

CARB Agreement 19AQP007

Survey of Recreational Marine Vessels (RMV) Operating within
California: Results from Survey

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Prepared by the Social Science Research Center (SSRC) at CSU, Fullerton

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This report was submitted in fulfillment of CARB Agreement 19AQP007: 2020 Recreational Marine Vessel (RMV) Activity Survey by the Social Science Research Center (SSRC) at California State University, Fullerton, under the sponsorship of the California Air Resources Board. Work was completed as of July 30, 2024.

ABSTRACT

The California Air Resources Board (CARB) develops emission inventories from various sources to determine baseline emissions estimates from air pollutants to support feasible air control measures locally and statewide. According to CARB, reactive organic gases (ROG) and oxides of nitrogen (NO_x) from recreational marine vessels (RMV) are a large source of ozone-forming precursors, especially in the non-attainment areas such as San Joaquin Valley and South Coast Air Basins. Obtaining current usage data is crucial to reliable emissions inventory development. But the most recent Pleasure Craft Emission Inventory (PC2014) developed emissions estimates for approximately one million RMVs from California using annual activity data (operating hours) based on a survey conducted during the Great Recession of 2008.

As CARB planned to update the RMV inventory model, there was a need to revisit the annual activity of vessels operating in California. To this end, the staff at CARB and the Social Science Research Center (SSRC), at California State University Fullerton (CSUF) conducted a survey of RMV owners whose vessels were registered with the California Department of Motor Vehicles (DMV). A stratified random sampling procedure was used to create a list of 87,691 DMV registries from which to sample potential RMV owners. Between February and September of 2022, the contractor administered an online survey to 2,857 RMV owners whose vessels were registered with the DMV to determine their frequency of use during the previous 12 months (February 2021 through September 2022), which encompassed the COVID-19 pandemic period. Boaters were also asked to compare their boating activity during this period to their activity "prior to the pandemic." Although a robust stratified sampling approach was used in the current study, the final survey sample over-represented jets, sailboats, and inboards, and under-represented sterndrives. To the extent that the distribution of survey responses differs depending on boat type, this sampling bias could have important implications for the results presented herein. To address this, vessel-level weights were calculated and applied to adjust for over- or underrepresentation of certain vessel types. Readers are encouraged to use the

weighted data for any modeling or further analysis and are cautioned to interpret unweighted results with these limitations in mind.

The 2,857 respondents surveyed owned 4,290 recreational marine vessels. The results indicate that more vessels were used in the warm period, May through October (67.1%), than during the cool period, November through April (39.5%). RMVs were also more likely to be operated 13 or more times throughout the warm period (14.1%) compared to the cool period (5.0%). A higher proportion of vessel engines operated for four to six hours a day in the warm period (27.7%) than in the cool period (19.2%). In the warm period, during the COVID-19 pandemic, the activity of 45.0% of the vessels in the study sample decreased compared to the year before. Similarly, in the cool period during the pandemic, the activity of 40.3% of vessels decreased. These results suggest RMV activity decreased during the COVID-19 pandemic (February 2021 through September 2022). Results suggest that changes in RMV use between February 2021 and September 2022 were primarily driven by the COVID-19 pandemic, followed by the 2020-22 California drought.

Drought is generally defined as “a deficiency of precipitation over an extended period of time (usually a season or more), resulting in a water shortage.”¹ According to the US Drought Monitor, California experienced level 1 (moderate) drought conditions in parts of the state starting in January of 2020, with conditions progressively worsening throughout the year.² By September 2020, much of the state was experiencing drought, with some areas in Northern California reaching level 3 (extreme drought) severity. By December 2020, the entire state was in drought, and by May 2021, 73.3% had reached level 3 or 4 (exceptional). At the close of water year 2021 in September, this rose to 87.8%. Atmospheric rivers in December 2021 brought temporary relief, reducing the amount of California experiencing level 3 and 4 drought to 32.9%. However, by the end of water year 2022 (September), severe drought returned to 40.9% of the state. Drought directly affects activities conducted on rivers and lakes, such as boating, rafting, canoeing, fishing, and swimming, due to reductions in snowpack and streamflows. Lake boaters experienced the drought from a unique vantage point, witnessing the West's water supply literally drop out from beneath them. For many, low water levels meant a short — and in some cases nonexistent — boating season. On certain lakes in California, such as Oroville and Shasta, authorities were forced to close boat ramps.³ Lake Oroville, California's second-largest reservoir, saw all of its boat ramps close as the water level dropped to the lowest level on record (roughly 25% of its capacity). On other lakes, trailering boaters couldn't access the water at all.

Because of these self-reported differences in RMV activity during the study period, caution is warranted for all inferences about overall use beyond the pandemic period. Whether the decreases in RMV use during the pandemic period relative to the year before were temporary is an area of further study.

¹ [Drought Basics | Drought.gov](https://www.drought.gov/)

² [Map Archive | U.S. Drought Monitor](https://www.drought.gov/)

³ <https://water.ca.gov/News/Blog/2022/Dec-22/Oroville-Update-12-9-22>, <https://www.tradeonlytoday.com/industry-news/worsening-california-drought-leads-boat-ramp-closures>, <https://www.sfgate.com/outdoors/article/Worsening-California-drought-starting-to-limit-5694646.php>, and <https://krctv.com/news/local/boat-ramps-reopen-at-shasta-lake-due-to-rise-in-lake-levels>

INTRODUCTION

The California Air Resources Board (CARB) develops emission inventories from various sources, such as on-road vehicles, off-road equipment, locomotives, and ocean-going vessels. Those emission inventories have supported many local and statewide emissions control measures in the past decades, leading to significant progress in reducing smog-forming pollutants. It is imperative to understand the baseline emissions of air pollutants from different sources before any feasible control measures are proposed. In particular, reactive organic gases (ROG) from recreational marine vessels (RMV) are a significant source of ozone-forming precursors, especially in the non-attainment areas such as the San Joaquin Valley and South Coast Air Basins, according to CARB.

One of the challenging aspects of inventory development is obtaining inventory-related data in a timely manner. In some cases, the data used in the inventory models is outdated, making it difficult to estimate current and future emissions inventories. The pleasure craft emission inventory (PC2014) estimates the emissions of ROG from approximately one million recreational boats operating in California. The annual activity data (operating hours) were based on a survey conducted during the last economic recession. As CARB is planning to update the RMV inventory model, there is a need to revisit the quantification of the annual activity of these vessels.

The new RMV inventory will reflect changes that have occurred but have not been captured since the last survey a decade ago. The previous survey did not inquire about the age of the engines for each vessel. CARB realized the age of the hull may not necessarily represent the age of the boat engines, as it is likely the engines will be replaced or repowered every 10 to 20 years, depending on the usage. There is also a lack of information regarding the turnover from old, worn-out engines to newer engines that meet cleaner emission standards. Additionally, the last survey did not collect information on the locations where the boats are operated and stored, both important factors in the development of an updated emissions inventory.

To estimate the annual activity of RMV owners in the State of California, CARB contracted with the Social Science Research Center (SSRC) at California State University, Fullerton (CSUF), to administer an online survey to a stratified random sample of RMV owners whose vehicles were registered with the California Department of Motor Vehicles (DMV). The primary goal of this endeavor was to estimate the annual boating activity of RMV owners in the state during both the warm and cool periods in the 12 months prior to survey completion, between February 2021 and September 2022. There were six (6) vessel types covered in this survey; namely, outboard, sterndrive, inboard, auxiliary sailboats, jet boats, and personal watercraft. The data collected as part of this survey can be used to support future updates to the RMV emissions inventory model, which would be used to support air quality planning and the development of pollutant emission-reduction programs.

Data Collection Materials and Methods

Study Sample

The population of inference for this study was all owners of RMV registered in California with DMV in active use. Based on the sample size used in past studies and budgetary parameters, the SSRC sought to collect surveys from 3,000 RMV owners from this population. To reach the target population, CARB obtained a complete list of DMV-registered RMVs in active use as of February 2021. This list contained

674,523 registries, most of which represented a single household.⁴ This list contained the name, address, and RMV type associated with each registry. To ensure adequate representation of vessels of all types and from all 58 counties, the list was stratified by county (58 counties) and vessel type (there were six vessel types reflected in the complete list), such that 348 homogenous groups, or strata, were generated. Once stratified, registries were randomly selected proportional to their distribution in the population, with oversampling as deemed necessary to create the study's final sample frame. In survey research, the sampling frame is the complete list of entries from which a survey sample is drawn. Once the sample frame was drawn, the resulting file was screened for duplicate addresses so that no one address was represented more than once. In total, 87,691 addresses, each representing a unique registry (13.0% of the complete list of registries), were contained in the final sample frame. Of the 87,691 addresses, 1,500 were used to collect a sample of 18 RMV owners to participate in cognitive interviews, 500 were used to select a sample of 23 RMV owners to participate in the pilot test, and the remaining 85,691 were used to obtain a sample of 2,857 RMV owners to complete the final survey. CARB can be 95.0% confident that the true population parameter lies between + or – 1.85 points (margin of error) from the sample estimate. For example, of the 4,290 vessels in the study sample, 36.5% were outboards. At a 95% confidence level and a margin of error of + or – 1.85 percentage points, if the sampling process were repeated many times, the sample estimate would fall between 34.7% (36.5% - 1.85) and 38.4% (36.5% + 1.85) in 95% of the samples, reflecting the expected variation due to the sampling error. However, the error rate will vary on individual survey items, depending on the level of missing data.

Survey Instrument Development

The instrument used in the administration of this study was comprised of approximately 43 items which were used to document the number and type of RMV owned (sailboat, inboard, outboard, etc.), the number and characteristics of engines contained within these RMV, vessel usage including how many days RMV were used, how long they ran when in use, what percent of time the engine(s) was idling or in neutral when in use, and how many times the engine was restarted. The survey instrument was also used to document the regions where vessels were operated, including whether they operated along the California Coast. The survey instrument was drafted by CARB staff and refined by the SSRC to improve flow, clarity, and ease of administration.

To inform stakeholders, such as the National Marine Manufacturers Association (NMMA), that a study was being undertaken to update California's recreational marine vessel's emission inventory and to obtain feedback on the survey instrument, a public workshop was hosted by CARB on March 30, 2021. To instill confidence in the study's methodology among stakeholders, the SSRC presented a description of its credentials, the study methodology, and the survey design. Stakeholders were given the opportunity to ask the SSRC questions and raise concerns during this workshop. Following the workshop, four workshop participants requested a copy of the survey instrument. All feedback from workshop participants was collected and distilled by CARB to create a list of recommendations that were

⁴ In a small fraction of cases, households were represented in the complete list more than once in cases where more than one vessel was registered to the same owner, or multiple people in the same household had a registered RMV.

used to guide improvements to the survey design. Feedback obtained from stakeholders can be characterized as falling into one of the six areas below:

- Defining terms
- Including “don’t know” as a valid response option for specific questions
- Allowing “select all that apply” for specific questions
- For specific questions, simplifying or eliminating response options
- Changing the order of specific survey items
- Changing the structure of specific questions to reduce the cognitive burden placed on survey respondents

Given the nuances of conducting a survey on such a complex and specialized topic, CARB and SSRC opted to put the survey through a beta-testing phase before full-scale implementation. This beta-testing took the form of cognitive interviews conducted via Zoom with 18 RMV owners who had completed the draft version of the survey as programmed into Qualtrics, an online survey software. These 18 RMV owners received a \$25 Amazon gift card for their participation. The results of the cognitive interviews were compiled into a report presented to CARB, and the survey was revised based on these results. Revisions to the survey at this stage included the following types of changes: adding a sentence about CARB's use of the data, clarifying instructions, removing overly difficult questions (e.g., vessel engine models), providing response ranges for hard-to-recall items, emphasizing the recall period throughout the survey, making questions more precise, and using examples to clarify the type of information needed. For a detailed report on the results of the cognitive interviews, see Appendix A. After final revisions, the survey instrument was pilot-tested on a sample of 23 respondents to determine its viability and appropriateness for the project's purpose. The findings of the pilot test resulted in more alterations to the survey, including adding visual aids to clarify vessel types and fuel containers, clarifying instructions on specific questions, allowing for “other” responses beyond those provided in certain items, including a “please specify” instruction for respondents selecting “other” as a response, clarifying question wording, updating or reframing response options, and adding a question about reasons for changes in boating activity, if applicable. The final survey instrument used is reproduced in Appendix B.

Technical Approach to Data Collection

The SSRC programmed the survey into Qualtrics, an online survey software. A multi-stepped approach was taken to ensure the programmed survey was functioning as intended. After the survey was programmed, it underwent a validation process involving staff at the SSRC simulating survey completions to identify any “breaks” or errors in the survey programming. As the survey design contained multiple paths to reach the conclusion, efforts were made to ensure simulated data collection tested each of these. Once all errors in the survey programming were identified, they were shared with the survey programmer for correction. This procedure was repeated several times until no errors in the survey programming were identified during the simulation process. Once no errors in the survey were identified, the programming underwent a second form of validation by reviewing a set of simulated data generated specifically for this purpose. A team at the SSRC, reviewed the frequencies of the simulated data to ensure all data were being captured as they should and all survey skip patterns were functioning

as expected. A final step in the survey programming process involved ensuring the survey was optimized for completion using smartphones.

Prior to data collection, the SSRC sought and received approval to conduct the research described herein from its Institutional Review Board (IRB). The IRB is an administrative body established to protect the rights and welfare of human research subjects recruited to participate in research activities conducted under the auspices of the institution to which it is affiliated. IRB requires risks to the research participant to be minimal and reasonable in relation to anticipated benefits, the subject selection to be equitable, privacy and confidentiality to be protected, and an informed consent process to meet federal regulatory and institutional requirements. Informed consent is a process of sharing information with potential research participants about the key elements of the study and what their participation will entail. Informed consent requires the researcher to communicate to the research participant why they were selected to participate in the research, what they are being asked to do in relation to the research project, the risks and benefits of participating in the research (including incentives they might receive for participation), how their data will be protected, and, most importantly, that their participation in the study is voluntary. Only individuals who consented to participate in the current study were allowed to participate in the survey.

The survey was administered between February 7th and September 14th, 2022. To obtain the study sample, postcards soliciting participation in the survey were sent to the 85,691 addresses in the remaining sample frame in three batches. A first batch of postcards was sent to a stratified random sample of 17,464 addresses in early February of 2022. The percentage of addresses sampled from each stratum matched the distribution of strata in the population, with one exception. Small towns with fewer vessels were oversampled to ensure adequate representation in the final study sample. The 17,464 selected addresses were assigned an external reference code, a combination of numbers to identify both geographic location and RMV type, to assess response rate and the representativeness of the study sample as survey completions were recorded.

The postcard sent to potential respondents was a five-by-eight bifold that addressed the “Boat Owner” on one side and included photos of various vessel types on the other. The return address on the postcard was the SSRC’s, as it was determined this population would be more likely to participate in the research if the invite came from an educational institution. The inside of the bifold contained a brief description of the study, along with an explanation of why they were chosen to participate in it. The postcard also contained information related to the incentive for participating (a \$10 Amazon gift card⁵ and entry into an opportunity drawing to win a \$100 Amazon gift card) and contact information should they have questions about the study. Finally, to access the survey, the postcard provided a QR code and their unique external reference code, which they were required to enter to begin the survey.

By early May of 2022, 740 survey responses were received. The SSRC provided CARB with a data file containing the external reference code for all completed surveys. CARB used this file to assess the representativeness of the sample and based on this information selected another 44,198 addresses to include in the sample frame and mail postcards to. The 44,198 addresses were selected using the same sampling procedure used to select the first 17,464 addresses, with one exception. Oversampling was

⁵ The SSRC was responsible for distributing the Amazon gift card to survey completers. They were also responsible for selecting from the sample of survey completers the individual who won the opportunity drawing for \$100.

used to adjust for the underrepresentation of certain strata observed in the survey sample. Postcards were sent to this batch of addresses in mid-May of 2022. In response to feedback received by survey completers, modifications to the study postcard, survey instrument, and study method were made between the mailing of the first and second batch of addresses. A short link to the survey, <https://boatownersurveyonline.com/carb>, was added to the postcard because some respondents contacted the SSRC to inform them they did not have a smartphone and could not use the QR code provided. In addition, respondents who did not have a smartphone or computer were offered a telephone version of the survey.

By early July, 2,379 surveys had been completed, and it became clear that CARB would need to send postcards to a third batch of addresses to meet the target number of 3,000 survey completions. Using the same sampling method to select the second batch of addresses, a third batch of 24,029 addresses was selected and subsequently sent a postcard soliciting participation in the survey in mid-July.

At the end of the data collection period, the SSRC conducted a thorough review of the survey responses and identified 934 submissions that were completed without an external reference code. Upon further examination, many of these entries shared identical IP addresses and were determined to be fraudulent. As a result, all 934 invalid responses were removed from the dataset, yielding a final total of 2,857 valid surveys for analysis.

The SSRC maintained a data file containing the external reference code and address of all postcards that were returned. In total, 2,484 postcards were returned during the data collection period. The most common reasons postcards were returned include “not deliverable as addressed” ($n = 786$), “vacant” ($n = 399$), “no mail receptacle” ($n = 286$), and “attempted-not known” ($n = 257$).

The SSRC calculates survey response rates using the American Association for Public Opinion Research (AAPOR) Response Rate Calculation Method 3 (RR3), which includes an estimate of eligibility among unscreened sample records based on the eligibility rate among respondents for whom a final determination could be made.

The RR3 formula is:
$$Rate = \frac{I}{(I+P)+(R+NC+O)+e(UH+UO)}$$

Where I = complete interviews, P = partial interviews, R = refusal and break off, NC = non-contact, O = Other, UH = unknown household, UO = unknown other, and e is the estimated proportion of cases of unknown eligibility that are eligible.

Considering the returned postcards, the response rate for the overall study was 3.7%.⁶ While the prevailing assumption is that higher response rates correspond with higher-quality data, there is a lack of guidance on the optimal response rate needed to achieve quality data. Furthermore, studies that have compared survey estimates to benchmark data from the U.S. Census or very large governmental sample surveys have questioned the positive association between response rates and quality. For example, a recent study found reliable estimates could be obtained with response rates between five

⁶ The 2,000 records used to conduct the cognitive interviews and pilot were not considered in the calculation of the response rate.

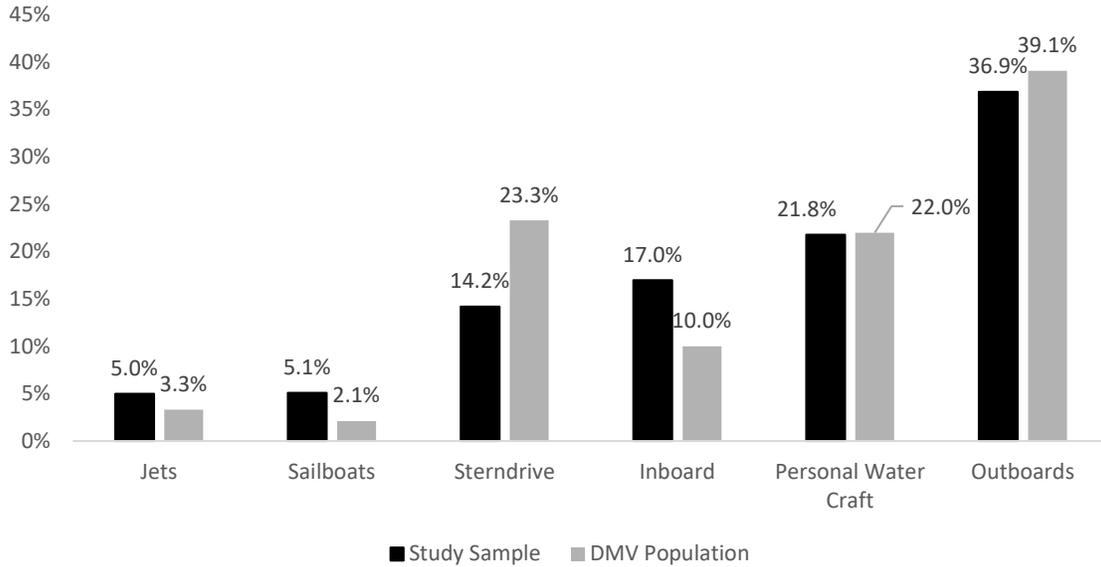
and ten percent and a sample size of 500. A low response rate is problematic to the extent that those who do not participate in a survey differ on some known or unknown characteristics from those who do participate. While there is no way to examine the extent to which responders and non-responders differed on unknown characteristics, survey completers in this study did not differ significantly from the population of DMV entries on region. However, despite the robust stratified random sampling strategy applied in the current study, individuals with jets, sailboats, and inboards were more likely to complete the survey. At the same time, those with sterndrives were less likely to, suggesting the presence of some sampling bias. While the large sample size in this study, to some extent, mitigated concerns about the low response rate, the presence of sampling bias should be considered when interpreting the results. To address this, vessel-level weights were applied to adjust for over- and underrepresentation across vessel types, and readers are strongly encouraged to rely on weighted data for any modeling or further analysis to ensure results more accurately reflect the population of registered motorized vessels. See Appendix C for more information on how the weights were calculated.

Data Collection Outcomes

A comparison of the survey sample and the population revealed that the survey sample was different from the DMV population with respect to vessel type (See Figure 1). As shown, sterndrives were underrepresented in the study sample, while jets, sailboats, and inboards were overrepresented.⁷ To adjust for this, a procedure known as “weighting” was applied to the data. Specifically, weighting factors were calculated based on the discrepancy between the sample's characteristic distribution and the corresponding DMV population distribution. For instance, the sample underrepresented sterndrives relative to their proportion in the DMV population. As a result, vessels of this type were assigned higher weights. Conversely, overrepresented groups received lower weights. By implementing this weighting strategy, we mitigate the impact of sampling biases and produce estimates that are more representative of the overall population, thereby improving the validity and reliability of our findings. This method is crucial for reducing distortion and producing more accurate results when the sample is not perfectly representative of the population from which it was drawn.

⁷ $\chi^2(5, 4,290) = 574.57, p < .001$.

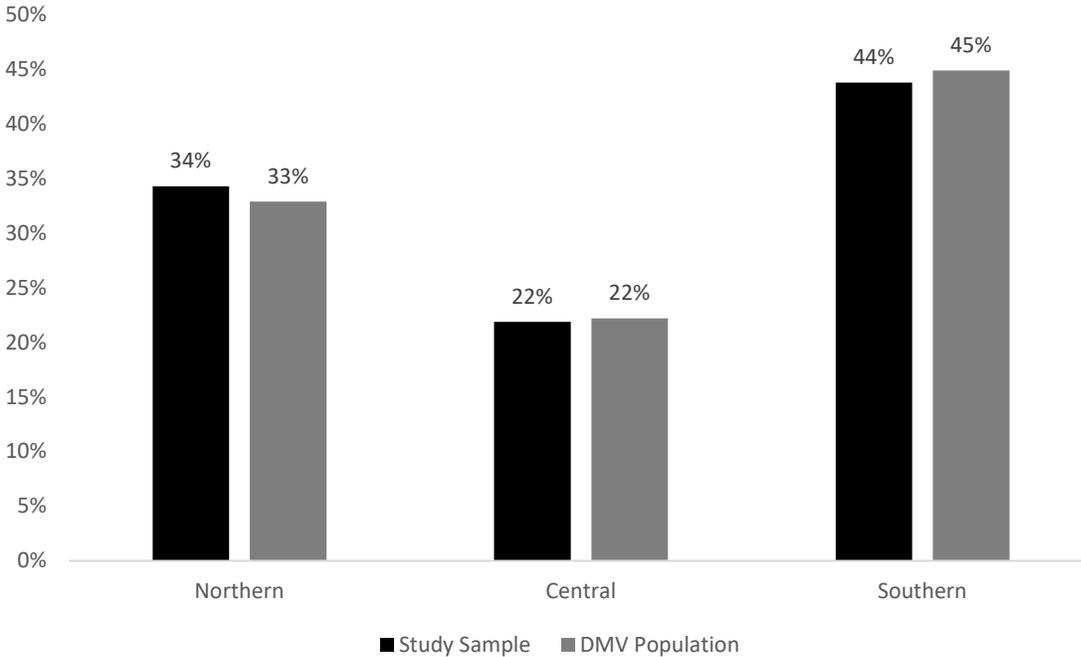
Figure 1. % of RMV Type-DMV vs. Study Sample



A comparison of the survey sample and the population revealed the survey sample largely mirrored the population with respect to the region RMV owners resided in (See Figure 2).⁸ As a result, weighting the data by county was not deemed necessary.

⁸ $\chi^2(2, 2,857) = 2.41, p = 0.30$.

Figure 2. % of RMV Owner County- DMV vs. Study Sample



All research has limitations, and this study is no exception. As with any public opinion research, there is unmeasured error that may influence the findings and should be considered when interpreting results.

SURVEY RESULTS

Number of Vessels

All 2,857 survey participants indicated how many vessels they owned. They were instructed to “only include ones with internal combustion or battery-operated engine(s) and are actively in use” and to “include sailboats with auxiliary engines, jet boats, personal watercraft, and other motorized boats.” The number of vessels owned by survey respondents ranged from one ($n = 1,930$) to 19 ($n = 1$), with a mean of 1.5⁹, a median of 1.0 and a standard deviation of .95. As shown in Table 1, most survey completers ($n = 1,930$; 67.6%) reported owning one vessel, while about one-fifth ($n = 614$; 21.5%) owned two. While nearly nine in ten ($n = 2,544$; 89.1%) survey completers owned between one and two vessels, another 10.6% ($n = 302$) owned between three and five. Finally, 0.4% of the sample ($n = 11$) owned more than five vessels. In total, the 2,857 participants in the study sample owned 4,290 vessels.

⁹ 95% CI [1.47, 1.54]

Table 1. Number of Vessels Owned		
Quantity	# of Participants	% of Participants
1	1,930	67.6%
2	614	21.5%
3	201	7.0%
4	67	2.3%
5	34	1.2%
More than 5	11	0.4%
Total	2,857	100.0%

Vessel Type

Of the 4,290 vessels in the study sample, the largest proportion ($n = 1,564$; 36.5%) were outboards (See Table 2). The next largest proportions were personal watercrafts ($n = 925$; 21.6%), inboards ($n = 719$; 16.8%), and sterndrives ($n = 600$; 14.0%). Less than 10.0% of the vessels in the sample were sailboats equipped with auxiliary engines ($n = 217$; 5.1%) and jets ($n = 214$; 5.0%). Fifty-one (1.2%) vessels were described as some “other” type. These other types are depicted in Table 2a. As described in the Data Collection Outcomes of the report, despite rigorous efforts to sample vessels proportionate to the DMV population, sample bias was still observed such that sailboats, inboards, and jets were significantly overrepresented in the study sample, while sterndrives were significantly underrepresented. To adjust for this, a procedure known as “weighting” was applied to the data. The weighted distribution of vessel type is also presented in Table 2. As shown, with the weights applied, the distribution of vessels in the survey sample more closely mirrors the distribution of the population from which they were drawn. Fifty-one vessels classified as “Other” were excluded from the weighted analysis, as the California DMV population data used for weighting does not include an “Other” boat type category. When a sample is not representative of the population, presenting weighted data is generally preferred over unweighted data because it aims to correct the sampling biases and provide estimates closer to the true population values. For this reason, only the weighted data will be presented in the remainder of this report, where applicable.

Table 2. Vessel Types

Type of Vessel	Unweighted Values		Weighted Values		Population Values	
	# of Vessels	% of Vessels	# of Vessels	% of Vessels	# of Vessels	% of Vessels
Outboard	1,564	36.5%	1,664	39.1%	263,884	39.1%
Personal Watercraft (PWC or Jet ski, up to 3 passengers, 8 - 13 ft. long)	925	21.6%	940	22.1%	149,285	22.1%
Inboard	719	16.8%	426	10.0%	67,552	10.0%
Sterndrive	600	14.0%	989	23.3%	157,225	23.3%
Sailboat equipped with auxiliary engine(s)	217	5.1%	90	2.1%	14,312	2.1%
Jet (or jet boat, up to 10 passengers, 14 - 25 ft. long)	214	5.0%	140	3.3%	22,262	3.3%
Other	51	1.2%	-	-	-	-
Total	4,290	100.0%¹⁰	4,249	100.0%¹¹	674,520	100.0%¹²

Vessels in the “Other, not classifiable” category depicted in Table 2a include “trawler,” “none,” “in storage being rebuilt,” “hovercraft,” “electric powered by trolling motor for fishing and is aluminum 12’ long,” “compact pond prowler,” “catamaran,” and “2019 Electracraft 153 all electric.” These data were not weighted as there was no estimate of the percentage of other vessels in the DMV population.

¹⁰ Due to rounding, the total of the percentages sum to 100.2%.

¹¹ Due to rounding, the total of the percentages sum to 99.9%.

¹² Due to rounding, the total of the percentages sum to 99.9%.

Table 2a. Other Vessel Types		
Type of Vessel	# of Vessels	% of Vessels
Duffy/Electric Duffy	8	15.7%
Electric, Not Otherwise Specified	7	13.7%
Houseboat	6	11.8%
Inflatable	4	7.8%
Canoe	4	7.8%
Dinghy	3	5.9%
Pram	3	5.9%
Trolling Motor	2	3.9%
Fishing Boat	2	3.9%
Pontoon	2	3.9%
Driftboat	2	3.9%
Other, Not Classifiable	8	15.7%
Total	51	100.0%¹³

¹³ Due to rounding, the total of the percentages sum to 99.9%

Vessel Registration

As shown in Table 3, the largest proportion of vessels represented in the survey sample ($n = 4,011$; 94.4%) were registered only with the DMV. Four percent ($n = 170$) of vessels represented in the survey sample were registered with both the DMV and the U.S. Coast Guard, while 0.7% ($n = 31$) were registered with the U.S. Coast Guard alone. Twenty vessels (0.5%) were registered with the Arizona Game and Fish Department, five (0.1%) were registered elsewhere, including, but not limited to, the “Nevada DMV,” “ADBA,” and “ADOT.” Thirteen vessels (0.3%) were not registered at all. While vessels not registered with the California DMV would seemingly not be in the survey sample, it is important to recall that the sample frame comprised households, not vessels. It is possible that certain sampled households maintained more than one vessel, some of which were not registered with the DMV. Since respondents were asked to report on all their RMV, several likely reported on vessels not registered with the California DMV.

Table 3. Vessel Registration				
	Unweighted Values		Weighted Values	
Registration Type	# of Vessels	% of Vessels	# of Vessels	% of Vessels
DMV Alone	3,993	93.1%	4,011	94.4%
Both DMV. and U.S. Coast Guard	198	4.6%	170	4.0%
U.S. Coast Guard Alone	56	1.3%	31	0.7%
Arizona Game and Fish Department	20	0.5%	20	0.5%
Other	8	0.2%	5	0.1%
Not Registered	15	0.3%	13	0.3%
Total	4,290	100.0%	4,250	100.0%

Primary Vessel Use

Table 4 shows that most vessels ($n = 4,096$; 96.4%) in the study sample were used for personal/private leisure or sport purposes. Sixty-one (1.4%) were used mainly for personal, but occasionally for the conduct of freelance work, while 58 (1.4%) were used for boating businesses such as boat cruises or tours. Thirty-four respondents (0.8%) selected “none of the above” in response to this survey item. Of these respondents, the majority noted their vessel was not being used, was inoperable or needed repair, was a government vessel, or used for safety coaching. Other responses included “to look at,” “this vessel is my residence,” “as a spare boat,” “an investment,” and “a historical artifact.”

Table 4. Primary Vessel Use

Use Type	Unweighted Values		Weighted Values	
	# of Vessels	% of Vessels	# of Vessels	% of Vessels
Personal/Private Leisure or Sport	4,133	96.3%	4,096	96.4%
Mainly Personal but Occasional Conduct of Freelance Work	62	1.4%	61	1.4%
Boating Business	57	1.3%	58	1.4%
None of the Above	38	0.9%	34	0.8%
Total	4,290	100.0%¹⁴	4,249	100.0%

Number and Characteristics of Vessel Engines

Respondents were asked to indicate how many engines were on each of their vessels. They were instructed that the engine “may provide power and/or electricity for the vessel. For example, please include trolling motors or onboard generators.” This information was available for all 4,249 vessels. Most vessels ($n = 3,615$; 85.1%) had one engine, as shown in Table 5. The 4,249 vessels in the study sample had 4,946 combined engines.

¹⁴ Due to rounding, the total of the percentages sum to 99.9%

Table 5. Number of Engines on Vessels Owned

Engine Quantity	Unweighted Values		Weighted Values	
	# of Vessels (% of Vessels)	# of Engines (% of Engines)	# of Vessels (% of Vessels)	# of Engines (% of Engines)
1	3,631 (84.6%)	3,631 (72.3%)	3,615 (85.1%)	3,615 (73.1%)
2	595 (13.9%)	1,190 (23.7%)	582 (13.7%)	1,164 (23.5%)
3	59 (1.4%)	177 (3.5%)	48 (1.1%)	144 (2.9%)
4	3 (<0.1%)	12 (0.2%)	2 (<0.1%)	8 (0.2%)
5	1 (<0.1%)	5 (0.1%)	1 (<0.1%)	5 (0.1%)
10	1 (<0.1%)	10 (0.2%)	1 (<0.1%)	10 (0.2%)
Total	4,290 (100.0%)	5,025 (100.0%)	4,249 (100.0%)¹⁵	4,946 (100.0%)

As shown in Table 6, most engines represented in the study sample were powered by gasoline ($n = 4,387$; 88.7%). Both electric/battery ($n = 351$; 7.1%) and diesel-powered ($n = 189$; 3.8%) engines individually accounted for less than 10% of the engines in the study sample. The 19 engines (0.4%) powered by some “other” fuel type include 12 fueled by gas oil mix and five fueled by propane. The fuel types of the other two engines classified as “other” were methanol and Jet A.

Of the 388 electric engines, 108 (27.8%) were the only engine in the vessel, while 280 were one of multiple engines. These 280 engines were spread across 266 vessels. Of the 266 vessels, only 10 were all electric. The remaining 256 vessels contained at least one electric engine, in addition to engines of other fuel types, mostly gas.

¹⁵ Due to rounding, the total of the percentages sum to 99.9%

Table 6. Number of Engines on Vessels Owned

Fuel Type	Unweighted Values		Weighted Values	
	# of Engines	% of Engines	# of Engines	% of Engines
Gasoline	4,303	85.6%	4,387	88.7%
Electric/Battery	388	7.7%	351	7.1%
Diesel	312	6.2%	189	3.8%
Other	21	0.4%	19	0.4%
Total	5,024¹⁶	100.0%¹⁷	4,946	100.0%

Respondents indicated which of the 28 makes in Table 7 best described their vessel engine. This information was provided for 4,758 engines.¹⁸ Due to space considerations, only the weighted data are presented in Table 7. The unweighted data is depicted in Table D1 in Appendix D. As shown in Table 7, more than a third of the engines represented in the study sample are Mercury ($n = 1,510$; 31.7%). The next most common engine types were Yamaha ($n = 640$; 13.4%), Bombardier ($n = 395$; 8.3%), Honda ($n = 325$; 6.8%), Volvo ($n = 317$; 6.7%), Kawasaki ($n = 232$; 4.9%), Outboard Marin ($n = 213$; 4.5%), and Minn Kota ($n = 209$; 4.4%). The least common engine makes were Zhejiang Hui Yuan Power Technology ($n = 1$; < 0.1%), Seven Marine ($n = 2$; < 0.1%), Kem/Kodiak ($n = 2$; < 0.1%), Lehr ($n = 2$; < 0.1%), Teague Custom Marin ($n = 3$; 0.1%), and Gibbs Sports Amphibians ($n = 3$; 0.1%). Two hundred and fifty-two engines (5.3%) could not be described as belonging to one of the 28 categories in Table 7. The makes of the vessels belonging to this “not listed” category are presented in Table 7a.

¹⁶ This information was not available for one engine.

¹⁷ Due to rounding, the total of the percentages sum to 99.9%

¹⁸ This information was unavailable for 3.8% ($n = 188$) engines in the study sample.

Table 7. Engine Make (Weighted Values)

Make	# of Engines	% of Engines	Make	# of Engines	% of Engines
Mercury	1,510	31.7%	Ford	39	0.8%
Yamaha	640	13.4%	Polaris	29	0.6%
Bombardier	395	8.3%	Yanmar	29	0.6%
Honda	325	6.8%	Cummins	28	0.6%
Volvo	317	6.7%	Malibu Power	22	0.5%
Kawasaki	232	4.9%	Outboard Group	19	0.4%
Outboard Marin	213	4.5%	Briggs & Stratton	17	0.4%
Minn Kota	209	4.4%	Ilmor Engineering	8	0.2%
Chevrolet/GMC	114	2.4%	Gibbs Sports Amphibians	3	0.1%
Tohatsu	83	1.7%	Teague Custom Marin	3	0.1%
Pleasurecraft Marine Engine	72	1.5%	Lehr	2	<0.1%
Indmar Products	68	1.4%	Kem/Kodiak	2	<0.1%
Suzuki	66	1.4%	Seven Marine	2	<0.1%
BRP U.S.	58	1.2%	Zhejiang Hui Yuan Power Technology	1	<0.1%
			Not listed	252	5.3%

Among the 252 engines belonging to the “not listed” category in Table 7, the most common are Nissan ($n = 20$; 7.9%), Universal ($n = 14$; 5.6%), Chrysler ($n = 13$; 5.2%), Detroit ($n = 13$; 5.2%), Johnson ($n = 12$; 4.8%), Caterpillar ($n = 11$; 4.4%) and Oldsmobile ($n = 11$; 4.4%). Forty-nine (19.4%) engines could not be classified as belonging to the 36 engine makes depicted in Table 7a. The unweighted data is depicted in Table D1a in Appendix D.

Table 7a. Engine Make of Vessels Described as “Not Listed” (Weighted Values) ¹⁹

Make	# of Engines	% of Engines	Make	# of Engines	% of Engines
Other	49	19.4%	Scott	4	1.6%
Nissan	20	7.9%	Lowrence	4	1.6%
Universal	14	5.6%	Kutoba	4	1.6%
Chrysler	13	5.2%	Duffy	4	1.6%
Detroit	13	5.2%	Kohler	3	1.2%
Johnson	12	4.8%	Sears	3	1.2%
Caterpillar	11	4.4%	Motorcraft	3	1.2%
Oldsmobile	11	4.4%	Montgomery Ward	3	1.2%
Torqeedo	8	3.2%	Electric	3	1.2%
Perkins	8	3.2%	Hummingbird	3	1.2%
Evinrude	7	2.8%	Mann	3	1.2%
Westerbeke	6	2.4%	Isuzu	3	1.2%
Northern Lights/Lugger	5	2.0%	Atomic 4	2	0.8%
Crusader	5	2.0%	Onan	2	0.8%
Trolling Motor	5	2.0%	Hino	2	0.8%
Chris Craft	5	2.0%	Hercules	2	0.8%
Buick	4	1.6%	Gray Marine	2	0.8%
Sea King	4	1.6%	Electra craft	2	0.8%

¹⁹ Due to rounding, the total of the percentages sum to 99.7%

Respondents were asked to report on the model year for each of their vessel engines. This information was reported for 4,785 engines.²⁰ The model year of the engines represented in the study sample ranged from 1948 ($n = 1$; $< 0.1\%$) to 2021 ($n = 160$; 3.3%), with a mean model year of 2001, a median of 2003, and a standard deviation of 12.7. This means the engines represented in the study sample ranged from one to 74 years of age, with a mean of 20.0 years, a median of 19.0, and a standard deviation of 12.7 years. Table 8 depicts the model years of the engines in ten-year increments and the average age within each category.

Table 8. Model Year of Engines						
	Unweighted Values			Weighted Values		
Model Year Category	# of Engines (% of Engines)	Mean Age	95% CI	# of Engines (% of Engines)	Mean Age	95% CI
1940-1949	1 ($< 0.1\%$)	74.0	-	1 ($< 0.1\%$)	74.0	-
1950-1959	28 (0.6%)	65.5	64.3 – 66.6	23 (0.5%)	65.5	64.3 – 66.7
1960-1969	63 (1.3%)	56.5	55.8 – 57.2	59 (1.2%)	56.4	55.7 – 57.1
1970-1979	200 (4.1%)	47.1	46.7 – 47.5	178 (3.7%)	47.2	46.8 – 47.6
1980-1989	527 (10.9%)	36.3	36.1 – 36.6	515 (10.8%)	36.3	36.1 – 36.5
1990-1999	994 (20.5%)	26.7	26.5 – 26.9	1,005 (21.0%)	26.7	26.5 – 26.9
2000-2009	1,730 (35.7%)	17.5	17.4 – 17.7	1,736 (36.3%)	17.5	17.4 – 17.6
2010-2019	1,032 (21.3%)	6.2	6.0 – 6.4	1,001 (20.9%)	6.2	6.1 – 6.3
2020+	271 (5.6%)	1.4	1.3 – 1.5	267 (5.6%)	1.4	1.2 – 1.6
Total	4,846 (100.0%)²¹	20.2	19.8 – 20.5	4,785 (100.0%)²²	20.0	19.6 – 20.4

²⁰ This information was unavailable for 3.3% ($n = 161$) engines in the study sample.

