7.3. Performing the Analysis

7.3.1. Overview of MAREA

MAREA stands for MArine Reserve Evaluation App. It is a web-based application developed to automate the analyses described in section 7.1. It is free and all you need is internet access, the link to the webpage, and the necessary data following the formatting guidelines mentioned in section 6. The run-time for the analysis automated by MAREA varies depending on the data. The general scorecard will be generated in about 4 seconds, while generating and downloading the report might take up to 20 seconds.

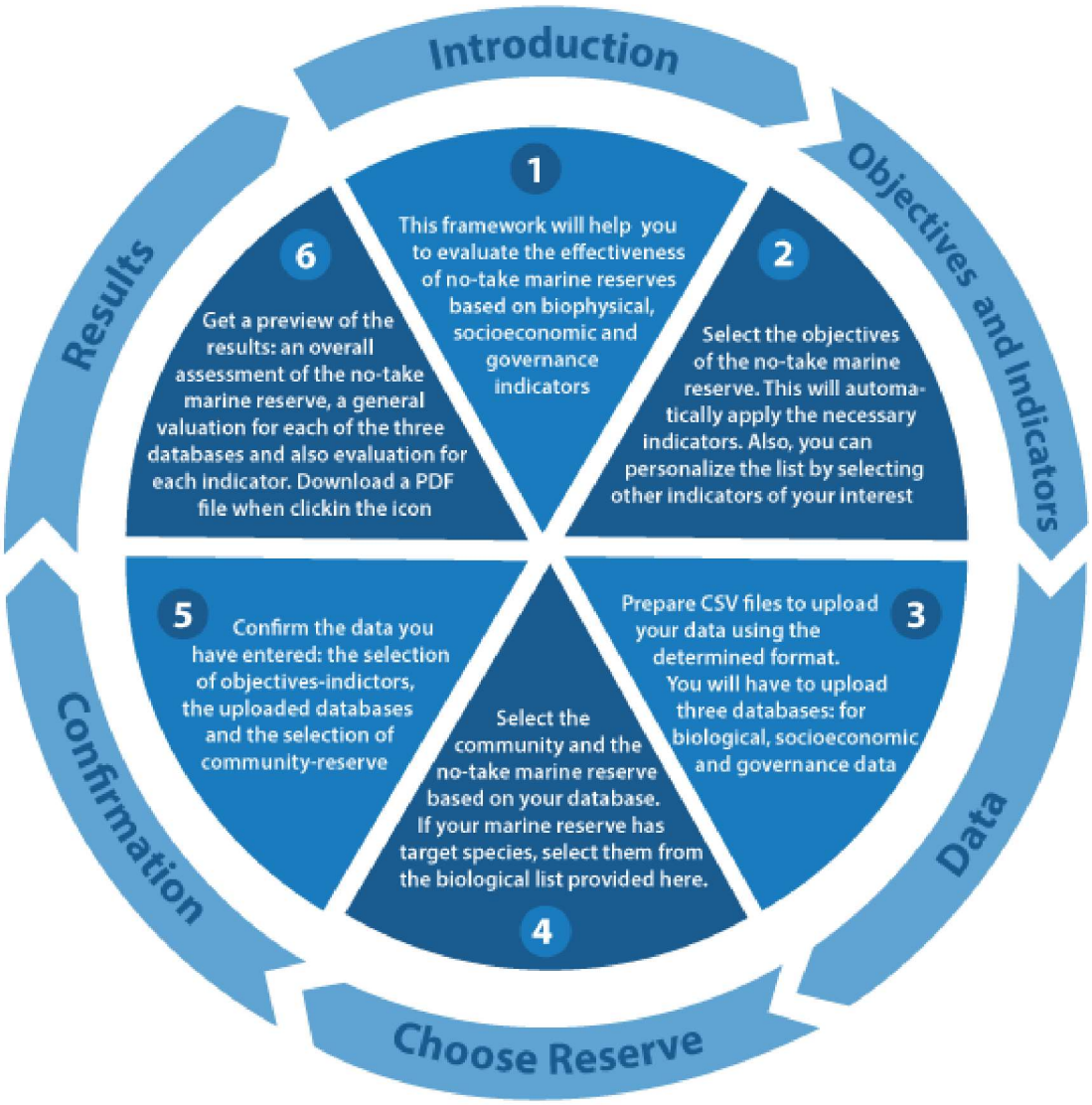

Figure 7.1- Workflow of MAREA, explaining what happens on each of the 6 tabs.

