

Marine Protected Area (MPA) Watch Data Analysis and Outreach: Identifying Human Use Patterns and Distributing Findings for Management and Public Education in Southern California

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Abstract:

Marine Protected Area (MPA) Watch community science program has been collecting human use data in and around California Marine Protected Areas (MPA) since the completion of California's MPA network in 2012. Human use data is useful in understanding the value of MPAs to the public and in assisting management decisions. MPAs regulate consumptive uses, defined as any use resulting in "Take" (to hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill of organism) (Fish and Game Code Section 86). MPA Watch data consist of consumptive and nonconsumptive uses (uses that do not result in "Take"). Nonconsumptive recreational uses consisting of 50-80% of all MPA Watch recorded uses. The analysis shows that individual MPAs have unique use compositions, which can help inform beach goers when choosing to visit a MPA. Surveys show that consumptive uses make up less than 1% of all uses inside Southern California MPAs. Consumptive uses have been recorded at different frequencies using three month seasonal intervals. Each MPA has a unique profile of consumptive uses and their frequencies, which can assist in the allocation of enforcement resources. MPA Watch data contains relatively low survey rates, the amount of surveyed days out of the total time surveyed. The highest surveyed site having a rate of 10% over 7 years. This can increase the difficulty of creating accurate representations of MPA usage. Increasing MPA Watch outreach and volunteers participation could lead to higher enrollment within the program and help to increase survey rate. MPA Watch data is a useful tool for education and management, and future analyses, as well as increasing data MPA Watch, could aid in the 2022 MPA management review.

Introduction:

In 2012 California finished implementing a 124 ecologically connected network of Marine Protected Area (MPA) (California Department of Fish and Wildlife, 2016). A MPA is an area of ocean or shoreline that is designed to restrict human uses in the area. This network meets the Marine Life Protection Act goals of protecting critical coastal and marine habitat to preserve natural biodiversity/abundance, populations with economic value, recreation/educational activities, and

cultural resources (CA FISH & G § 2850 - 2863). Public use of MPAs is a challenge interaction to monitor within the MPA network. The large area and separation between MPAs make it difficult to survey these areas using traditional scientific research. In order to help fill this information gap, MPA Watch has constructed a community science program to collect human use data in and around California MPAs.

MPA Watch is a network of programs that use community science to collect human use data in and around MPAs. The program started in 2008 along the central coast by the Otter Project and then expanded statewide. In 2013 a statewide, scientifically vetted, data collection protocol was established to ensure data integrity and comparability across programs. MPA Watch has developed a training program and field guide to allow volunteers to collect human use data that adheres to a scientific standards. Volunteers walk predetermined transects inside and outside of MPAs and record up to 70 different types of human use, as well as environmental conditions (WILDCOAST, 2018). The length of the program can provide a temporal view of human use inside MPAs. With beach visitation estimated between 150-400 million annually across California, the data collected by MPA Watch could provide vital information for public education and management of MPAs (Pendleton and Kildow, 2006).

In collaboration with WILDCOAST and the California Department of Fish and Wildlife (CDFW), this study is a preliminary assessment of the MPA Watch data and its general composition. Understanding the potential uses of the MPA Watch data will assist in future long term analyses and developing methods to improve management strategies. CDFW will conduct an MPA management review in 2022, and usage of the MPA Watch data could lead to better informed management decisions and enforcement allocation (California Department of Fish and Wildlife, 2016).

Summarizations of MPA Watch Data will aid in public education and enrollment of volunteers into the MPA Watch program. Visual aids of the MPA Watch data composition created during this study, will assist in the continual engagement between MPA Watch and the public. Increasing participation in the MPA Watch program will help to improve the quality of data and build stronger representations of human use inside of California's MPAs.

Analysis:

California breaks up its MPA network into five regional section (Northern, Northern Central, San Francisco Bay, Central, and Southern California) (California Fish and Wildlife 2016). The main focus of the analysis is to find the general composition of the data of Southern California MPAs and generate visualizations aids to summarize the community scientist data for both educational and management

uses. Along with the monitoring the MPAs, MPA Watch surveys control areas for future comparison opportunities. For the time frame of this study, control areas were not included in the analysis. In Southern California there are 17 MPAs with MPA Watch survey transects.

Total Usage:

MPA Watch volunteers chose when and where to conduct surveys and this does not evenly distribute the surveys over the monitored MPAs. In order to compare the total human usage for each MPA, all counts needed to be converted into the same unit of measure. The unit chosen was People per Survey per Mile. This measurement will give an average use for a mile inside each MPA. Miles were calculated by the sum distance of MPA Watch transects inside each MPA.

MPA Watch collects data on two different categories of human use, Consumptive and Non Consumptive. Total Consumptive and Total Nonconsumptive uses were converted into People/Survey/Mile and stacked to visualize the percentage of each inside MPAs. Figure 1. Shows the average uses of each MPA from north to south. The two MPAs with the highest average uses are neighbors geographically in Orange County. In all MPAs consumptive uses make up less than 1% of average uses.

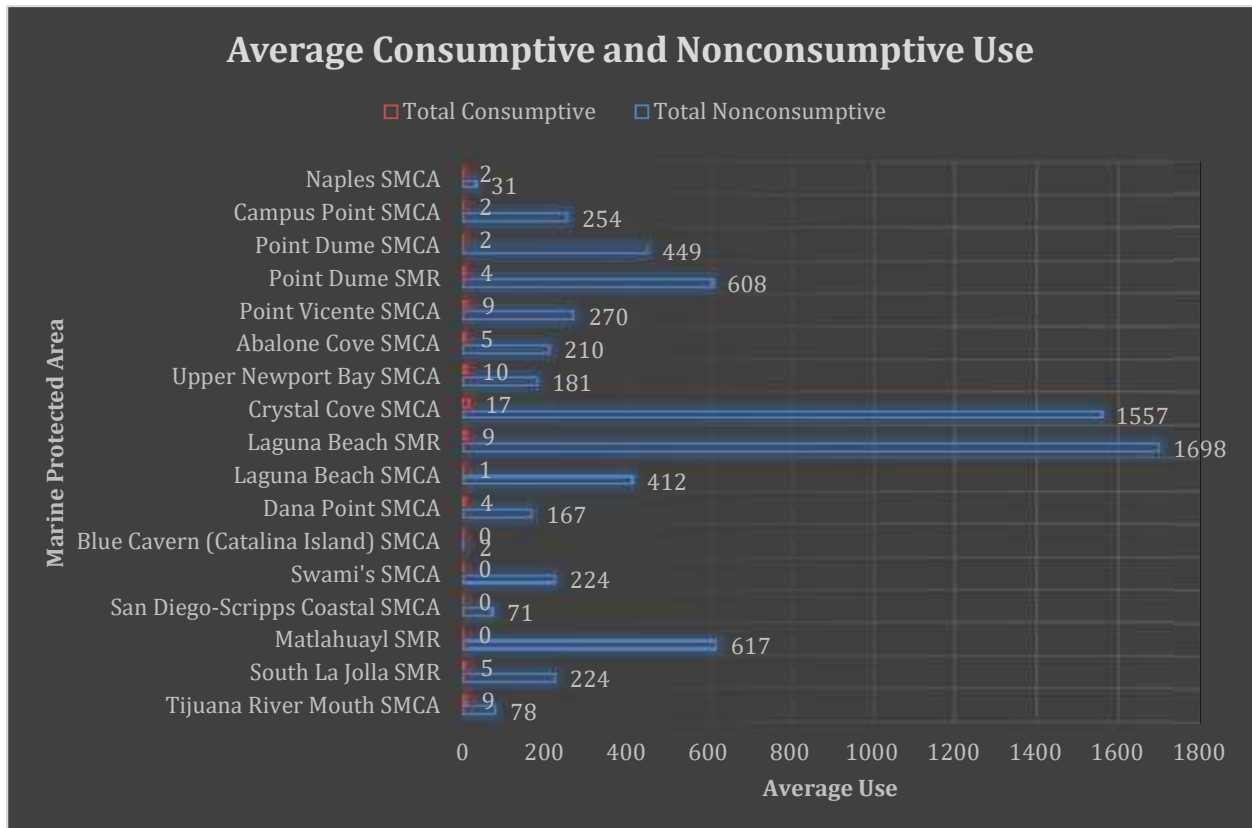


Figure 1. The average total counts of human usage inside MPA Watch transect areas. MPAs are listed from north to south in order to see any possible regional trends for average use. Average use is the average number of human uses counted for one mile of each MPA.

Total Uses per Year:

One of the goals of MPAWatch is an effort to determine if MPAs change human behavior. A temporal break down of MPA total use would show, in theory, changes in MPA usage over time. The largest issue with the MPA Watch data is a lack of systematic surveys. Survey counts vary between years and low survey rates result in high error margins for calculating averages. Community scientists choose when they survey and how often, which can lead to strong biases in temporal data representation. Point Dume SMCA is the most surveyed MPA with 1775 surveys over 7 years. These surveys are divided over 6 transect areas and result in a highest sample rate of 13% of days over the 7 year period (Table 1). Point Dume SMCA has an average sample rate of 10.1%. Small sample rates may restrict the ability to find statistically significant finding in future analyses. Figure 2 shows the average total recorded uses at Point Dume SMCA between 2011-2018. The variation between years may be generated by low sample rates caused bias.