²¹ Due to rounding, the total of the percentages sums to 100.1%.

²² Due to rounding, the total of the percentages sums to 100.0%.

Next, respondents reported the horsepower or, if electric, the equivalent kilowatts for each of their vessel engines. Respondents specified the horsepower or kilowatts for 4,505 engines.²³ A near equal proportion of engines in the study sample had a horsepower of 51 to 120 ($n = 877$; 19.5%) and 15 or less ($n = 860$; 19.1%). Slightly more than 5% of engines represented in the sample ($n = 238$; 5.3%) had a horsepower of 376 or higher.

Table 9. Engine Horsepower				
	Unweighted Values		Weighted Values	
	# of Engines	% of Engines	# of Engines	% of Engines
≤ 15 hp (≤ 11 kw)	914	20.0%	860	19.1%
16-25 hp (11.1 - 19 kw)	261	5.7%	241	5.3%
26-50 hp (19.1 - 37 kw)	434	9.5%	411	9.1%
51-120 hp (37.1- 89 kw)	862	18.9%	877	19.5%
121-175 hp (89.1 - 130 kw)	512	11.2%	561	12.5%
176 - 250 hp (130.1 - 186 kw)	610	13.4%	663	14.7%
251-375 hp (186.1 –280 kw)	683	15.0%	654	14.5%
376 -500 hp (280.1 – 373 kw)	167	3.7%	139	3.1%
501-650 hp (373.1 – 485 kw)	58	1.3%	49	1.1%
≥651 hp (≥ 485.1 kw)	47	1.0%	36	0.8%
Not listed	14	0.3%	14	0.3%
Total	4,562	100.0%	4,505	100.0%

²³ This information was not available for 8.9% ($n = 441$) of the engines in the study sample.

An item on the survey instrument inquired, “What is the estimated engine hour meter reading [of this engine]?” Respondents were instructed to provide only a single number of hours, not a range.

As indicated by respondents, 1,568 engines (31.7%) did not have hour meters. Furthermore, the hour meter readings of 1,082 engines (21.9%) were unknown. Thus, exact hour meter readings are available for 2,296 engines (46.4%). Of these 2,296 engines, the estimated hour meter readings ranged from zero ($n = 14$; 0.6%) to 25,000 ($n = 3$; 0.1%), with a mean of 435.4 hours²⁴, a median of 190 hours, and a standard deviation of 1,219 hours. Table 10 shows the reported meter readings organized into five categories, including the number of engines, the percentage of total engines, the mean hour meter reading, the total reported hour meter readings, and the percentage of total reported hours for each range. The total estimated hours for the engines where exact meter estimates were provided is 996,740, with an estimated mean meter reading of 435.4 hours. The unweighted data for this variable can be found in Table D2 in Appendix D.

Table 10. Reported Engine Hour Meter Reading in Ranges- For Engines With Known Exact Reading (Weighted Values)

Hour ranges	# of Engines	% of Engines	Mean Hours	95% CI	Total Hours (Using Mean)	% of Total Hours
0-500	1,863	81.1%	170.2	163.7 - 176.7	317,083	31.8%
501-1,000	246	10.7%	759.2	740.3 – 778.1	186,763	18.7%
1,001-1,500	89	3.9%	1,229.1	1,201.9 – 1,256.3	109,390	11.0%
1,501-2,000	34	1.5%	1,835.2	1,781.8 – 1,888.6	62,397	6.3%
>2,000	64	2.8%	5,017.3	3,735.2 – 62,99.4	321,107	32.2%
Total	2,296	100.0%	435.4	385.5 – 485.4	996,740	100.0% ²⁵

The owners of the 1,082 engines who did not know an exact hour meter were asked to estimate the hour meter reading for each of their vessel engines using the range of potential readings depicted in Table 10a (the same categories used in Table 10). The owners of 171 (15.8%) engines could not provide an estimate using these ranges. Of the remaining 911 engines, 61.1% ($n = 557$) had hour meter readings between 0 and 500 hours, 23.2% ($n = 211$) had readings between 501 and 1,000 hours, and 7.7% ($n = 70$) between 1,001 and 1,500 hours. Less than 10% of the 911 engines that provided an estimated hour meter reading ($n = 73$; 8.0%) were reported to have readings over 1,500 hours. To estimate the number of hours for these 911 engines, the mean hours for each category was imputed (shown in red) from the group of respondents shown in Table 10 who provided exact meter readings.²⁶ Table 10a provides the count of engines, percentage of total engines, imputed mean (from Table 10), estimated total hours, and the percentage of total hours each category. The total estimated hours for the engines where meter

²⁴ 95% CI [433.8, 528.4]

²⁵ Due to rounding, the total of the percentages sum to 99.9%

²⁶ Confidence intervals could not be calculated on imputed means.

estimates were provided in ranges is 567,280, with an estimated mean meter reading of 622.7 hours. The unweighted data for this variable can be found in Table D2a in Appendix D.

Table 10a. Estimated Engine Hour Meter Reading in Ranges- For Engines With Unknown Exact Reading					
Hour ranges	# of Engines	% of Engines	Imputed Mean Hours	Estimated Total Hours (Using Imputed Mean)	% of Total Hours
0-500	557	61.1%	170.2	94,801	16.7%
501-1,000	211	23.2%	759.2	160,191	28.2%
1,001-1,500	70	7.7%	1,229.1	86,037	15.2%
1,501-2,000	44	4.8%	1,835.2	80,749	14.2%
>2,000	29	3.2%	5,017.3	145,502	25.6%
Total	911	100.0%	622.7	567,280	100.0%²⁷

The hour meter readings for the 2,296 engines for which an exact number was provided (Table 10) were added to the estimated hour meter readings for the 911 engines for which only a range was provided (Table 10a), yielding a range of hour meter readings for 3,207 engines where an exact reading was provided or a range was selected.^{28, 29} Table 10b depicts the range of hour meter readings for these 3,207 engines. As shown, 75.5% ($n = 2,420$) of these engines reportedly have hour meter readings of between 0 and 500 hours, while 14.3% ($n = 457$) have readings between 500 and 1,000 hours, and 5.0% ($n = 159$) between 1,001 and 1,500 hours. Like Table 10a, less than 10% ($n = 171$; 5.3%) of the engines for which information is available have hour meter readings of over 1,500 hours. The combined total hours for both exact readings and those who provided ranges were 1,515,736 hours, with a mean hour meter reading of 472.6 hours. Unweighted data can be found in Table D2b in Appendix B.

²⁷ Due to rounding, the total of the percentages sum to 99.9%

²⁸ Of the 3,446 engines with an hour meter reading, this information was unknown for 171 or 4.9% of engines.

²⁹ Confidence intervals could not be calculated as this table contains both continuous and ordinal data.

Table 10b. Combined Engine Hour Meter Reading in Ranges- For all Engines That Some Information Was Provided (Weighted Values)

Hour ranges	# of Engines	% of Engines	Mean Hours	Combined Total Hours (Using Mean and Imputed Mean)	% of Total Hours
0-500	2,420	75.5%	168.1	406,802	26.8%
501-1,000	457	14.3%	758.5	346,635	22.9%
1,001-1,500	159	5.0%	1,239.4	197,065	13.0%
1,501-2,000	78	2.4%	1,834.7	143,107	9.4%
>2,000	93	2.9%	4,539.0	422,127	27.8%
Total	3,207	100.0%³⁰	472.6	1,515,736	100.0%³¹

Of the 4,946 engines in the study, data on whether the engine had ever been replaced, rebuilt, or repowered were available for 4,865. Among those, owners of 4,337 engines (89.1%) responded in the negative, while slightly under 11% ($n = 528$; 10.9%) reported that their engine had been replaced, rebuilt, or repowered. This information was not available for 81 engines (1.6%).

The owners of the 528 engines that had been replaced, rebuilt, or repowered were asked to approximate how old their engine was when it was replaced. Respondents were instructed to provide the age of their engine in years. Despite this instruction, several respondents provided invalid responses to this inquiry, including “5000,” which presumably was the hour meter reading on that engine, “1,000 hours,” “2017,” “2005,” “2015³²,” “1984,” “new,” “did not replace³³,” “rebuilt not replaced,” and “1968.” The owners of 104 engines (19.7%) could not generate a response to this item, leaving this information available for 424 engines. The 424 engines that were replaced, rebuilt, or repowered were between zero ($n = 4$; 0.9%) and 85 ($n = 1$; 0.2%) years old at the time this occurred. The mean age at which engines were replaced was 19.0 years, the median was 18 years, and the standard deviation was 11.6 years. Table 11 shows the reported age at which engines were rebuilt, replaced, or repowered organized into five categories, as well as the number of engines and the percentage of total engines that fall into each category.

³⁰ Due to rounding, the total of the percentages sum to 100.1%

³¹ Due to rounding, the total of the percentages sum to 99.9%

³² This response was given for two engines.

³³ The follow up question asked, “approximately how old was the engine when you replaced it.” Because the words “rebuilt,” and “repowered” were not included in the follow-up question, this person may have mistakenly thought this question was not directed to them.

Table 11. Age of Engines at Time of Replacement

Age Range	Unweighted Values			Weighted Values		
	# of Engines % of Engines	Mean Age	95% CI	# of Engines % of Engines	Mean Age	95% CI
≤ 5 Years old	44 (9.9%)	3.1	2.5 – 3.6	42 (10.0%)	3.0	2.5 – 3.5
6-10 Years old	69 (15.6%)	9.2	8.9 – 9.5	69 (16.2%)	9.2	8.9 – 9.5
11-15 Years old	78 (17.6%)	13.9	13.6 – 14.2	73 (17.2%)	13.9	13.6 – 14.2
16-20 Years old	101 (22.8%)	18.9	18.6 – 19.1	104 (24.5%)	18.8	18.5 – 19.1
More than 20 years old	151 (34.1%)	32.3	30.6 – 33.9	136 (32.1%)	32.0	30.3 – 33.7
Total	443 (100.0%)	19.4	18.4 – 20.6	424 (100.0%)	19.0	17.9 – 20.1

The owners of the 104 engines for which the exact age was unknown were asked to estimate the age of their engine at the time of replacement using the five categories presented in Table 11a (the same categories used in Table 11).³⁴ One respondent indicated the age of their engine did not fit into the categories provided, stating later that their engine was “rebuilt, not replaced.” Nineteen (18.3%) other respondents could not generate a response to this question, leaving this information available for 84 engines. As shown in Table 11a, of the engines that had been rebuilt, replaced, or repowered, the majority ($n = 26$; 31.0%) were over 20 years old when this occurred. The next largest proportion of engines were six to 10 years old ($n = 21$; 25.0%). Similar proportions were 11 to 15 ($n = 15$; 17.9%) and 16 to 20 years old ($n = 14$; 16.7%). Slightly under one in ten engines ($n = 8$; 9.5%) were rebuilt, replaced, or repowered before they were five years old.

³⁴ Unlike Table 11, confidence intervals are not shown here as they could not be calculated.

Table 11a. Age of Engines at Time of Replacement

Age Range	Unweighted Values		Weighted Values	
	# of Engines	% of Engines	# of Engines	% of Engines
≤ 5 Years old	9	10.2%	8	9.5%
6-10 Years old	21	23.9%	21	25.0%
11-15 Years old	15	17.0%	15	17.9%
16-20 Years old	16	18.2%	14	16.7%
More than 20 years old	27	30.7%	26	31.0%
Total	88	100.0%	84	100.0% ³⁵

The ages for the 424 engines for which an exact number was provided (Table 11) were added to the estimated ages for the 84 engines for which only a range was provided (Table 11a), yielding a range of ages for 508³⁶ engines where an exact age was provided, or a range was selected.³⁷ As shown in Table 11b, considering all engines for which some information was provided, the largest proportion of engines that had been replaced were over the age of 20 when this replacement occurred ($n = 162$; 31.9%).

³⁵ Due to rounding, the total of the percentages sum to 100.1%

³⁶ The age of 20 (3.9%) engines at the time they were rebuilt, replaced, or repowered was unknown.

³⁷ Unlike Table 11, confidence intervals are not shown here as they could not be calculated.

Table 11b. Age of Engines at Time of Replacement

Age Range	Unweighted Values		Weighted Values	
	# of Engines	% of Engines	# of Engines	% of Engines
≤ 5 Years old	53	10.0%	50	9.8%
6-10 Years old	90	16.9%	90	17.7%
11-15 Years old	93	17.5%	88	17.3%
16-20 Years old	117	22.0%	118	23.2%
More than 20 years old	178	33.5%	162	31.9%
Total	531	100.0%³⁸	508	100.0%³⁹

Asked whether their old engine was scrapped, still in use by the secondhand buyer, or handled in some “other” way, the owners of 159 engines (33.2%) indicated they had been scrapped, while 84 engines (17.6%) were still in use by the secondhand owner as indicated by survey respondents. According to survey respondents, 236 engines were handled in some “other” way, the majority of which ($n = 177$; 75.0%) were rebuilt. Other common responses were “repaired,” “recycled,” “gave it away,” “used for parts,” “returned or exchanged for core charge,” and “still have it.” This information was unknown for 48 (9.2%) of the 528 engines that had been rebuilt, replaced, or repowered.

Vessel Use During the COVID-19 Pandemic

RMV owners were asked four questions pertaining to how often they used their vessels and operated their engines in the 12 months prior to completing the survey which corresponded with the COVID-19 pandemic. Each of these four questions were asked for two different six-month time periods—first, during the warm period (May to October) and then the cool period (November to April). Because surveys were completed between February and September of 2022, the 12-month period ranged from February 2021 through September 2022. The initial question inquired about the number of days each vessel was used during the six-month period, followed by how long the vessel engine was running on average on the days it was used. Participants were then asked the percent of time their vessel engine was “idling or in neutral” on the days it was in use. Finally, an item on the survey inquired, “on the days that you did use your boat during each period, how many times was the engine restarted per day.”

³⁸ Due to rounding, the total of the percentages sum to 99.9%

³⁹ Due to rounding, the total of the percentages sum to 99.9%

Days of Vessel Use in Warm Period (May to October) During COVID-19 Pandemic

Nearly one-third ($n = 1,397$; 32.9%) of vessels were used zero days in the warm period (see Table 12) during the COVID-19 Pandemic. A little over fifteen percent ($n = 653$; 15.4%) were utilized one to two days in this time, followed 14.1% ($n = 598$) that were used more than 12 days. A slightly lower proportion of vessels ($n = 496$; 11.7%) were used between three and four days, while 8.7% ($n = 371$) were utilized five to six days. A nearly equal proportion of vessels were used between seven and eight days ($n = 260$; 6.1%) and nine and 10 days ($n = 269$; 6.3%) in the warm period. Finally, the lowest proportion of vessels ($n = 204$; 4.8%) was used between 11 and 12 days in the warm period during the COVID-19 pandemic.

Table 12. Days of Vessel Use in Warm Period (May to October)				
	Unweighted Values		Weighted Values	
Day Range	Count	%	Count	%
Zero Days per Period	1,385	32.3%	1,397	32.9%
One to Two Days per Period	642	15.0%	653	15.4%
Three to Four Days per Period	495	11.5%	496	11.7%
Five to Six Days per Period	380	8.9%	371	8.7%
Seven to Eight Days per Period	261	6.1%	260	6.1%
Nine to 10 Days per Period	270	6.3%	269	6.3%
11 to 12 Days per Period	217	5.1%	204	4.8%
More Than 12 Days per Period	640	14.9%	598	14.1%
Total	4,290	100.0%⁴⁰	4,249	100.0%

Hours of Vessel Use in Warm Period (May to October) During the COVID-19 Pandemic

Of the 2,852 vessels used at least once in the warm period during the COVID-19 pandemic, average engine run time when in use was available for 2,832.⁴¹ When used, the majority of vessel engines ($n = 1,464$; 51.7%) ran between one to three hours on average per day, followed by the next largest proportions that ran between four and six hours ($n = 785$; 27.7%) and less than one hour ($n = 416$; 14.7%), on average, per day. As shown in Table 13, less than 6.0% ($n = 167$; 6.0%) of vessels used at least once during this period had their engines running seven or more hours daily on average.

⁴⁰ Due to rounding, the total of the percentages sum to 100.1%

⁴¹ This information was only missing for <0.1% ($n = 20$) of vessels used at least once during the warm period.

Table 13. Average Hours Vessel Engine Was Used Each Day in Warm Period (May to October)

Hour Range	Unweighted Values		Weighted Values	
	Count	%	Count	%
Less Than One Hour per Day	476	16.5%	416	14.7%
One to Three Hours per Day	1,464	50.8%	1,464	51.7%
Four to Six Hours per Day	777	27.0%	785	27.7%
Seven to Nine Hours per Day	110	3.8%	112	4.0%
Ten to 12 Hours per Day	29	1.0%	27	1.0%
13 to 15 hours per Day	13	0.5%	13	0.5%
More than 15 hours per Day	14	0.5%	15	0.5%
Total	2,883	100.0%⁴²	2,832	100.0%⁴³

Percent of Time Engine Idling or in Neutral in Warm Period (May to October) During the COVID-19 Pandemic

Of the 2,852 vessels used at least once in the warm period during the COVID-19 pandemic, the percentage of the time their engine was in neutral or idle during use was available for 2,806.⁴⁴ As shown in Table 14, over half of the vessels ($n = 1,481$; 52.8%) had their engine in neutral or idle when in use less than 10% of the time. The next largest proportions had their engine in neutral or idling 0% ($n = 413$; 14.7%) and 10 to 20% ($n = 474$; 16.9%) of the time. One hundred seventy-nine vessels (6.4%), when in use, had their engine in neutral or idling 21 to 30% of the time. An equal proportion of vessels had their engine in neutral or idling between 31 and 40% ($n = 63$; 2.2%) and 41 and 50% ($n = 61$; 2.2%) of the time. Lastly, less than 5.0% of vessels ($n = 136$; 4.9%) had their engines in neutral or idling over 50% of the time when in use.

⁴² Due to rounding, the total of the percentages sum to 100.1%

⁴³ Due to rounding, the total of the percentages sum to 100.1%

⁴⁴ The owners of 45 vessels (1.6%) stated this question was either not applicable or declined to answer.

Table 14. % of Time Engine Idling in Warm Period (May to Oct)

Percentage Range	Unweighted Values		Weighted Values	
	Count	%	Count	%
0% of the Time	448	15.7%	413	14.7%
Less Than 10%/Day	1,490	52.3%	1,480	52.7%
10-20%/Day	474	16.6%	474	16.9%
21-30%/Day	178	6.2%	179	6.4%
31-40%/Day	66	2.3%	63	2.2%
41-50%/Day	62	2.2%	61	2.2%
51-60%/Day	41	1.4%	43	1.5%
61-70%/Day	28	1.0%	27	1.0%
70% of the Time or More/Day	64	2.2%	66	2.4%
Total	2,851	100.0%⁴⁵	2,806	100.0%

Number of Times Engine Restarted in Warm Period (May to October) During the COVID-19 Pandemic

Of the 2,852 vessels used at least once in the warm period during the COVID-19 pandemic, the number of times their engine was restarted per day was available for 2,802.⁴⁶ The largest proportion of vessels ($n = 899$; 32.1%) had their engines restarted two to three times per day when used in the warm period during the COVID-19 pandemic, followed by 30.2% ($n = 845$) that had their engines restarted four to six times per day when used during this time period (see Table 15). Close to 15.0% of vessels ($n=408$; 14.6%) used at least once in the warm period during the COVID-19 pandemic had their engine restarted more than ten times per day. Eleven and one tenth of vessels had their engines restarted seven to nine ($n = 310$) times per day when in use during this period. Meanwhile, 8.9% of vessels had their engines restarted one time ($n = 250$; 8.9%) per day when in use during this period and less than 5% of vessels ($n = 88$; 3.1%) did not have their engines restarted when in use during this period, according to the owner.

⁴⁵ Due to rounding, the total of the percentages sum to 99.9%

⁴⁶ Thirty-seven respondents (1.3%) did not know the answer to this question and 13 (0.4%) stated the question was not applicable.

Table 15. Number of Times Engine Restarted Warm Period (May to Oct)

Number of Times	Unweighted Values		Weighted Values	
	Count	%	Count	%
Zero Times/Day	102	3.6%	88	3.1%
One Time/Day	285	10.0%	250	8.9%
Two to Three times/Day	930	32.7%	899	32.1%
Four to Six Times/Day	797	28.0%	845	30.2%
Seven to Nine Times/Day	313	11.0%	310	11.1%
Ten or More Times/Day	418	14.7%	408	14.6%
Other	3	0.1%	2	0.1%
Total	2,848	100.0%⁴⁷	2,802	100.0%⁴⁸

Days of Vessel Use in Cool Period (November to April) During COVID-19 Pandemic

A little over 60% of all vessels in the study sample ($n = 2,571$; 60.5%) were used zero days in the cool period of November to April during the COVID-19 pandemic (see Table 16). This compares to 32.9% ($n = 1,397$) of vessels used zero days during the warm period of May to October. A little over fourteen percent ($n = 612$; 14.4%) were used one to two days in this time, followed by 8.5% ($n = 361$) that were used three to four days. An equal proportion of vessels were used five to six ($n = 214$; 5.0%) and more than 12 days ($n = 213$, 5.0%) during this time. Nearly seven percent of all vessels in the study sample ($n = 278$; 6.5%) were used between seven and twelve days in the cool period during the COVID-19 pandemic, as shown in Table 16.

⁴⁷ Due to rounding, the total of the percentages sum to 100.1%.

⁴⁸ Due to rounding, the total of the percentages sum to 100.1%

Table 16. Days of Vessel Use in Cool Period (November to April)

Day Range	Unweighted Values		Weighted Values	
	Count	%	Count	%
Zero Days per Period	2,553	59.5%	2,571	60.5%
One to Two Days per Period	600	14.0%	612	14.4%
Three to Four Days per Period	367	8.6%	361	8.5%
Five to Six Days per Period	220	5.1%	214	5.0%
Seven to Eight Days per Period	113	2.6%	108	2.5%
Nine to Ten Days per Period	102	2.4%	96	2.3%
11 to 12 Days per Period	85	2.0%	74	1.7%
More Than 12 Days per Period	250	5.8%	213	5.0%
Total	4,290	100.0%	4,249	100.0% ⁴⁹

Hours of Vessel Use in Cool Period (November to April) During the COVID-19 Pandemic

Of the 1,678 vessels used at least once in the cool period during the COVID-19 pandemic, the average engine run time when in use was available for 1,664.⁵⁰ Looking at the daily average run time during the cool period, Table 17 shows the majority of vessel engines ($n = 876$; 52.6%) were used between one and three hours, on average, a day. This is consistent with what was observed in the warm period. The engines of 23.4% ($n = 389$) of all vessels in the study sample ran for less than one hour, on average, per day in the cool period, while 19.2% ($n = 320$) of all vessel engines ran between four and six hours a day, on average. Less than five percent ($n = 79$; 4.7%) of vessels had their engines running more than seven hours daily, on average, when in use during this time.

⁴⁹ Due to rounding, the total of the percentages sum to 99.9%.

⁵⁰ Nine respondents (0.5%) noted the survey item was not applicable and another five (0.3%) declined to provide a response.

Table 17. Hours Vessel Engine Was Used Each Day in Cool Period (November to April)

Hour Range	Unweighted Values		Weighted Values	
	Count	%	Count	%
Less Than One Hour per Day	433	25.1%	389	23.4%
One to Three Hours per Day	895	52.0%	876	52.6%
Four to Six Hours per Day	317	18.4%	320	19.2%
Seven to Nine Hours per Day	48	2.8%	52	3.1%
Ten to 12 Hours per Day	14	0.8%	14	0.8%
13 to 15 hours per Day	7	0.4%	6	0.4%
More than 15 hours per Day	8	0.5%	7	0.4%
Total	1,722	100.0%	1,664	100.0%⁵¹

Percent of Time Engine Idling or in Neutral in Cool Period (November to April) During the COVID-19 Pandemic

Of the 1,678 vessels used at least once in the cool period during the COVID-19 pandemic, the percentage of the time their engine was in neutral or idle during use was available for 1,647.⁵² As shown in Table 18, half of the vessels ($n = 824$; 50.0%), when in use, had their engine in neutral or idle less than 10% of the time. Nearly equal proportions had their engine in neutral or idling 0% ($n = 263$; 16.0%) and 10 to 20% ($n = 272$; 16.5%) of the time. Ninety-four vessels (5.7%), when in use, had their engine in neutral or idling 21 to 30% of the time. An equal proportion of vessels had their engine in neutral or idling between 31 and 40% ($n = 42$; 2.5%) and 41 and 50% ($n = 40$; 2.4%) of the time. Lastly, when used, 6.9% of vessels ($n = 113$) had their engines in neutral or idling over 50% of the time.

⁵¹ Due to rounding, the total of the percentages sum to 99.9%.

⁵² This information was not available for 31 (1.9%) vessels.

Table 18. % of Time Engine Idling in Cool Period (November to April)

Percentage Range	Unweighted Values		Weighted Values	
	Count	%	Count	%
0% of the Time	295	17.4%	263	16.0%
Less Than 10%/day	846	49.8%	824	50.0%
10-20%/Day	271	16.0%	272	16.5%
21-30%/Day	94	5.5%	94	5.7%
31-40%/Day	40	2.4%	42	2.5%
41-50%/Day	40	2.4%	40	2.4%
51-60%/Day	35	2.1%	35	2.1%
61-70%/Day	24	1.4%	23	1.4%
70% of the Time or More/Day	53	3.1%	55	3.3%
Total	1,698	100.0%⁵³	1,647	100.0%⁵⁴

Number of Times Engine Restarted in Cool Period (November to April) During the COVID-19 Pandemic

Of the 1,678 vessels used at least once in the cool period during the COVID-19 pandemic, the number of times their engine was restarted per day was available for 1,637.⁵⁵ The largest proportion of vessels ($n = 661$; 40.4%) had their engines restarted two to three times per day when used in the cool period during the COVID-19 pandemic, followed by 23.6% ($n = 387$) that had their engines restarted four to six times per day when used during this time period (Table 19). Two hundred forty-four (14.9%) used at least once in the cool period during the COVID-19 pandemic had their engine started one time per day. A nearly equal proportion of vessels had their engines started seven to nine times ($n = 133$; 8.1%) and ten or more times ($n = 130$; 7.9%) per day when in use during this period. Five percent of vessels ($n = 82$; 5.0%) did not have their engines restarted when in use during this period, as reported by the owner.

⁵³ Due to rounding, the total of the percentages sum to 100.1%

⁵⁴ Due to rounding, the total of the percentages sum to 99.9%

⁵⁵ This information was unknown for 23 (1.4%) vessels and not applicable for 18 (1.1%), according to their owner.

Table 19. Number of Times Engine Restarted Cool Period (November to April)

Number of Times	Unweighted Values		Weighted Values	
	Count	%	Count	%
Zero Times/Day	101	6.0%	82	5.0%
One Time/Day	273	16.2%	244	14.9%
Two to Three times/Day	681	40.3%	661	40.4%
Four to Six Times/Day	372	22.0%	387	23.6%
Seven to Nine Times/Day	133	7.9%	133	8.1%
Ten or More Times/Day	129	7.6%	130	7.9%
Total	1,689	100.0%	1,637	100.0% ⁵⁶

Post COVID-19 Vessel Activity

An item on the survey instrument inquired, “How has your boating activity during each period within the past year with this boat (during the COVID-19 pandemic) compared to your boating activity with this boat before the COVID-19 pandemic?” Survey completers could select one of three response options: “increased,” “decreased,” or “stayed the same.” A follow-up item was administered to respondents whose boating activity had either increased or decreased in the past year compared to before the COVID-19 pandemic. The item inquired, “How much did your boating activity with this boat increase/decrease in the past year compared to before the COVID-19 pandemic?” Response options included: “≤ 10% higher/lower than before,” “Between 11% and 25% higher/lower,” “Between 26% and 50% higher/lower,” “Between 51% and 75% higher/lower,” “Between 75% and 100% higher/lower,” “Between 101% and 200% higher” and “≥ 201% higher.” Respondents were allowed to provide some “other” response.

Boating Activity Within the Past Year Compared to Activity Before COVID-19 in Warm Period (May to October)

Boating activity within the past year compared to that before the COVID-19 pandemic during the warm period was available for 3,906 vessels. The owner of 31 (0.7%) vessels did not know the answer to this survey item, and another 311 (7.3%) did not provide a response. As shown in Table 20, the activity of 397 (10.2%) vessels increased within the past year compared to activity before COVID-19 during the warm period. Meanwhile, a nearly equal portion of vessel activity either decreased ($n = 1,759$; 45.0%) or stayed the same ($n = 1,750$; 44.8%) within the past year compared to activity before COVID-19 during the warm period.

⁵⁶ Due to rounding, the total of the percentages sum to 99.9%

Table 20. Boating Activity Within the Past Year Compared to Activity Before COVID-19 in the Warm Period (May to October)

Number of Times	Unweighted Values		Weighted Values	
	Count	%	Count	%
Increased	412	10.4%	397	10.2%
Decreased	1,739	44.0%	1,759	45.0%
Stayed the Same	1,798	45.5%	1,750	44.8%
Total	3,949	100.0%⁵⁷	3,906	100.0%

The owners of the 1,759 vessels for which a decrease in use was reported, were asked the reason for this decrease. Of these, a response was provided for 1,199 vessels. Because more than one reason was provided for several vessels, a total of 1,309 unique responses were generated. These responses were classified into the 11 categories depicted in Table 20a. As shown, over half of responses ($n = 695$; 53.1%) suggest COVID-19 was the reason for the decrease in vessel usage within the past year during the warm period compared to activity before the COVID-19 pandemic, followed by drought ($n = 134$; 10.2%), time constraints ($n = 88$; 6.7%), issues related to aging/health ($n = 67$; 5.1%), and issues related to maintenance ($n = 60$; 4.6%). Other reasons included responses like “*didn’t have a truck to haul it on for a while,*” “*did not have possession of the boat full time,*” “*Didn’t need to use it,*” “*camping restrictions,*” “*I sold the boat,*” “*no bait,*” and “*moved.*”

⁵⁷ Due to rounding, the total of the percentages sum to 99.9%.

Table 20a. The Reason Boating Activity Decreased Within the Past Year Compared to Activity Before COVID-19 in the Warm Period (May to October)

Response Category	Unweighted Values		Weighted Values	
	Count	%	Count	%
COVID-19	682	53.2%	695	53.1%
Drought	131	10.2%	134	10.2%
Time/Busy/Work	86	6.7%	88	6.7%
Other	85	6.6%	88	6.7%
Health Reasons/Age/Retirement	65	5.1%	67	5.1%
Maintenance/Equipment Related	60	4.7%	60	4.6%
Family/Personal Issues	51	4.0%	51	3.9%
Money/Inflation/the Economy	36	2.8%	41	3.1%
Lack of Interest/Other Interests/Other Priorities	31	2.4%	31	2.4%
Weather/Fires/Nature (Not drought)	30	2.3%	30	2.3%
Access to Lake/Ocean	24	1.9%	24	1.8%
Total	1,281	100.0%⁵⁸	1,309⁵⁹	100.0%⁶⁰

Boating Activity Within the Past Year Compared to Activity Before COVID-19 in Cool Period (November to April)

Boating activity within the past year compared to that before the COVID-19 pandemic during the cool period was available for 3,453 vessels. The owner of 38 vessels did not know the answer to this survey item, and another 758⁶¹ did not provide a response. As shown in Table 21, the activity of 251 vessels (7.3%) increased within the past year compared to activity before COVID-19 during the cool period. A decrease in activity was reported among 40.3% ($n = 1,392$) of the vessels for which this information was available. Meanwhile, the largest proportion of vessel activity stayed the same ($n = 1,810$; 52.4%) within the past year compared to activity before COVID-19 during the cool period.

⁵⁸ Due to rounding, the total of the percentages sum to 99.9%.

⁵⁹ The weighted data show more cases than the unweighted data because underrepresented groups in the original sample (such as sterndrives, personal watercraft, and outboards) had a high share of respondents reporting decreased usage. Applying the weights amplifies these responses in the results.

⁶⁰ Due to rounding, the total of the percentages sum to 99.9%.

⁶¹ These 758 non-responses (17.8%) can be interpreted as refusals to provide a response to this item. It is likely that the high percentage of non-response to this item is attributed to the complexity of this survey item. Another possible explanation is that the respondents became frustrated with the item appearing a second time for the cool period. This is indicated by the higher rate of non-response on the cool period item compared to the warm period item.

Table 21. Boating Activity Within the Past Year Compared to Activity Before COVID-19 in the Cool Period (November to April)

Number of Times	Unweighted Values		Weighted Values	
	Count	%	Count	%
Increased	264	7.6%	251	7.3%
Decreased	1,371	39.3%	1,392	40.3%
Stayed the Same	1,854	53.1%	1,810	52.4%
Total	3,489	100.0	3,453	100.0%

The owners of the 1,371 vessels for which a decrease in use was reported were asked the reason for this decrease. Of these, a response was provided for 412 vessels. Because more than one reason was provided for several vessels, a total of 967 unique responses were generated. These responses were classified into the 11 categories depicted in Table 21a. Like Table 20a, over half of responses ($n = 497$; 51.4%) suggest COVID-19 was the reason for the decrease in vessel usage within the past year during the cool period compared to activity before the COVID-19 pandemic. The next largest proportion of responses ($n = 83$; 8.6%) suggest drought was the reason for the decrease in vessel usage during this period, followed by time constraints ($n = 62$; 6.4%), issues related to aging/health ($n = 49$; 5.1%), issues related to maintenance of the vessel ($n = 47$; 4.9%) and family/personal issues ($n = 47$; 4.9%). Other reasons included responses like “availability of fishing companion,” “did not have a working tow vehicle,” “I had this boat for one year,” “needed roller furling,” “no longer live near boat in the cooler months,” and “kayaking better for me and the environment.”

Table 21a. The Reason Boating Activity Decreased Within the Past Year Compared to Activity Before COVID-19 in the Cool Period (November to April)

Response Category	Unweighted Values		Weighted Values	
	Count	%	Count	%
COVID-19	486	51.4%	497	51.4%
Drought	83	8.8%	83	8.6%
Other	59	6.2%	64	6.6%
Time/Busy	59	6.2%	62	6.4%
Health Reasons/Age/Retirement	48	5.1%	49	5.1%
Maintenance/Equipment Related	50	5.3%	47	4.9%
Family/Personal Issues	47	5.0%	47	4.9%
Weather/Nature (Not drought)	40	4.2%	40	4.1%
Money/Inflation/the Economy	30	3.2%	33	3.4%
Other Interests/Other Priorities	25	2.6%	27	2.8%
Access to Lake	19	2.0%	18	1.9%
Total	946	100.0%	967⁶²	100.0%⁶³

Level of Increase in Boating Activity Within the Past Year Compared to Activity Before COVID-19 in Warm Period (May to October)

Among the 397 vessels for which owners reported increased boating activity in the warm period of the past year compared to activity before COVID-19, the level of increase was available for 385.⁶⁴ Table 22 shows that the largest proportion of vessels ($n = 130$; 33.8%) was used between 11% and 25% more in the past year compared to activity before COVID-19 in the warm period. The next largest proportion of vessels ($n = 103$; 26.8%), according to vessel owners, were used between 26% and 50% more during that period, followed by 22.9% ($n = 88$) in which owners reported an activity increase of 10% or less during that period. For 16% ($n = 64$; 16.6%) of vessels, owners reported an increase in usage of more than 50% during the warm period compared to pre-COVID-19 activity.

⁶² The weighted data show more cases than the unweighted data because underrepresented groups in the original sample (such as sterndrives, personal watercraft, and outboards) had a high share of respondents reporting decreased usage. Applying the weights amplifies these responses in the results.

⁶³ Due to rounding, the total of the percentages sum to 100.1%

⁶⁴ Twelve respondents (3.0%) declined to provide a response.

Table 22. % Increase in Boating Activity Within the Past Year Compared to Activity Before COVID-19 in the Warm Period (May-October)

Percentage Range	Unweighted Values		Weighted Values	
	Count	%	Count	%
≤ 10 % higher than before	90	22.6%	88	22.9%
Between 11% and 25% higher	136	34.1%	130	33.8%
Between 26% and 50% higher	109	27.3%	103	26.8%
Between 51% and 75% higher	27	6.8%	28	7.3%
Between 75% and 100% higher	18	4.5%	16	4.2%
Between 101% and 200% higher	10	2.5%	11	2.9%
≥ 201% higher	6	1.5%	5	1.3%
Other	3	0.8%	4	1.0%
Total	399	100.0%⁶⁵	385	100.0%⁶⁶

Level of Decrease in Boating Activity Within the Past Year Compared to Activity Before COVID-19 in Warm Period (May to October)

Among the 1,759 vessels for which a decrease in boating activity within the past year compared to activity before COVID-19 in the warm period was reported by the owner, the level of that decrease was available for 1,693.⁶⁷ A decrease in use of 25% or less in the past year compared to activity before COVID-19 during the warm period was reported for slightly more than a quarter of vessels ($n = 433$; 25.6%). Three hundred thirty-six vessels (19.8%) were used between 26% and 50% less during this period, while another 14.6% ($n = 247$) were used between 51% and 75% less. Nearly four in ten ($n = 648$; 38.3%) of vessels were reported to have been used between 75% and 100% less within the past year compared to activity before COVID-19 in the warm period. The owners of 29 (1.7%) vessels noted some “other” decrease level, the most common of which was “no use.”

⁶⁵ Due to rounding, the total of the percentages sum to 100.1%.

⁶⁶ Due to rounding, the total of the percentages sum to 100.2%.

⁶⁷ 66 (3.8%) respondents declined to provide a response to this item.

Table 23. % Decrease in Boating Activity Within the Past Year Compared to Activity Before COVID-19 in the Warm Period (May-October)

Percentage Range	Unweighted Values		Weighted Values	
	Count	%	Count	%
≤ 10 % lower than before	193	11.5%	189	11.2%
Between 11% and 25% lower	238	14.2%	244	14.4%
Between 26% and 50% lower	340	20.3%	336	19.8%
Between 51% and 75% lower	240	14.3%	247	14.6%
Between 75% and 100% lower ⁶⁸	632	37.8%	648	38.3%
Other	30	1.8%	29	1.7%
Total	1,673	100.0% ⁶⁹	1,693	100.0%

Level of Increase in Boating Activity Within the Past Year Compared to Activity Before COVID-19 in Cool Period (November to April)

Among the 251 vessels for which an increase in boating activity within the past year compared to activity before COVID-19 in the cool period was reported, the level of that increase was available for 245.⁷⁰ Table 24 shows that 25.3% ($n = 62$) of owners reported an increase in usage of less than 10% within the past year compared to activity before COVID-19 in the cool period. A similar proportion of vessels were used between 11% and 25% more ($n = 68$; 27.8%) and 26% and 50% more ($n = 61$; 24.9%) during this period. Twelve and two-tenths of vessels ($n = 30$; 12.2%) were used between 51% and 75% more during this period. Vessel owners reported that less than 10% of vessels ($n = 24$; 9.8%) had an increase in use of 75% or more within the past year compared to activity before COVID-19 during the cool period. The owner of one vessel reported an increase of some other rate during this period, simply noting, “30.”

⁶⁸ Due to a survey error, some individuals reported decreases exceeding 100%. Responses for the corresponding 279 vessels were categorized under this response option.

⁶⁹ Due to rounding, the total of the percentages sum to 99.9%.

⁷⁰ Six (2.4%) respondents declined to provide a response to this item.

