



Bermuda Ocean Use Survey Results

July 28, 2021



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EXECUTIVE SUMMARY

The Bermuda Ocean Prosperity Programme (BOPP) partnered with the University of California, Santa Barbara's McClintock Lab to conduct this Ocean Use Survey using two online platforms: SeaSketch and Maptionnaire. Some responses were also collected on paper maps by facilitators, which were later uploaded and digitized into the SeaSketch platform. Respondents, categorized into seven main marine sectors, identified ocean areas in Bermuda that they use, and assigned values to those areas. Survey responses were combined to create heatmaps of ocean use and value for each sector. These maps will contribute to BOPP's overarching goal of creating a marine spatial plan (MSP) for Bermuda that fosters the sustainable, profitable, and enjoyable use of Bermuda's ocean for present and future generations.

The survey asked respondents to choose the sector or ocean use they wished to represent, and then asked the respondents to draw areas in the ocean that they use and indicate the relative value to them or the sector. Respondents were asked to assign a value to the areas by distributing 100 points across all the areas that they drew (more points would indicate a greater value). Lastly, respondents had the option of providing their age, gender, and parish of residence. The sector or ocean use options available included: Commercial Fishing, Recreational Fishing, Aquaculture, Utilities and Infrastructure, Shipping, Tourism, Boating, Swimming/Snorkeling/Diving, and Passive Recreation and Conservation.

The survey ran from September 2020 to February 2021 with an aim to collect at least 380 total responses across all sectors. Targets for overall responses were exceeded with a total of 1,488 responses collected. Furthermore, all individual targets for each sector were exceeded. Responses for each sector or ocean use were compiled by aggregating areas and values into heatmaps, which can indicate how users from each group value ocean space in Bermuda.

To ensure the heatmaps created from the survey data aligned with stakeholders' knowledge of how Bermuda's marine space is used, we reviewed the maps with the [BOPP Ocean Village](#). This also helped determine which method of heatmap analysis – weighted or unweighted – provided the most accurate maps for use during the planning process.

There are several ways to interact with the results of the survey and the maps.

This Report: This report details the data gathered through the survey, including demographic data and sector representation. There is also a description of the

methodology (Appendix 1) used to analyze the data and what the different maps represent.

Online Heatmaps: Each sector or ocean use has an online webpage with dynamic maps, where users can zoom into the heatmaps and explore. Each webpage includes descriptions of the maps as well as some demographic data for each sector.

Static Map packet (Appendix 2): Users can also view static maps at the end of this report (meaning you cannot zoom into the maps and explore, but the same information as appears in the dynamic heatmaps is included), with each sector or ocean use’s maps displayed on a single pdf page.

Table 1

Sector	Online Heatmaps	Static Maps
Commercial Fishing	https://arcg.is/1HWbjy0	<u>Page 25</u>
Recreational Fishing	https://arcg.is/5XiqT	<u>Page 26</u>
Aquaculture	https://arcg.is/1XX1H8	<u>Page 27</u>
Utilities, Infrastructure and Shipping	https://arcg.is/1Kvam4	<u>Utilities: Page 28</u> <u>Shipping: Page 29</u>
Tourism and Boating	https://arcg.is/1jOOr0	<u>Tourism: Page 30</u> <u>Boating: Page 31</u>
Swimming, Snorkeling and Diving	https://arcg.is/1Wu1jL0	<u>Page 32</u>
Passive Recreation and Conservation	https://arcg.is/010r8b	<u>Page 33</u>

INTRODUCTION

From September 2020 to February 15th, 2021, the Bermuda Ocean Use Survey collected data on how the residents of Bermuda use and value marine spaces and resources. The survey was open to all Bermudian residents.

The Bermuda Ocean Prosperity Programme (BOPP) partnered with the University of California, Santa Barbara's McClintock Lab to conduct this survey using two online platforms: SeaSketch and Maptionnaire. Some responses were also collected on paper maps by facilitators which were later uploaded and digitized into the SeaSketch platform. Respondents, categorized into seven main marine sectors, identified ocean areas in Bermuda that were important to them, and assigned values to those areas of interest. Survey responses were then combined to create maps showing how the ocean around Bermuda is used and valued. These maps will contribute to BOPP's overarching goal of creating a Marine Spatial Plan for the Bermuda EEZ that fosters the sustainable, profitable, and enjoyable use of Bermuda's ocean for present and future generations.

This report summarizes the survey process, the number of respondents, and the information provided by respondents pertaining to non-spatial questions (demographics, gear type for fishers, etc.). Details on the methodology used to analyze the data can be found in Appendix 1. The results from the spatial questions can be found in the accompanying map packet, Appendix 2, or can be viewed online.

The BOPP MSP Process

Marine Spatial Planning (MSP) is a science-based and stakeholder-driven process to effectively zone and manage ocean space in a way that reduces user conflict, supports a thriving blue economy, and prioritizes environmental health and human wellbeing. The MSP process assembles existing knowledge of the marine environment, examines the priorities of stakeholders, and, through an iterative public process, creates a map that identifies different ocean uses and a management plan to maximize the benefit of ocean uses and minimize negative environmental and economic impacts. This planning process involves considerable stakeholder and governmental input.

The marine spatial planning process may be broadly characterized as (i) research and analysis, (ii) stakeholder consultations, (iii) options and scenario modelling, and (iv) plan formulation.

The Ocean Use Survey provides different functions in the MSP process, including: 1) a tool for stakeholder consultation, 2) generating data products for research and analysis, and 3) informing

the development of options and scenario modeling through the application of the data collected. The data products from the Ocean Use Survey are the heatmaps of ocean use.

The Ocean Use Survey maps will be used to develop various prospective marine plans (aka. scenarios). These scenarios will consider the data collected in the context of the principals, goals, and objectives identified by the BOPP Steering Committee and stakeholders. They will include possible placements for Marine Protected Areas (MPAs), as well as the placement of other possible ocean uses to bolster environmental health and support community ocean use. These scenarios will be considered by the BOPP Steering Committee and undergo a public review processes until they are acceptable, wherein which management plans and legal designations of use areas will be drafted into law, to be accepted by Bermuda’s government.

Methodology

Methods can be viewed in detail in Appendix Aa.

Results

Sector Responses

The total number of survey respondents was 1,488, collected using two online platforms (SeaSketch and Maptionnaire) and using paper maps that were later digitized in SeaSketch. This total includes individual respondents as well as all the individuals represented in group responses. Survey targets were established for each sector using a power analysis to ensure results accurately represented the interests of each sector group. The team was able to exceed the target responses for all seven sectors, totaling almost four times the minimum required for robust statistical analysis for the population size of Bermuda. Table 1 summarizes totals for each ocean use sector, and whether the response was collected on SeaSketch or Maptionnaire.

