NOAA FISHERIES – VIRTUAL ECOSYSTEM SCENARIO VIEWER (VES-V)

A SOFTWARE TOOL FOR VISUALIZING COMPLEX DATA AND MODEL OUTPUTS FOR MARINE ECOSYSTEMS

Version 1.37 – User Manual – last updated June 2020

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Distribution Notes

This distribution was originally released on 01 June 2020. The software was programmed using the Unity graphics engine and C#.

The software is designed to be used across platforms (PC, Apple, and Linux). More information on how to download or access a web-based version is available from NOAA-Fisheries Service at: https://nmfs-ecosystem-tools.github.io/VES-V/.

This software is distributed freely.

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Introduction

Successfully managing and recovering marine species in today's busy ocean requires us to understand the entire ecosystem and the suite of impacts on their survival, rather than considering just one species at a time. NOAA and especially NOAA Fisheries is using sophisticated ecosystem modeling tools, coupled with input from stakeholders, to explore the tradeoffs inherent in natural resource management decisions. The models incorporate classic population biology and a range of climate, environmental, ecological and human impacts to the ocean. These models, which are relied on by our scientists and managers, provide essential data for making well informed decisions. However, the complexity that makes the models and their output robust can also limit the ability of many audiences to understand and use the information provided. The underlying dynamics of these models are complex, and a new tool aims to show the results of those dynamics in an easy-to-view manner.

To address the concerns noted above, NOAA Fisheries has released a new, innovative software program called Virtual Ecosystem Scenario Viewer (VES-V). VES-V visually illustrates the responses of virtual marine ecosystems to a range of living marine resource management scenarios. Visualizations can help many audiences see the potential for widespread application of models in our work managing marine resources. This tool will facilitate stakeholder engagement and input for exploring tradeoffs among scenarios in future living marine resource management decisions for our nation's marine ecosystems. If there are various meetings where options are being discussed, visualizing is often more powerful than copious graphs and tables, and often the visualizations lead to previously unexplored options.

Additionally, VES-V can be used as an education and outreach tool. It can be used as an interactive virtual exhibit to allow users to explore the undersea world. This tool brings a wide range of scientific data and model output to life - enabling museum and aquarium visitors as well as students of all ages to visualize the results of perturbations and recoveries from various situations in the marine environment. These virtual worlds are meant to simulate real marine ecosystems, but also stimulate interest in a lot of "what-if" situations.

The main purpose of this tool is to demonstrate how we can better present and visualize marine ecosystems, their marine resources, and their collective responses to a range of pressures. VES-V was originally designed to be directly linked to and utilize output files from ecosystem models such as Atlantis, Multi-Species Production and Age-Structured Models, or Ecopath with Ecosim to explore different marine management scenarios. But VES-V is designed to handle a wide range of model outputs and data, such that survey time series or even multiple single-species stock assessment outputs could also be used to explore this virtual ocean world.

Although the example model results provided here have been published and reviewed, they are not necessarily intended for tactical management decision-making. Rather, these results are intended to describe in general terms what might happen to an entire system of species across a range of different options, conditions, and scenarios in order to provide a broad visualization of probable outcomes.

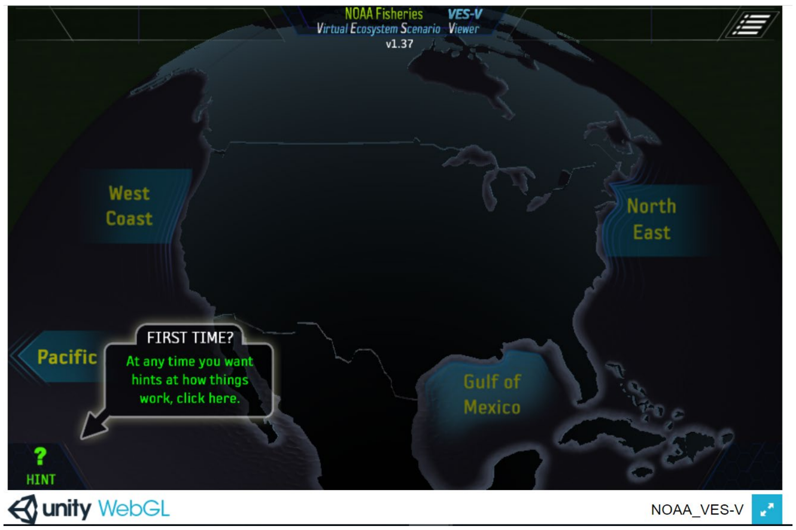
As we continue to develop this tool, we solicit your input. For example, if you have ideas on how to make VES-V better, data for your region that you would like to see animated, or feedback on how we can better present the dynamics of living marine resources in our shared ecosystems, please let us know. Please direct any comments to: Howard.Townsend@noaa.gov or Jason.Link@noaa.gov.

Getting Started

To start exploring the undersea world with VES-V, you have two options – Downloading and installing VES-V on your computer or Running VES-V directly from the web.

Running VES-V directly from the Web

If you do not want to install VES-V on your computer directly, you can run it from the web. You would need any web-browser and sufficient bandwidth when connected to the internet. Visit the VES-V website: https://nmfs-ecosystem-tools.github.io/VES-V/ and click the "Online Application" to get started. You should get a screen that looks like this:

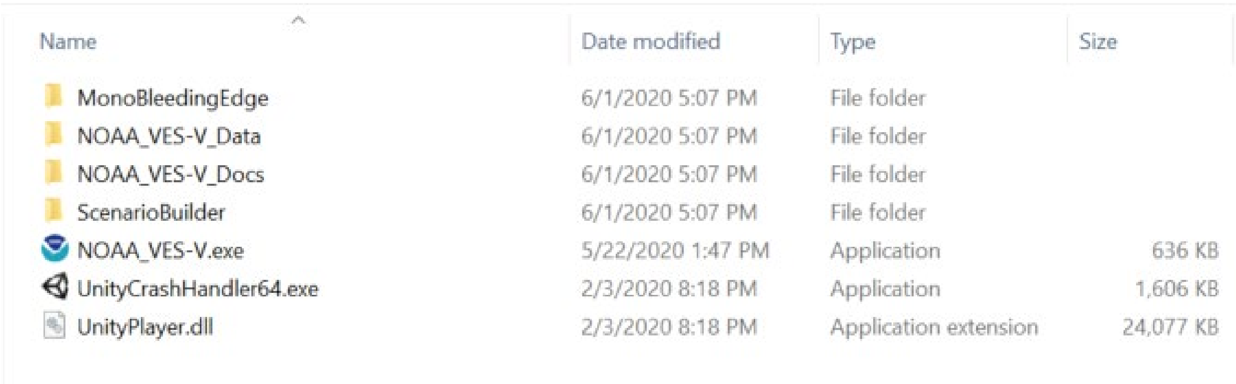


And you can then follow the steps below in the "Navigating VES-V" section to begin to use the software.