Table 24. % Increase in Boating Activity Within the Past Year Compared to Activity Before COVID-19 in the Cool Period (November -April)

Percentage Range	Unweighted Values		Weighted Values	
	Count	%	Count	%
≤ 10 % higher than before	68	26.4%	62	25.3%
Between 11% and 25% higher	69	26.7%	68	27.8%
Between 26% and 50% higher	69	26.7%	61	24.9%
Between 51% and 75% higher	28	10.9%	30	12.2%
Between 75% and 100% higher	10	3.9%	10	4.1%
Between 101% and 200% higher	8	3.1%	9	3.7%
≥ 200% higher	5	1.9%	4	1.6%
Other	1	0.4%	1	0.4%
Total	258	100.0%	245	100.0%

Level of Decrease in Boating Activity Within the Past Year Compared to Activity Before COVID-19 in Cool Period (November to April)

Among the 1,3792 vessels for which a decrease in boating activity within the past year compared to activity before COVID-19 in the cool period was observed, the level of that decrease was available for 1,329.⁷¹ The largest proportion of vessels ($n = 585$; 44.0%) were reported to have had a decrease in activity of between 75% and 100% within the past year compared to activity before COVID-19 in the cool period. Table 25 demonstrates that nearly 30% of vessels ($n = 369$; 27.8%) in this category had a reduction in activity by 25% or less during this period. Slightly less than 15% ($n = 198$; 14.9%) of vessels were used between 26% and 50% less, while usage decreased by 51% to 75% for another 10.5% ($n = 140$) of vessels. The owners of 37 vessels (2.8%) noted that the activity of their vessel decreased in some other way; the most common response was “not in use.”

⁷¹ 65 (4.6%) respondents declined to provide a response to this item.

Table 25. % Decrease in Boating Activity Within the Past Year Compared to Activity Before COVID-19 in the Cool Period November- April)

Percentage Range	Unweighted Values		Weighted Values	
	Count	%	Count	%
≤ 10 % lower than before	219	16.8%	216	16.3%
Between 11% and 25% lower	147	11.3%	153	11.5%
Between 26% and 50% lower	196	15.0%	198	14.9%
Between 51% and 75% lower	139	10.7%	140	10.5%
Between 75% and 100% lower ⁷²	567	43.5%	585	44.0%
Other	36	2.8%	37	2.8%
Total	1,304	100.0% ⁷³	1,329	100.0%

Location of RMV Activity

Boating in the State of California

Respondents indicated whether they operated their vessel(s) in the State of California. Based on their responses, it was observed that 3,835 (90.3%) vessels operated in the State at the time of the study, while 414 (9.7%) did not. Next, respondents indicated whether they operated their vessel(s) in the Northern, Central, and Southern regions of the state.

Boating in the Three Regions in the State of California

Of that were operated in the State of California, Table 26 shows nearly equal proportions the 3,835 vessels operated in Northern ($n = 1,521$; 39.7%) and Southern ($n = 1,474$; 38.4%) California. A little greater than one quarter ($n = 1,058$; 27.6%) of vessels in the study sample operated in Central California. Because respondents could select more than one region in this section of the survey, the percentages in Table 26 sum to greater than 100%. The majority of vessels ($n = 3,327$; 86.8%) were operated in one region, 338 (8.8%) were operated in two, and 16 vessels in the study sample (0.4%) were operated in all three regions. The owner of one vessel declined to provide a response to this question, and the owners of 155 (4.0%) vessels did not select any of the three regions, although they did state that they operate their vessels in the State.⁷⁴

⁷² Due to a survey error, some individuals reported decreases exceeding 100%. These responses were categorized under this response option.

⁷³ Due to rounding, the total of the percentages sum to 100.1%

⁷⁴ These 155 (4.0%) cases are assumed to have declined to provide this information.

Table 26. Boating Activity by Region

Region	Unweighted Values		Weighted Values	
	Count	%	Count	%
Northern California	1,521	39.2%	1,521	39.7%
Central California	1,062	27.3%	1,058	27.6%
Southern California	1,519	39.1%	1,474	38.4%

Boating in the Counties Contained in the Northern Region of California

Respondents indicated which counties in each of the three regions they operated their vessel(s). Of the 1,521 vessels operated in the northern region of the state, Table 27 shows the most popular counties for owners to operate their vessels were Sacramento ($n = 310$; 20.4%), Shasta ($n = 222$; 14.6%), Contra Costa ($n = 218$; 14.4%), and Lake ($n = 165$; 10.8%) counties. The least popular counties for vessels to be operated in were Sierra ($n = 27$; 1.8%), Tehama ($n = 18$; 1.2%), Del Norte ($n = 13$; 0.9%), and Modoc ($n = 8$; 0.6%) counties. The percentages in Table 27 sum to greater than 100% because respondents could select more than one county.

Table 27. Boating Activity in Counties (Northern Region)

County	Unweighted Values		Weighted Values	
	Count	%	Count	%
Butte	123	8.1%	125	8.2%
Colusa	31	2.0%	30	1.9%
Contra Costa	220	14.5%	218	14.4%
Del Norte	14	0.9%	13	0.9%
El Dorado	145	9.5%	152	10.0%
Glenn	19	1.2%	17	1.1%
Humboldt	43	2.8%	44	2.9%
Lake	161	10.6%	165	10.8%
Lassen	38	2.5%	41	2.7%
Marin	78	5.1%	69	4.5%
Mendocino	38	2.5%	38	2.5%
Modoc	9	0.6%	8	0.6%
Napa	105	6.9%	105	6.9%
Nevada	86	5.7%	83	5.4%
Placer	147	9.7%	149	9.8%
Plumas	86	5.7%	87	5.7%
Sacramento	304	20.0%	310	20.4%
San Francisco	75	4.9%	59	3.9%
Shasta	215	14.1%	222	14.6%
Sierra	28	1.8%	27	1.8%
Siskiyou	38	2.5%	38	2.5%
Solano	108	7.1%	104	6.8%
Sonoma	97	6.4%	95	6.2%
Sutter	33	2.2%	32	2.1%
Tehama	22	1.4%	18	1.2%
Trinity	71	4.7%	71	4.7%
Yolo	54	3.6%	56	3.7%
Yuba	86	5.7%	87	5.7%

Boating in the Counties Contained in the Central Region of California

Of the 1,058 vessels that were operated in the central region of the state, Table 28 shows the most popular counties for owners to operate their vessels were San Joaquin ($n = 235$; 22.2%), Fresno ($n = 174$; 16.5%), Calaveras ($n = 132$; 12.5%) and Tuolumne ($n = 131$; 12.4%) counties. The least popular counties for vessels to be operated in were Kings ($n = 16$; 1.6%), Mariposa ($n = 13$; 1.2%), San Benito ($n = 10$; 1.0%), and Alpine ($n = 10$; 0.9%) counties. The percentages in Table 28 sum to greater than 100% because respondents could select more than one county.

Table 28. Boating Activity Counties (Central Region)

County	Unweighted Values		Weighted Values	
	Count	%	Count	%
Alameda	104	9.8%	92	8.7%
Alpine	9	0.8%	10	0.9%
Amador	59	5.6%	57	5.4%
Calaveras	132	12.4%	132	12.5%
Fresno	168	15.8%	174	16.5%
Inyo	22	2.1%	22	2.1%
Kings	16	1.5%	16	1.6%
Madera	67	6.3%	71	6.7%
Mariposa	15	1.4%	13	1.2%
Merced	85	8.0%	93	8.8%
Mono	27	2.5%	30	2.9%
Monterey	73	6.9%	74	7.0%
San Benito	9	0.8%	10	1.0%
San Joaquin	231	21.8%	235	22.2%
San Mateo	39	3.7%	35	3.3%
Santa Cruz	45	4.2%	42	4.0%
Stanislaus	97	9.1%	101	9.6%
Tulare	47	4.4%	47	4.4%
Tuolumne	123	11.6%	131	12.4%

Boating in the Counties Contained in the Southern Region of California

Of the 1,474 vessels operated in the southern region of the state, Table 29 shows the most popular counties for owners to operate their vessels were Los Angeles ($n = 425$; 28.8%), San Bernardino ($n = 394$; 26.8%), Riverside ($n = 274$; 18.6%), San Diego ($n = 262$; 17.8%) and Orange ($n = 212$; 14.4%) counties. The least popular county for vessels to operate in was Imperial County ($n = 43$; 2.9%).

Table 29. Boating Activity Counties (Southern Region)

County	Unweighted Values		Weighted Values	
	Count	%	Count	%
Imperial	42	2.8%	43	2.9%
Kern	93	6.1%	89	6.0%
Los Angeles	443	29.2%	425	28.8%
Orange	232	15.3%	212	14.4%
Riverside	275	18.3%	274	18.6%
San Bernardino	376	24.8%	394	26.8%
San Diego	274	18.0%	262	17.8%
San Luis Obispo	109	7.2%	109	7.4%
Santa Barbara	72	4.7%	65	4.4%
Ventura	107	7.0%	98	6.7%

% of Time Spent Boating in the Counties Contained in the Northern Region of California

Participants who operated their vessel in particular counties were then asked to report the percentage of time they spent boating in those counties. The survey was programmed so that the sum of their responses was forced to total 100% (for example, a respondent who indicated only boating in one county would state they spent 100% of their time boating there). As shown in Table 30, the level of non-response to this item was significant (more than half in Humboldt and Lake Counties). This suggests respondents could not accurately estimate the percentage of time they spent boating in each of the counties in which they reported using their vessels. Looking at the mean percentage of time vessels spent operating in each of the northern counties, the largest mean value of 50.2% was observed for Humboldt County, followed by 38.4% for Napa County, 38.3% for Contra Costa County and 36.3% for Plumas County. Due to space limitations, Table 30 only depicts the weighted values. A table with the unweighted values can be found in Appendix D (Table D3).

Table 30. % of Time Spent Boating in Counties in Northern Region (Weighted Values)⁷⁵

County	Count	Non-Response	Min %	Max %	Mean %	Median %	SD %
Butte	64	62	0.0%	95.0%	30.4%	20.0%	27.3%
Colusa	27	3	0.0%	95.0%	23.9%	10.0%	27.0%
Contra Costa	124	94	0.0%	100.0%	38.3%	30.2%	29.2%
Del Norte	6	7	10.0%	90.0%	27.6%	20.0%	24.4%
El Dorado	90	62	0.0%	100.0%	30.7%	25.0%	25.0%
Glenn	16	1	0.0%	80.0%	15.8%	8.44%	20.0%
Humboldt	20	24	0.0%	90.0%	50.2%	50.1%	30.6%
Lake	75	90	0.0%	99.0%	28.7%	20.0%	29.8%
Lassen	34	7	0.0%	90.0%	31.0%	25.0%	25.7%
Marin	54	15	0.0%	95.0%	32.1%	20.0%	29.8%
Mendocino	26	12	0.0%	99.0%	18.4%	10.0%	20.8%
Modoc	5	3	0.0%	50.0%	19.2%	10.0%	21.6%
Napa	82	23	0.0%	100.0%	38.4%	30.0%	29.2%
Nevada	51	32	0.0%	80.0%	31.2%	25.0%	23.9%
Placer	90	59	0.0%	100.0%	34.1%	25.0%	27.3%
Plumas	59	28	0.0%	95.0%	36.3%	30.0%	28.8%
Sacramento	188	122	0.0%	99.0%	35.0%	29.4%	25.2%
San Francisco	51	8	1.0%	100.0%	24.9%	20.0%	23.3%
Shasta	114	108	0.0%	100.0%	31.6%	20.0%	27.4%
Sierra	22	5	0.0%	70.0%	19.2%	10.0%	21.0%
Siskiyou	24	14	0.0%	90.0%	35.2%	31.0%	30.4%
Solano	72	32	0.0%	100.0%	27.4%	20.0%	25.8%
Sonoma	53	42	0.0%	95.0%	32.0%	25.0%	26.7%
Sutter	27	5	0.0%	80.0%	27.1%	16.5%	24.4%
Tehama	13	5	0.0%	95.0%	35.2%	29.6%	30.8%
Trinity	44	27	0.0%	95.0%	31.4%	24.8%	28.0%
Yolo	48	8	0.0%	90.0%	23.1%	20.0%	20.7%
Yuba	66	22	0.0%	90.0%	27.8%	20.0%	24.9%

⁷⁵ Given the amount of missing data on these items, confidence intervals were not calculated as they would not be reliable.

% of Time Spent Boating in the Counties Contained in the Central Region of California

Table 31 depicts the percentage of time spent boating in the counties in the central region. As shown, the level of non-response to this item was significant (more than half in Alpine, Inyo, Tulare, and Tuolumne Counties). Looking at the mean percentage of time vessels spent operating in each of the central counties, the largest mean value of 40.9% was observed for Fresno County, followed by 37.1% for Mono County, 35.4% for Tulare County and 35.3% for Madera Costa County. Due to space limitations, Table 30 only depicts the weighted values. A table with the unweighted values can be found in Appendix D (Table D4).

County	Count	Non-Response	Min %	Max %	Mean %	Median %	SD %
Alameda	57	35	0.0%	100.0%	26.7%	20.0%	25.2%
Alpine	6	4	2.0%	25.0%	15.4%	15.3%	9.4%
Amador	46	11	0.0%	90.0%	19.3%	10.0%	19.9%
Calaveras	82	50	1.0%	100.0%	32.2%	24.6%	26.4%
Fresno	94	80	0.0%	100.0%	40.9%	40.0%	29.2%
Inyo	12	10	2.0%	50.0%	21.8%	20.0%	12.6%
Kings	16	0	2.0%	70.0%	33.9%	30.1%	20.5%
Madera	52	19	1.0%	90.0%	35.3%	27.3%	24.8%
Mariposa	11	2	5.0%	80.0%	30.8%	30.1%	24.0%
Merced	60	33	0.0%	95.0%	33.2%	25.0%	25.2%
Mono	16	14	2.0%	80.0%	37.1%	22.4%	28.5%
Monterey	47	27	0.0%	85.0%	28.6%	20.0%	25.0%
San Benito	9	1	5.0%	90.0%	17.4%	7.8%	29.0%
San Joaquin	134	101	0.0%	95.0%	34.1%	30.0%	22.9%
San Mateo	18	17	5.0%	98.0%	26.5%	20.0%	25.7%
Santa Cruz	23	19	0.0%	90.0%	30.5%	27.0%	23.2%
Stanislaus	72	29	0.0%	95.0%	31.9%	25.0%	25.4%
Tulare	16	31	0.0%	80.0%	35.4%	39.6%	21.0%
Tuolumne	64	67	1.0%	95.0%	33.1%	30.0%	24.6%

% of Time Spent Boating in the Counties Contained in the Southern Region of California

The percentage of time spent boating in the counties in the southern region is depicted in Table 32. As shown, the level of non-response to this item was significant (more than half in Kern, Los Angeles, Riverside, San Bernardino, San Diego, San Luis Obispo, and Ventura Counties). Looking at the mean percentage of time vessels spent operating in each of the southern counties, the largest mean value was 50.3% for San Bernardino County, 46.9% for Los Angeles County, 43.5% for San Luis Obispo County, and 39.3% for Orange County. A table with the unweighted values can be found in Appendix D (Table D5).

⁷⁶ Given the amount of missing data on these items, confidence intervals were not calculated as they would not be reliable.

Table 32. % of Time Spent Boating in Counties in the Southern Region (Weighted Values)⁷⁷

County	Count	Non-Response	Min %	Max %	Mean %	Median %	SD %
Imperial	21	22	2.0%	90.0%	38.2%	40.0%	24.1%
Kern	42	47	2.0%	80.0%	25.7%	20.0%	22.8%
Los Angeles	196	229	0.0%	98.0%	46.9%	50.0%	30.2%
Orange	126	86	0.0%	100.0%	39.3%	30.0%	28.3%
Riverside	139	135	0.0%	100.0%	36.7%	30.0%	26.1%
San Bernardino	157	237	0.0%	100.0%	50.3%	50.0%	27.8%
San Diego	95	167	0.0%	100.0%	36.1%	25.0%	29.9%
San Luis Obispo	48	61	2.0%	90.0%	43.5%	40.0%	29.3%
Santa Barbara	40	25	2.0%	80.0%	27.6%	20.0%	21.5%
Ventura	55	43	2.0%	90.0%	40.2%	31.6%	30.1%

Boating Along the California Coast

Respondents who operated their vessels in California responded to an item inquiring whether they used their vessel along the California Coast, including the Pacific Ocean, bays, or harbors along the coast. Of the 3,835 vessels operated in California, this information was only available for 1,275 vessels, as the owners of 2,560 (66.7%) vessels declined to respond to this item. This item may have elicited this level of non-response because it did not apply to a significant number of vessels, such as those operating in Central California. In fact, of the vessels registered in counties touching the California Coastline, this information was unavailable for 30.7%. The same was true of 87.9% of vessels registered in counties not touching the coastline. Thus, while the level of non-response to this item was notably high, it was less of a problem amongst vessels registered in counties touching the coastline. Of the 1,275 vessels for which this information was available, 851 (66.8%) were used along the California Coast, while the remaining 424 (33.2%) were not. Comparing vessels registered in counties touching the California Coastline to those that do not, there was no statistically significant difference in the percentage who operate off the coastline (65.4% of vessels registered in counties that touch the coastline compared to 71.3% of vessels registered in counties that do not touch the coastline).

A follow-up question asked, “What percentage of the time do you operate this boat along the California Coast (that is, not in freshwater bodies of water, like rivers, lakes, and reservoirs)?” The owners of 801 vessels responded, while the owners of 49 (5.8%) declined to do so. The owner of one vessel indicated “most of the time” instead of providing a percentage, while the owners of 801 vessels provided a valid response. Of the 801 vessels for which this information was available, the percentage of time operated along the California Coast ranged from 0% ($n = 18$; 2.2%) to 100% ($n = 513$; 64.0%), with a mean of 81.0%, a median of 100.0%, and a standard deviation of 32.4%.⁷⁸

⁷⁷ Given the amount of missing data on these items, confidence intervals were not calculated as they would not be reliable.

⁷⁸ 95% CI [77.9, 82.3]

Asked how far into the ocean from the shoreline they usually operated their vessel(s), the owners of 843 vessels operated along the California Coast responded. This information was not available for the remaining eight (<1.0%) vessels operated along the California Coast. Table 33 shows that the majority of vessels operated along the California Coast ($n = 495$; 58.7%) were used within three nautical miles of the shoreline, while the next largest proportion ($n = 278$; 33.0%) were operated between three and 24 nautical miles from the shoreline.

Table 33. Usual Distance from the Shoreline Operating in the Ocean				
Distance	Unweighted Values		Weighted Values	
	Count	%	Count	%
Within three nautical miles	517	57.5%	495	58.7%
Between 3 and 24 nautical miles	302	33.6%	278	33.0%
More than 24 nautical miles	80	8.9%	70	8.3%
Total	899	100.0%	843	100.0%

Vessel Storage Location

Most vessels were stored at a residence ($n = 3,183$; 74.9%), while 12.0% ($n = 508$) were stored at a storage facility and 9.8% ($n = 416$) at the marina. One hundred forty-one vessels were stored at some “other” location, including the residence of a friend or family member, at a secondary residence, “barged,” “moored,” on another boat, at a warehouse, on a farm, on a private lot, at work, at a business, among others.

Table 34. Vessel Storage				
Storage Area	Unweighted Values		Weighted Values	
	Count	%	Count	%
At a residence	3,122	72.8%	3,183	74.9%
Storage facility	500	11.7%	509	12.0%
At a marina	528	12.3%	416	9.8%
Other	140	3.3%	141	3.3%
Total	4,290	100.0%⁷⁹	4,249	100.0%

⁷⁹ Due to rounding, the total of the percentages sum to 100.1%.

Of the 509 vessels stored at a storage facility, the distance between the owner’s residence and the storage facility was available for 503 vessels.⁸⁰ For these 503 vessels, the distance between the owner’s residence and the storage facility ranged from zero to 1,000 miles, with a mean of 66.2 miles, a median of 10 miles, and a standard deviation of 115.8 miles.⁸¹ Of the 416 vessels stored at a marina, the distance between the owner’s residence and the marina was available for 412.⁸² For these 412 vessels, the distance between the owner’s residence and the marina ranged from zero to 500 miles, with a mean of 33.6 miles, a median of 10 miles, and a standard deviation of 64.9 miles.⁸³

Amount of Fuel Left in Tank After a Typical Trip

The amount of fuel left in the tank after a typical trip was available for 4,044 vessels.⁸⁴ As shown in Table 35, the largest proportion of vessels ($n = 1,086$; 26.9%) had between $\frac{1}{4}$ and $\frac{1}{2}$ a tank of fuel remaining after a typical trip, while 22.1% ($n = 893$) had between $\frac{1}{2}$ and $\frac{3}{4}$ of a tank left. An equal proportion of vessels had a nearly empty tank ($n = 813$; 20.1%) or $\frac{1}{4}$ of a tank ($n = 814$; 20.1%) remaining at the end of a typical trip. The smallest proportion of vessels ($n = 438$; 10.8%) had nearly full tanks at the end of a typical trip.

Amount	Unweighted Values		Weighted Values	
	Count	%	Count	%
The tank is near empty	821	20.3%	813	20.1%
About $\frac{1}{4}$ of a tank	799	19.7%	814	20.1%
Between $\frac{1}{4}$ to $\frac{1}{2}$ of a tank	1,052	26.0%	1,086	26.9%
Between $\frac{1}{2}$ to $\frac{3}{4}$ of a tank	896	22.1%	893	22.1%
The tank is nearly full	484	11.9%	438	10.8%
Total	4,052	100.0%	4,044	100.0%

Likelihood of Considering the Purchase of an Electric or Hybrid-Electric Boat

An item on the survey instrument inquired, “If you were in the market for a new boat, how likely would you be to consider purchasing an electric or hybrid-electric boat with similar specifications to a gasoline

⁸⁰ This information was missing for six (1.2%) vessels.

⁸¹ 95% CI [56.1, 76.3]

⁸² This information was missing for three (<1.0%) vessels.

⁸³ 95% CI [27.3, 39.9]

⁸⁴ This information was unavailable for 205 (4.8%) vessels.

boat, such as power, output, size, weight, and cost?” Two hundred forty-seven respondents (8.6%) declined to respond to this item. Among those who did, the largest proportion ($n = 874$; 33.5%) stated they were not at all likely to purchase an electric or electric-hybrid RMV if they were in the market for a new RMV, as shown in Table 36. The next largest proportion ($n = 572$; 21.9%) reported being somewhat likely to consider this type of purchase. Over a quarter of respondents ($n = 702$; 26.9%) reported being likely or very likely to consider purchasing an electric vehicle with similar specifications to a gasoline RMV if they were in the market for a new boat. The data in Table 36 were not weighted, as each participant had at least one RMV in the sampled category, making the participant-level sample representative of the population.

Table 36. Likelihood of Vessel Owners Purchasing an Electric or Hybrid-electric Vessel with Similar Specifications to a Gasoline Vessel

Likelihood of Buying Electric or Hybrid Electric Vessel	# of Owners	% of Owners
Not at all Likely	874	33.5%
Not Very Likely	462	17.7%
Somewhat Likely	572	21.9%
Likely	307	11.8%
Very Likely	395	15.1%
Total	2,610	100.0%

Portable Fuel Containers: Numbers and Specifications

An item on the survey instrument inquired, “In addition to the primary fuel tank, how many portable fuel containers (PFCs) do you use to fuel your boat(s)?” All 2,857 survey completers responded. The number of PFCs ranged from zero ($n = 1,810$; 63.4%) to 300 ($n = 1$; < 0.1%), with a mean of 0.81, a median of 0.0 and a standard deviation of 5.9 containers.⁸⁵ The total number of portable fuel containers in the study sample is 2,322. Table 37 depicts the distribution of PFCs used to refuel boats and the number of PFCs used. As shown, nearly 50% of the PFCs represented in the survey sample belong to respondents who owned one or two. Because population-level data on PFCs were unavailable, these data could not be weighted.

⁸⁵ 95% CI (.59, 1.0]

Table 37. Number of Portable Fuel Containers (PFC) Used to Refuel Boat(s)

PFC Containers Used	# of Vessel Owners	% of Vessel Owners	# of Portable Fuel Containers	% of Portable Fuel Containers
0	1,810	63.4%	0	0.0%
1	572	20.0%	572	24.6%
2	291	10.2%	582	25.1%
3	49	1.7%	147	6.3%
4	84	2.9%	336	14.5%
5	25	0.9%	125	5.4%
6	8	0.3%	48	2.1%
7	3	0.1%	21	0.9%
8	9	0.3%	72	3.1%
10	3	0.1%	30	1.3%
12	1	<0.1%	12	0.5%
20*	2	<0.1%	377	16.2%
Total	2,857	100.0%	2,322	100.0%

Respondents were asked to provide information on the type, size, and material of each PFC they used, along with how frequently they refilled it. This information could be provided for up to 20 PFCs. Thus, data were only available for 1,985 of the 2,322 PFCs in the survey sample.

Looking at container type, it was observed that the majority of PFCs in the survey sample are general consumer PFCs ($n = 1,543$; 80.3%), while one in five are marine PFCs ($n = 378$; 19.7%). The type of 64 PFCs (3.2% of PFCs in the sample) was unknown.

Table 38 shows that the majority of PFCs in the study sample ($n = 1,553$; 78.2%) were between zero and five gallons in size. Nearly 16.0% of gas cans in the survey sample ($n = 311$; 15.7%) were between six and 12 gallons in size, and 4.1% ($n = 81$) were between 13 and 25 gallons. The owners of 13 PFCs (0.7%) indicated that the range options provided in the survey (zero to 50 gallons) did not describe their PFC.

Table 38. Portable Fuel Container Size

Container Size	# of Portable Fuel Containers	% of Portable Fuel Containers
0-5 Gallons	1,553	78.2%
6-12 Gallons	311	15.7%
13-25 Gallons	81	4.1%
25-50 Gallons	27	1.4%
Not listed	13	0.7%
Total	1,985	100%⁸⁶

Nearly nine in ten PFCs in the survey sample ($n = 1,780$; 89.7%) were made of plastic, according to the owners. Less than 10% of the PFCs represented in the study sample ($n = 186$; 9.3%) were made of metal or fiberglass. The owners of 19 PFCs (1.0%) indicated that the material options provided in the survey (plastic, metal, and fiberglass) did not describe their PFC.

Table 39. Portable Fuel Container Material

Container Material	# of Portable Fuel Containers	% of Portable Fuel Containers
Plastic	1,780	89.7%
Metal	116	5.8%
Fiberglass	70	3.5%
Not listed	19	1.0%
Total	1,985	100%

⁸⁶ Due to rounding, the total of the percentages sum to 100.1%.

Lastly, respondents were asked how often they refilled their PFC(s). This information was unknown for 11.9% ($n = 236$) of PFCs in the study sample. As shown in Table 40, of those for which an answer was provided, the majority ($n = 1,160$; 66.3%) were refilled every time before boating. One in ten PFCs ($n = 177$; 10.1%) were refilled once a month, and less than 10.0% ($n = 115$; 6.6%) were refilled every week or every two weeks. Seventeen percent ($n = 297$; 17.0%) of PFCs were refilled at some “other” frequency. The frequency with which these 297 gas cans were refilled varied and included responses such as “whenever low,” “3 months,” “once a year,” “six months,” “every two months,” “when it needs filling,” “yearly,” “once every six months,” “whenever the boat fuel tank gets to less than $\frac{1}{4}$ full,” and “as needed.”

Table 40. Frequency of Refilling Portable Fuel Container		
Frequency	# of Portable Fuel Containers	% of Portable Fuel Containers
Every time before boating	1,160	66.3%
Every week	55	3.1%
Every two weeks	60	3.4%
Every month	177	10.1%
Other	297	17.0%
Total	1,749	100%⁸⁷

DISCUSSION

The primary goal of the current study was to assess the level of activity associated with RMV operating in California. A secondary goal was to obtain information on a variety of characteristics of the vessels, including the number of engines contained within them, how those engines are fueled, their horsepower, age, and hour meter reading (if present). A third goal was to ascertain where vessels operated, including whether they operated off the coast. Finally, the survey assessed the likelihood that vessel owners would consider purchasing an electric or hybrid vessel if they were in the market. These data will ultimately be used to inform updates to CARB’s RMV inventory that estimates emissions from these vessels within California.

⁸⁷ Due to rounding, the total of the percentages sum to 99.9%.

A postcard push-to-web procedure was used for the current study, whereby vessel owners who were randomly selected to be part of the study were sent a postcard asking them to participate in an online survey through the QR code or link that was provided. This approach was used based on the contractor's assumption that responding to the items contained in the survey would be easier and more convenient online as compared to over the telephone with a live interviewer. Furthermore, response rates in telephone survey research have been declining precipitously in recent decades, therefore obtaining the data through this mode of administration would have been cost prohibitive. One of the limitations of using this approach is that it excludes individuals who are not computer literate. Another limitation of using this mode of data collection is that it does not permit for clarification of survey responses that are contradictory, inconsistent, or outlying.

To get a representative sample of vessel owners, CARB relied on a complete list of DMVs registered RMVs in active use as of 2021. From this list, a stratified sample of 87,691 addresses, each representing a unique registry, was drawn. These addresses served as the sampling frame for the current study. Of these, 85,691 were sent a postcard inviting the recipient to participate in the online survey.⁸⁸ Potential respondents could access the survey through either a QR code or survey link. The postcard also informed the receiver that the survey would take between 10 and 15 minutes and that those who completed it would be sent an electronic Amazon gift card in the amount of \$10 for their time.

In total, 2,857 vessel owners participated in the study for a response rate of 3.7%. While this relatively low response rate introduces the potential for nonresponse bias, an additional concern of sampling bias was also identified. A chi-square analysis comparing vessel type distributions in the survey sample to those in the California DMV population revealed a statistically significant difference, indicating that certain vessel types were over- or underrepresented. Specifically, sailboats, inboards, and jets were overrepresented, whereas sterndrives were underrepresented. To correct for this imbalance, vessel-level weights were calculated by dividing the expected count for each vessel type (based on its population proportion and the total sample size) by its actual count in the sample. These weights were applied to the dataset to bring the sample distribution into alignment with the known population distribution. To ensure more accurate and generalizable findings, the weighted data should be used for all modeling and inferential analyses.

Multiple processes were implemented throughout the study to ensure a survey that collected the salient information accurately while minimizing respondent burden. These processes involved sharing the survey instrument with the NMMA and revising it based on their feedback. They also conducted 18 cognitive interviews with vessel owners via Zoom to explore how survey items were being interpreted, the clarity of the questions, and what type of salient information could be recalled. Based on the results of these interviews, CARB, in collaboration with the SSRC, made more revisions. A pilot test with 23 vessel owners was also conducted to determine the survey instrument's viability and appropriateness for the project's purpose. Finally, survey data were examined regularly throughout the life of the study to identify anomalies or other problems that might point to respondents' difficulty understanding items in the survey. Despite these efforts, the final data resulting from the administration of this survey suggest some respondents found survey items to be challenging and that the survey was too long. Removing outlying values of over an hour, analyses revealed the survey took 17 minutes, on average, to

⁸⁸ Of the 87,691 addresses, 2,000 were used to obtain 18 cognitive interviews and 23 surveys during the pilot study.

complete. Analyses also revealed that, in general, the amount of missing data increased as the survey went on, suggesting respondent fatigue. A review of the data also found instances where the respondent failed to understand the question correctly. For example, some owners whose vessels were not in use reported them in the survey, despite explicit instructions to report only vessels that were in use. These findings should be considered when interpreting the results of this study.

While efforts were made to minimize the likelihood of missing data (e.g., conducting cognitive interviews to improve the clarity of the survey items) for many of the survey items, missing data was still present. The level of missing data across all survey items ranged from a low of less than 1% to a high of over 50%. The literature on how to address missing data is complex and inconsistent in its recommendations, especially where categorical data are involved. For the current study, pairwise deletion (complete case analysis) was used to handle the missing data. Though this technique is one of the most commonly used to handle missing data (Peugh & Enders, 2004), it assumes the data are Missing Completely at Random or MCAR. The assumption of MCAR was not tested here, as it was beyond the scope of the current study. However, missing data can cause bias in the estimation of parameters and may reduce the representativeness of the sample. While this may not be the case where the amount of missing data is small (e.g., less than 5% of the cases), it is likely the case where the amount of missing data is large. Looking at the variables with information missing on more than 5% of the cases in the survey sample, the severity of missingness ranges from a low of 5.7% on the amount of gas remaining at the end of a typical trip to a high of 95% for the percentage of time spent boating in Ventura County (among those who reported they spent time boating there). Other items with a large amount of missing data included the horsepower of vessel engines (9.2% missing), the disposition of old engines that were replaced (9.6% of engines that were replaced), change in vessel usage during the reporting period compared to the pre-COVID-19 period (7.9% in the warm period, 18.6% in the cool period), the reason for change in vessel usage (69% of those who reported a change in the warm period and 70.0% of those who reported a change in the cool period), likelihood of purchasing an electric/hybrid vessel (8.6%), whether vessels were operated off the coast of California (65.0%), and the percentage of time spent boating off the coast (5.7% of those who reported boating off the coast). The amount of missing data should be considered when interpreting the results of the current study.

With respect to survey results, most survey completers reported owning one vessel ($n = 1,930$; 67.6%), while a fifth ($n = 614$) owned two. Slightly more than one in ten boaters in the study sample ($n = 313$; 10.9%) owned three or more vessels. Collectively, vessel owners in the study sample owned 4,290 RMV. The most common vessel type owned by survey completers was outboards ($n = 1,564$; 36.5%), followed by personal watercrafts ($n = 925$; 21.6%). As would be expected, given how the sample was selected, the majority ($n = 3,993$; 93.1%) of vessels represented in the study sample were registered with the California DMV alone. However, nearly 5% ($n = 198$; 4.6%) were registered with by both the DMV and the U.S. Coast Guard. The majority of vessels in the study sample ($n = 4,133$; 96.3%) were used for personal/private leisure or sports purposes. Given the small number of vessels used mainly for personal, but occasionally for business ($n = 62$; 1.4%) and for business purposes only ($n = 57$; 1.3%), analyses comparing vessels used for personal purposes to those used for business purposes were not pursued.

Most vessels ($n = 3,631$; 84.6%) had one engine, while slightly over 10.0% had two ($n = 595$; 13.9%). Collectively, the 4,290 vessels represented in the study sample had 5,025 engines. Most engines in the study sample ($n = 4,303$; 85.6%) were fueled by gasoline, while less than 10% were fueled by electric/battery ($n = 388$; 7.7%) or diesel ($n = 312$; 6.2%). The largest proportion of engines ($n = 1,360$;

28.3%) were Mercury. The next largest proportion ($n = 649$; 13.5%) were Yamaha. Engines in the study sample ranged from one to 74 years of age, with a mean of 20.2 years of age. While the largest proportion of engines had a horsepower of less than 16, engine horsepower was related to vessel type. The largest proportion of engines in sailboats ($n = 113$; 49.3%) and outboards ($n = 680$; 35.1%) were less than 16 horsepower; however, among inboards, the largest proportion of engines ($n = 334$; 43.8%) were between 251 and 375 horsepower. The horsepower of engines in sterndrives and jets were similar, with the largest proportion in each either being between 176 and 250 ($n = 183$; 31.2% and $n = 56$; 22.1%, respectively) or between 251 and 375 ($n = 194$; 33.6% and $n = 67$; 26.5%, respectively) horsepower. For personal watercrafts, the largest proportion of engines were between 51 and 120 horsepower. Of the engines with hour meters, the readings ranged from zero to 25,000 with a mean of 481 hours. It is estimated that the 5,025 engines in the study sample had 1,704,580 hours between them. Only 12% ($n = 552$) of the engines represented in the study sample had ever been replaced, rebuilt, or repowered. Engines were between zero and 85 years of age when they were replaced, and the mean age at the time of replacement was 19.4. The majority of old engines ($n = 195$; 35.3%) were rebuilt by their owner.

In the last 12 months during the COVID-19 pandemic, nearly a third of vessels ($n = 1,384$; 32.3%) in the study sample were not used during the warm months (May to October). In contrast, the majority ($n = 2,553$; 56.5%) were not used during the cool months (November to April). This indicates that vessel usage is less frequent during the cool period, which is expected. Looking at just those vessels where some activity was reported, the largest proportions were used between one and two days ($n = 642$; 22.0%) and three to four days ($n = 4495$; 17.0%) per period during the warm period. In contrast, among those vessels used during the cool period, the majority were used between one and two days ($n = 600$; 34.5%). Thus, among those vessels operated in the 12 months during the COVID-19 pandemic, they were used less often in the cool period. Among vessels used during the warm period, the majority ($n = 1,462$; 50.8%) were used for one to three hours per occasion. A similar finding was observed among vessels used during the cool period; that is, the majority ($n = 895$; 52.0%) were operated between one to three hours per occasion. While vessels were operated less frequently during the cool period, the amount of time they were in use per occasion did not differ between the warm and cool periods. The majority of engines contained in the vessels used during the warm period ($n = 1,490$; 52.3%) spent less than 10% of their use time in neutral or idling per occasion. This finding is like that observed among vessels used in the cool period; namely, nearly a majority of engines contained in vessels used during this period ($n = 846$; 49.8%) were left in neutral or idling less than 10% of the time per occasion. The largest proportion of vessels ($n = 930$; 32.7%) had their engines restarted two to three times per occasion when used during the warm period. Similarly, the largest proportion of vessels used during the cool period ($n = 681$; 40.3%) had their engines restarted between two and three times per occasion. These results suggest that while vessels were used less frequently in the cool period compared to the warm period, the way they were used was not different, as measured by these indicators.

The activity of similar proportions of vessels decreased ($n = 1,739$; 44.0%) and stayed the same ($n = 1,798$; 45.5%) in the warm period during the COVID-19 pandemic compared to the year before. Meanwhile, the activity of a larger proportion of vessels ($n = 1,854$; 53.1%) stayed the same in the cool period during the COVID-19 pandemic, than decreased ($n = 1,371$; 39.3%). The most common reason for decreased use during both periods was the COVID-19 pandemic, followed by the drought that affected the entire State between 2020 and 2022. Looking at vessels used less in the warm period during the COVID-19 pandemic compared to the previous year, near equal proportions decreased in use by

between 75% and 100% ($n = 353$; 21.1%) and 26% and 50% ($n = 340$; 20.3%). Likewise, the largest proportion of vessels used less during the cool period decreased in use by between 75% and 100% ($n = 307$; 23.5%), followed by the next largest proportion that decreased between 26% and 50% ($n = 196$; 15.0%).

The survey data provides valuable insights into boating activities across California, despite some challenges with data collection and high non-response rates in certain counties. The findings highlight distinct patterns in how vessels are used across different regions. In Northern California, Humboldt County was the most popular boating destination, with vessels spending an average of 46.9% of their time there. Central California saw Fresno County as the most frequented, with an average usage of 42.9%. In Southern California, San Bernardino County led with an average of 50.7% of boating time. Regarding coastal boating, the survey revealed that a significant proportion of vessels—67.5% of those for which data were available—were used along the California Coast, including the Pacific Ocean, bays, and harbors. The majority of these vessels (57.5%) operated within three nautical miles of the shoreline, with a smaller portion (33.6%) venturing between three and 24 nautical miles offshore. Overall, the data highlights regional preferences and the significant role of coastal waters in recreational boating. Most vessels were operated within a single region, reflecting specific local interests and patterns of usage.

The survey results reveal a growing interest in electric or hybrid-electric boats among respondents. While 8.6% did not respond to the question, a notable portion of those who did expressed a willingness to explore alternative energy options. Specifically, 26.9% of respondents indicated they were likely or very likely to consider purchasing an electric or hybrid-electric RMV with specifications similar to gasoline-powered RMV, and 21.9% were somewhat likely. Although 33.5% were not likely to consider these alternatives, the overall responses highlight a potential market for more sustainable boating options.

Looking lastly at PFCs, we note that the majority of respondents ($n = 1,810$; 63.4%) did not use a PFC to fuel their vessels. A total of 2,322 PFCs were represented in the study sample. Of these, most ($n = 1,553$; 78.2%) were between zero and five gallons in size. Nearly one in five PFCs ($n = 311$; 15.7%) were between six and 12 gallons. Additionally, most PFCs ($n = 1,780$; 89.7%) were made of plastic. The majority of gas cans ($n = 1,160$; 66.3%) were refilled every time the owner went boating.

RECOMMENDATIONS

Recommendations for Using the Study Data

In general, the SSRC has confidence in the findings of the results presented in this report. However, the following caveats should be considered when using the data to update the RMV inventory.