Table 1: Total responses collected by sector and platform used.

Sector	Target	SeaSketch	Maptionnaire	Progress
Commercial Fishers	40	52	17	173%
Recreational Fishers	80	131	26	196%
Aquaculture	5	8	3	220%
Passive recreation / Conservation (General public)	80	153	22	219%

Swimming, Snorkeling, Diving	80	561	79	800%
Tourism, Boating, and Sports	80	224	43	334%
Utilities, Infrastructure, and Development	17	63	11	435%
Other		95	0	--
Total	382	1,287	201	390%

Respondent demographics

Both the SeaSketch and Maptionnaire surveys included optional questions about the respondent’s age, gender, and area of residence (parish) in Bermuda. Demographic data was only collected from individual respondents.

Out of 605 respondents, 385 disclosed their age. Ages ranged from 13 to 79, with a mean age of 43. Of the 362 respondents that chose to disclose their gender, 36.5% identified as female, 62.9% identified as male and 0.5% declined to identify as either. Males outnumbered females for all age groups (Figure 1).

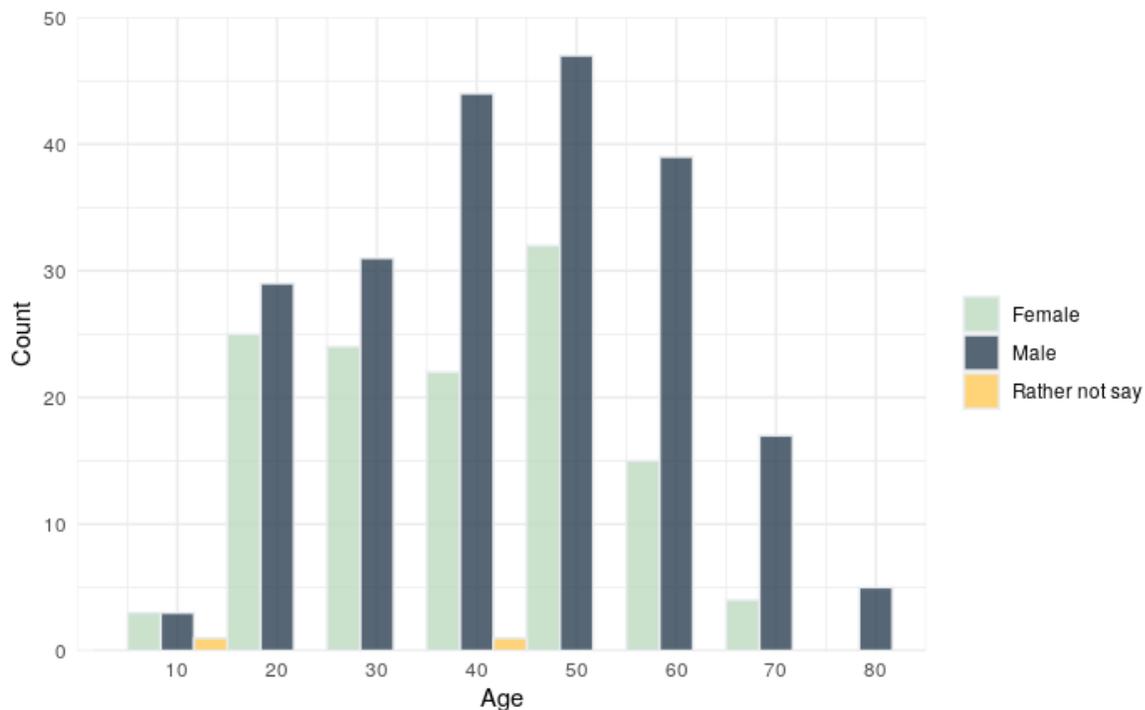


Figure 1: Age distribution of respondents separated by gender.

370 responses included the respondent's parish. The parish with the highest number of respondents was Pembroke (n = 66), while Hamilton had the lowest (n = 23). Table 4 and Figure 2 illustrate the full geographic distribution of results:

Table 4: Number of responses from each Parish as a percentage of the total responses collected.

Parish	Number of Responses	Percentage of total
Pembroke	62	18%
Paget	48	14%
St. George's	46	13%
Devonshire	42	12%
Smith's	38	11%
Southampton	34	10%
Warwick	34	10%
Sandy's	27	8%
Hamilton	19	5%

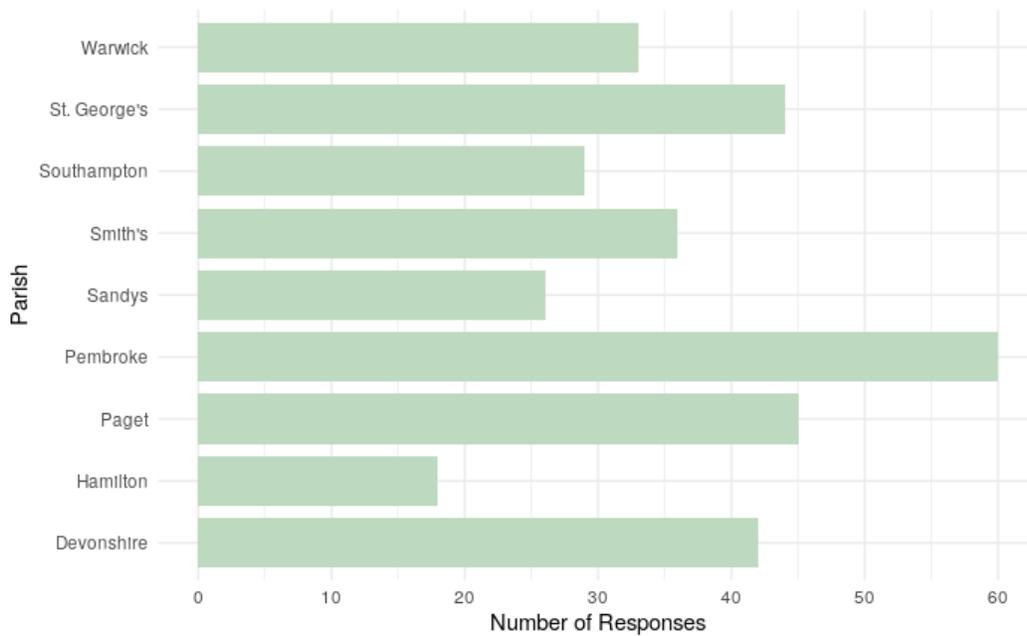


Figure 2: Number of respondents from each parish.

