OCS Study
BOEM 2018-031

Environmental Sensitivity and Associated Risk to Habitats and Species Offshore Central California and Hawaii from Offshore Floating Wind Technologies

Volume 3: Offshore Floating Wind Environmental Sensitivity Analysis Model Instruction Manual

US Department of the Interior
Bureau of Ocean Energy Management
Pacific OCS Region

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Environmental Sensitivity and Associated Risk to Habitats and Species on the Pacific West Coast and Hawaii from Offshore Floating Wind Technologies

Volume 3: Offshore Floating Wind Environmental Sensitivity Analysis Model Instruction Manual

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Authors:
Alicia Morandi – RPS Ocean Science
Christopher Moelter – ICF

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by
ICF
630 K Street, Suite 400
Sacramento, CA 95814-3300

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DISCLAIMER

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REPORT AVAILABILITY

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CONTACTS

Alicia Morandi
RPS Ocean Science
55 Village Square Drive
South Kingstown, RI 02879-8248
(401) 789-6224

Christopher Moelter
ICF
615 SW Alder Street, Suite 200
Portland, OR 97205
(503) 525-6145

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Offshore Floating Wind Environmental Sensitivity Analysis (OFWESA) Model

User Interface Quick Start Guide

Contents

1 Before You Start

1.1 Logging In

Log in using your credentials (email/username and password). If you don't yet have credentials, a user with Administrator Access will need to create an account for you. There is a checkbox to save your password for the future and a "Forgot password" button that will generate a password recovery prompt requesting the account email address, to which instructions to reset the account password will be sent.

1.2 Important data management tips to know before using the GUI:

1) If you add another region or habitat with the same name as one already in the graphical user interface (GUI), it will confuse the calculations. Also, the GUI cannot handle two species with the same exact name in the same region. Therefore, ensure that any new data created is unique.

2) If you edit data that already exists to temporarily view the effect (e.g., how sensitivity scores may change), be sure to manually change the data back to its original value, as there is no record of previous versions once information is changed.

3) It is important to know that there is no "Undo" feature once something is deleted in the GUI. Results and conclusions described in Volume I of the Study Report are based on the information in the database as it was delivered in July 2018, results may no longer match between the GUI and the study report if input data are edited or deleted.

4) The SQL database contains only the input data and static lookup tables used in the model. All of the calculations are performed in the web app/GUI code, and are recalculated whenever a page is loaded (i.e., a record of results is not retained in the database). Therefore, if a user needs to retain results that could change due to new data added or edited, the results should be exported to Excel via the "Export to Excel" button on the results pages.

5) Creating a backup of the SQL database before and after any major changes or additions to the input data is recommended.

2 The Basics of GUI Navigation

2.1 Instructions and User Management

There is a **User Management** page and **Instructions** page accessible through the drop-down menu / toolbar along the top of the main page.

1) The **Instructions** page will contain a link to the full OFWESA Instruction Manual and this Quick Start Guide.

2) Only admin users can add, edit access, or delete other users on the **Data Management** page. It is not accessible to users with read-only or editing access.

a. **Note:** A BOEM admin will initially need to add all users and assign them read, write, or admin access by checking the appropriate boxes.

b. All fields on the **User Management** page are required.

The **Dashboard** of the interface shows pages organized into two main categories: **Data Management** and **Calculations**. General features of each type of page are described below.

2.2 Data Management

Data Management pages consist of grids of input data for a particular model parameter. Each row contains a unique data entry.

3) **Add New Data**: This button is accessible to users with both read and write or admin access and brings the user to a blank data input page. These pages consist of combinations of drop-down menus and text box entry fields, with instructions for what to enter.
    a. **Note:** Users should refer to the full Instruction Manual for complete information on the data preparation and input requirements for each field.
    b. **Asterisks** indicate required fields.
    c. **"Save"** and "**Cancel"** buttons exist on each add/edit page.
4) **Edit Data**: This option is accessible for all users, but only users with write or admin access will be able to save changes made. Read-only users can only view the data within the page.
    a. **Note:** The **Edit** pages function just like the **Add New Data** pages for each parameter, except with data filling each field. These pages are the best way to view what is currently contained within the database.
5) **Delete Data:** This option is only accessible to users with write or admin access. When clicked, a prompt will pop-up asking if the user is sure, and then they must click "Ok" or "Cancel".

2.3 Calculations

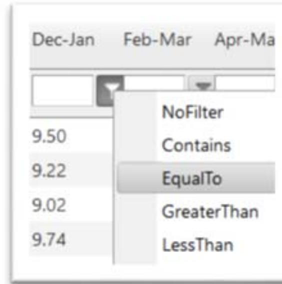
Calculations pages consist of grids of results for different model parameters.

6) **Table Filtering:** There are multiple drop-down menus that allow users to filter the results displayed (e.g., output, region, mitigated/unmitigated, etc.) at the top of each page. There is also a "Filter Help?" instructions box and a "Reset Filters" button to undo all filtering display options.
7) **Note:** Some pages retain filtering options chosen on prior pages, so it can help to hit the reset button if data appears to be missing.
8) **Column Sorting:** Each table of results consists of multiple rows of data that can be individually sorted by clicking on the column headings. Clicking once sorts in ascending order, clicking twice sorts in descending order, clicking a third time resets to default.

9) **Column Searching/Filtering**: There is a text box at the top of each column within which search terms can be typed.

    a. **Text:** Type all or part of the word you wish to search for. (Note that typing "HI" in a column that contains the Region names "Hawaii North" or "Hawaii South" will not return results because abbreviations and region names are stored as separate data and are thus not interchangeable for searching.)

    b. **Numerical:** Type all or part of the value you wish to search for, and then click on the funnel symbol to choose from "contains, equal to, less then, or greater than" the value typed for your search.



3 OFWESA Model Results

The **Calculations** pages display the results of the model. The pages are designed to successively "drill down" from final model results through various parameters and steps along the way, displaying results from multiple aspects of the study. For details on model concepts and parameter calculations, see Volumes I and II of the Study Report. For all results, higher numbers indicate greater sensitivity to potential impacts.

3.1 Final Environmental Sensitivity Results

This page contains four output types to view within one table (choose from drop-down menu): *final environmental sensitivity; interim environmental sensitivity; habitat sensitivity;* and *species sensitivity*. A brief overview of each is provided below. For additional details, see Volume I of the Study Report.

1) **Final Environmental Sensitivity** scores combine habitat and regional characteristics with the information derived from the literature review of species impact and recovery potential. These values represent the potential overall sensitivity of the study area to offshore floating wind (OFW) development, accounting for all variables evaluated in the OFWESA model. The range of hypothetical possible scores for any region is 4 – 60. Scores for a study area can be evaluated as a percent of the hypothetical maximum.

2) **Interim Environmental Sensitivity** score is calculated by adding the habitat sensitivity score to the species sensitivity score for each region and season. It represents the environmental sensitivity of a study area before modifying by the baseline conditions score. The range of possible scores is 4 – 30.

3) **Habitat Sensitivity** score is calculated by adding the water column habitat and marine bottom habitat scores together and then multiplying them by the protected area modifier. The range of possible scores is 1 – 15.

4) **Species Sensitivity** score consists of the impact-causing factor (ICF) vulnerability and recovery potential scores for all species within three species groups and incorporated seasonal large-scale event (LSE) rate scores, species presence, and the level of uncertainty for each assessment metric score. The range of possible scores is 3 – 15.

3.2 Species Sensitivity Interim Results

This page contains three output tables to view: *Impact-Causing Factor Vulnerability, Impact, and Recovery Scores*; *Species Sensitivity Scores for Individual Species*; and *Species Sensitivity Scores at the Species Group Level*.

5) **Impact-Causing Factor Vulnerability, Impact, and Recovery Scores –**The values in this table **(**columns **"AS Impact"** through **"VS Impact"**) represent the vulnerability of individual species to each ICF that is relevant to their species group, based on behaviors and life history traits assessed during literature review and the impact magnitude of each ICF (see Section 3.4 of the full Instruction Manual for methods and Appendix B of Volume II of the Study Report for scoring tables and ICF algorithms).

    a. The **"Impact Score"** column contains the sum of the ICF vulnerability score of each individual ICF shown in the eight prior columns. This represents the total vulnerability (or impact potential) for each species, accounting for relevant ICFs[1].

    b. Each of these columns has a different hypothetical maximum score, which also varies by species group. The maximum possible for each ICF vulnerability score and the summed ICF vulnerability/impact potential score can be viewed by typing search terms in the boxes at the top of three columns: "unmit" for the **Scenario** column, "mid" for the **Value** column, and "max" for the **Region** column, as shown below. The hypothetical minimum scores are all zero.

Impact-Causing Factor Vulnerability, Impact, and Recovery Scores — Export To Excel

Scenario	Value	Region	Species Group	Species Sub-Group	Common Name	AL Impact	AS Impact	CAS Impact	CSE Impact	EMF Impact	HD Impact	SN Impact	VS Impact	Impact Score	Recovery Score
unmit	mid	max													
Unmitigated	MID	General Hypothetical Max	Birds / Bats	Max	Max BB	5.50	8.10	3.80	0.00	0.00	5.00	8.90	0.00	31.30	2.50
Unmitigated	MID	General Hypothetical Max	Fish / Invertebrates	Max	Max FI	5.50	8.10	0.00	0.00	2.30	5.00	8.90	9.00	38.80	2.00
Unmitigated	MID	General Hypothetical Max	Marine Mammals / Turtles	Max	Max MT	5.50	8.10	0.00	8.50	0.00	5.00	8.90	9.00	45.00	2.50

[1] Note that these values do not measure an impact, nor do they indicate that a species will be impacted to any degree. They represent the potential for impact based on behaviors or traits that may make a species vulnerable to an impact.

c. The **“Recovery Score”** column contains the sum of all of the recovery potential assessment metric scores divided by 10. It serves as a modifier of the impact score. Possible recovery scores range from 0.4 – 2.5 depending on species group; species with a low recovery potential will end up with a high recovery score.

6) Species Sensitivity Scores for Individual Species – This table contains results for the species sensitivity of each species during each season. These scores have not yet been scaled in the model calculation steps so scores for each species group are on different scales (i.e., have different hypothetical maximum possible scores). They can be viewed as described above for the previous table (Result #5b). Maximum scores do not vary by season as it is assumed the hypothetical species is fully present in all seasons.

Species Sensitivity Scores for Individual Species

Scenario	Value	Region	Species Group	Species Sub-Group	Common Name	Dec-Jan
unmit	mid	max				
Unmitigated	MID	General Hypothetical Max	Birds / Bats	Max	Max BB	153.76
Unmitigated	MID	General Hypothetical Max	Fish / Invertebrates	Max	Max FI	152.48
Unmitigated	MID	General Hypothetical Max	Marine Mammals / Turtles	Max	Max MT	221.06

7) **Species Sensitivity Scores at the Species Group Level –** The final table on the species sensitivity interim results page contains the species-specific sensitivity scores averaged for each species group and scaled to the hypothetical maximum to allow comparisons between species groups. This value has a possible score range of 1 – 5 for each species group. These species group-level scores are summed together for the final species sensitivity score for the region as described in Result #4.

3.3 Habitat Sensitivity Interim Results

This page contains multiple output types to view: *Marine Bottom Habitat Sensitivity Scores* or *Water Column Sensitivity Scores* (depending on which output type is selected); *Proportion and Sensitivity of Marine Bottom Habitat Types;* and *Protected Marine Areas and Essential Fish Habitat.*

8) **Water Column Sensitivity Scores** are based on the mean net primary production in a region/season. These values are scaled against the maximum measured net primary productivity in each region over all seasons, to a range of 1 – 20.

9) **Marine Bottom Habitat Sensitivity Scores** are determined by the proportion of seafloor habitats that comprise a study area, the vulnerability scores of those habitats to habitat disturbance, the impact magnitude of the habitat disturbance ICF during each project phase, and the LSE score for the region/season. These scores are scaled against the hypothetical maximum score to a range of 1 – 20 for comparison with water column habitat sensitivity.

10) **Proportion and Sensitivity of Marine Bottom Habitat Types** presents the proportion of each habitat type in a study area that was used in calculating the marine bottom habitat scores.

11) **Protected Marine Areas and Essential Fish Habitat** presents the total marine area of a study region/buffer zone, the proportion that is considered protected, the number of essential fish habitat (EFH) designations in the study region, and the maximum EFH designations in the larger EEZ. The protected area modifier combines these proportions and the resulting value is scaled to a range of 1 – 2 and could effectively double the habitat sensitivity score of a region.

3.4 Large-Scale Event Results

Two tables are presented in the **Large-Scale Event Results** calculation page. These include *Interim LSE Scores for each Region, Period, Event Type, and Magnitude* and *Final LSE Scores for each Region and Period*. LSE Scores were calculated for each region and period at two magnitude levels (partial structural failure and full structural failure) for four LSE types (earthquake, hurricane, tsunami, and vessel accidents).

12) **Interim LSE Scores for each Region, Period, Event Type, and Magnitude –** The values in this table represent the frequency of occurrence of each event type and magnitude for each region/season. To convert value to recurrence times; divide 1 by each frequency value to estimate the number of years between recurrences (i.e., one event every # years). Refer to Appendix D and Appendix F in Volume II of the Study Report for the LSE input data development and background research. Refer to Section 3.1 of the full Instruction Manual for methods.

13) **Final LSE Scores for each Region and Period** displays the LSE score for each region and season, which includes the frequency of occurrence and the ICF impact magnitude for relevant ICFs during the operation phase. Scores are scaled so that the minimum is one, but they are not scaled to a particular hypothetical maximum[2]. The LSE scores are incorporated into calculations of species (Result #6) and marine bottom habitat (Result #9) sensitivity.

3.5 Baseline Conditions Score

Baseline conditions serve as a modifier to the overall environmental sensitivity of a study area based on the anthropogenic activities (e.g., oil wells, pipelines, light pollution, ocean acidification) already present in a region. The model assumes that areas with more activity would be more sensitive to development.

14) **Baseline Conditions Score –** This table contains the raw, maximum, and normalized baseline conditions (BC) scores for each region. The normalized score could effectively double the interim environmental sensitivity score of a region (Result #2) when calculating the FES score (Result #1).

[2] This means that if a new region is added to the database with greater frequencies of occurrence, the highest calculated LSE score may change, which will affect the maximum LSE score used later in some model calculations.

3.6 Baseline Metrics

In order to combine disparate data types and units representing anthropogenic activities within a study region, each individual baseline condition dataset is first normalized based on its data type.

15) Baseline Metrics – This table displays the various spatial datasets of anthropogenic activity (i.e., baseline metrics) that were summarized to calculate the score. Each baseline metric is scaled against its respective maximum to a range of 0 – 1. These scaled scores are summed for the raw BC score discussed in Result #14. Spatial data preparation for baseline metrics and methods for processing into scores are described in Section 3.3.2 of the full Instruction Manual, with background information is in Appendix D and algorithms in Appendix C of Volume II of the Study Report.

4 Step-by-Step Use Examples

4.1 Exporting Results for Analysis

1) Choose a **Calculations** page of interest and sort/filter results as desired using methods described in Section 2: The Basics of GUI Navigation in this Quick Start Guide.
2) Click the "**Export to Excel**" button at the upper right corner of the results table. This will generate a Microsoft Excel file (.xlsx) with the same rows of filtered/sorted data and column titles as shown in the GUI.
3) Follow directions in Section 5 of the full Instruction Manual to compare results to the hypothetical maximum scores for the model parameters under review, and to rank and color-code results.

4.2 Interpreting Impact-Causing Factor Scores

1) Vulnerability scores for each ICF can be viewed at the individual species level on the **Species Sensitivity Interim Results** page (under **Calculations**). These results can be filtered by species group or subgroup using methods described in Section 2: The Basics of GUI Navigation in this Quick Start Guide.
2) The first table on the page, **Impact-Causing Factor Vulnerability, Impact, and Recovery Scores**, contains scores derived from categorical rankings applied for each metric assessing behavior and life history characteristics that influence potential vulnerability to OFW development[3]. The ICFs are reported in the table as follows:
    a. AL Impact = Artificial Light (all species groups)

[3] See Appendix B of Volume II of the Study Report to view the scoring schemes for each assessment metric and the algorithms combining various assessment metric rankings for each ICF impact score, which differ by species group.

b. AS Impact = Accidental Spills (all species groups)

c. CAS Impact = Collisions Above Surface (birds/bats only)

d. CSE Impact = Collisions, Subsurface Entanglements (marine mammals/turtles only)

e. EMF Impact = Electromagnetic Fields (fish/invertebrates only)

f. HD Impact = Habitat Disturbance/Displacement (all species groups and marine bottom habitat)

g. SN Impact = Sound/Noise (all species groups)

h. VS Impact = Vessel Strikes (fish/invertebrates and marine mammals/turtles)

3) The maximum possible score for each ICF is unique based on the relevant scoring schemes and algorithms, and whether the impact is calculated under the unmitigated or mitigated scenarios.

    a. These maximum possible values can be used for comparison against the calculated vulnerability scores for each species and ICF. To do so, divide the species score by the hypothetical maximum score for an ICF and multiply by 100. This can be used to compare across species as greater % max can be interpreted as greater vulnerability of a species to a particular ICF.

    b. Users can type "hypothetical max" into the search box for the **Region** column to view these maximum possible values, also displayed in Species Sensitivity Interim Results section of this guide (See Section 3, Result #5).

4) The **"Impact Score**" column is a sum of the individual ICF-related impact vulnerability scores. The "**Recovery Score**" column is derived from assessment metrics described in Appendix B of Volume II of the Study Report to represent the resilience of a species population.

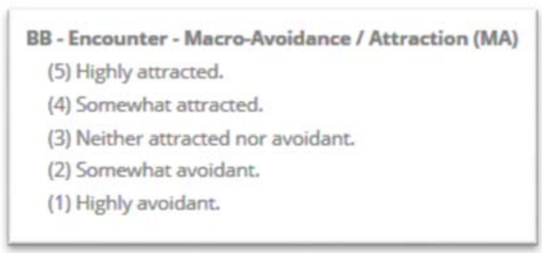
5) **Note:** The results in this table indicate the *vulnerability* of a species to a particular ICF impact, not a measure of the impact itself.

6) Relative species presence is accounted for in the second results table on the **Species Sensitivity Scores for Individual Species** page. Results in this table are derived by multiplying the Impact Score and Recovery Score of the previous table with the LSE Score (see **Large-Scale Event Results** page under **Calculations**) and Presence for a species in each period (see Viewing Species Behavioral Data and References section of this Quick Start Guide for details on species presence). The score can be considered a summation of all species-specific input data in the model.

7) The third table on this page, **Species Sensitivity at the Species Group Level**, shows scores that summed all of the species-level sensitivity scores together for each species group in each region, and then scaled them compared to the hypothetical maximum for each species group. Thus, these scores range from 1 (low) to 5 (high) and are comparable across species groups, periods, and regions.

4.3 Viewing Species Behavioral Data and References

1) Species life history, behavior, and presence data are viewable on the **Species Management** page (under **Data Management**). Click "**Edit**" to view the data for an individual species.
2) Each species is associated with one region and species group. Taxonomic information is recorded at the top of the page.
3) Presence data is recorded in the middle of the page. Presence during each two-month period is represented as 0 = not present, 0.5 = partially present (i.e., migrating in or out of region), or 1 = fully present. There are notes and reference codes justifying the presence value assignments.
4) To view the associated reference, hover over the **Data Management** menu at the top of the page, right click on **References,** and click "**Open Link in New Tab**" to open both pages at once.
    a. Copy the reference code from the **Species Management** page and paste it in to the search box at the top of the **Reference Code** column, and hit enter. This will filter the table and present the relevant reference. Click "**Edit**" to view details of this reference. Press "**Save**" or "**Cancel**" to return to the table of reference data.
    b. The **References** table can also be searched by Author, Year, or Subject (i.e., keywords).
    c. A new citation can be added to the database by clicking the "**Add New Reference**" button and entering the relevant information. Only fields with asterisks are required by the database. A new Reference Code will be automatically generated by the interface.
5) The bottom portion of the **Species Management** page contains all of the metrics assessed for a particular species.



    a. Each metric is delineated by a title and a series of rankings for a user to choose from.
    b. Drop-down menus accompany each metric to select the appropriate **Rank Category** and **Level of Uncertainty** for the assessment metric.
    c. **Note:** Refer to the scoring tables presented in Volume II, Appendix B of the Study Report for definitions of each assessment metric and category rank, the relationships between the category rank and how they are translated into ICF impact scores for each assessment metric, and how to assign the Level of Uncertainty. The species data entry process and the species selection and sensitivity scoring methods are also fully outlined in Sections 2.3.6 and 3.4 of the full Instruction Manual, respectively**.**
6) Click "Save" or "Cancel" at the bottom of the page after finished viewing/editing data to return to the table of species data.

4.4 Adding a New Region

The following steps are a summary of the spatial data preparation required to add a new study region to the model/database. Detailed instructions for each data preparation step and how to enter the data through the interface are presented in Sections 3.3 and 2.3 of full Instruction Manual, respectively.

1) Spatial data preparation:
    a. If the new study area is outside of the California EEZ or Hawaii EEZ zones, a new hypothetical region will be needed; otherwise the hypothetical California and Hawaii regions already included in the database can be used.
    b. Using ArcGIS, create shapefiles representing the new study region, and the new hypothetical region (if applicable). Buffer the region as needed (see Section 3.3.1 of full Instruction Manual).
    c. Acquire spatial data representing the present influence of anthropogenic activities on the environment in the new study region for the baseline conditions model parameter. Summarize multiple types of Baseline Metrics using ArcGIS as described in Section 3.3.2 of full Instruction Manual.
    d. Acquire net primary productivity data to serve as a proxy for water column habitat sensitivity. Analyze as described in Section 3.3.3.1 of full Instruction Manual.
    e. Acquire seafloor habitat type data to analyze the marine bottom habitat sensitivity in the study area. Prepare data as described in Section 3.3.3.2 of full Instruction Manual.
    f. Acquire datasets depicting marine protected areas, critical habitats, and essential fish habitats to develop the protected area modifier of the model. Clip and summarize data as described in Section 3.3.3.3 of full Instruction Manual.
2) Large-scale event data preparation:
    a. Calculate LSE frequencies for each region and period at two magnitude levels (partial structural failure and full structural failure) for four LSE types (hurricanes, earthquakes, tsunamis, and vessel accidents) as described in Section 3.1 of full Instruction Manual and Appendix F of Volume II of the Study Report.
    b. The model uses frequencies to calculate LSE scores, which include magnitude levels, frequency of occurrence, and relevant ICF impact magnitudes. Calculate frequency of occurrence for each LSE using historic data for each event type to first determine the likelihood of an event to occur at a magnitude large enough to cause structure failure.
3) Species life history and behavior literature review data preparation:
    a. Select species representative of major groups (birds/bats, fish/invertebrates, and marine mammals/turtles) and the variety of ecological niches occupied in a study region (species sub-groups).
    b. Evaluate relative species presence/absence based on historic stock assessments, primary literature, and web databases of species distribution. Represent presence during each two-

month period as 0 = not present, 0.5 = partially present (i.e., migrating in or out of region), or 1 = fully present. Record notes and reference codes justifying the presence value assignments on the **Species Management** page (under **Data Management**), see Section 3.4.2.1 of full Instruction Manual.

c. Using rank scores ranging from 0 (lowest risk of impact) to 5 (highest risk of impact), evaluate how severely a species could be affected in the event of spatiotemporal overlap with each ICF by ranking assessment metrics (i.e., questions based on ecological characteristics of a species group) for each individual species. Assessment metrics differ for each species group, but are assessed using the same general ecological themes for each group:

    i. encounter (i.e., likelihood of overlap with ICF based on behaviors such as escape behavior, time spent on the water surface, and attraction/avoidance responses to light/noise/chemicals);

    ii. concentration/aggregation (i.e., the degree to which a species aggregates in a given location);

    iii. physiology (i.e., physiological characteristics like fur that may affect magnitude of impact of certain ICFs); and

    iv. habitat flexibility/feeding specificity (i.e., how likely a species can adapt if an ICF impacts prey or habitat availability).

d. Assess recovery potential (i.e., how effectively a species population may recover in the event of an incident) based on:

    i. conservation/population status;

    ii. reproductive potential;

    iii. species range while in study region;

    iv. adult survival rate; and

    v. breeding score to describe how much a species forages for their young, which can be risky for both parent and offspring.

e. Record notes and reference codes justifying the ranks assigned for each assessment metric, recovery parameter, and level of uncertainty on the **Species Management** page (under **Data Management**), see Sections 3.4.2.2, 3.4.2.3, and 3.4.2.4 of full Instruction Manual.

4) Add any new references used for the species literature review and scoring to the database via the **References** page (under **Data Management**). Reference data entry will need to occur concurrently in order for the model to autogenerate the Reference Codes needed for species data entry.

5) Once all new data are entered through the GUI (Section 2.3 of full Instruction Manual), the model will automatically organize and normalize the input data and calculate results viewable on the **Calculations** pages.

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Offshore Floating Wind Environmental Sensitivity Analysis (OFWESA) Model: User Interface Quick Start Guide

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List of Abbreviations and Acronyms

Accidental Spill	AS
Artificial Light	AL
Birds/Bats	BB
BOEM	Bureau of Ocean Energy Management
California	CA
CA DWF	California Department of Fish and Wildlife
CAS	Collisions Above Surface
CSE	Collisions and Subsurface Entanglements
EEZ	Exclusive Economic Zone
EMF	Electromagnetic Field
EFH	Essential Fish Habitat
FI	Fish/Invertebrates
GUI	Graphical User Interface
HD	Habitat Disturbance/Displacement
HI DLNR	Hawaii Department of Land and Natural Resources
HI_N	Hawaii North
HI_S	Hawaii South
HDF	Hierarchical Data Format
ICF	Impact Causing Factors
IUCN	International Union for Conservation of Nature
LoU	Level of Uncertainty
MT	Mammals/Turtles
MPA	Marine Protected Areas
MODIS	Moderate Resolution Image Spectroradiometer
Nm	nautical miles
NPP	Net Primary Productivity
NASA	National Aeronautics and Space Administration
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OFWESA	Offshore Floating Wind Environmental Sensitivity Analysis
OCS	Outer Continental Shelf
PAM	Protected Area Modifier
SN	Sound/Noise
SME	Subject Matter Experts
U.S.	United States
USFWS	Us Fish and Wildlife Service
VS	Vessel Strike
WEA	Wind Energy Area
WDPA	World Database on Protected Areas

1 Introduction

1.1 Overview of the Instruction Manual

The Offshore Floating Wind Environmental Sensitivity Analysis (OFWESA) was developed to provide results to be used in a scoping-level assessment of environmental sensitivity and risk on the marine and coastal environmental resources in three study areas to the potential effects of the exploration, construction, maintenance, and operation of offshore floating wind (OFW) facilities. All factors contributing to environmental sensitivity were assessed in the OFWESA model on a categorical classification system. This assessment involved the development of a detailed model of region- and season-specific environmental sensitivity for the U.S. Outer Continental Shelf and coastal regions based on water column and seafloor habitat characteristics, large-scale event (LSE) frequencies, baseline conditions, seasonal presence/absence of species, species sensitivity to OFW impact causing factors (ICFs), and species recovery potential. The OFWESA model and associated database is intended to aid in identifying the habitats, species, regions, and seasons that are potentially more sensitive to impacts of OFW development among those included in the model. Through a user-friendly interface, users can view the results of the initial iteration of the model and update the database to include additional regions and species of interest for an analysis of their sensitivity compared to hypothetical minimum and maximum risk conditions within the model. This Instruction Manual is a guide to use that interface to view model results as well as update for future model iterations. A complete step-by-step walkthrough of the graphical user interface (GUI) is included to inform readers of what is produced by each portion of the interface. This manual has been written to provide users with the instruction necessary for editing and expanding the model database, producing updated results, and gaining proficiency in all components of the model GUI.

Section 1 of this manual provides an overview of the manual and GUI model. Section 2 provides users with the basic steps to use the GUI. Section 3 outlines the steps necessary for users to prepare data outside the GUI in order to enter into the GUI. Section 4 presents the static reference tables used in the model so the user understands what is contained in the model. Section 5 describes ways in which the model results can be further processed for analysis outside of the GUI. Finally, Section 6 of the manual includes references for data sources used in the model.

1.2 Spatial and Temporal Scope

The OFWESA model is conducted at the spatial resolution of the BOEM Wind Energy Area (WEA) lease blocks offshore of California and Hawaii, where unsolicited lease applications have been made (referred to as study regions throughout this instruction manual). The model was designed to assess environmental sensitivity at this general spatial scale (thousands of square kilometers) and can be expanded to include additional BOEM WEA lease block regions that need to be assessed in the future. The analysis was conducted in a buffered region of 25 nautical miles (nm) around three BOEM WEA lease block regions: California (CA), Hawaii North (HI_N), and Hawaii South (HI_S; Figure 1 and Figure 2). Calculations were also made within buffered regions of 10 nm and 5 nm, to understand how sensitivity results vary with buffer size. Buffer zones and geospatial parameters, such as marine bottom habitat type, included in the model were processed using ArcGIS. Methods for processing spatial data are explained in Section 3.3 in this manual. Six "seasonal" periods were included in the model to capture variations in species presence, water column habitat sensitivity, and risk of LSE occurrence throughout the year. Each period consists of two months, defined in

Table 10 in Section 4.1 of this manual. For the purposes of this manual, the terms "period" and "season" are used interchangeably.

The initial iteration of the OFWESA model focused on buffered zones around OFW WEA lease blocks near central California and Oahu, but can be expanded to include additional regions of interest. Species and habitat sensitivity information was combined with rates of LSEs that may lead to partial or complete structural failure of OFW fields, potentially increasing the impact scale and level of particular ICFs. Baseline environmental conditions in each study region were also considered within the OFWESA model as a proxy for cumulative effects of human activities in the OCS. Finally, mitigation measures that could reduce the impact of OFW were incorporated into model calculations to compare unmitigated and mitigated scenarios. These five main components (species sensitivity and habitat sensitivity, LSE rates, baseline environmental conditions, and mitigation measures) were the building blocks used to construct the OFWESA model and determine the regions/seasons of highest relative environmental sensitivity compared to hypothetical maximum values (Figure 3). This instruction manual explains how users can view and add data to the OFWESA model GUI (Section 2), model parameter data preparation (Section 3), static data tables used in the model (Section 4), and analysis of the export data outside of the model and GUI (Section 5).