1. Although the study sample mirrored the population of inference with respect to region, there was evidence of sampling bias with regard to vessel type. To address this, standard weighting techniques were applied to adjust for these imbalances. However, the study sample may differ from the population on some unmeasured variables. As a result, caution should be taken when interpreting the results of the current study.
2. While the margin of error on the overall study is narrow (+ or – 1.85 points), it is greater for items in which a large amount of missing data was present. Although the overall amount of missing data was acceptable, some items exhibited a substantial amount of missing data (up to

95% of observations). This may be due to the complexity of certain questions (for example, estimating the percentage of time spent boating in a specific county) or respondent fatigue toward the end of the survey. For example, among those who reported using their vessel in Ventura County, 95% declined to report the percentage of time spent boating there. In addition, among those who reported a change in their vessel use during the warm season of the 19-month COVID-19 period, 69% did not report a reason why. Among those who reported a change in their vessel use during the cool season of the 19-month COVID-19 period, 70% did not indicate the reason for this change. As it was outside of the scope of this study, missing data were not imputed when calculating results. For this study, a pairwise deletion (available cases) approach was used to handle missing data. While this is a commonly used method for handling missing data, it comes with limitations. Missing data treated in this way can cause bias in the estimation of parameters and may reduce the representativeness of the sample. While this may not be the case where the amount of missing data is small (e.g., less than 5% of the cases), it is likely the case where the amount of missing data is significant. The result is that some population estimates may be less accurate than desired, and caution should be taken when interpreting these estimates. For example, because the amount of missing data on the percentage of time spent boating in each of the 58 California counties was notably high, it would not be recommended to extrapolate these data to the population.

3. The results of the current study suggest that estimates of use during the last 12 months (a 12-month period from February 2021 to September 2022, depending on when the survey was completed) were, in some part, less than they were prior to COVID-19.
4. Respondents in the current study cited COVID-19 as the most common factor that affected their decrease in vessel usage. However, drought was also reported as being a significant factor. As a result, the study cannot conclude that factors cited by the respondents are temporary, or that the resulting decrease in use observed in the current study is also temporary.
5. These caveats notwithstanding, the SSRC is confident in the findings of the study and the results presented in this report. These survey data can be used to update the RMV inventory with reasonable confidence that it reflects the population.

Recommendations for Future Study

1. Since COVID-19 was the primarily cited reason for reduced RMV usage, a follow-up study is recommended to assess whether usage levels return to pre-pandemic norms or reflect a lasting shift. This would help determine the long-term effect of the pandemic on recreational boating behavior and ensure future emissions modeling is based on stable, post-pandemic patterns.
2. While COVID-19 was the most cited reason for decreased RMV usage, many respondents also reported drought conditions as a contributing factor. As a result of climate change, droughts are becoming a more regular occurrence in the state. However, their occurrence and duration vary and are difficult to predict and thus consider in emissions modelling. As a result, it is recommended that the study be replicated on a more regular basis.
3. Given the importance drought played in decreased usage, future studies should include items specifically targeting this topic. Usage patterns should be examined across areas of the state differentially impacted by droughts.

4. Although efforts were taken to mitigate cognitive burden while completing the survey, analyses of the data reveal that respondents, nevertheless, experienced survey fatigue toward the end of the survey. Furthermore, the amount of missing data suggests that information recall was hindered by the complexity of certain survey items. It is recommended that future studies further refine the survey instrument by shortening its length and decreasing the level of specificity required.
5. Although efforts were made to minimize the amount of missing data present in the final study sample, some survey items had a large amount data missing, lowering the sample size. While missing data imputation was outside the scope of the current study, future studies could ensure that data imputation is part of the analysis.
6. While one of the goals of the current study was to obtain surveys from 3,000 vessel owners, responses were lower than expected, with 2,857 completions. One way to increase the response rate in future studies is to increase the amount of the incentive offered to potential survey respondents.
7. Additionally, to improve the response rate, reminder postcards should be considered in future studies.

REFERENCES

Peugh, J. & Enders, C.K (2004). Missing data in educational research: A review of reporting practices and suggestions for improvement. *Review of Educational Research*, vol. 74 (4), p. 525-556.

APPENDIX A

Introduction

In an effort to update the Recreational Marine Vessel (RMV) emissions inventory for the State of California, the California Air Resource Board's (CARB) Air Quality and Planning and Science Division contracted with the Social Science Research Center (SSRC) at California State University, Fullerton to complete a survey of RMV owners regarding their vessels' engines and use. Given the nuances of conducting a survey on such a complex and specialized topic, CARB and SSRC opted to put the survey through a beta-testing phase prior to full scale implementation. This beta-testing took the form of cognitive interviews conducted via Zoom with 18 boat owners who had completed the draft version of the survey as programmed into Qualtrics online survey software. The Methods section that immediately follows provides additional background information on the cognitive interviewing process. The Detailed Findings and Suggestions section has extensive quotations extracted from those interviews about each item and additional topics of interest, as well as summary findings and suggestions for each. These sections are followed by Complete Lists of Findings and Suggestions for CARB to review so CARB and SSRC can collaboratively come to decisions on how to best improve the survey experience and data quality.

Methods

Sample and Recruitment

A convenience sample of 18 male boaters participated in one-on-one cognitive interviews to test the survey questions. In order to recruit participants, 1,500 post cards were mailed to boat owners registered with the California Department of Motor Vehicles (DMV). Postcards solicited participation in the beta-test survey and included a QR code that respondents could scan with their phones to gain easy access to the online survey. Furthermore, each participant entered a unique numeric code to authenticate and link their responses to their address. At the conclusion of the survey, respondents were asked if they would be willing to participate in a 30 minute interview to obtain their feedback regarding the survey completion process. Sixty survey completers initially agreed to participate in a cognitive interview. Eighteen of these individuals were successfully reached and scheduled to participate in a cognitive interview.

Boat owners had to be at least 18 years old, speak and understand English, and be willing to take part in one 30-45-minute interview. All participants were told of the nature of the study and informed consent was obtained to tape-record the sessions. In exchange for their time, students were paid \$25 per half-hour. Interviews were conducted via Zoom and lasted an average of 30 minutes. Two interviewers trained in cognitive interview techniques conducted the interviews.

Interviews

All interviews were tape-recorded, and the interviewer also took brief notes during the interview. Cognitive interviews were conducted using a probing technique that has increasingly come into favor by cognitive researchers (Willis, 1999). Recall that at the time of the cognitive interview, the respondent had already completed the beta version of the survey. During the cognitive interview, the respondent's version of the survey along with their answers were shared with them via Zoom's "share screen" function. After reviewing the respondents answers to specific questions the cognitive interviewer followed-up with a series of pre-determined probes designed to capture specific information relevant to the question or to the specific answer given. Cognitive probes fell into one of six categories: 1) comprehension/interpretation probes ("what does the term 'idle' mean to you?"; 2) paraphrasing ("can

I ask you to repeat the question in your own words?"); 3) confidence judgement ("how sure are you of your answer?"; 4) recall probes ("how do you remember that you used your boat 5 times during the summer?"; 5) specific probes ("why do you think this question doesn't apply to you;" and 6) general probes ("was that easy or hard for you to answer?"). This retrospective interviewing technique was selected so that the cognitive interviewer did not bias the respondents' answers to the survey questions during the original survey completion phase. A limitation to this approach is the possibility that respondents may not have remembered why they selected the answer they did when they completed the survey.

Analysis

Audiotapes from interviews were transcribed verbatim by a professional transcriptionist. Interviewers' notes were also examined to add detail to the transcripts. Use of interview guides helped structure and organize participants' responses and facilitated data analysis. Next, interviewers conducted a content analysis and responses were examined for emerging themes and dominant trends across interviews (issues that seemed to appear repeatedly). Content analysis is the process of identifying, coding, and categorizing primary patterns in data. Transcripts were reviewed and coded by hand. With each reading of the data, more subtle patterns were discovered, and recurring themes emerged. Particularly insightful, interesting, and thought-provoking comments—even if mentioned only by 1 or 2 respondents—were also noted.

Detailed Findings and Suggestions

Regarding introduction script:

Interview #2—"Well, it was easy for me. I read it and it seemed pretty straightforward."

Interview #3—"It was perfectly well received in the sense of I was able to understand it, it was enough ample information to make you feel comfortable in providing the answers, and the confidentiality you mentioned in there was appropriate to what it is."

Interview #5—"The only thing that I would say is sort of a little out of the ordinary is that "the study involves no more than minimal risk and there are no known harm or discomforts associated, other than those beyond what's encountered in daily life." That's just kind of a weird sentence in the midst of that, but I can understand there are some research that involve physical harm, but it just seems a little out of place in this one."

Interview #6—"Okay, looks good."

Interview #8—"That was part was – all that stuff was pretty straightforward."

Interview #9—"It's very straightforward."

Interview #10—

INTERVIEWER: "I have two questions for you, the first is: Is there anything about the background section that is unclear or confusing?"

INTERVIEWEE: “No.”

INTERVIEWER: “No? And do you have any feedback for us, any specific feedback for us, regarding this section?”

INTERVIEWEE: “No.”

Interview #11—

INTERVIEWER: “Okay, so you’ve found everything clear...There’s nothing about this section that would be off-putting or maybe perhaps concerning to somebody?”

INTERVIEWEE: “Maybe the QR code stuff for older people?...I think for me though, personally. I mean, I’ve seen... Yeah.”

INTERVIEWER: “Yeah, we did have an issue with an older gentleman and the QR code. He wanted us to send it to him by mail.”

Interview #12—“...I don’t have any confusion on that. Like, kind of wondered where it was all going and you know, how they use the information, why?” “I might hit some bullets on there. Something... you know... might like to see the five or six things. Usually, I lose track about five or six. If you’ve got three or four paragraphs, sometimes it’s strictly the facts, man. Let’s get to the point..... You might get more people engaged. It’s like looked simple up. This is where we are going. Bullet, bullet, bullet. You know, and you can expand the bullets down below.”

Interview #13—“is what exactly are you trying to do, right? What’s the end result of your research? That part is missing from this. You know what I’m saying? You’re trying to build the right boat? You’re trying to help people make use of boat better? Are you trying to protect the environment? Are you trying to figure out what people are doing with their boat? That information is not available. What’s your objective in your research?”

Interview #14—“No. I mean, I think it looks pretty clear to me, so, you know, I know my rights, and contacts, and everything, and the time you’ll take, and I think that was pretty clear.”

Interview #16—

INTERVIEWEE: Yeah, I think that – the only thing that I saw that I was like, “This is not associated with” I’m assuming, Laura who runs this as well? From my perspective, I wouldn’t know who that is, but when I started to read it, oh, our director, oh... Wait. And there was a part where it was like she has no...

INTERVIEWER: Here?

INTERVIEWEE: Yeah, but she has nothing to do with it. But I mean, other than that, no, I think it’s pretty straightforward in understanding this as to what’s the expectancy of the participant.

INTERVIEWER: Okay. So, what I’m gathering with this is that this is – her name appearing here out of nowhere caught you off guard?

INTERVIEWEE: Well, I just thought maybe when I was reading it, there was a part where it had said, “She has no part of it.” Was it up a little bit more or something, because then I think I let her... Okay, maybe I read it incorrectly, but I thought I saw something about she has no part in the research, but okay. Maybe I misread it, I’m sorry.

INTERVIEWER: So other than this, is there anything else that's unclear or confusing, or...?

INTERVIEWEE: No.

Interview #17—“...the very first thing is, it was comforting to know that this was a science, a social science research study at Cal State Fullerton. That being on there kind of deflected any kind of spam, or any type of phishing, or anything along those lines, because in these days, we're always very cautious of that kind of stuff. So, having that at the very beginning is a very helpful thing to ease my trepidations, if you will, that this is real or this is a phishing expedition.”

Interview #18—

INTERVIEWER: Okay, great. Now, my question is, is there anything about the background section that is unclear or confusing to you?

INTERVIEWEE: No.

Findings Summary: Overall, survey completers feel the introduction and background to the study is clear, easy to understand, and supplies sufficient information. However, two respondents noted that information on what CARB intended to do with the data being collected was missing from the introduction. Another suggested that the main points be summarized in bulleted form for individuals who might otherwise skip over the lengthier text.

Suggestions: It would be useful to add a sentence or two on how the data will be used by CARB could be added to the introduction. Addition of the bulleted format above may help those who might not otherwise give a truly informed consent due to skipping over the information do so.

Regarding type of vessel:

Interview #1—“Yamaha Waverunners, A.K.A. jet skis”

Interview #2—“I had an inflatable, two inflatables and one sailboat.”

Interview #3—“We have a pleasure craft or a ski boat, a ski boat, we have two jet skis, and we have a pontoon boat.” “So that would be a really good distinction to ask boat owners do you have an inboard, outboard, or inboard-outboard because that would tell you right away what type of engine it is”

Interview #5—“Just one sailboat, 25-foot sailboat. I have also a rubber inflatable boat, but I did not include that.”

Interview #7—“ My first boat was a Ski Sanger, which is a ski boat, an inboard boat. The second boat is a pontoon boat, outboard. The third boat is a small fishing boat that I didn't include.”

Interview #6—“Actually, yeah. I don't have any [jet skis], but if I had a jet ski or other motorized watercraft, I would have. I have a kayak and I didn't include that, so it would've been anything with a motor I would've put. It was just my one boat, my powerboat.”

Interview #8—“It's a 20-foot – essentially it's a runabout ski boat.”

Interview #9—

INTERVIEWEE: “I included the two jet skis that I own. I actually own a small sailboat as well—but I included the two jet skis.”

INTERVIEWER: “You did not include the sailboat?”

INTERVIEWEE: “No.”

INTERVIEWER: “Now, does the sailboat have an auxiliary engine or something you use to...?”

INTERVIEWEE: “No.”

Interview #10—

INTERVIEWEE: “I have a pontoon boat. What I didn’t know for this is maybe how many boats have you owned. I just took that as how many boats are under your registration.”

INTERVIEWER: “So...and had you had more boats, you would’ve included all of those, regardless of type? Or what would you have included?”

INTERVIEWEE: “No, I took this question as, how many boats do you currently own, under you?”

Interview #11—

INTERVIEWEE: “I have a kayak that I use regularly, and I added that, and I do have a boat with an outboard engine. So, real boat, I’d say one.”

INTERVIEWER: “Okay, and you included the kayak in here as well?”

INTERVIEWEE: “Yeah. The kayak has no engine whatsoever, just a paddle kayak.”

Interview #13—“How do I say this? What is it called? It’s called a personal cruiser. It has a kitchen. You have the toilet. You have a sleeping quarter in there, so...”

Interview #14—“It’s a sailboat.”

Interview #15—

INTERVIEWEE: “I have a sailboat...I do have two models of sailboats. I didn’t include those. They don’t get wet.”

INTERVIEWER: “Okay, alright. So, you use gasoline to fuel your sailboats. Sailboats are always interesting to talk about.”

INTERVIEWEE: “Yeah, it seems like most of your questions were about... I mean, none of your questions really were thinking about sailboats.”

Interview #16—“I... Well, I do have more than one boat but I did – as they said, they are only active. So, I only have one that’s currently active, and I did not include... Well, I mean, one that I include that’s registered to me. There’s another watercraft that we use, but I didn’t even think about that, but that’s not technically registered to me. So, I only thought of just the one that I actively use.”

Interview #17—“I have two boats. I have a large boat and I have a runabout. I have a ski boat.”

Interview #18—“It’s a jet ski, a PWC 3-seater.”

Findings Summary: *The personal use version of the survey does not provide information on what types of vessels the participant should include in their responses, which led to some confusion on what to include.*

Suggestions: *We suggest the addition of a description of all vessel types respondents should include in their responses at the very least. Adding an item regarding vessel type may provide additional data and determine what questions should be administered thereafter.*

On why people would have information on their engine:

Interview #1-- “I did research on mine, so from what –I understand, most boat owners or I guess people that want to buy boats do a research on them first and see what pros, cons, and durability and things like that.”

Interview #2-- “ Oh yes, yes. If you’re a boater, you have to know the engine better than any other single item. I mean if something’s going to go bad, it’s going to be the engine.”

Interview #3-- “I think more than not would be aware of the type and configuration of their engine in a boat. I think it’s one of the things that people buy boats around is the engine and engine type... like if a boat has a dual engine system, they would know that it’s a dual engine system.”

Interview #6--

INTERVIEWER: Are most boat owners aware of the engines in their boats?

INTERVIEWEE: Yes.

But one thing I realized – I don’t, but I used to have a boat that’s called a kicker motor. So, it has a big engine to make the boat go faster, to travel great distances. But a small little, you can pick it up, a little engine that you stick on the back. Sometimes, they’re a pull start that they just use for trolling, you know when they go fishing and they want to go real slow. You may want to clarify because I wouldn’t have thought... If I still had that boat, I would’ve still said one because I was thinking of the big engine on the back, but I haven’t thought of I wouldn’t have known if you wanted me to include the kicker engine as well.

INTERVIEWER: Oh, that’s a good point. Okay. Good, great to know.

INTERVIEWEE: Yeah, they’re gas powered and everything so they’re technically engines, but most people don’t think of them as engines. They think of them as this little tool that they use to go slow.

Interview #8--

INTERVIEWEE: “You know, I would probably think that... I would probably ---say 70% of them are aware of what’s in their boat.”

INTERVIEWER: Okay, 70%, that’s a pretty large proportion, and would you say that most of them would tend to be aware of the number of engines that are contained within their boats?

INTERVIEWEE: Yeah, I would assume that many of them... There might be a few exceptions, in that some of the wakeboard jet boats – some people might not be aware that there’s two engines in their jet boat – in their wakeboard jet boat, but for the most --- part I would think that they know that there’s two engines.

Interview #9-- “ Yes. I think they would be. If you’re a boater, you’re really dependent upon that. Let me put it this way: If you’re not aware of the engine that’s in your boat, then you’re a fool.”

Interview #11--

INTERVIEWEE: “You know what, what I’ve come to realize, right – as a young person – you know, I have to work for my money and stuff, right? And I bought this outboard for the boat, and I found that there’s such a, like, incremental [sic] part of boating – the engine, right? If you have a bad engine, your boating

life is...bad, stressful. So yeah, I feel like most people should know about their engines; how to fix them and know what they have.”

INTERVIEWER: “Okay, would you say that that goes for the number of engines that are contained within a boat...?”

INTERVIEWEE: “Yeah, you can go all the way up. They have like, six outboards, some of them. Some of the bigger sportfishers have two, like, inboard engines. So mine is only 17 foot, and it’s a kind of a classic boat...We use it for fishing, but that boat – you know, I was on a budget and I guess we could’ve put two smaller engines but you know, one was just fine for us. There’s some offshore boats, they like to have two or more in case one does break down. They can always get back in, but for us, that’s not really an issue.”

Interview #13—

INTERVIEWEE: “Yeah. Boat owners usually are much more knowledgeable than car owners because they spend a lot of time maintaining the boat, so they tend to know the boat much better. And also, the function of the boat, they’re very knowledgeable in general.”

INTERVIEWER: “Okay. When you were purchasing your boat, did the number of engines play a factor in your decision? Did you know you were looking for a boat with one engine is my question, I guess?”

INTERVIEWEE: “Yeah. It’s definitely a consideration, and it’s definitely a factor in people’s minds when they’re looking for it. But it’ll eventually come to all considerations, right? So, reliability in terms of cost, right, and maintenance, that kind of thing. What do you want to do with the boat, right? The purpose of the boat. You eventually settle down, you make a right, reasonable decision whether you want to buy the new boat with two engine or single engine. It’s definitely a factor.”

Interview #14—“I would think personally that a good mariner should be familiar with his or her engine, just because you’re out there, especially in the Bay Area, the conditions... It’s a rough area, in terms of – we’re not in Southern California or anything. So, your engine is really important, so I would expect people to know at least something about their engine, at least ---what it requires for maintenance, and that they would be basically on top of having it always running properly, and understanding if it’s obviously a gas or diesel. But now, this being said, I’m sure there may be some recreational boater. I’m thinking especially with outboard motors, that they just have a little boat and just want to go out fishing, and they go, and they may not know much about their engine. But I think all the serious sailors out there – and I would think fishermen and people who actually go... Especially if you go in the open ocean, that they would be familiar with their engine. I would expect that. Now, maybe you should ask the Coast Guard and see if it’s – if it’s the case, you know.”

Interview #15—

INTERVIEWEE: “Well, sailboat owners merely mostly want to curse at their engines, but do we do research on them? My motor is like 40 years old. It requires way more attention than I want to give it. So, I do know something about it, but... I don’t know how to answer that question. [INDISCERNIBLE].”

INTERVIEWER: “I guess what I’m trying to get at is what... So, a lot of the questions in this survey deal with the engine of one’s boat. And so, I’m trying to get at whether or not people can reliably answer questions about their boat’s engines. Would they...”

INTERVIEWEE: “Do they know what kind of fuel it uses...And I would think they mostly do know something about their motors...Engines.”

INTERVIEWER: “Okay, great.”

Interview #16—

INTERVIEWER: “Was that... Sorry. Are most boat owners aware of the engines in their boats, including the number of engines?”

INTERVIEWEE: “Yes.”

INTERVIEWER: “Okay. And was this question easy or difficult for you to answer, would you say?”

INTERVIEWEE: “It was easy.”

Interview #17—“Actually, technically speaking, it has three. One of them is a generator that regenerates or that brings power to the 110 outlets. So, there’s a generator motor. If you’re looking at how many engines, there are three engines on my boat but two of them are used to power the boat, as in move the boat. One of them is used to give power to the boat while we’re out...So, maybe changing how many engines does the boat have, you could say, how many props?...You see what I’m saying? I mean, or how many engines with props or propellers does your boat have? And that way, it would be two. And then, are there any other engines? Yes. What is that? A generator.”

Interview #18—“I don’t think they do, but I grew up dealing with engines, so I have an idea.”

Findings Summary: *There is an overwhelming consensus that boat owners have rudimentary knowledge of the engines in their boats (including the number), at the very least, but typically have extensive knowledge. There is some confusion on whether certain auxiliary or specialty engines should be included in the participant’s response.*

Suggestions: *Adding a description of which types of engines should be included in the respondent’s answer would help produce more accurate reporting of engine emissions.*

Regarding make and model of engine:

Interview #1-- “... because I think that the actual model number, I don't know if it corresponded to the model number that's on my vessel...I don't think it was in there...because I would have to look at the VIN numbers but it kind of doesn't look familiar, but I could be wrong. [But the make] is correct. For the model... It was because it looks almost like a VIN number, it looks like I would have to look at the VIN number for the vessel to see if closely matches this.” “Most of the model numbers are usually given out like a name, like you will see a Camry, so it’s like you have that name. They don't usually give you like a serial number. It’s very similar with a boat or watercraft.”

*Interview #2—*Regarding available list of engine makes: “I would say it was easy for me because you had a list. Let’s see, can I click on this? I can’t remember what it was. See, I have a Yanmar and you didn't have Yanmar listed.”

Interview #3—“I wouldn't be able to distinguish this model number without having to get under the engine”

Interview #5—Regarding available list of engine makes: “There’s some older boat outboard motors such as Evinrude, Johnson. Those should probably be on here. For sailors, for people in sailboats who have an outboard, they don’t use it very much. And so, it lasts for a long time.”

Interview #6—

INTERVIEWEE: “Actually, I can’t remember why I didn’t put the model, but there’s so many different models. So, I don’t remember what the pull down – oh yeah, there’s no way --we would know all this. These are factory codes.”

INTERVIEWER: “Okay. And so, there’s just no way that you would know?”

INTERVIEWEE: “No.”

INTERVIEWER: “But the make was easy for you to answer?”

INTERVIEWEE: “Make, absolutely, yeah.”

INTERVIEWER: “Okay, so you feel pretty confident of your answer in the make?”

INTERVIEWEE: “Mm-hmm.”

INTERVIEWER: “Okay, but the model, you weren’t able to... And is that just because the – it’s just too fine-grained?”

INTERVIEWEE: “Yeah. Nobody knows the factory code. They think of their engine in terms of there’s a model, like Verado. Mine’s Verado, some are four-stroke, and the horse power. So, when people think of their engines, they think of broad, not brand, but model and horsepower. Those are the two pieces. Like, if this is factory codes – no one knows this.”

Interview #7—Regarding make: “You should include in that list Mercruiser because Mercury and Mercruiser are not exactly the same. Mercury are outboard – Mercruiser are inboard.” Regarding model: “That’s a very specific question...I don’t know the exact model number. I could look it up.”

Interview #8—

INTERVIEWEE: “You know, I kind of guessed that based on what was there. The boat’s all tied down, strapped and covered and so I didn’t go out to look at it. So I kind of took a guess at that. I probably shouldn’t have done that, but...”

INTERVIEWER: “It’s okay, --- but you are confident of the make?”

INTERVIEWEE: “Oh yeah, it’s a Volvo but it’s got a 350 Chevy in it.”

INTERVIEWER: “Okay, let me ask you, if I would’ve put instead – if I would’ve left this as a blank box and said “Provide for me the make ---- and model of the engine of your boat.” Instead of “Provide it in the drop down menu.” like I did, what would you have entered instead of this? If I would’ve said just enter the make and model of your car? Car... Sorry, the engine.”

INTERVIEWEE: “I mean, firstly, --- I know it’s a Volvo and I know it’s got a 5.7 meter or 350 Chevy in it. When it came to -the specific Volvo designation for that specific engine, yeah I kind of made a guess at that and I probably should’ve said unknown.”

Interview #9—

INTERVIEWER: “So, what was it that you had to do in order to determine the model?”

INTERVIEWEE: “Pull out the owner’s manual, and honestly, I guessed at the actual model number. I think that’s the right one, because it is not prominently displayed in the owner’s manual. So, I think that’s the correct model number based upon my experience getting the boat serviced.”

INTERVIEWER: “If an empty text box had been provided here ... what would you have put?”

INTERVIEWEE: “I would have not provided anything. The only way for me to accurately answer that is to go out to the jet skis...but they’re already winterized, which means that they’re under two different coverings. I would have to remove those covers, remove the seat that covers the engine and then look at the model number on the engine, and I would not have done that.”

Interview #10—

INTERVIEWEE: “The make was easy, the model was hard because I even went out there, and I couldn’t see it from the engine.”

INTERVIEWER: “Got it. If an empty textbox had been provided here under model instead, what would you have provided in that space for the model of your engine, or what would you have put there if the model --- was an open box, rather than a drop down like this?”

INTERVIEWEE: “I would put ‘don’t know’”.

INTERVIEWER: “You would still put ‘don’t know’?”

INTERVIEWEE: “Or ‘not available’ or something.”

Interview #11—

INTERVIEWEE: “Yamaha was easy, I know...the horsepower and...it’s a 50TLR, but the models in that dropdown tab specific for Yamaha, I don’t know the engine by these models.

INTERVIEWER: “If I had to put an empty box here instead and put “Model” with an empty box here for you to fill it out, what would you have written inside that empty box?” “

INTERVIEWEE: Probably “50TLR” because the engine – I bought it used, of course, but it has a little sticker on it, right? It has a serial number, but it also has a 50TLR and I remember that. I still remember researching that.”

Interview #13—

INTERVIEWEE: “It’s fairly easy because you know your boat, you know the engine. So, you can just pick the one that’s on the list.”

INTERVIEWER: “You were one of the only people that was able to pick from the list the model of your boat. Now, how are you able to do that? Did you just guess the model from the list, or do you know that, or did you go and look at your manual? How were you able to select the model or how certain are you?”

INTERVIEWEE: “Usually, when you own the boat, you already know what boat you get, right? That’s [INDISCERNIBLE 00:06:11], right? Otherwise, [INDISCERNIBLE 00:06:15]. This is why you go buy a

refrigerator, right? So, you would know why you bought that thing. You know the model or the brand you bought, right? Whether it's Whirlpool, whether it's Samsung, right? So, that's... So, when you buy a boat, the same thing, right? So, you know what type of engine you have, right? So, you remember that. You don't need to go back and check the boat. "

INTERVIEWER: "Even with the model number?...So, you feel pretty confident of this answer then?"

INTERVIEWEE: "Yes."

Interview #14—

INTERVIEWER: "Okay, alright, thank you for that. It looks like your make and model are 'other' and 'other', and that you have a ---Yanmar YSM12. Okay, so is the Yanmar YSM12, is that an older model?"

INTERVIEWEE: "It's very old, yeah. It's from 1979, so it's a good little workhorse, but it's only 10 horsepower and it's... They've been – yeah, they've been around for years, but I think they stopped making those probably in the '80s or something. So... They're tractor engines too; they're the same...Yanmar makes a lot of engine for tractors. They're really good, reliable diesels, but that one is really small. It's a one-cylinder..."

Interview #15— Regarding selecting an "other" engine make/model:

INTERVIEWEE: "I know it's an Atomic 4 engine. I guess that wasn't on your list, so I guess that's why. An Atomic 4 is quite popular in older sailboats. That's probably why it wasn't on your list."

INTERVIEWER: "Because it's an older sailboat? Got it."

INTERVIEWEE: "Yeah, on pretty old sailboats. But sailboats last a long time." "I don't know who makes it. It's called an Atomic 4. That's all I know about it."

Interview #16—

INTERVIEWER: .."What is the make and model of this boat's engine? You put 'Other' for both of these. So, my first question for you is: Was this question easy or difficult to answer?"

INTERVIEWEE: "No. I think it was fine. I think that maybe I put other because I don't think I saw the make that's listed."

INTERVIEWER: "And that was Silver Line, huh? So, you didn't get to put that, then?"

INTERVIEWEE: "Mm-hmm."

INTERVIEWER: "So, if we had provided an empty textbox instead from the get-go, from the outset here what would you have provided as the model and make? If we had had two boxes here, make, model, what would you have put here and here? Like, empty boxes to type into or to..."

INTERVIEWEE: "If all sources were available, I would put Silver Line as the make and then [INDISCERNIBLE 00:08:36] as the model. I already know that that is an older boat so – or an older make. So, to me, it's kind of expected for it not to be listed. But I understand for researching purposes it's easier to... There's so many [INDISCERNIBLE 00:08:57] of makes and models that it's probably easier to [INDISCERNIBLE 00:09:02] put the other. But yeah, I know that it's an older boat, so I didn't expect it to kind of be in there."

INTERVIEWER: "To be in the... You didn't expect it in the list?"

INTERVIEWEE: “Mm-mm.”

INTERVIEWER: “Got it, okay. So, we’ll move on if you don’t have anything else to say about this here. Do you have an opinion of providing that open box versus this format. Because see here, there are all of these, you know, as to what would be easier for you, as the survey respondent...”

INTERVIEWEE: “As preference, maybe you could open it and you could have a search box, and you could just search a make before you just go into the whole list.”

Interview #17—

INTERVIEWEE: “Frankly, that’s a guess...I’m just being honest with you. You had a dropdown menu and I kind of went, “Alright, I think my engine is actually...” I’ve got pictures. I took pictures of my engines, but I didn’t know exactly which one it was, but I kind of looked at it and went, “I think it’s a 2.6.” But I’m an engineer, so it was a pretty educated guess, but it was a guess. So, this is not a really great question or dropdown menu for the average...And I’m not saying I’m above average, all I’m saying is that for a typical boat owner, they’re probably not going to know the answer to this.”

INTERVIEWER: “Right, and you’re sure on the make though?”

INTERVIEWEE: “I’m sure of the make, yeah.”

Interview #18—

INTERVIEWER: “And you don’t know the model, and so, that was a difficult question for you to answer. Is that because you didn’t see the model that you had in here? Is that because it’s just – I’ve had people say it’s impossible for them to answer the question. How difficult was this?”

INTERVIEWEE: “All I know is it’s a 2004. It has 185-horsepower motor in it, and it’s a GTX. So, as far – those are basically the models, they have letters. And GTX or – I forget the lower model numbers, but...”

INTERVIEWER: “Okay, is it fair to say that if I would’ve left an empty box here instead and said, with an open box, “What is the make and model of your boat’s first engine?” that you would’ve written down Bombardier, what did you just call it, a GTX?”

INTERVIEWEE: “GTX Supercharged, yeah.”

INTERVIEWER: “Supercharged, that you would’ve written that in instead?”

INTERVIEWEE: “Yeah, right.”

Findings Summary: *Most respondents were able to provide the make of their boat, but for several, that make was not provided in the drop-down list, especially if their boat was older. Selecting a model number proved more difficult, and almost all were unable to provide this using the drop-down.*

Suggestions: *There are a few potential improvements that may be made. Firstly, we suggest eliminating the drop-down list for engine models at the very least and replacing it with an open-response box so the participant can describe the model themselves. The list for makes has three potential solutions: either a) eliminate the list and provide an open-response box, b) improve the list by including more models, particularly older ones, or c) eliminate the item, should it be deemed by CARB that other information is sufficient to create an emissions estimate.*

Regarding year of engine:

Interview #1—"I'm very sure of it, I bought it brand new so I'm very sure of that."

Interview #2-- "Oh, I'm sure.--I mean I bought it brand new, although I bought it brand new and it was recorded in 2004, however it hadn't been sold. It was built in 2001 as a 2001 model but it was never sold until I bought it."

Interview #3—"The boat was new in '14, so it's a model year '15, I mean that's how it operates. I'm sorry, it was a '15 year boat, so if it was built in '15 then the engine was built in '15."

Interview #5—"The only way I could know would be to go to the motor, get the serial number, look up the serial number somehow in a Johnson website...It's just not something I would know. An outboard is, like I said, for sailors particularly, you might have them forever and just continue to maintain them, but not really know what year the thing is. I have no idea how old my engine is."

Interview #6—"Fairly sure. I purchased it brand new, so..."

Interview #7—"When I bought it that time of the year, the time of registration [INDISCERNIBLE] so I'm very sure that's the year it is."

Interview #8—"Because I know from working on the engine and doing some general maintenance and stuff that it is a '97 engine -- '97 --- 350, 5.7 L Chevrolet engine. It's an industrial marine engine. You know, to get parts and stuff like that, I had to look all the stuff up, so I know that it's a '97 350 Chevy."

Interview #9—"Positive... I bought it brand new and it was a 2018 model year, and I know that the engine is -- was brand new when I bought it."

Interview #10—"Yeah, I just bought it in 2019, I remember seeing [INDISCERNIBLE 00:07:17]."

Interview #11—"The boat's first engine was actually like -- well this boat's from the 60's, right?...I'd say '60 the first engine, but the current engine that I bought for the boat is a 2008... that [older] engine used to give me the hardest time so we pulled it off and saved up and got another one."

Interview #13—"I'm pretty sure. That's what I got when I thought about it, yeah."

Interview #14—"I'm pretty sure, because it's -- the boat is from 1979 and that the...I guess if somebody would have replaced the engine, I mean, I know the engine has been rebuilt, but I know that the boat came with a Yanmar YSM12. If somebody replaced it with another similar engine, I wouldn't know that, but it is the original equipment type of engine that should be on the boat. So, I'm pretty confident that it's been there, you know? But I'm not -- I couldn't tell you 100% for sure."

Interview #15—"I know the boat was built in 1977. '77 or '78, so I assume that's the engine model year too."

Interview #16—

INTERVIEWEE: "So, I have replaced a motor in that boat but the original motor that it came out of was

built in 1978 with the boat as well. Since then, I have put in a newer engine that is not of this make. So, I really pay attention to boat's first engine versus what model or what year is the boat's engine."

INTERVIEWEE: "Got it, got it. This is... Okay, so this is really good information to have. So, you put information on the older engine because of the word first here? So, this is because you only have one, if you had said that this boat had two engines, you would go through first and second. So actually, this is good information for me to have from you because first here is not necessary here because there's only one engine, and it made you think the previous engine. Okay, so thank you for that. So, had you provided information on the current engine in the boat, you said you would've put what now?"

INTERVIEWEE: "I had a newer engine that's come from a 1988."

INTERVIEWEE: "Okay, so you would've put 1988 here, huh?"

Interview #16—"Oh, I'm positive."

Interview #17—"Positive."

Findings Summary: Respondents are generally confident of the model years of their boats' engines, with some exceptions for much older boats where participants are less certain.

Suggestions: No changes to this item are proposed based on respondent feedback.

Regarding star certification:

Interview #2—"I would say it would be impossible for a boat owner to answer. Because that's just not – you're probably more oriented toward a computer and a monitor and the power usage, star is not something that is significant – I shouldn't say significant, it could be significant – but not something that is ever discussed in boats. I mean I know my monitor is star certified or whatever, but to ask about a boat is like saying is it Russian, you know, I don't know. Yeah, I've never seen boat motors rated in star certification or whatever. I go to Catalina all the time so you're crossing a fairly significant body of water, the San Pedro Channel, that has storms and everything else, so the significance of a motor is that it's going to run, all else becomes much less important because otherwise you could die."

Interview #3—"It's low emission, and it came with that identification sticker that you keep on there in the state of California, it says "Low Emission Engine," so they have a sticker that gets put on the boat." Participant then went on to state Star Certification was easy to answer.

Interview #5—"Yeah, I'm not even sure what that is. It might be a 'hover over to get information' kind of question, or an 'ask us to give you more info.'"

Interview #6—

INTERVIEWER: "Okay. And the STAR certification. It says here that you don't know. Was that a very difficult or... Because you don't know what STAR certification is or is it because you don't know what the STAR certification on your boat's engine is?"

INTERVIEWEE: "Mostly the latter. Yeah. That's not something you think about. It's just something that's there. It's on a sticker somewhere, you know, but it's not like I think about it very often, so yeah. It's just I didn't know what it was."

Interview #7—"I didn't know they had the Star Certification. Maybe they do. I've never seen it."

Interview #8—"Yeah, I know what the Star Certification is. It's emissions rating from the EPA. I don't know what the Star Certification – I have a complete --- factory manual for it and I looked through it and I couldn't find its Star Certification, and it's not labeled on the engine. So, I'm not sure when they started doing the Star Certifications, I didn't actually look that up, what year they started doing Star Certifications so... Yeah because I didn't look – I mean, I could've gone on the internet and --- looked up when Star Certification started because it would've been interesting just to know, but I'm not sure – it started in '97 so, you know..."

Interview #9—"I'm about 80% sure, the Star Certification is written on the motor, and I've serviced it several times, and that's why I believe I remember."

Interview #10—"I don't know what that means."

Interview #11—"I kind of had an idea of what it was, but I didn't buy the...engine from the factory, right? So I didn't necessarily see all that good information. It is a two-stroke, so I know they're less clean-burning than four-strokes but, I don't know the specific certification."

Interview #13—"I'm not clear. So, I don't know what's the... I kind of know what, maybe some environmental thing, but I just – I've never done that thing, right? I never got it certified so I don't really – that's why I don't know. Yeah. I don't know where to go look for that certification, do you know what I mean?"

Interview #14—

INTERVIEWEE: "My understanding is a Star Certification is like an EPA or some rating, and I was thinking, "Well, in 1979, it didn't exist." I mean, it's like... Yeah. That's why I put 'Not Applicable' so... And I don't know if I'm correct or not. And I wasn't sure also what...I don't remember exactly what the Star Certification is. I think I've seen this in appliances, and I thought maybe it's the same thing. And if it's the same thing, it definitely probably didn't exist in the '70s. But I'm not sure. So, maybe, you know, yeah. I just can't remember for sure exactly what the Star Certification is. I just know that it's an energy efficiency stamp. I think it's blue, and I think it's EPA but I'm not 100% sure and I know... I've only seen it – I didn't know they did it for engines. I've seen it on –refrigerators and others electrical units. Or maybe I'm even confusing, I don't know."

INTERVIEWER: "If the word Star Certification was a hyperlink in blue, and so that you can click on it and get the definition, do you think people would use it?"

INTERVIEWEE: "Yeah, probably. I mean, people like me that can't remember for sure or something, I would, yeah. That's a very good suggestion."

Interview #15—"I have no idea what that is."

Interview #16—"I don't know exactly what Star Certification means."

Interview #17—

INTERVIEWEE: "What are my selections?"

INTERVIEWER: "1, 2, 3, 4, 5 stars, don't know and not applicable."

INTERVIEWEE: “Okay. I guess I wasn’t exactly sure what this was, so I should just put ‘don’t know.’”

INTERVIEWER: “Okay. If we had put a hyperlink on the word Star Certification where you could click on it and get the definition of what a Star Certification was, would you have utilized that?”

INTERVIEWEE: “Yes, right away.”

Interview #18—“Well, that’s what I believe it is because it’s a 4-cycle, and up to that point, most jet skis and PWCs were 2-cycle. This is 4-cycle, and that alone would make it a five-star because it’s non-polluting, basically.”

Findings Summary: *Very few participants are sure of the Star Certification of their boat’s engine, with many unaware of what a Star Certification is. Respondents showed receptiveness to the idea of including additional information or a definition of the term.*

Suggestions: *If this item is to be included in the final version of the survey, additional information should be provided on what a Star Certification is, either in the form of a hover-over or link to resources. Based on some preliminary research, this information is very difficult to locate through an internet search. It may be helpful to refer to the “Low Emission” designation instead. Alternatively, this item could be deleted altogether, should the other information acquired be sufficient to create an emissions estimate.*

Regarding the horsepower of engine:

Interviewer #1—“It’s 110 horsepower, I believe.”