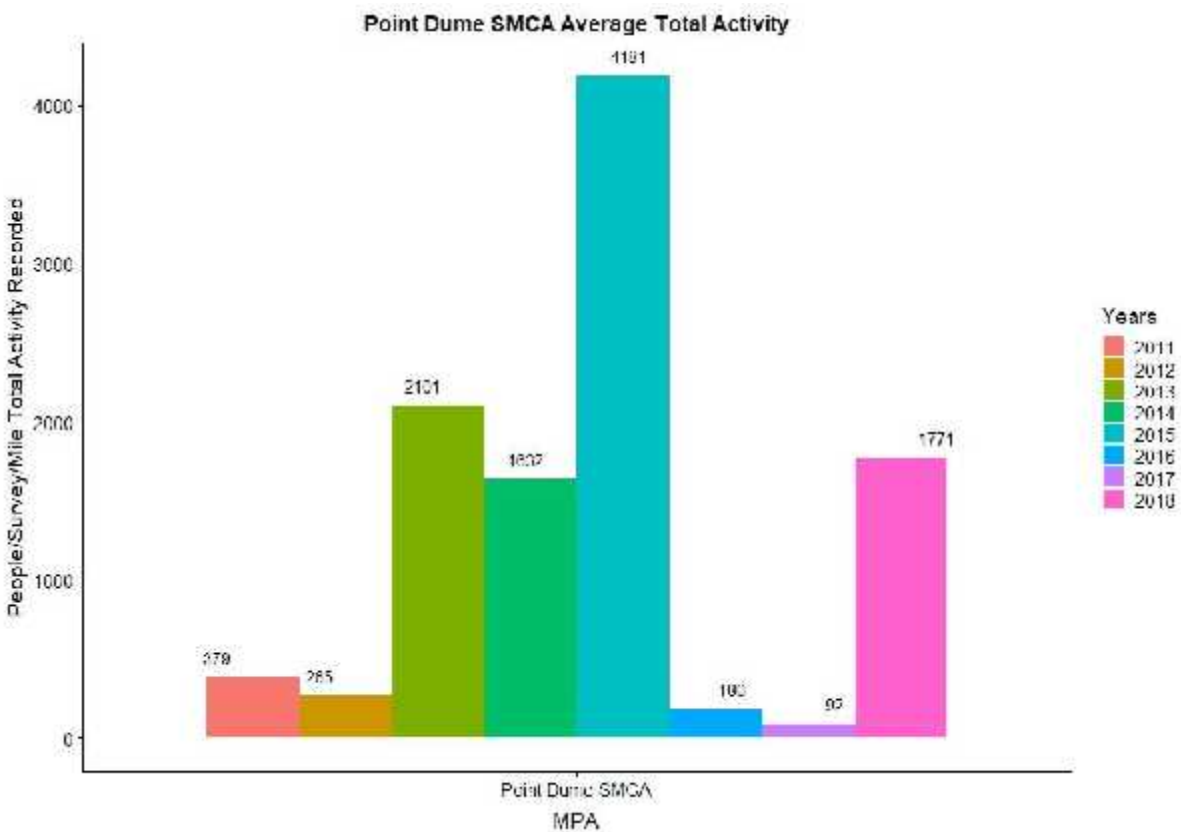


Figure 2. Average total use recorded at Point Dume SMCA over time. Point Dume is the most surveyed MPA in Southern California. Average totals are calculated by average sum of all 6 Point Dume SMCA transects. Point

Dume SMCA has the highest survey count of the Southern California MPAs and was used to mitigate bias from low sample rates

Table 1. Samples rates for Southern California MPA. Each survey represents one day of sampling over the programs duration. Sample rates were divided by the number of transects inside each MPA to generate the rate across the entire MPA.

MPA	Number of Surveys	Sample Rates
Abalone Cove SMCA	624	8.1%
Blue Cavern (Catalina Island) SMCA	95	13.0%
Campus Point SMCA	1246	7.1%
Crystal Cove SMCA	661	6.0%
Dana Point SMCA	643	7.0%
Laguna Beach SMCA	725	9.9%
Laguna Beach SMR	1141	5.7%
Matlahuayl SMR	289	4.4%
Naples SMCA	269	5.3%
Point Dume SMCA	1775	10.1%
Point Dume SMR	1193	6.8%
Point Vicente SMCA	573	5.6%
San Diego-Scripps Coastal SMCA	193	5.3%
South La Jolla SMR	27	1.8%
Swami's SMCA	601	6.6%
Tijuana River Mouth SMCA	224	5.1%
Upper Newport Bay SMCA	399	5.5%

Nonconsumptive Components:

MPA Watch community scientists are asked to record 24 different Nonconsumptive uses. To visualize a percentage breakdown of each usage, the Nonconsumptive usage were separated and compared within each MPA. This can be used to determine MPAs with distinct usages. Figure 3 is an example of this comparison for Point Dume SMCA.

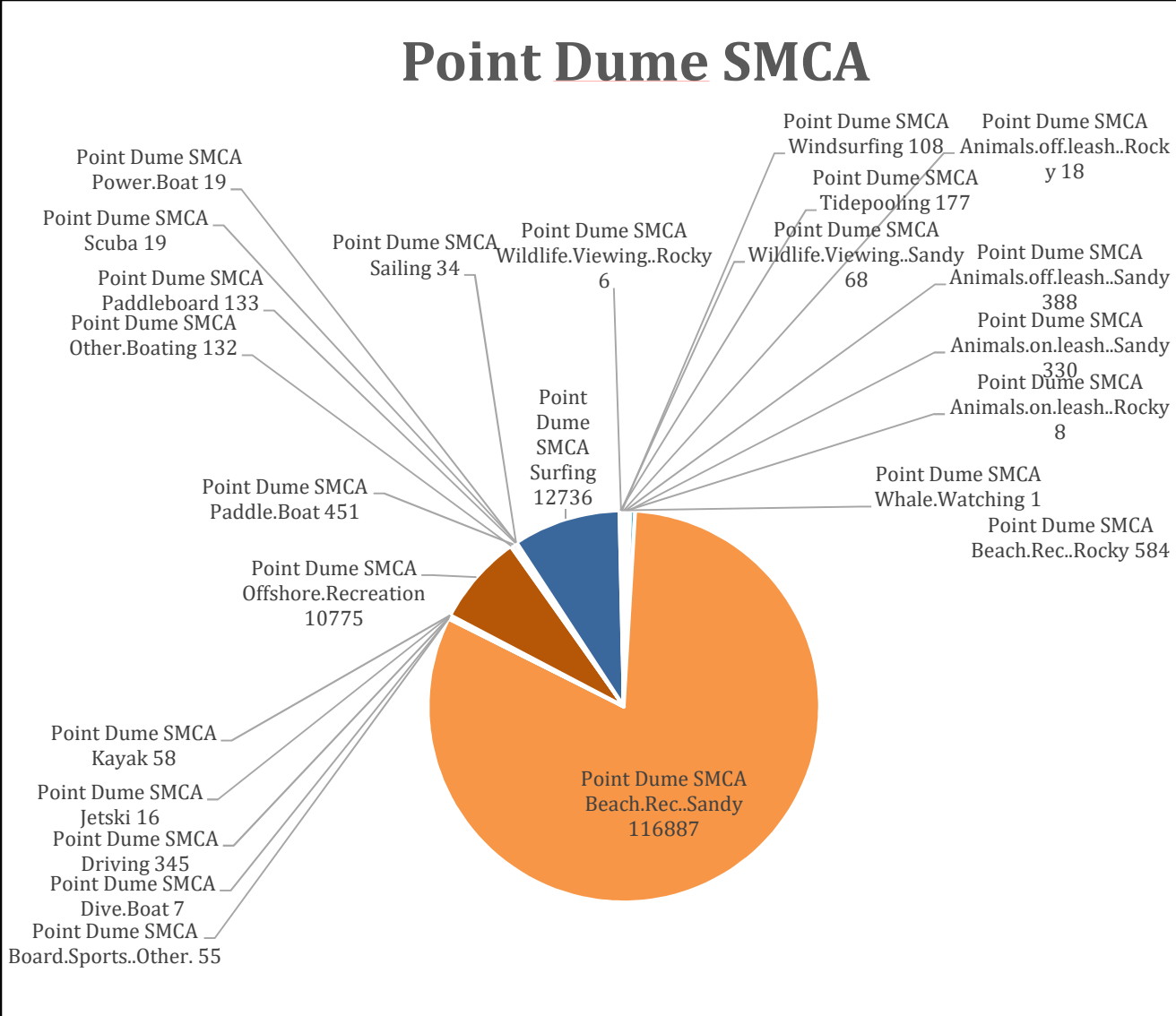


Figure 3. Nonconsumptive Usage at Point Dume SMCA. Values represent the total recorded counts for nonconsumptive uses inside Point Dume SMCA. Beach and offshore recreation make up ~90% of all total use of the MPA.

General beach use or non-defined uses are recorded categorized under recreation. At Point Dume SMCA, beach recreation and offshore recreation consists of ~90% of all nonconsumptive uses, and most of the Southern California MPAs have recreation usage equaling greater than 50% of all usage. In order to define the unique usage at each MPA, non-recreation usages were summed across the entire sampling timeframe for each MPA. The uses “Beach Rec...”, “Offshore Rec” and “Boat Rec” were removed to allow for a comparison of the other define uses inside each MPA. Of the non-recreation

usages, the top five for each MPA were chosen and plotted. These plots were attached to ArcGIS shapefiles for each Southern California County as a visualization of local MPAs and their most popular uses. Figure 4 shows Los Angeles County MPAs and can be used to determine important uses in individual MPAs in order to inform the public on which MPA best suits their interest.



Figure 4. The five monitored MPAs inside Los Angeles County and their top five defined nonconsumptive uses. Percentages are from the total number of use recorded across all years surveyed.

