in southern California. Ideally, unbiased information should be collected through the use of a representative sample of the entire angler population, which is extremely difficult at best, and impossible at worst (National Research Council, 2006). For my survey, restricted access to all kelp bass anglers may have resulted in a slightly less representative sample of the angler population in southern California. Correlations likley exist between those anglers who attend the fishing shows and a higher level of avidity for fishing and increased income levels. In studies, avidity bias (the disproportionate representation of avid anglers) has been demonstrated to result in inflated estimates of per capita fishing expenditures and consumer surplus as well as fishing effort (Thompson, 1991). Additionally, self-selection may have occurred, with only those individuals who chose to attend the booth having the opportunity to complete the survey versus those who did not attend the booth.

Nonetheless, I am confident that an adequate level of randomness was present in my sample for the purposes of this study by nature of the vast scale of the

venues and events where the survey was conducted. The Fred Hall Fishing Shows attract "hundreds of thousands of people annually" (Hall, 2013), the majority whom are anglers residing in southern California (Hall, 2013). Furthermore, the Coastal Angler Tagging Cooperative project is very well known across the kelp bass angling community, serving to attract a significant amount of attention at the shows.

Data Analysis:

Once collected, data was entered into an Excel Spreadsheet in a format compatible with data analysis in R and SYSTAT. Three individual Excel spreadsheets were complied - one for each fishing show and event. R and SYSTAT are software programs suitable for analyzing data of this nature. Qualitative responses were assigned quantitative values to facilitate efficient data entry and analysis. For example, all responses with a qualitative value of "very important" were assigned the numeric value of "4" (fourth in the list of possible answers). All questions that did not receive a selection were assigned the numeric value of "0".

Data was analyzed to answer questions that were framed around the null hypothesis that the Marine Protected Areas enacted in southern California in 2012 would have no perceived effect on the value of kelp bass fishery for the recreational anglers. The following statistical tests were performed and results found.

RESULTS

These data were used to answer questions surrounding angler behavior, fishing effort, congestion and crowding effects, beliefs about stock health, and various other topics. The results are as follows:

Question 1a: Has angler behavior changed since the implementation of the MPAs in 2012?

Survey question #12: Did you fish less for calicos in the 2012 season (last summer) than you did in prior years?

Values for Q12		
1 – Fished Less	2 – No Change	3 – Fished More
90(41.284%)	101(46.330%)	27(12.385%)

Test: Chi-square goodness-of-fit (G) tests for survey question #12.

Answer: Proportion of responses is significantly different from the null (expected) hypothesis of equal proportions (χ^2 = 43.881, df=2, p < 0.001).

53.669% of respondents changed their fishing habits in 2012.

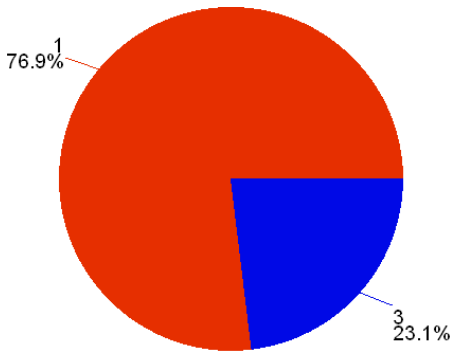
Excluding "no change in frequency" responses to specifically test directionality of change:

Values for Q12	
1 – Fished Less	3 – Fished More
90(76.923%)	27(23.077%)

Test: Chi-square goodness-of-fit (G) tests for survey question #12.

Answer: Proportion of responses is significantly different from null of 50/50.

Significantly more anglers responded that their fishing frequency decreased than those who responded that it increased (χ^2 = 33.923, df = 1, p < 0.001).



Of the anglers that changed their habits, the majority of individuals (76.9%) decreased their kelp bass fishing frequency.

Question 1b: Has behavior changed differently based on angler type?

Survey question #1: You are a: (select from list)

Survey Question #12: Did you fish less for calicos in the 2012 season (last summer) than you did in prior years?

Survey question 1: You are a:	
20/8.889%	1. Sportfishing vessel operator/owner
55/24.444%	2. Sportfishing vessel angler
93/41.333%	3. Private boat angler
28/12.444%	4. Other
21/9.333%	Individuals who selected both 2 and 3
8/3.554%	Other combinations of 1, 2, 3, and 4

Test: Chi-square contingency tests using survey question #1 versus survey question #12 responses.

Answer: No strong evidence that angler behavior differs by angler type (χ^2 = 27.876, df = 30, p = 0.577).

The data shows that the angler type that **increased** their fishing frequency the most was "private boat anglers".

Excluding insignificant results:

0 of 20 (0%) of "sportfishing vessel operator/owner" increased fishing frequency.

5 of 55 (9.091%) of "sportfishing vessel anglers" increased fishing frequency.

17 of 93 (18.230%) of "private boat anglers" increased fishing frequency.

The data shows that the angler type that **decreased** their fishing frequency the most was "sportfishing vessel anglers".

Excluding insignificant results:

8 of 20 (40%) of "sportfishing vessel operator/owner" decreased fishing frequency.

25 of 55 (45.455%) of "sportfishing vessel anglers" decreased fishing frequency.

31 of 93 (33.33%) of "private boat anglers" decreased fishing frequency.