Demographic Breakdown by Ocean Use Sector

This section summarizes the demographic data collected, organized by each sector or ocean use, including age, gender distribution, and geographic spread by parish of residence. Note that the demographic data do not reflect group responses, as those details were not collected for each person represented in a group response, just the individuals interacting with the survey.

Commercial Fishing

Of the respondents that drew shapes for commercial fishing, 23 indicated their age. Ages ranged from 19 to 73, with a mean of 49. 96.7% of respondents that indicated their gender was male, with 3.3% female. To gauge the geographic reach of the survey to commercial fishers, data collected on respondents' parish of residence was compared to lists of licensed fishing vessels in each parish. Results are shown below (Table 7).

Table 7: The number of responses as a percentage of licenced vessels in each parish.

Parish	Number of Survey Respondents	Number of Licenced Vessels	Percent*
Devonshire	1	21	4.8%
Hamilton	0	47	0%
Paget	0	7	0%
Pembroke	6	20	30%
Sandy's	9	22	40.9%
Smith's	3	11	27.3%
Southampton	10	21	47.6%
St. George's	9	35	25.7%
Warwick	2	10	20%
Did not disclose parish	29	N/A	N/A

*The last column shows the number of commercial fishing survey responses in each parish as a percentage of the number of licenced commercial fishing vessels in each parish.

For commercial fishing, the survey also included an option to indicate what gear a respondent used in a shape drawn. The table below summarizes the number of shapes drawn for each gear type (many respondents indicated more than one gear type per each shape drawn, especially for larger areas). Different gear options were included on the two platforms, so responses have been separated into those collected on SeaSketch and those collected on Maptionnaire.

Table 5: Number of shapes drawn where Commercial Fishing respondents indicated they used each type of fishing gear

Gear Type	Number of Shapes - SeaSketch	Number of Shapes - Maptionnaire
Bottom Fishing	108	32
Trolling	98	36
Bait Fishing	17	25
Traps	25	15
Long Lining	13	--
Net Fishing (Bait species)	11	--
Net Fishing (Schooling pelagics)	7	--
Hand Lining	29	--
Other	0	0

Recreational Fishing

Of the respondents that drew shapes valued for recreational fishing, 34 indicated their age. Ages ranged from 17 to 64, with a mean of 44. 83.8% of respondents that indicated their gender was male, with 16.2% female.

The geographic spread of respondents for recreational fishing is shown below in Figure 3, with the most respondents from Pembroke and Devonshire, and the least from Hamilton and Southampton.

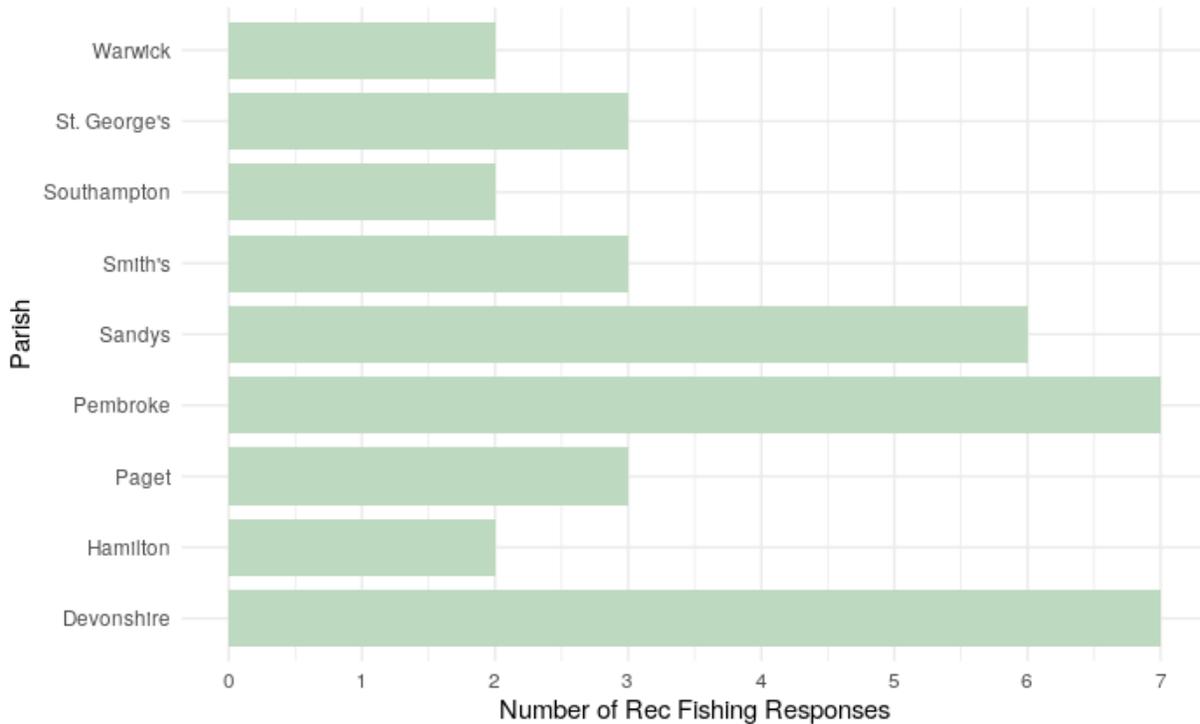


Figure 3: Number of respondents for recreational fishing from each parish.

Aquaculture

Of the individual respondents that drew shapes valued for aquaculture, 4 indicated their age. Ages ranged from 17 to 58, with a mean of 32. 100% of respondents that indicated their gender was male.

Respondents for aquaculture (n = 4) hailed from four parishes: St George’s, Paget, Southampton and Warwick.

Utilities and Infrastructure

Of the individual respondents that drew shapes valued for utilities and infrastructure, 10 indicated their age. Ages ranged from 17 to 62, with a mean of 49. 90% of respondents that indicated their gender was male, and 10% female. Due to the small number of respondents for both utilities and infrastructure and shipping, the geographic distribution for both sectors are combined and shown in Figure 4 below.

Shipping

Of the individual respondents that drew shapes valued for shipping, 4 indicated their age. Ages ranged from 35 to 55, with a mean of 49. 75% of respondents that indicated their gender was male, and 25% female.

Shipping respondents have been combined with respondents for utilities and infrastructure to show the geographic distribution in Figure 4.