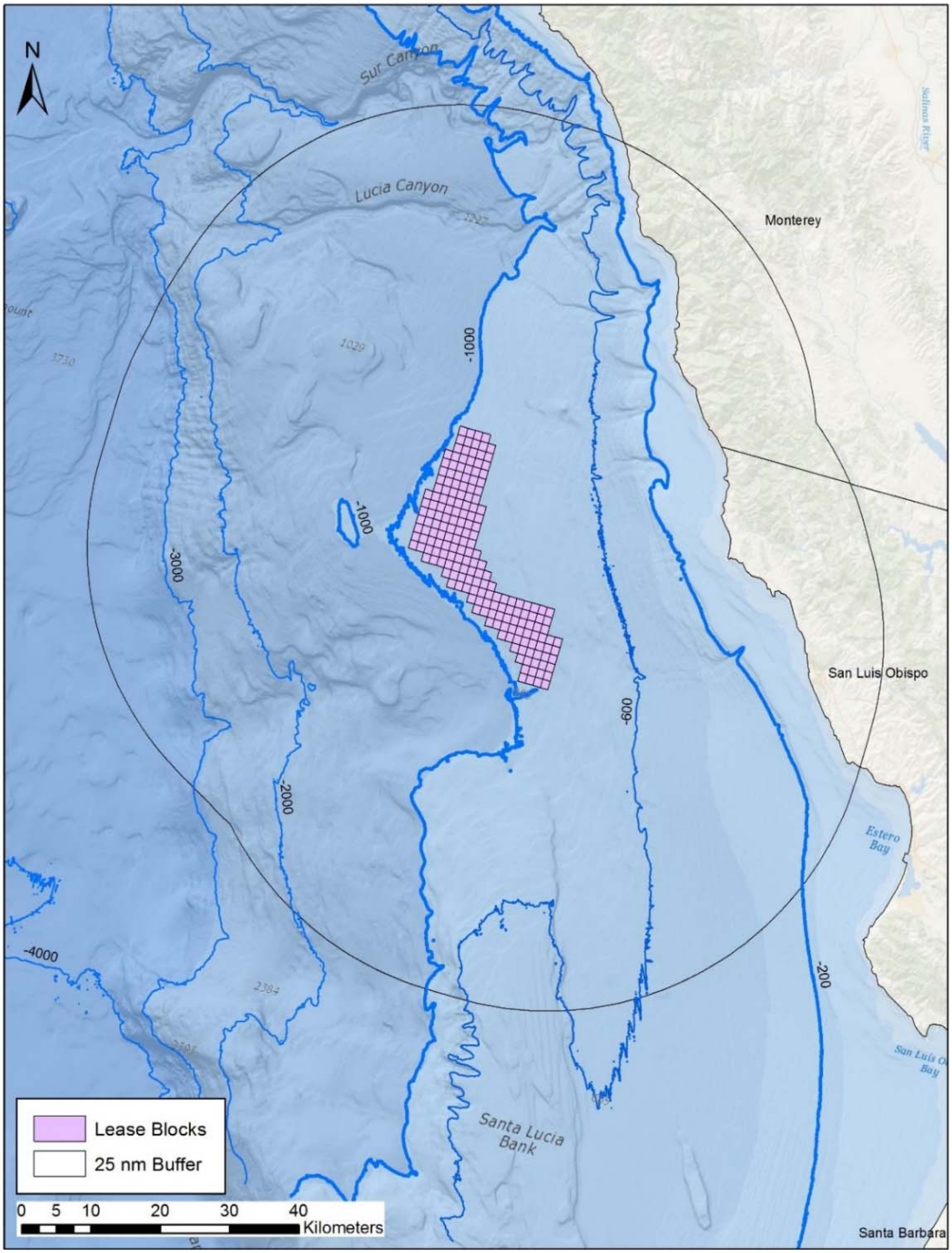


Figure 1. California study region, offshore of central California between Monterey and Morro Bays

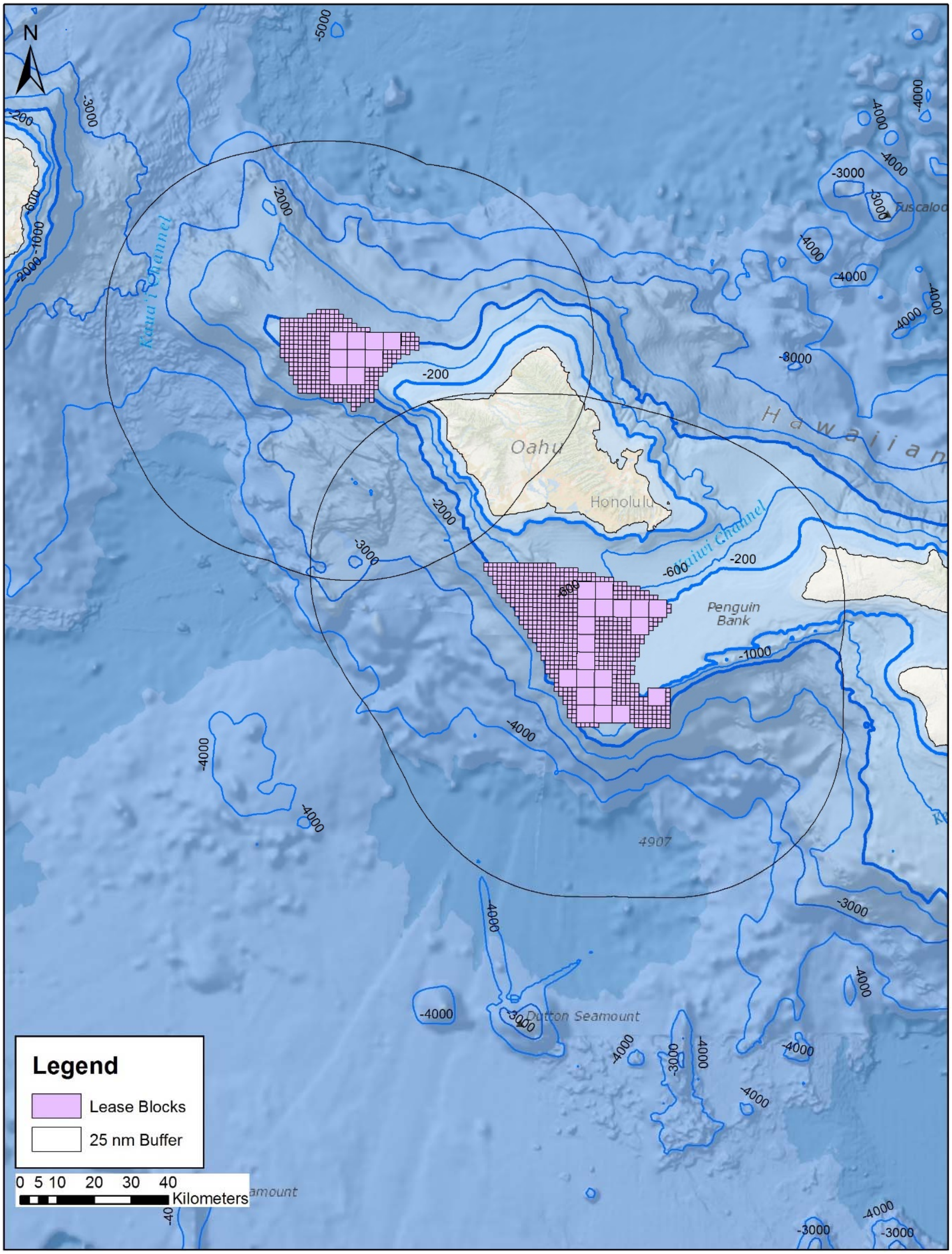


Figure 2. Hawaii North and South study regions, offshore of Oahu to the northwest and southeast

1.3 Model Structure

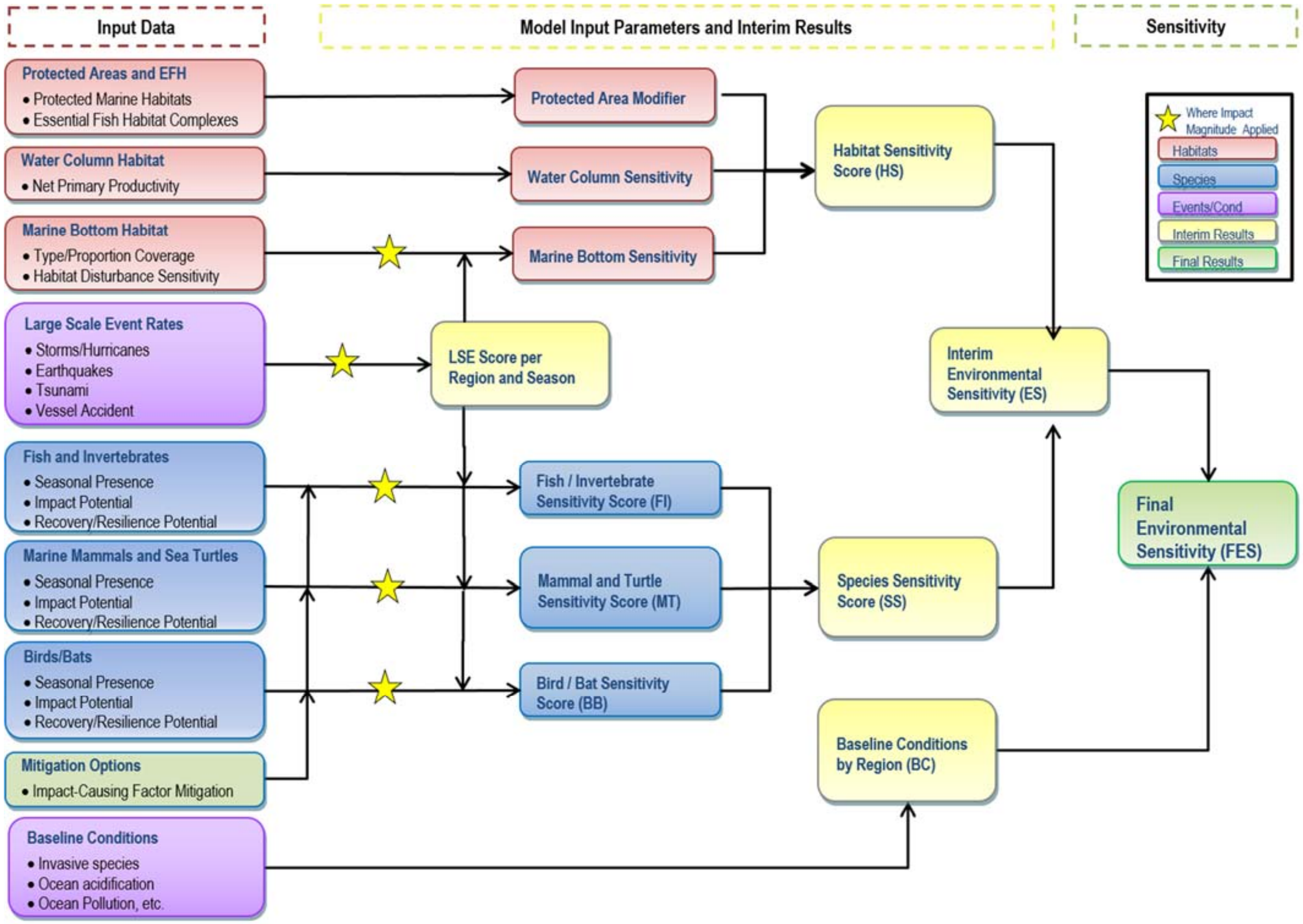


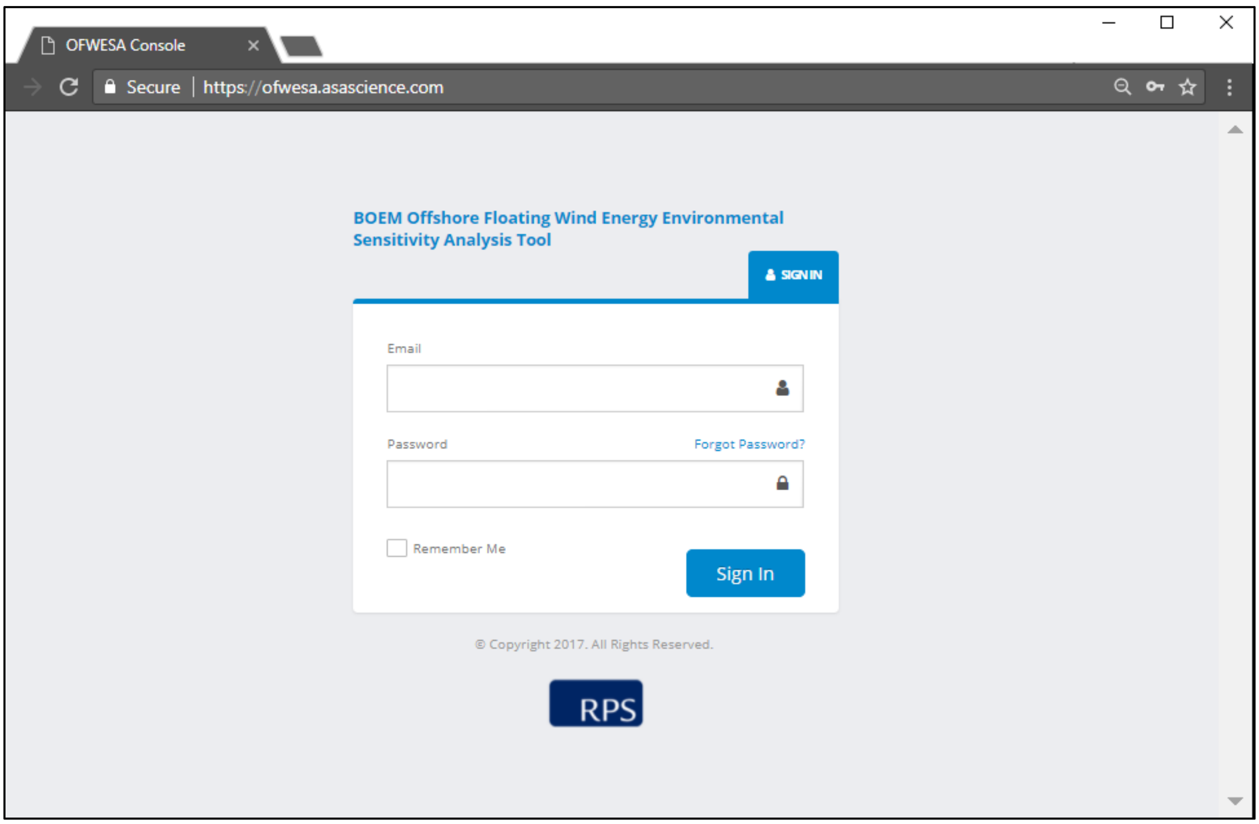
Figure 3. OFWESA model flow diagram

2 OFWESA Graphical User Interface (GUI)

This section of the manual provides users with the basic steps to use the GUI to review existing model input and results from the initial iteration of the model. A number of screenshot images from the GUI pages are included to aid the user.

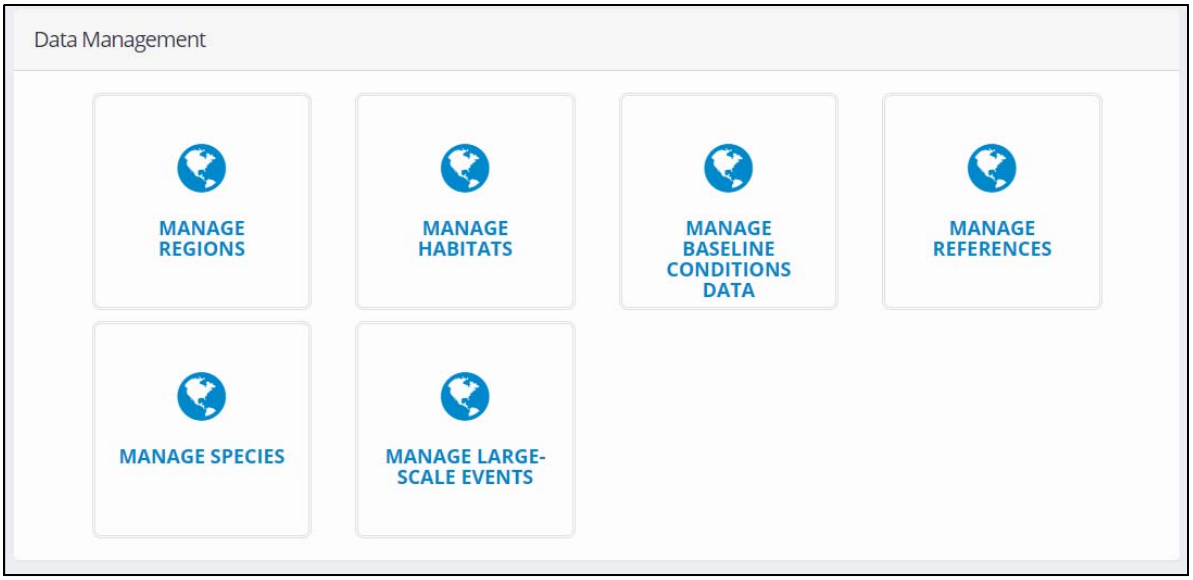
2.1 Interface at a Glance

The OFWESA GUI website directs users to a login prompt, seen below. To sign in and access the GUI, enter Email and Password in respective fields. Users that have been added into the system by an administrator (see Section 2.4 below) should be able to successfully log in with the correct email and password. Users can check the box next to "Remember Me" to bypass the log in for all subsequent visits to the site. If a user has forgotten their password, clicking "Forgot Password?" will redirect users to a password recovery prompt requesting the account email address. Instructions to reset the account password will be emailed to the account provided.

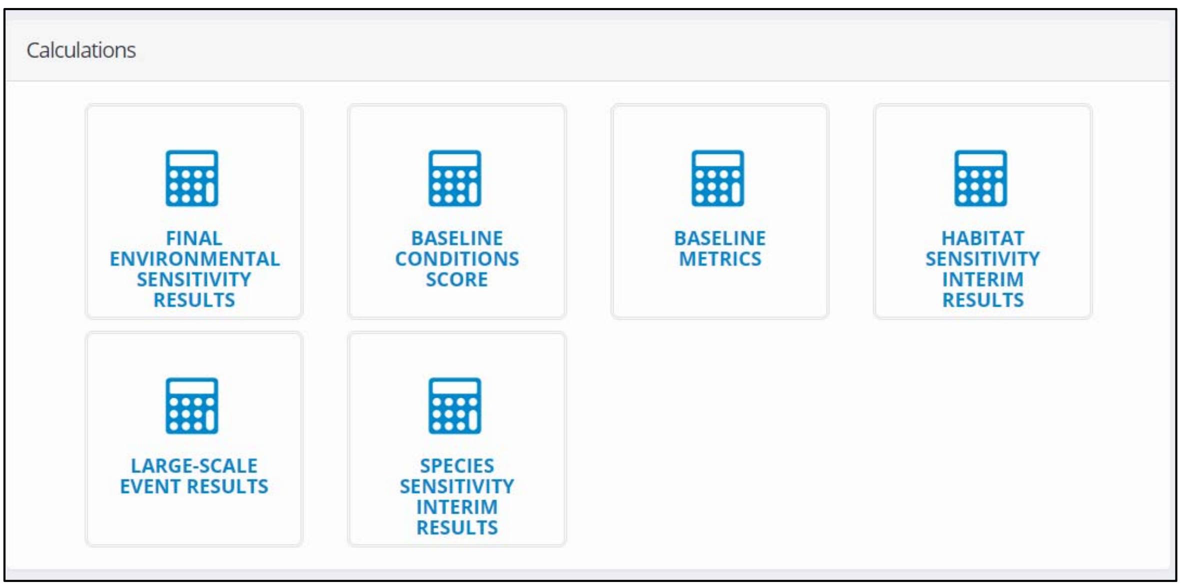


The OFWESA model interface Dashboard shows two categories of user options: **Data Management** and **Calculations.**

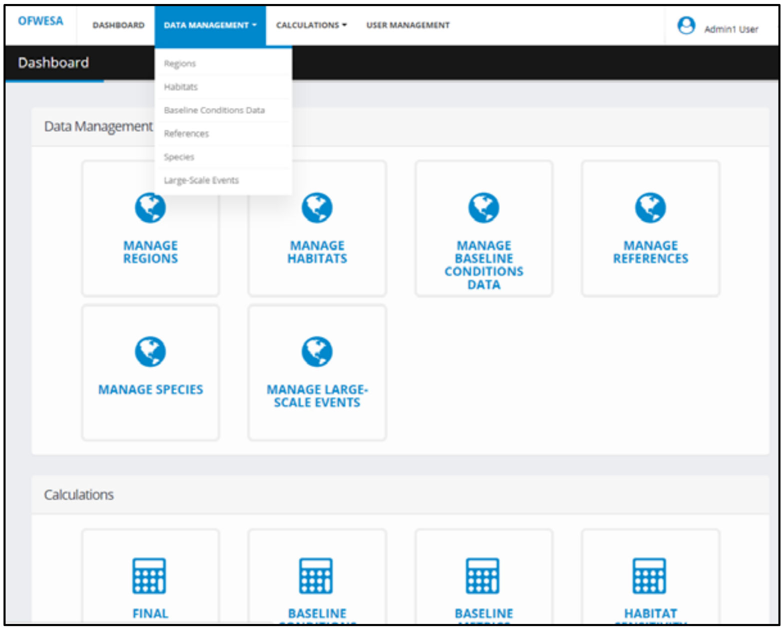
- The **Data Management** section includes the pages through which model input data can be added or edited. These include: Manage Regions, Manage Habitats, Manage Baseline Condition Data, Manage References, Manage Species, and Manage Large-Scale Events.



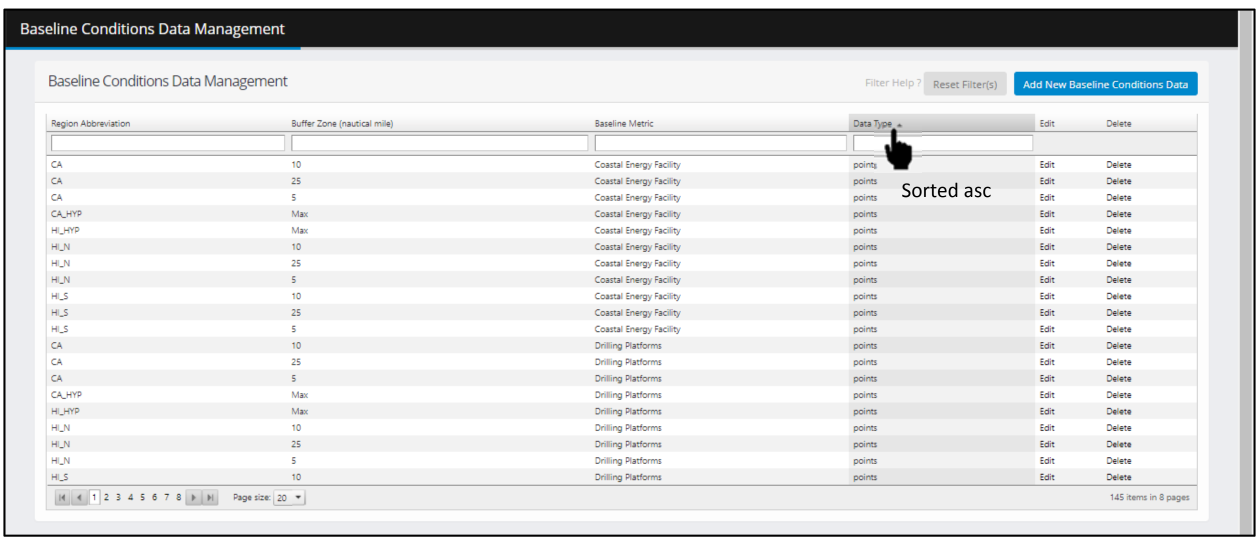
- The **Calculations** section includes the reports displaying the calculations for interim model stages and the final model results that can be generated. These include: Final Environmental Sensitivity Results, Baseline Condition Score, Baseline Metrics, Habitat Sensitivity Interim Results, Large-Scale Event Results, and Species Sensitivity Interim Results.



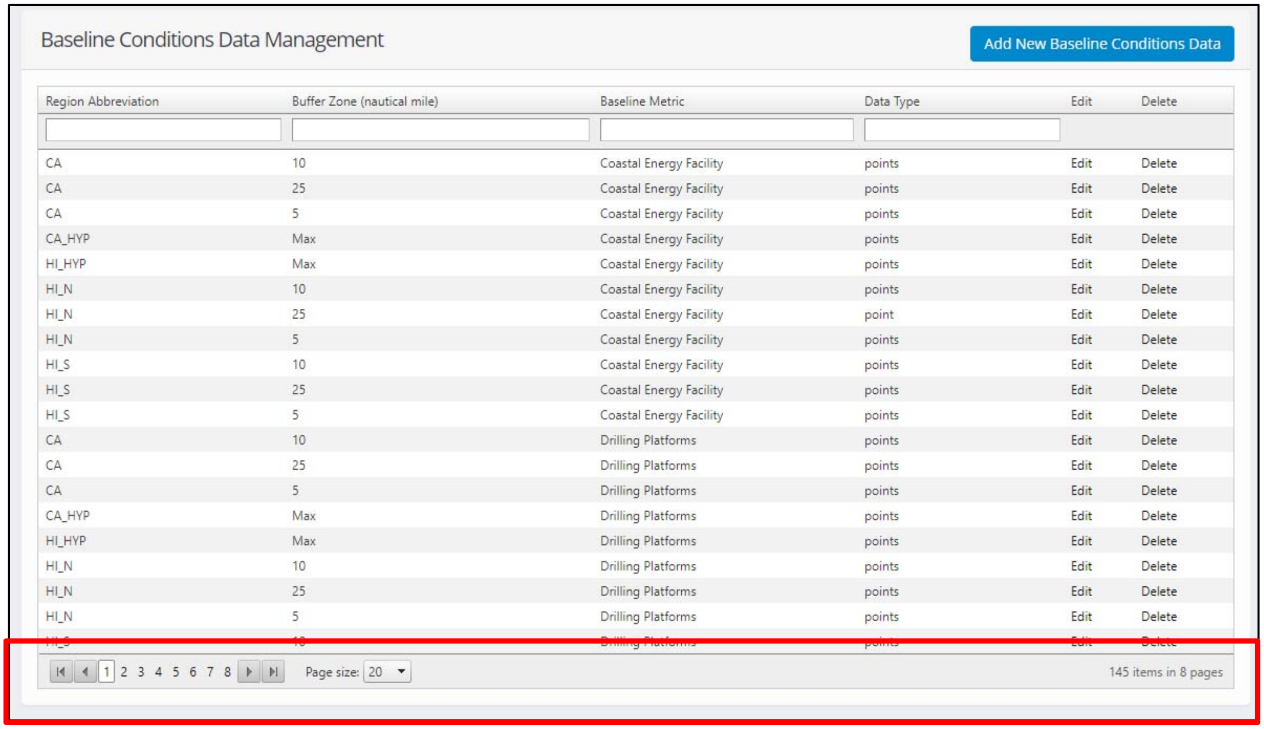
The pages in **Data Management** and **Calculation** sections can be accessed from the Dashboard or from the header bar menu that runs along the top left of the webpage.



Within each of the pages under Data Management, data can be sorted by clicking on the label of the column by which the user would like to sort. Sorting options are: default, ascending, and descending order.



The numbers of rows of data reported on a page can be customized using the tool bar at the bottom of the table (see red box in image below). Tables will automatically show 20 rows of data; however, users can also have the GUI show 10, 50, or All rows of data using the **Page size** drop-down menu. Use arrows on the left and right of the page numbers can be used to scroll forward or backward, respectively, through the data table records.



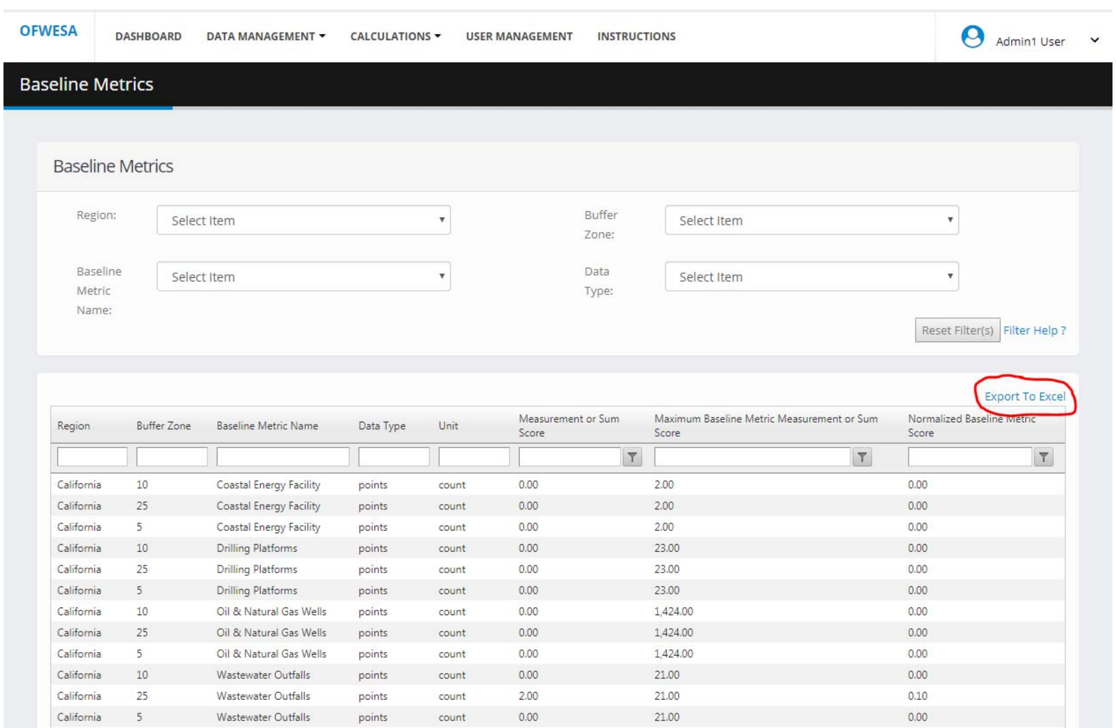
Baseline Conditions Data Management

Add New Baseline Conditions Data

Region Abbreviation	Buffer Zone (nautical mile)	Baseline Metric	Data Type	Edit	Delete
CA	10	Coastal Energy Facility	points	Edit	Delete
CA	25	Coastal Energy Facility	points	Edit	Delete
CA	5	Coastal Energy Facility	points	Edit	Delete
CA_HYP	Max	Coastal Energy Facility	points	Edit	Delete
HI_HYP	Max	Coastal Energy Facility	points	Edit	Delete
HI_N	10	Coastal Energy Facility	points	Edit	Delete
HI_N	25	Coastal Energy Facility	point	Edit	Delete
HI_N	5	Coastal Energy Facility	points	Edit	Delete
HI_S	10	Coastal Energy Facility	points	Edit	Delete
HI_S	25	Coastal Energy Facility	points	Edit	Delete
HI_S	5	Coastal Energy Facility	points	Edit	Delete
CA	10	Drilling Platforms	points	Edit	Delete
CA	25	Drilling Platforms	points	Edit	Delete
CA	5	Drilling Platforms	points	Edit	Delete
CA_HYP	Max	Drilling Platforms	points	Edit	Delete
HI_HYP	Max	Drilling Platforms	points	Edit	Delete
HI_N	10	Drilling Platforms	points	Edit	Delete
HI_N	25	Drilling Platforms	points	Edit	Delete
HI_N	5	Drilling Platforms	points	Edit	Delete
HI_S	10	Drilling Platforms	points	Edit	Delete

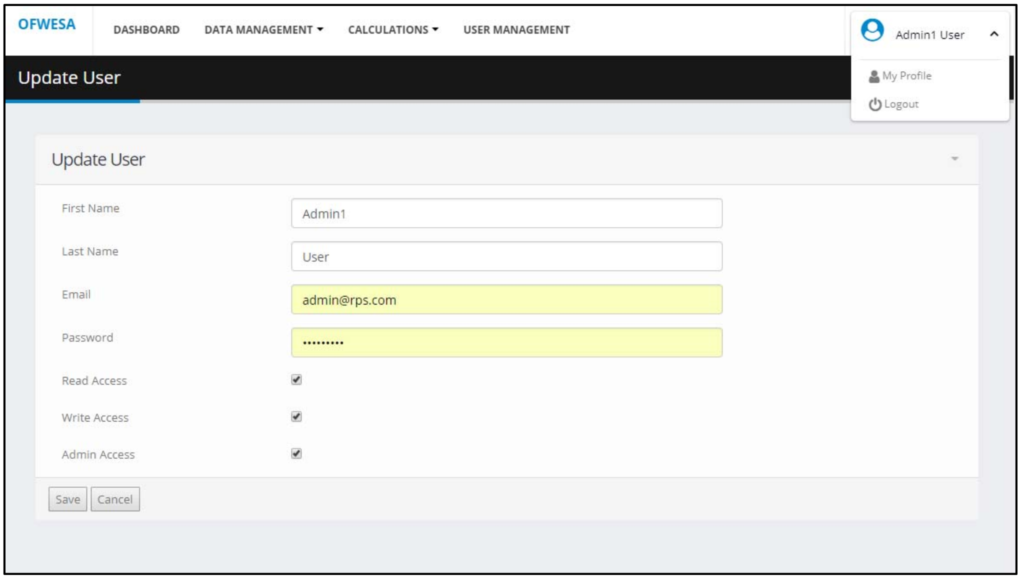
1 2 3 4 5 6 7 8 Page size: 20 145 items in 8 pages

Excel tables throughout the GUI can be exported with these data using the "Export to Excel" function (circled red below) on the upper right corner of the table to export full or filtered results.