Question 2*:* Will people who fished less in 2012 also fish less in the future due to the MPAs?

Survey question #12: Did you fish less for calicos in the 2012 season (last summer) than you did in prior years?

Survey question #17: Will you fish for calico bass less in the future due to the MPA closures?

Q12(rows) by Q17(columns)			
	1 – Less	2 – Same or More	Total
1 – Less	41(19.249%)	46(21.596%)	87(40.845%)
2 – Same	20(9.390%)	79(37.089%)	99(46.479%)
3 – More	4(1.878%)	23(10.798%)	27(12.676%)
Total	65(30.516%)	148(69.484%)	213(100.0%)

Test: Chi-square contingency test.

Answer: Whether an angler will fish less in the future due to the MPAs is contingent on whether that individual fished less in 2012 (χ^2= 19.426, df = 2, p < 0.001). By examining the standardized deviates, it is evident that the proportion of people who answered "fish less" for both questions is substantially higher than expected. Roughly one third of anglers surveyed will fish less for calico bass in the future due to the MPA closures.

Question 3: Do anglers who rate the fishing experience as "important" or "very important" exhibit a resistance to switch to fishing other species?

Survey question #6: How much do you value the calico bass fishing experience?

Survey question #22: Will you fish for different species given the closures of calico bass fishing grounds?

Q6(rows) by Q22(columns)			
	1 – Different	2 – Same	Total
1 – Not Important	3(1.395%)	3(1.395%)	6(2.791%)
2 – Somewhat Important	16(7.442%)	7(3.256%)	23(10.698%)
3 – Important	36(16.744%)	20(9.302%)	56(26.047%)
4 – Very Important	81(37.674%)	48(22.326%)	129(60.000%)

Test: Chi-square tests of association for survey question #6 and survey question #22.

Answer: Angler's willingness to fish for other species due to the MPAs is not contingent on how much they value the kelp bass fishing experience (χ^2 = 2.607, df = 4, p = 0.626). However, 63% of anglers surveyed responded that they would fish for other species versus 36% who responded that they would not switch to fishing another species. Those anglers surveyed who responded that they value kelp bass fishing experience as "very important" responded that they would also fish for a different species more than any other group.

Question 4a: Does fishing frequency correspond to likelihood of releasing kelp bass?

Survey question #8: Do you catch-and-release legal-sized calico bass?

Survey question #9: Historically, how often have you fished for calico bass during a calendar year?

Q9(rows) by Q8(columns)				
	1 - Rarely	2 - Sometimes	3 - Often	4 - Always
1 – 0-10 days	6(2.691%)	22(9.865%)	20(8.969%)	23(10.314%)
2 – 10-20 days	0(0.000%)	12(5.381%)	29(13.004%)	15(6.726%)
3 – 20-30 days	2(0.897%)	0(0.000%)	23(10.314%)	13(5.830%)
4 – 30+ days	0(0.000%)	1(0.448%)	19(8.520%)	34(15.247%)

Test: Standardized Deviates :(Observed-Expected)/SQR (Expected) & Chi-square tests of association for survey question #8 and survey question # 9.

Answer: Yes, the number of trips taken by anglers corresponds to the likelihood of those individuals releasing their catch ($\chi^2 = 65.947$, df = 24, $p < 0.001$). Those anglers who fish infrequently (0-10 day per year) are more likely to "rarely" or "sometimes" release legal-sized kelp bass, whereas those anglers who fish more frequently (30+ days per year) are more likely to always release legal-sized kelp bass.

Question 4b: Does fishing frequency correspond to number of kelp bass caught per trip?

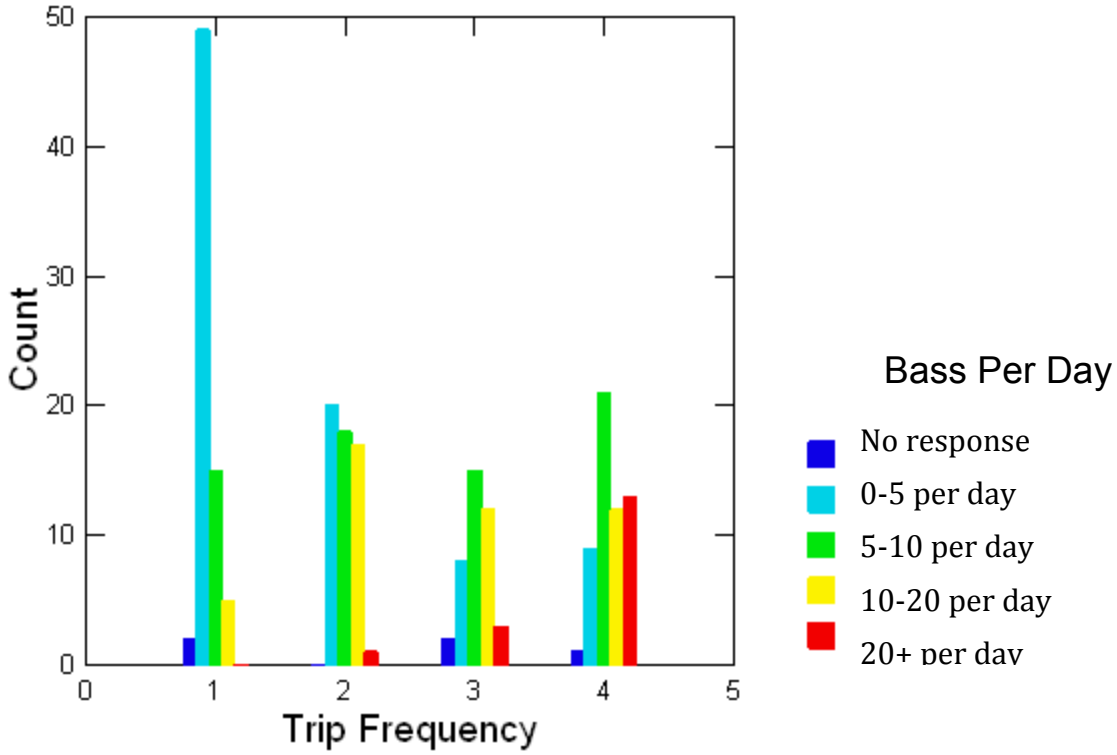
Survey question #9: Historically, how often have you fished for calico bass during a calendar year?