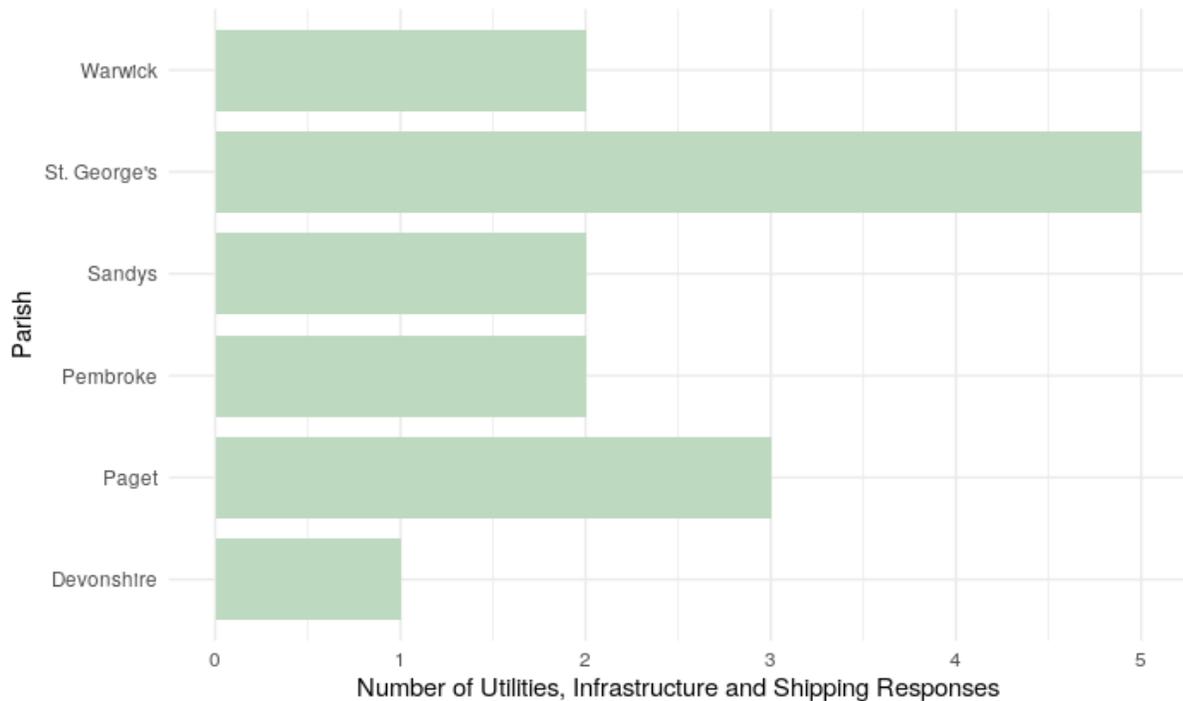


Figure 4: Number of respondents for utilities, infrastructure and shipping from each parish.

Tourism

Of the individual respondents that drew shapes valued for tourism, 3 indicated their age. Ages ranged from 17 to 56, with a mean of 49. 33% of respondents that indicated their gender was male, and 67% female.

The respondents for tourism that indicated their parish of residence (n = 3) were residents of Sandy's and Warwick.

Boating

Of the individual respondents that drew shapes for boating, 92 indicated their age. Ages ranged from 14 to 76, with a mean of 45. 67% of respondents that indicated their gender was male, and 33% female.

The geographic spread of respondents for boating is shown below in Figure 5, with the most respondents from Pembroke, and the least from Hamilton.

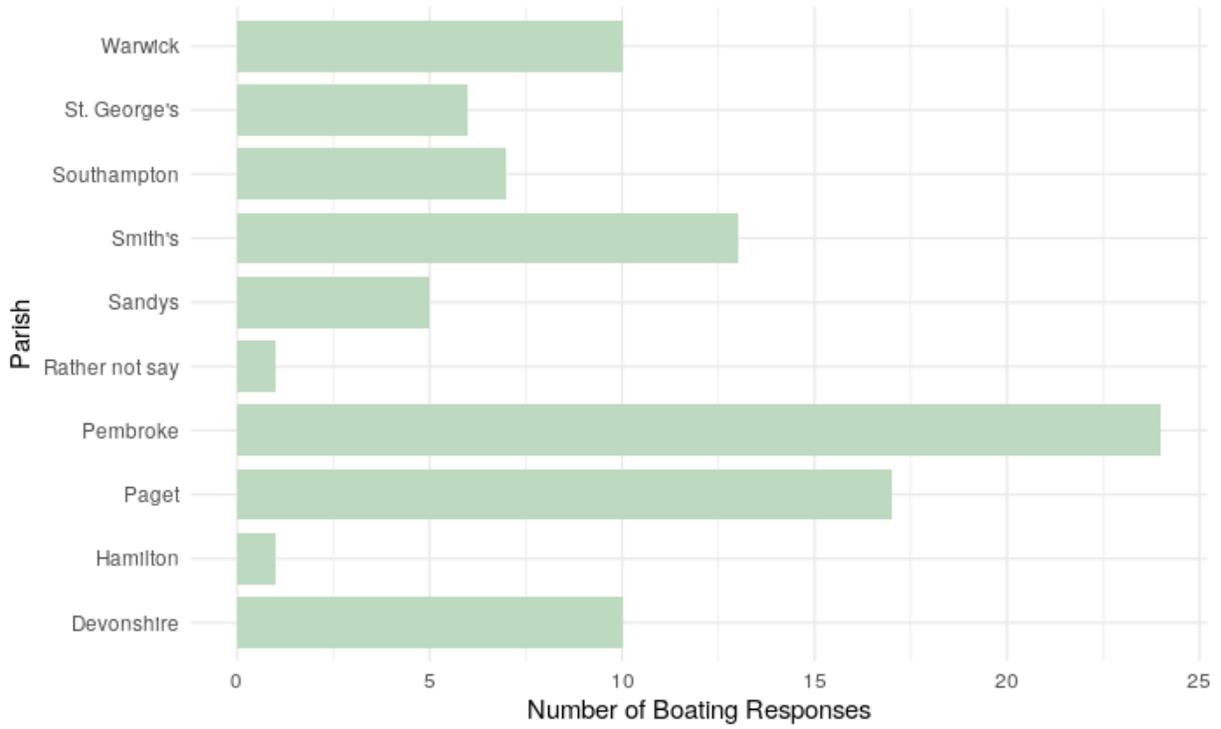


Figure 5: Number of respondents for boating responses from each parish.

Swimming, Snorkeling and Diving

Of the individual respondents that drew shapes valued for swimming, snorkeling or diving, 111 indicated their age. Ages ranged from 15 to 76, with a mean of 40. 48% of respondents that indicated their gender was male, and 52% female.

The geographic spread of respondents for swimming, snorkeling, and diving is shown below in Figure 6, with the most respondents from Pembroke, and the least from Sandy's.