Region	Buffer Zone	Baseline Metric Name	Data Type	Unit	Measurement or Sum Score	Maximum Baseline Metric Measurement or Sum Score	Normalized Baseline Metric Score
California	10	Coastal Energy Facility	points	count	0.00	2.00	0.00
California	25	Coastal Energy Facility	points	count	0.00	2.00	0.00
California	5	Coastal Energy Facility	points	count	0.00	2.00	0.00
California	10	Drilling Platforms	points	count	0.00	23.00	0.00
California	25	Drilling Platforms	points	count	0.00	23.00	0.00
California	5	Drilling Platforms	points	count	0.00	23.00	0.00
California	10	Oil & Natural Gas Wells	points	count	0.00	1,424.00	0.00
California	25	Oil & Natural Gas Wells	points	count	0.00	1,424.00	0.00
California	5	Oil & Natural Gas Wells	points	count	0.00	1,424.00	0.00
California	10	Wastewater Outfalls	points	count	0.00	21.00	0.00
California	25	Wastewater Outfalls	points	count	2.00	21.00	0.10
California	5	Wastewater Outfalls	points	count	0.00	21.00	0.00

To update user information or log out of the OFWESA GUI, click on the down arrow (⌄) next to the logged in username on the right side of the header bar menu and select My Profile or Logout.



Users can click on **OFWESA** or **DASHBOARD** in the header bar menu to return to the Dashboard.

2.2 Reports: OFWESA Model Results

In the **Calculations** pages, the user can view a number of interim and final sensitivity results of the model and generate customized reports based on the region, buffer zone, species group, or scenario of interest. For a detailed explanation of what each calculation represents, see Appendices C and D of the Study Report, which include model algorithms and implementation.

The following sections explain how to generate and customize reports using the calculations pages. Section 2.3 of this instruction manual describes how to add and modify data upon which the results and reports are based. These sections include brief explanations of the uses of the results, but for a full description of the different types of final and interim sensitivity scores, see the Study Report.

2.2.1 Calculations Page #1: Final Environmental Sensitivity Results

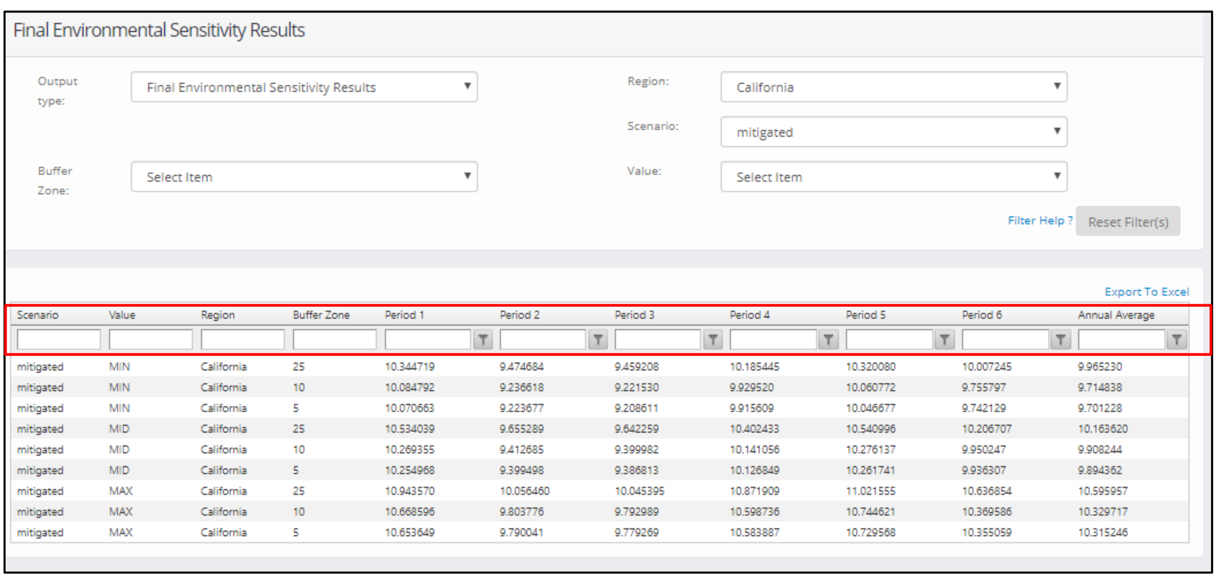
The **Final Environmental Sensitivity Results** calculations page generates report tables which include the following fields: Scenario (mitigated/unmitigated), Value, Region, Buffer Zone, Period 1, Period 2, Period 3, Period 4, Period 5, Period 6, and Annual Average. Reports can be generated to show the sensitivity scores for four different types of sensitivity measured in OFWESA. In the “Output type” field, click the arrow to open a pull-down menu and present the results listed below:

- Final Environmental Sensitivity Results
  - These results incorporate the environmental sensitivity and baseline conditions scores for each region, season, and buffer zone. Additional details about the equation used to calculate the final environmental sensitivity results are in Appendix C, Section C.3.14 of the Study Report.
- Interim Environmental Sensitivity Results
  - These results are calculated for each region and season as the sum of the habitat sensitivity and species sensitivity scores. Refer to Appendix C, Section C.3 of the Study Report for additional information on this calculation.

- Habitat Sensitivity Results
  - o These results incorporate the water column habitat and marine bottom habitat scores with the protected area modifier for each region, buffer zone, mitigation scenario, and season. Appendix C, Section C.3.6 of the Study Report includes additional information about this calculation.
- Species Sensitivity Results
  - o These results are calculated for each region and season as the sum of the three species group scores. Refer to Appendix C, Section C.3.10 of the Study Report for additional information on this calculation.

For all scores, higher values represent greater sensitivity. The final environmental sensitivity results can be filtered with the following options:

- Region:
  - o California
  - o Hawaii North
  - o Hawaii South
  - o Hypothetical for California
  - o Hypothetical for Hawaii
  - o plus any regions added by users
- Buffer Zone
  - o 25 nm
  - o 10 nm
  - o 5 nm
- Scenario:
  - o Mitigated
  - o Unmitigated
- Value:
  - o Min = lower sensitivity score estimate based on level of uncertainty (see Section 3.4.2.4)
  - o Mid = best sensitivity score estimate based on assigned rank
  - o Max = upper sensitivity score estimate based on level of uncertainty



Scenario	Value	Region	Buffer Zone	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Annual Average
mitigated	MIN	California	25	10.344719	9.474684	9.459208	10.185445	10.320080	10.007245	9.965230
mitigated	MIN	California	10	10.084792	9.236618	9.221530	9.929520	10.060772	9.755797	9.714838
mitigated	MIN	California	5	10.070663	9.223677	9.208611	9.915609	10.046677	9.742129	9.701228
mitigated	MID	California	25	10.534039	9.655289	9.642259	10.402433	10.540996	10.206707	10.163620
mitigated	MID	California	10	10.269355	9.412685	9.399982	10.141056	10.276137	9.950247	9.908244
mitigated	MID	California	5	10.254968	9.399498	9.386813	10.126849	10.261741	9.936307	9.894362
mitigated	MAX	California	25	10.943570	10.056460	10.045395	10.871909	11.021555	10.636854	10.595957
mitigated	MAX	California	10	10.668596	9.803776	9.792989	10.598736	10.744621	10.369586	10.329717
mitigated	MAX	California	5	10.653649	9.790041	9.779269	10.583887	10.729568	10.355059	10.315246

Users can search for data in each column by typing in the blank box above the data entries (shown in red box above). In addition, users can filter results based on the entry typed into the blank box by clicking on the  button and selecting: NoFilter, Contains, EqualTo, GreaterThan, or LessThan. To clear a search, delete text from box and press enter on keyboard.

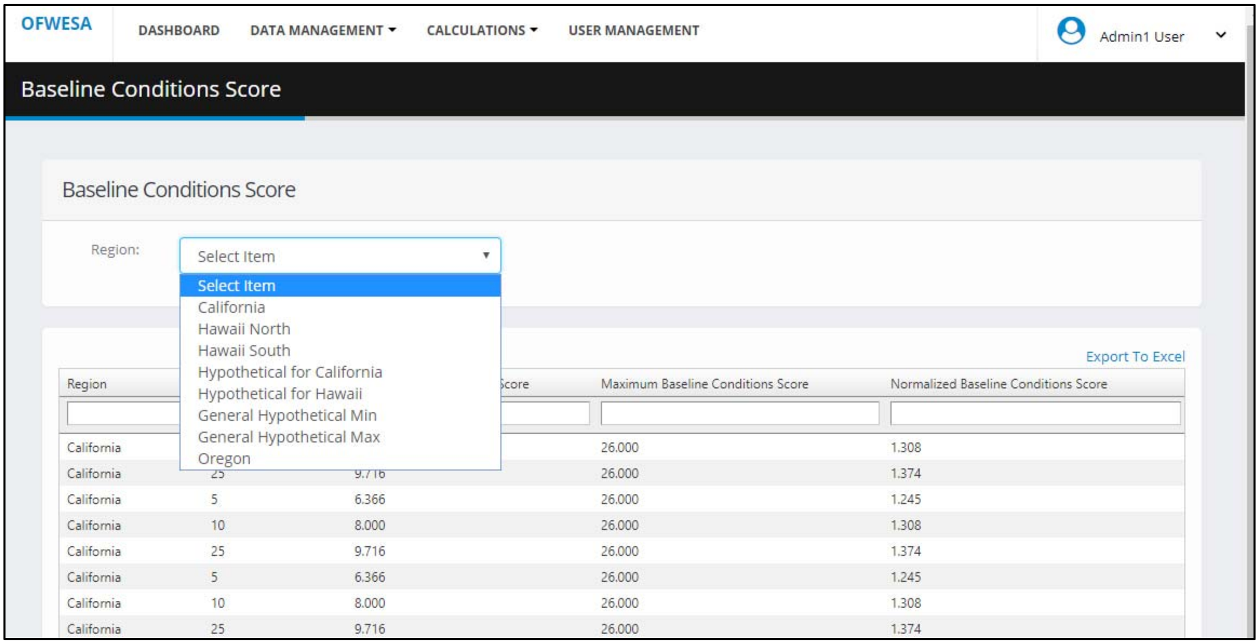
2.2.2 Calculations Page #2: Baseline Conditions Score

The **Baseline Conditions Score** calculations page generates report tables which include the following fields: Region, Buffer Zone, Raw Baseline Conditions Score, Maximum Baseline Conditions Score, and Normalized Baseline Conditions Score. The Raw Baseline Condition Score is a summation of the baseline metric scores for each study region and buffer zone. The Maximum Baseline Conditions Score is the maximum possible baseline condition score as calculated for the larger EEZ region. Scores reflect anthropogenic influences (Baseline Metrics) within a study region, compared to those impacts within a broader Exclusive Economic Zone (EEZ) for each region (i.e., hypothetical max). In general, a higher score represents higher influence of all existing anthropogenic conditions which could increase overall impact of OFW in a region. These are used to calculate the Normalized Baseline Conditions Score, which is incorporated into the final environmental sensitivity calculation later in the model steps. Additional information on how the Baseline Condition Scores are calculated is included in Appendix C, Section C.3.13 of the Study Report.

Results can be filtered by Region:

- California;
- Hawaii North;
- Hawaii South;
- Hypothetical for California;
- Hypothetical for Hawaii, and
- any regions added by users.

To return to the default data report view for all Calculation pages and filter option pull down menus, change selection back to **Select Item** to turn off filters and return to full table. Use the **Export to Excel** function (located in the upper right of the report table) to export results from the report tables. The exported data will reflect filtered data based on the filters applied in the GUI at the time the Export to Excel tool is selected.

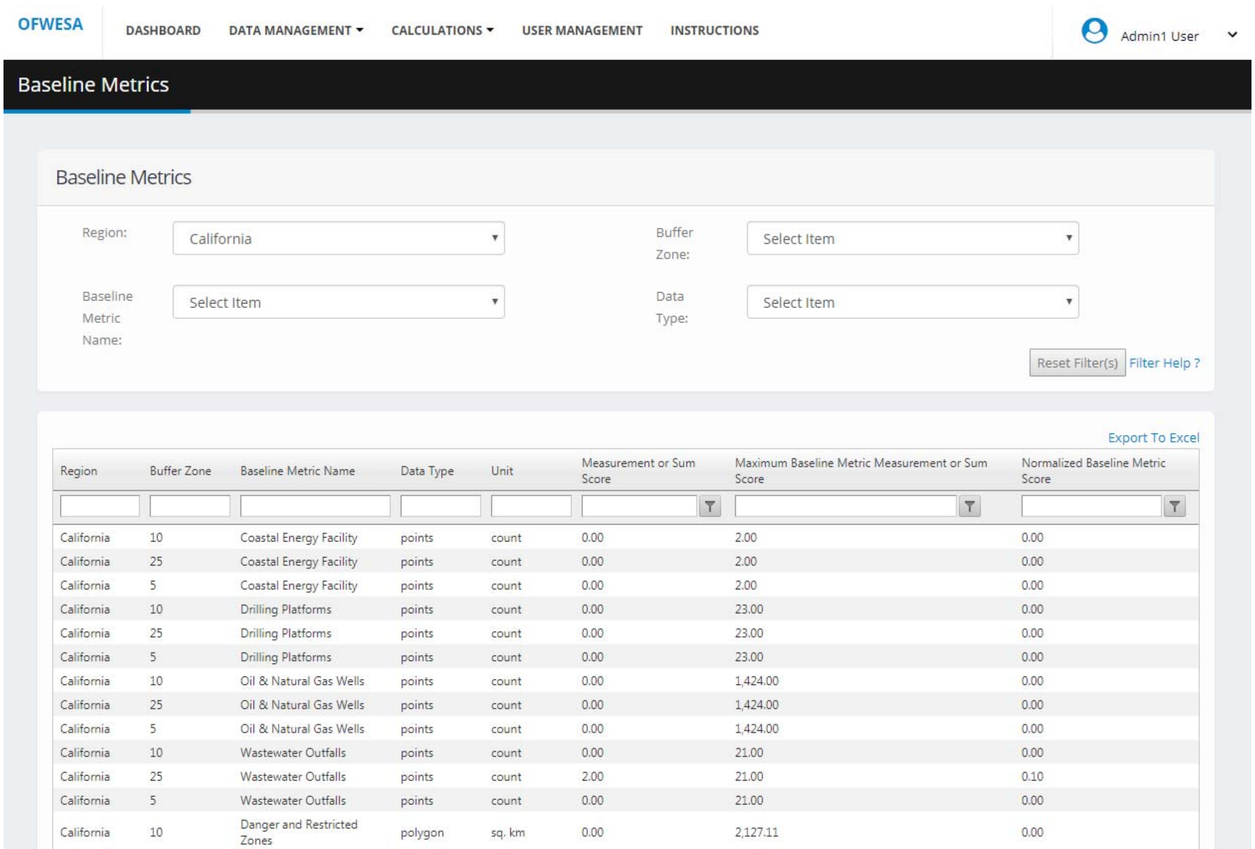


2.2.3 Calculations Page #3: Baseline Metrics

The **Baseline Metrics** score page generates report tables which include the following fields: Region, Buffer Zone, Baseline Metric Name, Data Type, Unit, Measure of Sum or Score, Maximum Baseline Metric Measurement or Sum Score, and Normalized Baseline Metric Score. Scores are calculated for each anthropogenic stressor dataset (i.e., other development, pollution, etc.) in each region and compared to the metric score within the broader EEZ for each region (i.e., hypothetical max). In general, higher scores represent individual anthropogenic conditions that make a region more sensitive to OFW (i.e. a high score for shipping lanes indicates increased traffic in the region and potential for collision with OFW facilities). The Baseline Metric Scores are summed for the Baseline Condition Score described in the previous section (Section 2.2.2).

Results can be filtered by Region:

- California;
- Hawaii North;
- Hawaii South;
- Hypothetical for California;
- Hypothetical for Hawaii, and
- any regions added by users.



2.2.4 Calculations Page #4: Habitat Sensitivity Interim Results

Three report tables can be generated in the **Habitat Sensitivity Interim Results** calculations page. These three tables are: **Marine Bottom Habitat Sensitivity Scores** or **Water Column Sensitivity Scores** (depending on which output type is selected), **Proportion and Sensitivity of Marine Bottom Habitat Types**, and **Protected Marine Areas and Essential Fish Habitat**. For all three, higher scores generally represent higher habitat sensitivity.

The **Marine Bottom Habitat Sensitivity Scores** or **Water Column Sensitivity Scores** report table includes fields for: Region, Buffer Zone, Period 1, Period 2, Period 3, Period 4, Period 5, Period 6, and Annual Average for two different output types (chosen via pull-down menu):

- Marine Bottom Habitat Sensitivity Score
- Water Column Sensitivity Score

Results represent the sensitivity of marine bottom habitat (based on proportion of habitat types with varying sensitivity ranks) and water column (based on net primary productivity). Appendix C, Section C.3.4 of the Study Report includes additional information about these calculations.

The **Proportion and Sensitivity of Marine Bottom Habitat Types** report table includes fields for: Region, Buffer Zone, Total Marine Area, Proportion Unknown / No Data, Proportion Soft Bottom Deep, Proportion Soft Bottom Shallow, Proportion Hard Bottom Deep, Proportion Hard Bottom Shallow, Proportion Anthropogenic Deep, Proportion Anthropogenic Shallow, Proportion Kelp Shallow, Proportion Seagrass Shallow, Proportion Volcanic Deep, Proportion Volcanic Shallow, Proportion Corals / Sponges Deep, Proportion Corals / Sponges Shallow, and the Sum Bottom Habitat Sensitivity Score.

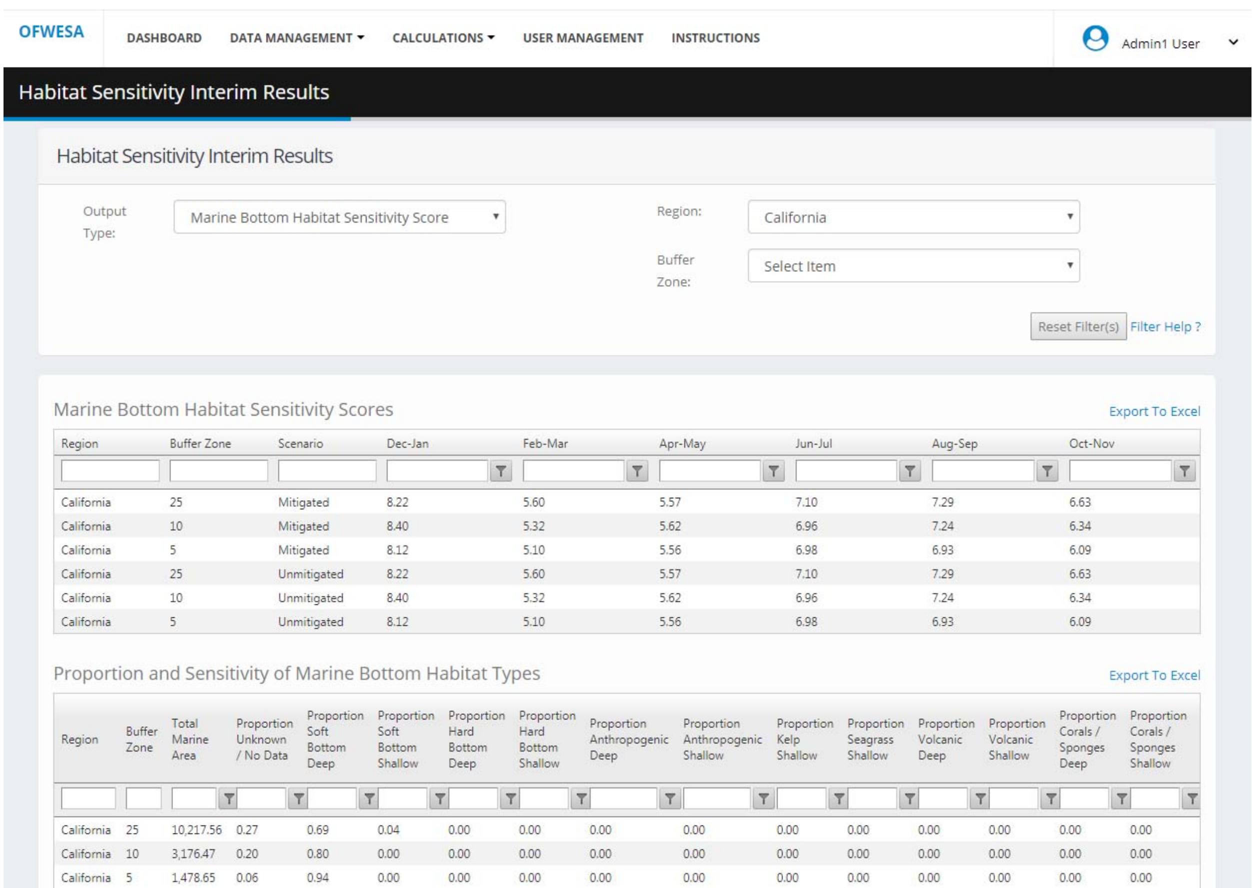
These results represent the proportion of different habitat types that vary in sensitivity, and the resulting summed sensitivity score across all marine bottom habitat types.

The **Protected Marine Areas and Essential Fish Habitat (EFH)** report table includes fields for: Region, Buffer Zone, Total Marine Area, Protected Marine Proportion, EFH Count, Maximum EFH Count, Protected Area Modifier. These results indicate the degree of sensitive resources and habitats within each region, which is associated with and used as a proxy for habitat sensitivity in the model.

These report tables are considered interim model results, and all three tables can be filtered by the following options:

- Region:
    - California;
    - Hawaii North;
    - Hawaii South;
    - Hypothetical for California;
    - Hypothetical for Hawaii, and
    - any regions added by users

- Buffer Zone:
    - 25 nm
    - 10 nm
    - 5 nm



2.2.5 Calculations Page #5: Large Scale Event Results

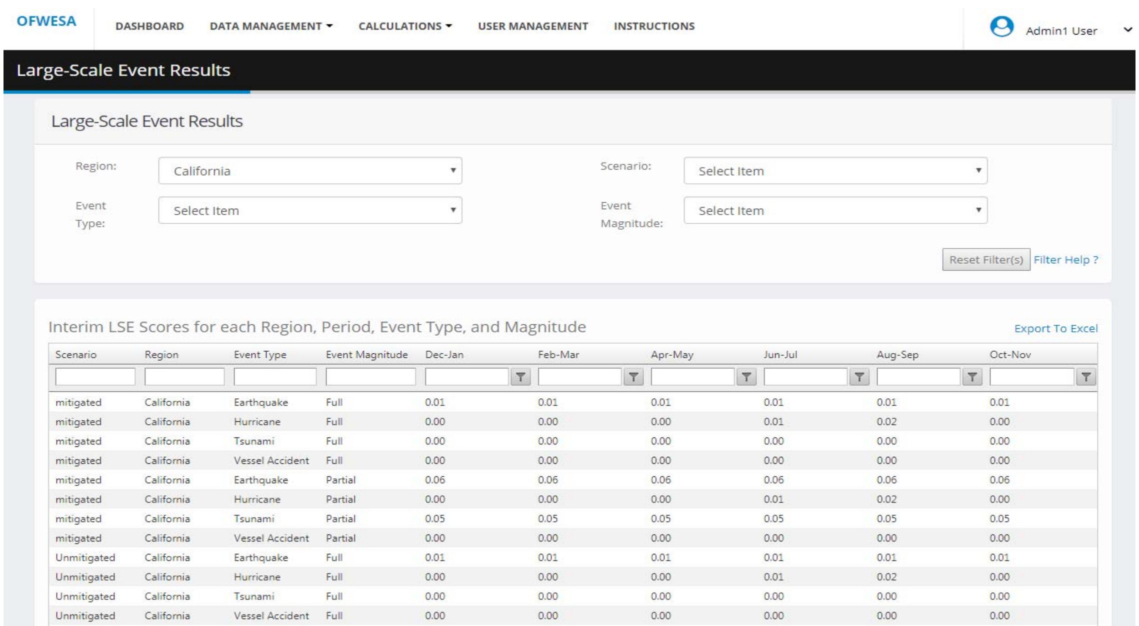
Two tables are presented in the **Large-Scale Event Results** calculation page. These include **Interim LSE Scores for each Region, Period, Event Type, and Magnitude** and **Final LSE Scores for each Region and Period**. LSE Scores were calculated for each region and period at two magnitude levels (partial structural failure and full structural failure) for four LSE types (earthquake, hurricane, tsunami, and vessel accidents). Higher scores generally represent higher sensitivity of a region to large-scale events. Additional information on LSE scores can be found in Appendix C, Section C.3.2 and Appendix F, Section F.3 in the Study Report.

The **Interim LSE Scores for each Region, Period, Event Type and Magnitude** report table includes fields for: Scenario, Region, Event Type, Magnitude, Period 1, Period 2, Period 3, Period 4, Period 5, Period 6, and Annual. These results represent the frequency and impact of different l LSEs and event magnitudes in each region.

The **Final LSE Scores for each Region and Period** report table shows: Scenario, Region, Period 1, Period 2, Period 3, Period 4, Period 5, Period 6, and Annual. These results represent the frequency of impact of all event types and magnitudes combined for each region.

These report tables are considered interim model results, and both tables can be filtered by the following options:

- Region:
  - California;
  - Hawaii North;
  - Hawaii South;
  - Hypothetical for California;
  - Hypothetical for Hawaii, and
  - any regions added by users.
- Scenario:
  - Mitigated
  - Unmitigated



Scenario	Region	Event Type	Event Magnitude	Dec-Jan	Feb-Mar	Apr-May	Jun-Jul	Aug-Sep	Oct-Nov
mitigated	California	Earthquake	Full	0.01	0.01	0.01	0.01	0.01	0.01
mitigated	California	Hurricane	Full	0.00	0.00	0.00	0.01	0.02	0.00
mitigated	California	Tsunami	Full	0.00	0.00	0.00	0.00	0.00	0.00
mitigated	California	Vessel Accident	Full	0.00	0.00	0.00	0.00	0.00	0.00
mitigated	California	Earthquake	Partial	0.06	0.06	0.06	0.06	0.06	0.06
mitigated	California	Hurricane	Partial	0.00	0.00	0.00	0.01	0.02	0.00
mitigated	California	Tsunami	Partial	0.05	0.05	0.05	0.05	0.05	0.05
mitigated	California	Vessel Accident	Partial	0.00	0.00	0.00	0.00	0.00	0.00
Unmitigated	California	Earthquake	Full	0.01	0.01	0.01	0.01	0.01	0.01
Unmitigated	California	Hurricane	Full	0.00	0.00	0.00	0.01	0.02	0.00
Unmitigated	California	Tsunami	Full	0.00	0.00	0.00	0.00	0.00	0.00
Unmitigated	California	Vessel Accident	Full	0.00	0.00	0.00	0.00	0.00	0.00

2.2.6 Calculations Page #6: Species Sensitivity Interim Results

Three results tables are presented on the **Species Sensitivity Interim Results** calculation page, these include **Impact-Causing Factor Vulnerability, Impact, and Recovery Scores**; **Species Sensitivity Scores for Individual Species**; and **Species Sensitivity Scores at the Species Group Level**. In general, higher scores represent a species that is more sensitive to an individual ICF or during a certain period. Higher recovery scores represent species that have a lower probability to recover should OFW cause substantial population declines (i.e., threatened or endangered species, or species with late maturation/ long gestation times).

The **Impact-Causing Factor Vulnerability, Impact, and Recovery Scores** report table includes fields for: Scenario, Value, Region, Species Group, Species Sub-Group, Common Name, Artificial Light (AL) Impact, Accidental Spill (AS) Impact, Collisions Above Surface (CAS) Impact, Collisions and Subsurface Entanglements (CSE) Impact, Electromagnetic Field (EMF) Impact, Habitat Disturbance/Displacement (HD) Impact, Sound/Noise (SN) Impact, Vessel Strike (VS) Impact, overall Impact Score, and Recovery Score. These scores represent the vulnerability to each kind of impact-causing factor as well as the recovery potential for each species based on assessment metric scores assigned during a thorough species life history literature review (see Section 3.4).

Impact causing factor (i.e., CSE, EMF, etc.) scores of NA indicate that a species/species group as a whole is not vulnerable to that factor in relation to OFW (e.g., collisions above surface impact-causing factor does not apply to fish or marine mammals, only birds).

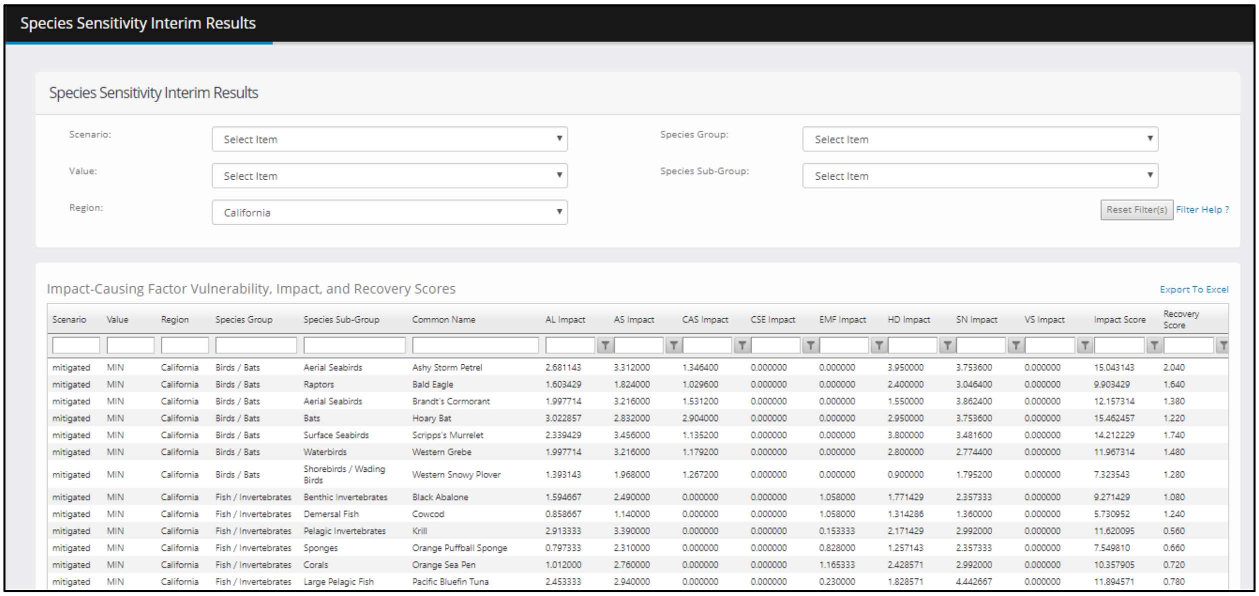
The **Species Sensitivity Scores for Individual Species** result table includes fields for: Scenario, Value, Region, Species Group, Species Sub-Group, Common Name, Period 1, Period 2, Period 3, Period 4, Period 5, Period 6, Annual. These scores represent the sensitivity of each species to OFW impacts, compared to a hypothetical maximum most sensitive species of each species group.