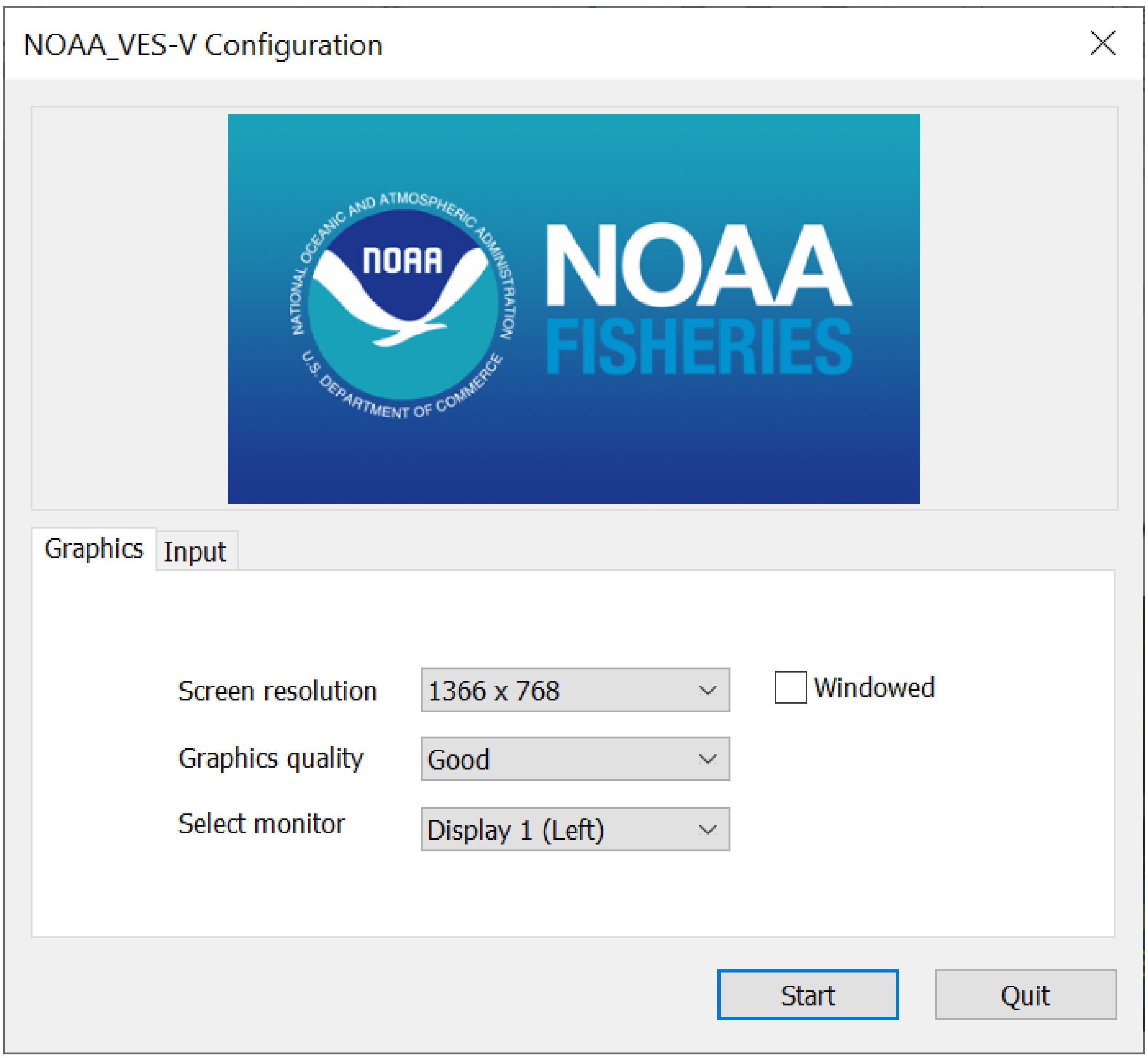
Downloading and Installing the Software

To use VES-V on a desktop or laptop computer directly you will need to download the software installation files appropriate for your computer's operating system. Downloads are available at: https://nmfs-ecosystem-tools.github.io/VES-V/.

After you have downloaded the appropriate VES-V software package - a zipped folder, open the zipped folder and click on the "Organize" menu tab at the top of the screen, and then click on "Select All" files. Once the files are highlighted, click on the "Home" menu tab at the top of screen and click "Extract Files." Select a location to extract the files to on your computer (e.g., an empty folder on your Desktop, My Documents, etc.) and click the "Extract" button at the bottom of the screen. To start the program, go to the folder the data was extracted to, and click on the file named "NOAA_VES-V.exe" (the file name has a NOAA logo, and does not end with Data or Docs, see figure below).



After you have successfully installed the software, it's time to get started exploring ocean ecosystems. When you run the software (NOAA_VES-V.exe) you should get an opening pop-up that looks like this:



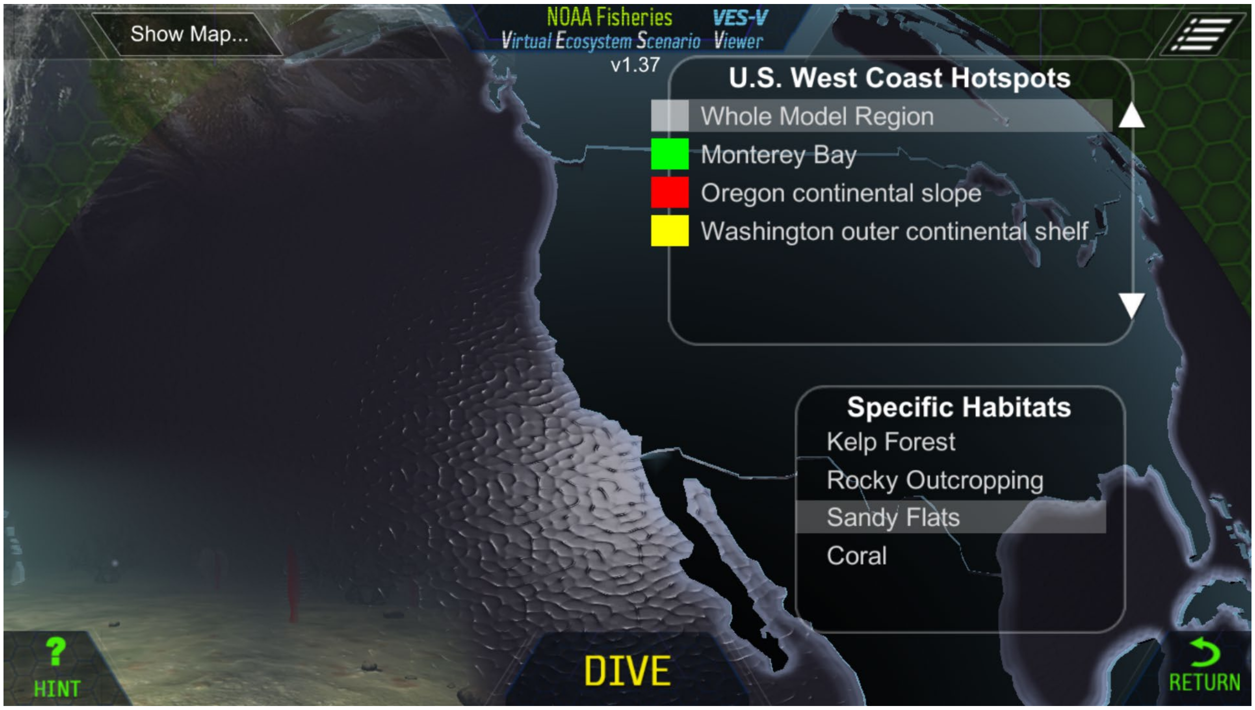
Use this to control the display location and quality of the software. After you have made these selections. Click ‘Start’, and you should get a window that looks like this.