Survey question #10: How many calico bass per day did you typically catch on your trips **prior** to 2012?

Q10(rows) by Q9(columns)				
	1 – 0-10 days	2 – 10-20 days	3 – 20-30 days	4 – 30+ days
1 – 0-5 per day	49(22.273%)	20(9.091%)	8(3.636%)	9(4.091%)
2 – 5-10 per day	15(6.818%)	18(8.182%)	15(6.818%)	21(9.545%)
3 – 10-20 per day	5(2.273%)	17(7.727%)	12(5.455%)	12(5.455%)
4 – 20+ per day	0(0.000%)	1(0.455%)	3(1.364%)	13(5.909%)

Test: Standardized Deviates: (Observed-Expected)/SQR (Expected) & Chi-square tests of association for survey question #9 and survey question #10.

Answer: Yes, anglers who fish infrequently catch fewer kelp bass, whereas those anglers who fish frequently catch more kelp bass (χ^2 = 178.899, df = 16, p = < 0.001).



1 – 0-10 days per year

2 – 10-20 days per year

3 – 20-30 days per year

4 – 30+ days per year

Question 4c: Does number of kelp bass caught per trip correspond to the likelihood of release?

Survey question #8: Do you catch-and-release legal-sized calico bass?

Survey question #10: How many calico bass per day did you typically catch on your trips **prior** to 2012?

Q10(rows) by Q8(columns)				
	1 - Rarely	2 - Sometimes	3 - Often	4 - Always
1 – 0-5 per day	7(3.211%)	23(10.550%)	28(12.844%)	26(11.927%)
2 – 5-10 per day	1(0.459%)	8(3.670%)	37(16.972%)	22(10.092%)
3 – 10-20 per day	0(0.000%)	4(1.835%)	20(9.174%)	20(9.174%)
4 – 20+ per day	0(0.000%)	0(0.000%)	4(1.835%)	13(5.963%)

Test: Standardized Deviates: (Observed-Expected)/SQR(Expected) & Chi-square tests of association for survey question #8 and survey question #10.

Answer: Yes, more kelp bass caught per trip equates to a higher likelihood that kelp bass will be released, whereas anglers who catch less fish maintain a lower likelihood of release (χ^2 = 46.925, df = 24, p = 0.003).

Question 5: Will kelp bass anglers fish less in the future due to the MPAs?

Survey question #17: Will you fish for calico bass less in the future due to the MPA closures?

Values for Q17		
0 – No Response	1 - Less	2 – Not Less
11(4.889%)	65(28.889%)	149(66.222%)

Test: Chi-square test of association for survey question #17.

Answer: No, most anglers (66%) will not fish less in the future due to the MPAs (χ^2 = 128.962, df = 2, p = < 0.001).

Question 6: Did anglers who fished less in 2012 because the "MPAs left few remaining good choices" witness a decrease in fishing costs since the closures?

Data for the following results were selected based on those anglers who responded to survey question #13 that they fished less because "MPA closure of calico bass fishing grounds left few remaining good choices".

Survey question #14: Have your calico bass fishing trip costs changed since the MPA closures?

Test: Chi-square test of association for survey question #14.

Answer: No significant findings for anglers who fished less due to the "MPAs leaving few remaining good choices" (χ^2 = 0.444, df = 1, p = 0.505). However, noteworthy, is the finding that most anglers surveyed (60%) believe that their fishing costs have increased since the MPA closures (χ^2 = 111.440, df = 2, p = < 0.001).

Questions 7: Will anglers who believe the MPAs will negatively affect the amount and size of kelp bass they catch fish less in the future?

Survey question #17: Will you fish for calico bass less in the future due to the MPA closures?

Survey question #18: Do you think the MPA closures will affect the size of calico bass you catch in the future?

Survey question #19: Do you think the MPA closures will affect the amount of calico bass you catch in the future?

Survey question #20: If so, do you think you will catch more or less?

Q18(rows) by Q19(columns)		
	1 - Yes	2 - No
1 – Yes, larger	61(29.327%)	17(8.173%)
2 – Yes, smaller	20(9.615%)	4(1.923%)
3 – No, same	46(22.115%)	60(28.846%)

Test: Standardized Deviates: (Observed-Expected)/SQR (Expected) & Chi-square test of association for survey question #18 and survey question #19.