The **Species Sensitivity Scores at the Species Group Level** result table includes fields for: Scenario, Value, Region, Species Group, Period 1, Period 2, Period 3, Period 4, Period 5, Period 6, Annual. These scores represent an average of the species-specific sensitivity scores for each species group.

These tables can be filtered by the following options:

- Region:
  - California;
  - Hawaii North;
  - Hawaii South;
  - Hypothetical for California;
  - Hypothetical for Hawaii, and
  - any regions added by users.
- Scenario:
  - Mitigated
  - Unmitigated
- Species Group:
  - Birds / Bats (BB)
  - Fish / Invertebrates (FI)
  - Marine Mammals / Turtles (MT)
- Value:
  - Min = lower estimate based on levels of uncertainty
  - Mid = best estimate based on assigned rank

- Max = upper estimate based on levels of uncertainty

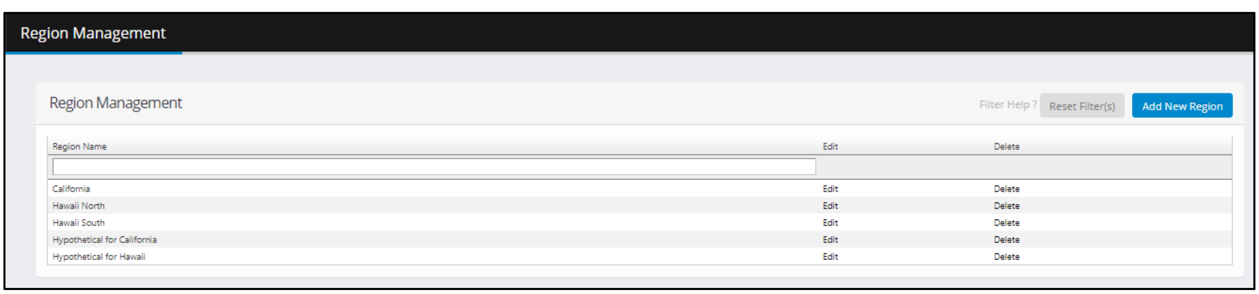


2.3 Data Management: Add/Update Data through GUI

This section of the manual provides guidance on how the user can add or update data through the GUI. The sections below walk through the instructions for different types of model input data including data for regions, habitats, baseline conditions, LSEs, references, and species. In order to add a new study area, users must populate GUI with all required data and information. Prompts and text throughout the GUI and explanations in this manual will guide users through the data entry process. In addition to adding new study areas, users can edit already included study regions or add more data to some sections, such as additional species or references, to make results more robust. Finally, the functions to add, edit, or delete data entries is very similar for all data management types and explained in greater detail in the following sections.

2.3.1 Region Management

Clicking the **Manage Regions** page from the dashboard will lead to the **Region Management** table, which has columns labeled: Region Name, Edit, and Delete. There is a search bar under Region Name, which allows users to search for specific data entries to edit or remove.

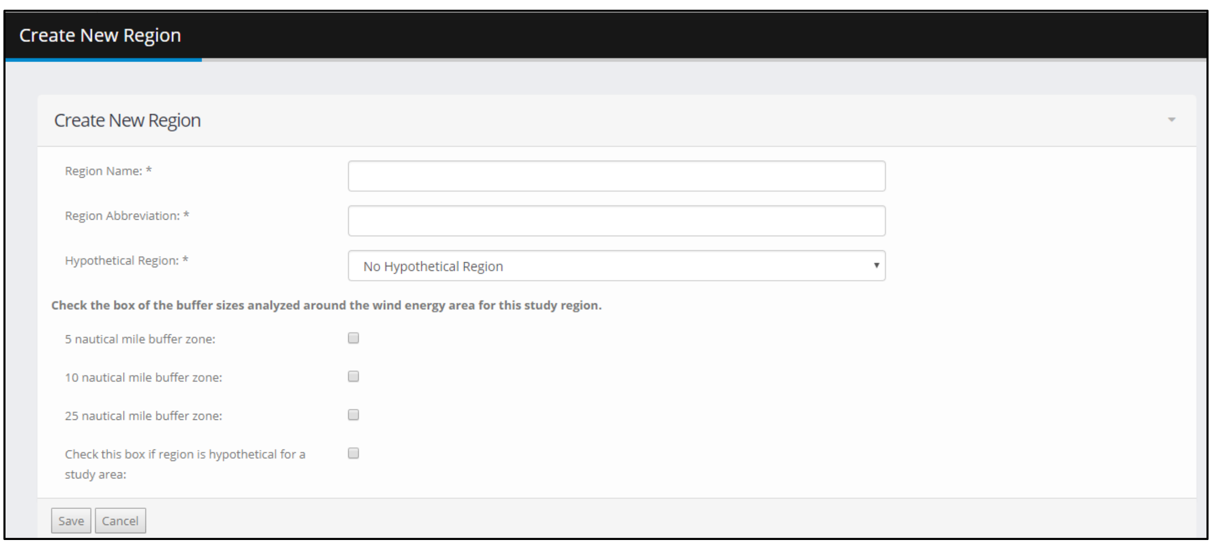


To add a new region, begin by clicking the **Add New Region** button to the right of the table (circled in red in below image).

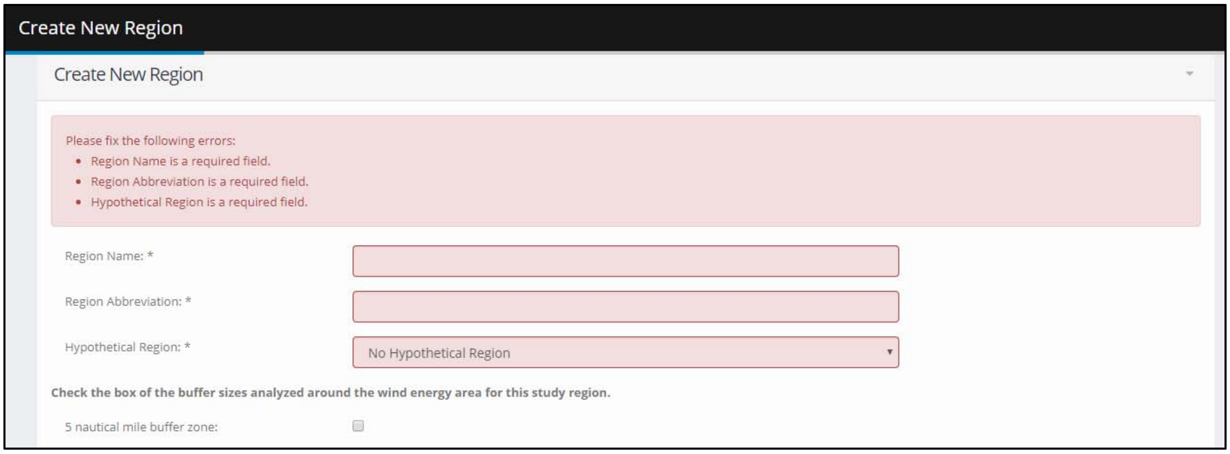
The page to add a new region contains the same fields as the page to edit a region. Required fields are indicated by an asterisk on the screen. Necessary steps include the following:

- Enter text into the Region Name and Region Abbreviation boxes. Select the appropriate corresponding Hypothetical Region for the model analysis from the drop-down menu.
  - For example, if adding a new region offshore of California, choose the Hypothetical for California option.
  - If adding a new region that does not have a corresponding hypothetical region in the drop-down menu, you must add the hypothetical region to the database first.
    - To add a hypothetical region, click Add New Region, include “Hypothetical for XX” as the Region Name, with “XX” as the same name as the study region, and check the box that says “check this box if region is hypothetical”. This would only need to be done if adding a new study region outside of California or the main Hawaiian Islands, as the hypothetical regions for these study areas already exist in the database.
    - For additional details regarding data preparation for hypothetical maximum regions, see Section 3.2 of this manual.

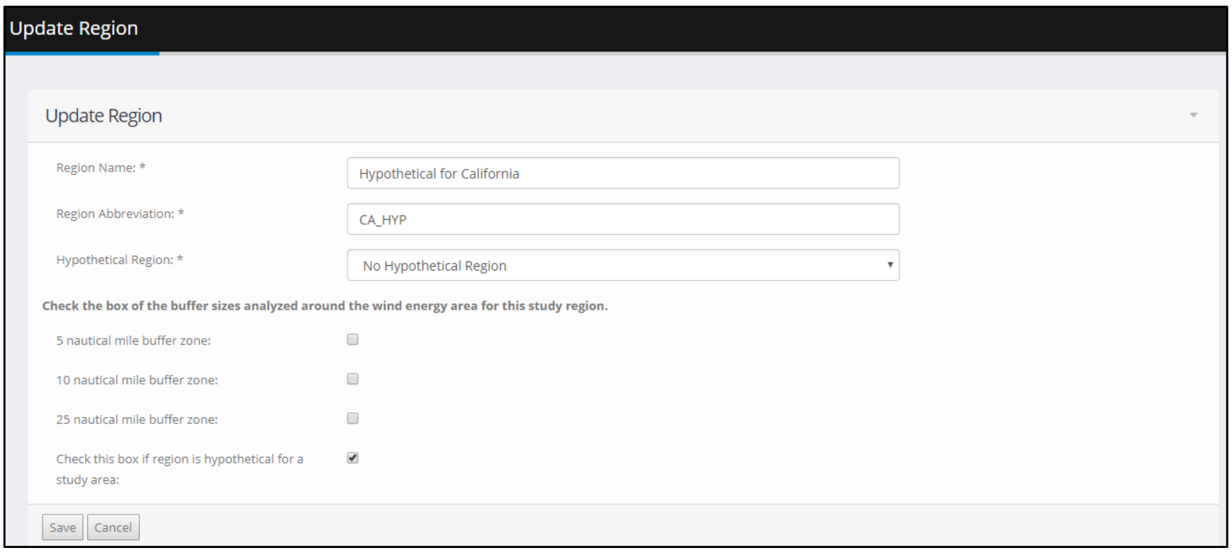
- Click the appropriate boxes to indicate the sizes of the buffer zones applied during spatial data preparation for baseline conditions and habitat analyses.



Click **Save** to save the entry. Any required fields that have not been filled in or were filled in incorrectly will be highlighted in RED after hitting **Save** (as seen below). Add or edit information and re-save. After saving, the GUI will return to the **Region Management** main page.



To edit a region, select **Edit** in the corresponding data row in the **Region Management** table. This will open a new page to update data for the region selected to edit (seen in image below).



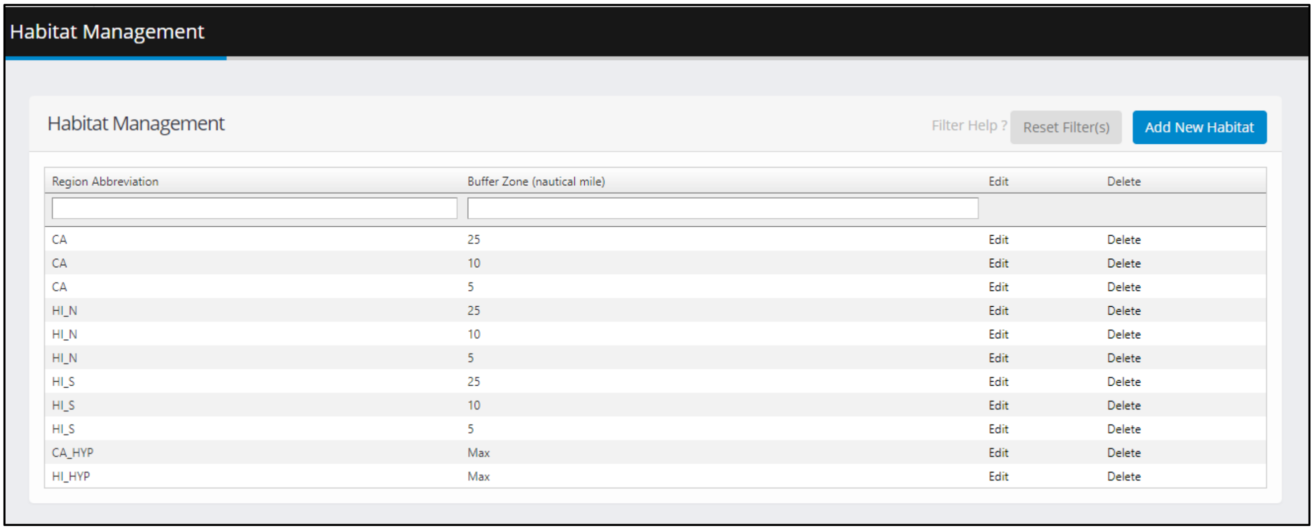
Either click **Save** or **Cancel** at the bottom of the prompt box to return to the main **Region Management** table.

To delete a region, simply click on **Delete** in the corresponding data row. As an important note related to the Delete function in all Data Management pages, when the user deletes something that data in another table relies upon, an error message will appear explaining that the delete was unsuccessful. In order for the delete function to work properly, the user must delete all of the data that is associated with the data they are trying to delete. For instance, the user is able to delete one species associated with a region if it is not linked to other tables. However, the user could not delete a region that had 10 other species associated with it until he/she first deleted the data entered for those species.

2.3.2 Habitat Management

The methods to **Add New Data**, **Edit**, or **Delete** data entries are similar to those described earlier for all Data Management pages in the GUI (i.e., region, habitat, baseline conditions, etc.).

Clicking the **Manage Habitats** page in the dashboard will lead to the Habitat Management table, which has columns labeled: Region Abbreviation, Buffer Zone (nautical mile), Edit, and Delete.


Habitat Management

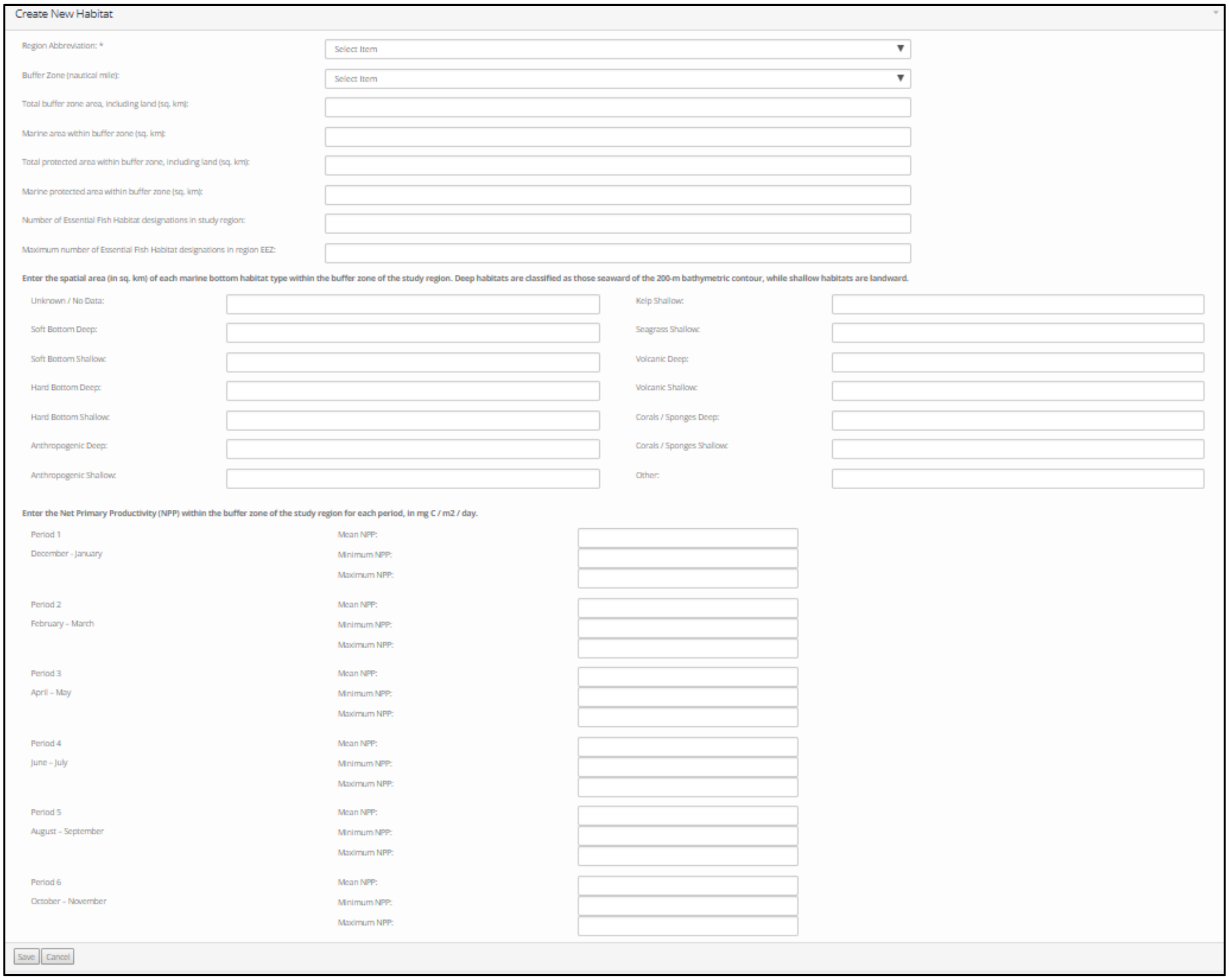
Habitat Management

Filter Help ? Reset Filter(s) Add New Habitat

Region Abbreviation	Buffer Zone (nautical mile)	Edit	Delete
CA	25	Edit	Delete
CA	10	Edit	Delete
CA	5	Edit	Delete
HI_N	25	Edit	Delete
HI_N	10	Edit	Delete
HI_N	5	Edit	Delete
HI_S	25	Edit	Delete
HI_S	10	Edit	Delete
HI_S	5	Edit	Delete
CA_HYP	Max	Edit	Delete
HI_HYP	Max	Edit	Delete

Clicking on the **Add New Habitat** button in the upper-right corner of the **Habitat Management** table will take the user to a page where they can add new habitat to the database. Data necessary to add new habitat in the **Habitat Management** page will be obtained from preliminary literature reviews (e.g., EFH designations) and GIS analyses (e.g., spatial area of marine bottom habitat type). Data preparation for these fields is explained in more detail in Section 3.3 of this manual. Required fields are indicated by an asterisk on the screen, as seen in the figure below. Steps for adding new habitat include the following:

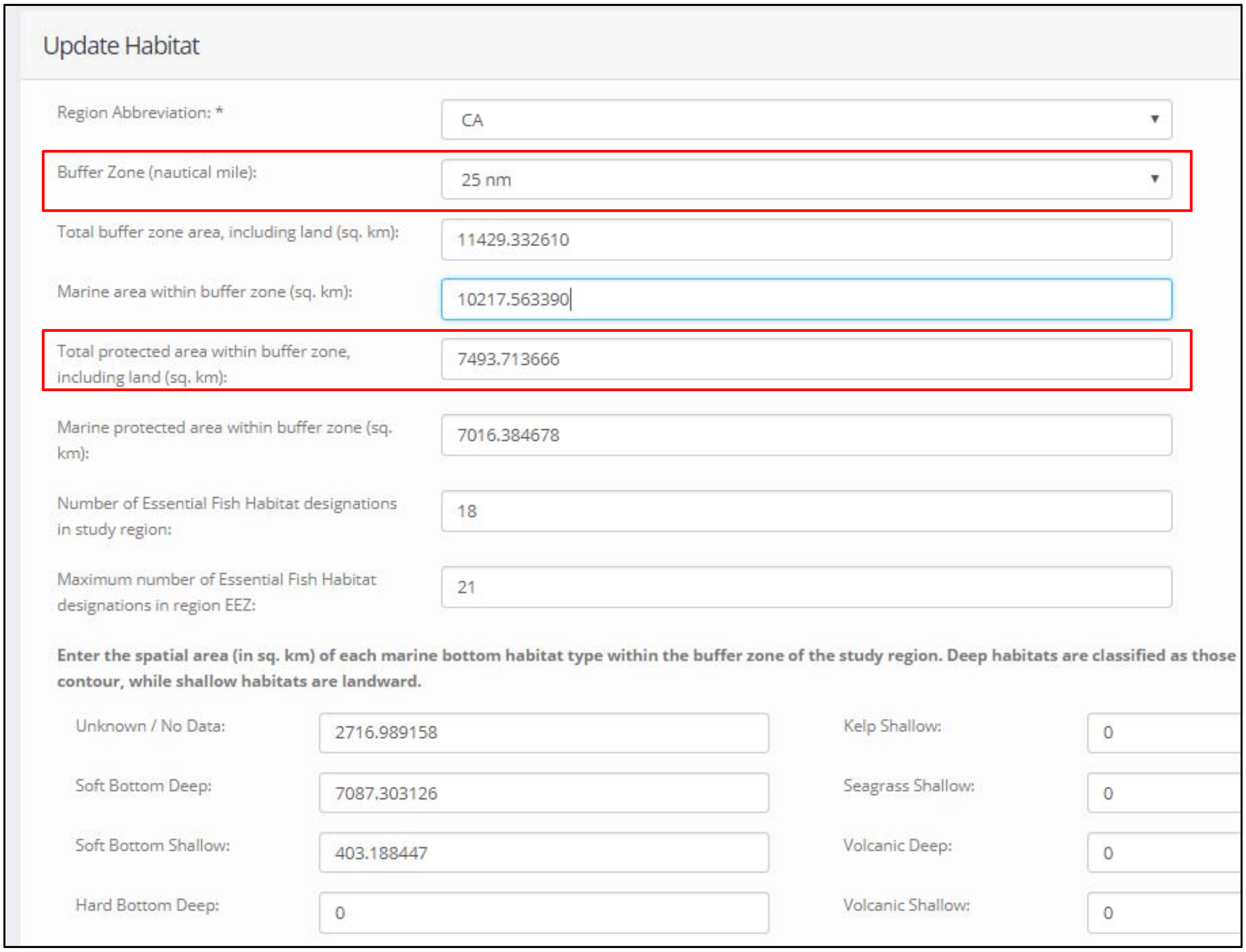
- Choose a region and buffer zone to add or update from the drop-down menu.
- Enter the total buffer zone area, marine buffer zone area, total protected area, and marine protected area in square kilometers into the boxes, up to 6 decimal places.
- Enter the count of Essential Fish Habitat designations in the study region and in the larger regional EEZ as integers.
- For each habitat type in the study region and buffer zone, enter the spatial area in square kilometers, up to 6 decimal places.
- Enter the mean, minimum, and maximum Net Primary Productivity (NPP) in each period for the study region and buffer zone in mg C/m^2/day, up to 6 decimal places.



Click **Save** to add the new Habitat and return to the **Habitat Management** page or cancel to return without saving.

Selecting **Edit** from the table on the **Habitat Management** page in the row for any regions will open a page of various fields pertaining to the habitat data for the region that is identical to the page for adding a new habitat.

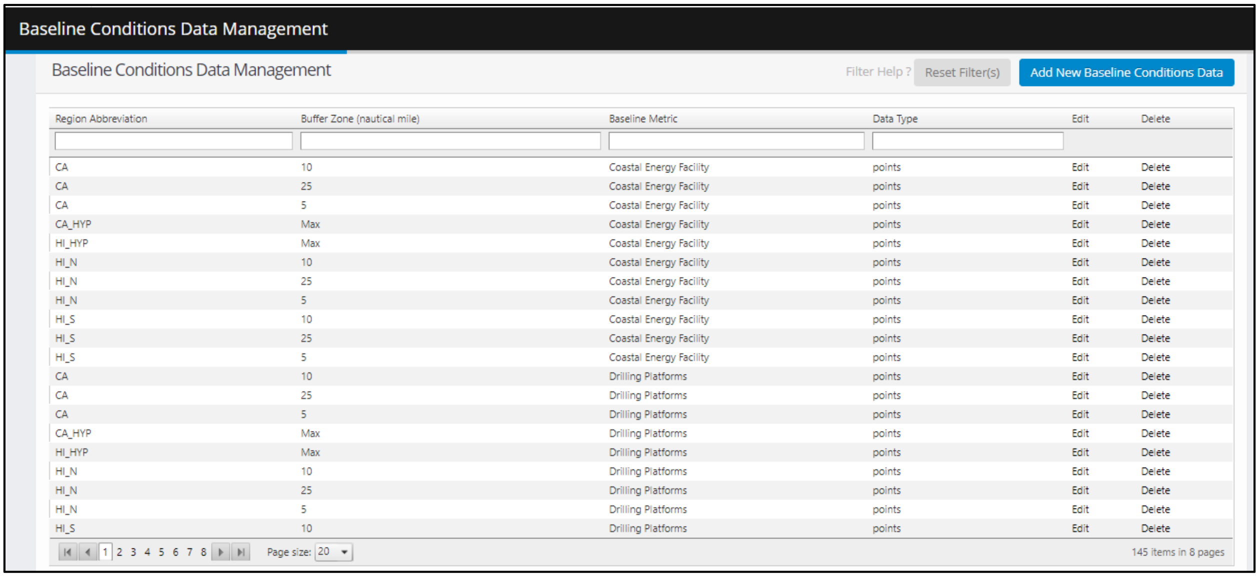
Data can be entered manually for some fields, such as **Total Protected Area Within Buffer Zone (sq. km)**, or selected from a drop-down menu, such as **Buffer Zone (nm)**.



As for adding a new habitat, clicking **Save** will save edits and return user to main table, while **Cancel** will return the user to the main table without saving edits.

2.3.3 Baseline Conditions Data

Clicking the **Manage Baseline Conditions Data** page in the dashboard will lead to the **Baseline Conditions Data Management** table, which has columns labeled: Region Abbreviation, Buffer Zone (nm), Baseline Metric, Data Type, Edit, and Delete. Baseline Metric refers to the type of anthropogenic activity in the lease area, while Data Type indicates the ArcGIS™ data type (e.g., points, polylines, polygons, or scores).



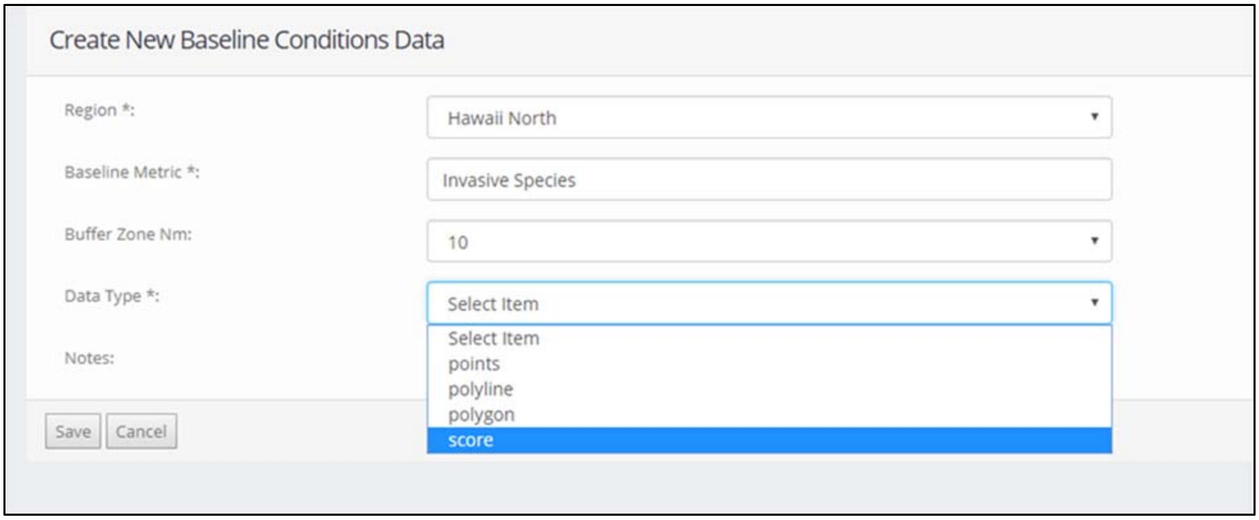
Region Abbreviation	Buffer Zone (nautical mile)	Baseline Metric	Data Type	Edit	Delete
CA	10	Coastal Energy Facility	points	Edit	Delete
CA	25	Coastal Energy Facility	points	Edit	Delete
CA	5	Coastal Energy Facility	points	Edit	Delete
CA_HYP	Max	Coastal Energy Facility	points	Edit	Delete
HI_HYP	Max	Coastal Energy Facility	points	Edit	Delete
HI_N	10	Coastal Energy Facility	points	Edit	Delete
HI_N	25	Coastal Energy Facility	points	Edit	Delete
HI_N	5	Coastal Energy Facility	points	Edit	Delete
HI_S	10	Coastal Energy Facility	points	Edit	Delete
HI_S	25	Coastal Energy Facility	points	Edit	Delete
HI_S	5	Coastal Energy Facility	points	Edit	Delete
CA	10	Drilling Platforms	points	Edit	Delete
CA	25	Drilling Platforms	points	Edit	Delete
CA	5	Drilling Platforms	points	Edit	Delete
CA_HYP	Max	Drilling Platforms	points	Edit	Delete
HI_HYP	Max	Drilling Platforms	points	Edit	Delete
HI_N	10	Drilling Platforms	points	Edit	Delete
HI_N	25	Drilling Platforms	points	Edit	Delete
HI_N	5	Drilling Platforms	points	Edit	Delete
HI_S	10	Drilling Platforms	points	Edit	Delete

1 2 3 4 5 6 7 8 Page size: 20 145 items in 8 pages

Clicking on the **Add New Baseline Conditions Data** button in the top-right corner of the baseline conditions management page will allow the user to add new data. Clicking on **Edit** will take users to the same data entry page as when adding a new entry, as seen below in example figures. When adding new Baseline Condition Data, the data entry page will change depending on **Data Type** selected from the drop-down menu for that field. **Data Type** options include: points, polyline, polygon, and score. The point, polygon, and polyline options refer to shapefile data and the score option refers to categorical (low, med, high) Raster data. The processing of these data must be done in ArcGIS™, prior to data entry. Methods to prepare these data are explained in Section 3.3 of this manual.

All fields in the **Create New Baseline Condition Data** page are required except for Notes.

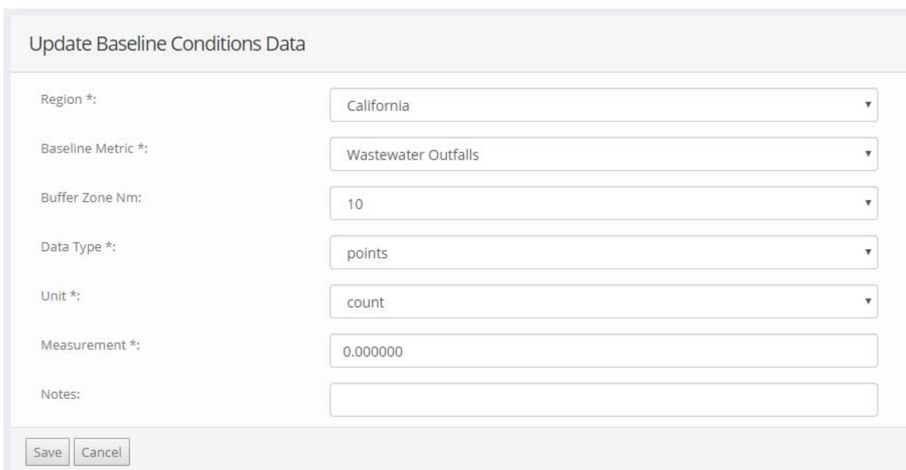
- Select the appropriate **Region** and **Buffer Zone** via drop-down menu.
- Enter short text into the **Baseline Metric** box.
- Select **Data Type** and Unit from drop-down menus.
- Enter long text into the Notes field with any notes or comments pertaining to the data or the entry.