7.3.2. How to Use MAREA

The app is currently hosted at http://turfeffect.shinyapps.io/marea, and can also be found in http://www.turfeffect.org/apps.html

7.3.2.1. Introduction Tab

The first tab will welcome you to MAREA, and will show the overview of the app. On the left side, we have placed a set of links with resources. To access the sidebar, click on the three horizontal bars to the left of MAREA's logo. You will find useful links to some of our resources, a widget to translate into any language (using google translate), and a button to bookmark the current state of the app.

MAREA has six tabs, which we will describe soon. You can always switch back and forth across tabs by directly clicking on them or using the Previous and Next buttons. Nevertheless, some tabs will be empty if you have not completed previous tabs (*i.e.* the Results tab will be empty if you have not entered any data).

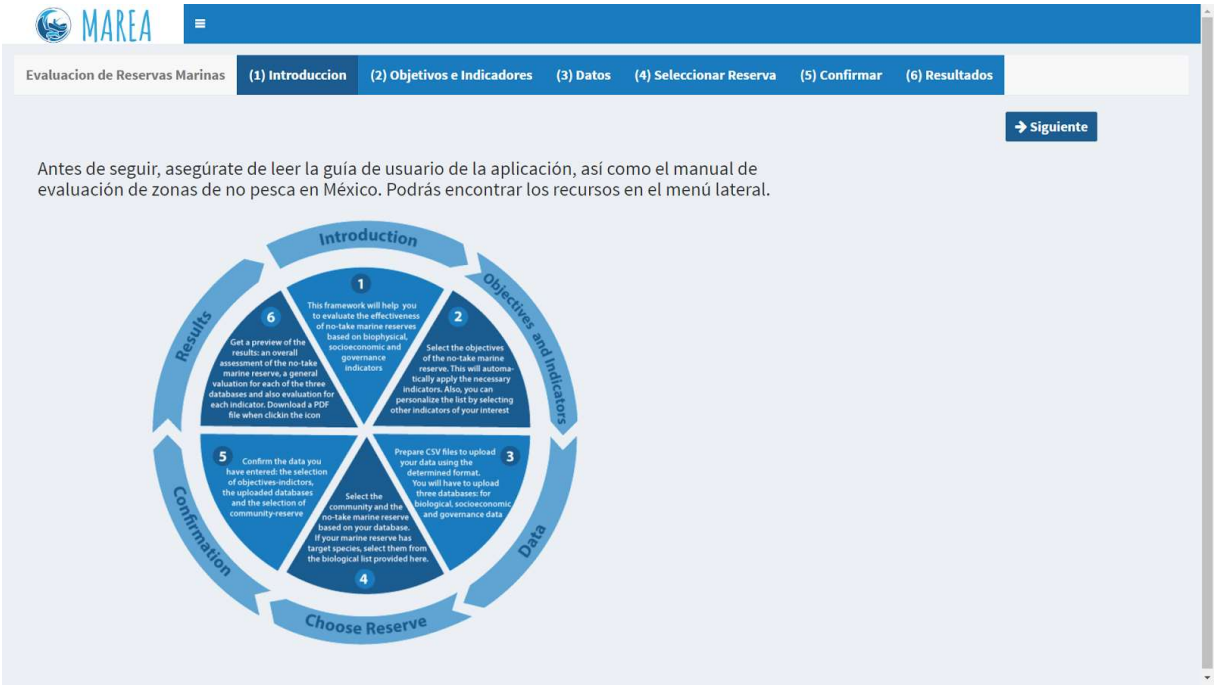

Figure 7.2- First tab of MAREA. It introduces you to the app and provides a sidebar with resources.

7.3.2.2. Objectives and Indicators Tab

The second tab will show you two panels. The one on the left contains the objectives of your reserve, defined in our seven main categories. On the right, you can see the indicators, separated by category. Based on the objectives you select on the left, indicators will be automatically selected for you. However, you can add or remove indicators as you wish. For the indicators that make reference to objective species (e.g. Objective species biomass), MAREA will allow you to select up to eight species in the fourth tab.