Answer: Those anglers who believe the MPAs will have no effect on the size of kelp bass they catch also believe that the MPAs will have no effect on the number of kelp bass they catch (χ^2 = 28.5602, df = 2, p = < 0.001). Furthermore, anglers surveyed are split (60 to 61) who believe there will be no effect on size and number versus anglers who believe that size and number will increase.

Values for Q20		
0 – No Response	1 – More	2 – Less
62(27.556%)	68(30.222%)	95(42.222%)

Test: Chi-square test of association for survey question #20.

Answer: Most anglers think they will catch fewer kelp bass due to the MPAs (χ^2 = 8.240, df = 2, p = 0.016).

Q17(rows) by Q18(columns)			
	1 – Yes, Larger	2 – Yes, Smaller	3 – No, Same
1 – Fish less	26(12.745%)	11(5.392%)	28(13.725%)
2 – Not less	51(25.000%)	12(5.882%)	76(37.255%)

Test: Standardized Deviates: (Observed-Expected)/SQR(Expected) &Chi-square test of association for survey question #17 and survey question #18.

Answer: No relationship exists between angler fishing frequency in the future and perceived effect on size (χ^2 = 3.997, df = 2, p = 0.136).

Q17(rows) by Q19(columns)		
	1 – Yes	2 – No
1 – Fish Less	44(20.755%)	21(9.906%)
2 – Not Fish Less	83(39.151%)	64(30.189%)

Test: Standardized Deviates: (Observed-Expected)/SQR(Expected) & Chi-square test of association for survey question #17 and survey question #19.

Answer: No relationship exists between angler fishing frequency in the future and perceived affect on number of kelp bass caught (χ^2 = 2.366, df = 1, p = 0.124).

Question 8: Will those anglers who believe the MPAs will decrease the amount and size of kelp bass they catch switch to fishing another species? Data for the following results were selected based on those anglers who responded to survey question #18 by saying that they think the MPA closures will affect the size of calico bass they catch in the future in making them smaller.

Survey question #22: Will you fish for different species given the closure of calico bass fishing grounds?

Values for Q22	
1 – Yes	2 – No
15(62.500%)	9(37.500%)

Test: Chi-square tests of association for survey question #22.

Answer: Kelp bass anglers that were surveyed will not switch to another fishery due to the belief they will catch smaller fish as a result of the MPAs (χ2= 1.5000, df = 1, p = 0.221).

Data for the following results were selected based on those anglers who responded to survey question #20 who believe that their catch will be negatively impacted in the future by the MPA closures.

Test: Chi-square tests of association for survey question #22.

Answer: A significant portion (71.6%) of kelp bass anglers that were surveyed will switch to another fishery due to the belief that they will catch fewer fish as a result of the MPAs (χ^2 = 72.400, df = 2, p = < 0.001).

Question 9a: Will congestion and crowding on remaining kelp bass fishing grounds increase as a result of the expanded MPAs, serving to restrict fishing on a previously highly productive fishing grounds?

Survey question #16: Did crowding on the calico bass fishing grounds seem to change as a result of the MPA closures?

Survey question #17: Will you fish for calico bass less in the future due to the MPA closures?

Values for Q16			
0 – No Response	1 – Less Crowded	2 - Same	3 – More Crowded
22(9.778%)	17(7.556%)	95(42.222%)	90(40.000%)

Test: Chi-square tests of association for survey question #16.

Answer: The majority of anglers believe that crowding on fishing grounds has remained the same (42%) or has increased (40.4%).

Question 9b: Will those anglers surveyed who feel that crowding has stayed the same or increased change their fishing behavior? Data for the following results were selected based on those anglers who responded to survey question #16 by saying that they think crowding on calico bass fishing grounds has stayed the same or increased.

Values for Q17	
1 – Fish Less	2 – Not Fish Less
29(31.868%)	61(67.033%)

Test: Chi-square test of association for survey question #16 and survey #17.

Answer: Anglers believe kelp bass fishing grounds have become more crowded but will not change fishing behavior as a result.

Question 10: What do anglers surveyed believe about the current health of the kelp bass stock in southern California?

Survey question #7: What do you think about the current status of calico bass stocks in southern California?

Test: Tallied in R

Answer: 4.8% = no response, 47.6% = healthy, 48% unhealthy (21% = overfishing, 12.9% = pollution, 11.6% = sea lions, 1.8% = other)

Question 11: What percentage of anglers think the calico anglers will disproportionality bear the costs of the MPA closures?

Survey question #23: Do you think calico anglers will disproportionality bear the costs of the MPA closures?

Values for Q23		
0 – No response	1 - Yes	2 – No
8(3.556%)	131(58.222%)	86(38.222%)

Test: Chi-square tests of association for survey question #23.

Answer: A significant proportion of anglers (58%) surveyed believe that kelp bass anglers will disproportionality bear the costs of the MPA closures.

Question 12: Have kelp bass anglers changed where they fish as a result of the MPA closures?

Survey question #15: Have you changed where you fish for calico bass due to the MPA closures?