For Baseline Metrics with point data selected in the **Data Type** field:

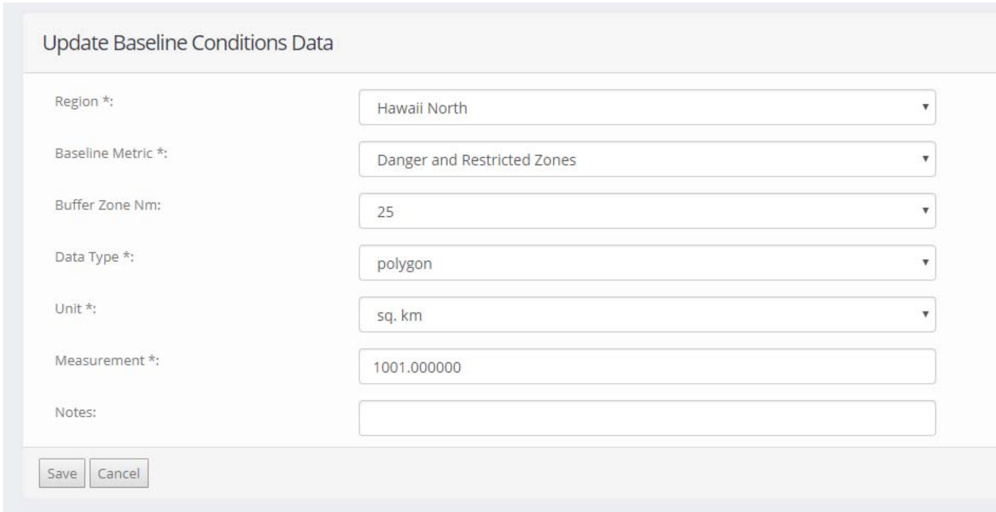
- Select Points from the **Unit** drop-down menu.
- Enter the number of points (integer) within the selected Buffer Zone in the **Measurement** field.

For example, in the figure below, the entered data indicates that within the 10 nm Buffer Zone of the California Lease Block, there are 0 Wastewater Outfalls, while within the California EEZ, there are 21 Wastewater Outfalls.



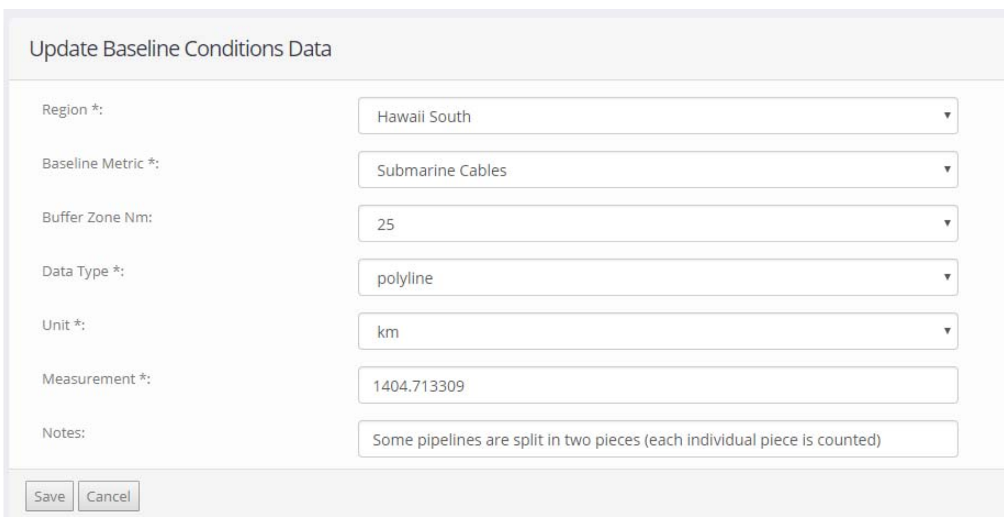
For Baseline Metrics with polygon data selected in the “Data Type” field:

- Select sq. km in the **Unit** drop-down menu
- Enter the total area (km^2), up to 6 decimal places, of the polygons for the Baseline Metric that are within the selected Buffer Zone in the **Measurement** field.



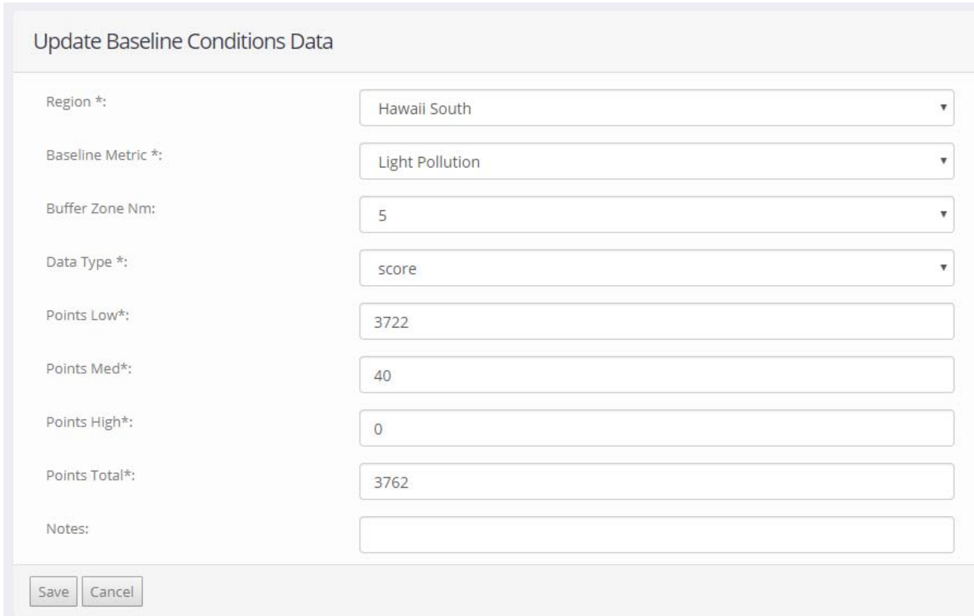
For Baseline Metrics with polyline data selected in the **Data Type** field:

- Select km in the **Unit** drop-down menu.
- Enter the total length (km), up to 6 decimal places, of all lines for the Baseline Metric that are within the selected Buffer Zone in the **Measurement** field.



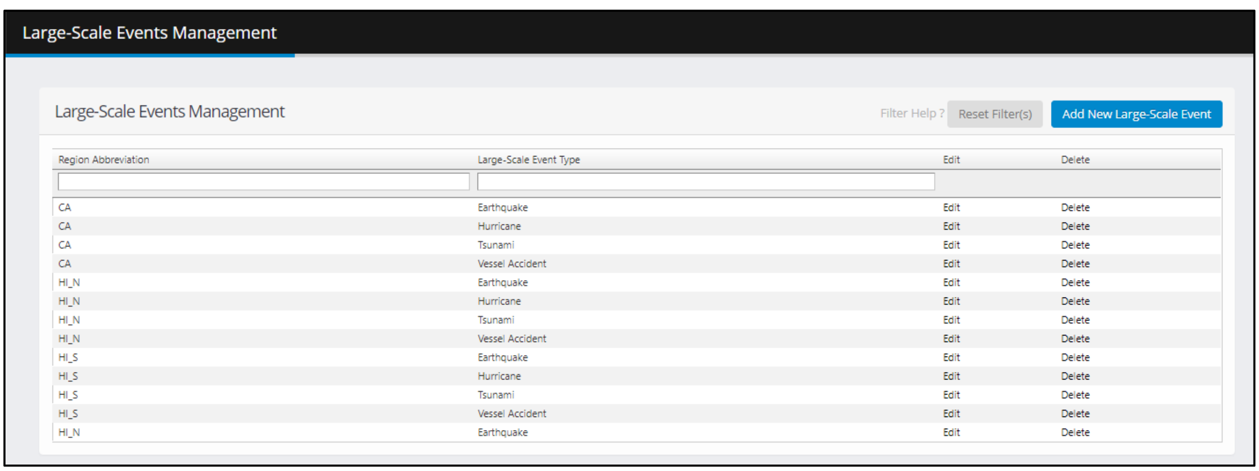
For Baseline Metrics with score data (categorical raster data) selected in the **Data Type** field:

- Enter the count of low, medium, and high value points in the Buffer Zone for that metric in the respective **Points Low**, **Points Med**, and **Points High** fields as an integer.
- If the "score" data type is selected (as shown below), enter the total count of points (low, medium, and high) in the Buffer Zone in the **Points Total** field as an integer.



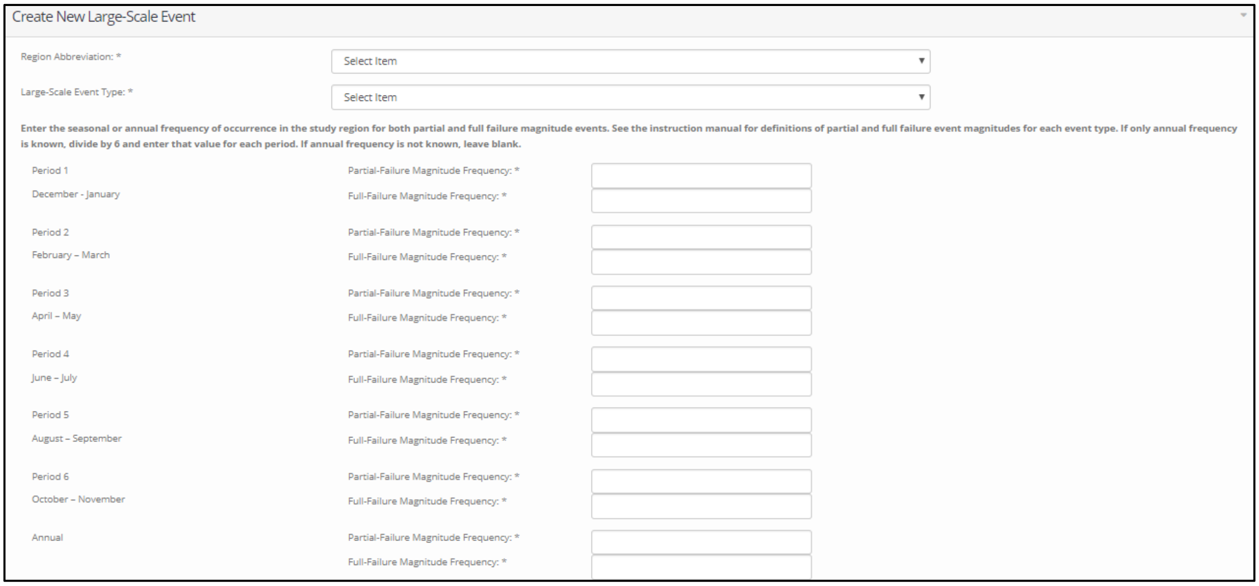
2.3.4 Large-Scale Events

Clicking the **Manage Large-Scale Events** page in the dashboard will lead to the **Large-Scale Events Management** table, which has columns labeled: Region Abbreviation, Large-Scale Event, Edit, and Delete.

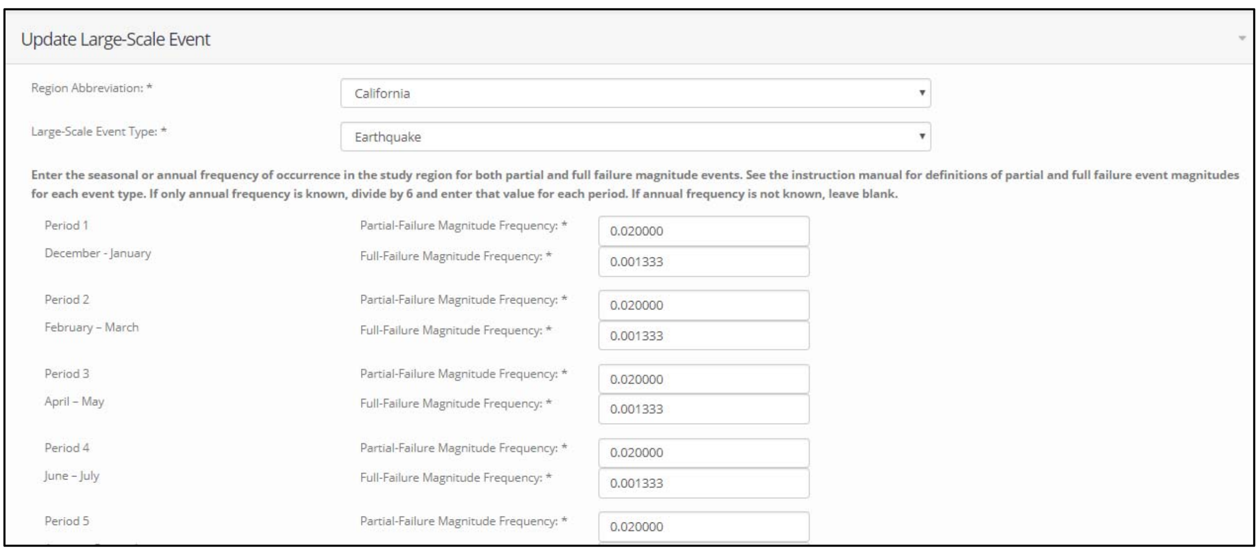


Clicking on the **Add New Large-Scale Event** button in the top-right corner of the **Large-Scale Events Management** page will allow the user to add new data. To add new data to the Large-Scale Event section:

- Select the Region and type of Large-Scale Event from the drop-down menus.
  - Types of Large-Scale Events include: Earthquake, Hurricane, Tsunami, and Vessel Accident.
- Enter frequencies between 0-1 up to 6 decimal places in the Partial and Full Frequency fields.
  - The frequency data are calculated by the user in analyses outside of the GUI. Detailed explanation of frequency values and how they are derived outside of the GUI are explained in more detail in Appendix F.3 in the Study Report.

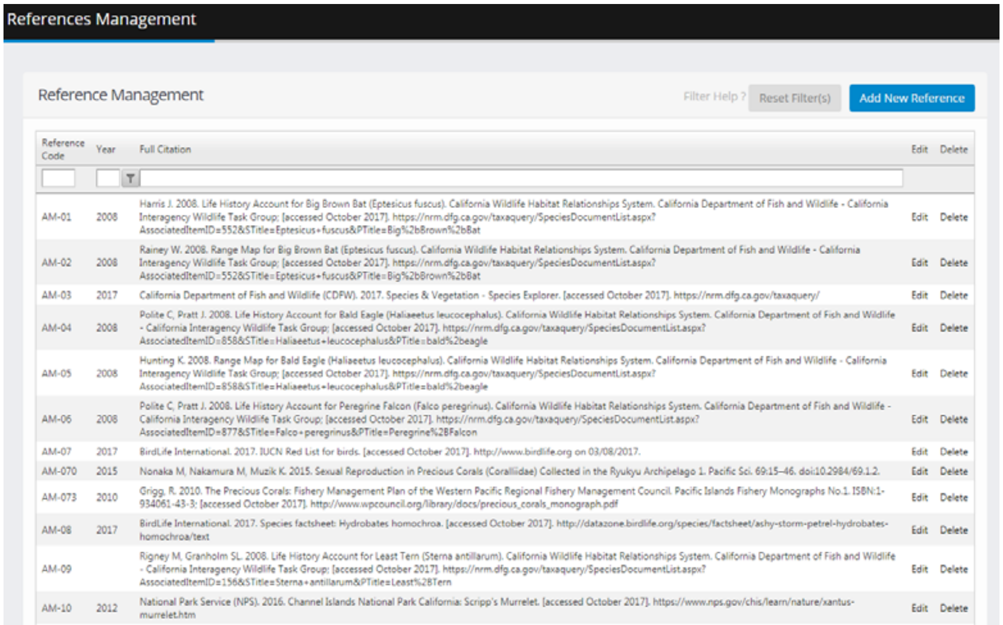


To edit an existing LSE entry, click **Edit** in the row corresponding to the entry of interest in the **Large-Scale Events Management** table.



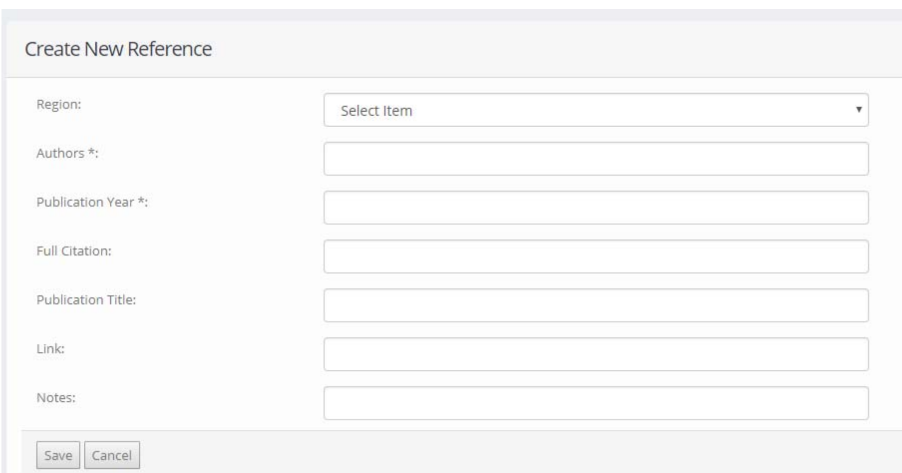
2.3.5 References

Clicking the **Manage References** page in the dashboard will lead to the **References Management** table, which has columns labeled: Reference Code, Year, and Full Citation. All references used in data acquisition for the model should be logged in the GUI. To edit or delete an existing Reference entry, click **Edit** or **Delete** in the corresponding row. Click the blue “Add New Reference**”** button to create a new reference.



The Authors and Publication Year fields are required. Steps to add a reference include the following:

- Select the Region to which the reference applies from the drop-down menu, if applicable.
- Enter short text in the **Authors** field, separating multiple authors using a comma (,).
- Enter the **Publication Year** as an integer.
- Enter data into **Full Citation** and **Publication Title** fields as short text.
- Enter any **Notes** about the reference or the data entry the reference will support as long text in the **Notes** field.



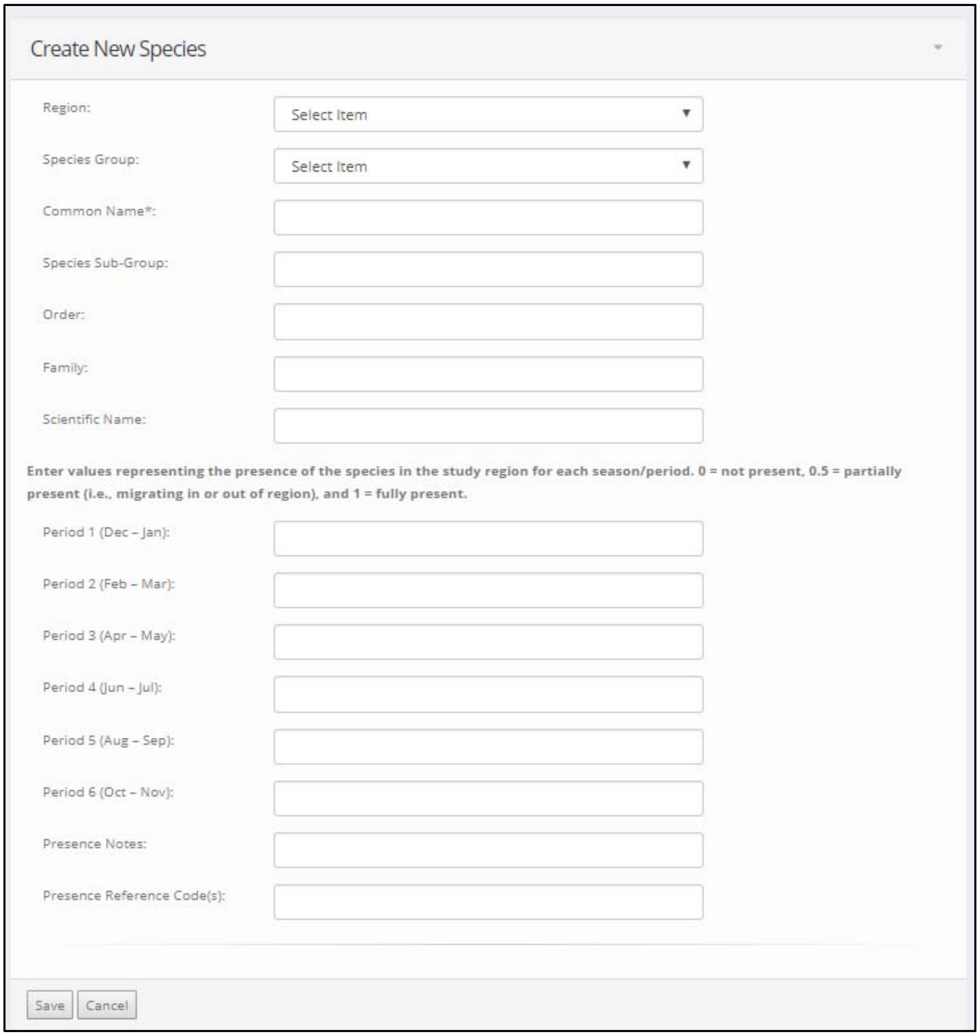
2.3.6 Species

Clicking the **Manage Species** page in the dashboard will lead to the **Species Management** table, which has the columns labeled: Region Abbreviation, Group, Sub-Group, Common Name, Edit, and Delete.

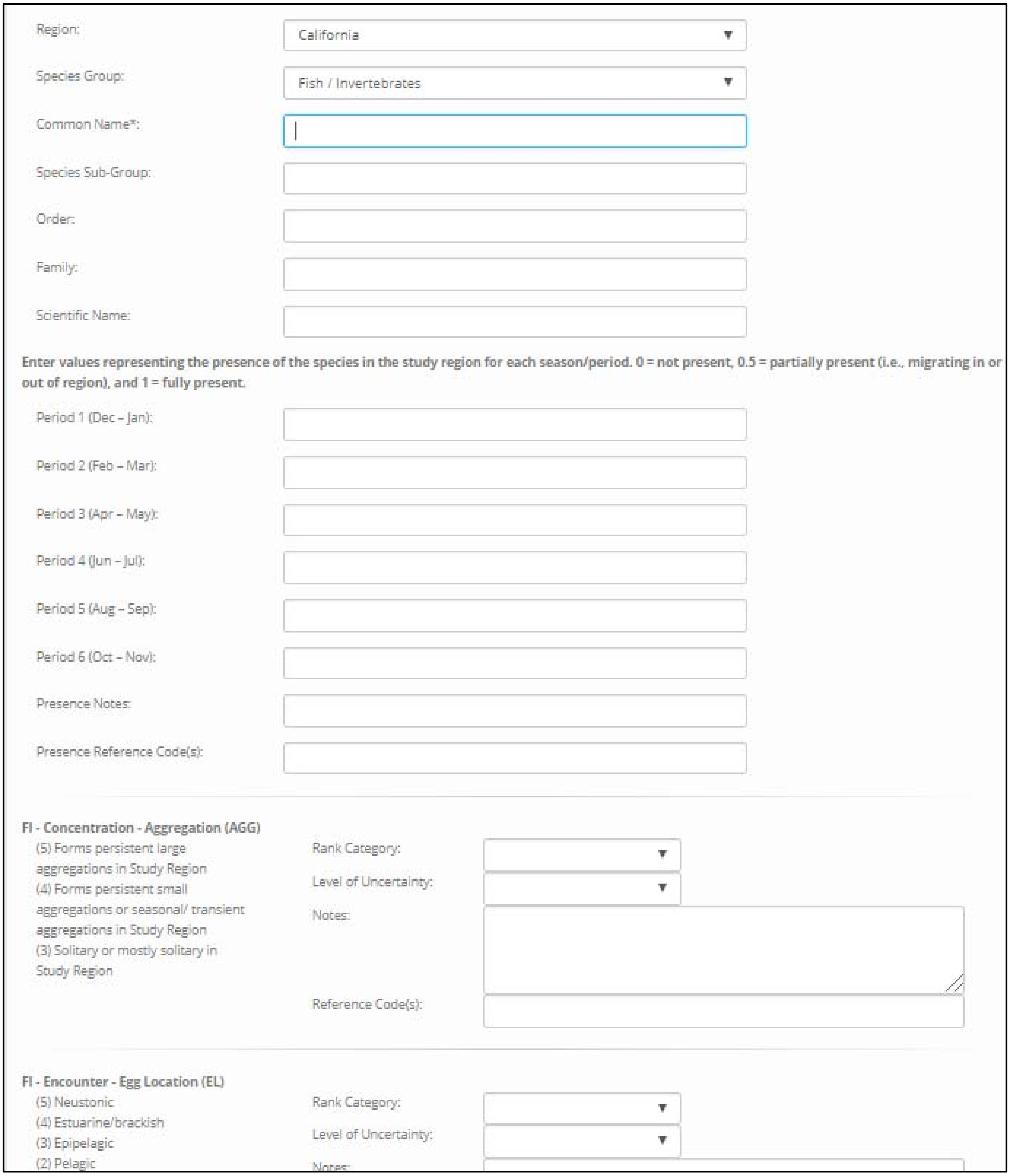
Clicking on the **Add New Species** button in the top-right corner of the **Species Management** page will allow the user to add new data. For the **Species Management** data table, users will answer three sets of questions: general (e.g., Region, Species Group, etc.), presence and absence (e.g., Period 1, Period 2, etc.), and Species Scoring Tables specific to each species group. Data for Species should be obtained from a thorough literature review of life history characteristics and behaviors of each species analyzed in the Region.

- Select **Region** and **Species Group** via drop-down menus.
- Enter **Common Name, Species Sub-Group, Order, Family**, and **Scientific Name** as short text. All of these fields, other than **Common Name**, are optional as they are not used in any of the model calculations.
- Enter numeric values (between 0 and 1) in each of the **Period** fields based on the presence of the species in the selected region during particular months of the year.
- Notes pertaining to the presence/absence fields can be entered as long text in the **Presence Notes** field. **Presence Notes** can be any relevant information from references that supports the presence/absence scores given for that species.
- List the **Presence Reference Codes** for the references consulted to make presence/absence decisions in short text. The **Presence Reference Codes** field refers to the unique code applied to each reference as it is added to the **References Data Management** table. Include the **Presence Reference Codes** for all references used to make the decision and included in the **Presence Notes** field. If multiple **Presence Reference Codes** need to be listed, separate with a comma (,). **Presence Reference Codes** contain the user's initials followed by a dash (-) and the sequential number for that reference. The **Presence Reference Codes** are autogenerated by the GUI, so the reference needs to be added to the database first to obtain a code.

For a more detailed description of Species data acquisition that provides information necessary to obtain data for all fields, see Section 3.4.1 of this manual.



When creating a new species, defining **Species Group** from the drop-down menu will cause several group-specific species scoring questions to appear. Questions will be prefaced with an abbreviation for the species group selected (e.g., “FI” the questions pertaining the fish and invertebrates group).



The answers to the Species Scoring questions should be based on a literature review.

- Select the number that corresponds to the **Rank Category** text via the drop-down menu.
  - **Rank Category** corresponds to the description that best matches the behavior or life history of the species under review. More detailed descriptions of the **Rank Categories** are located in Appendix B of the Study Report (seen in example below) and should be referred to during data entry to ensure that the most informed scoring decisions are made.

Table B-28. Fish and invertebrate aggregation assessments for concentration impact during all project phases

Ranking Score - Category	Category Description	ICF Scores							
		AS	AL	CAS	CSE	EMF	HD	S/N	VS
(5) Forms persistent large aggregations in Study area	While in Study area, species maintains large schools or aggregations.	5	5	--	--	--	--	5	--
(4) Forms persistent small aggregations or seasonal/ transient aggregations in Study area	While in Study area, species forms persistent small aggregations/schools or seasonal (usually breeding- or feeding-related) aggregations/schools. Large aggregations/schools do not persist throughout the year.	3	3	--	--	--	--	3	--
(3) Solitary or mostly solitary in Study area	While in Study area, species is solitary, or forms very small transient groups.	1	1	--	--	--	--	1	--

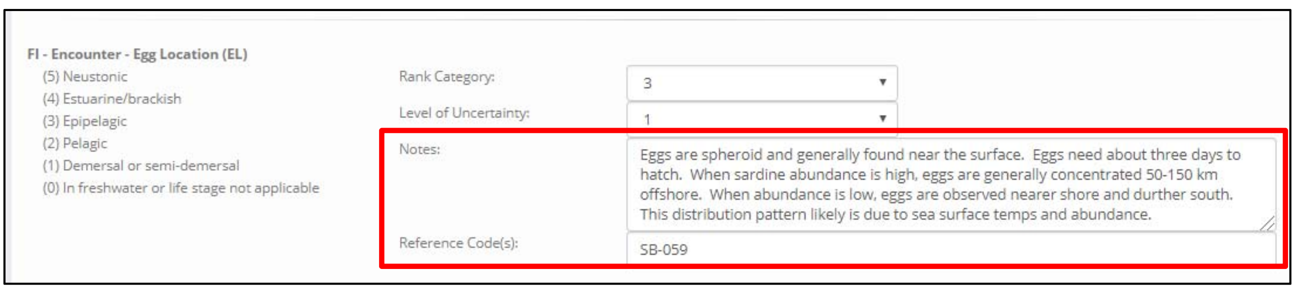
Species that form large aggregations are both more likely to be impacted and more likely to be impacted at a population scale by accidental spills (Niedoroda et al. 2014) and artificial light. Species that are more solitary are less likely to have population level impacts from OFW.

- For example, if a Rank Category score of 5 is given to a fish / invertebrate species for **Concentration-Aggregation (AGG)**, a score of 5 is added to the Impact Causing Factor (ICF) Scores for Accident Spill (AS), Artificial Light (AL), and Sound/Noise (S/N). If a ranking score of 4 is given, a score of 3 for the ICFs would be applied. Possible ICF scores range from 0 (lowest) to 5 (highest impact).

- Select the numerical value for **Level of Uncertainty** via the drop-down menu.
  - **Level of Uncertainty** refers to the confidence of the user in the rank category assigned, based on information (or lack thereof) found during the literature review. A **Level of Uncertainty** score of 1 indicates the user is confident in the Rank Category assigned, while a score of 3 indicates a lack of confidence and typically related to a lack of data available for that species. For a more detailed description of the Level of Uncertainty, refer to Section 3.4.2.4 in this manual and Appendix B B.6 of the Study Report.

- Enter any notes from the literature used to assign **Rank Category** in the **Notes** field as long text.

- Enter the **Reference Codes** for all of the references used to make the decision on **Rank Category** as short text.
  - The **Reference Code** field refers to the unique code applied to each reference as it is added to the **References Data Management** table. Include the **Reference Code** for all references used to make the decision and included in the **Notes** field. If multiple **Reference Codes** need to be listed, separate with a comma (,). **Reference Codes** contain the user's initials followed by a dash (-) and the sequential number for that reference. The **Reference Codes** are autogenerated by the GUI, so the reference needs to be added to the database first to obtain a code.