Respondent then reported being “very sure” of his answer.

Interview #2—“Oh, I’m positive. Well, I qualified that, I don’t know how much you want me to elaborate, but I do go to Catalina a lot so I’m possibly more aware than somebody -- that might have their boat out on Lake Arrowhead or something. ... the significance of making sure everything’s working perfect and that they understand that motor wouldn’t be nearly as significant because in the worst case they would have to paddle over to the shore ---with an oar, let’s say, where if you get caught in the middle of a storm in Catalina and your motor goes out, many, many things kick in on trying to get it to work again and even maybe making a cell phone call to somebody that knows about the motor -- that kind of thing, and therefore you have to understand the motor in the first place just so you could ask somebody for help. You know, boating is a life-and-death situation, in a worst possible case it is anyway, and you’ve got to make sure that you’re prepared to take care of a motor, where on a much less -- demanding circumstance, like being out on a lake, there’s a lot of other forgiveness. You just call somebody and they come over and pick you up.”

Interview #3—“Very sure because you have to register the boat with that information...I can tell you it’s stuck on the outside cavity of the boat, it says “60 horsepower” on it.”

Interview #5—“Totally sure. This is a 6-hp.”

Interview #6—“100%”

Interview #7—“Very sure...because that’s how I bought it.”

Interview #8—“Pretty sure, because the engine originally came with a 2 barrel carburetor and I’ve changed it --- to a 4 barrel, and the 4 barrel versions of that are rated at around 240 to 260 so I just put the 250. The old versions are rated at... I think it’s 225, if I remember right, --- and the 4 barrel versions are rated right around 250. My ‘97 was not offered with a 4 barrel so you’d have to look at other places to try to find it, but I’m just going based on what I know from experience. I worked on boats as a mechanic for seven or eight years and I’ve been around the automotive industry, I taught automotive technology at a community college for almost 30 years.”

Interview #9—“Probably 70% [sure], again, from you know, when I bought the boat and everything else. I believe that’s what it says. I think it was 160 horsepower, about...I could be wrong on it, but that’s what I believe.”

Interview #10—“I’m sure it’s 75 horsepower, so I’m very sure.”

Interview #11—“It’s 100% a 50 horsepower engine...[it] says it on the engine.”

Interview #12—

INTERVIEWEE: “In terms of year ranges, I think that makes the most sense for me but I might have put a couple of different categories in there. There is a lot of 70 horsepower engines, a lot of 50s. So, less than 50 would make sense for smaller...So, 51-120. There is a lot of... If I think of like Evinrude, or Mercury, or other outboards, you might break that out a little bit more, or maybe you are fine with that for that reason of the survey with CARB. I don’t know.”

INTERVIEWER: “Uh-huh. This is still information that I will take back.”

INTERVIEWEE: “Okay. I just opened up a couple more categories. 121-175...”

INTERVIEWER: “Is it that, you’re saying that in some of these categories there is a lot of variety? Is the variation wide between those or... That’s what I was gathering.”

INTERVIEWEE: “Yeah. So, between 50 and 120, there’s probably about 5 typical horsepowers. So, you might break up the 50 to 120 into about two to three more categories.”

INTERVIEWEE: “So, less than 15 horsepower...You know, a lot of sailboats use real small horsepower engines. Like, up to 25, 27 feet, people are using like 5 horsepower motors. You know, sailboat racers. People get out to the race course with fairly lightweight sailboats while the other ones are more cruisers so they might have a 10 horse or a 15 horse. So, there’s a couple of categories. You might break that up less than 15, you know? You might say 2-5 horsepower, 5-15 maybe. There is a break off with outboard engines at 10 horsepower and anything up to 10, I’d say less than 10, and then go 15-20 maybe... or 15-25 because there is a whole class of outboards. They used to have a 9.9 and that was the most that they could put into an outboard and still remain in a lower class.”

Interview #13—“I’m pretty sure. I remember the horsepower; I just don’t know the exact number anymore. I know pretty sure it’s in this range.”

Interview #14—“Yeah, yeah, yeah. Fully confident.”

Interview #15—

INTERVIEWER: “Your horsepower you say is 26 to 50 horsepower’s. How sure are you of the response to this question?”

INTERVIEWEE: “Maybe 50%.”

INTERVIEWER: “50%? Okay. Why do you think that you’re 50% on this?”

INTERVIEWEE: “Because somewhere, I get the feeling that I saw that it was that but I’m not really sure. I do have a lot of the original documents on the boat, but I don’t look at them. I’ve had the boat for 20 years and I haven’t looked down for a while, for 20 years.”

Interview #16—

INTERVIEWEE: “Yeah, so I replaced the en... Even though it was, uh, a newer motor, I replaced the motor of what it originally had in it. So, my expectancy was is that I should be getting the same amount of horsepower that’s rated --- for that motor to get the same amount of horsepower from the first engine to the second engine.”

INTERVIEWER: “Got it. So, this would apply to either one, huh?”

INTERVIEWEE: “Yes.”

INTERVIEWER: “Got it. So... And how certain are you of the horsepower of either of those engines?”

INTERVIEWEE: “I’m pretty certain it’s 250 horsepower.”

Interview #17—“I’m sure of that one because I know what model number it is, and I know what the horsepower is.”

Interview #18—“It was easy because I knew it was 185.”

Findings Summary: *All but a couple boat owners were very sure of the horsepower of their boat’s engines, more so than other aspects such as model or Star Certification. One respondent suggested the categories be finer grained for greater accuracy.*

Suggestions: *Although it was only suggested by one participant, creating more narrow horsepower categories may be an option if it would be helpful to CARB.*

Regarding estimated engine hour meter:

Interview #1—“I’m not sure why it recorded that, but I have 58 hours. Yes, I knew because I do the service on them. I do the service myself on these. So I make sure that I record, every time I do a service, I record the hour meter on it. It’s basically like mileage almost.”

Interview #2—“Well, bigger boats automatically have an hour meter -- --on them, and I look at it all the time because you use it for servicing. Let’s say you have your oil change every 100 hours or something like that, okay, so you measure a lot of things in terms of hours of engine since mileage -- --is kind of meaningless on a boat. You could be sitting in a marina and run your motor. But more importantly, and hour meter on a boat, let’s say a boat that’s 25 feet or longer, and maybe even -- --much smaller for all I know, always have an hour meter on them or the owner is going to be in the dark as to servicing and things like that. Every single time I leave the dock, I write down in a log book my hours.”

Interview #3—“There’s a little gauge that tells you on the boat, and most boats have an hour gauge on it....as boat owners, you watch the hours...on boats for your maintenance”

Interview #5—“I’m not sure what the question is asking...Some boats that use their engines more frequently will keep track of the number of hours they have used it between services. Again, on a sailboat with an outboard, it’s probably unlikely someone will be keeping track of that. When you’re sailing, you’re pretty much – you get it out of the slip, and then you put the sail up, and you turn the motor off. So it’s going to be different there.”

Interview #6—

INTERVIEWEE: “This was easy.”

INTERVIEWER: “Why is that?”

INTERVIEWEE: “Boat owners... You know, like a car goes by how many miles it has, boat owners go by how many hours their engine has and they know “I have to maintain it every 100 hours, 200 hours, 300 hours.” It all goes by hours, so it’s just like mileage on the car.”

INTERVIEWER: “Okay, but you pay attention to this?”

INTERVIEWEE: “Yeah, oh yeah.”

INTERVIEWER: “Okay. I know you’re supposed to pay attention to it on your car too, but I don’t really pay attention to that. That’s why I’m just asking.”

INTERVIEWEE: “Yeah. Well, you pay attention to it in like, “It’s 25, not 45,000.” You know, so it’s... but boat owners are I think more attune to this because it’s every 100 hours that you have to do maintenance typically. So, I think – I don’t even know what my car mileage is either, but most of us know exactly what our boat hours are.”

Interview #7—“That’s an estimate. That’s about right.”

Interview #8—“I keep pretty good track because I change the engine oil about every 50 hours... And so, I’m five hours overdue for its oil change.”

Interview #9—“That one’s fairly easy because you have to service the engine. I service it at the end of every season. And based upon the hours on it – there’s an hour meter on the boat, on the jet ski – so you read that to determine what service you need to do...when I winterized it, when I looked at the hours to see, you know.”

Interview #10—

INTERVIEWEE: “Actually, it was hard, because I have my boat covered, and I just wondered how many times we went camping, --- and how much I rode, so it was definitely an estimate.”

INTERVIEWER: “You estimated using the number of times you’d gone camping you said?”

INTERVIEWEE: “Yeah, and each time was roughly about an hour that I rode, so an hour or maybe a little more, give or take a couple hours.”

Interview #11—“Yeah, so I know some boats, they have gauges, right, with hours? That [number] is just an estimate of what I think. This engine was rebuilt by somebody in Minnesota before... I bought it from them, so I estimate that I put maybe 35...running hours on the engine. I don’t have a more solid answer but just an estimate. But the engine could’ve had more before the rebuilding... that [current] engine in particular...[has 35], the other engine previous, maybe 40 [hours] or something, but for the current engine, that’s accurate.”

Interview #13—

INTERVIEWEE: “It’s pretty easy because when you go ask for a boat, that number is displayed on the odometer, right? So, you just remember the number.”

INTERVIEWER: “Okay, do you think this would be easy or difficult for most boat owners to answer?”

INTERVIEWEE: “I would say the same for most people. See, boat is different from the car, right? When you drive a car, you don’t know too much. You don’t pay much attention to that number, right? How much mileage, right? But a car – a boat is different. You don’t really go out every day, right? You go every few weeks, right? Then you notice how many hours you’re using the boat. And it’s an important number because that’s when you know – you have to maintain the boat, right? So, most boat owners pay attention to the number. I’m not sure – at least for the boat my size. Maybe for people with smaller boat, maybe less clear, you know what I’m saying? Like, the smaller ones.”

Interview #14—

INTERVIEWEE: “Well, I replaced the meter reading. And I think it had been replaced before already, so I have 100 hours in it. And I know for sure that that engine, it’s been in that boat for a long, long time, so it’s probably had a lot more. And I know the engine has been rebuilt. Typically, you rebuild an engine after at least 5,000 to 10,000 hours, right? So, yeah. That’s why I’ve said I don’t know. But on the rebuilt – since the engine has been rebuilt, I’m pretty confident that it’s been about 100, 150 hours, yeah.”

INTERVIEWER: “Okay, okay. But when you talk about an engine’s estimated hour meter reading, would you include the number of hours before it had been rebuilt, or do you only include the hours since it’s been rebuilt?”

INTERVIEWEE: “That’s a good... You know, I’m not sure. Maybe that’s something you may want to say – you could maybe add ‘since last rebuild’ or something, if that’s what... You know, I don’t know what your –what’s the goal of the question, if the goal of the question is, say, pollution or something, like a really old engine. You may want to say something like ‘since last rebuild’ or something, or so...”

INTERVIEWER: “Yeah, the goal is pollution. So, okay, alright. And then...”

INTERVIEWEE: “Because that would make a big difference, yeah.”

INTERVIEWER: “Yes, it would. And so, you haven’t replaced your engine, but maybe another good question would’ve been whether or not you know whether the engine has been rebuilt.”

INTERVIEWEE: “Exactly.”

Interview #15—

INTERVIEWEE: “I don’t have a meter reader, an hour meter.”

INTERVIEWER: “Okay, so this would probably be better if you would’ve put Not Applicable, because you don’t have one. So, it’s not that you don’t know – it’s that you don’t have one.”

Interview #16—

INTERVIEWEE: “So, this one I did think about the current motor, or at least the amount of hours I’ve put on that boat – I mean, put on that engine. And I’ve had it for the last about three summers or so. I think you average like throughout the summer, I think it’s like 20 hours this summer. So, I kind of average what I would do per summer since at least I’ve owned it, or at least what I’ve put on that new motor that I put in.”

INTERVIEWER: “Got it. I think I understand .Sort of a process of averaging over the summers, if I’m understanding you correctly. Okay.”

INTERVIEWEE: “Because to be quite honest, I don’t really have one of those hour meters on the motor. So, I can’t be very clear because I don’t know exactly, but it’s just as far as I understand what I feel like I’ve put on it, and I think in the condition that I’ve gotten the motor in, I would estimate it to be around that.”

INTERVIEWER: “You estimated that if it did happen, it would be. So, you could have selected here Not Applicable also, or would it have been... Is there something else we could’ve put here that would’ve made it so that you could’ve selected an option?”

INTERVIEWEE: “No, I think this is straightforward because like I said, most boat – as far as I understand, most boats have their hour meter on there. So, I feel that, you know, most boat owners have an idea of how many hours are typically on my boat , just like you would think how many miles I typically have on my car. So, I think this is pretty straightforward to the point that, you know, you’re getting what you would get out of it.”

INTERVIEWER: “Got you.”

INTERVIEWEE: “Yeah, because to me, I also kind of think about, like I said, summers. I don’t really think about it as in like how long I’ve had it. I think about the summers. So, that’s why I estimate it to be there, but I don’t know, I think that’s a pretty straightforward question.”

Interview #17—

INTERVIEWEE: “Well, it just happened to be that I was at the boat about a couple weeks ago, because I’m looking to sell it after the summer, and I happened to look at the meter, at the hour gauge, and it was about 500.”

INTERVIEWER: “Oh, okay. So, we just – I happen to be lucky that you happened to have looked at it recently.” “

INTERVIEWEE: Bingo, yes. I live about an hour away from the boat, so I would’ve had to... I would’ve said I don’t know, or I would’ve given an estimate of what I thought it was, but anyway...”

Interview #18—

INTERVIEWEE: “That was a guess because I was too lazy to go out, and turn the engine on, and push the button to figure out, because it’ll tell you exactly.”

INTERVIEWER: “Okay.”

INTERVIEWEE: “But I didn’t want to go out, so I...”

INTERVIEWER: “That’s understandable. How good do you feel about this guess?”

INTERVIEWEE: “Fair.”

Findings Summary: *Most participants stated they are very certain of their engine’s hour meter reading, noting that knowledge of the hours on the engine are central to maintenance. Some were less certain, and for those engines without a meter, owners did mental calculations to come to their estimates. Furthermore, boat owners who had rebuilt their engines were unsure whether to report the number of hours they had on their meter prior to rebuilding their engines or the full life of the vessel.*

Suggestions: *A potential addition to the survey instrument might be the provision of hour ranges for those who initially indicate they “don’t know” their reading to minimize the amount of missing data. Additionally, it may be helpful to include an item that asks whether the engine of the vessel has even been rebuilt.*

Regarding engine replacement:

Interview #9—

INTERVIEWER: “So this one, you said you have replaced. And then you said zero years, presuming – what did you mean by zero years here?”

INTERVIEWEE: “When I bought this boat, so this jet ski is a 1999 model year, and it had sunk. So, the previous owner had sunk it, and I bought it from a shop that put a brand new engine in it. They rebuilt it.”

Interview #11—Regarding certainty of engine age at replacement: “So, say we replaced that in ...2018 so... The engine was probably from the year ‘65, around that. I’m confident it was in the ‘60s, that one engine. So, 40... Maybe 57 years, something like that.”

Interview #12—“Yeah. I bought that outboard engine used from the same outboard motor shop that I’ve been doing business with my whole life. And then my dad probably went there. The engine that he had was an old Seagull engine that finally snapped the chain on it and that thing was a gaseous mess. It was a polluting engine, it was terrible, and it finally bit the dust and I went out and bought a used 4½ horsepower Johnson, it still runs.”

Interview #16—“Yeah. So, that motor, when I replaced it, that motor has been sitting in that boat for 39 years. I did the math and I figured, “Okay, it was obviously both 1978. I took it out and yeah. 2018, 2017 I think it was. And so then, I just calculated it to be – yeah, that it was in there for 39 years.”

Interview #18—“No. I’ve replaced parts on it but not the engine.”

Findings Summary: *Boat owners had different methods for calculating when engines were replaced on their vessels, with event-based methods being one way this was done. Respondents sometimes even knew about engine replacement prior to owning the boat themselves.*

Suggestions: *SSRC has no suggestions for this particular item based on feedback.*

Regarding the formatting of the questions:

Interview #2—“For me personally, it’s better to go in the sequence of boats because each boat is different and you think of a boat as an entity, not as that laundry list of questions --you know, what fuel does it use, etcetera. It’s oh, on this boat I use this fuel, on this boat I do that, so I think your format on going through each boat individually is very appropriate.”

Interview #3—“It would have saved me a lot of time if I could have just went how many boats do you have? 3. Boat number 1, what kind of gas, boat number 2, what kind of gas, you know, and did it in one big long survey. I almost stopped in the middle of the survey...if they put two at the top then it gives boat 1 fuel, boat 2 fuel in the next question. Instead of going through each boat, that’s what I’m saying, because if you’re asking those questions, because I’m going to tell you something, I went back and it actually made me go grab all my materials on my boats because I was like, “I need to know a little bit of this,” which is great, but we should be able to answer the survey for you in a format that we can get through it, especially if we have multiple crafts.”

Interview #7—“I mean, it’s probably more straightforward to answer all the questions about boat one, and all the questions about boat two, and all the questions about boat three.”

Interview #9—“Regarding use of interleaved instead of grouped format for follow up questions: “I think this one is easier to understand. I prefer this one, the way you did it.”

Interview #11—“I feel like going through each boat individually would probably be a little easier on the person to be interviewed or person taking the survey, just so they stay constant with each boat – they’re not trying to think about all four, all five of their boats at once, you know?”

Findings Summary: *All but one respondent who was asked about the format of the survey preferred the interleaved (current) format over an alternate grouped format.*

Suggestions: *SSRC has no suggestions for this particular item based on feedback.*

Regarding number of days vessel was used in summer and winter:

Interview #1—“It’s easy to remember because this is the time that I have my vacation time, and so that’s when I take my vacation is between May and September. I split it up and we go as often as we can. This data looks correct for an average year. Not for last year. Yeah, zero for last year. ... in winter it’s zero. We don’t do anything in [winter]. Well, between May and September is usually the warmest time of the year where it’s the right time to be out with a boat. It’s not fun if you’re out in a watercraft, especially a watercraft, when it’s cold and you’re out getting wet, and then there’s always rain and the inclement weather just doesn’t lend itself to go out and hang out at the beach or at the river, you know what I mean? [During the summer] sometimes we go every other weekend, or at least one weekend we’ll do like a week. So like I said, the way I divide my time is I’ll take maybe a week at a time, since between my saved time and vacation time, I can get up to six weeks so I split them up.”

Interview #2—

INTERVIEWEE: “Well, first of all, saying that I did 100 I think is misleading. I don’t think I interpreted that question correctly.”

INTERVIEWER: “Okay, can you tell me how you did interpret the question?”

INTERVIEWEE: “I’m trying to remember, I don't know how I came up with 100. I probably used all of my boats that many times. Well, just to give you a little feel for my lifestyle, I live on the water. I have two boats right in front of my house that are smaller boats, and then I have a bigger boat that's in Alamitos Bay, which is part of Long Beach, so at any one time -I use the boats. Even at that, though, I don't use it 100 days. I'd say my sailboat probably 30 days during the summer. I have no idea why, let's see, how many days did you operate your boat during each season. Yeah -- -I would say I must have misinterpreted that as to how long a season is or something, I don't know. I don't know what was on my mind when I wrote 100, that would be incorrect. Yeah, the other ones I use now and then anytime. They're just small little outboard motors, or in the case of my Duffy it's an electric motor--and I just go get in them, go across the water to see somebody and come back, and I don't even think in terms of that being a use per day.”

Interview #5—“I’m just going to pull out of my memory how many times I went out on average during the summer and during the winter the last couple of years. I mean, I understood the question and it was pretty easy to answer it.”

Interview #6—

INTERVIEWEE: “For me, it’s easy just because I know I go every other week, so that’s where those numbers came from. Other people may not know of... They go a lot. You just have to guess. Yeah, but most people they know, “Oh, I go once a week or I go twice a week” and they would just multiply that out.”

INTERVIEWER: “Okay, but you go like an actual set frequency?”

INTERVIEWEE: “Yeah, right.”

Interview #8—

INTERVIEWEE: “I probably messed up on those because I went on what my [INDISCERNIBLE] last summer’s or last season’s uses was. I didn’t go on what the previous season would have been pre-pandemic, so I might have messed up on some of those.”

INTERVIEWER: “Okay so these estimations were – so then what you’re saying is that these estimations were summer of... So when COVID was happening?”

INTERVIEWEE: “Yeah, summer 2020.”

INTERVIEWER: “Okay, so here you have 15 and then in winter, you have 1.”

INTERVIEWEE: “So, these probably reflect what was going on during COVID. How, even – so assuming that they are what was going on in COVID, how easy or hard was it for you to come up with the estimates of 15 and 1?”

INTERVIEWEE: “Because I ---- just know what we did last Summer, I mean, we went to Tahoe and we used the boat several days up there, not extensively, but I know about... So, one day we put --- we used the boat two days.”

Interview #9—

INTERVIEWEE: “It’s very easy [to answer] because ...I store them for the winter so I know I’m not using them at all, and then in the summer, we used some detour in the Delta or we take them on vacation

with us. And this year, because of the fires, we cut our vacation short. We hardly used the boat at all because of the fire.”

INTERVIEWER: “Would you say it was easier to, or more difficult, to determine one season over the other here?”

INTERVIEWEE: “It was easy for both. It was not a problem for either one.”

Interview #10—

INTERVIEWEE: “Yeah, it was a little challenging, but because it was kind of recent I just went by memory how many times I remember I was going.”

INTERVIEWER: “You just tried to remember from each of the seasons?”

INTERVIEWEE: “Yeah. I mean, some of it was on my calendar, I --- researched, but I was pretty confident that that’s how many times we’ve went.”

Interview #11—

INTERVIEWER: “So, this is the way that we set it up is, in this page, we asked you to provide the following information on how you’ve used your boat within the past year, and in parentheses we say “before the COVID-19 pandemic between March 2019 and February 2020.” So, “About how many days did you operate your boat during each season?” And then we don’t put “before the COVID pandemic” here, so you have to have remembered that we said that previously. So, here you say; May to September, you used it 12 times and in winter you used it three times. So can I ask you, are these estimates before the pandemic?”

INTERVIEWEE: “Yeah, my boating habits haven’t really changed with the pandemic. I haven’t got sick or anything and went out and vaccinated, thankfully. But yeah. Camping, we ended up getting delayed but we still made it and we go camping for like six, five – six days, and that’s boating every day, going to the ocean, stuff like that, you know, and yeah, [it] hasn’t really changed so... I took this survey a while ago so I’m not sure if I remember that from...the previous page, but I guess it would be good to reiterate...”
“...we get asked this question at Half Moon Bay... quite frequently when the conservation guys...come. They measure all your rockfish...all that stuff. They always ask you how many times you’ve gone out this year, so those are numbers I give them too. But yeah.”

INTERVIEWER: “How accurate do you feel the answers are?”

INTERVIEWEE: “Yeah, pretty closely, it might be on the lesser side of the spectrum.”

INTERVIEWER: “What do you mean, like, underestimates?”

INTERVIEWEE: “Yeah not totally underestimates but sort of underestimates.”

INTERVIEWER: “Yes, like you would say on the – like if you’re saying that they’re pretty accurate but if you had to say, they’d lean on the lower side. Is that what you’re saying?”

INTERVIEWEE: “Yeah.”

INTERVIEWER: “Okay, and was it easier to answer for one season over the other? Was it harder to answer for winter or summer compared – you know what I mean, like, was it”

INTERVIEWEE: “Yeah. I guess winter, we don’t really take the boat out too much, it’s either raining or... But we try to go out for crab, sometimes we sell sometimes a dozen, so thinking back a few times we’ve gone out, but...”

Interview #12—Regarding the business survey format:

INTERVIEWEE: “Yeah. Okay, that is... You have up at the top in your question, it has boats as in plural question mark, and in the summer... Is it all boats or is it... You know, I use the sailboat a lot more during the summer, and probably the powerboat less.”

INTERVIEWER: “So here, you’re saying... You’re asking whether we are asking about each boat or all boats, huh?”

INTERVIEWEE: “Yeah, and so if I were looking at how much I was using a 100 horsepower outboard versus a 4.5 horsepower outboard, I would pollute a lot more carbon footprint, if you will, with a 100 horse than I would. So, if I could break down that into the sailboat and the power boat, I would probably have sailboat. I can go 40 miles on 3.5 gallons of gas.”

INTERVIEWER: “So do you know how you... what had caused you to put 8 days per month for summer and 4 for winter?”

INTERVIEWEE: “That’s pretty much how much I use the sailboat and I added maybe six days for the sailboat and two days for the powerboat...But I couldn’t differentiate between the two so I put down the best possible answer.”

INTERVIEWER: “Mm-hmm, so you’re saying that this would have been a sum of the two boats?”

INTERVIEWEE: “Yeah, and so I did not answer average hours per day because with the sailboat, I might run that thing for an hour and as soon as I can shut that thing off, I’m sailing. So there’s like, wind – I might run it for two hours a day for the six times I use the sailboat, and for the other boat, I might go out and use it for three hours twice. So, it’s a little... Not enough information but how much do you put in a survey? Surveys are not always... They’re kind of difficult to figure out. I don’t know...”

INTERVIEWER: “So if you were going to say how difficult or easy this question was for you to answer, you would say?”

INTERVIEWEE: “I would say break it down into Boat A or Boat B, or... Yeah, because my carbon footprint with the sailboat is next to nothing whereas with the powerboat, it would be more.”

Interview #13—

INTERVIEWEE: “Let me think. Maybe this one was more difficult to answer. I just – my memory don’t recall that kind of thing very well. But for me, I think this is probably less – maybe a common issue for most boat owners. People don’t use boat a lot in general. I’m not sure – you came from other surveys. It’s just my observation on my neighborhood, right? My neighborhood, everybody has a boat, and I can see most boats never move. It seems to me is a common issue, that’s why you only see a small number of usage of boat in general. It’s very true for me because it’s not easy to use boat. You have to prepare for it, right? You have to clean. You have to check everything before you go out. Secondly, you have to get people to go with you, right? It’s difficult to go alone, right?”

INTERVIEWER: “Right. I don’t think it’d be much fun to go by yourself.”

INTERVIEWEE: “Exactly, so that’s why you see a small number of usage of boat in general, and in terms of COVID, because in this area, I don’t see a difference at all, that COVID made any difference with people that use it. If there’s any problem, maybe they use more rather than less because you cannot go anywhere else, right? So, you can go to water, so that’s much safer than going to the road.”

INTERVIEWER: “Interesting. So, how accurate do you think your answers are there?”

INTERVIEWEE: “I think it’s pretty accurate. It’s just my estimate but not exactly. I don’t have a note or recall that, but I think it’s fairly accurate, you know.”

Interview #14—

INTERVIEWEE: “I think the summer looks about right. The winter... I think now that as I read the survey, I remember on the summer when I’m filling the survey, I was thinking I did two trips down the coast, so that’s why I put 20 days. And then in the winter, I was thinking, okay, that’s up to, whatever, March when COVID hit, it may have been a little bit more than that. It may have been maybe five. I’m just trying to think if you’re counting winter, like from... It might be easier maybe if you just put from what month to what month, but if the winter month... So, you feel like December, January, February, or...? Oh no, you have it there.”

INTERVIEWER: “Yeah, October to April.”

INTERVIEWEE: “Sorry, I’m absent-minded.”

INTERVIEWER: “No, it’s okay.”

INTERVIEWEE: “October -to April... I would say on average, yeah, maybe once a month. It might be a little bit more, so maybe yeah. I would put five if I redid it, yeah.”

Interview #15—

INTERVIEWEE: “I’ll tell you what I had to do. So, I had to go out most weeks, once a week when I’m in town. And summer is 4 months, so that’s 16, 17 weeks, 18 weeks. So, I figured, “Yeah, 15.” And... Oh, wait a minute. So, that’s May to September. That’s May, June, July, August, September. That’s...20 weeks. Yeah, maybe I’d bump it up a little bit, not too bad. In October to April – October, November, December, January, February, March, April...That’s 7 months? Yeah, I’d bump that up some. Yeah, it’s basically I go out... Most weeks when I’m home, and I travel a fair amount. Or I used to travel a fair amount – not now, and then... And this is talking about pre-COVID or is that...?”

INTERVIEWER: “It’s pre-COVID, yeah.”

INTERVIEWEE: “Okay. And then in the winter, sometimes it’s cold and rainy, I don’t go. So, a little bit less. Maybe half as much... in the winter.”

INTERVIEWER: “Okay, so your answers are 15 times in the summer and 10 in the winter you would say are a little bit underestimated here?”

INTERVIEWEE: “Maybe summer’s about right. Maybe winter should be a little bit higher.”

INTERVIEWER: “Okay, alright. But you would say that they’re pretty close estimates?”

INTERVIEWEE: “Yeah, they’re okay, uh-huh.”

Interview #16—

INTERVIEWEE: “So, like I said, I think I’ve kind of been – yeah, probably in the past year, within the summer, I averaged at like that too. I did kind of forget and I was like, ‘Oh yeah, I did go a little bit in October too.’” But it is considered more of the winter months. Because also, again, growing up, the boating season for us would be Memorial Day to Labor Day. So, [INDISCERNIBLE] not really going to the lake anymore. That’s how in my mind, you know.”

INTERVIEWER: “Memorial Day to Labor Day? Got it.”

INTERVIEWEE: “Yeah. And we just – it’s [INDISCERNIBLE] I use my boat more for the summer. I don’t really... I mean, it was purchased as like a fishing boat. I don’t really think of it is as a fishing boat, whereas there’s a lot of people that do go out to that lake and do go fishing throughout the winter months, but that’s just not something I’ve grown up doing. So, that’s how I figure like, yeah, probably read that many times, I’ve probably not went every single weekend, but you know, I went a good portion. You know, I guess a good portion of it kind of here and there, so that’s kind of how I arrived to that time to...”

INTERVIEWER: “To 20 days?”

INTERVIEWEE: “20 days go around, yeah.”

Interview #17—

INTERVIEWEE: “Now, here’s the thing. I take the boat and on one day, I motor to where... I’m going, I anchor it, I stay there – let’s say on a Friday. I’m there on Saturday. I haven’t started the engines, and on Sunday when I return, I start the engines when I’m returning. So, if you’re looking for fossil fuel and how the engines are running and all that kind of stuff, I think there needs to be a clarification there on that question because that’s deceiving. You think that I’ve been out 15 times during that period, but I wasn’t. I wasn’t using the engines. You might want to... The question might be something like, “How many days are you running the engines when you’re using the boat?” If that’s the goal of the survey, is to see what the carbon usage is of the engines and what’s being put into the atmosphere, that would be more accurate data than not. That’s for my houseboat. The ski boat, when I tow it, when I go out there, so I’m not using the engines when I tow it. But when I get to where I am and I’m taking the kids out on water skis or something like that, then I’m using it. So, it’s a little different in how – in what you’re asking and then the answers that you get.”

INTERVIEWER: “Right, right. And so, the way that you utilized it then in the summer is 15 days winter, 3 days which doesn’t have anything, doesn’t correlate with engine use is what you’re saying necessarily?”

INTERVIEWEE: “Right. Of those 15 days that I – how many days did I operate the boat during – so operate is kind of...I’m operating the boat while I’m out there tied up, not using the engines, but I’m still operating the boat. So, I think that question could be cleaned up a bit. I think you get better data if you word it differently...How many days... How many days are the engines running? How many days are you on the boat? How many days are the engines running while using the boat? Gosh.”

INTERVIEWER: “It’s tricky.”

INTERVIEWEE: “It has to be something related with the engines.”

Interview #18—

INTERVIEWEE: “Exactly. It’s still the same because on a jet ski or PWC, you are going to get wet. And if you’re not wearing a wet suit in the winter, you’re going to freeze your butt off.”

INTERVIEWER: “Okay, so how confident do you feel about your answer to this question?”

INTERVIEWEE: “Positive.”

Findings Summary: *Participants were relatively sure about their estimates of the number of days they used their boats in an average season and employed a variety of methods to estimate this. There were some cases in which respondents provided estimates for time during COVID due to the format of the survey. Additionally, the business format of the survey was difficult for that respondent to navigate due to having to average two boats with very different uses. Finally, some respondents with unique uses, such as a houseboat, found the focus on the vessel rather than the engine to be problematic.*

Suggestions: *The survey should reiterate the period to report on (pre-COVID) more often, so the participant does not lose track of this. It may be useful to implement ranges rather than exact values since participants were not fully confident of their responses. Additionally, we recommend the business format of the survey be eliminated due to confusion created for the respondent and low overall usage. Finally, due to problems associated with certain vessel types (houseboats and sailboats), the focus should be on the engine rather than usage of the vessel.*

Number of hours vessel was used in the summer and winter:

Interview #1—

INTERVIEWEE: “That’s kind of a difficult question to answer because it’s a little vague because you can go out for an hour or two, and you will eventually be tired because it’s a watercraft so you have to do a lot of physical work. Obviously, you’re going to get thirsty, you’re going to get hungry, so you’re not going to want to go out that far somewhere without wanting a break. So every time we operate, I’d say about an hour, an hour and a half, sometimes two ---depending on how far we go, but that would be like one hour out and then one hour to come back in average, and then we break for lunch or whatever it is, and then we go back out for another hour and change, so it could go up to sometimes eight hours a day if you combine everything. Not just myself but somebody will be riding it instead of myself, somebody will grab it, and you take turns.”

INTERVIEWER: “I see, and so the two hours is per session almost.”

INTERVIEWEE: “ Yes, yes, there you go, per session. So it can go up to between 8 to 10 hours.”

Interview #2—

INTERVIEWEE: “It takes about 5 hours to get to Catalina, including warming the motor up, getting there, sitting there a little bit, -- and turning the motor off, so I was using that as my gauge.

INTERVIEWER: “Gotcha, okay, average on any given day, and on any given day, do you make a round trip or one trip?”

INTERVIEWEE: “One trip over, spend two or three nights there, maybe five or six nights there, and then one trip back.”

Interview #3—

INTERVIEWEE: “There’s days where I use the boat a half hour to go across the lake to have dinner...and then there’s days where I’m out on the water for 6 hours a day towing kids on innertubes... so on an

average consistently over that 75 days, I can say I'm using my boat about 4 hours a day. And then in the winter it's the same thing, those times that I'm going out, I'm going out to fish, and see that's just it, boats aren't constantly on. If you get out to a point and you anchor and you're sitting out there on the lake for 4 hours, you're not using the boat. It took you 10 minutes to get out there and 10 minutes to get back... Even in a 6-hour period that boat won't be on that whole time on the water. You might cut it off, sit in a cove for a couple hours, listen to some music, people jump off rocks..."

INTERVIEWER: "Do you subtract the times when the boat is not moving...?"

INTERVIEWEE: "Well, I did just because I see things a little bit differently than most people... you might want to make a distinction that says, you know, operational not anchored or idling or sitting in the middle of the lake or the ocean or wherever people take their boats."

Interview #5—"This part...is a little more challenging... Because we're discussing the engine and now we're discussing the boat...I don't use the engine very much on a given day when I'm using it... If your question is: How long was I running my engine? That's what this is responsive to. I have to put my engine not for the boat, because when I go out sailing, like I said, in one day of sailing, I might be out for 6 or 8 hours but only operate the engine for half an hour."

Interview #6—

INTERVIEWEE: "That's also just an estimate, but you know, it's just an estimate. If I'm out there 8 to 10 hours, a little bit more than half of that is with the engine on and half of it is with the engine off. So, it's kind of a guess but you know. I think – yeah, it would've been better. I would've been more comfortable in providing a range. If I had to have ranges, I would've said 4 to 6. It's like 6 may be a little high, yeah."

INTERVIEWER: "Okay, and for this question, did you indicate the number of hours that your boat was operating or the number of hours that your engine was operating?"

INTERVIEWEE: "That's an interesting question. I did that with the engine because I assume... Yeah. I assumed it was an engine, but looking at it again, it didn't specify."

INTERVIEWER: "Okay."

INTERVIEWEE: "Some people could've interpreted it either way."

Interview #7—"I have no way of really knowing, that's an average over [INDISCERNIBLE] trips, so [INDISCERNIBLE] that's pretty close."

Interview #8—

INTERVIEWEE: "I know we put about 10 hours on the boat when we were up at Tahoe, and so then I know the rest of the time we were out at San Francisco Bay once and we probably put about...We probably put about five hours on the boat that day and then we took the boat out another time. It's a guess because I know that typically, that -- I've been putting about between 25 and 35 hours of use in the boat every year – every season, and I know that we did about the same – we took the boat out about the same amount of time, we just didn't go out with other people like we normally do."

INTERVIEWER: "Okay, so about 15 times during the summer, you feel pretty confident is the right answer, or..?"

INTERVIEWEE: “What did I put down for the numbers I usually used it last year?”

INTERVIEWER: “For the summer, you put four hours and for the winter you put three hours, on average.”

INTERVIEWEE: “Yeah, --- we didn’t use it as much last year as we did the previous year.”

INTERVIEWER: “Yeah, well that would make sense.”

INTERVIEWEE: “Yeah, because we just weren’t able to. I swim competitively and do a lot of open water swims, and I take the boat to some of those and so, those --- were all cancelled, so we just didn’t go out. We didn’t take the boat out as much last year. We were pretty disappointed – I like to go out and water ski. My girlfriend and I just – we didn’t want to be around with other people, so...”

INTERVIEWER: “Did you miss the part about where it said “before COVID” or did you – was it not obvious enough? Or did you just miss the instructions? Was there something we could do to make it more obvious --- that what we meant was pre-COVID?”

INTERVIEWEE: “I probably read that, and then I forgot about it when I was trying to estimate the hours. And I didn’t get it, and I was just thinking – I just automatically reflected back to last Summer because it’s the --- most current memory, and so if I thought about the year before, I know that I used the boat a lot more hours the year before.”

INTERVIEWER: “Got you, okay. Yeah, so there was nothing that we could do to make it more apparent to the respondent on our end.”

INTERVIEWEE: “Pre-pandemic, maybe a little --- bit bigger print or bolder.”

INTERVIEWER: “Yes, okay.”

INTERVIEWEE: “And maybe underlining it or something like that to do it, because I know that I probably – I probably messed up on that one. I read it, but then when I started calculating hours, I immediately thought back to last summer – what I did last summer.”

INTERVIEWER: “Right, well I’m looking at it right now actually and it says on one page please provide the following information on how you’ve used your boat within the past year before COVID. That’s on one page, and then the instructions, the little instructions on the grid is on another page, but it doesn’t say anything about pre-pandemic on the second page --- so, maybe putting the pre-pandemic on this page would be helpful too.”

INTERVIEWEE: “Yeah, on the second page where you’re actually throwing out the answer, it probably – you know, remember pre-pandemic.”

INTERVIEWER: “Remember pre-pandemic, okay.”

INTERVIEWEE: “Just something to kind of reinforce that you’re trying to get pre-pandemic usage.”

Interview #9—“I know that, one, we take out the jet skis...1 to 3 hours. I don’t know if you’re into jet skiing, but you’re beat up after a couple of hours. So, you don’t take them out more than that.”

Interview #10—

INTERVIEWEE: “Just estimating how long our trips were on water. It’s a rough number, but it’s close to it. But there’s no scientific that I have, you know. I don’t keep track of that, so it’s just by memory.”

INTERVIEWER: “So by memory, you’ve said that regardless of the season... So for example in summer, approximately each of the six times you went out, you would’ve gone out for on average an hour?”

INTERVIEWEE: “Correct.”

INTERVIEWER: “And the time you went in the winter, you went out for an hour also?”

INTERVIEWEE: “Sure, and I’m assuming engine running is [INDISCERNIBLE 00:11:39].”

INTERVIEWER: “Engine running, so when you answered this, the one hour, you only counted time the engine was running, do you mean?”

INTERVIEWEE: “Correct.”

INTERVIEWER: “So if you had it docked or something somewhere else, you would not have included that?”

INTERVIEWEE: “Correct.”

Interview #11—

INTERVIEWER: “Okay, so the next question asks for about how many hours on average you operated your boat on any given day during each season, and you said one hour. So basically, what you’re saying is that for each of the 12 days that you went out during the summer, on average you operated your boat about an hour, and then for each of the three times that you went out during the winter, you operated your boat for an average of about three hours. How did you arrive at an answer to this question, or how did you arrive at these answers?”