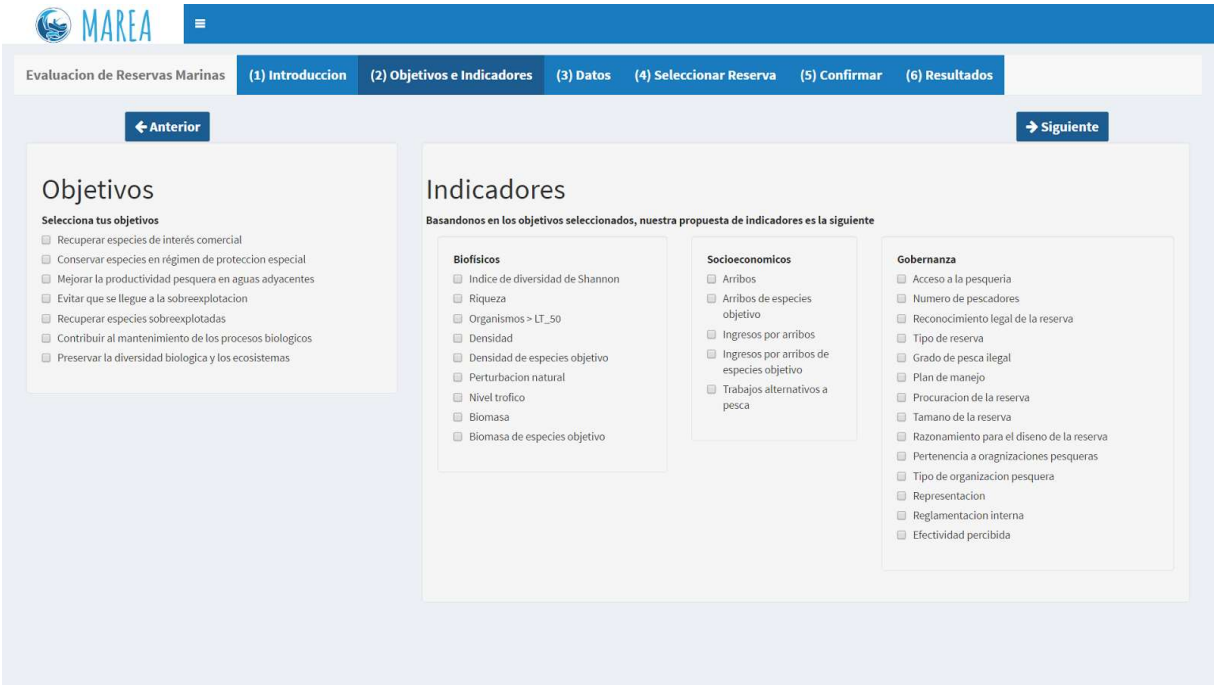

Figure 7.3- Second tab of MAREA. Provides a list of reserve objectives and indicators.

7.3.2.3. Data Tab

After selecting your objectives and indicators, you will move on to the third tab where you will upload your data. On the left side, you will see four buttons that say “browse.” Clicking them will create a window that you can use to browse for the folder where you keep your nicely formatted databases. The first slot is intended for fish data, the second for invertebrate data, then socioeconomic and lastly governance data. If you are not sure if your data is in the correct format, you can download sample datasets provided under “Examples.” The datasets are saved as comma-separated value text files, and have a *.csv extension. You can directly export an excel file as csv by looking at the “Save as” options.

To the right, you will see a set of four tabs that say “Fish,” “Invertebrates,” “Socioeconomic,” and “Governance.” Once you upload a dataset, these tabs will show previews of your data. You can upload or change a dataset at any time by re-clicking the “browse” button for the dataset you want to replace. You do not need to start all over again.

Loading time of each dataset will depend on its size, but you can see a progress bar for each dataset. Be patient; as long as the screen doesn’t turn opaque and a message that says “disconnected from server” appears, MAREA is still responding and loading your data. MAREA allows you to load data of up to 200 Mb, which is often more than enough. You can upload a dataset while one is being loaded. In this example, the user has already uploaded the fish dataset, and has started browsing for the invertebrate data.

While we encourage you to use all four datasets, MAREA will work as long as you supply at least the fish database. However, the analysis will only be performed on that dataset and some indicators will be ignored.