Navigating VES-V

VES-V starts off with a global view. This is a view of the North American area with several regions shown – areas you can select that have unique species, habitats, and geographies. From this screen, you can click on any one of the regions to explore. From this screen, you can also:

- Click on the “List” icon in the upper right corner to adjust the settings for the software,
- Click on the “Hint” icon in the bottom left to display information about the screen,
- Click on the “Exit” icon in the bottom right corner to close the software.
  Note that the “List” and “Hint” icons will be avaialable throughout all levels of the application.

After you click on a region to explore, you should see a screen that looks like this:



The hotspots and habitats listed in this screen will vary depending which region you chose to explore. First,you must choose one of the“Hotspots”, then the “Specific Habitats” list will change depending on what habitats are found in the area your are exploring. Hotspots are predefined areas within a given region, and may contain a specific scenario as part of the selection. It’s a quick ‘preset’ to the data. You can then select other habitats or scenarios once in the underwater simulation. Habitats are unique underwater conditions, for example, sandy, muddy, coral, rocky, bedrock etc. Habitats may differ from one marine region to another. If you do not want to look at a particular locale, then simply select “Whole Model Region” to see the composite results across all habitats.

After you select a hotspot and a habitat, you can click the ‘Dive’ button (bottom center of the screen) to dive under the surface to see conditions and look through the time simulated conditions. From this screen, you can also:

- Click on the “Show Map” icon in the upper left corner to see an inset map of the region
- Click on the “Return” icon in the bottom right to return to the previous screen

Be sure to have your sound on and turned up to get the full effects of diving!

Exploring the Ecosystem

Once you click the 'Dive' button you move from Global View to Habitat View, you are looking underwater at a specific habitat. So, for example, a Pacific Region Pelagic habitat your screen should look something like this:

The habitat and species you see will vary depending on your earlier Region and Habitat selections. At this stage, you also want to make sure you have your computer's volume up enough so that you can hear the underwater sounds. From this screen, you have a lot of options for exploring the habitat you are in, basic navigation methods are listed below.

- To rotate the camera and look around the habitat, hold the left mouse button down and drag either direction.
- To adjust the camera's position in the water column, use the up and down arrow keys, or the slider shown on the far right,
- To zoom the camera, use the center wheel on your mouse Alternatively, you can adjust the zoom using the left bracket key '[' to zoom out, and the right bracket key ']' to zoom in. You can increase the zoom speed by holding down the Shift key, and decrease the zoom speed by holding down the Control key.
- To view the habitat in different times within the scenario you have open, use the plus and minus keys, home or end keys, or the bottom buttons or slider, to move the time slider. You can also auto play the time in the scenario using the play and stop buttons. You can drag the time marker left and right to do the same.
- To show or hide the species and habitat icons, use the 'Icon' button in the upper left.
- To see a graph of a species' data/model output, click any species' icon.Click again to dismiss this graph.
- To see the highest concentration of a species, click on the species' icon and the binoculars icon in the top right of the screen. Click the binoculars again to dismiss.
- The 'Scope' view which is a top down view with no habitat visible (silouhettes of the animals only) can be seen by clicking on the 'Scope' button in the top left of the screen. This"bird's-eye view" is a good way to see a higher concentration of all the species.
- Return will take you back to global view.
- Press 'X' or "ESC" at any time to exit the global view.

Comparing Scenaros

In the initial Habitat View, when you were exploring the ecosystem, the software loaded a baseline scenario for the system. Exploring the ecosystem is certainly entertaining in itself, but the real power of this software is in exploring what the ecosystem may look like under the influence of different drivers, stressors and management policies.

To explore additional scenarios, you can click the folder icon in the top left corner of the screen and select another preloaded scenario. This actually changes the data file that the software is using and is based on another set of model output or other data. If the scenario is sufficiently different from your original baseline scenario, then you will see a markedly different scene on your screen (e.g., fewer or more of certain animals). For example, a scenario where lower fishing occurs might look something like this:

On the other hand, a scenario with higher fishing might look something like this:

So this Higher Fishing Scenario looks soemwhat different from the previous screenshot example with Lower Fishing – flip back to the previous page to compare. Note that the software displays the Scenario title in the upper left corner.

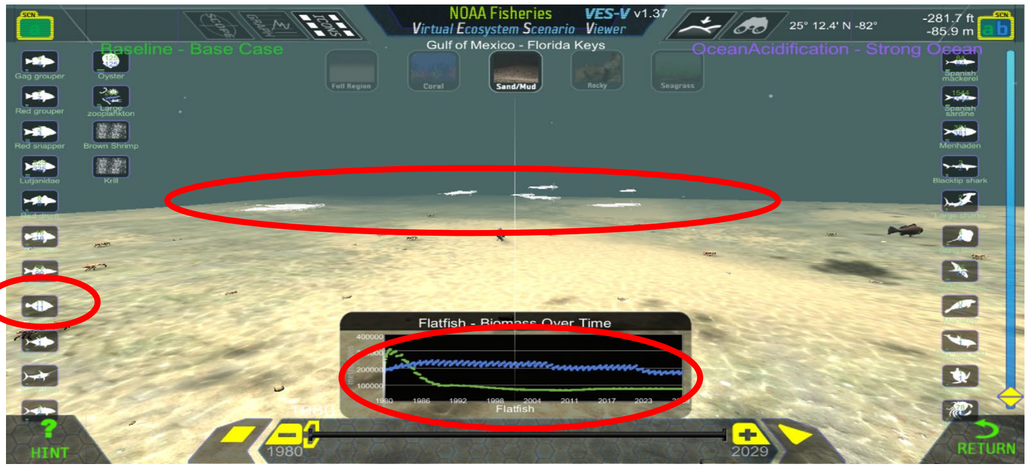
Flipping between pages is an awfully inconvenient way to compare scenarios, so the software is set up to allow visual comaprisons between two different sceanrios. To compare scenarios, click the folder icon in the upper right corner and select another preloaded scenario. Your screen should look something like this:

Again, the actual views will vary depending on the region and scenarios that have been loaded.