Consumptive Usages:

Individual MPAs have unique regulations on legal consumptive (take) uses (Title 14, Section 632). MPA Watch identifies 30 different types of consumptive usage and recorded uses could show potential violations patterns. Total counts of consumptive uses were calculated for each MPA over the duration of the program. These totals are across the entire MPA as there is no direct location information in the MPA Watch Data. In order to help potential enforcement allocation, consumptive data was divided into 3 month seasonal intervals. This will allow enforcement to different consumptive

patterns throughout the year. Figure 5. shows the consumptive breakdown of Point Dume SMCA where different seasons have unique compositions of the top five most common consumptive uses. All consumptive figures are located at the end of this paper (Pages 12-20).

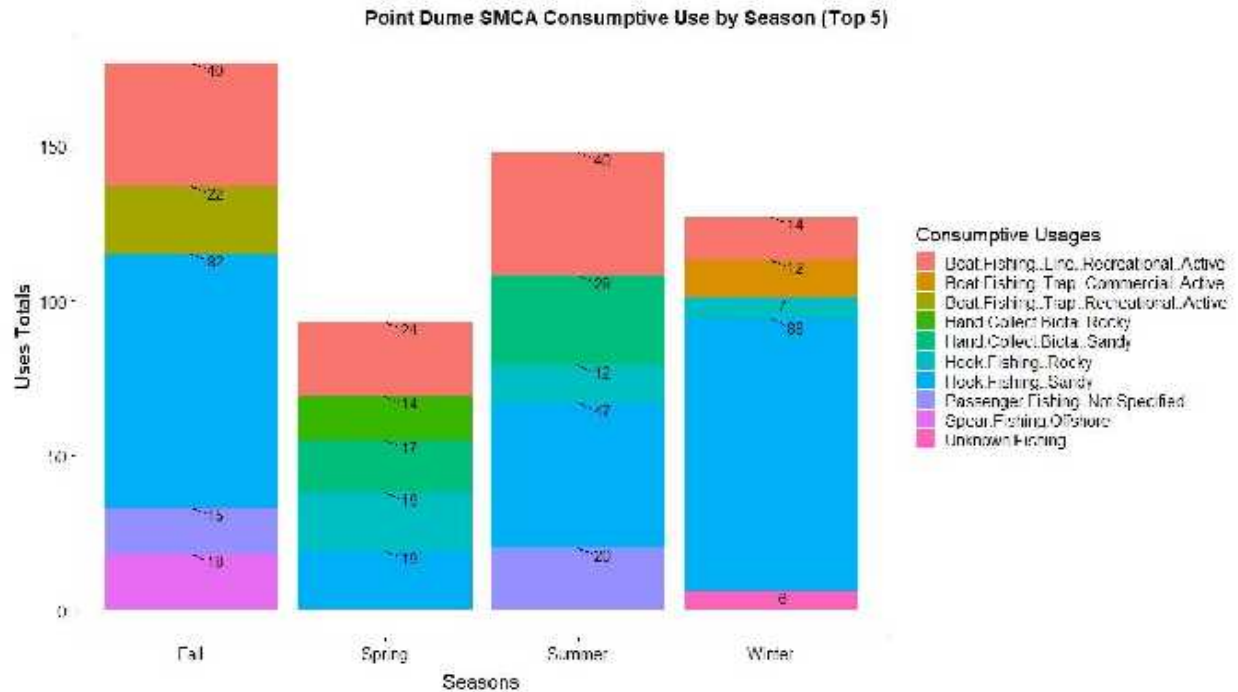


Figure 5. Top five most common consumptive uses by season in Point Dume SMCA. Each Season shows a different composition of consumptive uses and could be used as an enforcement tool to identify times with the highest rate of the most common consumptive uses.

Discussion:

MPA Watch community science program share insight on how the public uses Southern California MPAs. The community science aspect of MPA Watch allows for larger survey areas and durations, which would be improbable to fund through traditional scientific research; however, it also allows for a reduction in significant findings. Being the preliminary look at MPA Watch data, this study helps to formulate new understanding of how the MPA Watch Data may be useful for future analyses, public education, and management decision making.

Throughout one potential problem MPA Watch faces is lower survey rates that may restrict accurately representing human usage inside each MPA. Community science has been criticized to be lower quality than data collected by researchers, however these depends on the different perspective of data collection between the public and scientists (Wiersma et al., 2016). MPA Watch combats this

difference by training volunteers. Volunteers are given data collection forms and shown proper sampling techniques, which greatly increases the quality of individual surveys. While quality is high for individual surveys, it is the quantity of surveys that could diminish the usability of MPA Watch data. The most surveyed MPA, Point Dume SMCA, has a sample rate of 10% over the past 7 years. MPA Watch volunteers chose when and where to sample creating a non systematic sampling protocol. Non systematic sampling can create a potential for biases and error. As MPA Watch grows and survey rate increase, stronger correlations can be drawn from this data and there will be a reduction in non systematic sampling bias.

One way to improve survey rate across the program is to increase public outreach. Community science programs, such as MPA Watch, allow the public an opportunity to engage with the scientific community. The general trends found and visualizations created in this study can be used as tools to expand public knowledge of the usage of California MPAs and the importance of the MPA Watch program. Detailed usage figure (Figure 3) can be exported through URL and can potentially be added to the mpawatch.org for visitors to the composition of the data so far. Figures like Figure 4 can inform the public and help them choose the best MPA for their desired use. Creating public access to both types of visualizations could help to reinforce MPA Watch importance to existing volunteers and help increase recruitment of community scientists.

Along with public outreach MPA Watch data has great potential in assisting management decisions for California MPAs. CDFW is charged with patrolling both large terrestrial landscapes and California's 840-mile coastline, including the MPA network (Natural Resource Defense Council, 2015). The network consists of 124 MPAs covering 16% of California's coastline and offshore Island. This large geographic expanse creates logistical problems for enforcement (Botsford et al., 2014). The public can already assist CDFW enforcement, with tools such as CalTIP, to report possible violations and help pinpoint areas of concern (Natural Resource Defense Council, 2015). MPA Watch Data could be used as another tool to inform adaptive management strategies and enforcement patrols. Temporal break down of recorded consumptive behavior like Figure 5 (and on pages 12-20) could lead to more efficient enforcement efforts inside MPAs throughout the year by giving CDFW the ability to target higher consumptive seasons. Looking at the seasonal differences in each MPA can also help CDFW pinpoint potential violations based on each MPAs regulations. In this study total consumptive uses was calculated from all years, however, further break down of the data into individual years may provide a better understanding of consumptive trends inside the MPAs. Further analysis of MPA Watch data could be

useful for CDFW and the 2022 MPA management review. Breaking up the seasonal consumptive data into years could reveal temporal trends in consumptive uses.

Conclusion:


Trends of MPA usage can be seen from the data collected by the MPA Watch community science program. Each MPA has a unique composition of popular usages and this information can be used to further public education of MPAs, as well as promote the growth of MPA Watch. Both consumptive and nonconsumptive data trends may be useful informational aids for CDFW enforcement. Seasonal consumptive usages patterns could allow for increase efficiently with enforcement allocation inside the MPA network. Low survey rate in the Southern California MPAs limit the ability to construct realistic representations of MPA human use, however, increased survey rates will greatly improve the MPA Watch findings. MPA Watch has great potential to inform public education and CDFW enforcement of MPAs. Future analysis beyond this preliminary study could provide useful information for CDFW's 2020 Master Plan for Marine Protected Areas.

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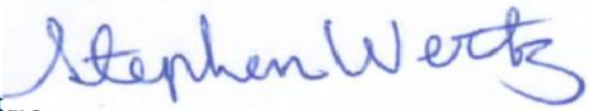
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Capstone Committee:


Chair: Angela Kemsley

Signature  Date 6/13/2019

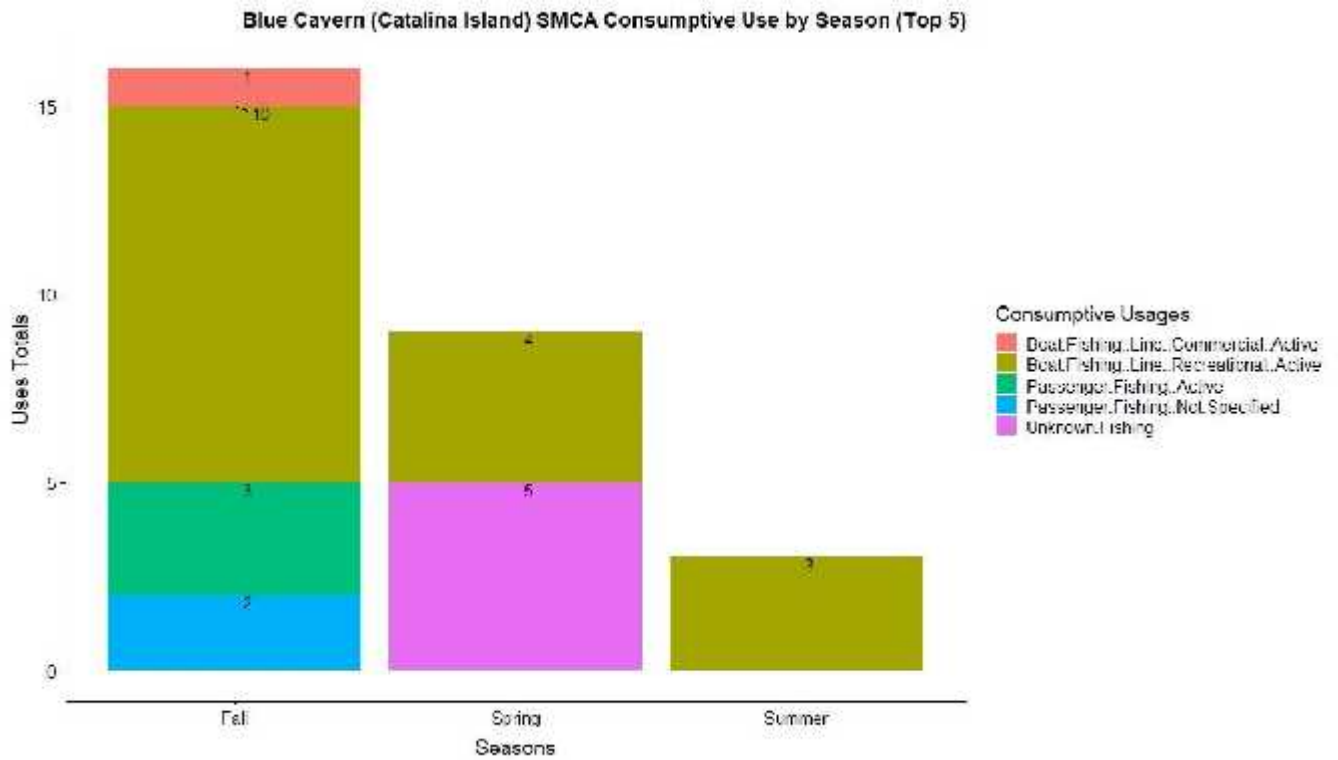
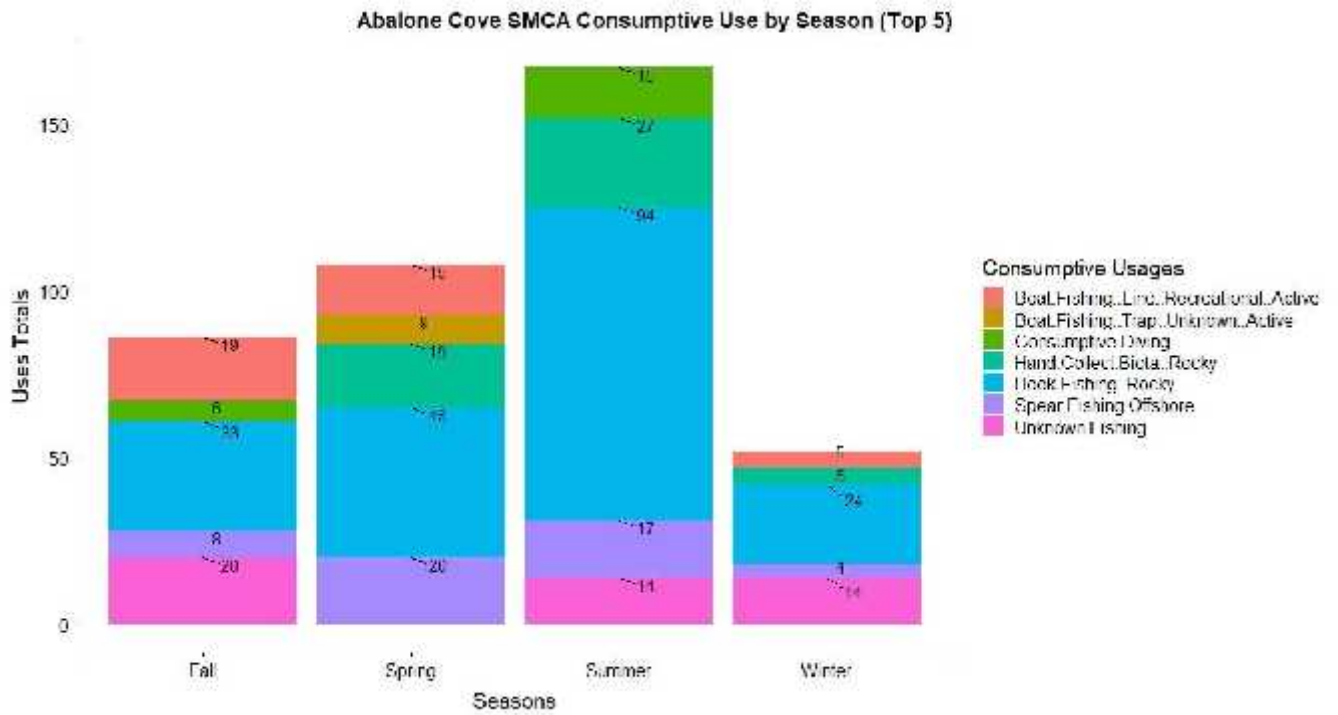
Stephen Wertz

Signature  Date 6/28/19

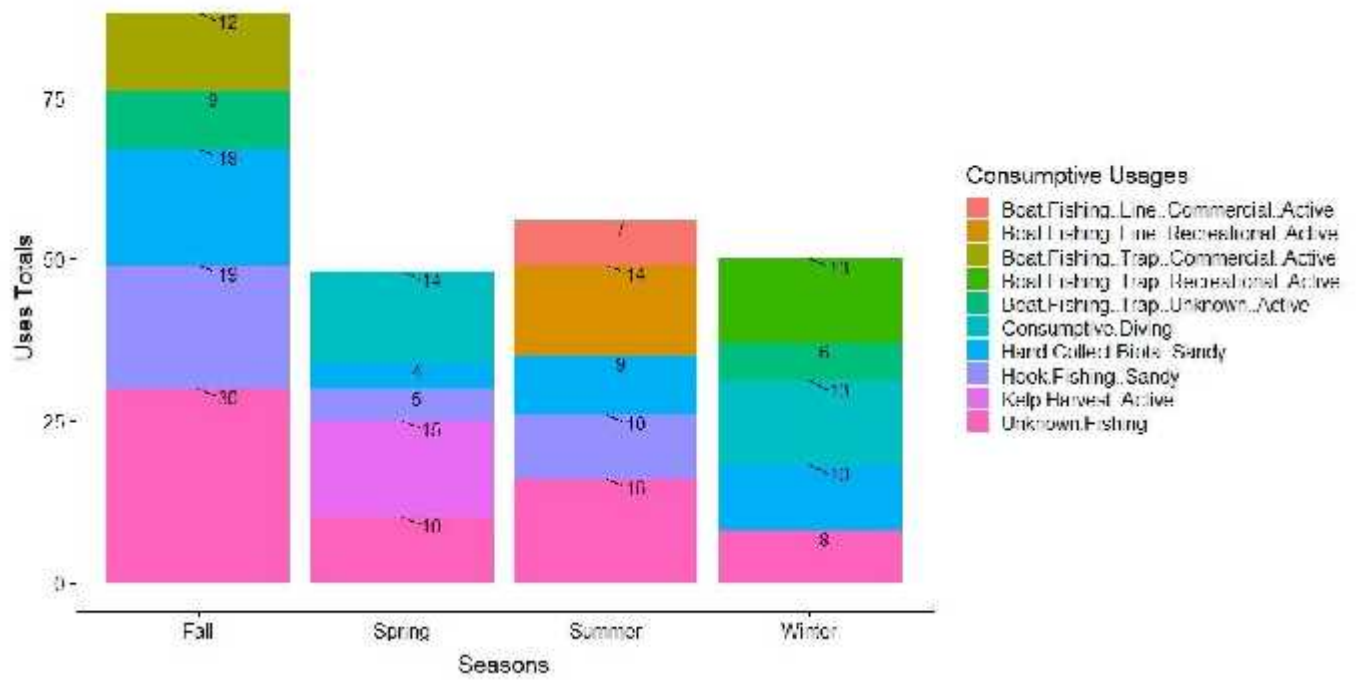
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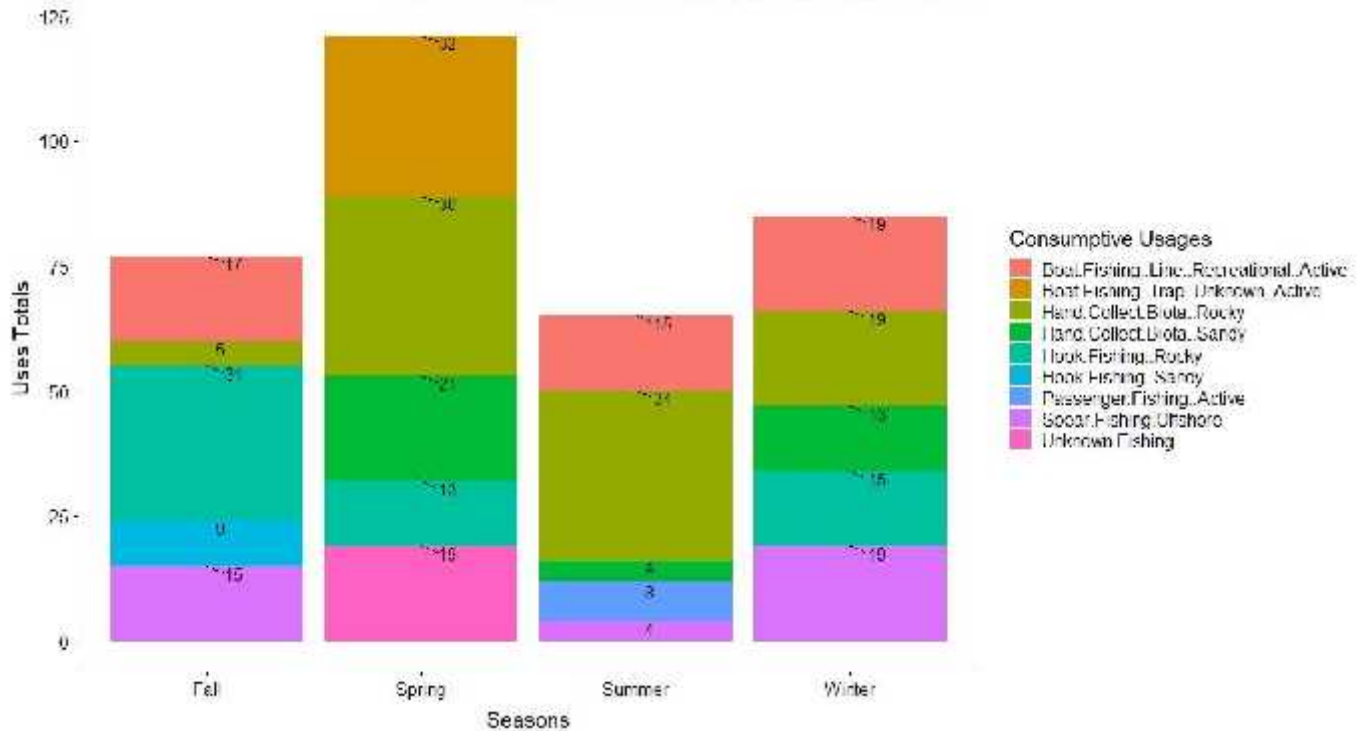
Consumptive Seasonal Figures:



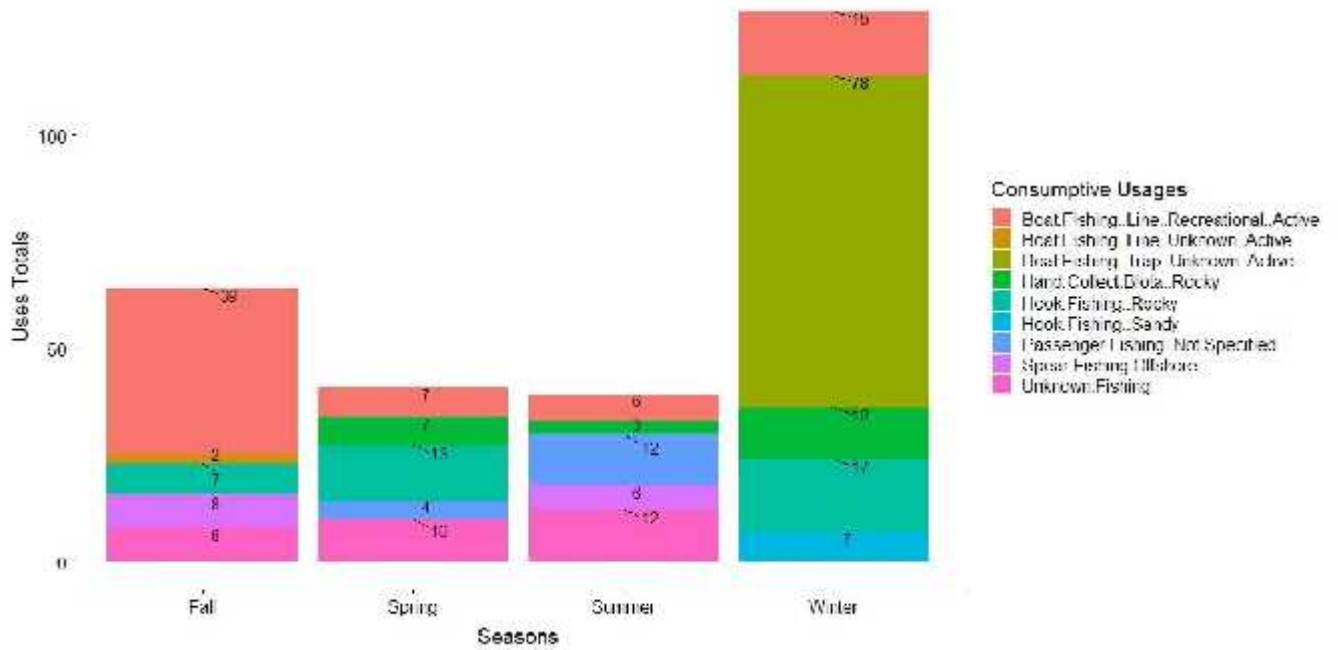
Campus Point SMCA Consumptive Use by Season (Top 5)



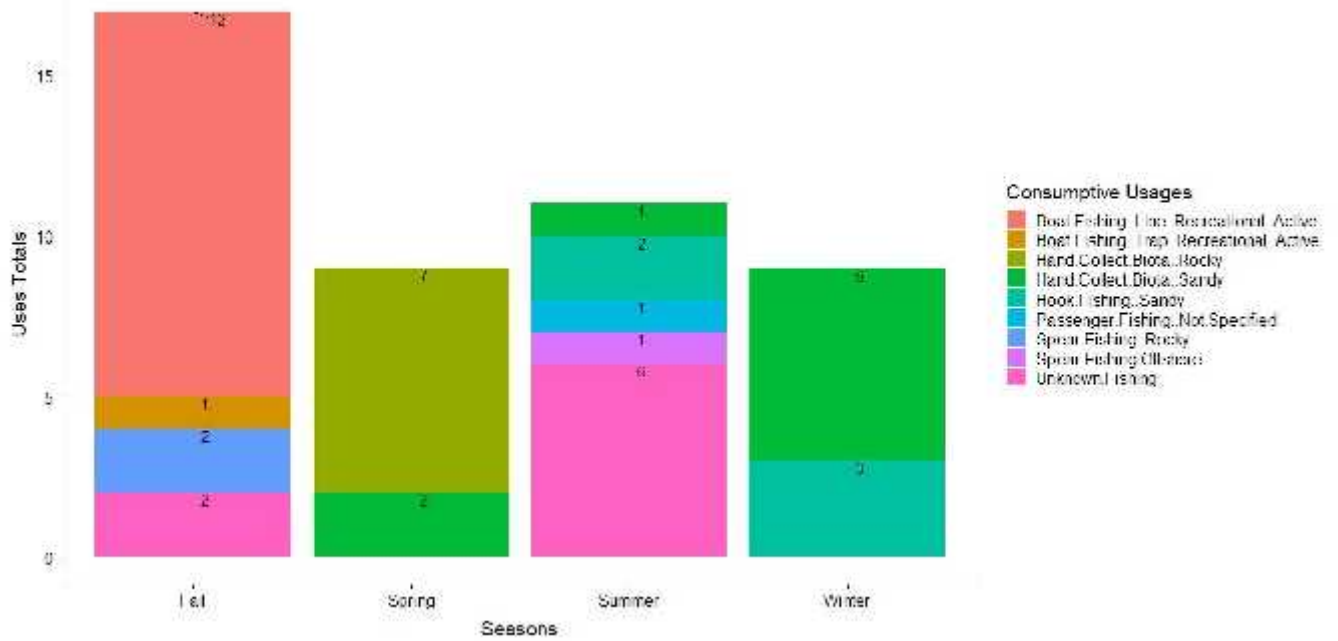
Crystal Cove SMCA Consumptive Use by Season (Top 5)



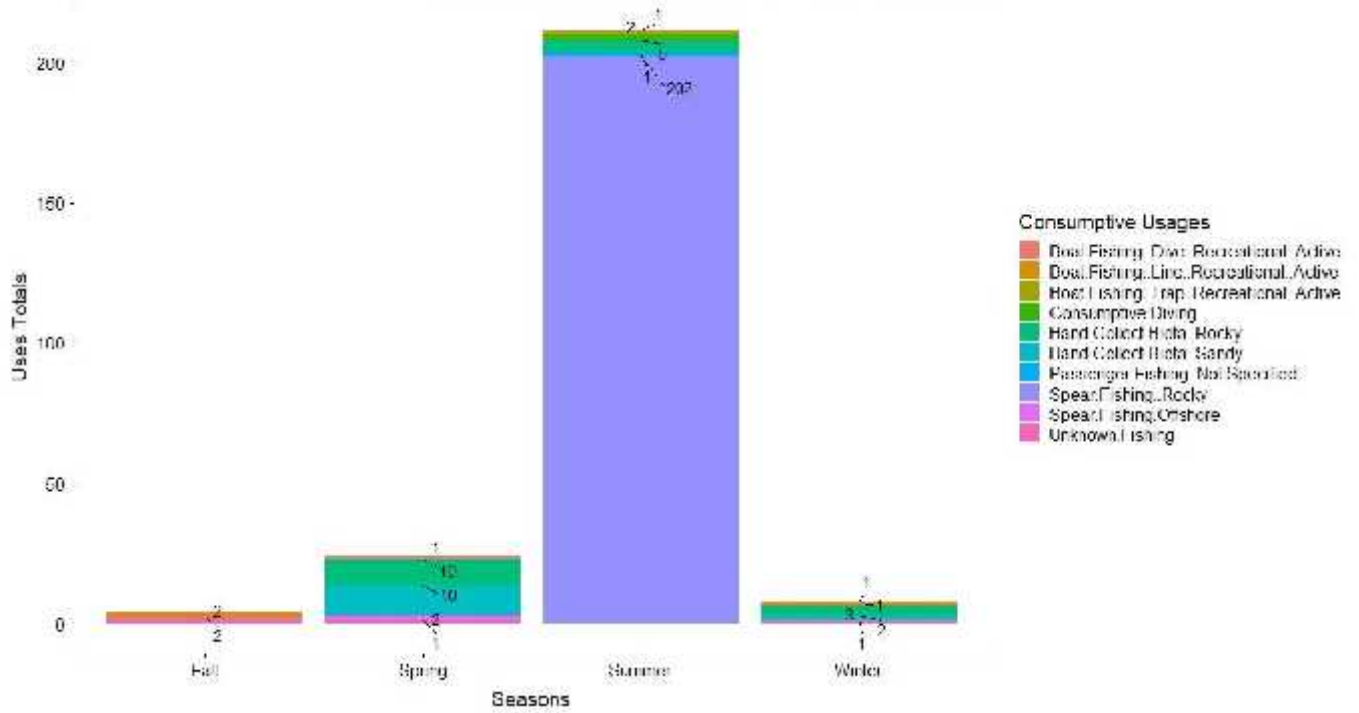
Dana Point SMCA Consumptive Use by Season (Top 5)