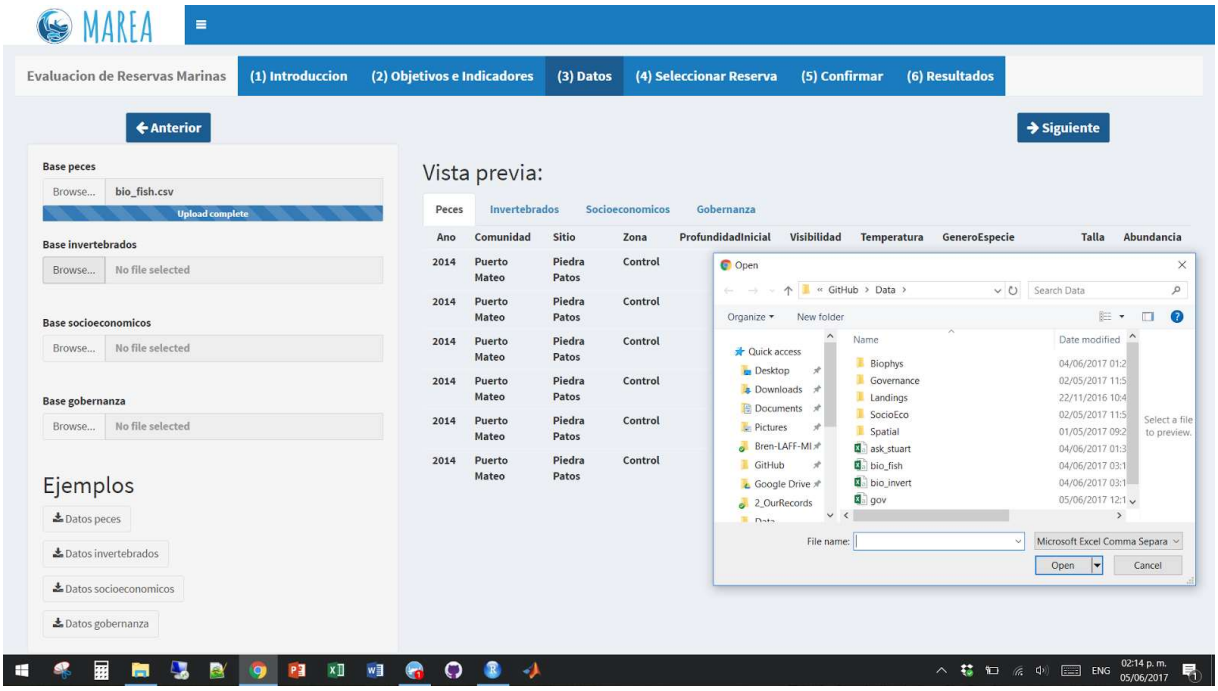

Figure 7.4- Third tab of MAREA. You can upload your four datasets using the panel to the left. Previews of your data will appear to the right.

7.3.2.4. Select Reserve Tab

You have now uploaded your data to MAREA! At this point, your data already lives inside MAREA, and you can go back and forth across tabs any time you want. This means you can change anything you want without having to repeat the upload process. Now it is time for you to select which community and reserve you want to analyze, which can be chosen in the fourth tab. If your indicators require objective species, this is the place to select them.

This tab works based on the data you have uploaded. Here, the dataset loaded contains information of three communities, "Puerto Mateo", "San Bartolo", and "Punta Rompiente". MAREA identifies the reserve-control pairs available for each community. It will also identify, for each reserve-control pair, the species that have been observed before and after the implementation of the reserve for both sites.

In this case, the user has selected "Puerto Mateo", which has two reserves, "Gran Reserva" and "Punta Arenas", and two control sites "Piedra Patos" and "Punta Focas", respectively. Within "Gran Reserva - Piedra Patos", we see the available species to the right. You can select up to eight objective species.

You must also specify the year of implementation of the reserve, which will tell MAREA how to manage the data to create the "Post" variable (see Section 7.1).