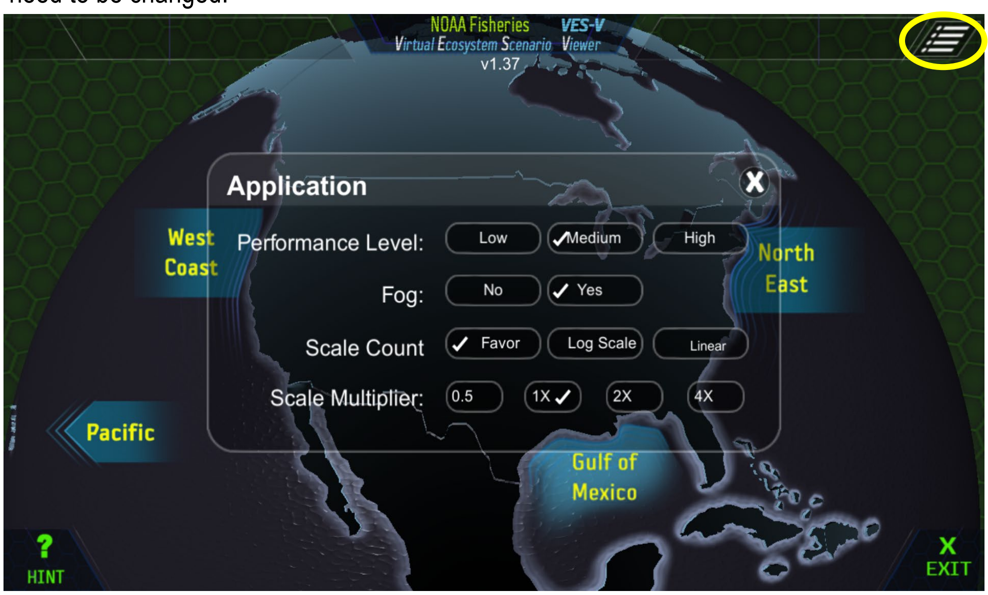
To this point this manual has focused on the basics of VES-V, and using preloaded scenarios. An advanced user can load additional model outputs and data for their own scenarios.

Note on comparing scenarios

In some cases, you may find that a particular species graph shows that you should see stark contrasts in species number, but the scenario comparison mode does not show much contrast in the scene. See the example below with flatfish in the Gulf of Mexico Region – Florida Keys habitat.



If this situation occurs, there are a few things to check. Press "C" on your keyboard and the number of each species and each scene will be displayed in the species icon. If these numbers do differ greatly, check to see that you have the time slider at a point where there is appreciable contrast on the species graph. If you still do not see appreciable contrasts, then the scaling may need to be changed.

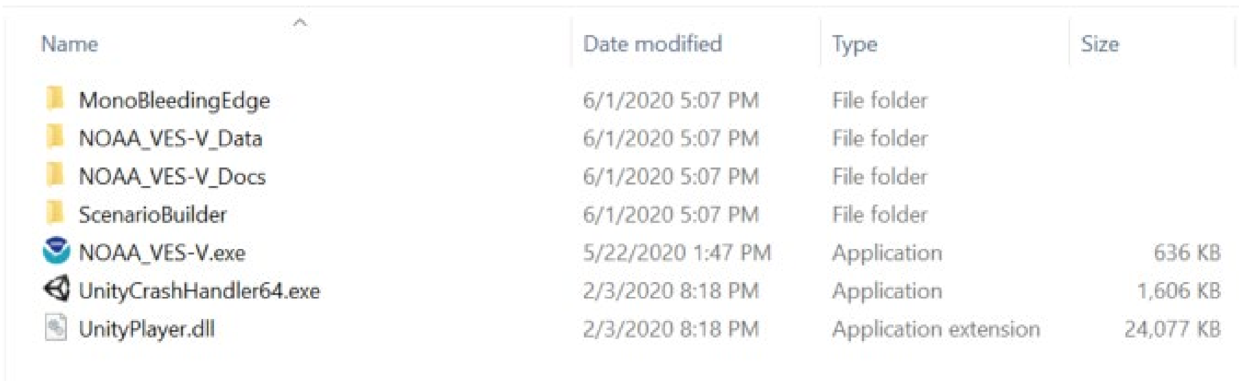


Return to the main screen of VES-V, click the "List" icon in the upper right corner to adjust the settings for the software - select a different scale count (Favor, Log Scale, or Linear). When you dive back into your scene and compare scenarios, the contrasts should be more apparent in the scene.

Loading New Scenarios

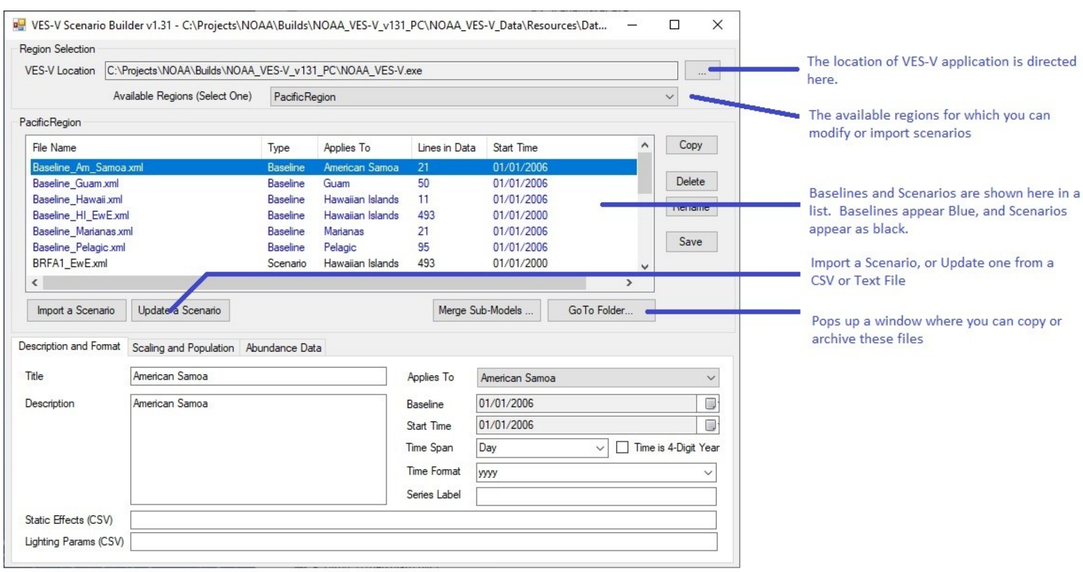
The New, Easier Way – ScenarioBuilder

The VES-V ScenarioBuilder allows you to import, update, and modify abundance scenarios to enhance the end user experience in VES-V. This tool does not work with the web-accessible version of VES-V. You can only modify scenarios in VES-V if you have installed it on your computer. The ScearioBuilder software is bundled with VES-V. When you open up the folder where VES-V is stored. You'll see a ScenarioBuilder folder.



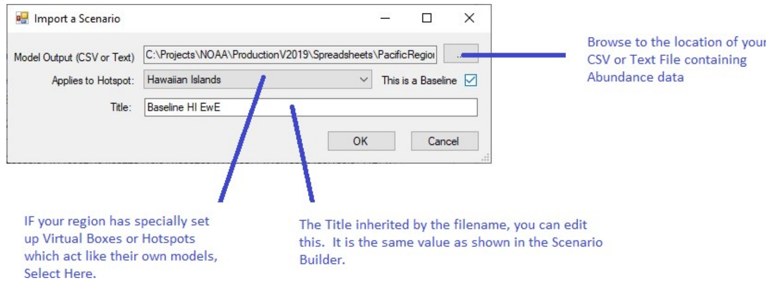
Open the ScenarioBuilder folder, and click the "ScenarioBuilder.exe" file to start running it.

How it works, is that first you browse to the location of your VES-V application from which you want to test. After that, you select the appropriate region that you want to import/update/modify scenarios. Then, you can adjust each scenario including how it presents its population and changes to the end user within the VES-V application.