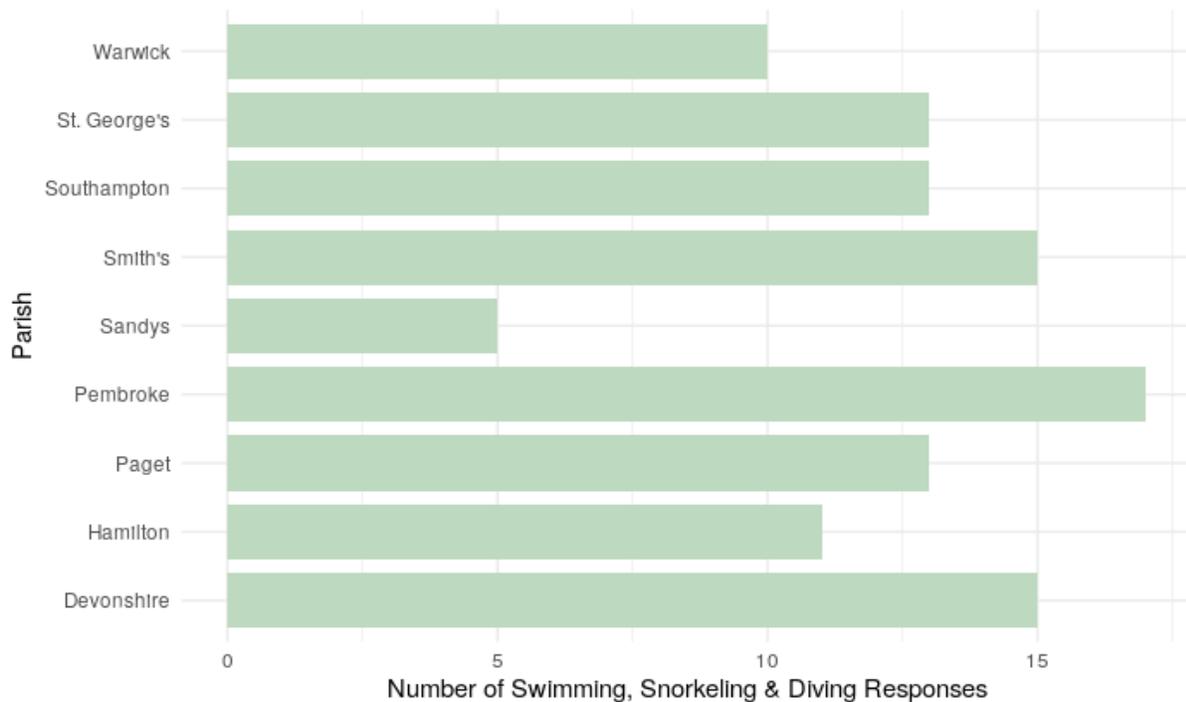


Figure 6: Number of respondents for swimming, snorkeling and diving responses from each parish.

Passive Recreation and Conservation

Of the individual respondents that drew shapes values for passive recreation and conservation, 47 indicated their age. Ages ranged from 14 to 79, with a mean of 42. 50% of respondents that indicated their gender was male, and 50% female.

The geographic spread of respondents for passive recreation and conservation is shown below in Figure 7, with the most respondents from St. George's and the least from Sandy's.

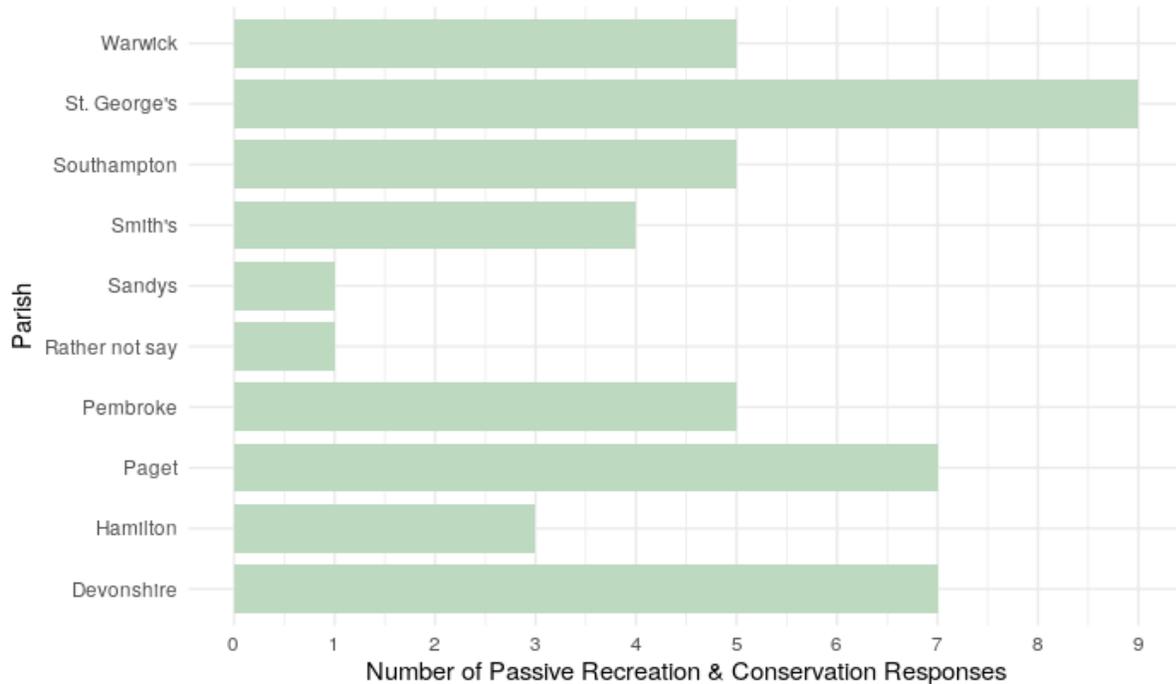


Figure 7: Number of respondents for passive recreation & conservation responses from each parish.

Other responses

Respondents also had the option to indicate areas valued that were outside the seven ocean use groups by choosing "Other". Respondents drew 103 shapes in this category. Based on the comments submitted with these additional shapes, the SeaSketch team has categorized the types of "Other" responses collected into the following groups:

Bequest value:

These responses included places that respondents had high aesthetic value or were personally significant or important to them and their families. This group also included responses indicating areas that were intrinsically valuable habitats or ecosystems for wildlife.

Transportation and Development:

These responses indicated places that are valuable to respondents for commuting, accessing homes, or built environments.

In need of additional protection:

These include places people felt were overused or degraded, such as areas where trash buildup or heavy fishing has been observed.