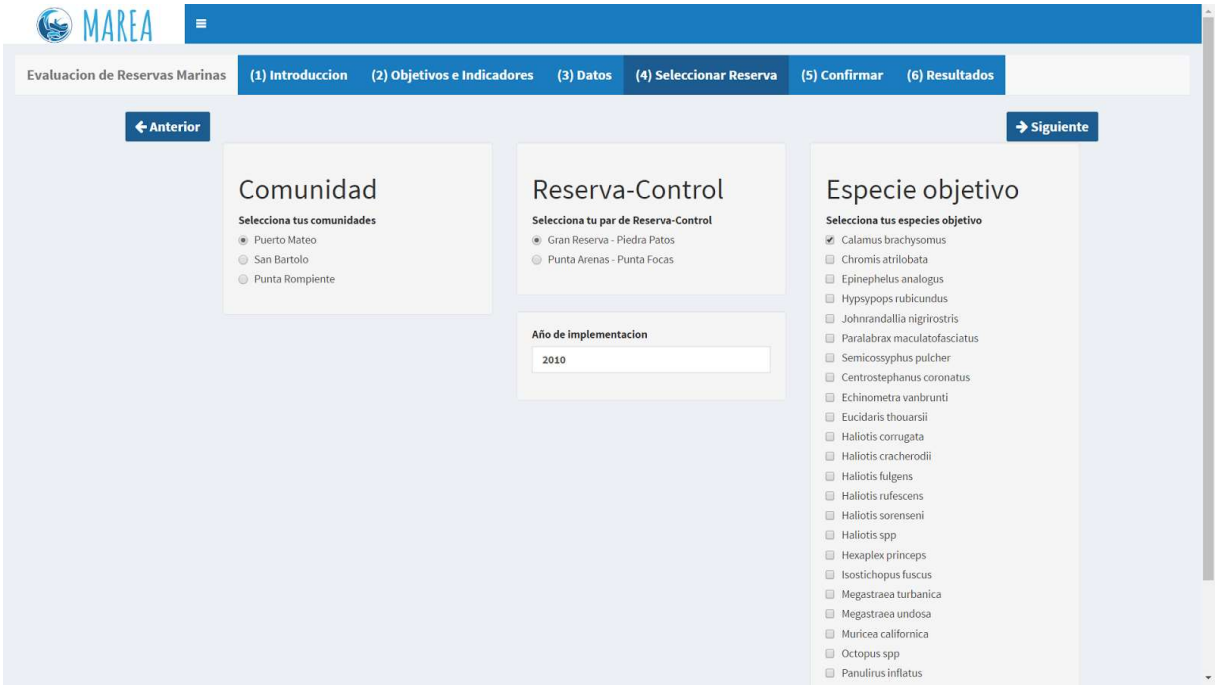

Figure 7.5- Fourth tab of MAREA. Based on the databases provided, the app generates lists of Communities, Reserve-Control Pairs and Objective Species (if required). You can select the appropriate boxes to specify which reserve and species to evaluate, and specify a year of implementation.

7.3.2.5. Confirmation Tab

You now get to the confirmation tab, where all the choices made in the previous tabs are summarized for your convenience. After reviewing this information and confirming that this is what you want MAREA to calculate, click on the sixth tab to view your results!

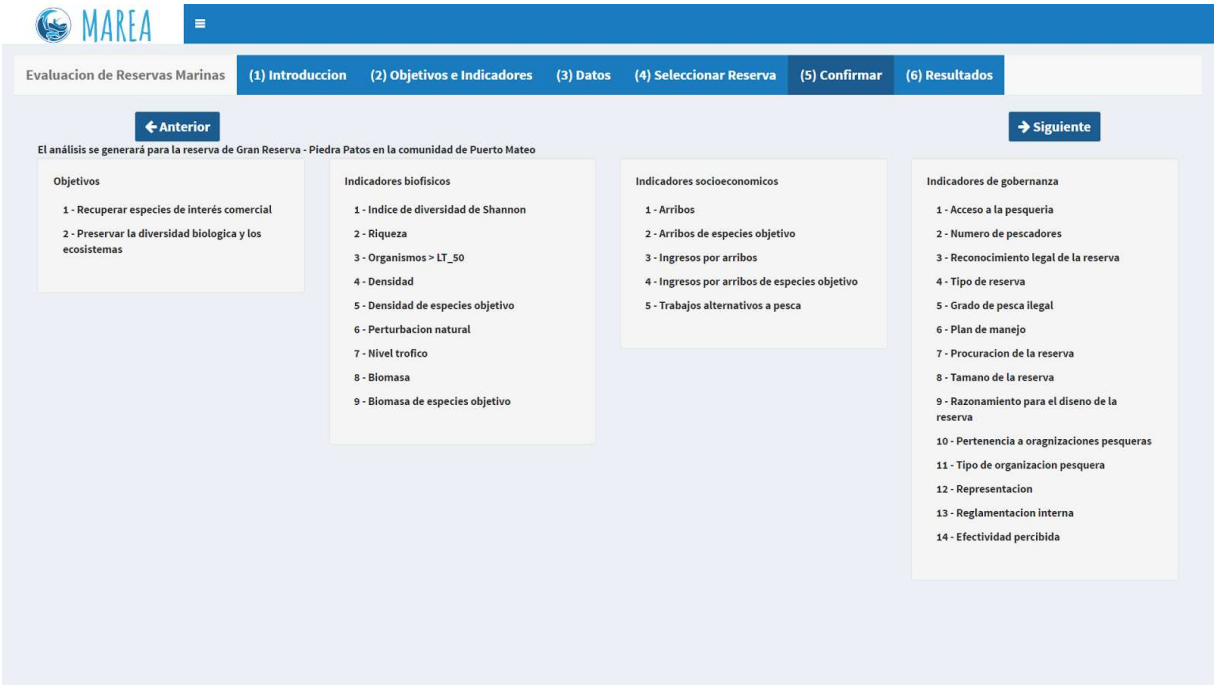

Figure 7.6- Fifth tab of MAREA. The tab displays all of your selections from the previous tabs to confirm objectives and indicators. The first line of text explicitly includes the reserve - control pairs and the community of interest.