Values for Q15		
0 – No Response	1 – Yes	2 – No
7(3.111%)	145(64.444%)	73(32.444%)

Test: Chi-square tests of association for survey question #15

Answer: Yes, a significant proportion of kelp bass anglers (64%) surveyed have changed where they fish due to the implementation of the MPAs. 32% of anglers have not changed where they fish due to the MPAs.

DISCUSSION

Recreational fisheries around the world provide humans with important economic benefits as anglers derive well-being from participating in the act of fishing, enjoying the natural environment, viewing marine wildlife, consuming the fish they catch, and engaging in social interactions with fishing companions. However, many of these benefits are difficult to value as they are non-market in nature and depend on 'free' ecological services (Pitcher et al., 2002). Together, use value and non-use value comprise the total economic value of the kelp bass fishery to the anglers surveyed. Contingent on the kelp bass resource, this value is determined by comparing anglers' experience using the resource to not having access to it. Kelp bass anglers, in recently losing some of their most prime kelp bass fishing grounds to the MPAs in 2012, have experienced a loss in value of this 100 year old fishery of southern California in a variety of ways from spending less time on the water to the perception they will catch smaller fish in the future due to the MPAs.

Despite a growing interest in MPAs, relatively little is known in practice regarding their economic impact for a variety of stakeholders, including anglers (Whitmarsh at al., 2000). Policies such as MPAs that affect recreational fisheries maintain costs and benefits, for both anglers and other members of society, that need to be accounted for if social well-being is to be maximized. The use of economics can be used to quantify such costs and benefits of various policy options, and perhaps make recommendations to improve overall economic efficiency (Squires, 2013).

Non-market values associated with fishing for kelp bass represent the value individual anglers place on the marine resources they utilize, beyond what they are required to pay to access the resource. For California anglers alone, the non-market use value is estimated to be between $304 million and $1.83 billion (Pendleton et al., 2006). Such values are represented by the net economic value to the angler of fishing opportunities; essentially, these values capture the added economic well-being realized by anglers as a result of access to an area with high quality fishing. Alterations in these non-market values, for better or worse, reflect changes in the net economic value of the resource. Such changes may result from modifications in access to fishing sites, fluctuations in catch per unit effort at sites, or changes in interactions with other anglers including increased congestion and crowding.

Furthermore, if anglers believe they will bear the costs of being displaced from an area, and due to the lack of exclusive harvesting rights, maintain no guarantee that they will realize the benefits of stock recovery, then it is likely that their support will wane. 58% of the kelp bass anglers of southern California who were surveyed believe that they will 'disproportionately bear the costs of the MPA closures', so it is no surprise that the present sentiments regarding the MPAs exist. Conversely, if anglers believe that they will eventually benefit from the MPAs, it is more likely that they will support implementation. While improvements in catch size and composition may not be realized in the short-term, due to anglers' uncertainty regarding the benefits and costs of MPAs today, anglers may be inclined to take political action to block further MPA implementation in the future.

Changes in Angler Behavior:

Significantly more anglers surveyed (76.9%) responded that they decreased their kelp bass fishing frequency in 2012 than previous years. The loss in total economic value represented by this change will be realized by anglers that no longer fish as frequently as they did prior to the MPA implementation. Those anglers who stopped fishing experienced a drop in their utility so much so that they chose the alternative of not fishing over fishing. Here, another experience that had a higher utility was selected for over fishing.

Those anglers that believe they will catch less fish as a result of the MPAs and will thus will switch to fishing another species demonstrate the fact they the number of fish they catch plays a significant role in the utility function of kelp bass fishing. The number of fish caught plays a more significant role in utility for the kelp bass fishery that does the size of fish caught. This revealed preference is demonstrated by an actual change in behavior.

Overall, kelp bass anglers agree that they will catch fewer fish in the future as a result of the MPAs, however no relationship exists between their fishing frequency in the future and their perceived effect on size of fish caught. This is likely given that many anglers place significant value on "just getting out on the water", which ranks higher in importance than simply catching many big fish, proving again that there is a lot more to fishing than simply catching fish.

Conversely, of those angles that *increased* their fishing frequency the most were the private boat anglers, whereas sportfishing vessel anglers *decreased* their fishing frequency the most. This is important because estimates of the non-market values for a recreational day of fishing in California range from $15 to $97 per day,

or from $34 to $536 per trip. Non-market values tend to be higher for anglers who use a CPFV compared to those using a private boat. According to (Wegge et al., 1986), the non-market value of a day of fishing from CPFV anglers ranges from $24 to $97 per day. Those same anglers constitute nearly 60% of the kelp bass fishery (California Recreational Fisheries Survey 2004 – 2011). Furthermore, one-third of kelp bass anglers surveyed believe they will *continue* to fish less in the future due to the MPA closures, serving to continue this decrease in utility value for the kelp bass anglers of southern California.

Congestion Effects:

With the reduction of prime fishing areas open to kelp bass anglers, vessel congestion has increased on remaining fishing grounds according to 40% of anglers, and has remained the same according 42% of anglers. This escalation in congestion is likely the result of anglers being displaced from old fishing grounds, and re-locating to remaining fishing grounds – 64% of anglers surveyed have switched where they fish since the MPAs were established. When anglers must switch locations to fish, I infer that the shift to fish to another areas equates to a loss of value. Here, the anglers are no longer able to fish their 'first choice' spot for fishing.