Importing a scenario

To import a scenario, click on the "Import a Scenario" button, which will bring a window like this up:



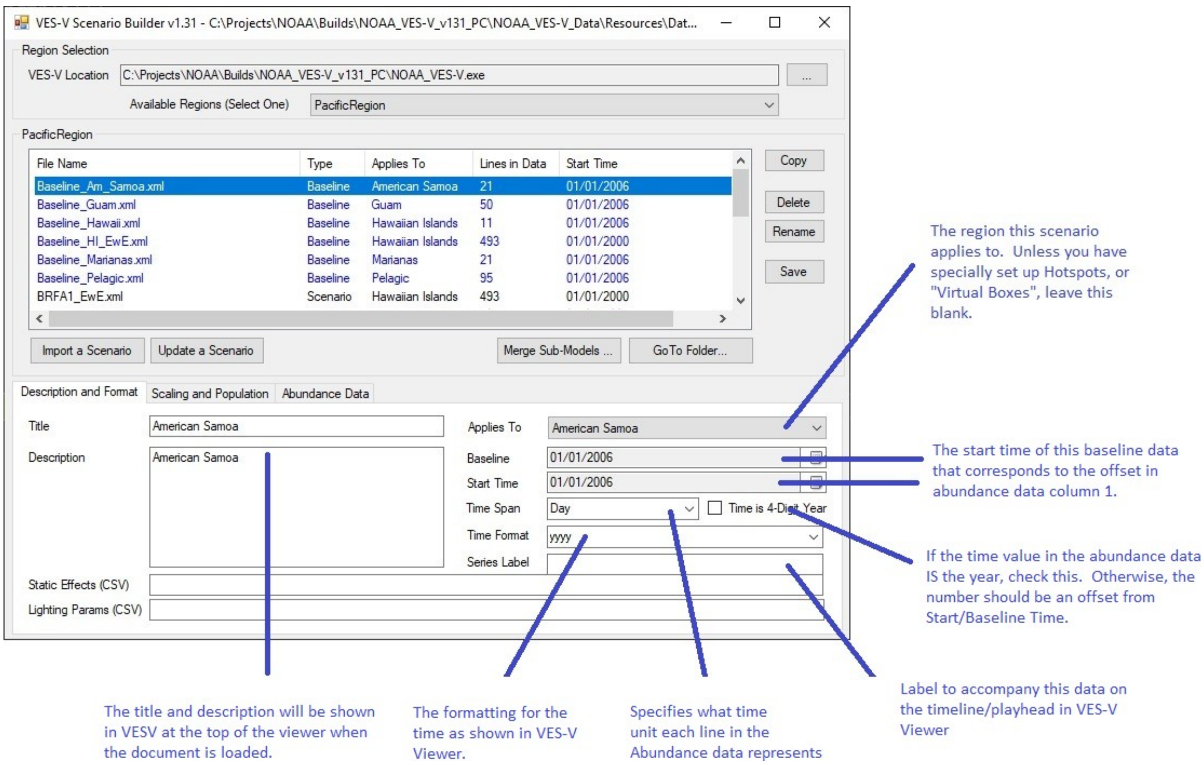
You can then browse to the model output, and set options as to which hotspot (if specially designated) the document is assigned to. You can select whether or not the document is a baseline as well.

The “Update a Scenario” button will allow you to quickly browse to a new CSV or Text document location and will refresh it’s data.

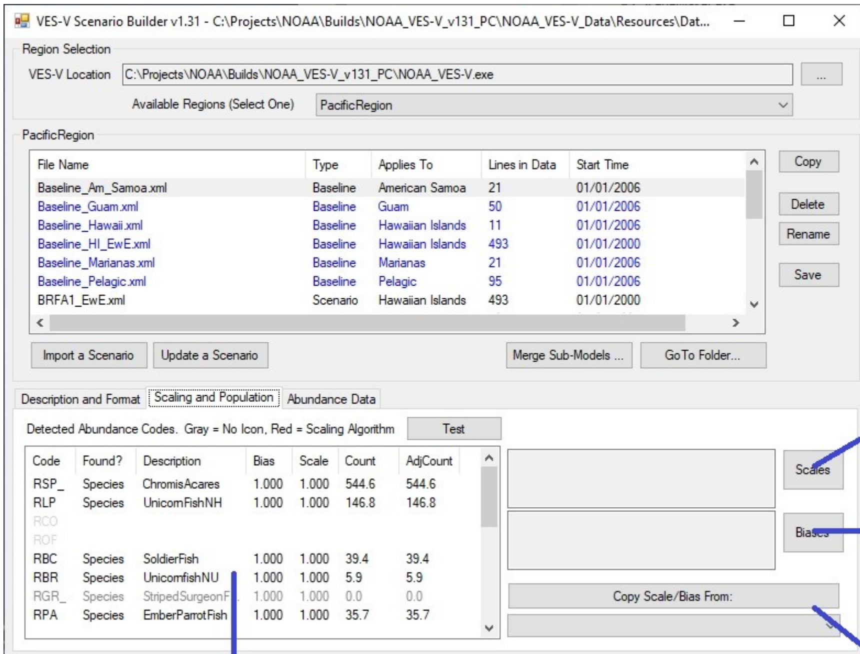
Once imported, the lower portion of the screen will now contain information and parameters specific to the document selected or imported.

It is broken down in to three sections or tabs:

Description and Format



Scaling and Population



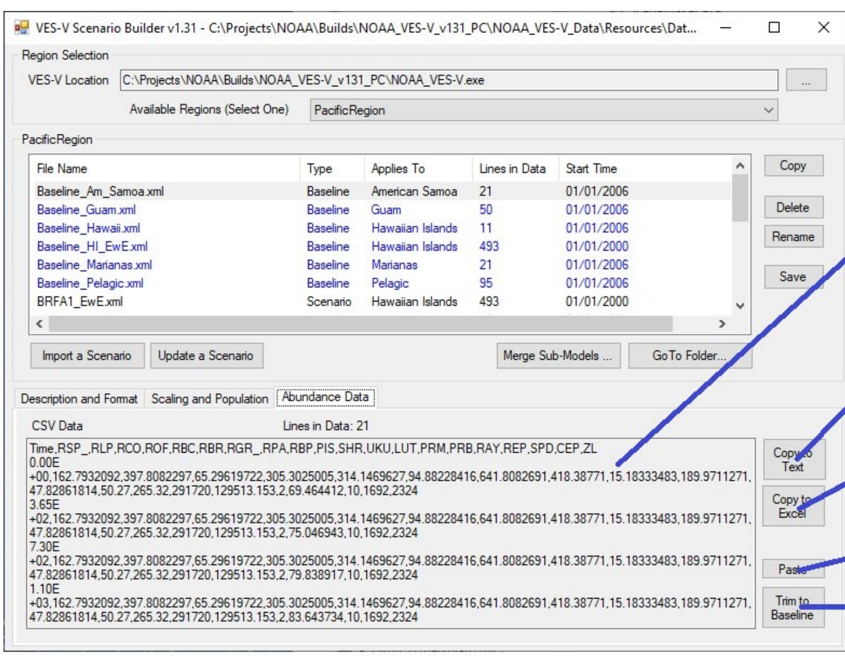
Scales allow a per species adjustment to make sure presence is visible if you want it to be.

Biases allow for preference on species or deference, on how they will be given priority to show more abundance than others. This applies to situations where the maximum number of meshes/critters is being shown.