6.3.2.6. Results Tab

You can now view your results! It will take about three seconds for things to appear here. Be patient, MAREA is performing all the analysis at once and bringing them to you. Once the results are ready, the dashboard will populate with colored boxes. This dashboard summarizes all your indicators in one place.

Let's walk through this together. In the center, you will see aline of text that states the reserve and community for which the analysis was generated. Below that, you will see a legend with five colors, which indicate the state of each of the DiD estimates (described in section 7.1). In section 8, we cover in depth what this colors mean, but the overall message is that green is better than red.

First you will only see four sections, labeled "Global," "Biophysical," "Socioeconomic," and "Governance." Inside each section, a box labeled "General" will tell you the percentage of indicators that were positive for each category, or overall for your reserve ("Global" score). In this case, the socioeconomic and governance datasets were not uploaded, so MAREA has excluded them from the analysis. If you wish to see more information about each category of indicators, click on the "More/Less" button under each general tab. This will show you one colored box for each of the selected indicators.

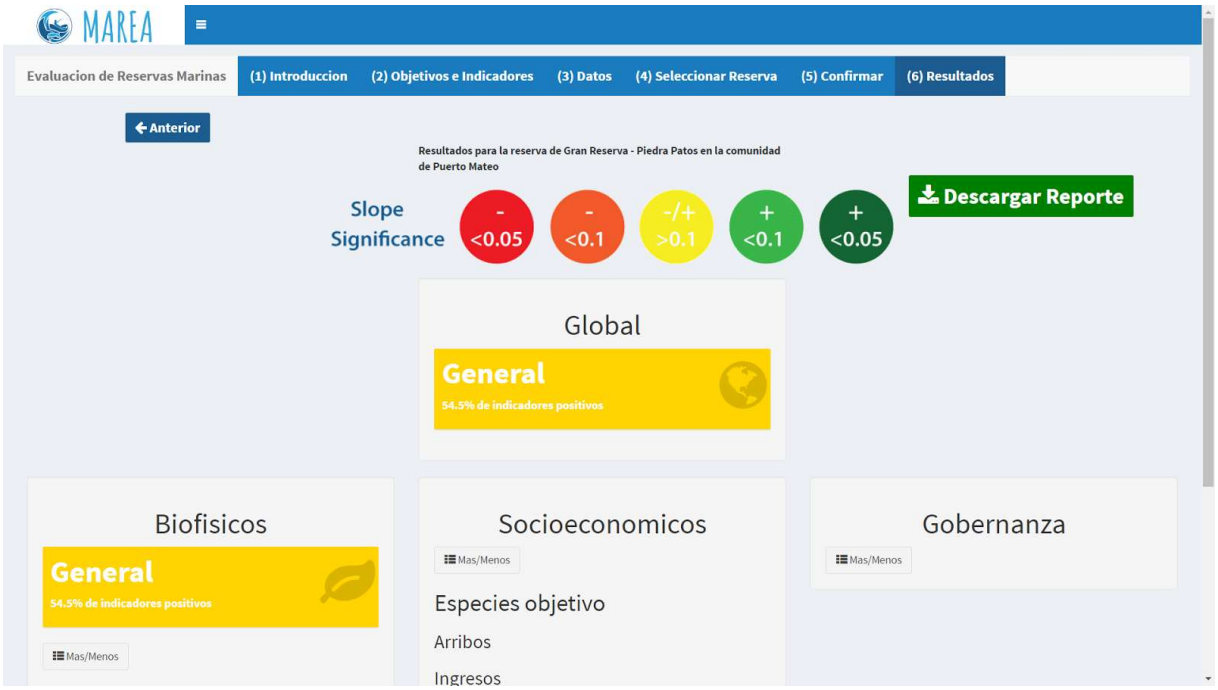

Figure 7.7- Dashboard with results from the evaluation. You will see the results displayed as a scorecard.