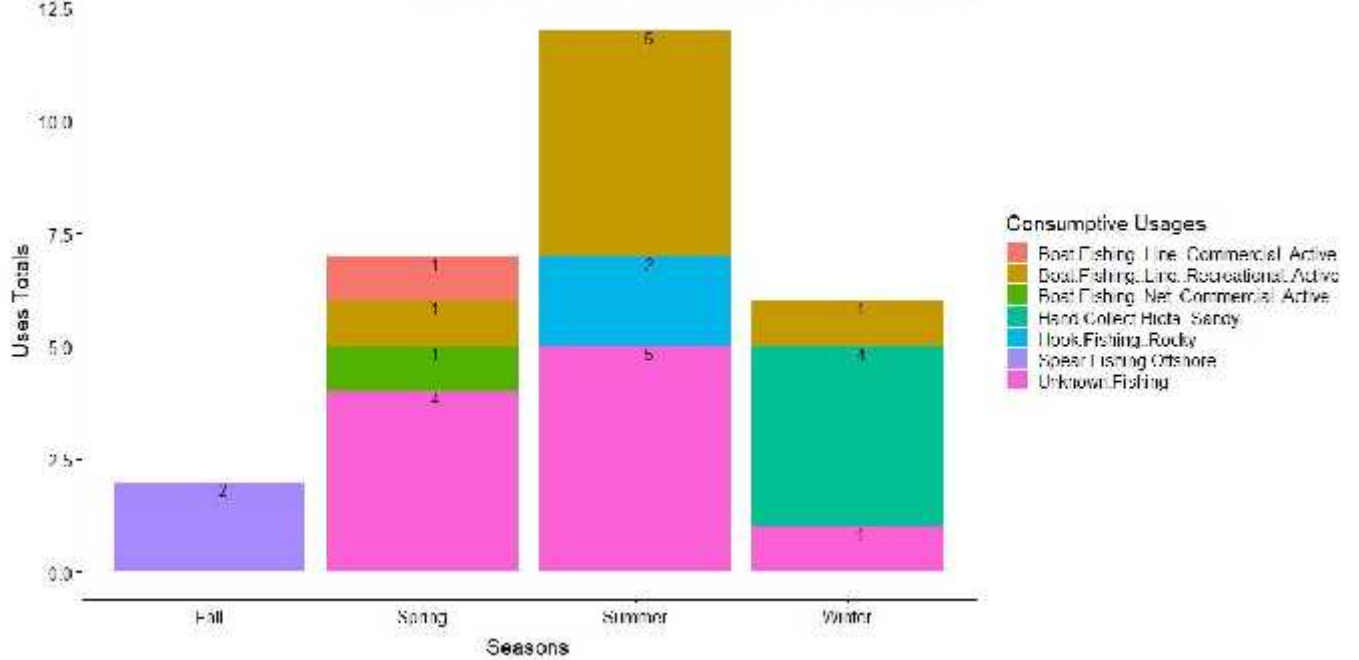
Laguna Beach SMCA Consumptive Use by Season (Top 5)



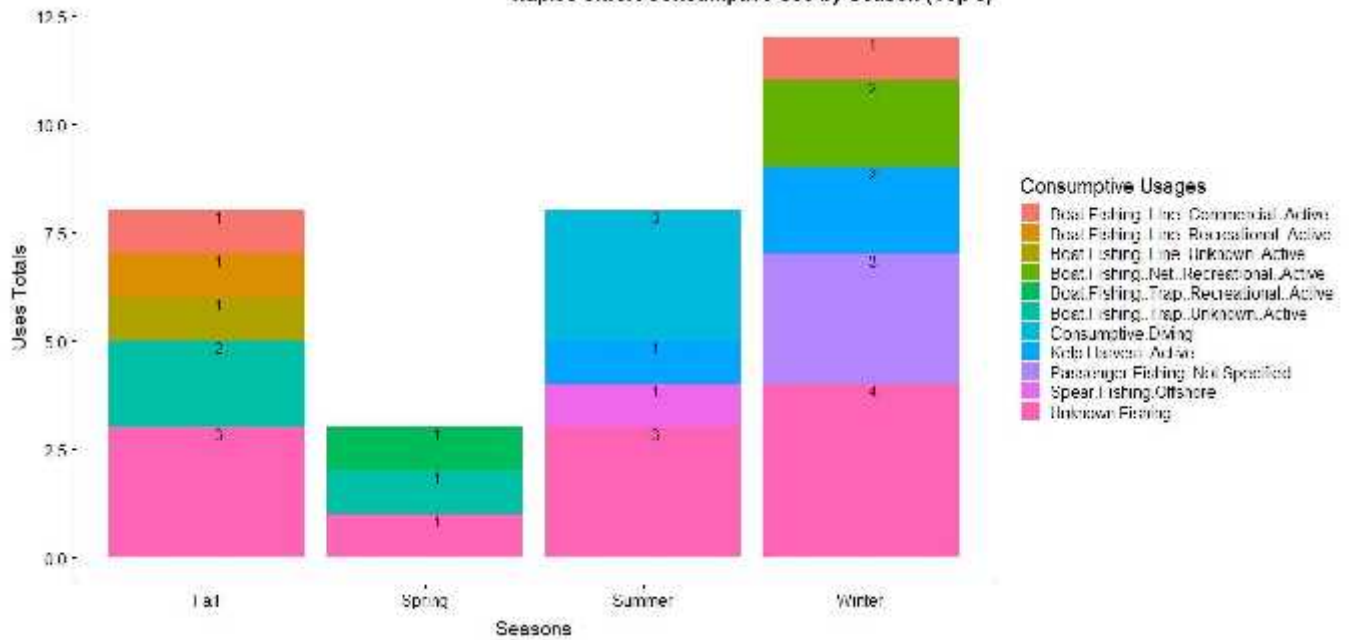
Laguna Beach SMR Consumptive Use by Season (Top 5)