This table shows what is present in the abundance data for this scenario as well as what anticipated populations will be present in the VES-V viewer. It is not exact as VES-V has some strict limits on the number of meshes or critters that can be shown, so know the whole of the population will be scaled back accordingly if you have very large numbers in any of the counts. Those heavy populations will be marked with red.

This allows you to easily copy the scales and biases from a baseline or another scenario document. Generally speaking you want to make sure the scales and biases in the baseline are copied to the scenarios that will be compared to it.

Abundance Data



This is a read-only presentation of the CSV data within this scenario.

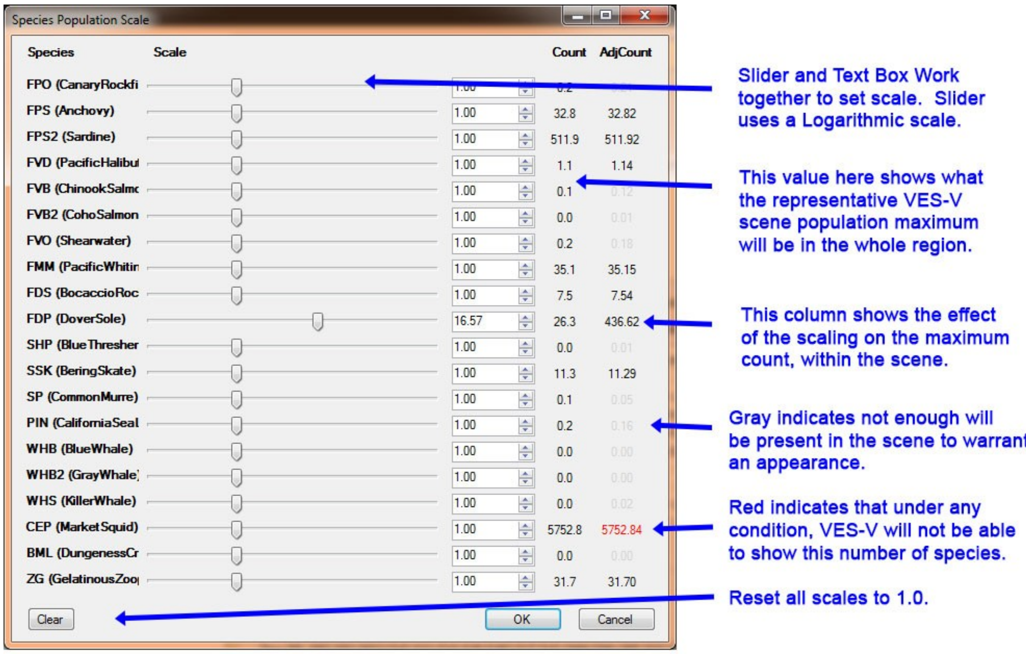
This button will copy the CSV data to the clipboard so you can paste it in to a text or word document.

This button will copy the CSV data to the clipboard so you can paste it in to an Excel Spreadsheet or Table.

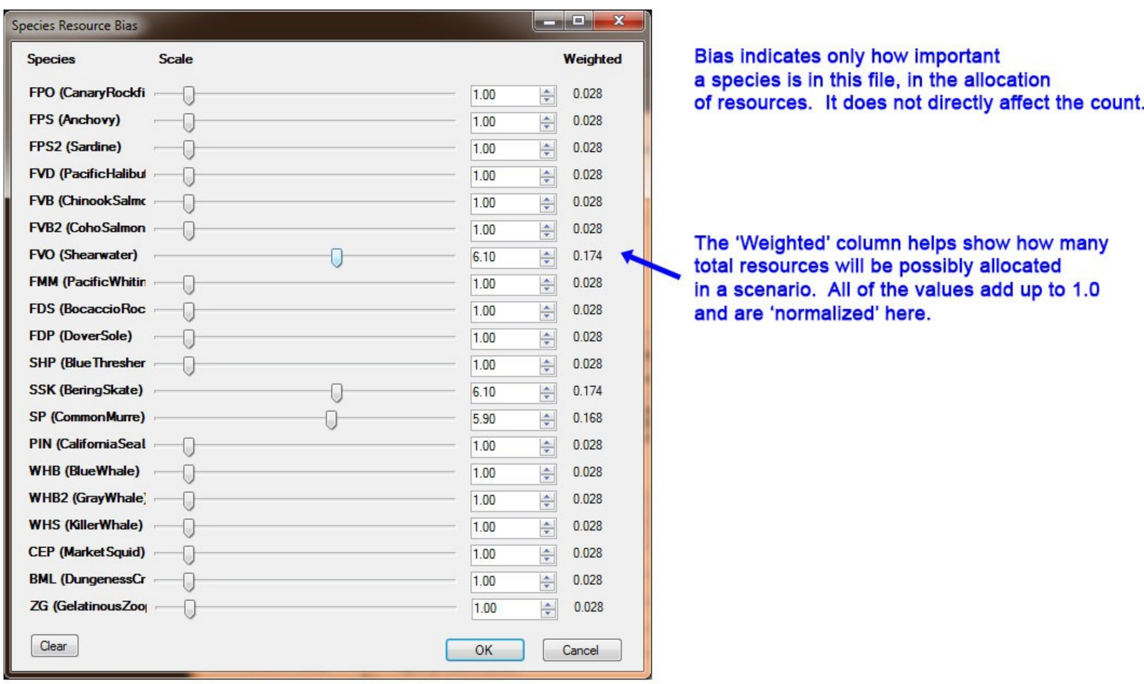
This button will allow you to paste either text or Excel data back in to this scenario. Should include header line and time.

This button will allow you to trim this document back to the same number of lines as the baseline document.

Species Scale and Population Editor



Note, that you can type a value in to the numerical part of the control beyond what you can if using the slider.



The bias functions in a similar way. It shows the distribution of the species in terms of importance.

Using VES-V While Editing Scales and Biases

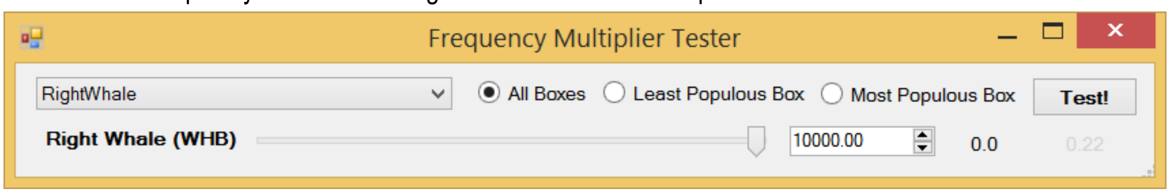
All that you need to do to edit within VES-V, is save your Scenario Document or Baseline document in Scenario Builder, and then “Return” and “Redive” in to a hotspot or region. Scenario Builder does not keep the files opened or locked, allowing this ability to run ScenarioBuilder and VES-V simultaneously.

FrequencyMultiplier

Is located in each species lookup record in the species table, allows a per region adjustment to scale, beyond the **SpeciesScales** value. This is useful in edge cases where the population is consistently too high or scarce. It is also useful if you arrive at one set of scales for a region, as you can use this singular value per species instead of the SpeciesScales in each document. Note if you do this you would have to clear the scales to get a proper result. We find that the visual density is obviously higher than what one would see if snorkeling or scuba diving, but if psychological studies show a visual density of 3-10X higher than what is actually in the environment helps people see the situation to match their perspective. The main point is to show the organisms in a region and be able to contrast them across different scenarios, based on model or survey data.