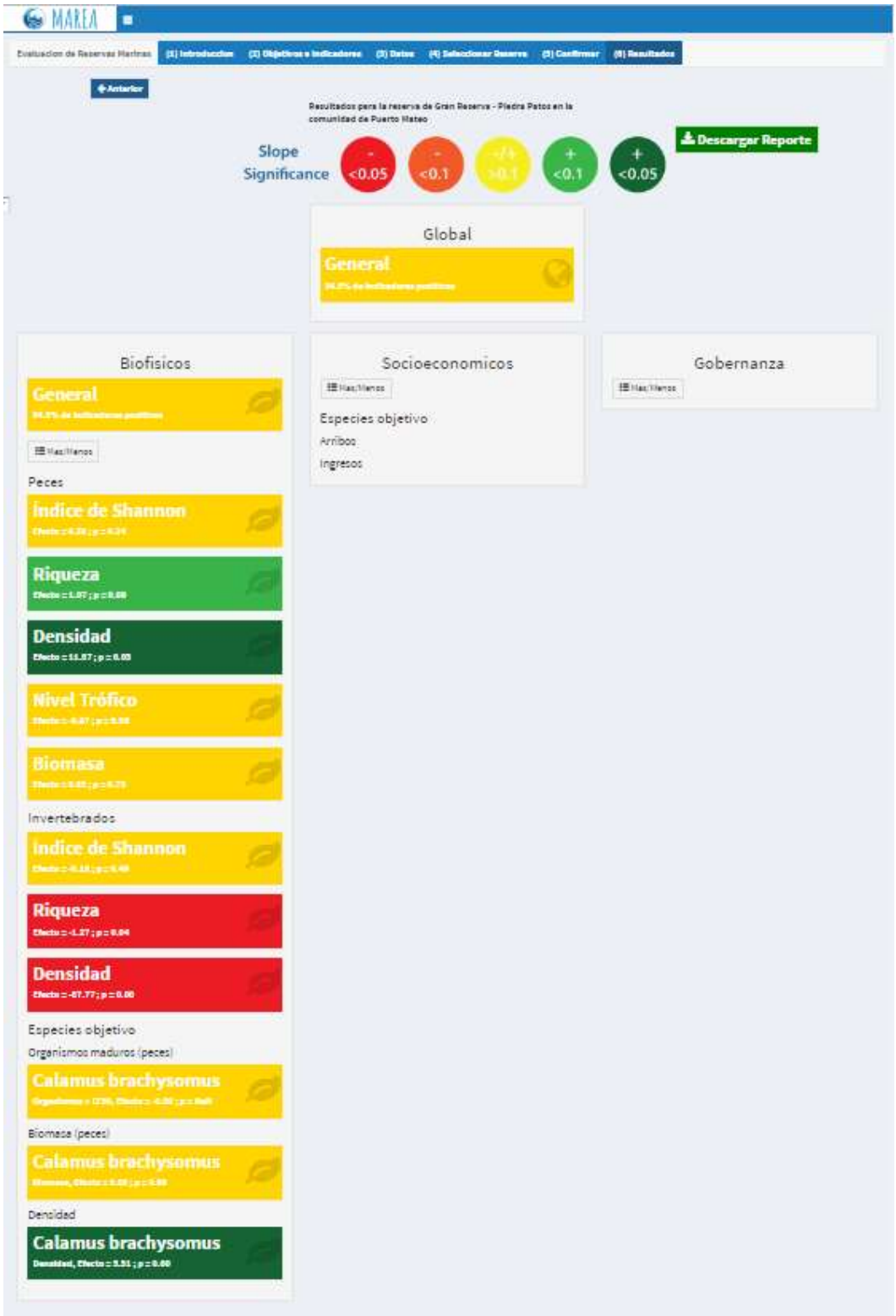

Figure 7.8- Dashboard with results from the evaluation, displaying all biophysical indicators on the screen.

If you are interested in a more detailed and technical description of your indicators, you can download a report (in *.pdf format). You can do this by clicking the green button in the upper right corner. This will automatically generate a report including graphs and tables of all the selected indicators. Since a document is being generated, this operation can take up to a minute.. A progress bar will be shown in the lower right corner of MAREA. When the document has been generated, a window will open, or a file will begin to download (based on your browser preferences). Section 8 will provide you with more information on how to interpret the results in the scorecard and the report.