Surfing, boating, diving:

There were a number of responses in the Other category that indicated areas for specific sporting activities, mainly: surfing, specific boating types, or areas important for dive training.

Science and Education:

These areas indicated places respondents felt were important for research, education, or ecological recovery of specific species.

Fishing: Places where respondents indicated they liked to go fishing.

This categorization was somewhat subjective based on the interpretation of the analyst. Therefore, the number of responses for each group are summarized below, rather than aggregated into heatmaps.

Table 6: Types of responses collected in the “Other” category

Use Category	Number of Responses
Bequest Value	43
Transportation and Development	3
In need of additional protection	8
Surfing, boating, diving	28
Science and Education	8
Fishing	4

APPENDIX 1:

Ocean Use Survey Methodology

Outreach for the Ocean Use Survey started in September 2020 and the survey closed on February 15, 2021. Over 1,400 survey responses were collected, almost four times the minimum required for robust statistical analysis for the population size of Bermuda. Seven marine sectors were identified that encompass the various ocean uses affected by or involved in marine resource management. These include:

1. Commercial Fishing
2. Recreational Fishing
3. Aquaculture
4. Passive Recreation and Conservation
5. Swimming, Snorkeling, and Diving
6. Tourism, Boating and Sports
7. Utilities, Infrastructure and Development

Respondents could choose to provide information relating to more than one sector and additionally could include answers under an “Other” category if they wished to specify valued areas for an activity not covered by the above sector groupings.

Sampling

The survey was open to all Bermudan residents and outreach started in September 2020. BOPP hosted a webinar that included a call for public participation from Minister for Home Affairs, Mr. Walter Roban, JP, MP. BOPP also recruited a team of public outreach volunteers to help with survey collection. At least six newspaper adverts and over 30 radio adverts were released, along with social media advertising and information dissemination through Government channels. Nearly 1000 fliers were distributed and two 3-hour pop-up events were held in public areas. Several organizations distributed the survey to their mailing lists and all Ocean Village stakeholder groups were encouraged to engage. In-person facilitation, outreach phone calls, and paper surveys were offered to over 200 individuals who preferred a non-digital survey platform. Four local Bermudians were assigned the task of reaching out to the fishing sector. At least one outreach attempt was made to 123 licensed commercial fishing vessel owners (~70% of the industry) over a 6-week period. This includes 95% of all full-time fishers and 55% of all part-time fishers. In addition, a notification about the survey was included in the Department of Environment and Natural Resources Fisheries Newsletter, which was sent to all registered fishers. Out of those contacted, 35% of full-time fishers and 30% of part-time fishers went on to complete a survey.

Surveys were accessible on SeaSketch (bermuda.seasketch.org) through a desktop computer, or accessible on Maptionnaire (<https://new.maptionnaire.com/q/2sjf4njx9gz9>) from a mobile device. Both individual and group responses were accepted. Responses were continuously reviewed by the UCSB team and BOPP Administration to ensure validity and accuracy.

Survey Design

If accessing the survey through SeaSketch, respondents were able to display various different data layers on a map of Bermuda to help guide their responses. Respondents could then draw points or shapes indicating locations they felt were important for the ocean sector they represented. To capture the value of a particular area, respondents were asked to distribute 100 points among the various shapes drawn for a given sector or ocean use, assigning more points to the places they valued most.

If accessing the survey through Maptionnaire on a mobile device, respondents were also able to draw points or shapes to indicate important areas. They could then assign up to 100 points per area to indicate value. To ensure that the Maptionnaire responses were equivalent to the responses from SeaSketch in the analysis, the value of each shape drawn by a respondent was divided by the total number of points that person used for a particular sector or ocean use, therefore capping the total points a respondent could use for a given sector at 100.

Map creation

A weighted method was used to create the maps summarizing the responses for each sector or ocean use. The values respondents assigned to each mapped shape are divided by the area of the shape in km²– this weighs small areas that have a high value more than large areas and highlights “hotspots”. The responses are then summed by pixel to find the total value of a given area. This results in gridded heatmaps where higher values indicate places of higher importance. The weighted method can be summarized with the equation:

$$V_p = \sum_{i=1}^n \frac{VS_i}{AS_i}$$

Where V_p is the pixel value, VS is the value assigned to the shape drawn and AS is the area of shape in km².

Group Responses

Table 1 summarizes totals for each sector or ocean use, and whether or not the response was collected on SeaSketch or Maptionnaire.

Table 1: Total responses collected by sector and platform used.

Sector	Target	SeaSketch	Maptionnaire	Total	Progress
Passive recreation / Conservation (General public)	80	153	22	175	219%
Commercial fishermen	40	52	17	69	173%
Tourism, Boating, and Sports	80	224	43	267	334%
Aquaculture	5	8	3	11	220%
Swimming, Snorkeling, Diving	80	561	79	640	800%
Recreational Fishers	80	131	26	157	196%
Utilities, Infrastructure, and Development	17	63	11	74	435%
Other		95	0	95	
Total	382	1,287	201	1,488	390%

As some respondents were submitting on behalf of larger groups, the total number of individuals that interacted with each platform was also calculated (i.e., one submission reflects one interaction). Table 2 summarizes the total number of individual interactions with each platform:

Table 2: Number of unique interactions with each survey platform

Sector	SeaSketch	Maptionnaire	Total
Passive recreation / Conservation (General public)	62	22	84
Commercial fishermen	41	17	58
Tourism, Boating, and Sports	89	43	132
Aquaculture	3	3	6
Swimming, Snorkeling, Diving	125	79	204
Recreational Fishers	55	26	81
Utilities, Infrastructure, and Development	11	8	19
Other	21	0	21
Total	407	198	605

If using SeaSketch, respondents were able to submit one response on behalf of a larger group. The total number of people represented in the response was recorded. To ensure that the group responses were accurate, project facilitators followed up directly with responses that represented more than 20 people, or group responses that on their own represented more than 20% of a sectors' total responses. Overall, there were 147 responses collected that represented more than one person, with the majority representing a group smaller than 5 people. Table 3 summarizes the number and size of group responses submitted:

Table 3: Summary of group response sizes.

Group size	Number of Responses
50 - 100	5
21 - 50	2
11 - 21	6
5 - 10	29
0 - 5	105

APPENDIX 2
BOPP Ocean Use Survey Results
Map Packet



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Using and Understanding the Map Packet

SUMMARY: This packet contains a collection of heatmaps produced using the Bermuda Ocean Use Survey (OUS) responses, conducted by the Bermuda Ocean Prosperity Programme (BOPP) in 2019 - 2020. Heatmaps are a representation of data (in this case, data presented as a series of maps) where values are represented as colors: “hot” or High Values are on the red end of the scale, while “cold” or Low Values are on the blue end of the color scale. All heatmaps in this packet are sector based calculations of Use and Value produced directly from OUS responses. Readers should be able to use these maps to learn how specific sectors of ocean stakeholders use and value ocean space in Bermuda.