You can use Scenario Builder, to determine rough FrequencyMultiplier values to enter in the Species Lookup Table.

a) Select the baseline scenario for the region of interest.
b) Select the “Frequency” Button. A dialog like this one will come up:



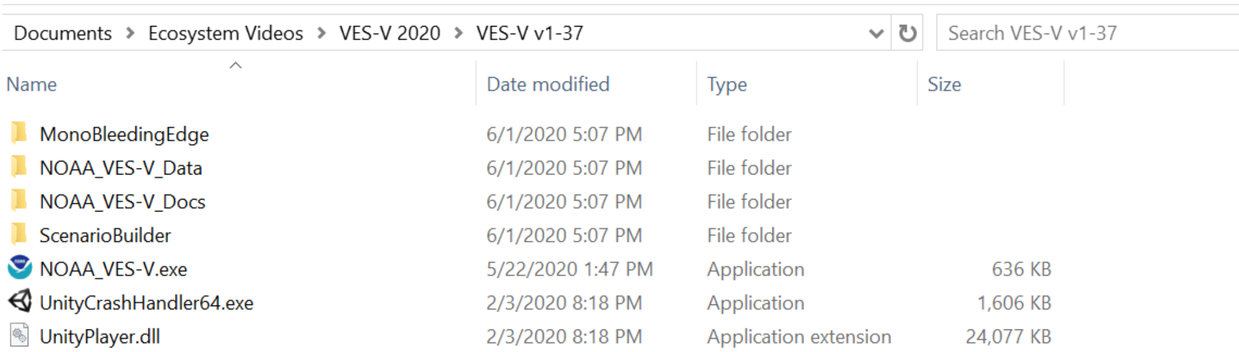
This version of the scale function helps you discover optimal frequency multiplier values.

c) Select any of the region’s species in the top left corner.
d) select “Most Populous Box”.
e) Press “Test!”.
f) Adjust the scale (note you need to use the text area for values > 10,000), until the value onthe far right, is a reasonable number of critters to see in the VES-V scene.
g) Select “Least Populous Box”, and see if the number on the right still makes sense. (This will represent the max critters in the presumably lowest population box).
h) If you select “All Boxes” you will see the max critters in the scenario, all boxes.
i) If this scale value is extreme check your data, namely weight in grams.
j) If there is no difference between least populous and most populous, check the proportions in the species lookup table, they appear to be identical.
k) Note the final scale value! It is not programmed in to the species lookup table for you. Move on to the next critter.

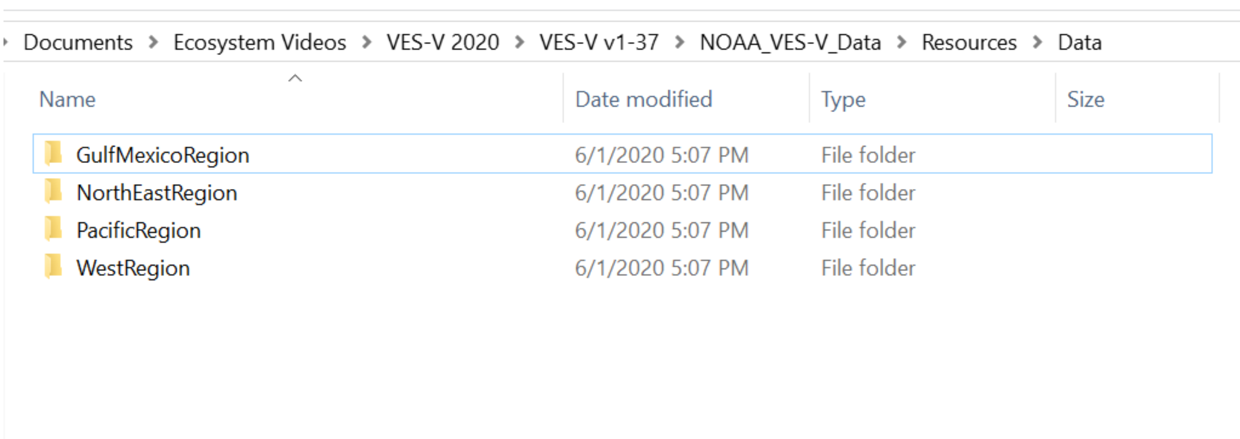
Once you get all of the data straightened out, you should enter the frequencies you discovered in the Species Lookup table for this region. This will give you the best balance of data and populations possible, and we recommend doing this on the baseline only, not the extreme scenarios.

The Old, More Difficult Way

Another way to add a new scenario, you will need abundance/biomass time series data or model output for the species listed under the particular VES-V region and habitat of interest. You will be working with files that were installed under the data folder of the VES-V Software (NOAA_VES-V_Data).



The abundance/biomass files are stored away in a subfolder, called Scenarios within each region. These files can be the original, raw TEXT abundance files separated by spaces, or a preferred file format with an .xml file extension.



Region folders are found at “ABC\NOAA_VES-V_Data\Resources\Data”; “ABC\” indicated the filepath where you installed VES-V. Regions folders include Gulf of Mexico, Northeast and West. Scenario folders for each region are found in these region folders. New scenarios should be stored in the Scenario for the region to which they should be applied.

NOAA_VES-V_Data > Resources > Data > GulfMexicoRegion > Scenarios

Name	Date modified	Type	Size
Baseline.xml	2/28/2020 4:25 PM	XML Document	1,247 KB
DoubleFishingInvertebrates.xml	2/28/2020 4:25 PM	XML Document	780 KB
DoubleFishingSmallPelagics.xml	2/28/2020 4:25 PM	XML Document	782 KB
HalveFishingDemersalFish.xml	2/28/2020 4:25 PM	XML Document	783 KB
MarineProtectedAreas.xml	2/28/2020 4:25 PM	XML Document	777 KB
No_oil.xml	2/28/2020 4:25 PM	XML Document	1,332 KB
OceanAcidification.xml	2/28/2020 4:25 PM	XML Document	1,204 KB
Oil.xml	2/28/2020 4:25 PM	XML Document	1,328 KB
StockAssessments.xml	2/28/2020 4:25 PM	XML Document	4 KB