Congestion effects suffered by anglers may result in increased fuel costs and higher capital costs, such as fish finding equipment and the need to travel further to suitable fishing grounds (Pitcher et al., 2002). As the perceived costs of fishing rise, the number of fishing trips will decrease, which is a function of basic supply and demand economics. Furthermore, congestion on fishing grounds has proven to lead to increased conflicts between users of the resource, such as allocation disputes. The Canada-United States Pacific Albacore Tuna Treaty is an example of increased

congestion on fishing grounds that lead to significant tension between hundreds of anglers which ultimately resulted in an abrupt suspension by the United States government of the 31 year-old mutually beneficial, bilateral fishing regime (Fisheries and Oceans Canada, 2012).

Moreover, congestion effects may not be solely concentrated in the kelp bass fishery, as the establishment of the MPAs has the potential to shift fishing pressure from one species to another thereby increasing the competition for catch of the alternate species and thus imposing congestion effects on those anglers (Sanchirico, 2000). Here, the costs of the MPAs not only affect the kelp bass anglers, but also those anglers who otherwise may have not been affected directly by the closures.

Increasing Costs:

Many anglers surveyed (60%) believe that fishing costs have increased since the MPA closures, which may be due to the need to travel further to find new fishing locations, or simply because of increasing fuel costs. Increased costs in fishing may result in a reduction in the number of fishing trips taken. An increase in fishing costs further reduces utility, and thus the value of the fishery decreases with an increase in cost. In order for an angler to continue fishing with rising costs, the perceived value of the trip must be at lease as high as the cost outlay. Those anglers that have reduced their fishing frequency have hit a cost threshold where increased cost drives them to forfeit fishing.

However, anglers that believe they will catch fewer fish as a result of the MPAs showed a high likelihood to switch to another fishery, whereas those anglers who think they will catch smaller fish as a result of the MPAs show much more resistance to switching to another fishery. Those anglers that may shift their fishing

efforts to another species may increase the competition for catch of alternate species, which in turn will affect the total economic value experienced by various other types of anglers in the region that target other species.

A Case for Catch-And-Release MPAs?

The data demonstrates that more highly skilled anglers, who fish more days per year, catch more fish and maintain a significantly higher rate of release when compared to less skilled anglers who fish less days per year, catch less, yet retain a much higher proportion of their catch. Documenting such angler behavior may serve to support the development of MPAs that allow for catch-and-release of certain species that exhibit low mortality rates when released properly, such as kelp bass (Bellquist, *unpublished data*). Skilled kelp bass anglers also maintain low by-catch rates when fishing which also serves to support catch-and-release MPAs for the species (Bellquist, *unpublished data*). Furthermore, there has been a gradual decline in kelp bass landings since the early 1980s according the CPFV landings data further supporting the case for catch-and-release MPAs (Jarvis, 2013). Here, the total economic value of the fishery could be maintained for the kelp bass anglers by allowing them to continue to fish in highly productive fishing grounds while still achieving the stated goals of the MPAs which include the objective to "sustain, conserve and protect marine populations, including those of economic value" (California Department of Fish and Game, 2012). Furthermore, by allowing for catch-and-release of kelp bass in MPAs, the stress of increased congestion on remaining fishing grounds will be mitigated against.

Finally, there is a potential market value that could be realized by CPFV operators from establishing catch-and-release fishing opportunities inside MPAs.

Long-Term Benefits of MPAs?

This study focused on the immediate and short-term economic impacts of the MPAs on the kelp bass anglers of southern California. It is important to acknowledge that such impacts will change over time, and in fact, the same anglers that experienced devaluation in the short term may experience an increase in value in the long-term as a result of the MPAs in the form of increased size and biomass of fish. The potential benefits of MPAs – healthier fish stocks and increased sustainable yield via 'spillover effects'– may be realized at some future date, whereas the majority of costs are being incurred initially (Whitmarsh, 2000).

The MLPA requires that species 'likely to benefit' from MPAs be identified. Such species must meet a list of criteria including that the species biomass or abundance will increase due to the protection of features that species are known to favor. Species on the list are ranked on a scale from 1 to 5, with a higher score indicating that the species is more apt to benefit or respond to the MPAs. Kelp Bass have been allocated a 4, signifying a high likelihood of benefiting from the MPAs (Mason, 2013). Studies on kelp bass in existing small MPAs at Catalina, Anacapa Islands, and La Jolla have demonstrated that size and abundance of kelp bass are higher inside the reserves that outside (Froeschke et al., 2006). I expect that large MPAs could protect populations of large adult kelp bass that maintain significantly higher reproductive potential than smaller individuals. However, as there does not appear to be a deficit in recruitment potential presently, any increased potential realized through larval production inside MPAs may be outweighed by the economic loss to the fishery through the MPAs. Furthermore, as noted, studies indicate kelp bass may travel up 50 miles, which suggests that large reserves would be required

to protect all members of an intact population to mitigate a large number of the individuals in the population being exposed to fishing pressure a high percentage of the time. Conversely, some portion of the population may travel outside of the reserve, providing added large kelp bass to the fishery in adjacent areas open to fishing and thus increasing the value of fishing for anglers in the region over the long-term.

