**Shiny App Outline Document**

1. **App Summary**

The Environmental Defense Fund (EDF) wishes to incorporate climate change into their Framework for Integrated Stock and Habitat Evaluation (FISHE) tool to make more accurate recommendations with data-limited fisheries. This Shiny app, as a deliverable, will provide a visualization tool to stakeholders that utilize FISHE to basically communicate the main messages behind complex quantitative modeling and analysis. It will allow stakeholders to visualize which locations around the world are most vulnerable to climate change, compare trade-offs to determine whether it is a good management decision to keep a fishery open or not, and investigate how fish biomass responds over time to different variables.

1. **Data**

Originally, with the Group Project (GP), EDF did not provide any data on how FISHE was being successfully utilized in other countries. As a result, the Somefin’ FISHE GP team had to simulate all of the data that was utilized in the project with a baseline fisheries population dynamics model. Over time, the team incorporated climate change into the model by including gradual changes, range shifts, and shock events into it. Finally, it was necessary to include management strategies in the model that would accurately represent real-world FISHE management decisions. For example, a fishery manager in a data-limited situation could implement management decisions that could be represented as perfect management or bad management decisions.

**Table 1:** List of Variables in Each Phase of the Model

|  |  |  |
| --- | --- | --- |
| **Baseline Model** | **Climate Model** | **Management Model** |
| *r* (growth) | Δr (change in growth) | Fishing pressure |
| *K* (carrying capacity) | ΔK (change in carrying capacity) | Harvest control rules |
| *b0* (initial biomass) |  | Assessment intervals |
| *p* (shape biomass) |  | Sampling error |
| Time |  |  |

For the baseline model, the variables would include terms such as *r* (growth of biomass), *K* (carrying capacity), *b0* (initial biomass), *p* (shape biomass), and time. Incorporating climate change into the model results in calculating the Δ*r* (change in growth) term to calculate an *r* slope value to use in the model. Additionally, the Δ*K* (change in carrying capacity) term is used to simulate different scenarios where fisheries can start at varying levels of biomass. The management model portion includes variables such as fishing pressure, harvest control rules, assessment intervals, and sampling error.

Over 100,000 simulations were ran with the model resulting in a massive number of diverse scenarios. This data can be filtered through several variables to get scenarios with no adaptation and moderate climate change as an example. An Excel spreadsheet in csv format holds all 100,000 simulations and is in tidy format since it was used previously by the GP Team.

1. **Widgets**

**Widget** **1**: Two sliders that give the maximum and minimum values of latitudes and longitudes of locations around the world that are most vulnerable to climate change. As a user slides the latitude and longitude ranges, different pins will appear at specific locations on a world projected map. A legend will display the severity of the climate change scenario from moderate to extreme. The inputs for this widget will be latitude and longitude coordinate pairs that are retrieved from scientific literature.

**Widget 2:** A checkbox group widget will list the variables that affect the proportion of "bad outcomes" (i.e. proportion of closed/overfished fisheries) and one can choose from the options listed. Under several checkboxes, there will be a drop-down menu that can list the number of options associated with each variable (within the realm of climate severity, there are the choices of "moderate", "severe", and "extreme" climate change). Not all variables will have drop down menus as some variables only contain single choices. The inputs for this widget will include variables that can alter the data such as growth rates, error reduction, harvest control rules, assessment intervals, and climate severity.

**Widget 3**: Like Widget 2, this is a checkbox group widget that will list the variables that affect the amount of fish biomass where one can choose which option they want. Under several checkboxes, there will a drop-down menu that can list the number of options associated with each variable (within the realm of growth rates, there are slow, medium, and fast growing fish). Not all variables will have drop down menus as some variables only contain single choices. The inputs for this widget will include variables that can alter the data such as growth rates, error reduction, harvest control rules, assessment intervals, and climate severity.

1. **Outputs**

**Output 1**: A Mercator or Robinson projected world map will be displayed on the tab page and will have pins that will point to different locations on the map representing areas of climate severity depending on longitude and latitude pairs.

**Output 2**: A stacked bar graph that will show the proportion of closed/overfished fisheries on the y-axis and the changing variable (i.e. growth rates, error reduction, etc) on the x axis. Based on the choices selected in the checkbox group, the stacked bar graph will change to reflect the choices that are selected.

**Output 3:** A scatterplot graph which shows the proportion of biomass on the y axis and the changing variable (growth rates, error reduction, etc) on the x axis. Based on the choices selected in the checkbox group, the scatterplot graph will change to reflect the choices that are selected.