SURVEY PLATFORMS AND RESPONSE TYPE: Two online platforms were used to collect OUS responses: SeaSketch and Maptionnaire. Respondents could submit responses individually or as a group. Responses could also be given a spatial weight or not. After review by the BOPP Ocean Village, the weighted maps were deemed to have a more accurate reflection of stakeholder ocean use. As such, we have included weighted maps based on the above parameters in this report. A more detailed description of the types of heatmaps can be found below:

RESPONSE WEIGHTING: To calculate the cumulative value from the survey response areas submitted, the value assigned to a shape was divided by its area in km², and then summed with other responses in the same sector for the total value per pixel. High value areas (red) therefore reflect areas chosen by many respondents as well as areas that respondents value particularly highly.

MAP NOTES: Some maps had slightly different response options or results than others, specified below:

- **Shipping:** There was only one shipping response on Maptionnaire, while the rest were on SeaSketch.
- **Utilities:** There were no group responses.
- **Swimming, Snorkeling and Diving:** Respondents used both points and polygons to indicate important areas for swimming, snorkeling, and diving and the polygons were only collected on Maptionnaire. The final map combines both data types.
- **Tourism:** There was only one group response for Tourism.
- **Map Frame of Reference:** Maps are not all based on the same frame of reference. We used different frames of reference to provide focus on areas with the greatest amount of detail which can get lost at large map scales.

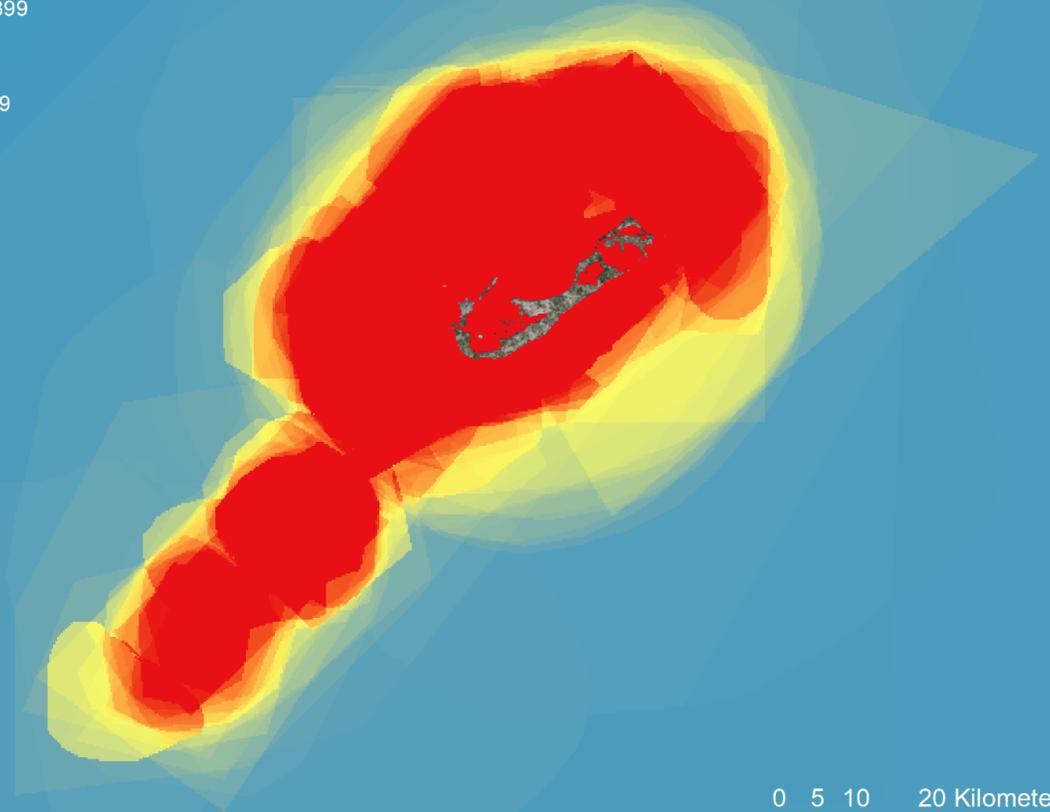
SHAPES AND POINTS INCLUDED IN EACH MAP: The table below summarizes how many areas were submitted on each platform and as individual responses or group responses. The heatmaps in this packet were created using all responses. Keep in mind that some of these