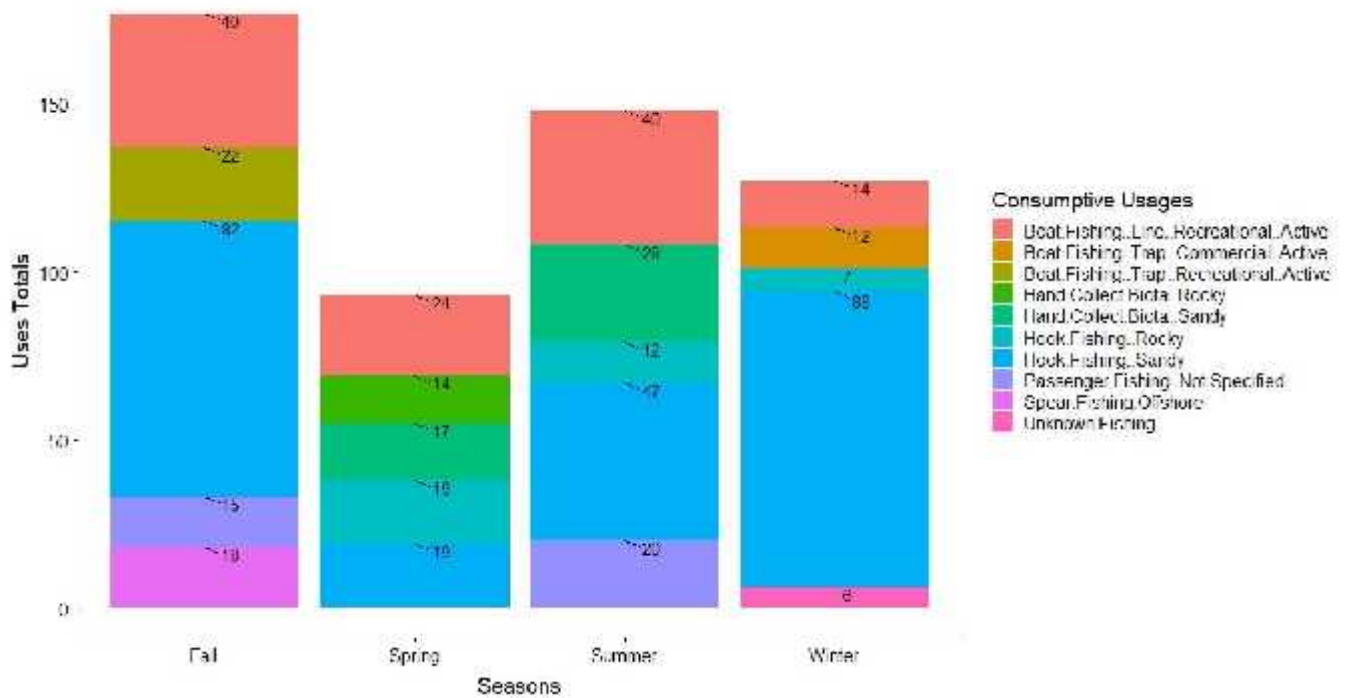
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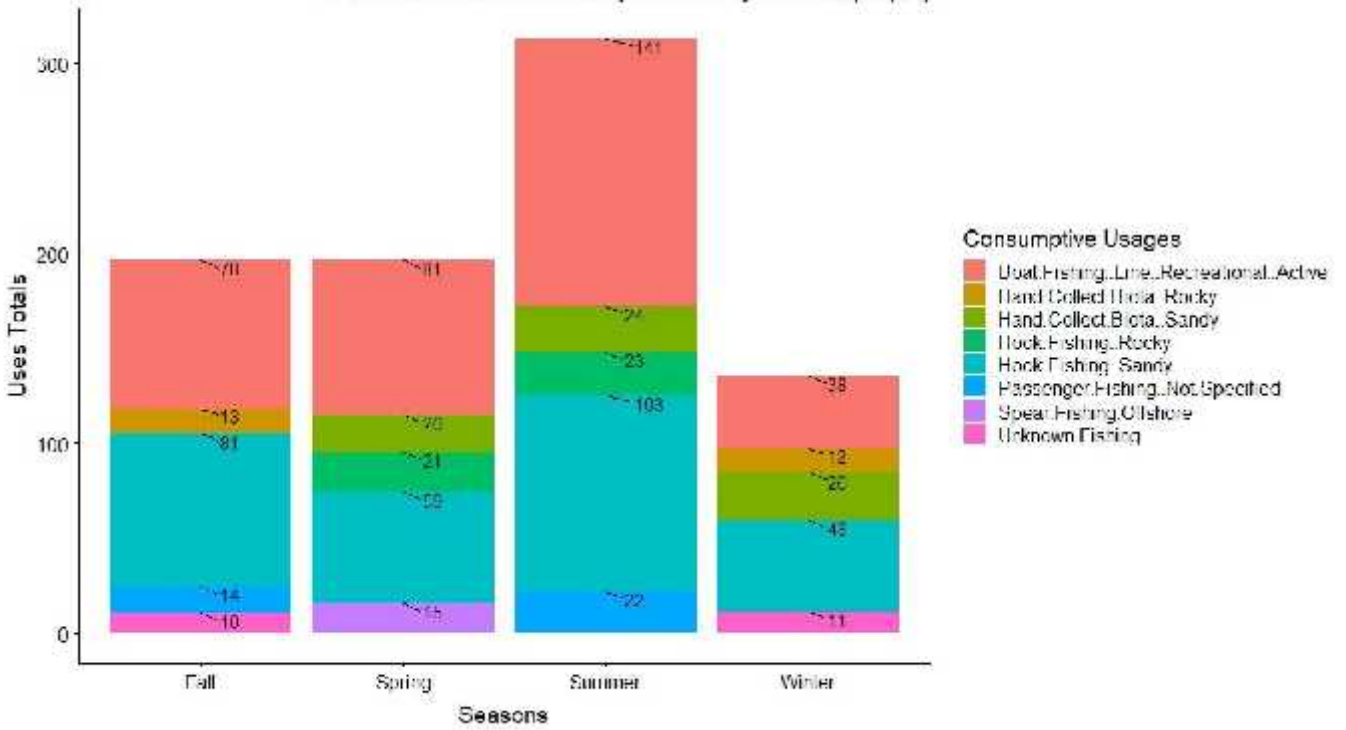
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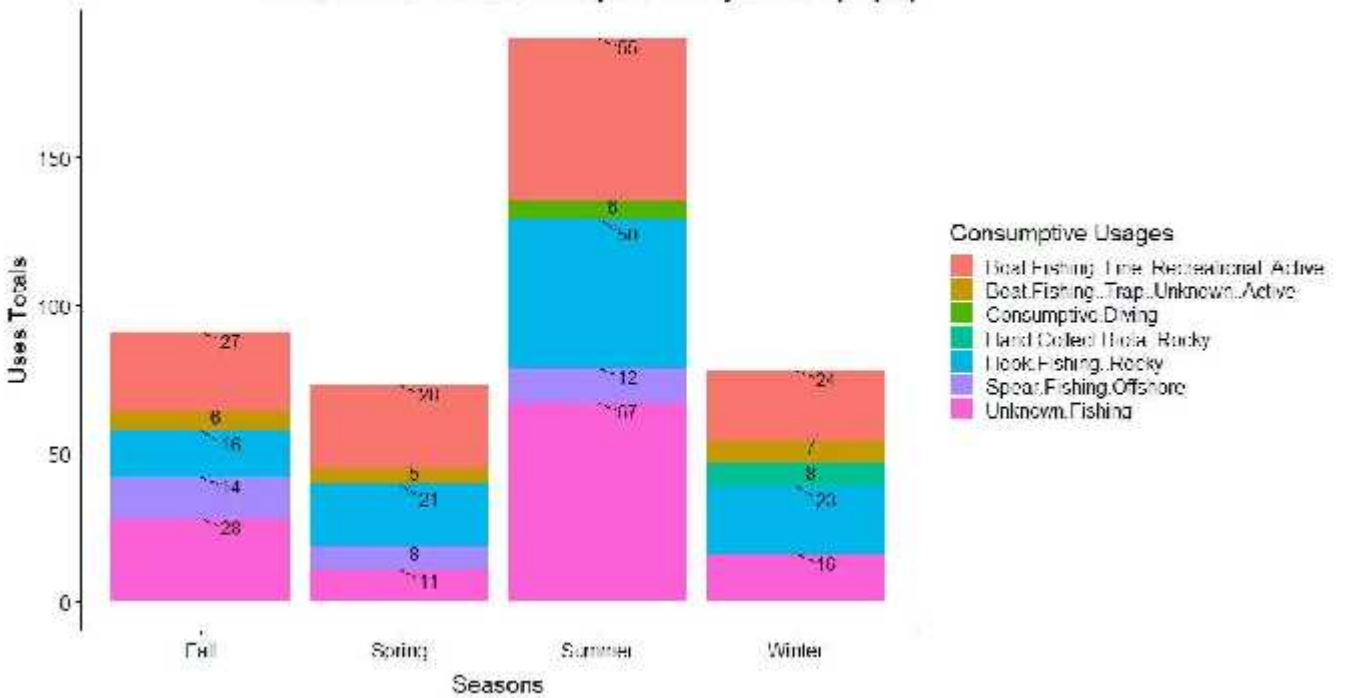
Point Dume SMCA Consumptive Use by Season (Top 5)



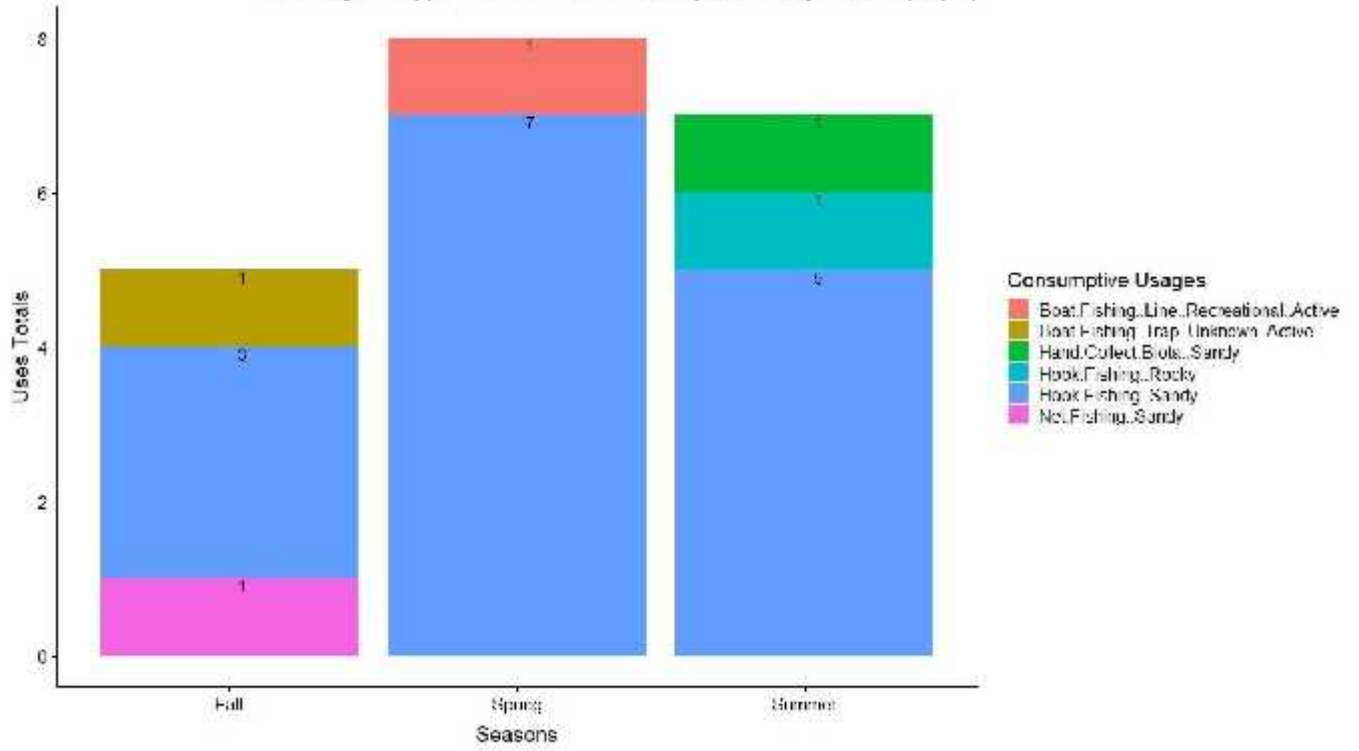
Point Dume SMR Consumptive Use by Season (Top 5)