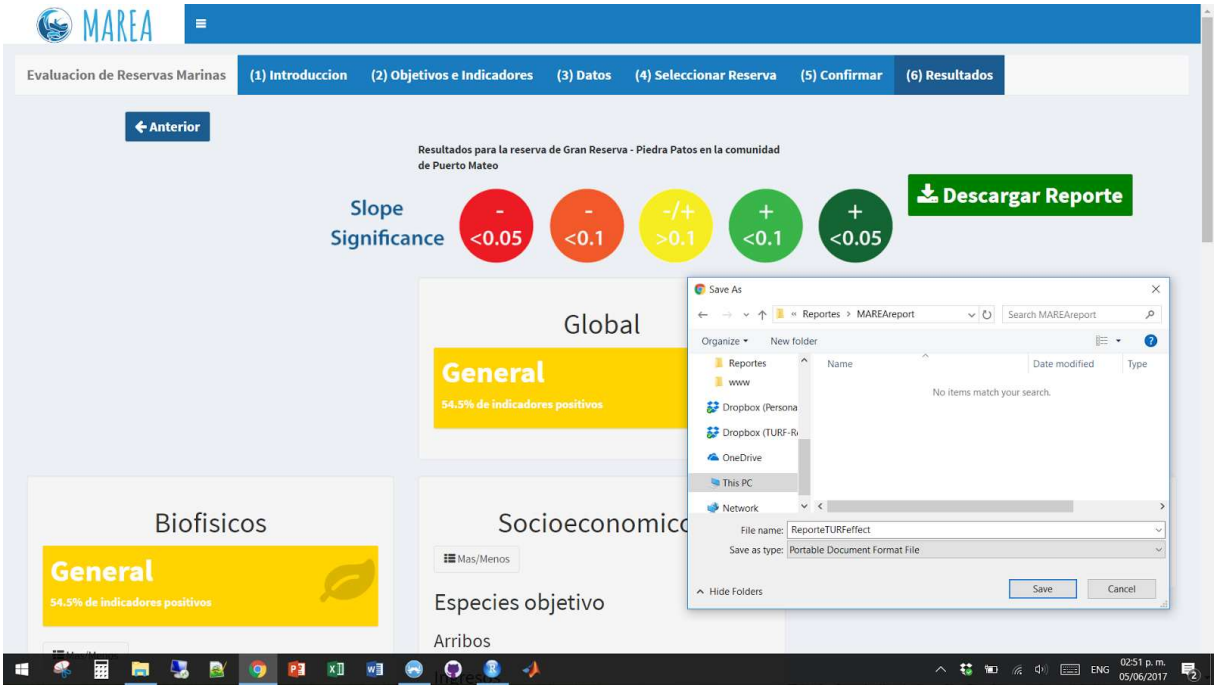

Figure 7.9- The user has reviewed the scorecard, and has clicked the "Download Report" button.

8. Interpretation of results

8.1. Numeric indicators

8.1.1. Biophysical

After MAREA performs the analyses described in section 7.1, a scorecard will be displayed. This will show a Global score box that indicates the overall score for your reserve, an overall score box for each of the three types of indicators (biophysical, socioeconomic, governance), and one score box for each indicator you selected. The color of general boxes will be assigned based on the percentage of positive indicators, using 20% intervals. For each indicator box, the color will be assigned based on the DiD estimate (see section 7.1). A yellow color will indicate that no change was observed, while green and red colors indicate positive and negative changes, respectively.

Thanks to the way in which MAREA performs the analysis, we can not only obtain a positive or negative value of our DiD estimate, but also a p-value associated with it. A p-value is a number that ranges from 0 to 1 that is used to make conclusions based on our data. Generally, with p-values smaller than 0.05, we can conclude that our DiD estimate is a representation of the actual changes in the environment, and was not caused by sampling biases or bad measurements. We incorporate this measure of "certainty" into the color scheme by having two tones of green and red. Darker tones of this colors will let you know that the p-value associated to your DiD is more statistically significant than those with lighter tones. Yellow indicates no statistically significant change was observed. If your indicator is green, then the value of that indicator is significantly greater in the reserve than the control area. That indicates a success!

Figure 8.1- Legend to interpret the box colors on the scorecard generated by MAREA. Values represent the p-value associated with the DiD estimate. + and - indicate if the DiD estimate was positive or negative, respectively.

8.1.2. Socioeconomic

MAREA will automate the linear regression analysis for each socioeconomic indicator selected (landings or income from landings). Similar to analysis of biophysical data, MAREA will generate an overall score for socioeconomic indicators and an individual score for each socioeconomic indicator. Colors and p-values have the same meaning as in section 8.1.1.

8.2. Descriptive indicators

The relationship between descriptive indicators and reserve effectiveness is not causal. Even if a descriptive indicator is different than what we expect to be beneficial to the reserve, it is not certain whether it has indeed caused a decrease in reserve effectiveness. See section 11 for more information on limitations.

8.2.1. Biophysical

The natural disturbance indicator is interpreted in a manner similar to the governance indicators (section 8.3). The description associated with the natural disturbance indicator will be displayed on the results report of the MAREA. A caution warning will appear if a natural disturbance occurred, indicating that this may have decreased reserve effectiveness.

8.2.2. Socioeconomic

MAREA will display a caution warning if the level of alternative opportunities decreased after reserve implementation. A warning message will not appear if there was an increase or no change.

8.2.3. Governance

The description associated with each governance indicator will be displayed on the results report of MAREA. The description associated with each governance indicator will be displayed on the results report of the MAREA. A caution warning will appear if the governance indicator differs from what we expect to be beneficial.