INTERVIEWEE: “So I guess wintertime when you’re crabbing and stuff, it’s a lot more idling, right? So you pull up to the pots, your boat’s on, and you know you’re going back and forth through the pots...driving out quite a distance. So that’s how I got – I figured idle time is run time, right? So some of the idles, you don’t turn it off... [on the other hand] summertime at the lake...we always cut the engine when we arrive to a spot, right? Trout fishing usually, so... Go up to a little beach, you know, kind of park on the boat and the lakes are kind of small we go to, you know. We’re not water skiing or anything, right? And when fishing in the summer, you do a lot of drift fishing, so we go to our drift, start, and cut the engine and then just drift for a while, drive to the next spot. I can bump that up to maybe 2 hours in the summer, like, 1½, but I try to balance out. Maybe out in the ocean, we’d be running for two hours, but in a lake we’d do half an hour, or 25 minutes, or something, right? So, maybe 1.5 hours, 1.25...”

INTERVIEWER: “...can you...tell me...the definition of drifting?”

INTERVIEWEE: “Yeah...in the ocean or the bay, there’s a lot of factors that move your boat around when you’re not under propulsion, and so, the wind will push you...and your cabin and stuff will get caught and act as a sail. Not the most efficient sail, but you’ll still get pushed through the water, or if the

current's moving really fast, you can get caught in that and kind of drift with the water like that. And it's a good way to cover ground when you're fishing. Sometimes, you can anchor, but that means you're only fishing in one spot. If you're drifting, you're moving your lines with the boat basically and you'll be covering a lot of ground. It's a really good technique in some cases."

Interview #13—

INTERVIEWEE: "That's pretty accurate because..."

INTERVIEWER: "Is that?"

INTERVIEW: "Yeah. The reason is this area is like – you don't go very long distance, right? You go to neighborhood, go to restaurant. You go to the marina. You go see the neighborhood, you cruise around. That's how long it takes to go around, right? My neighborhood is different from like – you live in San Diego for example, right? You probably need to go very far, right? Go to different island and come back. That takes much longer, right? In my neighborhood, it's more like a lake situation. The lake is just that big, right? You cannot go too far. You have nothing to do if you go too far, right? That's why you end up always two hours to go out, eat some food and come back, right?"

Interview #14—

INTERVIEWEE: "It wasn't difficult but that's when I was wondering, are they – do they know I'm – if it's only sailboat owners or not? Because I thought, well, you know, I mean, my boat is in Berkeley, right? So, you don't need very far and you ride there with the wind. So typically, I'll fire it up. I may use it even less than an hour, but I think an hour altogether, because sometime the wind dies, and as an average, but I can get in and out of my slip even... Getting out is harder without the engine, but I can get in my slip without the motor, and typically, I sail all away to the middle of the harbor, the marina, and then I use my engine maybe 20 minutes or something, coming back, 20 minutes going out. The wind dies, maybe another 10. So, I thought maybe an hour is about right. I think on average it's probably about right. But it's a sailboat, so remember that."

INTERVIEWER: "Uh-huh. So, let me ask you this. Is that hour how much you use your engine, or how much you use the boat?"

INTERVIEWEE: "That's how much the engine is turned on, how long the... I am actually using the engine to propel the boat."

INTERVIEWER: "I got you, okay, that makes sense."

INTERVIEWEE: "So, I might... Typically, I never go out for less than... It always takes time because it's not a super big boat, but it takes time to put the sail, get everything ready, and all that. So, a typical outing is at minimum three hours, often it's more like six, sometimes a whole day, but I only use the engine when I leave the marina and when I come back."

Interview #15—

INTERVIEWER: "Okay...you said that on average, you operated your boat zero hours during each one of these sessions."

INTERVIEWEE: "...I thought that said engine. Maybe it's because everything was talking about engines...Here it says boat."

INTERVIEWER: “‘For about how many hours on average did you operate your boat on any given day during each season?’ Now, this is interesting because I think it should’ve said engine. So, let me ask you this. If it was boat, how many hours would you say you operate your boat on each occasion?”

INTERVIEWEE: “So, on any given day, so we’re talking about weekly, or seven days, on how many hours did I average?”

INTERVIEWER: “On any day that you go out that you use your boat.”

INTERVIEWEE: “That’s probably – Maybe that’s what I did because I was thinking on any given day. On most days, they don’t go sailing, so maybe zero. Maybe that’s what I was... Yeah.”

INTERVIEWER: “Yes, I think that’s what you were thinking. The question is basically asking... On the days, on the 15 days that you went out on average, how many hours did you go out?”

INTERVIEWEE: “So, let’s see, about 12:30 to 5... 4 or 5 hours.”

INTERVIEWER: “Okay, alright. Now, if the question were to ask about the engine, how would that answer differ?”

INTERVIEWEE: “Well, that would be zero because when I do use the engine, it’s for like maybe 15 minutes.... sometimes, you sail into a place where there’s no wind and then you motor back out into the wind. And sometimes, the wind is... So, I sail in and out of my dock. I don’t think most people do, but I do. And if the wind is coming from a direction that I just can’t get out there practically without the motor, then I’ll turn on the motor, but then it’s only on for like 10 minutes.”

Interview #16—

INTERVIEWEE: “Maybe, yeah. Maybe I misread this.”

INTERVIEWER: “So, how did you answer here?”

INTERVIEWEE: “So yeah, on a given day, maybe I would use like the motor for an hour or two on a given day we’re out there, not 20 hours.”

INTERVIEWER: “Okay. Is there anything we could have done to make this clearer so that you could have arrived at the answer that you just gave me? Anything on the formatting or something that we could’ve...?”

INTERVIEWEE: “Honestly, I think I misread it, but I think if anything, probably not putting like anything about the season in there. For about how many hours on average did you operate your boat on a given day? Not putting the season, because I think that’s what I probably got confused with, is...”

INTERVIEWEE: “Okay, during each season being listed here again, meaning you’re already going to see the season when you come down here and give your answers?”

INTERVIEWEE: “Yeah.”

Interview #17—

INTERVIEWER: "... I actually think what they're interested in is, on average, how many hours did you operate your engine...And so, if the question were reworded to for about how many hours on average did you operate your engine on any given day during each season? Would that be helpful?"

INTERVIEWEE: "It would be helpful. It wouldn't change my answer because I know how much... I mean, it takes probably 25 minutes to get to where it is that we normally anchor out, and so that's... And then once we anchor, we're there and sit for two more days, and then we pull up anchor and we go on back another 25 minutes. So, that's less than one. It's probably a half-hour on average for the number of days, but there wasn't a half-hour selection. There wasn't a less than one selection. There was one, one or zero...it can't be zero...So, if you're looking to refine the data, then maybe it should be 0.5 to 1 selections."

Interview #18—

INTERVIEWER: "And then the next set of questions are asking you about the hours on average that you operated your boat on any given day during each season. And so, you put five hours in the summer. So, that tells me that on the five days that you used your boat during the summer, on average, you used it for five hours. Does that sound accurate to you?"

INTERVIEWEE: "No, I double that. I put it up to 10 hours."

INTERVIEWER: "You would put up to 10 hours?"

INTERVIEWEE: "Yeah, I'd say a minimum of two hours, each of them five days. So, it'd be 10 hours. Now, if I go out there with other people this is the average 10 hours, if I go out there with other people, we'd be out there all day."

INTERVIEWER: "So basically, on any day that you use it, you use it 10 hours?"

INTERVIEWEE: "No, I'll use it two hours when it's just me out there on those five days."

INTERVIEWER: "Okay, and on those five days, is it typically only you out there?"

INTERVIEWEE: "Yes."

INTERVIEWER: "Okay, and so, where did the five hours come from?"

INTERVIEWEE: "It was just a general guess, now that I'm sitting here thinking and I've had time to think about after this thing in, I'm going, "I don't... It takes me an hour to get to the lake, I'm not going to just spend an hour out there."

INTERVIEWER: "Yeah, so is it possible that part of the difficulty is the question wasn't very clear?"

INTERVIEWEE: "No, I knew what you wanted, it's just – I just grabbed the number five."

INTERVIEWER: "Okay, and then you also put for the winter season, zero hours, which makes sense because you put zero days."

INTERVIEWEE: "Yeah."

INTERVIEWER: "Okay. Yeah, actually, the better answer would've been, "Did not use boat, does not apply," actually. Because zero indicates zero hours, and 'did not use boat', which you didn't do because you put zero days."

INTERVIEWEE: “Right, okay.”

INTERVIEWER: “Which you probably didn’t notice that that was there, right? Because it says ‘zero’ here and you have to scroll all the way down to see it’s ‘don’t know, did not use.’”

INTERVIEWEE: “Yeah, I probably never scrolled down to see that.”

INTERVIEWER: “And you wouldn’t.”

INTERVIEWEE: “Just saw the zero and that’s it.”

INTERVIEWER: “Yeah, no, I see where you would think that, for sure.”

Findings Summary: Boat owners estimate the average number of hours they use their boat each day by reflecting back on the activities they typically engage in. The certainty they have in their responses varies (with jet ski owners being most certain), and it is unclear for some whether the survey is referring to their boat or its engine. Several noted that the engine is turned off for many recreational activities, including anchoring to relax or fish, drifting, and sailing. As with days used, some are unclear that they should be referencing the time before the COVID Pandemic.

Suggestions: The survey needs to clarify to respondents that we are referring to the amount of time they use their boats’ engine(s). It should include a statement instructing the respondent to exclude time they are anchored, drifting, sailing (without the engine) or any other activity when the engine is not running. Addition of ranges for those who “don’t know” how many hours they use their boat may be helpful. In particular, it may be helpful to have very small ranges for sailboat owners. The survey should also remind the participant that they should be reporting on the time prior to the pandemic.

Keeping the engine idle:

Interview #1—

INTERVIEWEE: “Basically, if you just have it running without really doing anything, just sitting there, and so that’s what I understand. And in this case it’s usually within minutes, within a couple minutes, if somebody is getting in or you’re setting up, you’re strapping your vest, or you’re waiting for someone to tie a rope so you can pull someone that’s in a ski or something to ride the waves, so it’s usually not very long. I would say maybe 5 minutes, 5 to 10 minutes tops.”

INTERVIEWER: “Okay. You put 0 to 33% of the time. Is this something that you usually pay attention to, like how often the engine in your jet ski is idle?”

INTERVIEWEE: “No, not really, no. As long as it’s in water, it can idle all day.”

Interview #2—

INTERVIEWEE: “It’s something that is hard to answer because --you idle a boat when you’re in the slip for a lot of reasons, just to make the engine run, okay. Boats deteriorate real fast if you don’t use them, so I got down and turn the engine on a lot just to blow out the carbon and that kind of stuff and then turn it off, but I’ll leave it on for a half hour to an hour sometimes, and that’s much more often than the amount of time that I use the boat, I mean it adds to the number of times to the boat usage, but if I was at Catalina and I had a generator, I wouldn’t turn the motor on at all. If I didn’t have a generator, you’ve still got to charge the batteries, and if you don’t have a generator, you turn the main boat on and let it sit there idling while it charges the batteries, and that’s probably a couple hours a day, so there’s variations there -- --that become important when you’re looking at the bigger boats that would go to Catalina than a lake boat.

INTERVIEWER: “Okay. Does it make a difference that the question asks about how often is the engine of your boat idle during a typical trip during each season?”

INTERVIEWEE: “Well, you can say that, but see I answered here ----incorrectly or I didn't fully answer it because there was no question about the generator. Generator it would have been six times per trip, and the generator is a 6kw so it uses fuel.”

Interview #3— In response to what question is asking: “So it’s like when I’m fishing and I get to the place I’m going to start fishing, and I pull it into the neutral, the engine is on, we’re sitting there but the engine is on because I don't want to bleed my battery listening to the radio, so I leave the engine on because the alternator is going to charge my battery and I’m not going to get stuck in the middle of the lake, so I’m sitting there idling the boat, and so that means the engine is on but there’s no force or movement.” “There’s no force on it, the engine’s not moving, the prop’s not moving, the jet’s not pushing water, the engine is just on idling and it is burning fuel and it’s to keep the electronics on the boat operational.” “In the ocean...you would never turn off your engines as a safety precaution...so when your engines are on, they’re on”

Interview #5— “This...is the difference between a sailboat and a powerboat. With a sailboat, you’re using the engine to move the boat when you can’t use the sails. And so, you’re typically not going to be sitting there idling. Whereas a powerboat is going to be, let’s say they’re doing water skiing or something, they’re going to be idling while the skier’s getting ready, and then they’re going to hit the power and pop the skier out of the water. So, you’re going to have that idling time.”

Interview #6—

INTERVIEWEE: “So, when the engine’s on, you’re either using giving it gas to make it go forward at a certain speed, or just idle, like a neutral or just pop it into gear so that you move very slowly. So, that’s what I interpreted as idle. It’s not like going fast, going from one place to another, but either just being on, just – some people don’t like to turn off their outboard when they’re out there just in case it doesn’t turn back on. Or for my case, I used to go very slowly just in gear to troll and catch more fish.”

INTERVIEWER: “Okay, and how sure are you of your responses here?”

INTERVIEWEE: “For a broad range like this, I’m pretty sure.”

Interview #7— “I’m sure it’s a lot less than 33%, probably less than 10%...or less than 5%. Thirty-three percent is a pretty big window.”

Interview #8—

INTERVIEWEE: “It’s how much time do you spend at the dock when it’s fired up ---- and you idle it, let it warm up prior to – because this specifically says, in neutral, no load. Yeah, no load which is even if you’re in gear and moving, that engine is under a slight load, so if you --- want to make it – that in ‘neutral’, because it says ‘no load’ and I... Anytime you’re in gear and moving, you’re under load. So if their intent was just idling or was it idling --- in gear, that makes a big difference and I look at it as idling with no on the engine which meant ‘in neutral’. Because I think it specifically says ‘no load’. So, was it in the question, ‘no load’ in the question?”

INTERVIEWER: “Yes, it was.”

INTERVIEWEE: “Okay, to me that’s in neutral. I think it would be a little bit more clear if they said ‘in neutral or in gear’ depending on what their intent was. And I took it as how much does a boat idle without it being in gear, no load. Because --- even if you were trolling – fishing and trolling, that’s in gear and that’s under load, so if they want to make it more clear, then it should be ‘neutral or in gear.’”

INTERVIEWER: “Okay, and are those two separate things or are they the same thing?”

INTERVIEWEE: “No, they’re different. I gear is under load. Neutral, it’s no load.”

Interview #9—“They’re asking you: Are you sitting, not moving with the engine running? ...you wouldn’t do that on a jet ski. You might do that on a fishing boat, but I’m not fishing off the jet skis, so I knew it was 0% of the time. A fishing boat might be idling to keep the electronics on the boat running or whatever, but for me, on a jet ski, you would not sit and idle. Hardly at all would you do that. It’s not good for the jet ski and it’s obnoxious, to be honest, a jet ski that’s idling.”

Interview #10—

INTERVIEWEE: “How long you’re idling for your each trip [INDISCERNIBLE].”

INTERVIEWER: “Okay. Was this something that you would usually pay attention to, --- how often the boat is idle?”

INTERVIEWEE: “When I first started, yes, I idled three to four minutes, and you know. Sometimes, you stop in the middle of the lake and idle for a minute or two. And then when we get to a destination, so --- you know... It’s like you know, roughly percentage of – small percentage, I guess. So, I’m assuming I guess for an hour, maybe, I don’t know, two or three, five percent of the time. It’s hard to exact a number, but that’s what I’ve said.”

Interview #11—

INTERVIEWEE: “So, when we’re talking about idle, right, I think of the boat being in neutral, not engaged in a forward or reverse gear, right? So, summertime we idle the boat when we’re warming it up or... right when it gets into the water, when the engine submerges and we turn the boat on, let it warm up just like you would a car...that’s idle time...during the summertime...might be when only times I idle. But wintertime, like I said, when you pull up to a crab pot, you put the boat in neutral but you don’t turn the engine off because you might have to readjust or move to a different spot rather quickly. So, that’s where that answer comes from.”

INTERVIEWER: “I see, and you put summer as 0 to 33 and winter, 66+. And this 66+ for the winter is because of the crabbing?”

INTERVIEWEE: “Yeah, that or – that’s about it, yeah...And you know if you’re running like a charger off your battery, sometimes I do like the engine has the alternator, leave it on and so the battery won’t die, basically.”

*Interview #12—*Regarding the business survey format:

INTERVIEWER: “So these other questions below also on usage but on percent of time idle and number of times restarted, how did you calculate or arrive at these...”

INTERVIEWEE: “Okay, so 66% – so during the summer, I took an average of...I probably kicked it up to 66% considering that I would use the powerboat for something realistically, while I was using the sailboat for six of the eight times in the summer in the above question. The time it sits idle is probably

closer to 90% but I kicked that up a little bit for the powerboat. So again, there's a Boat A or B question. You could break that 3 inches of percentage of time idle into maybe above and put a Boat A, Boat B, Boat C."

INTERVIEWER: "So to have them separated out, huh?"

INTERVIEWEE: "Say it one more time?"

INTERVIEWER: "To have these separated out – to have the two separate boats."

INTERVIEWEE: "Yeah, I would try to bring in – if it was an Excel spreadsheet, I'd put an A above the 66, divided into three columns of C, for Boat B, say you've got more than three boats. Yeah, if it had more than three boats, they would fall into a commercial class or something."

Interview #13—

INTERVIEW: "I assume idle means that you go – you're taking a boat out and either boat sit on the water or your boat sit on a dock, right, with an engine running, I would say, maybe. Maybe that's what it means."

INTERVIEWER: "Okay, and you noted 0% of the time. How easy was that to answer for you?"

INTERVIEWEE: "Because the way I do, I just go – when I get at the place, I need to shut down the engine, right? And then do what I need to do. If I need to go back again, I just restart, right? So, I don't let the boat idle – stay in the water idle."

Interview #14—

INTERVIEWEE: "I think you're asking if I let my engine running when I'm not really propelling the boat forward with the engine, right?"

INTERVIEWER: "Okay. And you put 0% of the time. Was that a difficult question for you to answer?"

INTERVIEWEE: "I think if I recall the different possibilities were either zero or were quite big, yeah. So, I didn't want to put less than 33%, because I'm definitely not there. But obviously, my engine idles right before I leave the slip and right before – but it may be five minutes and five minutes, so that's why I put zero. But if you had put 0 to 10%, or 5 to 10% of the time or something, I may have clicked the 5 to 10%."

INTERVIEWER: "Oh, I see. These categories are too big."

INTERVIEWEE: "Exactly, at least for sailboats."

Interview #15—

INTERVIEWEE: "So, running but not in gear. So, how often... 0%, during a typical trip... So, I would have a very hard time interpreting that for my situation because I'm not using the engine for a trip. I'm using it to – for just a few minutes to get a little bit of distance, not to go a little – away, it's not very far. I've never used it for an entire trip that I can think of, okay? So, I would... If forced to answer this question, I would say of the time that the engine is turned on and running, what percentage of that is in idle and what percentage is in gear? And... Oh, I answered between 0 and 33%?... So yeah, because I run it – and I also run it at idle when I get back. If I run it on a day because it circulates saltwater to cool it, just water out of The Bay, I want to flush the saltwater out with freshwater. So, I turn it. I attach a hose to it and run it for a while just in idle to get rid of saltwater, and that's a big portion of its use. So, it's certainly less than... Well, in those cases, it certainly less than 33%."

INTERVIEWER: “Okay, but so 0 to 33% is – would Not Applicable be a better answer for you?”

INTERVIEWEE: “Well, I wouldn’t be happy with any of those answers to tell you the truth, but I don’t know. If you said Not Applicable, I wouldn’t be terribly happy with that either. Engine’s weird on my boat. I’m sorry. I got a weird boat.”

Interview #16—“In the first one, how often is your engine on your boat... So, you know --- just to kind of keep the battery running. And again, so maybe just kind of grown up doing too, other people are running their radios, running batteries in the boats because we... I grew up on a cruiser that we could sleep in and live in throughout the weekend. So, you know, a lot of the times, people were just going to start their boat and just kind of keep it running for a little bit --- but it’s just to kind of keep it flowing, mainly because... At least in my mind, the motors aren’t ran every day like a car. So, any time you’ve got any motor sit, in my mind, it’s not good. You know, you kind of need to kind of keep it moving. And I feel like especially with older motors, you kind of – you get a little vapor lock. You know, you want to kind of keep it flowing. So, we’ll go out there, start it up. And so yeah, it’s not for a long time, but yeah. Like, not that long, you know, that you would just let it run for a little bit. Or... And also, just to kind of get up and go, if you wanted to get going and, “Hey guys, we’re going to go cruise on the boat.” So, we’ll go down there and set up the boat for a little bit, and everyone will load in. So, it’s not a long period of time that it’s really sitting there, maybe like 5, 10 minutes. So yeah, that’s kind of how I did the least amount.”

Interview #17—

INTERVIEWEE: “Well, how often do you have the throttle down to just idling, and you’re not throttle up, you’re not going faster? You’re just at a typical idle RPM.”

INTERVIEWER: “Okay. And you say 0 to 33%. How sure, how confident are you of your answer to this?”

INTERVIEWEE: “Well, I’m very sure because how often is your engine on your boat idle? Well, there’s a lot of times when I’m in idle. Sometimes, when I start the engines, they’re in idle, and then when I get going, then I’ve got to go slow when you’re around other boats. So, it’s definitely no more than 33%, so that’s why 0 to 33 was a good answer.”

Interview #18—

INTERVIEWEE: “How often is... You know, I was sort of confused when I read that one, ‘engine is on ---- but no load on it.’ Yeah, to me, I’m thinking well, they’re wondering if I’m zooming around out on a lake or I’m just sitting there floating around, eating my lunch with the motor on. And I wouldn’t do that either. So, I was sort of – I didn’t know how to answer that, really.”

INTERVIEWER: “Okay. So, you put 0% of the time. And why did you choose that answer?”

INTERVIEWEE: “Because I thought it was a goofy question and I thought I’ll give them a goofy answer.”

INTERVIEWER: “Okay. Is it that the question doesn’t necessarily apply to the type of boat that you have?”

INTERVIEWEE: “Yeah. I mean, with either a jet ski or what they call a PWC jet ski is you stand up on all the time. PWCs, you can stand or sit, but you’re never sitting there for more than, I don’t know, 10, 15 seconds at most that you’d be idling and doing nothing. but you’re always moving. You’re not just sitting there floating around while the motor’s idling.”

INTERVIEWER: “Right, because you would sink, wouldn’t you? I mean, like...”

INTERVIEWEE: “No, you wouldn’t sink, but it’s – I don’t know, most people I can see in a regular boat, you may idle, or drift, or whatever, but you don’t do that in a jet ski.”

Findings Summary: *Participants generally interpret the term “idle” correctly and define it as running the engine without the propeller or jet moving any water. Some suggest the term “in neutral” might be a good way to describe idling. They listed various uses for idling, including to warm up the engine, for maintenance of the engine, to charge batteries to run auxiliary equipment, to avoid situations where the engine might not turn back on, and for trolling. Both sailboat and jet ski owners feel this item does not apply to their vessels. Finally, several respondents feel the categories are too broad and should be refined.*

Suggestions: *The survey item itself appears to be adequate to capture the desired information. However, we may want to add the words “in neutral” to the definition for clarification. For sailboats and jet skis, we might skip this item, since it does not seem to apply to them (the answer will always be near zero). Finally, the categories may benefit from being broken down into smaller ones, particularly on the low end.*

Regarding how often the engine is restarted:

Interview #1—

INTERVIEWEE: “During a typical trip –? I’m going to lose count. I’m going to say maybe, I don’t know, 20 times, 15-20 times per trip.”

INTERVIEWER: “Okay, and then how sure are you of that answer?”

INTERVIEWEE: “Very sure. Now as far as the winter, it’s zero. Well, I take it back because I do start it sometimes, but no, that’s fine because I usually don’t start. I haven’t started them in a while.”

Interview #2—“Oh, I’m pretty sure on that.”

*Interview #3—*On how sure they are of their answer: “Really sure, yeah...when that boat goes out...it’s got all the bells and whistles, so that idle position is what we normally sit in because we’ve got to keep readjusting that, it won’t anchor, so you’re constantly adjusting it, and on a trip it’s about that many times because once you get it adjusted, you’ll keep it on. You may turn it off once in a while but you’re not going to turn that boat off very often, you’re just not.” “You usually stop the boat maybe once or twice every trip for some reason, you’ve got a tangle, somebody needs to get on the boat, a kid’s scared of the prop so you turn the boat off so everybody can get on while they were all swimming. I mean there’s so many different reasons that you could on an average trip if you’re out on the water, it happens a couple of times.”

*Interview #5—*Respondent was “very sure” of answer and explained: “You start it to pull out of the slip, you stop it when you get under sail, and then when you’re coming back in, you drop the sails and you start the motor again and then we get back into the slip.”

Interview #6—“That one is much more variable, so I’m not quite as sure. You know, some trips you do it more often. Some trips, it could be 12, 14... Some maybe, you know, literally just once. You start it, go someplace, and stop it. So, there’s a huge variation in this. So, I just try to give an average.”

Interview #7—“Because during the winter... we just cruise around. You don’t go to the beach or anything, just cruise. So, it’s kind of like lodged in, go on a little ride...Not like in the summer, you go to the beach, [INDISCERNIBLE] the boat, and climbing the boat, and top – you have the boat. [INDISCERNIBLE] climb in, so that’s bigger.”

Interview #8—

INTERVIEWEE: “Relatively, that’s...I’m just trying to think, when we go out – I mean, that’s per trip – that’s per day out on the boat?”

INTERVIEWER: “Yeah, it’s approximately how many times you restart this boat’s engine during a typical trip.”

INTERVIEWEE: “Yeah, a typical day out, --- I would say six to eight times. There’s certain times you’re going to shut it down; people getting in the boat from skiing and you turn it off and then restart it. Yeah, I’m going to say six to eight times.”

INTERVIEWER: “Okay well, you put four to six during the summer, and then --- zero to three during the winter, so does that mean that you are not very sure of your answers that you’ve put?”

INTERVIEWEE: “No, on a winter, when I take it out, we stow it up at the dock and we usually run it and we go – if we go out, we go for a ride and we don’t --- we usually maybe will stop maybe one time down to restart then we come back to the dock. So, in the winter, yeah. In the off-season, yeah, it’s zero to three. In the summertime when we’re skiing and doing that --- kind of thing, eight times – six to eight times in a day for sure.”

Interview #9—

INTERVIEWEE: “Very sure of that. When you take the jet skis out, you’re either going somewhere or you might stop for lunch or a fuel dock or something. But you’re not stopping and starting and stopping and starting.”

INTERVIEWER: “Got it. So when you answered this question, between zero and three, zero, one, two, three, what was it that you meant for each of these?”

INTERVIEWEE: “One or two.”

Interview #10—“I’m pretty sure because usually we stop at the spot in the summer. You spend an hour or two in the spot and then move onto somewhere else, or we might drive around and stop somewhere else --[INDISCERNIBLE 00:14:01] in the summer. In the winter, it’s a little bit cooler, so we move around less and just stay in one spot. So, I’m pretty confident in these numbers.”

Interview #12—

“Okay, if it’s a sailboat, I start it up, I drive out of the dock, I get to the wind and then I turn it off, okay? Maybe the wind dies halfway through the trip. I’d put it on for a little bit and then I’d fire it back up before I go back into the docks. Of a day of sailing, I probably only run that thing for a couple of – maybe two hours max, but if I can sail any of that distance, I do, but sometimes you just want to get home a little bit quicker. But if there’s wind, you sail as fast as you power.”

Interview #13—

INTERVIEWER: “Okay, that makes sense. And then approximately how many times do you restart your boat’s engine during a typical trip? And you put zero to three times. How sure are you of your answer to this question?”

INTERVIEWEE: “I guess the right answer would be two, right? Because you start first, you go there, then you stop and maybe start again, right? Usually, that would be two, right? That’s between zero and a three.”

Interview #14—“I think it’s a pretty good average, because I will start it when I leave, right? And I will start it when I come back. And then often, it’s not uncommon it happens that we get stuck with that wind or something, so I’m restarting it all the time in between. And so, I was thinking on average, it would be about three times, yeah.”

Interview #15—“I’m sure it’s between 0 and 3 times. I would rarely start it more than 3 times, so – and 0 would be a common time, so if I go on a trip, it’s like, “Oh, got into wind shadow, start the engine. Oh, sunset, the wind died, start the engine.”

Interview #16—

INTERVIEWER: “Here, you said in a summer, 10+ times. Winter, 0 to 3 times, which makes sense because you said 0 here. Could you tell me, this answer here, how sure you are of that answer, 10+ times, that’s the boat’s engine would be restarted during a typical trip?”

INTERVIEWEE: “So, I’m just thinking again throughout the duration. So, if we went for the weekend, I’m thinking of, a whole weekend, how many times that would start the boat. I would assume maybe close to about 10 times because between going from the launch and going to the [INDISCERNIBLE] spot, dropping things, you know, dropping things off, running into the marina going back, you know what I mean? Just kind of back and forth. I think 10 times would be probably – or 10 trips in my mind.”

INTERVIEWER: “Uh-huh, so this is kind of like the total for the day is what the 10+ is?”

INTERVIEWEE: “I would think the total for like throughout the weekend.”

Interview #17—“I don’t restart my boat – so zero, because zero – so zero was a good answer.”

Interview #18—

INTERVIEWEE: “Okay, basically because that’s why the idle time meant nothing to me. Zero, because if I’m going to sit there idling, I’m just going to turn the engine off and maybe eat my lunch and then turn the engine back on and start moving. So, that’s why I wouldn’t select any time idling, because I’ll turn the engine off. And sometimes, what I’m – if I just want to look at something or take some pictures while I’m out there, I’ll turn the engine off and take my pictures. But if I need to start the engine, because the boat is being moved by the waves, I’ll start the engine and get me in the position I need to be in to take the picture. And if I’m not moving around too much, I’ll take the picture without turning the engine off. But there’s usually about, on an average each time I go out, it’s about six times I’ll start it, and that’s how I figured out I needed a new starter in my craft at one point.”

INTERVIEWER: “Yeah. And then why did you put 0 to 3 times in the winter?”

INTERVIEWEE: “Because some – rather than just letting the engine sit out there for, I don’t know, October, November, December, January, February, March, April, 7 months, with not turning the engine on, that’s why I’ll just go out to turn it on to circulate things as a test.”

INTERVIEWER: “Got you. Oh, okay, that makes sense. I wondering “Why would you turn it on when you haven’t used the boat?” Okay.”

Findings Summary: *The number of times boat owners restarted their engines varied by type of vessel and how they used their boat. Sailboat owners were all very sure of their answers. Those boat owners who started their boats more times were less sure of their answers, but tended to manage using the existing categories.*

Suggestions: *One potential solution is to reference the number of days when asking for the number of hours to jog the respondent’s memory.*

Applicability of question regarding electric powered vessel:

Interview #1—“Yes, applicable-- It could, it could very well apply to me. If it’s like a hybrid or electric, electric motors are very strong so I can’t see ---why I wouldn't want to try that. And it will probably be lighter than the engine, I mean who knows, I don't know.”

Interview #2—“Well , I think that what’s missing in the question is the state of electric motors right this minute is terrible, so a person that truly needs power, you want to get in your dingy and run from Emerald Bay over to the isthmus, and since you’re not a boater, that's about a two or three-mile trip, you’re not going to do that in an electric boat. You won’t have any battery left. If you’re just going from your boat to shore, that's one thing. If you’re in a lake and you’re doing some little fishing or something and you’ve got a couple of oars, it's different. The batteries run out of power and you can’t carry – I mean I guess you could carry two or three batteries with you but that's different than having a little jug of gas, which is common with a small boat. The bigger boat, on the other hand, there’s no such thing as an electric sailboat or an electric powerboat.”

Interview #3—“Oh, I mean if they had a Tesla boat, I’d buy one, I mean if they had that kind of power source...the problem is getting that power source.”

*Interview #5—*Participant’s suggestion for additions to item: “If there were an electric alternative...that I was using a solar-powered charger or something that’d fill up a battery that would then allow me to electrically move out of the slip, I’d be good with that. I think there’s other considerations as far as size and weight. I mean, if the cost is the same, then yeah. For me, it’s pretty easy to say yes. I understand it and if there were a comparable – and maybe that’s a place to – a **comparable size, weight, and cost**, how likely would you be to purchase one in the future?”

Interview #6—“Well, it doesn’t apply very well because there aren’t very many electric boats that go as fast and as far as mine. But this one was a hard question to answer because what the boaters are very sensitive to the range, like how far you can go on a tank of gas. And just saying electric without saying the range makes it hard to answer this question. Is it an electric boat with the equivalent range of my gas tank, which is like 300 miles? Which would be a huge battery. That’s one answer, but we all know the range of electric boats are way less, maybe a 10th of that. So without knowing the range, it’s hard to

answer this, but I just assume that with today's technology, electric boats will go maybe 30 miles. So, I just said not at all likely because it's just not enough for me."

Interview #7—"Well, I drive a Tesla car. So, that makes sense to me. I've seen electric have very short battery life, costs a lot of money, so they're not very practical for our use...right now, there's no boats that meet our needs."

Interview #8—"Well, you said 'in the future.' Based on current and projected technology, that's going to be a real – you're talking about the hybrid – The hybrid boat? Maybe. A pure electric... Well, my type of boat, I've already seen what pure electrics can do. And performance-wise, they're not really capable of the performance or... Typical I go out for a day on a boat, --- we're out for – we put four hours of runtime on the boat. The electric boats that are currently available, in a pure electric, you might get two hours of usage there, of runtime out of it, without a recharge. So based on that – in an EV, an EV I --- would say, probably not. A hybrid? It's a possibility."

Interview #9—"I think it applies very well. I should tell you that I worked for Mercedes-Benz for Daimler. I was the guy sent to California to study how to market electric vehicles. I know the product very, very well. I'm also an avid boater so I understand how the application would fit. And there's a lot of benefits to an electric-powered boat, which was also a huge negative, and that is: If you run out of gas when you're out on the water, every other boat, almost every other boat can help you, and there's usually a marina around. If you run out of electric charge, nobody's going to be able to help you."

Interview #10—"I would love to have an electric or hybrid-powered boat, so I'm definitely for this."

Interview #11—"So I know kayaks, they make all kinds of electric little motors for those guys which is great, but the only thing for those boats is that you have to register them and that's the hard part, right? You have to go through the DMV and all that. But for my bigger boat, if they came out with a cost-efficient outboard that didn't have humungous batteries and wasn't super expensive, right? Then it would be a good option. And I'm all about environmental-friendliness and all that good stuff but right now, it's just budget and I don't think – the technologies are okay now, but I think I'm kind of way conscious with my boat since it's not that big either, right? And like right now... No, I guess I wouldn't get one of those Torqeedo, they have an electric engine. They have really good performance, say like a Tesla car versus a natural gas car or a fossil-fueled car. A Tesla will always outshine a fossil-fuel car, but in terms of boats, I don't think the technology is there yet, right? But in the future, yeah, it'd be a good thing to look into."

Interview #12—"Okay, when I chose not very likely, I'm thinking about the power to weight ratio. And I haven't seen one yet, so I don't know what it looks like. I have seen trolling motors, little electric trolling motors, you know, couple of horsepower... Sometimes, if I were out fishing the boat, we would go outside the Golden Gate, we go outside, and we'd go salmon fishing, right? So, when you're idling or trolling, I'd use an electric outboard for that, if there was four or five horsepower, but typically there are only about one or two, and it would require, like, an additional electric battery. So, I would... we call that a kicker engine, so the kicker – kicker might be okay if it was a strong, electric horsepower, strong horsepower electric motor. And you can position your battery in a place where the weight makes sense. Boats are sensitive to weight. You don't want to put too much weight on the bow, you don't want to put too much weight on the stern, or the boat will hobby horse, the sailboat will hobby horse, a powerboat... You know, if it's too heavy, it's not going to get up on a plane and go fast, it's going to – and

you're going to have – be a slave to battery maintenance. So, like a Prius battery... I don't know how much that would weigh. I have no idea. That's about 90 horsepower. Is that enough? That might be enough to run my main engine on the runabout boat, but gosh, some of these boats, you know, would be more like a Lexus engine, 200-300 horsepower... So, how likely... So, I would say not very likely until I know what's on the market..."

Interview #13—

INTERVIEWEE: "I think it's a very good question. This question motivated to answer your survey, to answer your call, actually, right? I want to help you and it motivated me to participate in this survey. I think for most, majority of boat owners, the maintenance cost is very high, actually. Also, the [INDISCERNIBLE] very high because most people [INDISCERNIBLE] die because of the battery. It's so inconvenient to charge a battery, keep your battery running all the time. If you ask most boat owners what's a typical problem they have, the number one answer will be battery. Battery just dies when they don't use them, right? So, that's why the fossil fuel-based boat for [INDISCERNIBLE] people is just a bad idea, actually. It's just very bad design, so if you have a battery boat, you can charge them with [INDISCERNIBLE] battery, and then you charge them with a motor. They'll be much better for the people who use the [INDISCERNIBLE] easy to use, reliability, so..."

INTERVIEWER: "Okay. So then the question is applicable to you, so this question made sense to you. It was applicable to you. You didn't read this question and say, "Okay, this question shouldn't be here. It's not applicable to me." Correct?"

INTERVIEWEE: "I'd say it's a very bad question. [INDISCERNIBLE] two boat. One is a battery boat, one is a power boat." You definitely would choose a battery boat. Assuming they had the same functionality, right?"

INTERVIEWER: "Yes, assuming they have the same functionality, and I'd imagine the same price tag."

INTERVIEWEE: "Yeah, yeah. This is like a Tesla versus another car, right? I mean, everything equal, you know it's just a simple decision, right? You always buy Tesla, yeah. And I would say even for a boat, even much stronger desire because you see with a car, you drive more frequently, you have to charge them, right? So, charging becomes a difficult issue, right, for long distance. But for a boat, the problem even less because the boat will sit at the dock for most of the time, so that gives you a lot of time to charge, right? So, you don't need [INDISCERNIBLE], you know. And also, when you get to the place, usually, you sit down, relax, you have time to charge again..."

Interview #14—

INTERVIEWEE: "It would be applicable to sailboats to the extent they're making now, electric engines for sailboats, and I think some people are attracted to them. For me, I wouldn't be very likely just because I'm doing some coastal cruising also, and then I think having an electric motor may not quite cut it. But I think for bay sailing, or for getting in and out of your slip on a sailboat, an electric motor would make complete sense. But if you want to do some coastal cruising, then we're not there yet in terms of having batteries that would last long enough. So, I wouldn't be very likely."

INTERVIEWER: "Okay, so this question really isn't applicable to you because of the type of boating that you do?"

INTERVIEWEE: "That's right."

Interview #15—

INTERVIEWEE: “So, I think it’d be cool to have an electric-powered boat. Right now, I’m not fully convinced that the batteries would last long enough to go very far or something. I know there’s... So, I’m in a sailing club, and one of the people is working on electrifying some boats. And I pay attention to it because I think it’s really interesting. But you know, the motor’s not very expensive but the amount of batteries you need, that’s the expensive part. And it depends on how far you go. Typically, I don’t go very far, but you know, once, I actually had to go – I had to run the engine for like 6 or 7 hours. That’s a lot of battery. The gasoline was easy. The battery... To have that option with the battery would be very expensive. But I’m not going to buy a new boat, so... I don’t have to worry about it.” **INTERVIEWER:** “Okay, so it’s not very applicable to you then?”

INTERVIEWEE: “Nah, but it’s a cool idea.”

Interview #16—“I think that regardless of car motors and boat motors, I mean, obviously hybrid and electric boats and vehicles, or anything like that, is obviously more fuel-efficient. Yeah, like they’re more fuel-efficient and it’s economically – and obviously for the environment, it’s good. So, I think to me in my mind, and maybe it’s just kind of like the olden me, I feel like the power just comes from a motor. And I always kind of – sorry, like not an electrical motor. And I’ve always felt that – unfortunately, it’s sad, but gas motors do pollute a lot more which is...But I, you know, I just feel like the power comes from there. But in... I feel like for electrical, I think that it’s coming, you know what I mean? I know that I can see that there’s definitely a push for it. I just don’t know exactly...I’ll have to just wait and see. See if it’s something that would be something that would catch my interest or performs the same way as a motorboat, I guess. So, I think it would be kind of here to see. You know what I mean? I might kind of --- still think like, “I don’t know, I still want to stick with my motor.” But I feel like at some point in time, yeah, it would have to be a point where everybody would have to kind of make that switch over.”