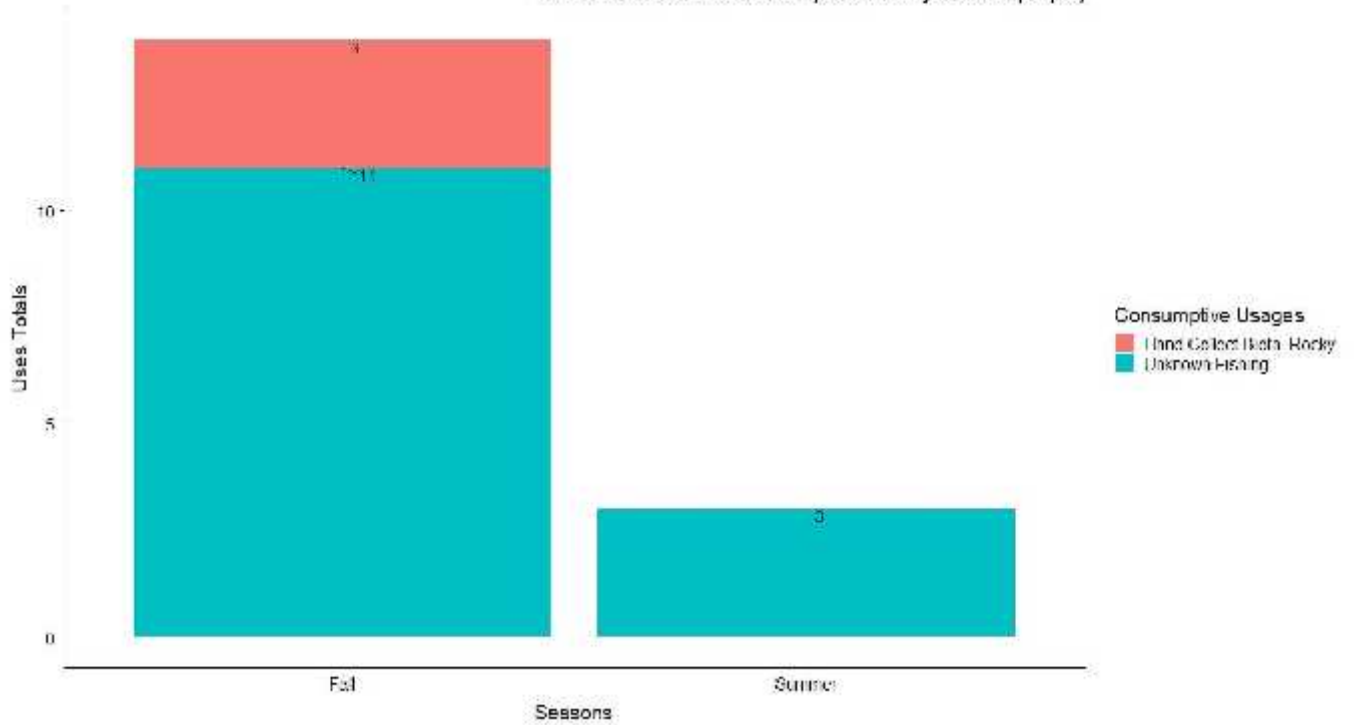
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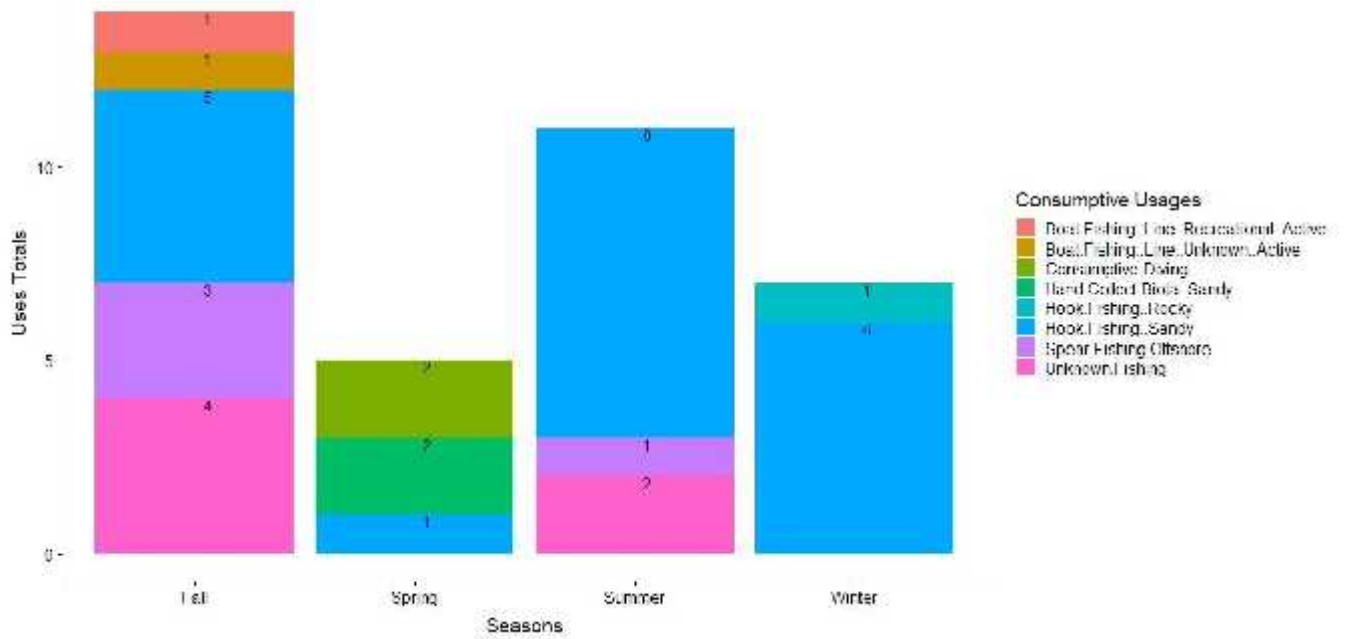
San Diego-Scripps Coastal SMCA Consumptive Use by Season (Top 5)



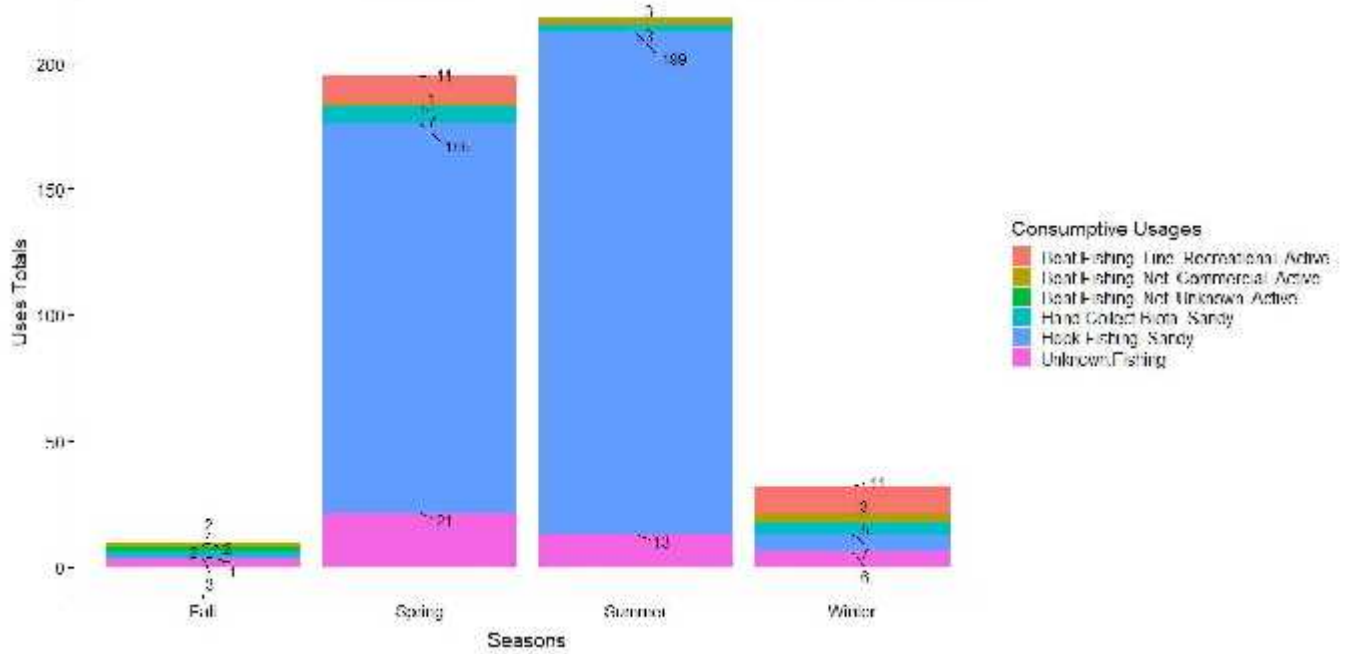
South La Jolla SMR Consumptive Use by Season (Top 5)



Swami's SMCA Consumptive Use by Season (Top 5)



Tijuana River Mouth SMCA Consumptive Use by Season (Top 5)



Upper Newport Bay SMCA Consumptive Use by Season (Top 5)