Future Anglers:

With kelp bass anglers reducing their fishing rates on previously productive fishing grounds due to the MPAs, the potential exists for anglers to further reduce their fishing even in areas outside of the reserves. This may result from anglers becoming increasingly disheartened by the entire MPA process, which includes extensive rules and regulations. I would expect that some trips are forgone as a result of anglers erroneously assuming that their preferred fishing locations are no longer available, as well as the uncertainty of not knowing if they are fishing in a legal location or not. This concern has been vocalized to me repeatedly over the past 10 months by anglers in southern California.

However, in the future, as the upcoming generation of kelp bass fishers enter the fishery a shift in attitudes surrounding the MPAs and the fishery may arise. These new anglers will have never known the kelp bass fishery without the MPA network, and thus will likely not display the same level of disapproval. This will be especially true if the MPAs do in fact serve to benefit anglers in the long term, with increased numbers and size of kelp bass in southern California as a result of spillover and productivity from reserves. In that case, with improved fishing

conditions resulting from the MPAs that were implemented years prior, such anglers may shift their position to one of support for the MPAs.

CONCLUSIONS

The kelp bass angling community in southern California is comprised of thousands of avid anglers, all who participate in a fishery that provides them with important non-market values, including the enjoyment experienced from simply getting out on the water, the opportunity to fish their favorite fishing grounds, and socializing with fellow anglers. Significant management changes over the past several years, including the implementation of a statewide network of Marine Protected Areas, has lead to a general frustration throughout the kelp bass angling community as a result of prime kelp bass habitat no longer available for fishing. It is now apparent that such actions have lead to an immediate reduction in the non-market values of the fishery for anglers. However, such economic costs may be short-term in nature, and in fact, those same anglers may experience improved fishing conditions in the future due to the MPAs, with increased abundance of kelp bass the result of potential spill-over from the reserves into fishable waters.

Appendix 1: Survey (Printed on one page double-sided for distribution)

Recreational Fishing for Calico Bass: Anonymous Survey

A UCSD graduate student is conducting this **anonymous** survey to understand the impacts of the Marine Protected Area (MPA) closures in southern California on the calico bass fishery.

1. You are a:
   - o Sportfishing vessel operator/owner
   - o Sportfishing vessel angler
   - o Private boat angler
   - o Other: _____

2. Your skill level as an angler is:
   - o Beginner
   - o Novice
   - o Intermediate
   - o Advanced
   - o Professional

3. What city do you live in? _____

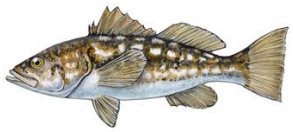
4. What is the main port you fish out of?_____

5. What aspect of your fishing trip experience is most important to your satisfaction?
   - o Catch lots of calico bass
   - o Catch large calico bass
   - o Catch lots of fish (any species)
   - o Catch large fish (any species)
   - o Just getting out on the water (how many or how large the fish you catch are not important)
   - o Other? _____

6. How much do you value the kelp bass fishing experience?
   - o Not important
   - o Somewhat important
   - o Important
   - o Very important

7. What do you think about the current status of calico bass stocks in southern California?
   - o Healthy
   - o Unhealthy, due to (circle): overfishing pollution sea lions other_____

8. Do you catch-and-release **legal-sized** calico bass?
   - o Rarely
   - o Sometimes
   - o Often
   - o Always



9. Historically, how often have you fished for calico bass during a calendar year?
- o 0-10 days per year
- o 10-20 days per year
- o 20-30 days per year
- o 30+

10. How many calico bass per day did you typically catch on your trips **prior to** 2012?
- o 0-5 per day
- o 5-10 per day
- o 10-20 per day
- o 20+

11. How many calico bass did you typically catch **during** the 2012 season (last summer)?
- o 0-5 per day
- o 5-10 per day
- o 10-20 per day
- o 20+

12. Did you fish less for calicos in the 2012 season (last summer) than you did in prior years?
- o I fished less for calico bass this past season
- o My fishing frequency did not change
- o I fished more for calico bass this past season

13. If you fished less, why?
- o MPA closures of calico bass fishing grounds left few remaining good choices
- o Fishing generally wasn't as good in 2012 as in other years
- o Cost of fishing (fuel prices, etc.) increased
- o Other?_____

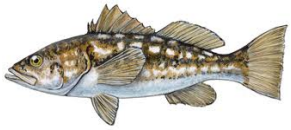
14. Have your calico bass fishing trip costs changed since the MPA closures?
- o No
- o Costs have increased
- o Costs have decreased

15. Have you changed where you fish for calico bass due to the MPA closures?
- o Yes
- o No

16. Did crowding on the calico bass fishing grounds seem to change as a result of the MPA closures?
- o Less crowded than before
- o About the same as before
- o More crowded than before

17. Will you fish for calico bass less in the future due to the MPA closures?
- o I will fish less for calico bass in the future
- o I will NOT fish less for calico bass in the future

18. Do you think the MPA closures will affect the size of calico bass you catch in the future?
- o Yes, they will be larger
- o Yes, they will be smaller
- o No, they will stay the same size



19. Do you think the MPA closures will affect the amount of calico bass you catch in the future?
    Yes No

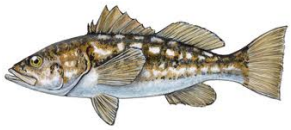
20. If so, do you think you will catch more or less?
    More Less

21. Will this affect how often you go fishing?
    Yes No

22. Will you fish for different species given the closures of calico bass fishing grounds?
    Yes No

23. Do you think calico anglers will disproportionately bear the costs of the MPA closures?
    Yes No

24. Do you think most anglers will abide by the new laws?
    Yes No



REFERENCES

Baird, B. E., Miller-Henson, M., and Semmens, B. X. (1999). Analyzing California's Marine Managed Areas: Existing Classifications and Options for the Future. CalCOFl Rep., Vol. 40.