Reference Code	Year	Full Citation
SB-039	2014	Meyer A. 2014. Whale Adaptations-Body Temperature. http://www.whalesforever.com/whale-adaptations-body-temprature.html
SB-040	1990	Hokkanen JEI. 1990. Temperature Regulation of Marine Mammals. Journal of Theoretical Biology. Volume 145, Issue 4, 1990, Pages 465-485. https://doi.org/10.1016/S0022-5193(05)80482-5
SB-041	2005	COSEWIC. 2005. COSEWIC assessment and update status report on the fin whale Balaenoptera physalus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 37 pp. (www.sararegistry.gc.ca/status/status_e.cfm).
SB-042	2014	Bailey H, Brookes KL, Thompson PM. 2014. Assessing environmental impacts of offshore wind farms: lessons learned and recommendations for the future. Aquat. Biosyst. 10:8. doi:10.1186/2046-9063-10-8.
SB-043	2014	Ramp C, Delarue J, Berube M, Hammond PS, Sears R. 2014. Fin whale survival and abundance in the Gulf of St. Lawrence, Canada. Endangered Species Research 23: 125-132. http://www.int-res.com/articles/esr2014/23/n023p125.pdf
SB-044	2015	NOAA Fisheries. 2015. Fin Whale (Balaenoptera physalus). http://www.nmfs.noaa.gov/pr/species/mammals/whales/fin-whale.html
SB-045	2003	Butler JL, Jacobson LD, Barnes JT, Moser HG. 2003. Biology and population dynamics of cowcod (Sebastes levis) in the southern California Bight. Fish. Bull. 101:260–280.
SB-046	2009	NOAA NMFS. 2009. Species of Concern: Cowcod (Sebastes levis). http://www.nmfs.noaa.gov/pr/pdfs/species/cowcod_detailed.pdf
SB-047	2001	Johnson KA, Yoklavich MM, Cailliet GM. 2001. Recruitment of three species of juvenile rockfish (Sebastes spp.) on soft benthic habitat in Monterey Bay, California. Calif. Coop. Ocean. Fish. Investig. Reports 42:153–166.
SB-048	2012	Hess JE, Chittaro P, Elz A, Gilbert-Horvath EA, Simon V, Garza JC. 2014. Cryptic population structure in the severely depleted cowcod, Sebastes levis. Canadian Journal of Fisheries and Aquatic Sciences 2014, 71 (1): 81-92. https://doi.org/10.1139/cjfas-2012-0510
SB-049	2012	Hanan DA, Curry BE. 2012. Long-Term Movement Patterns and Habitat Use Of Nearshore Groundfish: Tag-Recapture in Central and Southern California Waters. Open Fish Sci. J. 5:30–43.
SB-050	2000	Yoklavich M, Greene H, Gregor E, Sullivan D, Lea, R, Milton L. 2000. Habitat associations of deep-water rockfishes in a submarine canyon: An example of a natural refuge. Fishery Bulletin. 98. https://www.researchgate.net/publication/241398753_Habitat_associations_of_deep-water_rockfishes_in_a_submarine_canyon_An_example_of_a_natural_refuge
SB-051	2002	Love MS, Yoklavich M, Thorsteinson LK. 2002. The rockfishes of the northeast Pacific. University of California Press. 404 pp. https://books.google.com/books?id=DA9sxkan-rgC&pg=PA23&lpg=PA23&dq=do+cowcod+school&source=bl&ots=tx1YY-b_SB&sig=ZLH4_EJJA2DNs_SAQiVxhiR0iyw&hl=en&sa=X&ved=0ahUKEwiZ4IvvibXWAhVKOMAKHewGCd8Q6AEIXTAK#v=onepage&q=do%20cowcod%20school&f=false
SB-052	2006	Allen LG, Pondella DJ, Horn MH. 2006. The ecology of marine fishes: California and adjacent waters. University of California Press. 660 pp. https://books.google.com/books?id=XQMmDQAAQBAJ&pg=PA258&lpg=PA258&dq=do+cowcod+school&source=bl&ots=UN5MOM-YPR&sig=DITD9GwKabITwjAKvjFO58EybZA&hl=en&sa=X&ved=0ahUKEwjnlIn3irXWAhWgF8AKHRLwCzw4ChDoAQg0MAM#v=onepage&q=do%20cowcod%20school&f=false

An example of the data entry for Species is provided in the image below.

BB - Concentration - Aggregation (AGG)

(5) Forms persistent large aggregations in Study Region
(4) Forms persistent small aggregations or seasonal/ transient aggregations in Study Region
(3) Solitary or mostly solitary in Study Region

Rank Category: 5
Level of Uncertainty: 1
Notes: Hoary bats would be in the study region during fall migrations. They have been spotted on offshore islands off of san fransico. During migration and during feeding they form large groups.
Reference Code(s): SB-115, SB-116

BB - Encounter - Diurnal Flight Activity (DFA)

(5) 0-20 Percent
(4) 21-40 Percent
(3) 41-60 Percent
(2) 61-80 Percent
(1) 81-100 Percent

Rank Category: 4
Level of Uncertainty: 1
Notes: Bats are nocturnal. Hoary bats roost in trees and forage at night. During migrations they fly during the day.
Reference Code(s): SB-115

BB - Encounter - Feeding Method (FM)

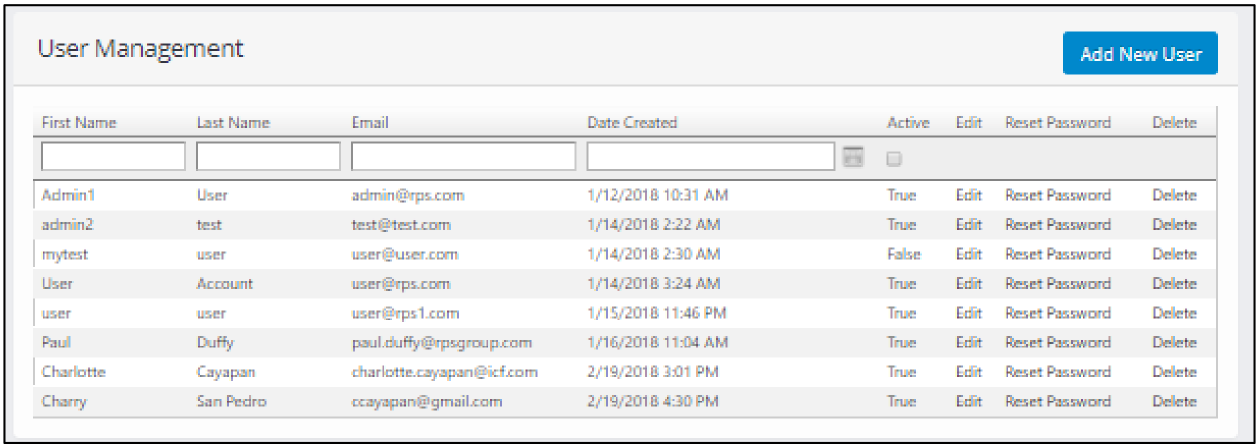
(5) Feeds from surface waters (< 10 m deep)
(4) Dives below surface to feed from deeper portions of the water column (> 10 m deep)
(3) Forages in intertidal sediments
(2) Does not forage from estuarine or marine habitat

Rank Category: 2
Level of Uncertainty: 1
Notes: Hoary bats feed primarily on moths. Depending on moth availability, they also feed on flies, beetles, wasps and other insects.
Reference Code(s): SB-115

2.4 User Management: Admin Only

The **User Management** page can be accessed from the menu bar at the top of the webpage from any page in the GUI. This is for Administrative use only and is the control center for adding or managing users and setting permissions for their ability to edit the database.

The **User Management** table shows: First Name, Last Name, Email, Date Created, Active, Edit, Reset Password, and Delete. There is also an **Add New User** button above and on the right side of the table, which allows an Admin to add users.


User Management

Add New User

First Name	Last Name	Email	Date Created	Active	Edit	Reset Password	Delete
Admin1	User	admin@rps.com	1/12/2018 10:31 AM	True	Edit	Reset Password	Delete
admin2	test	test@test.com	1/14/2018 2:22 AM	True	Edit	Reset Password	Delete
mytest	user	user@user.com	1/14/2018 2:30 AM	False	Edit	Reset Password	Delete
User	Account	user@rps.com	1/14/2018 3:24 AM	True	Edit	Reset Password	Delete
user	user	user@rps1.com	1/15/2018 11:46 PM	True	Edit	Reset Password	Delete
Paul	Duffy	paul.duffy@rpsgroup.com	1/16/2018 11:04 AM	True	Edit	Reset Password	Delete
Charlotte	Cayapan	charlotte.cayapan@icf.com	2/19/2018 3:01 PM	True	Edit	Reset Password	Delete
Charry	San Pedro	ccayapan@gmail.com	2/19/2018 4:30 PM	True	Edit	Reset Password	Delete

3 Model Data Preparation

The OFWESA model incorporates data of three different types: frequency data, spatial data, and literature review ranking data. This section of the manual describes the required steps to prepare data for each parameter before input into the GUI where the model calculations occur. The data entry steps are described in Section 2.3 above.

3.1 Large-Scale Event Frequencies

LSEs are considered categorically within the OFWESA model as those events that could lead to partial or complete structural failure of an OFW turbine or field. LSEs represent incidents that occur outside of normal operational parameters of OFW facilities as earthquakes, tsunamis, and storms (e.g., hurricanes), as well as accidents from vessels servicing or transiting by an OFW facility. Specifically, these events could cause or increase the occurrence of accidental spillage of oil and/or chemicals from wind turbine generators and other facility structures; bird collisions with above-surface facility structures; entanglement by fish and other marine organisms with sub-surface structures, and/or habitat disturbance (Table 1).

Effects of LSEs are incorporated into the model by increasing the impact scale and impact level score for each relevant ICF and project phase, thus increasing impact magnitude scores for some ICFs and phases. For additional information on how to calculate LSE frequencies, refer to Appendix C.3.2 and F.3 of the Study Report. For the impact magnitude tables included in the model, see Section 4.3 of this manual.

Table 1. OFWESA model risk matrix for large-scale events of different magnitudes.

Location	Hurricane		Earthquake		Tsunami		Vessel Allision with Damage to Wind Facility Structures	
	Partial Structure Failure	Major Structure Failure	Partial Structure Failure	Major Structure Failure	Partial Structure Failure	Major Structure Failure	Partial Structure Failure from Medium Vessel Allision	Complete Structure Failure from Larger Vessel Allision
Data Applied	Annual Frequency of Hurricanes in Region by Category		Annual Frequency of Earthquakes in Region by Magnitude		Annual Frequency of Tsunamis in Region by Magnitude		Vessel Traffic Data Annual Tonnage Annual Vessel Trips by Size	
Factor Magnitude	4	>5	5	>7	6	>7.9	Medium *Tows* *Tugs*	Larger *Tankers* *Bulkers* *Containers*

As described in more detail in Appendix F.3, the following steps should be followed to add LSE data for a new region:

1. Calculate LSE frequencies for each region and period at two magnitude levels (partial structural failure and full structural failure) for four LSE types (hurricanes, earthquakes, tsunamis, and vessel accidents). The model uses frequencies to calculate LSE scores, which include magnitude levels, frequency of occurrence, and relevant ICF impact magnitudes. Calculate frequency of occurrence for each LSE using historic data for each event type to first determine the likelihood of an event to occur at a magnitude large enough to cause structure failure.

2. For Hurricanes:

   a. Determine frequency of Category 4 and Category 5 hurricanes based on data from the NOAA National Hurricane Center (http://www.nhc.noaa.gov/climo/) using the assumption that storms of or above a Category 4 would be expected to cause partial structural failure, while Category 5 or above storms would be expected to cause a major structural failure.
   b. Calculate the frequency of storms expected to occur per year based on the historic occurrence of Category 4 or above hurricanes. Since increases in hurricane occurrence and force are expected as a result of climate change, the following adjustments[4] may be included in the frequency estimates to account for the increase over time (for more detail on making these adjustments, see Appendix F Section 4.6 of the Study Report).

      - Assume Category 4 hurricanes to increase in frequency by 10%.
      - Assume Category 5 hurricanes to increase in frequency by 25%.

   c. Calculate seasonal hurricane frequencies by dividing the expected annual number of hurricanes across the six model seasons based on low, medium, or high relative frequency of occurrence across the seasons.

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[4] The Category 5 hurricane frequency increase was based on a 10% increase from the 1970s, as per Mei et al. (2015), and by an additional factor of 2.5 times above that to account for the increase in stronger hurricanes. This additional factor is mid-point of the two to three times increase cited in Mei and Xie (2016).

3. For Earthquakes:

    a. Obtain data from the U.S. Geological Survey Earthquakes Hazards Program and NOAA's National Geophysical Data Center/World Data Service (NGDC/WDS).
    b. Use these data to calculate frequencies of occurrence based on the assumption that earthquakes above Richter 5.0 would result in partial structure failure and above 7.0 would result in full structure failure.
    c. Although there is no existing data to categorize earthquake damage to OFW facility structures due to the lack of existing OFW developments to observe, these assumptions are consistent with earthquake damage applied for other offshore wind farm studies (e.g., Etkin 2006; Etkin 2008).
    d. Calculate seasonal earthquake frequencies by dividing the expected annual frequency evenly across the six model seasons, as there is no distinct seasonal pattern in occurrence.

4. For Tsunamis:

    a. Use earthquake data from NGDC/WDS to calculate frequencies of occurrence using the rough correlation between the magnitude of tsunami, or underwater earthquake, and wave height (see Appendix F Section 5 of the Study Report for details).
    b. Use assumptions that wave height from an earthquake of Richter 6.0-7.9 causes partial structural failure and earthquakes of 8.0 or higher result in full structural failure (noting that due the rarity of tsunamis, all of these scenarios are highly unlikely).
    c. Calculate seasonal tsunami frequencies by dividing the expected annual frequency evenly across the six model seasons, as there is no distinct seasonal pattern in occurrence.

5. For Vessel Accidents:

    a. Summarize the annual tonnage and annual number of trips of medium sized (tows/tugs) and larger vessels (tankers, bulkers, containers) for each major port near the OFW facility. Obtain port data from the following sources to determine which ports near the OFW facility capable of accommodating large cargo vessels:
    b. Assume that increased vessel densities are correlated with increased collision frequencies. Therefore, use vessel density as a proxy for the likelihood of a vessel collision or allision, with the density of medium versus large vessels providing relative probability of the likelihood of collisions that cause partial or full structural failure, respectively (see Appendix F Section 6.4 of the Study Report for further discussion).
    c. Divide the worldwide allision frequency value of 0.0006 per ship-year (based on Det Norske Veritas 2011) by 8,760 hours in a year to obtain an hourly allision rate. Assume that the length of time that a vessel would transit past the OFW facility is two hours, and multiply by two. This results in a 1.37×10^{-7} probability of an individual vessel experiencing an allision during the two hours they are passing the facility.
    d. Multiply the individual vessel allision probability by the number of medium and large vessel trips assumed to transit past the OFW facility in a year (from port summary step) to obtain the partial- and full-failure magnitude vessel accident annual frequencies, respectively.
    e. Calculate seasonal vessel accident frequencies by dividing the expected annual frequency evenly across the six model seasons, as there is no distinct seasonal pattern in occurrence.

3.2 Hypothetical Minimum and Maximum Values

Note: It is not necessary to add new hypothetical regions unless a new study region is being added to the model that falls outside of the California and Hawaii hypothetical regions already prepared and incorporated into the first iteration of the OFWESA model. These hypothetical regions encompass the entire California EEZ, and the portion of the Hawaii EEZ that surrounds the main southeast Hawaiian Islands.

In contrast to other relative environmental sensitivity models, the OFWESA model incorporates hypothetical minimum and maximum values into the data normalization calculation so that the results are an independent assessment of sensitivity in each study area with results for each region unrelated to the sensitivity of other regions included the model. For example, in a typical model of this type, a raw score for habitat sensitivity would be compared between regions and normalized such that the region with the highest sensitivity would have a final score of 5, and the region with the lowest sensitivity would have a final score of 1.

If a new region were added to the typical model that contained very vulnerable habitat types, the normalization ranking would recalculate such that the new, very sensitive region received a final score of 5, the previously highest region would now have a mid-level score between 1 and 5, and the lowest sensitivity region would remain at 1. By normalizing scores against region-specific hypothetical minimum and maximum values instead, the results for the existing study areas will not change in response to any new information added or edited in the OFWESA model. Study regions are independent from each other and evaluated in the context of their own larger regional conditions.

The hypothetical minimum and maximum values for comparison were developed differently for each model parameter and carried through each step of the model calculations. For each region in the original iteration of the OFWESA model, a "dummy" region was incorporated into the model to calculate the hypothetical values for the habitat-related parameters. These regions were the Economic Exclusion Zones (EEZ) for HI (include only the EEZ for the major southeastern islands) and for CA. For each new study area added to the database that does not fall within the boundary of the existing hypothetical regions for CA or HI, the EEZ that encompasses the new study region should be included as a new hypothetical region. The EEZ may be edited as needed to indicate a reasonable area for comparison in the model; for example, one might wish to combine EEZs from different states into one broad hypothetical region if they are close to each other and contain similar characteristics.

Follow these steps to develop hypothetical values (HYP_Min and HYP_Max) for the following parameters for all new EEZ regions:

- *Water Column Habitat*: Assign a HYP_Min and HYP_Max score for each study area and period using the minimum and maximum Net Primary Productivity (NPP) measured for each period within the new EEZ regions.
- *Marine Bottom Habitat*: Assign a HYP_Min and HYP_Max score for each study area assuming that these regions contained 100% of the least sensitive natural habitat (i.e., non-anthropogenic; score of 1) and 100% of the most sensitive habitat (score of 5), respectively.
- *Protected Area Modifier (PAM):* Calculate a HYP_Min and HYP_Max score for each study area assuming that 0% and 100% of the hypothetical regions consist of protected marine areas. For the EFH portion of the PAM calculation, compile the number of EFH species/complexes present in the EEZ regions.
- *Large-Scale Event (LSE) Rate Scores:* There is not a feasible way to calculate HYP_Min and HYP_Max LSE scores using the EEZ regions. Instead, assign the maximum score across all

seasons for the study areas. Repeat this using the minimum scores across all seasons for each region to assign HYP_Min LSE scores.

- *Baseline Conditions*: For each baseline condition spatial dataset, assign a HYP_Max score for each region based on the measured data (e.g., counts of points, lengths of lines, or areas of polygons) that fell within the new EEZ regions. The HYP_Min was assumed to be zero for all datasets in both regions.

For species data, the model assumes a most sensitive and least sensitive "general hypothetical" species for each species group that is built into the model and static across regions. Users do not need to add or edit these species when adding or editing other species or region data. The hypothetical species assumptions built into the model are as follows:

- *Species Seasonal Presence*: Assigned presence score of 0.167 for a HYP_Min "species" in each season. This value is a result of the requirement for inclusion in the model that a species needed to be fully present in a study area for at least one season, divided over 6 seasons (i.e., 1 ÷ 6 = 0.167). Assigned a presence score of 1 (fully present) for a HYP_Max "species" in each season.
- *Species Impact and Recovery Scoring*: For each species group, assigned a zero score to every assessment metric for a HYP_Min "species", and the highest possible score for every impact-causing factor and recovery metric for each HYP_Max "species" of a particular species group. These hypothetical species scores are then carried through the rest of the model calculations to the final environmental sensitivity results.

3.3 Spatial Data Preparation

Spatial data are used to calculate some model components, including baseline conditions and habitat sensitivity parameters. These data are prepared using ESRI ArcGIS™ prior to input into the model GUI. The steps to input spatial data, once prepared, are explained in Section 2.3 above.

3.3.1 Study Areas

To begin analyzing study areas, shapefiles representing the study areas must be created:

- Download GIS polygon shape files of the lease block areas from the BOEM Wind Planning Areas on the Marine Cadastre data registry (BOEM and NOAA, 2016).
- In ArcGIS, project lease block shapefiles to a regionally appropriate projection in order to limit the amount of distortion.
    - For the original iteration of the OFWESA model, Hawaii and California files were all projected in North America Albers Equal Area Conic.
    - To ensure consistency in all geospatial files, project all subsequent files to the same projection.
- Create up to three buffered regions (5 nm, 10 nm, 25 nm) around the wind energy area (WEA) lease blocks to compare sensitivity results, if desired.
    - Create the buffered regions for each lease block, using the geoprocessing tool "Buffer" in ArcGIS to make the 5 nm, 10 nm, 25 nm buffer rings around each WEA lease block. Select dissolve type "all" in the tool function box in order to create one polygon per buffered region around the entire group of lease blocks (the shapefile from Marine Cadastre is made up of many separate blocks). Use these buffered lease block shapefiles in all subsequent analyses.
    - For the initial iteration of the OFWESA model, data from the 25-nm buffer zone were used to calculate final results because this is considered the outermost region of potential impact from turbines in the lease blocks.

- Create a separate shapefile containing polygons representing the hypothetical maximum area for each study region analyzed. For the initial iteration of the model, the Economic Exclusion Zone (EEZ) was chosen to calculate the hypothetical maximum values used to compare against each study region, as this is a relative environmental sensitivity model (i.e., every calculation in the model is normalized or compared to the hypothetical values; see Section 3.2 of the manual for how to create the hypothetical region). The entire California EEZ was used for the California study region, while only the portion of the Hawaii EEZ surrounding the Main Hawaiian Islands was used for the Hawaii study region. These hypothetical study areas are referred to as HYP_Max (when maximum values are recorded/calculated for a buffer zone labeled “max”) and HYP_Min (when minimum values are recorded/calculated for a buffer zone labeled “min”) throughout this manual.
- Note the latitude and longitude in decimal degrees of the center point of each study area and hypothetical maximum area for input into the GUI on the **Region Management** table (see Section 2.3.1 of this manual).

3.3.2 Baseline Conditions

Baseline conditions are included in the model to characterize the present influence of anthropogenic activities on the environment in the lease areas. This parameter is considered a type of proxy for cumulative impacts in the study areas. In the model, the baseline conditions score ranges from 1 – 2 and is applied as a multiplier to the interim environmental sensitivity score in the final calculations, and thus can potentially double the final environmental sensitivity score for a study area.

3.3.2.1 Data Acquisition

Baseline data were primarily downloaded from:

- Marine Cadastre data registry (BOEM and NOAA, 2016),
- KNB Data Repository (Halpern et al. 2015), and
- Pacific Cadastral Database (BOEM 2014).

For the initial iteration of the model, only data that was available at similar data quality and structure for all study regions was included.

3.3.2.2 Data Analysis

To process metric data for Baseline Conditions and prepare it for the GUI using ArcGIS:

- Project all Baseline Conditions Metric data files to North America Albers Equal Area Conic in ArcGIS.
  - If there are multiple shapefiles that need to be projected, use the “Batch Project” data management tool to project all the files at once.
    - Raster files must be projected individually.
  - Clip all Baseline Conditions Metric data files to the three buffered regions (5 nm, 10 nm, 25 nm around WEA lease blocks).
- Use the geoprocessing tool “Clip” for all baseline condition shapefiles and “Raster Clip” for the raster datasets. The types of data and data sources used in the OFWESA model are presented in Table 2 below.

Table 2. Baseline condition data sources used in initial OFWESA iteration.

Dataset	Download Source	Type	Description	Units
Oil/Gas Pipelines	Pacific Cadastral Data (BOEM 2014)	Polylines	Polyline locations of subsurface oil and gas pipelines	Presence/ Absence - Type
Drilling Platforms - Pacific OCS Region	Marine Cadastre (BOEM and NOAA 2016)	Points	Point locations of structures used to drill into the seabed for mineral exploration or to bring resources to the surface. These structures are particularly used for oil and gas.	Presence/ Absence
Oil and Natural Gas Wells	Marine Cadastre (BOEM and NOAA 2016)	Points	Point locations of surface boreholes drilled into the seabed within the Outer Continental Shelf for mineral exploration and mining.	Presence/ Absence - Type & Status
Coastal Energy Facilities	Marine Cadastre (BOEM and NOAA 2016)	Points	Point locations of coastal facilities that generate energy.	Presence/ Absence - Type & Energy Capacity (MW)
NOAA Submarine Cables	Marine Cadastre (BOEM and NOAA 2016)	Polylines	Polyline locations of submarine cables in US Navigable waters. Some cables may be present in the dataset, but no longer actually located in the seabed.	Presence/ Absence
Danger Zones and Restricted Areas	Marine Cadastre (BOEM and NOAA 2016)	Polygons	Polygon locations of zones within coastal and marine waters. A Danger zone is defined as "A defined water area (or areas) used for target practice, bombing, rocket firing, or other especially hazardous operations, normally for the armed forces. The danger zones may be closed to the public on a full-time or intermittent basis, as stated in the regulations."	Presence/ Absence
Shipping Lanes	Marine Cadastre (BOEM and NOAA 2016)	lines/ polygons	Polygons delineating activities and regulations for marine vessel traffic.	Presence/ Absence - Type
Wastewater Outfalls	Marine Cadastre (BOEM and NOAA 2016)	Points	Point locations of EPA's Facility Registry Service	Presence/ Absence - Type
Ocean Disposal Sites	Marine Cadastre (BOEM and NOAA 2016)	Polygons	Polygon locations of permitted areas for ocean disposal. Materials that are dumped include dredged material (sediments), fish wastes, human remains, and vessels	Presence/ Absence - Type, Status, Coverage Area
Invasive Species	KNB Data Repository (Halpern et al. 2015)	TIF	Raw stressor data (2013) of invasive species	Low, Medium, High Score
Light Pollution Levels	KNB Data Repository Halpern et al. 2015)	TIF	Raw stressor data (2013) of light pollution levels	Low, Medium, High Score
Rates of Ocean Acidification	KNB Data Repository Halpern et al. 2015)	TIF	Raw stressor data (2013) of ocean acidification	Low, Medium, High Score
Ocean Pollution	KNB Data Repository (Halpern et al. 2015)	TIF	Raw stressor data (2013) of ocean pollution derived from shipping data	Low, Medium, High Score

Analysis of the Baseline Conditions Metric data files is conducted differently for each data type: point shapefiles, polyline shapefiles, polygon shapefiles, and raster datasets. The recommended spreadsheet column headers for input data organization is presented in Table 3 below.

For all point shapefiles:

- Determine the number of points within each buffer region for each Baseline Conditions Metric by using the “Select by Location” tool to select all points in a region or buffer zone then opening the attributes table to get a count of the number of points selected.
- Compile point counts for each point parameter into a spreadsheet.

For polyline shapefiles:

- Determine the number of polylines and the total length (km) of all lines within each buffer region.
- Compile total length measurements (km) for each polyline parameter in spreadsheet.

For polygon shapefiles:

- Summarize the number of polygons and total area within each buffer region.
- Compile total area measurements (km^2) for all polygon parameters in spreadsheet.

To analyze raster datasets:

- Convert the clipped raster data (clipped to buffer zones) to points using the “Raster to Point” conversion tool in the Conversion Tools toolbox.
- Categorically classify data points as low, medium, or high using natural breaks, which allows unique data distributions to be accounted for.
- Summarize counts of low, medium, and high value points for the buffered zones, including the Hypothetical Maximum EEZ regions using the “Select by Attribute” tool.
    - In the Select by Attribute input menu, make statements:
        - GRID_CODE>x – for low value points
        - GRID_CODE<y – for high value points
        - GRID_CODE>y AND GRID_CODE<x – for medium value points
        - Where x and y are the values used to classify low, medium, and high points

Enter the count of low, medium, and high value points into the spreadsheet set up as shown in Table 3 below.

Table 3. Recommended columns for the organization of input data for the Baseline Conditions parameter, based on SQL database setup.

Column Heading	Data Type	Contents
MetricID	Autonumber	Generate an automatic ID number
Region_Buffer	Short text	Concatenate fields for Region and Buffer Zone (e.g., CA_25)
Region	Short text	CA, HI_N, HI_S, CA_HYP, HI_HYP, and regions added by user in future with a corresponding "xx_HYP" region added
Baseline Metric	Short text	Name for the baseline metric dataset
Buffer Zone_nm	Short text	5, 10, 25, or max
Data Type	Short text	Point, polyline, polygon, or score
Unit	Short text	Count, km, sq.km (only for shapefile data)
Measurement	Value, 6 decimal places	Measurements of points, lengths, and areas (only for shapefiles)
Points_Low	Value (integer)	The number of points that fall within low, medium, and high score ranges, along with the total # of points (only for raster files)
Points_Med	Value (integer)	
Points_High	Value (integer)	
Points_Total	Value (integer)	
Notes	Long text	Any relevant notes about data or methods

3.3.3 Habitat Sensitivity

The habitat sensitivity parameter is composed of water column habitat sensitivity, marine bottom habitat sensitivity, and a protected area modifier. Water column habitat sensitivity was analyzed for six “seasonal” periods to capture variations in primary productivity throughout the year. Because the seasonal periods were used for several portions of the OFWESA model calculations, they are considered “static” and cannot be changed.
Table 10 in Section 4.1 of this manual defines the seasonal periods used throughout the model.

3.3.3.1 Water Column Habitat

Net Primary Productivity (NPP) data (in mg C/m^2/day) from the NASA Moderate Resolution Image Spectroradiometer (MODIS) were analyzed as a proxy for sensitivity of water column habitats (Running 2015). Regions with higher NPP were assumed to be more sensitive to OFW impacts.

3.3.3.1.1 Data Acquisition

Net primary productivity data was downloaded from the Oregon State Ocean Productivity website

(http://orca.science.oregonstate.edu/2160.by.4320.monthly.hdf.vgpm.m.chl.m.sst.php).

- Monthly MODIS hierarchical data format (HDF) files from the past five years (2012-2016, for the CA and HI study areas of the OFWESA model) were acquired.

3.3.3.1.2 Data Analysis and Preparation

The recommended columns for the organization of input data for the Water Column Habitat parameter are presented in Table 4, below. The following steps may be used to process NPP data for Water Column Habitat Sensitivity and prepare it for the GUI using ArcGIS:

- Use the “Raster to ASCII” in the ArcGIS Conversion Tools toolbox to convert the HDF files to ASCII files.
- Coordinates of the monthly HDF files downloaded directly from the Ocean Productivity site may need to be adjusted to properly project in ArcGIS.
  - To edit coordinates:
    - Open newly converted ASCII files using the program Notepad++.
    - Edit coordinates and cell size located in the lower left and lower right corners.
      - Correct coordinate and cell information can be found in the metadata of the original HDF files.
- Use the “Define Projection” tool to define WGS1984 as the native projection for the new ASCII files.
- Use the “Project Raster” tool to project all data into North America Albers Equal Area Conic projection.

To obtain NPP seasonal mean values:

- Use “Raster Calculator” to calculate two-month averages of NPP over the five years of data for each region and buffer zone.
- Use the “Zonal Statistics as Table” tool to determine the mean and standard deviation of the average NPP for each of the six periods within each region and buffer zone.
- Organize data in summary tables in a spreadsheet as seen in Table 6 in Section 3.2.2.4.
  - The minimum and maximum NPP represents minimum and maximum productivity values for the hypothetical region, or the minimum/maximum NPP of the regional EEZ for each seasonal period. These values are *not* means but the lowest and highest NPP across the 5 years in each season within the EEZ region.

Table 4. Recommended columns for the organization of input data for the Water Column Habitat parameter, based on SQL database setup.

Column Heading	Data Type	Contents
Region_Buffer_Pd	Short text	Concatenate fields for Region and Buffer Zone and Period (e.g., CA_25_Pd1)
Region	Short text	CA, HI_N, HI_S, CA_HYP, HI_HYP, and regions added by user in future with a corresponding "xx_HYP" region added
Buffer Zone_nm	Short text	5, 10, 25, min, max
Period	Short text	Pd1, pd2, pd3, pd4, pd5, pd6
MeanNPP	Value, 6 decimal places	Mean NPP measured in each period, buffer zone, and region
MinNPP	Value, 6 decimal places	Minimum NPP measured in each period for the Hypothetical Maximum region (i.e., EEZ)
MaxNPP	Value, 6 decimal places	Maximum NPP measured in each period for the Hypothetical Maximum region (i.e., EEZ)

3.3.3.2 Marine Bottom Habitat

The Marine Bottom Habitat parameter is composed of proportions of seafloor habitat type for each region and buffer zone, and vulnerability of each type to the habitat disturbance ICF. The steps below outline how data was acquired and prepared for the California and Hawaii study areas analyzed in the initial iteration of the OFWESA model. A similar process would be employed for other study areas and may need to include acquisition of data from sources outside of California and Hawaii.