Interview #17—“Well, I’m very much... I mean, I’ve got solar panels on my roof. My carbon footprint is good. The only negative I had towards it is the boat, both boats, they’re gas guzzlers. So... But I’m very climate change conscious. And so, if that were something that came out or would be out, I would be very likely to want to buy something that is more power-efficient and more along the lines of where we’re going.”

Interview #18—

INTERVIEWEE: “It isn’t.”

INTERVIEWER: “Okay.”

INTERVIEWEE: “Yeah, I just don’t see... I know cars and it’s the same price, but I don’t see it as – coming out from what I know of the automotive industry, they aren’t anywhere near the same price, an electric vehicle compared to a gasoline.”

INTERVIEWER: “Yeah. So, is that the primary reason why the question isn’t applicable to you, is primarily the price?”

INTERVIEWEE: “Yeah, yeah. I know they’re saying they can do it, but as far as being feasible at this time, I just don’t see it being feasible, so I said no.”

Findings Summary: Respondents generally feel the question applies to them, but expressed concerns over the available technology, including issues with range, battery life, the size of the batteries, and

lower than desired “power.” Some potential applications of small electric motors noted by participants include trolling and moving sailboats in and out of slips. One participant mentioned question might include that the boat would be of “comparable size, weight, and cost.”

Suggestions: Taking together the suggestions of the respondents, we could add the phrasing of “of a comparable size, weight, cost, and power” to the survey question. We also may want to consider asking participants whether they would prefer a hybrid vessel.

Interpretation of counties boated in:

Interview # 9—“Well, I wasn’t certain of where – which counties I’m boating in because I like to go and explore the Delta. And you know, the Delta’s over a lot of different counties. So, I’m not really sure all the counties that I’ve boated in. I do know that this covers places that I’ve gone out recently, but I’m not sure what county... Is it Sacramento? Is it... Whatever, when you’re out on the water, you’re going all over the place in the Delta. You don’t even know where you’re at. It’s easy to get lost in the Delta. You have to bring navigation with you, so I’m not sure that it covers actually all the counties, but I know that I’ve been in those counties.”

Interview #11—

INTERVIEWEE: “Yeah, was this a multiple choice question? I might have only picked one.”

INTERVIEWER: “Okay, is that because you only boat in Alameda County or did you not realize that you could select more than one?”

INTERVIEWEE: “Yeah, probably the second thing you just said. Alameda County, that’s where we live but we’ve boated in the past in Alpine, so probably the beginning of that time... 2019 that summer, I think we boated in Alpine County and Stanislaus, if that’s an option.”

INTERVIEWER: “Okay, and so how could this have been better worded so that you – so that other people understand that you can select more than one?”

INTERVIEWEE: “It’s clear to me now. Maybe like, how well they control stuff, and with the asterisks maybe below it. I don’t know, I was just – the survey was kind of long up to this point so I was reading kind of fast...Plus, Alameda was one of the first ones that popped up, I was like “Oh, it’s mine.””

Interview #13—“That part didn’t come to my mind because I don’t have the requirement, right? So, I’m sure if this becomes an issue, I can definitely try to figure out multiple answers. Yeah, but I would say if that’s your concern, you might design differently. Instead of using the dropdown list. You want to be using a checkboxes, right? You know what I’m saying? Just a different design to the website.”

Interview #15—

INTERVIEWER: “...you indicated Alameda. Is that the only county that you boat in?”

INTERVIEWEE: “Oh. Yeah, I guess. So, I’m in The Bay, and I go to all parts. I go to San Francisco into Marin. Did I go to Marin? And yeah, I’m sure I crossed into the Marin County line and into the Contra Costa County line. I didn’t think about that. The boat is in Alameda all the time, which is probably my answer why I answered that...I didn’t think about that I actually cross into other counties.”

INTERVIEWER: “Okay. You could’ve actually selected more than one county. Was it clear to you from the survey that you could select than more than one county?”

INTERVIEWEE: “It does say that. I see it says that, but I wasn’t thinking properly either.”

INTERVIEWER: “It’s okay. I’m wondering if it would be more clear if all the counties were listed out with a little checkbox so that you could check all that apply if it would’ve been more clear and easier to understand...”

INTERVIEWEE: “That’s probably true, what you just said. But I was thinking of where the boat – where I get on the boat rather than what the counties are where the boat ends up moving around in. So, that’s probably where my problem was.”

Findings Summary: *Participants shared some of their difficulties with this item, which cause some concern for the accuracy of responses provided. Some noted it was difficult to tell exactly which counties they boat in. Others did not realize they could select multiple counties (though not all would have done so had they known). Lastly, one respondent noted they chose the county they enter the water and excluded those they crossed into when boating.*

Suggestions: *The instructions on the ability to select more than one county should be more explicit or emphasized. In addition, the instructions should explain that the respondent should include all counties they cross into once in the water, not just the place they enter the body of water.*

% of time boating in counties (if more than one):

Interview #8—

INTERVIEWEE: “Yeah, that was pretty much a guess, that was – again, based on 2020 season. I had a hard time figuring out which counties I always boat in but because when you go – when we went out in the bay, we usually are in Alameda, and then we’d go over to San Francisco, and then it kind of gets fuzzy about what county are you in --- when you come back. Did you crossover into Contra Costa? Did you make it over to Marin County? I’m not really – because you’re out in the waters, the distinctions are not really that specific, you know what I mean? It kind of gets fuzzy about --- which county you’re at so I just kind of guesstimated for San Francisco, Alameda. We could have gone over into maybe Marin Country and we could have gone into Contra Costa County. I’m not really sure, I didn’t – the maps that I looked at don’t show the county lines over the water.”

INTERVIEWER: “Okay, and in terms of the percentages, you pretty much guesstimated here.”

INTERVIEWEE: “Yeah, that’s an approximate guess, yes.”

INTERVIEWER: “But you would --- say that of all the counties you’ve boated, the most often in El Dorado and that’s accurate?”

INTERVIEWEE: “Right, because that’s where we use the boat most – we used it up there, we were up there last year and we used it. We took it out, I think, three days on the water? And then the rest of the time I think we went to San Joaquin once, one day for just a short – not very much, and then... Yeah, and then went out --- on the bay. Those are pretty good guesses. They’re estimates, obviously.”

Interview #9—

INTERVIEWER: “You gave these percentages here for each of the counties. How did you arrive at the 30 for Contra Costa, 30 for Lake, and 40 for Lassen County?”

INTERVIEWEE: “We go up to Lake Almanor which I believe is in Lassen County, and that was the majority of it. But we also go up to Lake County, and Contra Costa is where I live...So, I just gave it my best guess.”

INTERVIEWER: “Alright. So, those places in the Delta that you mentioned, are they [included] here [in your selections]...?”

INTERVIEWEE: “Well, when I go on the Delta, we typically leave out of Contra Costa County.”

INTERVIEWER: “Okay, and then these two are – these are counties that are more inland, right? These are not the...”

INTERVIEWEE: “Well, they’re out north.”

INTERVIEWER: “Okay. So, the county in the delta that you included was this here, which is where you live.”

INTERVIEWEE: “Correct.”

Interview #12—

INTERVIEWER: “How did you get your percentages exactly here?”

INTERVIEWEE: “How did I get them to a hundred?”

INTERVIEWER: “Yeah, I mean, what went into choosing how you allocate it.”

INTERVIEWEE: “Well, I was a little frustrated with the survey because I couldn’t differentiate between powerboat and sailboat. So, you know, the powerboat, I would tow to other counties, the sailboat I would only sail to two of them. So, if I were a water skier, I might go to four or five different counties, depending on where the family wanted to go water skiing or, you know, sometimes we go to the Delta, sometimes we’d go to Lake Don Pedro, sometimes we go to Lake Tahoe, you know. It would kind of vary, so I kind of asked myself, “What’s your intent here?” So for me, I would say probably 90% Alameda County, and the rest would be where I might drag the boat on the trailer, so I haven’t been doing much of that in recent years.”

INTERVIEWER: “Mm-hmm. So I got that there was some difficulty here because of having to put the two boats together, right?”

INTERVIEWEE: “Yeah. It was a boat AB, you know, in my case AB.”

Interview #18— “Just the number of times I go out to these. Usually, during the summer, it’ll be one time to Lake Berryessa or Napa, and maybe two times up to Lake County, but 97% of the time, because Sonoma County is closest, that’s where I go.”

Findings Summary: Boat owners explained their difficulties in allocation a percentage to each county boated in and admitted to a high level of guesswork in reaching their answers. Having to combine the use of multiple vessels and create an overall percentage caused additional strain for one respondent.

Suggestions: Given the nature of this item, some degree of estimation is inherent and, to some extent, expected. However, this does mean the data derived on percentage of time in each county may not be as accurate as other markers in the survey. If it is feasible, we may consider breaking up use percent into larger geographic groupings, perhaps with a visual aid. Furthermore, we may consider asking this for each vessel rather than all combined (if the respondent has more than one).

Amount of gas left in tank at end of typical trip:

Interview #1—“It’s fairly easy. I try to leave them low on fuel just because so I can ---transport back and it’s less weight. So it’s fairly easy.”

Interview #2—“Well, that’s something that I pay attention to because if you run out of fuel, you’ve got a problem, so it wasn’t hard at all.”

Interview #3—“Real easy because – no offense to any other boat owners – but if you’re going to store your boat or leave your boat on the water, you don’t want a lot of fuel in it.”

*Interview #5—*Regarding applicability of the item to sailboat owners: “I think there’s probably a need early on to identify: Do you consider your boat to be a powerboat or a sailboat? Because you go down rabbit holes that don’t really apply for – that color the future answers. If you recognize that I’m a sailboat, then I’m not going to be using much fuel. If I’m on a big powerboat or racing over to Catalina, then my tank’s going to be nearly empty by the time I get back.”

Interview #6—

INTERVIEWEE: “This was easy.”

INTERVIEWER: “Could you clarify why that was easy?”

INTERVIEWEE: “Every boater does it differently. Some boaters like to keep their tanks full. So, they’ll go out in the water and they’ll do their thing, and then they’ll come back and hit the fuel dock on the way back and fill it up. Some will drain it all the way down. They don’t like to keep a lot of fuel in the boat because it weighs a lot, and for other reasons. I just... Everyone has their preference. And so, it’s my preference to not have it all the way full because it’s a hassle and not have it all the way empty because I’m worried about running out of range. So, I always just habitually keep it pretty much in this range: 1/2 to 3/4 of a tank.”

Interview #8—“It was pretty easy because I usually keep – I usually want to know how much fuel I use for the day, so I – you know, ‘can I take the boat out again?’ I usually typically, we – that’s --- based on how much fuel your boat holds so it’s – mine holds 34 gallons so I know that typically we will use around 15 to 16 gallons each time we take the boat out, so I know we’d use about a – we have, maybe half a --- tank left, roughly.”

Interview #9—“I think most boaters would know because you always want to know how much fuel is in the tank before you head out from the docks. So, you track how much fuel is in the tank pretty well...the jet ski, you never get below 1/4.”

Interview #10—“It was easy. Because I do keep track of that, -- and usually, it’s a quarter tank left. We might cut our trip on water short if I don’t have enough gas, just so I have enough gas to get back to the dock. I’m very confident in my answer.”

Interview #11—“It’s pretty easy. Our tank, I have to fill it up every time I have to pay for it, right? So – and the tanks, I think is a 19 gallon. So, if we took that to the gas station, we’re running 60 bucks, right? Now, usually I only pay about 30 bucks, so I figured half a tank’s in there, still. Engine gets relatively good gas mileage, it’s a 2½ miles a gallon, which is good for a boat.”

Interview #12—

INTERVIEWEE: “Well, show me the categories of, what were the other answers? Tank is nearly full, you know, in any survey, a creator would hate this one, is it depends, and it would depend on the day. I take the sailboat out, any time I don’t have to put the outboard on the back of a sailboat, I don’t. I will sail out of the marina. My boat is very nimble and...”

INTERVIEWER: “So, what did “typically” mean to you here?”

INTERVIEWEE: “One more time?”

INTERVIEWER: “What was key for you here, what did “typically” mean to you here?”

INTERVIEWEE: “Typically is about a quarter of a tank, so I would say that’s pretty normal.”

Interview #13—“It’s very easy because I just have a habit when the boat reaches a quarter, I go fill in the tank, then when I fill in, I don’t really fill the whole, full thing. I fill it at half, right? That’s what I do. I know it’s enough to [INDISCERNIBLE 00:23:58] to get a boat going, and I don’t want to fill too much gas. It’s heavy, right? So...It’s very heavy. It’s like 70 gallons, almost like 500 pounds.”

Interview #14—“It was pretty easy because I know the consumption of my boat engine, and I use it so little, at about a 10th of a gallon per hour. It’s just a small engine, so, it’s... Yeah, that was pretty easy to answer, so... But I’m not your typical. That’s the thing, is that if the survey is really for boat owners, motorboat owners, I don’t want to — that’s kind of throwing a monkey wrench in all the data, because it’s so – I mean, it’s a little tiny one-cylinder, putt-putt engine, you know?”

Interview #15—

INTERVIEWEE: “Well, as I say, I rarely use much – the engine very much, so... I guess if it started out full, it’s almost always pretty near full when I’m done. I don’t – now, I’m thinking about... I didn’t interpret that right because if it started out at half full, because they don’t fill it up every time, then – and I didn’t use it, it would still only be half full, right? So, maybe I interpreted that wrong. I don’t know.”

INTERVIEWER: “How do you think you interpreted it?”

INTERVIEWEE: “How much fuel is typically left in the tank.”

INTERVIEWER: “At the end of a typical trip?”

INTERVIEWEE: “I guess the easier answer would be about the same as I started with. Like, that may not be your answer. But I’m still not sure that’s the wrong answer because if I fill it up, I don’t know. I don’t know what the answer would be. If I started a quarter full and it comes back as a quarter full, and then

we're talking about – at the end of a typical trip, so I don't know what the average would be, I would have no idea how to answer that question.”

Interview #16—“It was good.”

Interview #17—“Very [sure]...Because I check the level of my tanks before I leave my boat every time.”

Interview #18—

INTERVIEWEE: “Very easy, because with jet skis, because they're out of the water for so long during the winter months, they always tell you, “Don't leave the gas in your tank.” So...”

INTERVIEWER: “They do?”

INTERVIEWEE: “Yeah, the manufacturers tell you that. Or if you do, fill it up near the top and then put some type of preservative or something that you dump into the gas so that it... I don't know what happens to gas but, so that it doesn't happen.”

Findings Summary: *The majority of participants find it easy to determine the amount of gas they typically leave in their tank at the end of a trip, though they described distinct ways of arriving at their answers. Some noted it was a result of manufacturer recommendation, while others explained their answers based on convenience or additional weight of the fuel.*

Suggestions: *SSRC has no recommendations for this item based on participant feedback.*

Regarding the term “additional” portable fuel containers:

Interview #1—“Additional means how much I have aside from the —factory fuel tank, I guess, so if need something to put fuel in it, that would be my additional, that's how I understood it.”

Interview #2—“Well, if the boat is big enough to have a fuel tank, then it would be the portable fuel tank that you might also have, and I have one of those on my sailboat. Excuse me, I don't have one for the diesel, I don't have extra on the sailboat. On the other boats, I have a portable that carries about 5 gallons of gas so I can refuel them if I need to.”

Interview #3—“Oh, a jerrycan or a gas pump, a portable gas pump. We have a 4-gallon portable gas pump that we can roll down to our dock to fuel the boat or boats...and it's actually better to use that because it costs a lot less.”

Interview #5—“I would say that does raise questions for me. Because of the arrangement of my boat, I have one fuel tank, which is portable, which is connected to the engine. And then I also carry a small additional portable tank...a backup. That's different from, again, the powerboaters who would say, “Well, I have my 500-gallon diesel tank...that's part of the boat and then I also have two 10-gallon...plastic jugs that they store somewhere on their vehicle or on the vessel just in case they run out.” So, there's – for me, the additional was, beyond the one I'm using as my main fuel source, I have a backup. That's the way I interpreted this. If you were to [ask] “in addition to the main fuel storage tank or something like that, do you have any additional... my main supply is a portable fuel container. So, that may be of interest.”

Interview #6—

INTERVIEWEE: “Yeah, that was interesting. I wasn’t sure but my boat... Luckily, my boat has a built-in fuel tank. So, to me I used two like those five-gallon cans to fuel it, so I just said... I just assumed additional meant those two. For me, it was easy. But some boats only use portable tanks. Like, they’ll put a five-gallon thing in there and put the holes into the tank and use that for a while and then, you know, swap it out once that one is out. So, if I had a boat like that which I used to, that would’ve been a little bit confusing. Like, did you mean the one that’s always in the boat as well or just the additional ones that you bring in along just in case that one runs out?”

Interview #8—“Do I need some kind of a portable fuel tank?’ I don’t. I’ve never had a need with --- this boat with its fuel capacity. I don’t have a need to take an external or portable – you know, a fuel can or anything like that.”

Interview #9—“That’s in addition to the fuel tanks on board the boat, built into the boat.”

Interview #10—“If I had any portable tanks that I fill up my tank with?”

Interview #11—“[Additional is]..anything above the normal amount in a gas tank, I guess. Before we had – I always had a bigger gas tank but I didn’t like how much it weighed. Once it’s fully gassed, I’ll put it back in the boat. But during that time period, I had another tank on the boat which was 0.3 gallons compared to 19 gallons, so a big difference. And I had another 5-gallon gas tank with me because I’d only use about probably 7 gallons in a day, right? So, nothing crazy, and that’d just be enough, right? So, the beginning of that time period, maybe I had a real gas tank and another portable one, but now I generally just carry the big one with me that has plenty of fuel.”

Interview #12—

INTERVIEWEE: “I don’t – I have two original fuel containers that are in good shape. I keep them inside, I keep them out of the weather, and they’re steel tanks, but they’re high quality steel, and I don’t leave them in the saltwater, and I always rinse off my gear, and so...”

INTERVIEWER: “Those are not these two additional portable things listed here right? You have a zero to five gallon metal container and a...”

INTERVIEWEE: “Just a container... Okay, so are they asking me, are these the ones that I’m taking down or topping off my tanks with, or am I carrying these tanks around, or is it the actual tank on the boat? I don’t think they know what they’re talking about.”

Interview #13—“I know people who go long distances, they carry a portable tank, right? For actual gasoline, right? That’s my understanding – people do that. Actually, there’s a fixed tank, right? There’s a portable tank, right? But you don’t have them. I don’t use them. To me, it’s dangerous, right? You put a [INDISCERNIBLE 00:25:01], you know.”

Interview #14—“I think I remember on that one meant if I had like a fuel container on board. And I do have one. It’s never full though. I use it when I want to refill my tank, or to top it up, so then I take that thing, and then I go to the gas station, and... So, that’s how I read it and that’s why I put one. I remember I hesitated putting zero because I don’t know if you’re looking for a full additional – something in addition to your tank, or not. So, in my case, it’s an empty tank and maybe that’s not what you are after I don’t know...It’s an empty container that I have on board, yeah.”

Interview #15—

INTERVIEWEE: “So, it’s...I wasn’t thinking about this. If you get rid of the word ‘additional’ and I’m happy with the answer. But additional, I don’t know what you mean then. So, I take a tank to the gas station, I fill it up and then I transfer it to the one that’s pretty much fixed into my boat.”

INTERVIEWER: “So, you have a tank that’s fixed into the boat, right?”

INTERVIEWEE: “I have a tank that is effectively permanently attached to the boat. So, I fill that with a portable one. I don’t take my boat to a gas station to fill it up. I hear some people do.”

INTERVIEWER: “And so, you think the word ‘additional’ is just...”

INTERVIEWEE: “I ignored it.”

Interview #16—“I just thought of like the containers of like, you know, five-gallon gas containers that you bring with you.”

Interview #17—

INTERVIEWEE: “That tells me that if you have like a five-gallon can, that you want to fill up with gas at the local gas station, which is a fraction of the cost of what it is out on the water, and then you fill it up and then you take the gas cans to the boat, and you put the gas in the boat from those containers.”

INTERVIEWER: “Do you think that would be clear to others that that’s what it means? I’ve heard other terms like ‘jerry can’ would be more helpful to people in helping them understand that that’s what that means.”

INTERVIEWEE: “I know what a jerry can is. How many additional portable fuel containers do you use to refuel your boat?”

INTERVIEWER: “Or the word ‘extra’ might be helpful. For some reason, the word ‘additional’ is confusing to people, that they that doesn’t help them understand what it is that we mean.”

INTERVIEWEE: “How many additional portable fuel containers? Okay, portable is you’re carrying it. It’s an external thing. I mean, I knew exactly which was being asked for in this particular question. I didn’t need anything that says better clarification. How many additional portable fuel containers? I mean, that’s about as explicit as you can get.”

INTERVIEWER: “Do you think the word ‘additional’ is throwing people off? Because the key is ‘portable’.”

INTERVIEWEE: “Well, how many portable fuel containers do you use? Sure, ‘additional’ could probably be removed.”

Findings Summary: *Most respondents seem to understand that gas cans or “jerry cans” should be included in their answers, but there is confusion for some over whether other types should be accounted for. Particularly, there is ambiguity for boats that use only portable tanks as to whether the primary one*

should be included. A portable gas pump was also mentioned as a piece of equipment that might be in the list of containers covered in this item.

Suggestions: The instructions on the item need to be reworked to include a list examples of what should be included as a an “additional portable fuel container.” If there are any tanks or containers that should be excluded (for example, the boat’s primary portable tank), it should be explicitly stated in the instructions.

Regarding size of fuel container:

Interview #1—“Yes, that's how you purchase them. You could purchase a bigger one, but to pick it up and ---to pour fuel in the boat or the watercraft, a 10-gallon tank is really, really heavy, so 5 gallons is the most common out there.”

Interview #2—“Well, fuel tanks come in fairly standard sizes, and 3 and 5 are the two common ones. I have one of each.” Respondent was 100% sure of his answer.

Interview #3—Regarding his own answer: “It says it on the pump thing, it says 6 gallons. Yeah, it’s pretty easy...You have 2 gallon tanks, 4 gallon tanks, 6 gallon tanks. One of our pumps is 6 gallons, that's why when I was thinking of this I remember it was one that was a pump tank and it’s 6 gallons.” Regarding *others’ ability* to answer: “But guys may have like three different or four different portable fuel cans around for different stuff that own boats or jet skis or personal watercraft like that. If anybody owns personal watercraft, they usually have a couple of jerrycans.”

Interview #6—

INTERVIEWEE: “So yeah, reading it again, it can be interpreted differently. I assume you meant the portable one from the previous question, not the main one that’s built in with the boat. So if that’s the case, then again, I just have two of the five-gallon cans but you could interpret this as, you know... I could’ve interpret this as the main one, but typically those, for most boats, they’re much bigger than 50 gallons, so I guess just looking at it in the context and the fact that it came after that previous question made me just assume it was the portable one that I carry around.”

INTERVIEWER: “Yes, and I think it is the portable one. I could be wrong, but I think it’s talking about the portable one, so zero to five gallons. And so, assuming we’re talking about the first portable one, zero to five, how sure are you of the answer to this question?”

INTERVIEWEE: “It’s 100%.”

Interview #7—“They’re all five gallons.”

Interview #9—

INTERVIEWEE “The 5 gallon plastic fuel tank that I take... You know, if there’s a...need to refill, that’s what it is.

INTERVIEWER: “So, your certainty of the answer to this question is...?”

INTERVIEWEE : “100%.”

Interview #14—

INTERVIEWEE: “Oh, maybe that’s a little bit confusing, I thought this was basically my gas tank. And I thought the additional one on the previous question is in addition to the gas tank.”

INTERVIEWER: “Okay. So, these 13 to 25 gallons, that’s your gas tank?”

INTERVIEWEE: “That’s my fuel tank, yeah, exactly. And I’m pretty confident in that because I measured it.”

INTERVIEWER: “Okay, got it. So, this was confusing because you didn’t think it meant your portable gas... You didn’t think this was in reference to the portable fuel container, you thought this was in reference to the gas tank?”

INTERVIEWEE: “Exactly. Because otherwise, that would have been 0 to 5 gallons. Yeah, I don’t have a portable 13 to 25 gallon tank, that would be pretty tough.”

Interview #15—“I think it’s a five-gallon tank. It might even be less, but I’m sure it’s between zero and five. It’s not more than five.”

Interview #16—

INTERVIEWEE: “So, I think that the first was asking about what’s the primary one. Like, what’s the one they actually have on the boat, correct?”

INTERVIEWER: “Oh. So here, you actually did... This is the one that’s attached to the boat, you’re saying?”

INTERVIEWEE: “Yeah, [INDISCERNIBLE 00:29:30] first fuel container? That’s how I thought of it.”

INTERVIEWER: “Okay, so you gave two, and one of them is the boat?”

INTERVIEWEE: “Yeah.”

INTERVIEWER: “This first one is the boat, and the other one is something else then?”

INTERVIEWEE: “The additional.”

INTERVIEWER: “Got you, okay. And when you said two initially, you meant these two, or did you...”

INTERVIEWEE: “So, additionally, the other question you just asked me about the additionally, I thought that those were separate that you bring... that I bring with me when I go boating. You see what I’m saying?”

INTERVIEWER: “Okay. So, if we had here – if I had put the word ‘portable’ here, then you would not have done this, or you would have gave the same... If I would’ve put portable here in this question, I’m trying to find... Because here, this is the actual fuel tank on the boat, right?”

INTERVIEWEE: “Yeah. I’m responding based on the fuel size of the fuel tank in the boat.”

INTERVIEWER: “Got it, okay. Thank you. I just wanted to clarify there what this was. So, there’s that metal...”

Interview #17—“Positive. I think anything more than 5 gallons is way too heavy for me to carry, so it has to be 5 gallons.”

Findings Summary: *While the aforementioned confusion over which containers to include persisted during discussion of the containers’ sizes, respondent’s confidence in the size of their containers was strong. Nearly all indicated they are sure of the size of their containers.*

Suggestions: *No changes are suggested to the item regarding size of fuel containers.*

Regarding how often fuel containers are replaced:

Interview #1—“It’s fairly easy because the gasoline will dry up the plastic --- and the reason I’m saying it is because it happened already where I went to put fuel in and it was leaking out because it cracked, so I just make it a habit now of every two years getting new fuel containers to avoid spillage.”

Interview #2—

INTERVIEWER: “The next question is how often do you replace your fuel containers, and you put that you don’t know.”

INTERVIEWEE: “Yeah, there’s not a lot of reason to replace a fuel container, never had one I guess.”

Interview #5—

INTERVIEWEE: “My regular fuel tank... I don’t recall ever having replaced it since I got the boat, and then the portable tank, I don’t know that I’ve replaced it either, so I don’t really have a time frame of – if I was to say... If there was a checklist of never replaced fuel container once every five years, once every 10 years, that’d be easier to answer for me... So, rather than having to come up with how many – because I don’t know that I’ve ever replaced it, so I can’t fill in the box, because I don’t have a number of years, plus I don’t know.”

INTERVIEWER: “So, instead of putting zero number of years, you just put ‘don’t know.’” “Yeah.”

Interview #6—“It was easy for me. I’ve been boating 10 years and I’ve replaced them once, so I just kind of said five.”

Interview #7—“We haven’t replaced them in years. It’s really easy to say.”

Interview #9—

INTERVIEWER: “You picked ‘don’t know.’ So...”

INTERVIEWEE: “I’ve never had to replace it.”

INTERVIEWER: “Alright...you selected Don’t Know here because you have never had to replace it... Would you have a typical range or know when you might replace it?”

INTERVIEWEE: “I would only replace it when it looked like it was going to fail, which a plastic fuel container, it’s empty most of the time unless I’m going out boating and I want to make sure I’ve got fuel, I’m leaving it empty. So, I can imagine I’d need to replace it less than 10 to 15 years. It’s just sitting around as a backup in case there’s a problem.”

Interview #11—

INTERVIEWEE: “Did I put one year?”

INTERVIEWER: “Yes.”

INTERVIEWEE: “I guess that during that timeframe, I replaced the fuel container that year but after putting this big one in, they don’t – these plastic ones don’t really decay. I know a lot of people – I’m on boating forums, fishing forums quite often and...I’m always looking for a bigger boat, but I don’t have any money for one. But a lot of the boats, they have in-mounted fuel tanks, like metal ones that...corrode and decay and they have to be replaced. But in my case, the plastic one, it’s super easy to get out too, but I’m not replacing it anytime soon since they last for so long. Yeah..., if I were to redo it I would have put 0.”

Interview #14—

INTERVIEWEE: “Because I guess I confused here also, if the fuel container was an additional jerrycan that I have on the side, or if it was my fuel tank, so that’s why I put ‘I don’t know.’”

INTERVIEWER: “Okay, okay.”

INTERVIEWER: “So, if you said: How typically do you fill up or replace the fuel in your fuel tank? Or something, then I could say every other year or something because I use so little fuel. But here... Maybe I think it’s from the start it was clearly stated that you’re talking about additional containers, or maybe... Or you know what? Maybe they’re thinking about outdoor – outboard motors, maybe that’s what it is, yeah, because when you have an outboard, you have this little red tank that you bring in your boat and you plug it in. And often, people have two of those if they’re afraid to run out of gas or something.”

INTERVIEWER: “Mm-hmm. So, to you, this question wasn’t clear?”

INTERVIEWEE: “No, right.”

Interview #15—“I’ve had the boat for 20 years and I actually got that installed when I first bought the boat, so it’s been 20 years...It really is a plastic... I think it was designed to be a portable one, but I’ve strapped it down and that’s my fuel container. That’s my fuel tank for the boat...I actually have a steel gas tank in there, but I bypassed it 20 years ago for this plastic one because it’s huge and I don’t want that big amount of fuel. So, I don’t use that.”

Interview #16—“Yeah. I just kind of – this is... Yeah, I just thought about the additional ones that you bring with you. And I think after a while, they either get sun damaged, or they get a hole, or the [INDISCERNIBLE 00:31:17] not working or whatever, and we just, you know, in my mind it’s probably just safety-wise just to get new ones. But yeah, a couple season – when they see they’re starting to kind of get bad, we would replace them.”

Interview #17—“I think if you put ‘portable’ in there between ‘your’ and ‘fuel’, I think that would solidify whatever that question would be.”

Findings Summary: *Many participants noted they have never replaced their fuel containers and thus put “don’t know” for how often they are replaced. Furthermore, some were unsure of which containers were to be included and whether these should be just additional portable containers or all of them.*

Suggestions: *At a minimum, a “never” option should be added for individuals who have never replaced their containers. Additionally, the instructions should note specifically which containers should be included here, and whether the primary fuel tank should be counted.*

Other findings:

Interview #2— Discussion of including on-vessel generators: “There is one ancillary part of this, however, which might be important to your survey, and that is the boat has a generator. The generator is a 6kw generator that runs on the same diesel. I use that. --2 to 4 hours a day every day when I’m over there to charge the batteries, so that’s an additional consideration that does two things. It uses fuel that I have to pay attention to, and for you it doesn’t mean that there’s just like one engine in a boat like you think of one engine in a car. ” “Well, one of the problems of non-boaters trying to do boater things -- is not appreciating the fact that a powerboat is much, much different than sailboat, as an example. A powerboat could use 100 gallons fuel just to get over to Catalina, where a sailboat uses 8 gallons --to get to Catalina maybe or even less, but that kind of comparison in terms of fuel consumption, but then you have this ancillary use of fuel which is for the generator which you use every day, and a powerboat probably has a bigger kw generator and both boats are using that generator a number of times because it makes the ice, it charges the batteries primarily, it keeps the lights on, all that kind of stuff.”

Suggestion: *CARB should consider whether on-vessel generators should be counted as engines, analyzed separately, or be excluded from the survey entirely. Changes can be made to the instructions based on CARB’s decision.*

Interview #3—Discussion of including trolling and electric motors: “So a lot of guys troll all the time, and that’s another question you could ask is like “do you troll with your boat, and if you do, do you use an electric troll motor or do you use the engine? Because a lot of guys who troll, they have electric trolling motors, so they’ll use their big engine to get out to wherever they want to troll, then they turn off that engine and then they get on their electric engine and they use their electric engine while they’re trolling.”

Suggestion: *The use of electric motors for the purposes of trolling should be accounted for in the survey, and if these should not be included in the total engine count and total engine use, that should be stated explicitly.*

Interview #5—Approach to engines that can be moved from one vessel to another: “Because it’s an outboard, it doesn’t have to be on this boat. It can go – actually, I can put it on the rubber inflatable boat.”

Suggestion: *For boats with outboard engines, an item could be added to determine whether the outboard engine is used on any other vessel and account for that use.*

Interview #8—Feedback on the implementation of a logbook for tracking boat use:

INTERVIEWER: “Right, so you don’t – do you think that in general, the accuracy of people’s self-reports in terms of the use of their boats would be pretty bad – moderately bad, pretty good, or mostly accurate?”

INTERVIEWEE: “Most recreational boaters, --- I’m going to say would be on the poor side.”

INTERVIEWER: “On the poor side?”

INTERVIEWEE: “They’re not going to keep an accurate record of – you know, they might keep a record of how many hours when they serviced it, but how many hours they use it each day and how much fuel they used each day, I doubt it. Commercial --people would probably keep a better record of it because they’re required to by regulation – to keep some kind of a logbook, but recreational boaters, no. I would say, probably 90% don’t even keep a record of how much fuel they use for the day. As a follow up later on, especially for people that responded back to your survey, before the next boating season you might want to send them out something that says if you want to do a follow up survey, but send them out a logbook --- sheet – it doesn’t have to be anything elaborate, just here’s a page with recorded number of hours that you’re on the boat at the start of the day, at the end of the day. And if you have an idea – if they knew how many gallons of fuel their boat held, --- where was the gas gauge at the beginning of the day and where was the gas gauge at the end of the day, or how many gallons of fuel did you use.”

INTERVIEWER: “Do you think people would be willing to do that?”

INTERVIEWEE: “I would, I don’t know how many other people would but I would be willing to do it.”

INTERVIEWER: “What kind of incentive do --- you think people would need in order to do something like that?”

INTERVIEWEE: “Well, I don’t know that I would specifically need an incentive for that. Now that I think about it...If you have the log, you’d know the date, you’d know how many hours they put on their boat, you could even have what county did you boat in, you have a lot of that information.”

***Suggestion:** This participant’s feedback supports the use of a logger or logbook to get more accurate measure of a subsample of boaters vessel use. This data could then be used to compare and potentially weight results for more accuracy.*

Interview #12—Regarding type of use:

INTERVIEWEE: “So, in the 12 months prior to COVID, which way have you primarily operated your boats...And yes, it is boats. So, one of the boats I used for a boating business, I go out and clean boat bottoms, change propellers, things like that. It’s also... it can be used recreationally but I don’t use it that much. So, boating business. So, I would check two boxes there and the second one would be personal and private leisure or sport. The other boat is a sailboat and I use it to go sailboat racing and take family and friends out.”

INTERVIEWER: “Okay, this is newer information. So, you’re saying here that these three options for you were not exhaustive. That is what I’m gathering. You would have...”

INTERVIEWEE: “I would have checked both top boxes and left the bottom one blank.”

INTERVIEWER: “Because your usage of the boat for business purposes is not for you rent them out. It’s that you use it for specific business purpose other than that, correct?”

INTERVIEWEE: “Yeah, and I know a lot of other divers that do business by boat. They take their boats out to the clients’ boats, clean the boat bottoms, change propellers, change zincs, and things like that. It’s easier to pop on to the next one. Jump to the water, clean it and move on. I designed the boat for that back in the 80s and I’ve been using it to do that and to...We fished that boat, we water skied it. I used it for hull cleaning, I still use it for hull cleaning and sometimes just going out to watch events on the bay, or just to go out and run it. Because it’s just better to run a boat than not to run it.”

Suggestion: *At least one participant found the boat use type item to be insufficient. At the very least, the respondent should have the option of multiple selections. We may also need to include an option for other “side business” use.*

Interview #17—Regarding boat registration: “One of the two boats is registered with the Coast Guard, the other one has a California registration. So, maybe that would be a... After this tab right here, maybe you go and say, “Okay, which one?” If it says two, then go next. What’s the next screen? Okay, so it probably would be helpful if it’s important... this is important to know: Are both boats part... Are they both registered with the Coast Guard, or is one and then the other one is something else?”

Suggestion: *If it is important, the registration item could go with each both (in the roster) rather than all boats overall.*

Interviewer #12—Regarding appearance of the survey: “I would go with black instead of light gray letters on a white screen. You know, I would go a little darker on your fonts... I can hardly read my ones in each of the category.”

Suggestion: *Darker fonts should be used for the answer options to make the survey more readable and improve user experience.*

Interviewer #12— Regarding boat storage:

INTERVIEWER: Okay. So this is here was the...Where and how do you typically store your boat? So when you answered this question, I see you answered “Not Listed” and then provided something, could you tell me whether...”

INTERVIEWEE: Okay, so the powerboat is stored at my residence, and the sailboat is stored in the marina. I just got frustrated, and you know, I would have checked both of those boxes.

INTERVIEWER: So you’re saying that this caused trouble because your two boats are in different – they don’t fit the same categories, huh?

INTERVIEWEE: That’s correct.

Suggestion: *It may be helpful to include the boat storage item for each boat rather than all boats to avoid respondent confusion and frustration.*

Interview #16—Regarding use of the term “first” boat:

INTERVIEWEE: “So, I have replaced a motor in that boat but the original motor that it came out of was built in 1978 with the boat as well. Since then, I have put in a newer engine that is not of this make. So, I really pay attention to boat’s first engine versus what model or what year is the boat’s engine.”

INTERVIEWER: “Got it, got it. This is... Okay, so this is really good information to have. So, you put information on the older engine because of the word “first” here? So, this is because you only have one, if you had said that this boat had two engines, you would go through first and second. So actually, this is good information for me to have from you because first here is not necessary here because there’s only one engine, and it made you think the previous engine.”

Suggestion: *The use of the phrase “first engine” may cause the participant to think of the chronological first engine if the engine was replaced. This could lead to inaccuracies in the data. We recommend “Engine #1, #2, #3...” be used instead.*

Complete List of Findings

- **Regarding introduction script:** Overall, survey completers feel the introduction and background to the study is clear, easy to understand, and supplies sufficient information. However, one respondent noted that information on what CARB intended to do with the data being collected was missing from the introduction. Another suggested that the main points be summarized in bulleted form for individuals who might otherwise skip over the lengthier text.
- **Regarding type of vessel:** The personal version of the survey does not provide information on what types of vessels the participant should include in their responses, which led to some confusion on what to include.
- **On why people would have information on their engine:** There is an overwhelming consensus that boat owners have rudimentary knowledge of the engines in their boats (including the number), at the very least, but typically have extensive knowledge. There is some confusion on whether certain auxiliary or specialty engines should be included in the participant's response.
- **Regarding make and model of engine:** Most respondents were able to provide the make of their boat, but for several, that make was not provided in the drop-down list, especially if their boat was older. Selecting a model number proved more difficult, and almost all were unable to provide this using the drop-down.
- **Regarding year of engine:** Respondents are generally confident of the model years of their boats' engines, with some exceptions for much older boats where participants are less certain.
- **Regarding star certification:** Very few participants are sure of the Star Certification of their boat's engine, with many unaware of what a Star Certification is. Respondents showed receptiveness to the idea of including additional information or a definition of the term.
- **Regarding the horsepower of engine:** All but a couple boat owners were very sure of the horsepower of their boat's engines, moreso than other aspects such as model or Star Certification. One respondent suggested the categories be more fine grained for greater accuracy.
- **Regarding estimated engine hour meter:** Most participants stated they are very certain of their engine's hour meter reading, noting that knowledge of the hours on the engine are central to maintenance. Some were less certain, and for those engines without a meter, owners did mental calculations to come to their estimates.
- **Regarding engine replacement:** Boat owners had different methods for calculating when engines were replaced on their vessels, with event-based methods being one way this was done. Respondents sometimes even knew about engine replacement prior to owning the boat themselves.
- **Regarding the formatting of the questions:** All but one respondent who was asked about the format of the survey preferred the interleaved (current) format over an alternate grouped format.
- **Regarding number of days vessel was used in summer and winter:** Participants were relatively sure about their estimates of the number of days they used their boats in an average season and employed a variety of methods to estimate this. There were some cases in which respondents provided estimates for time during COVID due to the format of the survey. Additionally, the business format of the survey was difficult for that respondent to navigate due to having to average two boats with very different uses. Finally, some respondents with unique uses, such as a houseboat, found the focus on the vessel rather than the engine to be problematic.