Bellquist, Lyall (2012, 2013). Coastal Angler Tagging Cooperative. Personal Communication.

Brizzendine, Buzz (March 29th, 2013). Owner & Captain of the F/V Prowler. Personal Communication.

California Cooperative Oceanic Fisheries Investigations (2009). Fisheries Review. Rep., Vol. 50.

California Department of Fish and Game (2001). California's Marine Living Resources: A Status Report. pp. 222-223.

California Department of Fish and Game (2012). Guide to the Southern California Marine Protected Areas – Point Conception to California-Mexico Border.

California Department of Fish and Game (2011). Southern California State and Federal Marine Protected Areas. Accessed May 1, 2013: http://www.dfg.ca.gov/mlpa/pdfs/scmpas121510.pdf

California Department of Fish and Game (2013). New Sport Ocean Fishing Regulation Changes for 2013. Accesses May 2, 2013: http://cdfgnews.wordpress.com/2013/03/01/new-sport-ocean-fishing-regulation-changes-for-2013/

California Department of Fish and Game (2012). 2012 California Legislative Fisheries Forum - Department of Fish and Game Annual Marine Fisheries Report.

Erisman, Brad (January 17th, 2013). Assistant Research Biologist at Scripps. Personal Communication.

Franke, Ken (Feb 14th, 2013 & March 23, 2013). Sportfishing Association of California. Personal Communication.

Froeschke, J. T., Allen, L., Pondella, D.J. (2006). The Fish Assemblages Inside and Outside of a Temperate Marine Reserve in Southern California. Bulletin of the Southern California Academy of Sciences 105 – 3 – 3.

Golden, Marty (December 18th, 2012 & March 8, 2013). NMFS Pacific Recreational Fisheries Coordinator - NOAA. Personal Communication.

Hall, Bart (March 23rd, 2013). Fred Hall Fishing Shows. Personal Communication.

Hilger, James (October 26th, 2013). Regional Coordinator to the Recreational Fisheries Engagement Initiative – NOAA. Personal Communication.

Huber, Fred (March 8th, 2013). Owner and Captain of F/V Daily Double. Personal Communication.

Jarvis, Erica (March 9th, 2013). Marine Biologist CA Dept. of Fish & Game. Personal Communication.

Loomis, J., Kent, P., Strange, L., Fausch, K., and Covich, A. (2000). Measuring the Total Economic Value of Restoring Ecosystem Services in an Impaired River Basin: Results from a Contingent Valuation Survey. Ecological Economics 33 -103–117.

Love, M.S., Brooks, A., Busatto, D., Stephens, J., Gregory, P. A. (1996). Aspects of the Life Histories of the Kelp Bass, Paralabrax clathratus, and Barred Sand Bass, R nebulifer; from the Southern California Bight. Fishery Bulletin 94:472-481.

Lowe, G. C ., Topping, D. T., Cartamil, D. P., Papastamatiou, Y. P. (2003). Movement Patterns, Home Range, and Habitat Utilization of Adult Kelp Bass *Paralabrax Clathratus* in a Temperate No Take Marine Reserve. Marine Ecology Progress Series 256: 205-216.

Mason, Tom (May 2nd, 2013). California Department of Fish and Game. Personal Communication.

McDonnell, Pat (March 8th, 2013). Editorial Director of Western Outdoors News. Personal Communication.

Myers, Noel (April 3rd, 2013). UCSD Human Research Protections Program Personal Communication.

National Research Council (2006). Review of Recreational Fisheries Survey Methods, Washington, D.C.: The National Academies Press.

Pendleton, L. H. and Rooke, J. (2006). Understanding the Potential Economic Value of Marine Recreational Fishing. Environmental Science and Engineering Program, University of California, Los Angeles.

Pitcher, T. J., Hollingworth, C. (2002). Recreational Fisheries Ecological, Economic and Social Evaluation, Osney Mead, Oxford: Blackwell Publishing.

State of California Fish And Game Commission Final Statement of Reasons for Regulatory Action (2012). Amend Sections 27.65 and 28.30 Title 14, California Code of Regulations Re: Basses.

Thomson, C.J. (1991). Effects of the Avidity Bias Survey Estimates of Fishing Effort and Economic Value. Creel and angler surveys in fisheries management, D. Guthrie et al., eds. American Fisheries Society Symposium, 12: 356-366.

Wegge, T. C., W.M. Hanemann, and Strand, I. E. (1986). An Economic Assessment of Marine Recreational Fishing in Southern California. NOAA Technical Memorandum Series – NMFS.

Whitmarsh, D., James, C., Pickering, H. (2000). Economic Effects of Marine Protected Areas on Small-Scale Fisheries: A Case Study of the Trawl Ban on the Gulf of Castellammare, Sicily. IIFET 2000 Proceedings.