3.3.3.2.1 Data Acquisition

- Download California offshore substrate data from the California Department of Resources.
    - These data were created from 7 paper maps from the California continental Margin Geologic Map Series with a resolution of 1:250,000.
    - https://catalog.data.gov/dataset/offshore-substrate828e0

- Download seafloor data from Office of Planning for the State of Hawaii.
    - These data are derived from NOAA Raster Nautical Charts.
    - http://planning.hawaii.gov/gis/download-gis-data/
    - *Note: U.S. Seabed data did not provide enough data for these two regions used in the initial iteration of the manual; however, this source would be a good starting point for study in other areas.*

- Download state boundary polygons from state GIS portal.
    - CA: http://portal.gis.ca.gov/geoportal/catalog/main/home.page
    - HI: http://planning.hawaii.gov/gis/

- Download bathymetric data for all lease block regions.
    - California: 3-arc second data from NOAA National Centers for Environmental Information
    - Hawaii: NOAA Center for Tsunami Research, ‘Hawaii_36s’
        - http://www.ngdc.noaa.gov/mgg/inundation/

- Project all datasets to the projection selected to best represent spatial region.
    - North_America_Albers_Equal_Area_Conic projection was used for CA and HI files.

3.3.3.2.2 Data Analysis and Preparation

To process substrate and area data for Marine Bottom Habitat Sensitivity:

- Using the bathymetry data downloaded for each region, create bathymetric contours with the "Create Contour Lines" tool in ArcGIS with 200-m intervals.
- Using the Select Attributes option, select the 200-m contour line and create a polygon of this contour line for each region. Habitat in areas shoreward of the 200-m depth contour are categorized as 'shallow' and habitat areas seaward of the 200-m depth contour are categorized as 'deep'.
- Recode the marine bottom habitat type for California and Hawaii Bottom Type datasets into 13 classes:
    - Anthropogenic (deep and shallow), corals/sponges (deep and shallow), hard bottom (deep and shallow), kelp (shallow only), no data (not differentiated by depth), soft bottom (deep and shallow), seagrass (shallow only), and volcanic (deep and shallow).
    - For the initial iteration of the OFWESA model, habitat types were coded as shown in Table 5 below for the California, Hawaii North, and Hawaii South study areas.

For the initial iteration of the OFWESA model, two different processes were applied to bottom habitat data because the California habitat source data was in a polygon shapefile format and the Hawaii source data was in a point shapefile.

To further process Hawaii bottom habitat point data in ArcGIS:

- Clip point data to each of the 3 zones around the study areas (5 nm, 10 nm, and 25 nm).
- Use the "Thiessen Polygon" tool in the Analysis toolbox to convert points into polygons.
    - Note: ArcInfo Licenses are needed for use of this tool.
- Clip each Thiessen polygon dataset to the 3 buffer zones (5 nm, 10 nm, and 25 nm).
- Dissolve the Thiessen polygons with the same bottom types using the "Dissolve" tool in the Data Management toolbox.
- Clip the habitat dataset to using the state land boundary shapefile as the clipping extent to obtain a polygon that includes terrestrial land within each buffer region.
- Create a new field in the attribute table, called "Area" and use the "Calculate Geometry" option within the attribute table to calculate area (km^2) of bottom habitat type within each buffer region.
- Calculate total area (km^2) for:
    - each bottom habitat type in all buffer zones,
    - terrestrial habitat (land) within each buffer zone, and
    - any area that is not classified by a bottom habitat type within the buffer zone.
        - Areas with no specific bottom type habitat classification are classified as "No Data"
    - These values should be stored in the Protected Area Modifier table (see Section 3.3.3.3 of this manual).

To further process California bottom habitat polygon data:

- Clip the California substrate polygon layer to the 3 buffer zones around the study area (5 nm, 10 nm, and 25 nm).
- Clip the habitat dataset to using the state land boundary shapefile as the clipping extent to obtain a polygon that includes terrestrial land within each buffer region.

- Calculate total area (km^2) for:
    - each bottom type in all buffered regions,
    - terrestrial habitat (land) within each buffer zone, and
    - any area that is not classified by a bottom habitat type within the buffer zone.
        - Areas with no specific bottom type habitat classification are classified as “No Data”
    - These values should be stored in the Protected Area Modifier table (see Section 3.3.3.3 of this manual).

Table 5. The OFWESA bottom habitat categories applied to source data seafloor categories that fell within the study regions

OFWESA Category	Source Dataset Seafloor Category		
	California	**Hawaii North**	**Hawaii South**
Corals / Sponges – Deep or Shallow	n/a	Coral Coral Mud Coral Rocky Coral Sand Coral Sand Mud Coral Sand Rock Coral Weeds Sand Coral Sand Coral Rocky	Broken Coral Broken Coral Mud Coral Coral Mud Coral Sand Coral Sand Mud
Soft Bottom – Deep or Shallow	Mud	Black Sand Coarse Sand Pebbles Fine Sand Gravel Gray Sand Mud Mud Clay Mud Gravel Mud Sand Sand Sand Gravel Sand Mud Sand Mud Lava Sand Shells Shells Silt	Black Sand Clay Clay Shells Coarse Sand Pebbles Fine Sand Gravel Gravel Sand Gray Sand Light Shells Mud Mud Clay Mud Sand Mud Shells Sand Sand Sand Broken Shells Sand Gravel Sand Mud Sand Pebbles Sand Shells Sand Sticky Shells Shells Sand
Hard Bottom – Deep or Shallow	Rock	Hard Rock Rocky	Hard Hard Mud Mud Rocky Rock Rocky Sand Rocky Sand Shells Rocky
Volcanic – Deep only	n/a	Lava Volcanic Ashes Volcanic Mud	Volcanic Gravel Volcanic Mud
No Data	no data collected, bottom type unknown	n/a	n/a

For the final preparation of marine bottom habitat source data of both polygon and point types:

- Calculate marine bottom habitat within each buffer zone by subtracting land area from total buffer zone area. This value should be stored in the Protected Area Modifier table (see Section 3.3.3.3 of this manual).
- Record the bottom habitat area measurements in a spreadsheet as seen in Table 6 below.

Table 6. Recommended columns for the organization of input data for the Marine Bottom Habitat parameter, based on SQL database setup.

Column Heading	Data Type	Contents
Region_Buffer	Short text	Concatenate fields for Region and Buffer Zone (e.g., CA_25)
Region	Short text	CA, HI_N, HI_S, CA_HYP, HI_HYP, and regions added by user in future with a corresponding "xx_HYP" region added
Buffer Zone_nm	Short text	5, 10, 25, min, max
No_Data	Value, 6 decimal places	Area in km^2 of each habitat type in the region/buffer zone defined above
Soft_Bottom_Deep		
Soft_Bottom_Shallow		
Volcanic_Deep		
Volcanic_Shallow		
Hard_Bottom_Deep		
Hard_Bottom_Shallow		
Coral_Sponges_Deep		
Coral_Sponges_Shallow		
Kelp_Shallow		
Seagrass_Shallow		
Anthropogenic_Deep		
Anthropogenic_Shallow		
Notes	Long text	Any relevant notes about data or methods

3.3.3.3 Protected Area Modifier

The Protected Area Modifier (PAM) increases the sensitivity of study areas in the model that contain higher proportions of important protected habitats or resources.

3.3.3.3.1 Data Acquisition

- Download the following datasets from sources listed below for use in calculating the PAM:
    - Marine Protected Areas (MPA)
        - NOAA Marine Protected Areas Center/ Department of the Interior
    - World Database on Protected Areas (WDPA) dataset
        - Protected Planet, managed by the United Nations World Conservation Monitoring Center
    - Critical Habitat Dataset
        - USFW Threatened and Endangered Species Act Report
- Project all data to North_America_Albers_Equal_Area_Conic projection in ArcGIS.

3.3.3.3.2 Data Analysis and Preparation

To analyze data for the Protected Area Modifier in ArcGIS:

- Clip all data for the 3 buffer zones around the study areas (5 nm, 10 nm, and 25 nm).
- Edit datasets to remove state parks, easements, and fishing management areas, as they are not protected.
- Create summary table for each region of protected areas and type of designations (e.g., MPA, Critical Habitat, etc.)
- Use the "Dissolve" tool in the "Geoprocessing Toolbar" to create one polygon for each buffer zone and study area representing the total protected area within in each study area and calculate the proportion of each buffer region that is protected.
- Use the "Intersect" tool in the "Geoprocessing Toolbar" to determine area of protected area on land and over water in each buffer region.

Record the PAM area measurements in a spreadsheet as shown in Table 7 below, including the Total Buffer Area (km^2) and Marine Area (km^2) from the Marine Bottom Habitat data preparation (Section 3.3.3.2).

Table 7. Recommended columns for the organization of input data for the Protected Area Modifier parameter, based on SQL database setup.

Column Heading	Data Type	Contents
Region_Buffer	Short text	Concatenate fields for region and buffer zone (e.g., ca_25)
Region	Short text	Should be a new region, not already in the database, with a corresponding "xx_hyp" region added
Buffer Zone_nm	Short text	5, 10, 25, min, max
Total Buffer Area_sqkm	Value, 6 decimal places	All habitat types, including land. Can be null for hyp_max and hyp_min regions
Marine Area_sqkm	Value, 6 decimal places	Difference of total buffer area and land area. Should = 1 for hyp_max and 0 for hyp_min regions
Total Protected Area_sqkm	Value, 6 decimal places	Can be null for hyp_max and hyp_min regions
Marine Protected Area_sqkm	Value, 6 decimal places	Should = 1 for hyp_max and 0 for hyp_min regions
EFH_Count	Integer	Note: count for hyp_min regions should be 0, count for hyp_max regions should by equal to EFH_max for that region
EFH_Max	Integer	One max per region. Hi_n and hi_s and hi_hyp_max have the same value. Ca and ca_hyp_max have the same value.
Notes	Long text	Any relevant notes about data or methods

3.4 Species Data Preparation

This part of the instruction manual provides information on the process for obtaining and preparing the species information that needs to occur in order to add species data to the model database. This includes information regarding literature review, species selection, species scoring, and level of uncertainty.

The three main components of the Species Sensitivity model calculations include:

- the relative presence/absence of a population in the study area in each seasonal period (i.e., how much of the species population could be affected);
- impact-causing factor (ICF) specific impact score (i.e., how vulnerable a species is to each ICF); and
- recovery potential (i.e., how quickly the species population could be able to recover from an impact).

The seasonal LSE rate scores for each region are also incorporated into the species-specific ICF impact scores. For more details on Species Sensitivity methods utilized for the OFWESA model, see the Study Report.

3.4.1 Species Selection

Species included in the initial iteration of the OFWESA model were selected to represent major species groups and varieties of ecological niches in the study areas. Species were selected to represent three broad species groups: marine mammals and sea turtles (MT), birds and bats (BB), and fish and invertebrates

(FI). Species were further divided into unique sub-groups to capture a wide range of ecological niches, behavior groups, and various potential effects of OFW based on differences in the air-water interface interactions and physiology between niche groups. Primary and secondary choice species were selected for each sub-group based on an initial review of literature on species distribution, conservation status, and life history. These initial choices were reviewed by subject matter experts at BOEM and their feedback was considered during the final selection step. Experts provided feedback on: 1) the appropriateness of the primary species choices as representatives of each sub-group; 2) whether the secondary choice species needed to be included in the model to appropriately represent the sub-group; 3) any concerns regarding the selection process or rationale provided for each choice; and 4) any species not in the list that the SME believed should be included instead of one of the primary or secondary choices that had been selected.

For the initial iteration of the OFWESA model, 22 species were chosen for each of two study regions (CA and HI, 44 total), with 7 or 8 species included for each species group (BB, MT, and FI) in each study area. Because literature was not available at a fine spatial resolution, the same species selections and species data were applied to both the Hawaii North and the Hawaii South study areas.

To find relevant information on regionally abundant or important species, review online resources from state and federal agencies. For the initial iteration of the OFWESA model, the main sources of data used in the species selection process included:

- National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS);
- United States Fish and Wildlife Service (USFWS);
- Hawaii Department of Land and Natural Resources (HI DLNR);
- California Department of Fish and Wildlife (CA DFW);
- BOEM; Robinson Willmott et al. 2013: The Relative Vulnerability of Migratory
- Bird Species to Offshore Wind Energy Projects on the Atlantic Outer Continental Shelf: An
- Assessment Method and Database;
- Bishop Museum;
- International Union for Conservation of Nature (IUCN) Red List;
- FishBase, and
- Cornell Lab of Ornithology.

3.4.2 Species Sensitivity Scoring

3.4.2.1 Presence/Absence

Once the species list is finalized, seasonal presence/absence information must be researched to capture relative abundance, migratory, behaviors and habitat use patterns in the model. Presence/absence scores are based on a three-level scale, with a score of 0 representing full absence, 0.5 representing a species/region/season combination during which the species is migrating in or out of the region (partially present), and 1 representing that a species is fully present in the region during that season. Historic stock assessments, literature, and web databases are useful in conducting this in-depth examination of local presence and migratory patterns for each species. Notes and references to justify the presence score assigned should be recorded. Presence/absence data is entered through the GUI (see Section 2.3.6 of this Manual).

Major sources of data that can be used to assess species presence/absence for the OFWESA project included:

- NOAA NMFS;
- USFWS;
- HI DLNR;
- CA DFW, and
- Cornell Lab of Ornithology.

3.4.2.2 Impact Potential

To evaluate how severely a species could be affected in the event of spatiotemporal overlap with each ICF, an impact score is calculated. These scores are calculated using the assessment metrics (i.e., questions based on ecological characteristics of a species group) for each individual species and are designed to evaluate ecological themes. Assessment metrics could differ for each species group, but are assessed using the same general ecological themes for each group: encounter (i.e., likelihood of overlap with ICF based on behaviors such as escape behavior, time spent on the water surface, and attraction/avoidance responses to light/noise/chemicals), concentration/aggregation (i.e., the degree to which a species aggregates in a given location), physiology (i.e., physiological characteristics like fur that may affect magnitude of impact of certain ICFs), and habitat flexibility/feeding specificity (i.e., how likely a species can adapt if an ICF impacts prey or habitat availability).

For further explanation of individual species, rank categories, level of uncertainty scores, and written rationales and references cited are recorded for each assessment metric pertaining to that species group through the GUI (see Section 2.3.6 of this Manual).

Rank categories between 0 and 5 must be entered for each unique assessment metric as described in Section 2.3.6. In general, higher rank categories are associated with higher risk of impact from OFW for the ICFs related to that assessment metric. The rankings assigned for each species/assessment metric are based on a thorough literature search and accompanied by a short rationale for that assignment as well as all related references.

The assigned scores are translated into impact scores for each relevant ICF (see the species scoring tables in Appendix B of the Study Report) before incorporation into model calculations. The ICFs considered in the OFWESA model include: accidental spills (AS); artificial light (AL); collisions with above surface structures (CAS); collisions with subsurface structures or entanglement (CSE); electromagnetic fields (EMF); habitat disturbance/displacement (HD); sound/noise (SN); and vessel strikes (VS). Some ICFs did not apply to certain species groups (e.g., EMF is not relevant for birds/bats); the ICFs assessed for each group are presented in Table 8.

Table 8. Impact-causing factors that are assessed for each species group. "X" indicates that an ICF was assessed.

Species Group	Assessed ICFs							
	AS	AL	CAS	CSE	EMF	HD	S/N	VS
Birds / Bats	X	X	X			X	X	
Marine Mammals / Sea Turtles	X	X		X		X	X	X
Fish / Invertebrates	X	X			X	X	X	X

Different scoring equations were developed for each ICF to capture all the impacts assessed in the metrics relevant to each ICF and species group. These are already built into the OFWESA model and require no input from the user. Scoring equations for the species-group specific ICFs is in Appendix B of the Study Report. Major sources of data used to assess impact metrics for the OFWESA project included:

- NOAA NMFS;
- USFWS;
- BOEM;
- HI DLNR;
- CA DFW;
- Bishop Museum;
- IUCN Red List;
- Fish Base;
- Cornell Lab of Ornithology;
- National Audubon Society;
- National Park Service;
- Bird Life International;
- Adams et al. 2016: Collision and Displacement Vulnerability among Marine Birds of the California Current System Associated with Offshore Wind Energy Infrastructure;
- Wahlberg & Westerberg 2006: Hearing in fish and their reactions to sounds from offshore wind farms;
- Normandeau et al. 2011: Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species; and
- Croll et al. 2001: Effect of anthropogenic low-frequency noise on the foraging ecology of Balaenoptera whales.

3.4.2.3 Recovery Potential

The recovery potential score assesses how effectively a species population may recover in the event of an incident. Recovery parameters were the same for the three species groups and included metrics assessing:

- conservation/population status;
- reproductive potential;
- species range while in study region;
- adult survival rate; and
- breeding score to describe how much a species forages for their young, which can be risky for both parent and offspring (mammals/sea turtles and birds/bats only).

Species that would recover more readily after an incident would experience lower impacts from ICFs at the population level, while those that would not recover as readily would experience greater population-level impacts from ICFs. The scoring scale is similar to that for the impact potential parameter, with a score of 0 indicating high recovery potential (lower impact), and a score of 5 indicating low recovery potential (higher impact).

Score assignments for recovery metrics for each species must be based on a thorough review of historic stock population data, the literature, and web databases and accompanied by a written rationale for that assignment as well as all related references. These values are entered through the GUI (see Section 2.3.6 of this Manual).

Major sources of data used to assess impact parameters include:

- NOAA NMFS;
- USFWS;
- HI DLNR;
- CA DFW;
- IUCN Red List;
- FishBase; and
- Cornell Lab of Ornithology.

3.4.2.4 Level of Uncertainty

A level of uncertainty (LoU) for scores assigned to the impact or recovery metrics must also be assigned as presented in Section 2.3.6. By keeping track of this information, several goals are accomplished. Data gaps may easily be identified for species or groups that are continually marked with low data certainty information. Results derived from species and assessments with low data certainty may be considered ‘less important’ than those with higher data certainty. And finally, using the associated data certainty information, species sensitivity scoring can be binned into lower, ‘best’, and upper estimates for all impact potential scoring.

The level of uncertainty for each metric is determined to be low (10%), medium (25%), or high (50%) depending on the number of data sources, how current the data sources were, and the range of values published in those data sources.

For a quantitative assessment metric, such as the percent of time a bird/bat species spent flying at night, the uncertainty levels are defined as follows:

- low (10%) = published values fall within a single category range, optimally based on multiple sources;
- medium (25%) = published values fall within two category ranges, but most current and/or most abundant literature supports chosen value, or published values fall within a single category range but literature is limited (fewer than 3 sources), and
- high (50%) = published values vary between three or more category ranges, but most current and/or most abundant literature supports chosen value, or published values fall within one or two category ranges and literature sources are limited (fewer than 3 sources), or there was no data found on the species of interest so values assigned were based on data from a similar or proxy species.

For a qualitative or descriptive assessment metric, such as whether a species is an opportunistic forager (high habitat flexibility) or a highly-specific forager (low habitat flexibility), the uncertainty levels are defined as follows:

- low (10%) = consensus on answer among all literature sources;
- medium (25%) = inconsistent or conflicting answers reported in literature (fewer than 3 sources); and
- high (50%) = little to no data available, answer assigned based on similar/proxy species.

The application of the LoU score in the model adjusts the assigned rank score. This serves to create a range of possible results for each assessment metric and species: mid (the ICF impact scores corresponding to the rank category as it was assigned), min (the lower ICF impact scores after the uncertainty range is applied to the mid score), and max (the upper ICF impact scores after the uncertainty range is applied to the mid score). Additional information on the LoU can be found in Appendix B of the Study Report. The static tables used in the model to look up the score ranges derived from the LoU can be found in in Section 4 of this Manual.

3.4.3 Scoring Example

An example of the entire species scoring process for one assessment metric ("Encounter – Feeding Method") used in the OFWESA model is described below. Bigeye tuna was selected as the primary choice for the large pelagic fish sub-group in the HI study region because it is present throughout both HI study regions, EFH designations for all life stages overlap the HI study regions, and it is currently listed as 'vulnerable' on the IUCN Red List. "Feeding Method" is an assessment metric representing an encounter impact for the fish and invertebrates species group. The ranking given for this metric and the associated ICF scores were used to calculate the ICF impact score for accidental spills (AS), artificial light (AL), electromagnetic fields (EMF), and habitat disturbance (HD); the remaining ICFs do not apply to this assessment metric or species (Table 9). While the process provided below is specific to "Feeding Method" and bigeye tuna, a similar process can be used to score other species against other assessment metrics in the model.

To provide a ranking for the feeding method assessment metric for bigeye tuna, a literature review was conducted. According to NOAA and a review by the IUCN Red List, bigeye tuna forage opportunistically within the water column through all life stages and primarily consume locally abundant crustaceans, cephalopods, and fish (WPRFMC 2009; Collette et al. 2011).

Where and how a fish or invertebrate species feeds may increase or decrease the likelihood of impact with a given impact ICF and consequently changes the impact score used in the model. Appendix B of the Study Report included several tables (similar to Table 9 below) that can be used in determining ICF scores for all species groups.

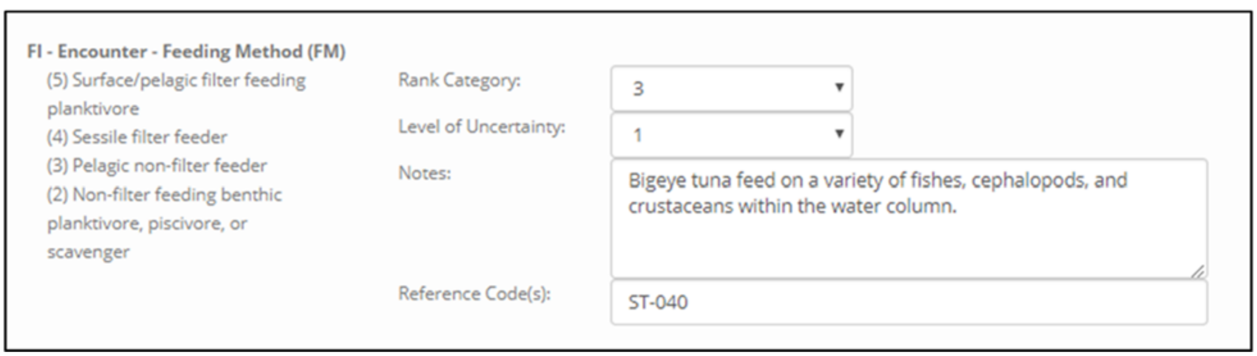
Table 9. Fish and invertebrates feeding method assessments for encounter impact during all three project phases from Appendix B of the Study Report.

Ranking Score - Category	Category Description	ICF Scores							
		AS	AL	CAS	CSE	EMF	HD	S/N	VS
(5) Surface/pelagic filter feeding planktivore	Species utilizes filter-feeding strategies to extract plankton from the upper water column (e.g., whale shark, sunfish)	5	5	--	--	1	5	--	--
(4) Sessile filter feeder	Species utilizes filter-feeding strategies to extract plankton from the water (e.g., mollusks, coral)	5	0	--	--	3	3	--	--
(3) Pelagic non-filter feeder	Feeds on plankton, fish, and invertebrates from within water column (e.g., jellyfish, herring).	3	3	--	--	1	2	--	--
(2) Non-filter feeding benthic planktivore, piscivore, or scavenger	Species feeds in deeper water near the seafloor (e.g., crabs, flatfish).	1	0	--	--	5	3	--	--

Filter feeding planktivores are most likely to come into contact with accidental spill and artificial light ICFs, while species that forage in benthic sediments are more likely to be affected by habitat disturbance and EMF. As a pelagic non-filter feeder, bigeye tuna falls in the mid-range of potential ICF impacts and was assigned a score of 3.

Based on this information, the assessment metric of feeding method for bigeye tuna was assigned a rank score of 3 for the pelagic non-filter feeder category. A rank category of 3 for the feeding method assessment metric translated to scores of 3 for AS and AL, 1 for EMF, and 2 for HD. These scores will contribute to the AS, AL, EMF, and HD scoring equations for this species. Because the information used to rank this metric came from two reputable sources, the level of uncertainty was scored as 1 or "low" uncertainty.

A summary of the justification and reference codes linked to the literature was should be included with the metric ranking and uncertainty score (Table 9) in the species tables (see Section 2,3,6).


FI - Encounter - Feeding Method (FM)
(5) Surface/pelagic filter feeding planktivore
(4) Sessile filter feeder
(3) Pelagic non-filter feeder
(2) Non-filter feeding benthic planktivore, piscivore, or scavenger

Rank Category: 3
Level of Uncertainty: 1
Notes: Bigeye tuna feed on a variety of fishes, cephalopods, and crustaceans within the water column.
Reference Code(s): ST-040

4 Static Model Reference Tables

This section of the instruction manual contains tables that are not updated or edited by the user in the GUI. They are here as reference so the user may refer to other information within the model.

4.1 Period

Table 10. Two-month "seasonal" periods considered in the analysis.

Period	Months Included
1	December, January
2	February, March
3	April, May
4	June, July
5	August, September
6	October, November

4.2 Habitat Type Sensitivity Scores

Table 11. Habitat sensitivity score reference table. 0 represents no sensitivity, 5 represents highest sensitivity to the habitat disturbance (HD) impact-causing factor. Total HD score is an average of the short-term and long-term habitat sensitivity ranks.

Hab_Code	Hab_Name	Short-Term HD Rank	Long-Term HD Rank	Total HD Score
AP_Dp	Anthropogenic - Deep	0	0	0
AP_Sh	Anthropogenic - Shallow	0	0	0
CS_Dp	Coral/ Sponges - Deep	5	5	5
CS_Sh	Coral/ Sponges - Shallow	5	5	5
HB_Dp	Hard Bottom - Deep	2	2	2
HB_Sh	Hard Bottom - Shallow	2	2	2
KP_Sh	Kelp - Shallow	5	5	5
NoDat	No Data	3	3	3
SB_Dp	Soft Bottom - Deep	5	4	4.5
SB_Sh	Soft Bottom - Shallow	4	3	3.5
SG_Sh	Seagrass - Shallow	5	5	5
Vol_Dp	Volcanic - Deep	1	1	1
Vol_Sh	Volcanic - Shallow	1	1	1

4.3 Impact Magnitude Tables

Table 12. Effects of the application of mitigation option to impact scale and impact level. Green cells represent scores for an ICF and phase that were decreased by 1, unless they were already at the minimum score of 1.

ICF	Phase	Impact Duration	Impact Scale		Impact Level		Current Development	Notes
			Unmitigated	Mitigated	Unmitigated	Mitigated		
Artificial Light	Development	2	3	2	1	1	1	Mitigation measures assumed for the development and operation phases.
	Exploration	1	2	2	1	1	1	
	Operation	5	3	2	2	1	1	
Accidental Spills	Development	1	2	1	4	3	1	Mitigation assumed for all three phases.
	Exploration	1	2	1	4	3	1	
	Operation	1	2	1	4	3	1	
Collisions Above Surface	Development	0	0	0	0	0	0	Mitigation assumed for operation phase. ICF not applicable to exploration or development phases.
	Exploration	0	0	0	0	0	0	
	Operation	5	1	1	5	4	1	
Collisions and Subsurface Entanglement	Development	1	1	1	4	4	1	No mitigation measures assumed.
	Exploration	2	1	1	4	4	1	
	Operation	5	1	1	4	4	1	
Electromagnetic Fields	Development	0	0	0	0	0	0	No mitigation measures assumed for operation phase. ICF not applicable to exploration or development phases.
	Exploration	0	0	0	0	0	0	
	Operation	5	1	1	2	2	1	
Habitat Disturbance / Displacement	Development	2	1	1	1	1	1	No mitigation measures assumed.
	Exploration	1	1	1	2	2	1	
	Operation	5	1	1	2	2	1	
Sound / Noise	Development	1	2	1	4	3	1	Mitigation measures assumed for all three phases.
	Exploration	1	2	1	4	3	1	
	Operation	5	2	1	4	3	1	
Vessel Strikes	Development	1	1	1	5	4	1	Mitigation measures assumed for all three phases.
	Exploration	1	1	1	5	4	1	
	Operation	1	1	1	5	4	1	

Table 13. Effects of different types of large-scale events (LSEs) on the impact scale and impact level of particular impact-causing factors (ICFs). The other components of impact magnitude are unaltered by LSEs and not included in the table. Red cells represent scores for an ICF and phase that were increased by 1, unless they were already at the maximum score of 5.

ICF	Phase	Impact Scale			Impact Level			Notes
		Unmitigated	Hurricane or Tsunami	Earthquake or Vessel Accident	Unmitigated	Hurricane or Tsunami	Earthquake or Vessel Accident	
Artificial Light	Development	3	3	3	1	1	1	No increased impact from LSEs assumed.
	Exploration	2	2	2	1	1	1	
	Operation	3	3	3	2	2	2	
Accidental Spills	Development	2	3	3	4	4	4	LSE impact of all four event types assumed during all three project phases.
	Exploration	2	3	3	4	4	4	
	Operation	2	3	3	4	4	4	
Collisions Above Surface	Development	0	0	0	0	0	0	LSE impact of hurricanes and tsunamis assumed during operation. ICF not applicable to exploration or development phases.
	Exploration	0	0	0	0	0	0	
	Operation	1	2	1	5	5	5	
Collisions and Subsurface Entanglement	Development	1	2	1	4	4	4	LSE impact of hurricanes and tsunamis assumed during all three project phases.
	Exploration	1	2	1	4	4	4	
	Operation	1	2	1	4	4	4	
Electromagnetic Fields	Development	0	0	0	0	0	0	No increased impact from LSEs assumed.
	Exploration	0	0	0	0	0	0	
	Operation	1	1	1	2	2	2	
Habitat Disturbance / Displacement	Development	1	2	2	1	1	1	LSE impact of all four event types assumed during all three project phases.
	Exploration	1	2	2	2	2	2	
	Operation	1	2	2	2	2	2	
Sound / Noise	Development	2	2	2	4	4	4	No increased impact from LSEs assumed.
	Exploration	2	2	2	4	4	4	
	Operation	2	2	2	4	4	4	
Vessel Strikes	Development	1	1	1	5	5	5	No increased impact from LSEs assumed.
	Exploration	1	1	1	5	5	5	
	Operation	1	1	1	5	5	5	

Table 14. Impact magnitude applied in sensitivity algorithms throughout the model for each impact-causing factor and project phase under unmitigated and mitigated scenarios, including influences from different large-scale events (hurricane or tsunami; earthquake or vessel accident).