- **Number of hours vessel was used in the summer and winter:** Boat owners estimate the average number of hours they use their boat each day by reflecting back on the activities they typically engage in. The certainty they have in their responses varies (with jet ski owners being most certain), and it is unclear for some whether the survey is referring to their boat or its engine. Several noted that the engine is turned off for many recreational activities, including anchoring to relax or fish, drifting, and sailing. As with days used, some are unclear that they should be referencing the time before the COVID Pandemic.
- **Keeping the engine idle:** Participants generally interpret the term “idle” correctly and define it as running the engine without the propeller or jet moving any water. Some suggest the term “in neutral” might be a good way to describe idling. They listed various uses for idling, including to warm up the engine, for maintenance of the engine, to charge batteries to run auxiliary equipment, to avoid situations where the engine might not turn back on, and for trolling. Both sailboat and jet ski owners feel this item does not apply to their vessels. Finally, several respondents feel the categories are too broad and should be refined.
- **Regarding how often the engine is restarted:** The number of times boat owners restarted their engines varied by type of vessel and how they used their boat. Sailboat owners were all very sure of their answers. Those boat owners who started their boats more times were less sure of their answers, but tended to manage using the existing categories.
- **Applicability of question regarding electric powered vessel:** Respondents generally feel the question applies to them, but expressed concerns over the available technology, including issues with range, battery life, the size of the batteries, and lower than desired “power.” Some potential applications of small electric motors noted by participants include trolling and moving sailboats in and out of slips. One participant mentioned question might include that the boat would be of “comparable size, weight, and cost.”
- **Interpretation of counties boated in:** Participants shared some of their difficulties with this item, which cause some concern for the accuracy of responses provided. Some noted it was difficult to tell exactly which counties they boat in. Others did not realize they could select multiple counties (though not all would have done so had they known). Lastly, one respondent noted they chose the county they enter the water and excluded those they crossed into when boating.
- **% of time boating in counties (if more than one):** Boat owners explained their difficulties in allocation a percentage to each county boated in and admitted to a high level of guesswork in reaching their answers. Having to combine the use of multiple vessels and create an overall percentage caused additional strain for one respondent.
- **Amount of gas left in tank at end of typical trip:** The majority of participants find it easy to determine the amount of gas they typically leave in their tank at the end of a trip, though they described distinct ways of arriving at their answers. Some noted it was a result of manufacturer recommendation, while others explained their answers based on convenience or additional weight of the fuel.
- **Regarding the term “additional” portable fuel containers:** Most respondents seem to understand that gas cans or “jerrycans” should be included in their answers, but there is confusion for some over whether other types should be accounted for. Particularly, there is ambiguity for boats that use only portable tanks as to whether the primary one should be

included. A portable gas pump was also mentioned as a piece of equipment that might be in the list of containers covered in this item.

- **Regarding size of fuel container:** While the aforementioned confusion over which containers to include persisted during discussion of the containers' sizes, respondent's confidence in the size of their containers was strong. Nearly all indicated they are sure of the size of their containers.
- **Regarding how often fuel containers are replaced:** Many participants noted they have never replaced their fuel containers and thus put "don't know" for how often they are replaced. Furthermore, some were unsure of which containers were to be included and whether these should be just additional portable containers or all of them.
- **Discussion of including on-vessel generators:** One respondent was unclear whether on-vessel generators should be included in the count of engines.
- **Discussion of including trolling and electric motors:** One respondent was unsure of whether electric motors used for trolling should be included in the survey.
- **Approach to engines that can be moved from one vessel to another:** Some boaters have engines that are portable and can be moved from vessel to vessel
- **Feedback on the implementation of a logbook for tracking boat use:** One participant noted that having some boaters who took the survey keep a log book might help provide a more accurate measure of usage.
- **Regarding type of use:** One participant noted the item on type of use was insufficient as is and should include additional options and be of the "select all" type.
- **Regarding boat registration:** One boat owner noted this item might be better suited within the boat roster so participants can provide this information for each boat.
- **Regarding appearance of the survey:** One boat owner mentioned that darker fonts would make the survey more readable.
- **Regarding boat storage:** One participant noted that this item might be better suited within the boat roster, since storage may vary for multiple boats.
- **Regarding use of the term "first" engine:** One boat owner shared that they thought the term "first" in reference to their boat's engine was pointing to the original engine that had been replaced.

Complete List of Suggestions

- **Regarding introduction script:** It would be useful to add a sentence or two on how the data will be used by CARB could be added to the introduction. Addition of the bulleted format above may help those who might not otherwise give a truly informed consent due to skipping over the information do so.
- **Regarding type of vessel:** We suggest the addition of a description of all vessel types respondents should include in their responses at the very least. Adding an item regarding vessel type may provide additional data and determine what questions should be administered thereafter.
- **On why people would have information on their engine:** Adding a description of which types of engines should be included in the respondent's answer would help produce more accurate reporting of engine emissions.
- **Regarding make and model of engine:** There are a few potential improvements that may be made. Firstly, we suggest eliminating the drop-down list for engine models at the very least and

replacing it with an open-response box so the participant can describe the model themselves. The list for makes has three potential solutions: either a) eliminate the list and provide an open-response box, b) improve the list by including more models, particularly older ones, or c) eliminate the item, should it be deemed by CARB that other information is sufficient to create an emissions estimate.

- **Regarding year of engine:** No changes to this item are proposed based on respondent feedback.
- **Regarding star certification:** If this item is to be included in the final version of the survey, additional information should be provided on what a Star Certification is, either in the form of a hover-over or link to resources. Based on some preliminary research, this information is very difficult to locate through an internet search. It may be helpful to refer to the “Low Emission” designation instead.
- **Regarding the horsepower of engine:** Although it was only suggested by one participant, creating more narrow horsepower categories may be an option if it would be helpful to CARB.
- **Regarding estimated engine hour meter:** A potential addition to the survey instrument might be the provision of hour ranges for those who initially indicate they “don’t know” their reading to minimize the amount of missing data.
- **Regarding engine replacement:** SSRC has no suggestions for this particular item based on feedback.
- **Regarding the formatting of the questions:** SSRC has no suggestions for this particular item based on feedback.
- **Regarding number of days vessel was used in summer and winter:** The survey should reiterate the period to report on (pre-COVID) more often, so the participant does not lose track of this. Additionally, we recommend the business format of the survey be eliminated due to confusion created for the respondent and low overall usage. Finally, due to problems associated with certain vessel types (houseboats and sailboats), the focus should be on the engine rather than usage of the vessel.
- **Number of hours vessel was used in the summer and winter:** The survey needs to clarify to respondents that we are referring to the amount of time they use their boats’ engine(s). It should include a statement instructing the respondent to exclude time they are anchored, drifting, sailing (without the engine) or any other activity when the engine is not running. Addition of ranges for those who “don’t know” how many hours they use their boat may be helpful. The survey should also remind the participant that they should be reporting on the time prior to the pandemic.
- **Keeping the engine idle:** The survey item itself appears to be adequate to capture the desired information. However, we may want to add the words “in neutral” to the definition for clarification. For sailboats and jet skis, we might skip this item, since it does not seem to apply to them (the answer will always be near zero). Finally, the categories may benefit from being broken down into smaller ones, particularly on the low end.
- **Regarding how often the engine is restarted:** One potential solution is to reference the number of days when asking for the number of hours to jog the respondent’s memory.
- **Applicability of question regarding electric powered vessel:** Taking together the suggestions of the respondents, we could add the phrasing of “of a comparable size, weight, cost, and power” to the survey question.

- **Interpretation of counties boated in:** The instructions on the ability to select more than one county should be more explicit or emphasized. In addition, the instructions should explain that the respondent should include all counties they cross into once in the water, not just the place they enter the body of water.
- **% of time boating in counties (if more than one):** Given the nature of this item, some degree of estimation is inherent and, to some extent, expected. However, this does mean the data derived on percentage of time in each county may not be as accurate as other markers in the survey. If it is feasible, we may consider breaking up use percent into larger geographic groupings, perhaps with a visual aid. Furthermore, we may consider asking this for each vessel rather than all combined (if the respondent has more than one).
- **Amount of gas left in tank at end of typical trip:** SSRC has no recommendations for this item based on participant feedback.
- **Regarding the term “additional” portable fuel containers:** The instructions on the item need to be reworked to include a list examples of what should be included as an “additional portable fuel container.” If there are any tanks or containers that should be excluded (for example, the boat’s primary portable tank), it should be explicitly stated in the instructions.
- **Regarding size of fuel container:** No changes are suggested to the item regarding size of fuel containers.
- **Regarding how often fuel containers are replaced:** At a minimum, a “never” option should be added for individuals who have never replaced their containers. Additionally, the instructions should note specifically which containers should be included here, and whether the primary fuel tank should be counted.
- **Discussion of including on-vessel generators:** CARB should consider whether on-vessel generators should be counted as engines, analyzed separately, or be excluded from the survey entirely. Changes can be made to the instructions based on CARB’s decision.
- **Discussion of including trolling and electric motors:** The use of electric motors for the purposes of trolling should be accounted for in the survey, and if these should not be included in the total engine count and total engine use, that should be stated explicitly.
- **Approach to engines that can be moved from one vessel to another:** For boats with outboard engines, an item could be added to determine whether the outboard engine is used on any other vessel and account for that use.
- **Feedback on the implementation of a logbook for tracking boat use:** One participant’s feedback supports the use of a logger or logbook to get more accurate measure of a subsample of boaters vessel use. This data could then be used to compare and potentially weight results for more accuracy.
- **Regarding type of use:** At least one participant found the boat use type item to be insufficient. At the very least, the respondent should have the option of multiple selections. We may also need to include an option for other “side business” use.
- **Regarding boat registration:** If it is important, the registration item could go with each both (in the roster) rather than all boats overall.
- **Regarding appearance of the survey:** Darker fonts should be used for the answer options to make the survey more readable and improve user experience.
- **Regarding boat storage:** It may be helpful to include the boat storage item for each boat rather than all boats to avoid respondent confusion and frustration.

- **Regarding use of the term “first” engine:** The use of the phrase “first engine” may cause the participant to think of the chronological first engine if the engine was replaced. This could lead to inaccuracies in the data. We recommend “Engine #1, #2, #3...” be used instead.

Conclusion

SSRC is pleased with the outcome of the cognitive interview analysis, and we believe there is much to be improved based on participant feedback. We await the response of CARB to initiate changes to the survey for full scale implementation.

APPENDIX B

2021 California Recreational Marine Vessel Survey

- **Background:**

This research is being conducted by the Social Science Research Center (SSRC), at California State University, Fullerton on behalf of the California Air Resources Board (CARB). This is an online study of recreational marine vessels' (RMV) activity in California waterways. CARB will use the survey results to estimate RMV emissions in California as a whole, as well as more specific locations such as South Coast and San Joaquin Valley air basins, two areas with an "Extreme" classification for the federal ozone standard. Ultimately, this study will help CARB in making decisions to improve air quality and protect public health in California.

Approximately 40,000 RMV owners will be randomly selected from the California DMV registration database to participate in the survey. This survey takes about 15 to 20 minutes to complete. For participating in this survey, you will receive a \$10 Amazon gift card. All participants will be entered into an opportunity drawing for a \$100 Amazon gift card. You will have the chance to provide your email address at the end of the survey so we can send the eGift card to you.

- **Rights as a Research Participant:**

The data collected in this survey will be kept strictly confidential to the extent permitted by law and in no case will be used to identify any one individual. This study involves no more than minimal risk, and there are no known harms or discomforts associated with this study beyond those encountered in daily life. You are free to decline to answer any survey question or to decline to participate entirely. Only research staff at the SSRC will have access to the data collected during this survey. At the conclusion of the study, a file containing the data with no identifying information will be provided to CARB. Our center director, Laura Gil-Trejo, has no financial interest in the results of this study, and the research is being done solely for academic purposes.

- **Contact Information:**

If you have questions about your rights as a research participant, you may contact California State University, Fullerton Regulatory Compliance Coordinator at irb@fullerton.edu or (657) 278-7719. For any other questions about the study, contact Laura Gil-Trejo at lgil-trejo@fullerton.edu or 657-278-7691

- **Instructions:**

As noted, the survey should only take about 15 to 20 minutes to complete. However, if you need to stop the survey and come back to it at a later time, you can close your web browser and your responses will be saved. To return to the survey, scan the QR code again and enter your ID number. You will return to the same part of the survey where you left off. Please take your time, as there are some points in the survey where there is no "back" button. Use the "next" button to move forward through the survey. If you have any technical issues with the survey, please contact Frederick Rose at frose@fullerton.edu or 657-278-4905. Please complete the survey by December 31, 2021, to be eligible for the incentive and drawing.

Please click "next" below if you have read and understood the above to proceed to the survey.

[Note for the reader: The options for all multiple-choice items are presented as dropdown menus in the programmed survey.]

1. How many boat(s) do you own? Please only include the ones that have internal combustion or battery-powered engine(s) and are actively in use. Include sailboats with auxiliary engines, jet boats, personal watercraft, and other motorized boats. Do not include paddleboats such as kayaks.

[LOOP THROUGH Q2A TO Q5 FOR EACH BOAT]

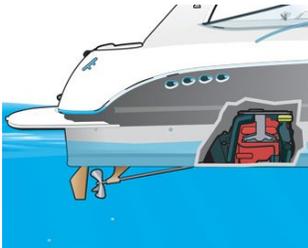
Boat #. [NUMBER]

A: Select the type of vessel. To enlarge an image, simply click on it. [PHOTO OF EACH VESSEL TYPE TO BE DISPLAYED]

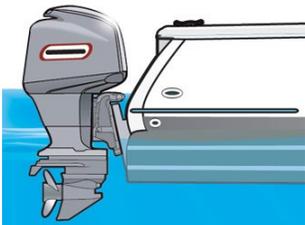
- a) Sailboat equipped with auxiliary engine(s)



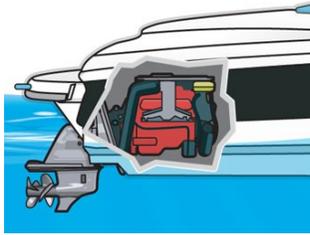
- b) Inboard



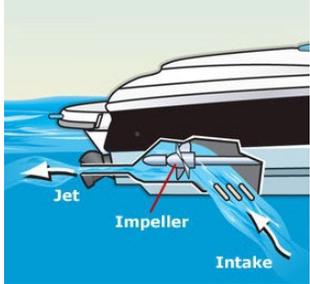
- c) Outboard



d) Sterndrive



e) Jet (or jet boat, up to 10 passengers, 14 - 25 ft. long)



f) Personal Watercraft (PWC or jet-ski, up to 3 passengers, 8 - 13 ft. long.)



g) Other, please specify _____

B: Which agency is this boat registered with?

- a) D.M.V.
- b) Both D.M.V. and U.S. Coast Guard
- c) Other, please specify _____

C: In which way have you primarily operated this vessel?

- a) Boating business such as boat cruises or tours.
- b) Personal/private leisure or sport.
- c) Mainly personal use but occasionally conduct freelance work with my vessel.
- d) None of the above, please specify _____

D: How many engines does this vessel have? The engine may provide power and/or electricity for the vessel. For example, please include trolling motors or onboard generators.

Engine #. [NUMBER]

[LOOP THROUGH 1E TO 1K FOR EACH ENGINE]

E: What type of fuel is used to operate this engine?

- a) Gasoline
- b) Diesel
- c) Electricity/battery (such as an electric trolling engine)
- d) Other, please specify_____

F: What is the make of this engine? If the engine is a replacement for an older one, please provide information on the new engine.

- a) Bombardier
- b) Briggs & Stratton
- c) BRP U.S.
- d) Gibbs Sports Amphibians
- e) Honda
- f) Ilmor Engineering
- g) Indmar Products
- h) Kawasaki
- i) Kem/Kodiak
- j) Lehr
- k) Malibu Power
- l) Mercury
- m) Outboard Group
- n) Outboard Marin
- o) Pleasurecraft Marine Engine
- p) Polaris
- q) Seven Marine
- r) Surfango
- s) Suzuki
- t) Teague Custom Marin
- u) Tohatsu
- v) Volvo
- w) Weber Motor
- x) Yamaha
- y) Zhejiang Hui Yuan Power Technology
- z) Not listed, please specify_____
- aa) Don't know

G: What is the model year of this engine?

- a) Year list: 1950 to 2021
- b) Don't know

H: What is the horsepower of this engine? Please select the appropriate range.

- a) ≤ 15 hp (11 kw)
- b) 16 -25 hp (11.1 - 19 kw)
- c) 26 - 50 hp (19.1 - 37 kw)
- d) 51 - 120 hp (37.1 - 89 kw)
- e) 121 - 175 hp (89.1- 130 kw)
- f) 176 - 250hp (130.1 - 186 kw)
- g) 251 - 375 hp (186.1 - 280 kw)
- h) 376 - 500 hp (280.1 – 373 kw)
- i) 501 - 650 hp (373.1 – 485 kw)
- j) ≥ 651 hp (≥ 485.1 kw)
- k) Not listed, please specify _____
- l) Don't know

I: What is the estimated engine hour meter reading? Please provide only a single **number** of hours (such as "10"). If at all possible, please **do not** provide a range (such as "10 to 15 hours").

- a) _____ hours
- b) Don't know
- c) Don't have an engine hour meter

[ASK IF Q1I = b]

I2: Would you say it is...

- a) 0-500 hours
- b) 501-1,000 hours
- c) 1,001-1,500 hours
- d) 1,501-2,000 hours
- e) > 2,000 hours
- f) Not listed, please specify _____
- g) Don't know

J: Have you replaced, rebuilt, or repowered the engine?

- a) Yes
- b) No
- c) Other, please specify _____
- d) Don't know

[ASK K AND L IF Q1I = a]

K: Approximately how old was the engine when you replaced it?

- a) _____ years
- b) Don't know

[ASK IF Q1K= B]

K2: Would you say it was...

- a) < 5 years old
- b) 6 to 10 years old
- c) 11 to 15 years old
- d) 16 to 20 years old
- e) More than 20 years old
- f) Not listed, please specify_____
- g) Don't know

L: What did you do with the old engine?

- a) It was scrapped
- b) It is still in use by the secondhand buyer
- c) Other, please specify_____
- d) Don't know

- 2. Please provide the following information about how often you use this boat and run the engine(s). For the following questions, please exclude the time when the boat is anchored, drifting, sailing (without the engine), or any other activity when the engine is not running. Please provide average values to the best of your ability.**

A) In the past 12 months, during the COVID-19 pandemic...

	How many days did you use your boat over each six-month period ?	On the days that you did use your boat, how long was the boat's engine running, on average during each season?	On the days that you did use your boat, what % of the time was your engine idling or in neutral during each season?	On the days that you did use your boat during each season, how many times was the engine restarted per day?
May to October (6-month warmer season)	a. 0 days/period b. 1 to 2 days/period c. 3 to 4 days/period d. 5 to 6 days/period e. 7 to 8 days/period f. 9 to 10 days/period g. 11 to 12 days/period h. More than 12 days/period, please specify: _____	a. Less than 1 hour/day b. 1 to 3 hours/day c. 4 to 6 hours/day d. 7 to 9 hours/day e. 10 to 12 hours/day f. 13 to 15 hours/day g. More than 15 hours/day, please specify: _____ h. Not applicable	a. 0% of the time b. Less than 10%/day (but not 0%) c. 10% to 20%/day d. 21% to 30%/day e. 31% to 40%/day f. 41% to 50% g. 51% to 60%/day h. 61% to 70%/day i. 71% of the time or more/day j. Don't know k. N/A	a. 0/day b. 1/day c. 2-3/day d. 4-6/day e. 7-9/day f. 10 or more/day g. Other, specify ____ h. Don't know i. N/A
November to April (6-month cooler season)	a. 0 days/period b. 1 to 2 days/period c. 3 to 4 days/period d. 5 to 6 days/period e. 7 to 8 days/period f. 9 to 10 days/period g. 11 to 12 days/period h. More than 12 days/period, please specify: _____	a. Less than 1 hour/day b. 1 to 3 hours/day c. 4 to 6 hours/day d. 7 to 9 hours/day e. 10 to 12 hours/day f. 13 to 15 hours/day g. More than 15 hours/day, please specify: _____ h. Not applicable	a. 0% of the time b. Less than 10%/day (but not 0%) c. 10% to 20%/day d. 21% to 30%/day e. 31% to 40%/day f. 41% to 50% g. 51% to 60%/day h. 61% to 70%/day i. 71% of the time or more/day j. Don't know k. N/A	a. 0/day b. 1/day c. 2-3/day d. 4-6/day e. 7-9/day f. 10 or more/day g. Other, specify ____ h. Don't know i. N/A

B) How has your boating activity during each season within the past year with this boat changed (during the COVID-19 pandemic) compared to your boating activity with this boat before the COVID-19 pandemic?

	My boating activity has...	[IF INCREASED] How much did your boating activity with this boat increase in the past year compared to before the COVID-19 pandemic?	[IF DECREASED] How much did your boating activity with this boat decrease in the past year compared to before the COVID-19 pandemic?	[IF INCREASED/DECREASED] Was this change in your boating activity due to the COVID-19 pandemic itself, or was it caused by something else?
May to October (6-month warmer period)	a. Increased b. Decreased c. Stayed the same d. Don't know e. Not applicable	a. ≤ 10% higher than before b. Between 11% and 25% higher c. Between 26% and 50% higher d. Between 51% and 75% higher e. Between 75% and 100% higher f. Between 101% and 200% higher g. ≥ 201% higher h. other, specify _____ i. Don't know	a. ≤ 10% lower than before b. Between 11% and 25% lower c. Between 26% and 50% lower d. Between 51% and 75% lower e. Between 75% and 100% lower f. Between 101% and 200% lower g. ≥ 201% lower h. other, specify _____ i. Don't know	a. COVID-19 pandemic b. Something else, specify: _____ c. Don't know d. Not applicable
November to April (6-month cooler period)	a. Increased b. Decreased c. Stayed the same d. Don't know e. Not applicable	<u>a. ≤ 10% higher than before</u> <u>b. Between 11% and 25% higher</u> <u>c. Between 26% and 50% higher</u> <u>d. Between 51% and 75% higher</u> <u>e. Between 75% and 100% higher</u> <u>f. Between 101% and 200% higher</u> <u>g. ≥ 201% higher</u> h. other, specify _____ i. Don't know	a. ≤ 10% lower than before b. Between 11% and 25% lower c. Between 26% and 50% lower d. Between 51% and 75% lower e. Between 75% and 100% lower f. Between 101% and 200% lower g. ≥ 201% lower h. other, specify _____ i. Don't know	a. COVID-19 pandemic b. Something else, specify: _____ c. Don't know d. Not applicable

Q3b. In which of these counties do you generally use this boat? You may select more than one if applicable.

Northern Region	Central Region	Southern Region
Butte	Alameda	Imperial
Colusa	Alpine	Kern
Contra Costa	Amador	Los Angeles
Del Norte	Calaveras	Orange
El Dorado	Fresno	Riverside
Glenn	Inyo	San Bernardino
Humboldt	Kings	San Diego
Lake	Madera	San Luis Obispo
Lassen	Mariposa	Santa Barbara
Marin	Merced	Ventura
Mendocino	Mono	
Modoc	Monterey	
Napa	San Benito	
Nevada	San Joaquin	
Placer	San Mateo	
Plumas	Santa Cruz	
Sacramento	Stanislaus	
San Francisco	Tulare	
Shasta	Tuolumne	
Sierra		
Siskiyou		
Solano		
Sonoma		
Sutter		
Tehama		
Trinity		
Yolo		
Yuba		

[SKIP TO Q3D IF ONLY ONE COUNTY SELECTED]

Q3c. What percent of your time do you spend boating (with this particular boat) in each of these counties? The total must sum to 100%.

[PULL IN LIST OF COUNTIES SELECTED]

[SKIP TO Q4 IF NO COASTAL COUNTIES SELECTED]

Q3d. Do you use this boat along the California Coast? Examples include the Pacific Ocean, bays, or harbors along the coast.

1. Yes
2. No [SKIP TO Q4]

Q3e. What percentage of the time do you operate this boat along the California Coast (that is, not in freshwater bodies of water, like rivers, lakes, and reservoirs)?

1. ____% of time along the coast
2. Don't know

Q3f. How far into the ocean from the shoreline do you usually operate this boat?

1. Within 3 nautical miles
2. Between 3 and 24 nautical miles
3. More than 24 nautical miles
4. Not listed, please specify
5. Don't know

4. Where and how do you typically store this boat? Please select a place and then select a storage type.

Place:

- a) Typically stored at a storage facility _____ miles away from my residence.
- b) Typically stored at a marina _____ miles away from my residence.
- c) Typically stored at my residence.
- d) If not listed, please specify. _____

5. How much fuel is usually left in the tank of this boat at the end of a typical trip?

- a) The tank is near empty.
- b) About $\frac{1}{4}$ of a tank.
- c) Between $\frac{1}{4}$ to $\frac{1}{2}$ of a tank.
- d) Between $\frac{1}{2}$ to $\frac{3}{4}$ of a tank.
- e) The tank is nearly full.
- f) Don't know.

6. If you were in the market for a new boat, how likely would you be to consider purchasing an electric or hybrid-electric boat with similar specifications to a gasoline boat, such as power, output, size, weight, and cost?

- a) Not at all likely
- b) Not very likely
- c) Somewhat likely
- d) Likely
- e) Very likely
- f) Don't know

7. In addition to the primary fuel tank, how many portable fuel containers (PFC) do you use to refuel your boat(s)? _____

[IF Q7 = 0, SKIP TO Q9]

[ASK 7a ,7b,7c and 7d FOR EACH FUEL CONTAINER]

Fuel Container No.	7a. What is type of portable fuel container (PFC) is your...PFC?	7b. What size is your...PFC?	7c. What material is your...PFC made of?	7d. How often do you refill the PFC?
1, 2, 3, 4, etc.	a. A general consumer PFC that looks similar to  b. A marine PFC that looks similar to  to c. Don't know.	a. 0-5 gallons b. 6-12 gallons c. 13-25 gallons d. 25-50 gallons e. If not listed, please specify _____ gallon	a. Metal b. Plastic c. Fiberglass d. if not listed please specify _____	a. Every time before boating. b. Every week. c. Every two weeks. d. Every month. e. Other, specify____ f. Don't know.

8. How often do you typically replace your additional fuel container(s)?

- a) Approximately every _____ years
- b) Don't know
- c) Never

9. We are interested in learning more about the profile of recreational boat users throughout the state. One aspect that might shape the way people boat is their age. With this in mind, can you please select the category that applies to you?

- a) 18 – 24
- b) 25 – 34
- c) 35 – 44
- d) 45 – 54
- e) 55 – 64
- f) 65 – 74
- g) 75 – 84
- h) 85 +
- i) Decline to state

10. Please provide your email address and phone number so we can send you your eGift card.

- a) Email: _____
- b) Phone: _____

11. For us to better understand how marine engines and boats operate under various conditions, we are interested in installing data loggers on the boats of a group of survey participants. Would you be willing to let us install a data logger on your boat engine for one month? You would receive a \$200 incentive as compensation.

- a) No.
- b) [IF EMAIL/PHONE PROVIDED IN Q10] Yes, please contact me with the email address or phone number listed in the previous question.
- c) [IF NO EMAIL/PHONE PROVIDED IN Q10] Yes, please contact me at the email address and phone number below:
 - i. Email: _____
 - ii. Phone: _____

12. Please share any additional comments you have regarding your boats, boating activity, or the survey itself in the space below.

APPENDIX C

Weighting to Match Population Proportion

In survey research, “weighting” is a standard practice used to correct for differences between a study’s sample and the target population. It helps ensure that the analysis results are generalizable and that overrepresented groups do not exert undue influence on findings. Weights are especially important when survey participation varies systematically across known categories, such as vessel type in this case.

Determining the Need for Weights

To assess whether weighting was necessary, the distribution of vessel types in the survey sample was compared to the official statewide vessel registration data provided by the California DMV. A chi-square test of independence revealed a statistically significant difference between the two distributions.⁸⁹ This finding confirmed that the sample was not representative of the broader vessel population and that weighting was needed to adjust for these discrepancies.

Vessel-Level Weighting Methodology

The weighting procedure involved calculating the proportion of each vessel type in the DMV population, then determining how many responses we would have expected from each type if the survey sample matched those proportions. This expected number, referred to as the target count, was calculated by multiplying the total number of survey responses by each vessel type’s proportion in the DMV data. The final weight was calculated using the formula: Weight = Target Count / Sample Count. These weights were applied to each vessel record in the dataset to ensure the analysis more accurately reflected the true distribution of vessel types in the DMV population. See Table C1 for the vessel type distributions in the sample and population, and the weights applied.

Vessel Type	Sample Count	% of Sample	% of Population	Target Count	Weight Applied
Sailboats	217	5.1%	2.1%	90	0.41
Inboards	719	16.8%	10.0%	426	0.59
Jets	214	5.0%	3.3%	140	0.65
Outboards	1,564	36.5%	39.1%	1,662	1.06
Personal Watercraft	925	21.6%	22.1%	940	1.01
Sterndrives	600	14.0%	23.3%	990	1.65
Other	51	1.2%	0.0% ⁹⁰	0	0.00

Weights below 1.0 indicate overrepresentation in the sample (e.g., sailboats and inboards), while weights above 1.0 reflect underrepresentation (e.g., outboards and personal watercraft). These weights were applied to all vessel-level analyses to ensure the data better reflected the actual population of RMVs.

⁸⁹ $\chi^2(5, 4,290) = 574.57, p < .001$

⁹⁰ Population-level data were not available for vessels classified as “other.” As a result, RMVs identified as “other” vessel types were not assigned weights and were excluded from the weighted analysis.

Application of Weights to Engine-Level Data

Although the weights were calculated based on vessel-level data, much of the survey analysis occurred at the engine level. Because vessel type and engine type are correlated (e.g., sailboats are more likely to have inboard engines) the initial over- or underrepresentation of certain vessel types also influenced the engine dataset.

To maintain consistency and correct for this carryover imbalance, each engine record was assigned the weight of its parent vessel. Therefore, since sailboats were underweighted at 0.41, all engine records linked to a sailboat also received a weight of 0.41. This approach ensured that engine-level findings remained reflective of the actual vessel distribution and avoided compounding sampling bias. Vessels with multiple engines had each engine assigned the same weight, under the assumption that each engine contributed equally to vessel use and characteristics.

APPENDIX D

Table D1. Engine Make (Unweighted Values)

Make	# of Engines	% of Engines	Make	# of Engines	% of Engines
Mercury	1,360	28.3%	Yanmar	58	1.2%
Yamaha	649	13.5%	Ford	57	1.2%
Bombardier	394	8.2%	Cummins	39	0.8%
Honda	338	7.0%	Polaris	29	0.6%
Volvo	252	5.2%	Malibu Power	29	0.6%
Kawasaki	232	4.8%	Briggs & Stratton	20	0.4%
Minn Kota	210	4.4%	Outboard Group	20	0.4%
Outboard Marin	183	3.8%	Ilmor Engineering	12	0.2%
Chevrolet/GMC	140	2.9%	Gibbs Sports Amphibians	5	0.1%
Indmar Products	105	2.2%	Kem/Kodiak	3	0.1%
Pleasurecraft Marine Engine	100	2.1%	Lehr	3	0.1%
Tohatsu	89	1.9%	Teague Custom Marin	3	0.1%
Suzuki	64	1.3%	Seven Marine	1	<0.1%
BRP U.S.	58	1.2%	Zhejiang Hui Yuan Power Technology	1	<0.1%
			Not listed	355	7.4%

Table D1a. Engine Make of Vessels Described as “Not Listed” (Unweighted Values)

Make	# of Engines	% of Engines	Make	# of Engines	% of Engines
Other	68	19.2%	Mann	5	1.4%
Universal	29	8.2%	Isuzu	5	1.4%
Detroit	22	6.2%	Sea King	4	1.1%
Nissan	21	5.9%	Scott	4	1.1%
Oldsmobile	17	4.8%	Lowrence	4	1.1%
Caterpillar	17	4.8%	Kohler	4	1.1%
Torqeedo	16	4.5%	Buick	4	1.1%
Perkins	16	4.5%	Atomic 4	4	1.1%
Johnson	12	3.4%	Sears	3	0.8%
Chrysler	12	3.4%	Onan	3	0.8%
Westerbeke	11	3.1%	Motorcraft	3	0.8%
Northern Lights/Lugger	9	2.5%	Montgomery Ward	3	0.8%
Crusader	8	2.3%	Hummingbird	3	0.8%
Kutoba	8	2.3%	Hino	3	0.8%
Evinrude	7	2.0%	Hercules	3	0.8%
Duffy	7	2.0%	Gray Marine	3	0.8%
Chris Craft	6	1.7%	Electric	3	0.8%
Trolling Motor	5	1.4%	Electra craft	3	0.8%

Table D2. Reported Engine Hour Meter Reading in Ranges- For Engines With Known Exact Reading (Unweighted Values)

Hour ranges	# of Engines	% of Engines	Mean Hours	95% CI	Total Hours (Using Mean)	% of Total Hours
0-500	1,834	77.8%	168.1	161.5 - 174.6	308,230	27.2%
501-1,000	280	11.9%	758.5	740.9 - 776.2	212,391	18.7%
1,001-1,500	107	4.5%	1,239.4	1,213.1 – 1,265.7	132,619	11.7%
1,501-2,000	49	2.1%	1,834.7	1,790.7 – 1,878.6	89,898	7.9%
>2,000	86	3.7%	4,539.0	3,664.9 – 5413.1	390,352	34.4%
Total	2,356	100.0%	481.1	433.8 – 528.4	1,133,490	100.0%⁹¹

Table D2a. Estimated Engine Hour Meter Reading in Ranges- For Engines With Unknown Exact Reading (Unweighted Values)

Hour ranges	# of Engines	% of Engines	Imputed Mean Hours	Estimated Total Hours (Using Imputed Mean)	% of Total Hours
0-500	563	61.3%	170.2	94,640	16.6%
501-1,000	209	22.7%	759.2	158,527	27.8%
1,001-1,500	69	7.5%	1,229.1	85,519	15.0%
1,501-2,000	45	4.9%	1,835.2	82,562	14.5%
>2,000	33	3.6%	5,017.3	149,787	26.2%
Total	919	100.0%	621.4	571,035	100.0%⁹²

⁹¹ Due to rounding, the total of the percentages sum to 99.9%

⁹² Due to rounding, the total of the percentages sum to 100.1%

Table D2b. Combined Engine Hour Meter Reading in Ranges- For all Engines That Some Information Was Provided (Unweighted Values)

Hour ranges	# of Engines	% of Engines	Mean Hours	Combined Total Hours (Using Mean and Imputed Mean)	% of Total Hours
0-500	2,397	73.2%	168.1	402,870	23.6%
501-1,000	489	14.9%	758.5	370,918	21.8%
1,001-1,500	176	5.4%	1,239.4	218,138	12.8%
1,501-2,000	94	2.9%	1,834.7	172,460	10.1%
>2,000	119	3.6%	4,539.0	540,139	31.7%
Total	3,275	100.0%	520.5	1,704,525	100.0%

Table D3. % of Time Spent Boating in Counties in the Northern Region (Unweighted Values)⁹³

County	Count	Non-Response	Min %	Max %	Mean %	Median %	SD %
Butte	63	60	0.0%	95.0%	31.7%	20.0%	27.4%
Colusa	28	3	0.0%	95.0%	25.3%	10.0%	27.5%
Contra Costa	126	94	0.0%	100.0%	37.5%	31.5%	28.4%
Del Norte	9	5	10.0%	90.0%	27.2%	20.0%	26.8%
El Dorado	84	61	0.0%	100.0%	30.3%	25.0%	25.2%
Glenn	17	2	0.0%	80.0%	19.2%	10.0%	22.2%
Humboldt	20	23	0.0%	90.0%	46.9%	50.0%	30.7%
Lake	71	90	0.0%	99.0%	28.4%	20.0%	29.2%
Lassen	32	6	0.0%	90.0%	30.4%	25.0%	26.6%
Marin	64	14	0.0%	95.0%	29.0%	20.0%	27.0%
Mendocino	26	12	0.0%	99.0%	18.8%	10.0%	22.9%
Modoc	6	3	0.0%	50.0%	20.0%	17.5%	19.6%
Napa	78	27	0.0%	100.0%	39.3%	30.0%	28.9%
Nevada	54	32	0.0%	80.0%	34.2%	35.0%	28.9%
Placer	90	57	0.0%	100.0%	34.4%	25.0%	27.4%
Plumas	58	28	0.0%	95.0%	36.5%	30.0%	28.8%
Sacramento	184	120	0.0%	99.0%	34.7%	27.5%	25.2%
San Francisco	64	11	1.0%	100.0%	26.6%	20.0%	23.9%
Shasta	111	104	0.0%	100.0%	33.1%	25.0%	28.1%
Sierra	28	0	0.0%	70.0%	19.7%	10.0%	20.4%
Siskiyou	24	14	0.0%	90.0%	34.2%	27.5%	30.0%
Solano	75	33	0.0%	100.0%	27.4%	19.0%	28.3%
Sonoma	57	40	0.0%	95.0%	31.5%	25.0%	26.6%
Sutter	28	5	0.0%	80.0%	27.2%	17.5%	24.3%
Tehama	16	6	0.0%	95.0%	34.4%	30.0%	28.0%
Trinity	71	0	0.0%	95.0%	31.8%	24.5%	28.4%
Yolo	48	6	0.0%	90.0%	21.8%	15.0%	20.5%
Yuba	66	20	0.0%	90.0%	29.7%	20.0%	26.2%

⁹³ Given the amount of missing data on these items, confidence intervals were not calculated as they would not be reliable.

Table D4. % of Time Spent Boating in Counties in the Central Region (Unweighted Values)⁹⁴

County	Count	Non-Response	Min %	Max %	Mean %	Median %	SD %
Alameda	63	41	0.0%	100.0%	27.7%	20.0%	25.4%
Alpine	6	3	2.0%	25.0%	15.3%	15.0%	9.4%
Amador	48	11	0.0%	90.0%	20.5%	10.0%	21.1%
Calaveras	80	52	1.0%	100.0%	32.1%	23.5%	26.9%
Fresno	87	81	0.0%	100.0%	42.9%	40.0%	29.5%
Inyo	11	11	2.0%	50.0%	22.0%	20.0%	12.8%
Kings	16	0	2.0%	70.0%	31.7%	25.0%	19.3%
Madera	48	19	1.0%	90.0%	38.8%	30.0%	24.7%
Mariposa	12	3	5.0%	80.0%	33.2%	40.0%	25.2%
Merced	53	32	0.0%	95.0%	32.6%	25.0%	24.8%
Mono	14	13	2.0%	80.0%	36.2%	22.5%	28.0%
Monterey	46	27	0.0%	85.0%	30.0%	20.0%	25.2%
San Benito	7	2	5.0%	90.0%	18.5%	5.0%	31.5%
San Joaquin	129	102	0.0%	95.0%	34.0%	30.0%	22.5%
San Mateo	20	19	5.0%	98.0%	28.7%	20.0%	27.1%
Santa Cruz	26	19	0.0%	90.0%	29.0%	24.0%	23.4%
Stanislaus	68	29	0.0%	95.0%	31.3%	25.0%	25.0%
Tulare	16	31	0.0%	80.0%	41.0%	40.0%	21.5%
Tuolumne	57	66	1.0%	95.0%	32.3%	30.0%	22.5%

Table D5. % of Time Spent Boating in Counties in the Southern Region (Unweighted Values)⁹⁵

County	Count	Non-Response	Min %	Max %	Mean %	Median %	SD %
Imperial	21	22	2.0%	90.0%	38.2%	40.0%	24.1%
Kern	42	51	2.0%	80.0%	24.8%	20.0%	22.2%
Los Angeles	199	244	0.0%	98.0%	45.5%	50.0%	30.1%
Orange	132	100	0.0%	100.0%	39.5%	30.0%	28.8%
Riverside	134	141	0.0%	100.0%	37.0%	30.0%	26.5%
San Bernardino	149	227	0.0%	100.0%	50.7%	50.0%	28.1%
San Diego	101	173	0.0%	100.0%	36.3%	25.0%	30.0%
San Luis Obispo	46	63	2.0%	90.0%	40.6%	35.0%	29.3%
Santa Barbara	45	27	2.0%	80.0%	27.1%	20.0%	21.3%
Ventura	5	102	5.0%	60.0%	38.0%	55.0%	28.0%

⁹⁴ Given the amount of missing data on these items, confidence intervals were not calculated as they would not be reliable.

⁹⁵ Given the amount of missing data on these items, confidence intervals were not calculated as they would not be reliable.