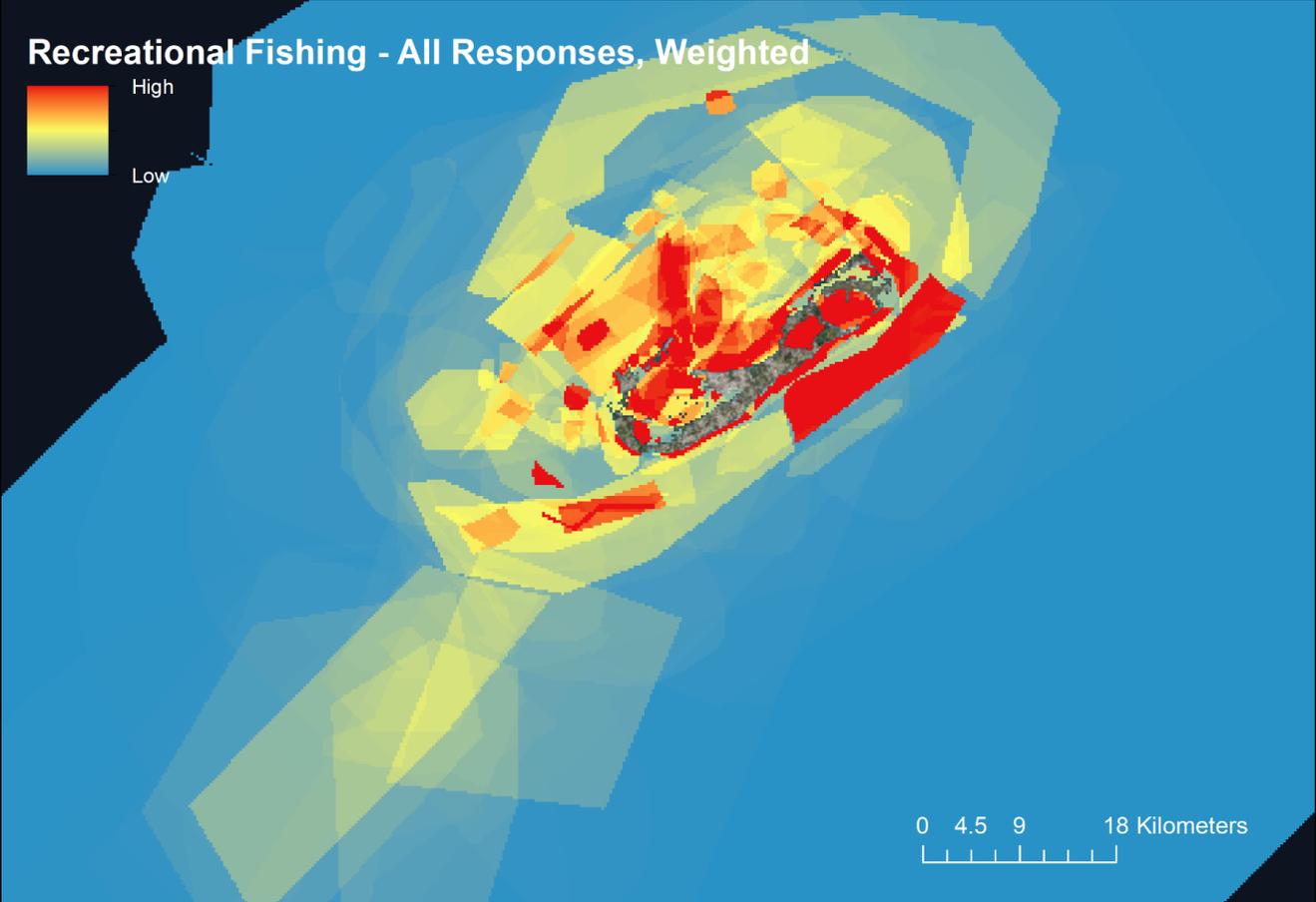
areas represent the opinion of more than one person (the group responses), so the number of areas does not equal the number of people responding.

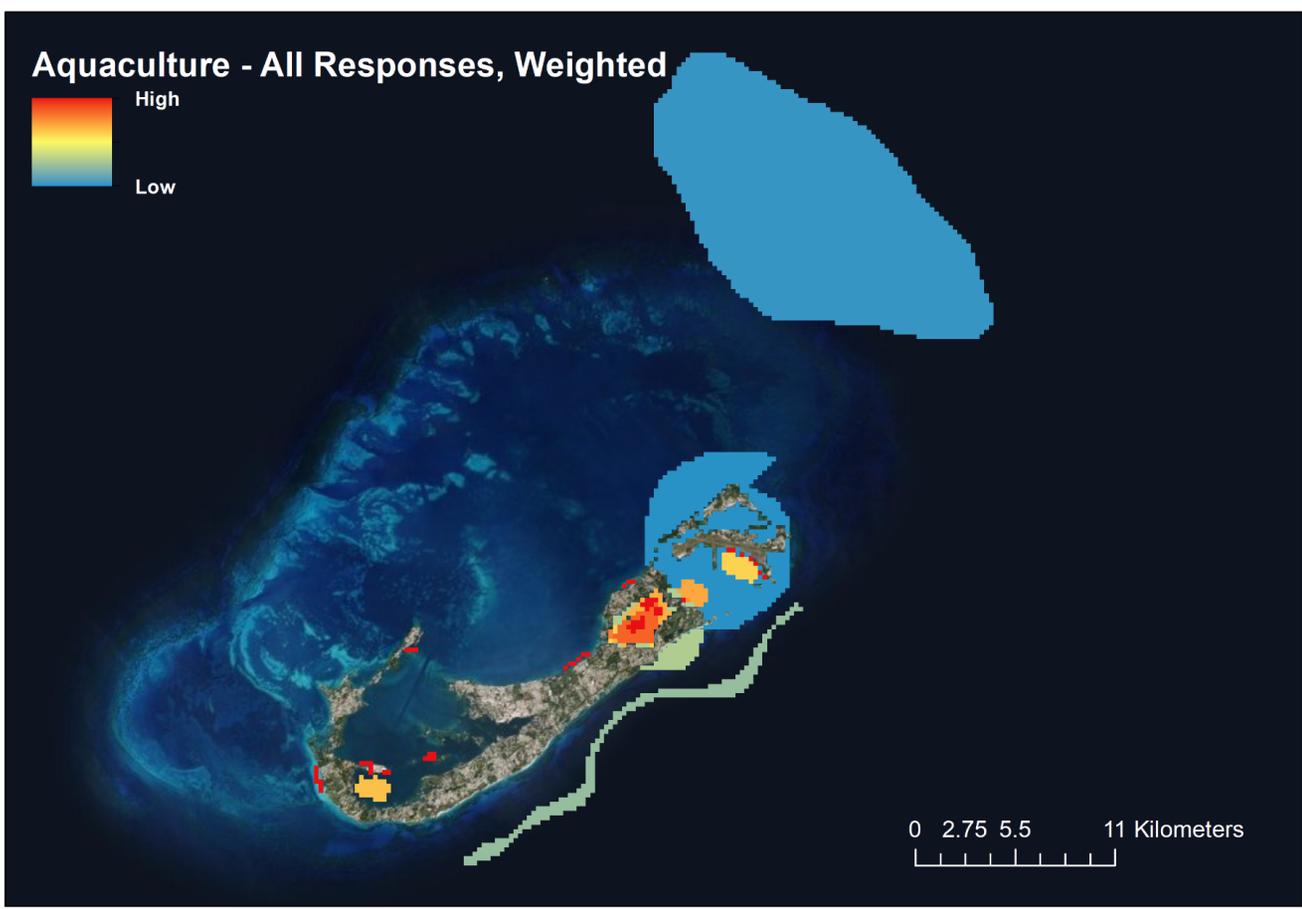
Sector	All Responses	Individual	Group	SeaSketch	Maptionnaire
Commercial Fishing	196	182	14	148	48
Recreational Fishing	232	180	52	152	80
Aquaculture	43	27	16	19	24
Utilities and Infrastructure	118	118	0	20	98
Shipping	25	15	10	-	-
Tourism	49	47	1	38	10
Boating	397	278	46	235	162
Swimming, Snorkeling, Diving	837	617	220	610*	227*
Passive Recreation and Conservation	216	148	68	160	56

*These are the number of points-only or polygon-only responses, rather than SeaSketch or Maptionnaire only responses

Commercial Fishing - All Responses, Weighted







Utilities - All Responses, Weighted