ICF	Phase	Impact Magnitude – Unmitigated			Impact Magnitude - Mitigated			Notes
		Unmitigated	Hurricane or Tsunami	Earthquake or Vessel Accident	Unmitigated	Hurricane or Tsunami	Earthquake or Vessel Accident	
Artificial Light	Development	1.6	1.6	1.6	1.4	1.4	1.4	Mitigation assumed during development and operation phases. No increased impact from LSEs assumed.
	Exploration	1.2	1.2	1.2	1.2	1.2	1.2	
	Operation	2.7	2.7	2.7	2	2	2	
Accidental Spills	Development	2.7	3.4	3.4	2	2.7	2.7	Mitigation assumed for all three phases. LSE impact of all four event types assumed during all three phases.
	Exploration	2.7	3.4	3.4	2	2.7	2.7	
	Operation	2.7	3.4	3.4	2	2.7	2.7	
Collisions Above Surface	Development	0	0	0	0	0	0	Mitigation assumed for operation phase. LSE impact of hurricanes and tsunamis assumed during operation.
	Exploration	0	0	0	0	0	0	
	Operation	3.8	4	3.8	3.3	4	3.3	
Collisions and Subsurface Entanglement	Development	2.5	3.2	2.5	2.5	3.2	2.5	No mitigation measures assumed. LSE impact of hurricanes and tsunamis assumed during all three phases.
	Exploration	2.7	3.4	2.7	2.7	3.4	2.7	
	Operation	3.3	4	3.3	3.3	4	3.3	
Electromagnetic Fields	Development	0	0	0	0	0	0	No mitigations measures assumed. No increased impact from LSEs assumed.
	Exploration	0	0	0	0	0	0	
	Operation	2.3	2.3	2.3	2.3	2.3	2.3	
Habitat Disturbance / Displacement	Development	1.2	1.9	1.9	1.2	1.9	1.9	No mitigation measures assumed. LSE impact of all four event types assumed during all three phases.
	Exploration	1.5	2.2	2.2	1.5	2.2	2.2	
	Operation	2.3	3	3	2.3	3	3	
Sound / Noise	Development	2.7	2.7	2.7	2	2	2	Mitigation measures assumed for all three phases. No increased impact from LSEs assumed.
	Exploration	2.7	2.7	2.7	2	2	2	
	Operation	3.5	3.5	3.5	2.8	2.8	2.8	
Vessel Strikes	Development	3	3	3	2.5	2.5	2.5	Mitigation measures assumed for all three phases. No increased impact from LSEs assumed.
	Exploration	3	3	3	2.5	2.5	2.5	
	Operation	3	3	3	2.5	2.5	2.5	

4.4 Level of Uncertainty Scores

Table 15. Level of uncertainty (LoU) score modifications to assigned rank for the assessment metric data collected for each species.

Rank Score Assigned	Lower and Upper Score Ranges after LoU Applied		
	Low LoU (Score 1 or 10%)	Medium LoU (Score 2 or 25%)	High LoU (Score 3 or 50%)
1	1 – 1.4	1 – 2	1 – 3
2	1.6 – 2.4	1 – 3	1 – 4
3	2.6 – 3.4	2 – 4	1 – 5
4	3.6 – 4.4	3 – 5	2 – 5
5	4.6 – 5	4 – 5	3 – 5

4.5 Hypothetical Maximum Value Tables

Table 16. Maximum possible values for generalized hypothetical species of each species group for ICF-specific impact scores, overall impact score, and recovery potential score.

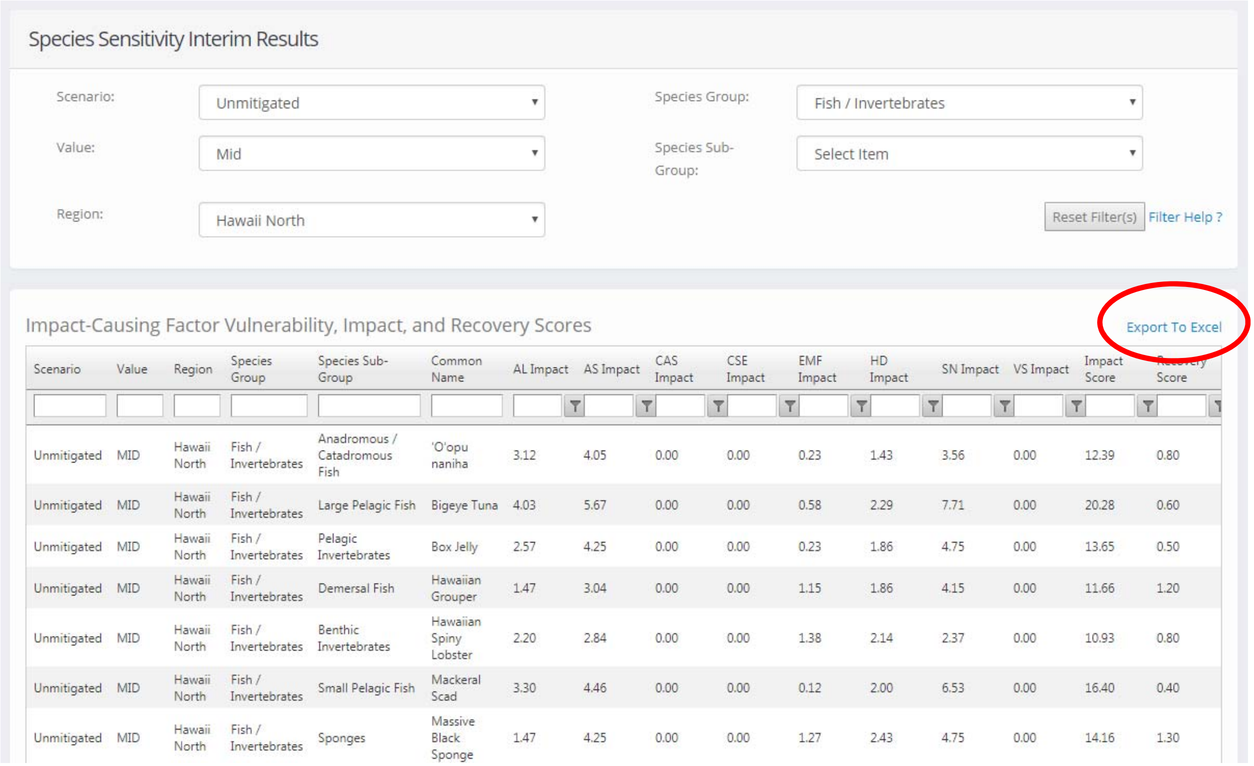
General Hypothetical Species	Scenario	Estimate Value	AL Impact	AS Impact	CAS Impact	CSE Impact	EMF Impact	HD Impact	SN Impact	VS Impact	Sum Impact Score	Recovery Potential Score	Raw Species Sensitivity Score (same for every period)
Max BB	mitigated	max	4.600	6.000	3.300	--	--	5.000	6.800	--	25.700	2.500	122.437
Max BB	mitigated	mid	4.600	6.000	3.300	--	--	5.000	6.800	--	25.700	2.500	122.437
Max BB	mitigated	min	4.232	5.520	3.036	--	--	4.600	6.256	--	23.644	2.300	103.631
Max BB	unmitigated	max	5.500	8.100	3.800	--	--	5.000	8.900	--	31.300	2.500	153.756
Max BB	unmitigated	mid	5.500	8.100	3.800	--	--	5.000	8.900	--	31.300	2.500	153.756
Max BB	unmitigated	min	5.060	7.452	3.496	--	--	4.600	8.188	--	28.796	2.300	130.139
Max FI	mitigated	max	4.600	6.000	--	--	2.300	5.000	6.800	7.500	32.200	2.000	122.723
Max FI	mitigated	mid	4.600	6.000	--	--	2.300	5.000	6.800	7.500	32.200	2.000	122.723
Max FI	mitigated	min	4.232	5.520	--	--	2.116	4.600	6.256	6.900	29.624	1.840	103.873
Max FI	unmitigated	max	5.500	8.100	--	--	2.300	5.000	8.900	9.000	38.800	2.000	152.479
Max FI	unmitigated	mid	5.500	8.100	--	--	2.300	5.000	8.900	9.000	38.800	2.000	152.479
Max FI	unmitigated	min	5.060	7.452	--	--	2.116	4.600	8.188	8.280	35.696	1.840	129.058
Max MT	mitigated	max	4.600	6.000	--	8.500	--	5.000	6.800	7.500	38.400	2.500	182.941
Max MT	mitigated	mid	4.600	6.000	--	8.500	--	5.000	6.800	7.500	38.400	2.500	182.941
Max MT	mitigated	min	4.232	5.520	--	7.820	--	4.600	6.256	6.900	35.328	2.300	154.842
Max MT	unmitigated	max	5.500	8.100	--	8.500	--	5.000	8.900	9.000	45.000	2.500	221.055
Max MT	unmitigated	mid	5.500	8.100	--	8.500	--	5.000	8.900	9.000	45.000	2.500	221.055
Max MT	unmitigated	min	5.060	7.452	--	7.820	--	4.600	8.188	8.280	41.400	2.300	187.101

Table 17. Maximum and minimum possible values for regional hypothetical scores for Habitat Sensitivity, Species Sensitivity, Interim Environmental Sensitivity, and Final Environmental Sensitivity.

Score Type	Hypothetical Minimum Value	Hypothetical Maximum Value	Hypothetical Value Explanation
Final Environmental Sensitivity	4	60	The interim environmental sensitivity score multiplied by the baseline conditions score for each region.
Interim Environmental Sensitivity	4	30	The addition of normalized species sensitivity and normalized habitat sensitivity scores together for each region.
Baseline Conditions Score	1	2	The sum of the highest baseline metric measurements within the regional EEZ zones were used to normalize the baseline metric scores on a scale of 1 to 2 to effectively double the interim environmental sensitivity in regions with high anthropogenic influence.
Normalized Species Sensitivity	3	15	The sum of the normalized min and max species sensitivity scores for each species group within a region.
Species Group Sensitivity	1	5	Raw species sensitivity scores for the hypothetical most sensitive species of each species group (from Table 16) were used to normalize the sum of the sensitivity scores for every species within a region on a scale of 1 to 5.
Species Seasonal Presence	0.167	1	The hypothetical min species was assumed to be fully present for 1 period out of 6 (average of 0.167 presence score per period) while the max species was assumed to be fully present for all seasons (score of 1 for each period).
Normalized Habitat Sensitivity	1	15	Raw habitat sensitivity scores normalized on a scale of 1 to 15.
Raw Habitat Sensitivity	2	80	Addition of water column and marine bottom habitat sensitivity min and max values together.
Water Column Habitat Sensitivity	1	20	The lowest and highest NPP measurements within the larger regional EEZ zones were used to normalize the mean NPP scores for a region and season on a scale of 1 to 20.
Marine Bottom Habitat Sensitivity	1	20	Assumed 100% of marine bottom habitat of hypothetical regions consisted of lowest and highest sensitivity habitat, then normalized scores on a scale of 1 to 20.
Protected Area Modifier	1	2	Assumed 0% and 100% of hypothetical regions consisted of protected areas, then normalized scores on a scale of 1 to 2 to effectively double the habitat sensitivity scores when water column and marine bottom scores are added together.
Large-Scale Event Scores	1	1.965	The highest LSE Score across all regions and seasons was assigned as the hypothetical max, while the hypothetical min was assumed to be 1.

5 Further Analysis of Export Data Outside of the GUI

To increase the interpretability and to summarize model results, users can manipulate exported model data in Excel. As mentioned above in Section 2.1 of this manual, users can export results tables using the “Export to Excel” function in the upper right corner of the table (circled in red in the image below).



Species Sensitivity Interim Results

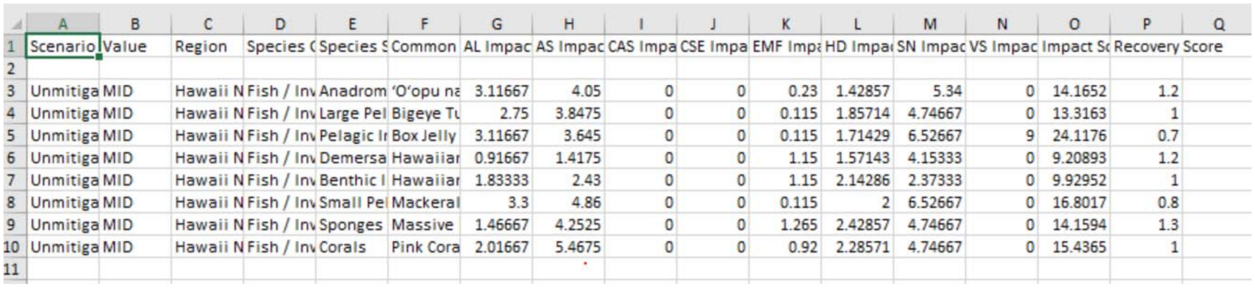
Scenario: Unmitigated
Value: Mid
Region: Hawaii North
Species Group: Fish / Invertebrates
Species Sub-Group: Select Item
Reset Filter(s) Filter Help ?

Impact-Causing Factor Vulnerability, Impact, and Recovery Scores

Export To Excel

Scenario	Value	Region	Species Group	Species Sub-Group	Common Name	AL Impact	AS Impact	CAS Impact	CSE Impact	EMF Impact	HD Impact	SN Impact	VS Impact	Impact Score	Recovery Score
Unmitigated	MID	Hawaii North	Fish / Invertebrates	Anadromous / Catadromous Fish	'O'opu naniha	3.12	4.05	0.00	0.00	0.23	1.43	3.56	0.00	12.39	0.80
Unmitigated	MID	Hawaii North	Fish / Invertebrates	Large Pelagic Fish	Bigeye Tuna	4.03	5.67	0.00	0.00	0.58	2.29	7.71	0.00	20.28	0.60
Unmitigated	MID	Hawaii North	Fish / Invertebrates	Pelagic Invertebrates	Box Jelly	2.57	4.25	0.00	0.00	0.23	1.86	4.75	0.00	13.65	0.50
Unmitigated	MID	Hawaii North	Fish / Invertebrates	Demersal Fish	Hawaiian Grouper	1.47	3.04	0.00	0.00	1.15	1.86	4.15	0.00	11.66	1.20
Unmitigated	MID	Hawaii North	Fish / Invertebrates	Benthic Invertebrates	Hawaiian Spiny Lobster	2.20	2.84	0.00	0.00	1.38	2.14	2.37	0.00	10.93	0.80
Unmitigated	MID	Hawaii North	Fish / Invertebrates	Small Pelagic Fish	Mackeral Scad	3.30	4.46	0.00	0.00	0.12	2.00	6.53	0.00	16.40	0.40
Unmitigated	MID	Hawaii North	Fish / Invertebrates	Sponges	Massive Black Sponge	1.47	4.25	0.00	0.00	1.27	2.43	4.75	0.00	14.16	1.30

If the results table in the GUI have filters turned on, as above, only filtered data will be exported into the Excel file. This filtering allows a user to customize the data they are most interested in, and export only what they want to analyze. To turn filters off, return the drop-down menus above the data tables back to “Select Item.” Exported data in Excel will have the same column titles as in the GUI report tables, as shown in the image below.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	Scenario	Value	Region	Species (	Species S	Common	AL Impac	AS Impac	CAS Impa	CSE Impa	EMF Imp	HD Impa	SN Impac	VS Impac	Impact Sc	Recovery Score	
2																	
3	Unmitiga	MID	Hawaii N	Fish / Inv	Anadrom	'O'opu na	3.11667	4.05	0	0	0.23	1.42857	5.34	0	14.1652	1.2	
4	Unmitiga	MID	Hawaii N	Fish / Inv	Large Pel	Bigeye Tu	2.75	3.8475	0	0	0.115	1.85714	4.74667	0	13.3163	1	
5	Unmitiga	MID	Hawaii N	Fish / Inv	Pelagic Ir	Box Jelly	3.11667	3.645	0	0	0.115	1.71429	6.52667	9	24.1176	0.7	
6	Unmitiga	MID	Hawaii N	Fish / Inv	Demersa	Hawaiiar	0.91667	1.4175	0	0	1.15	1.57143	4.15333	0	9.20893	1.2	
7	Unmitiga	MID	Hawaii N	Fish / Inv	Benthic I	Hawaiiar	1.83333	2.43	0	0	1.15	2.14286	2.37333	0	9.92952	1	
8	Unmitiga	MID	Hawaii N	Fish / Inv	Small Pel	Mackeral	3.3	4.86	0	0	0.115	2	6.52667	0	16.8017	0.8	
9	Unmitiga	MID	Hawaii N	Fish / Inv	Sponges	Massive	1.46667	4.2525	0	0	1.265	2.42857	4.74667	0	14.1594	1.3	
10	Unmitiga	MID	Hawaii N	Fish / Inv	Corals	Pink Cora	2.01667	5.4675	0	0	0.92	2.28571	4.74667	0	15.4365	1	
11																	

One methods of analyzing the scores generated by the OFWESA model it to compare impacts for the study areas as the percent of the hypothetical maximum score or value. This allows scores to be compared in relation to the worst possible case relevant to a particular study region. Users can generate these data by following a few simple steps in Excel.

The steps below demonstrate one method to analyze the species-specific impact scores exported from the **Impact-Causing Factor Vulnerability, Impact, and Recovery Scores** table on the **Species Sensitivity Interim Results** calculations page of the GUI:

- Move the hypothetical maximum scores in the exported Excel spreadsheet to a row under the results data using cut and paste functions.
  - For species-specific impact scores, the hypothetical maximum scores are associated with the General Hypothetical Maximum region. These are the same for all study regions.
  - For habitat-related scores, the hypothetical maximum scores may differ by study region, so there will be Hypothetical for California, Hypothetical for Hawaii, etc.
  - If obtaining the hypothetical maximum values through the GUI is not simple enough, there are also tables of all possible maximum values in Section 4.5 of this manual that can be used to manually enter hypothetical maximum values into the Excel spreadsheet.

- In Excel, insert new data columns for each score category within which to calculate the percent of hypothetical maximum.
  - Score categories can be ICFs (e.g., AL, AS, EMF) or Periods (e.g., Period 1, Period 6).
  - Label each column with unique score category and something simple to indicate these scores are the percent of the hypothetical maximum.
    - Example: “AS % Max”, “Period 1 % Max”, or something similarly descriptive.

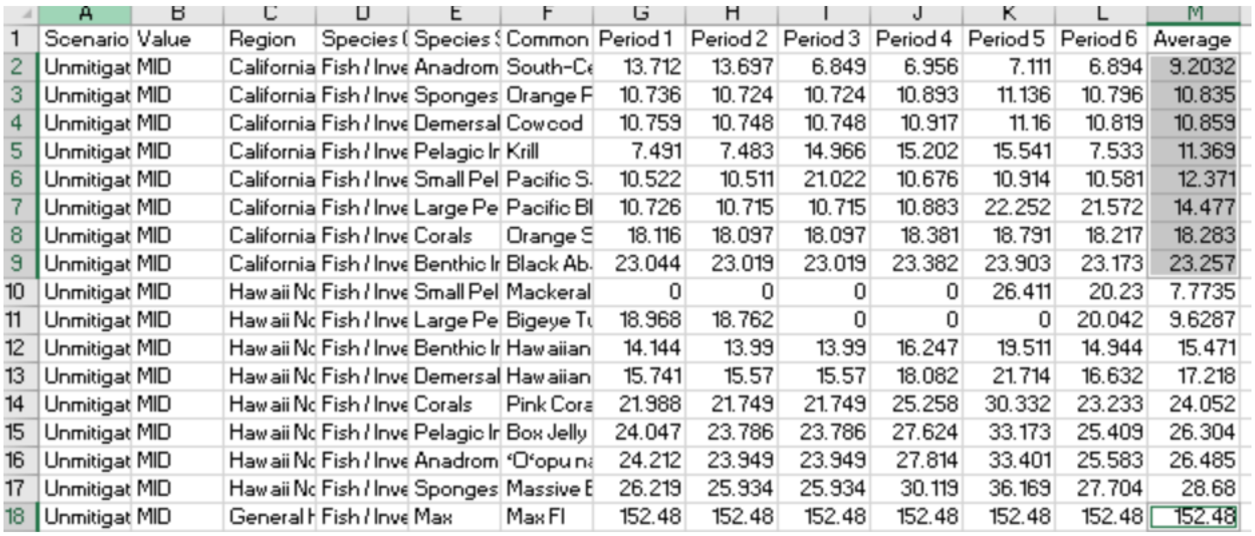
- In each new score column, calculate the original score divided by the maximum score.
  - In the figure below, original scores are in purple, hypothetical maximum scores in red, and the percent maximum calculation columns are in green.
  - Calculations can be made in Excel using “=” sign before the equation.
  - Users can use “$”, as seen below in the equation in column R, to refer back to particular cells in rows or columns when copying and pasting the formula into other rows and columns. The dollar sign will allow the equation in multiple rows and columns to refer back to the same row or column, in this case the row containing the hypothetical maximum values.
  - Calculated values are shown as proportions under 1, but users can switch scores to percentages by changing the value category in the format cells option in the Home tab or by editing the example calculation in cell R5 to read “=(H5/H$11)*100”.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
Scenario	Value	Region	Species (	Species S	Common	AL Impac	AS Impac	CAS Impa	CSE Impa	EMF Impa	HD Impa	SN Impac	VS Impac	Impact Sc	Recovery	AL % Max	AS % Max C
Unmitiga	MID	Hawaii N	Fish / Inv	Anadrom	‘O‘opu na	3.11667	4.05	0	0	0.23	1.42857	5.34	0	14.1652	1.2	0.38477	0.73636
Unmitiga	MID	Hawaii N	Fish / Inv	Large Pel	Bigeye Tu	2.75	3.8475	0	0	0.115	1.85714	4.74667	0	13.3163	1	0.33951	0.69955
Unmitiga	MID	Hawaii N	Fish / Inv	Pelagic In	Box Jelly	3.11667	3.645	0	0	0.115	1.71429	6.52667	9	24.1176	0.7	0.38477	=H5/H$11
Unmitiga	MID	Hawaii N	Fish / Inv	Demersa	Hawaiiar	0.91667	1.4175	0	0	1.15	1.57143	4.15333	0	9.20893	1.2	0.11317	0.25773
Unmitiga	MID	Hawaii N	Fish / Inv	Benthic I	Hawaiiar	1.83333	2.43	0	0	1.15	2.14286	2.37333	0	9.92952	1	0.22634	0.44182
Unmitiga	MID	Hawaii N	Fish / Inv	Small Pel	Mackeral	3.3	4.86	0	0	0.115	2	6.52667	0	16.8017	0.8	0.40741	0.88364
Unmitiga	MID	Hawaii N	Fish / Inv	Sponges	Massive	1.46667	4.2525	0	0	1.265	2.42857	4.74667	0	14.1594	1.3	0.18107	0.77318
Unmitiga	MID	Hawaii N	Fish / Inv	Corals	Pink Cora	2.01667	5.4675	0	0	0.92	2.28571	4.74667	0	15.4365	1	0.24897	0.99409
			Hypothetical Max			8.1	5.5			2.3	5	8.9	9	38.8	2.2		

Exported results tables can be formatted in Excel to be color-coded based on score value in relation to the hypothetical maximum or other scores in that region. This is a useful tool when displaying tabular data to allow for a quick visual assessment of sensitivity. Steps to apply this formatting is provided below.

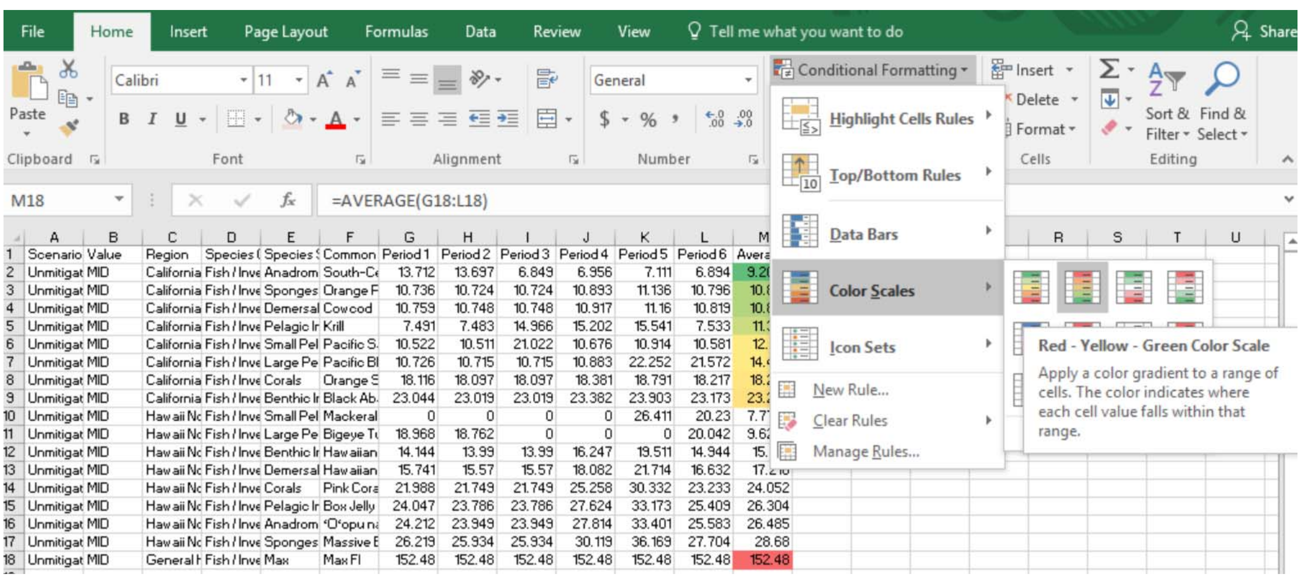
To apply conditional formatting to tabular data in Excel:

- Select data by region and the hypothetical maximum value. In column M of the example below, the species-specific average sensitivity scores for the fish species in California are selected along with the general hypothetical maximum score for the fish species group (cell M18 in the image below).



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Scenario	Value	Region	Species (	Species :	Common	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Average
2	Unmitigat	MID	California	Fish / Inve	Anadrom	South-Ce	13.712	13.697	6.849	6.956	7.111	6.894	9.2032
3	Unmitigat	MID	California	Fish / Inve	Sponges	Orange F	10.736	10.724	10.724	10.893	11.136	10.796	10.835
4	Unmitigat	MID	California	Fish / Inve	Demersal	Cowcod	10.759	10.748	10.748	10.917	11.16	10.819	10.859
5	Unmitigat	MID	California	Fish / Inve	Pelagic Ir	Krill	7.491	7.483	14.966	15.202	15.541	7.533	11.369
6	Unmitigat	MID	California	Fish / Inve	Small Pel	Pacific S.	10.522	10.511	21.022	10.676	10.914	10.581	12.371
7	Unmitigat	MID	California	Fish / Inve	Large Pe	Pacific Bl	10.726	10.715	10.715	10.883	22.252	21.572	14.477
8	Unmitigat	MID	California	Fish / Inve	Corals	Orange S	18.116	18.097	18.097	18.381	18.791	18.217	18.283
9	Unmitigat	MID	California	Fish / Inve	Benthic Ir	Black Ab.	23.044	23.019	23.019	23.382	23.903	23.173	23.257
10	Unmitigat	MID	Hawaii Nc	Fish / Inve	Small Pel	Mackeral	0	0	0	0	26.411	20.23	7.7735
11	Unmitigat	MID	Hawaii Nc	Fish / Inve	Large Pe	Bigeye Tu	18.968	18.762	0	0	0	20.042	9.6287
12	Unmitigat	MID	Hawaii Nc	Fish / Inve	Benthic Ir	Hawaiian	14.144	13.99	13.99	16.247	19.511	14.944	15.471
13	Unmitigat	MID	Hawaii Nc	Fish / Inve	Demersal	Hawaiian	15.741	15.57	15.57	18.082	21.714	16.632	17.218
14	Unmitigat	MID	Hawaii Nc	Fish / Inve	Corals	Pink Cora	21.988	21.749	21.749	25.258	30.332	23.233	24.052
15	Unmitigat	MID	Hawaii Nc	Fish / Inve	Pelagic Ir	Box Jelly	24.047	23.786	23.786	27.624	33.173	25.409	26.304
16	Unmitigat	MID	Hawaii Nc	Fish / Inve	Anadrom	'O'opu na	24.212	23.949	23.949	27.814	33.401	25.583	26.485
17	Unmitigat	MID	Hawaii Nc	Fish / Inve	Sponges	Massive E	26.219	25.934	25.934	30.119	36.169	27.704	28.68
18	Unmitigat	MID	General H	Fish / Inve	Max	Max Fl	152.48	152.48	152.48	152.48	152.48	152.48	152.48

- While cells are selected, open the “Conditional Formatting” tool in the Styles section of the Home tab in Excel.
- Click “Color Scales” and select the “Red-Yellow-Green Color Scale.” This will format the cells such that the highest score (the general hypothetical maximum) is red, mid-range scores are yellow, and the lowest scores are green.



- Repeat for each region and column, separately, if desired. The image below shows the California species compared amongst themselves and the hypothetical maximum, as well as the Hawaii North species compared amongst themselves and against the hypothetical maximum.

A	B	C	D	E	F	G	H	I	J	K	L	M
Scenario	Value	Region	Species (	Species S	Common	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Average
Unmitigat	MID	California	Fish / Inve	Anadrom	South-Ce	13.712	13.697	6.849	6.956	7.111	6.894	9.2032
Unmitigat	MID	California	Fish / Inve	Sponges	Orange F	10.736	10.724	10.724	10.893	11.136	10.796	10.835
Unmitigat	MID	California	Fish / Inve	Demersal	Cowcod	10.759	10.748	10.748	10.917	11.16	10.819	10.859
Unmitigat	MID	California	Fish / Inve	Pelagic Ir	Krill	7.491	7.483	14.966	15.202	15.541	7.533	11.369
Unmitigat	MID	California	Fish / Inve	Small Pel	Pacific S.	10.522	10.511	21.022	10.676	10.914	10.581	12.371
Unmitigat	MID	California	Fish / Inve	Large Pe	Pacific Bl	10.726	10.715	10.715	10.883	22.252	21.572	14.477
Unmitigat	MID	California	Fish / Inve	Corals	Orange S	18.116	18.097	18.097	18.381	18.791	18.217	18.283
Unmitigat	MID	California	Fish / Inve	Benthic Ir	Black Ab.	23.044	23.019	23.019	23.382	23.903	23.173	23.257
Unmitigat	MID	Hawaii Nc	Fish / Inve	Small Pel	Mackeral	0	0	0	0	26.411	20.23	7.7735
Unmitigat	MID	Hawaii Nc	Fish / Inve	Large Pe	Bigeye Tu	18.968	18.762	0	0	0	20.042	9.6287
Unmitigat	MID	Hawaii Nc	Fish / Inve	Benthic Ir	Hawaiian	14.144	13.99	13.99	16.247	19.511	14.944	15.471
Unmitigat	MID	Hawaii Nc	Fish / Inve	Demersal	Hawaiian	15.741	15.57	15.57	18.082	21.714	16.632	17.218
Unmitigat	MID	Hawaii Nc	Fish / Inve	Corals	Pink Cora	21.988	21.749	21.749	25.258	30.332	23.233	24.052
Unmitigat	MID	Hawaii Nc	Fish / Inve	Pelagic Ir	Box Jelly	24.047	23.786	23.786	27.624	33.173	25.409	26.304
Unmitigat	MID	Hawaii Nc	Fish / Inve	Anadrom	ʻOʻopu na	24.212	23.949	23.949	27.814	33.401	25.583	26.485
Unmitigat	MID	Hawaii Nc	Fish / Inve	Sponges	Massive E	26.219	25.934	25.934	30.119	36.169	27.704	28.68
Unmitigat	MID	General H	Fish / Inve	Max	Max FI	152.48	152.48	152.48	152.48	152.48	152.48	152.48

If a comparison of sensitivity across periods is needed, select data within columns representing all periods for a region (G-L in the image above), along with the hypothetical values in row 18. Then proceed with the conditional formatting step. This will allow a user to detect seasonal differences in sensitivity. For this exercise, do not include the average column in the cells selected, as the numbers may skew the color-coding results.

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The mission of the Bureau of Ocean Energy Management is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.

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