A scenario file is divided into an XML section, and a CSV (comma separated value) section. If you are an Atlantis user, the CSV section is just the same as the abundance file output from an Atlantis file – except that commas separate all of the values. If you are interested in animating output from a stock assessment or surveys or other model, simply arrange your abundance time series data (total population biomass in metric tons) in columns, one row per year, with column headers (species names), then save as a .CSV file (for instance in Excel). The first column should be Time, in days since the start of the time series. There must be no blank lines or empty columns. It should look something like this;


```
<?xml version="1.0" encoding="UTF-8"?>
<ScenarioDocument xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns:xsd="http://www.w3.org/2001/XMLSchema" Title="Hypothetical Extreme Fishing
scenario">
  <Description>Hypothetical extreme fishing scenario, based on 5x higher fishing mortality rates than in 2007. Atlantis ecosystem model output. See
Kaplan, Horne, and Levin (2012) Progress in Oceanography 102:5-18 </Description>
  <SeriesLabel>Year</SeriesLabel>
  <SeriesStart>2008-01-01T00:00:00</SeriesStart>
  <SeriesTimeSpan>Day</SeriesTimeSpan>
  <SeriesTimeFormat>yyyy</SeriesTimeFormat>
</ScenarioDocument>
<CSV>
Time,FPL,FPO,FPS,FPS2,FVD,FVV,FVS,FVB,FVB2,FVT,FVO,FMM,FMN,FBP,FDD,FDE,FDS,FDM,FDP,FDB,FDC,FDO,FDF,SHB,SHD,SHC,SHP,SHR,SSK,SB,SP,PIN,REP,WHB,WHB2,WHS,WH
T,WDG,CEP,BFS,BFF,BFD,BG,BMD,BML,BMS,PWN,ZL,BD,MA,SG,BC,ZG,PL,PS,ZM,ZS,PB,BB,BO,DL,DR,DC,DIN,RelFPL,RelFPO,RelFPS,RelFVD,RelFVV,RelFVS,RelFVB,RelFVT,Rel
FVO,RelFMM,RelFMN,RelFBP,RelFDD,RelFDE,RelFDS,RelFDM,RelFDP,RelFDB,RelFDC,RelFDO,RelFDF,RelSHB,RelSHD,RelSHC,RelSHP,RelSHR,RelSSK,RelSB,RelSP,RelPIN,Rel
REP,RelWHB,RelWHS,RelWHT,RelWDG,RelCEP,RelBFS,RelBFF,RelBFD,RelBG,RelBMD,RelBML,RelBMS,RelPWN,RelZL,RelBD,RelMA,RelSG,RelBC,RelZG,RelPL,RelPS,RelZM,RelZ
S,RelPB,RelBB,RelBO,RelDL,RelDR,RelDC,RelDIN,PelDemRatio,PiscivPlankRatio,DivCount,InfEpiRatio,BSSslope,HabitCover
0,1259289.993,21088.02612,93826.24767,3659223.659,113778.8381,63999.99998,34744.05777,8914.153062,469.1659507,851.370975,1742.323475,3697999.984,156676.
0169,244363.3903,179206.9012,38617.21509,252990.712,457082.0146,423049.0029,48221.20794,489618.6079,172270.504,314931.7621,117834.6187,933.781814,595.11
6953,3742.500549,62043.99859,96239.20676,51.3115,1537.030973,577159.1551,155.69099,138009.2611,519177.6965,21648.48562,71593.41299,87.969802,49336.85063
,64748.20496,955636.8748,82097.81594,173406.8255,321952.2897,107.438976,149948.961,126832.9852,8368395.138,610151.2364,246891.0953,441336.71,5754823.703
,49127.89664,3896682.603,1300502.781,361353.7093,1789783.723,70662.83129,10683.24548,10.683245,5341622.74,21366490.96,0,15543838435,1,1,1.001096,1,1,1,1
,1.666667,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,0,0,0,0,-346.943411,1.642613
365,1532197.611,21628.65766,75817.88742,2956897.61,69958.87302,66586.40493,28914.58809,4450.504418,234.2370747,15.953132,1781.150449,2917966.124,136696.
0404,274005.2861,165079.7731,19435.24398,247214.872,420522.4179,394183.7367,42577.60205,470952.5304,145170.826,328693.4183,85351.49844,665.116907,452.99
3383,2178.984655,45127.92671,89043.88738,52.084901,1708.984905,650794.8744,146.441644,144608.7105,544004.1965,21445.77631,69657.81909,102.440352,50.8991
```


This format is not particularly easy to work with, so you may want to copy the section between the CSV markers, paste it into a text editor, save it as a comma-separated variables dile (".csv" extension), and work with it in your favorite spredsheet software.

	A	B	C	D	E	F	G	H	I	J
1	Time	GAG	RGR	SCM	SSR	DSR	RSN	VSN	LUT	BIO
2	0	15556.02	46901.59	1810.318	506863.6	209585.9	46630.63	143049.9	666690.9	139467.5
3	30	16567.11	48864.4	1909.03	671182.8	217651.1	51632.46	189360.8	675531.8	129506.7
4	60	16736.62	32383.4	2000.131	601662	224116.9	55921.5	222524.6	591974.3	121759.8
5	90	10286.71	33412.11	2088.549	465480.2	225821.5	59986.47	240248.2	424733.9	116437.2
6	120	10870.02	35321.52	2178.147	373420.5	224990.7	63761.02	244976	338884.8	113013.6
7	150	12374.98	36132.74	2267.117	312376.2	182631.9	67541.71	238476.3	220412.2	111589.4
8	180	12682.19	36541.59	2342.272	267855.4	180030.2	71218.87	225033	189321.9	111513.6
9	210	13001.71	37152.24	2424.452	238330.1	191913.4	74885.53	132452.2	166352.2	100635.2
10	240	13315.47	37594.03	2495.643	215056.1	195041.7	78468.01	127159.6	140584.5	102956.5
11	270	13498.07	38079.68	2575.889	184719.4	197593.3	51708.88	118118.2	81605.82	106206.3
12	300	13591.86	38660.16	2645.009	175151.5	194769	58203.59	110592.3	0	108560.4
13	330	13694.94	39096.33	1725.079	182131.8	190087.6	62382.35	104813.3	0	111493.3
14	360	13694.56	39685.18	1824.848	178029.7	183073.7	66472.66	98117.74	0	114698.2
15	365	13697.51	39750.21	1841.266	176472.1	180741.7	67102.49	97082.32	0	115282.3
16	390	13736.32	39873.72	1910.25	166287.8	166523.7	70178.03	93076.71	0	118159.3
17	420	13746.84	40088.61	2010.429	157757.5	147181.1	73842.37	86909.45	0	121608.1
18	450	13645.33	27196.86	2118.573	151851.9	131532.8	77384.92	80302.49	0	124892.2
19	480	8979.521	29219.83	2227.249	146865.7	127711.6	80744.66	73737.61	0	127917.2

This format places the species time and species codes in convenient columns.

You can create as many scenario files as you like in the Scenarios folder, and these will then be selectable by the user within the Habitat View.

Scenario file rows may contain species abundances, or effect abundances (reference the specieslookup table or the effectslookup table). Some effects may be initialized only in the XML header and not dynamic or present in the row data.

Creating Scenarios - Simplified

1) Take a Scenario file, such as new.xml to start with (in the desired Scenario folder). Or, if you have a similar scenario you can rename that file and start with that. Make sure all lines between <CSV> and </CSV> are deleted.

2) Paste in your own content from Atlantis, MS-Prod, EwE, Stock assessment models,etc. such that the data is between the <CSV> and </CSV> tags as shown above. Please note that this data must be comma, not space separated. Units are metric tons, total population biomass in the model domain.

3) Modify the Header lines above. Title, Description, etc. etc. As needed. The <Baseline></Baseline> tag will let you indicate at what point simulated data ends.

4) Save this final Scenario file with a name that you like, make sure the file extension remains .xml

5) Copy this data in to NOAA_VES-V_Data folder that accompanies the application of the same name. Enter the Resources\Data\Region\Scenarios folder where “Region” is the region the data is generated for. This Scenarios folder is where all the scenario .xml files must be in order for the program to choose them.

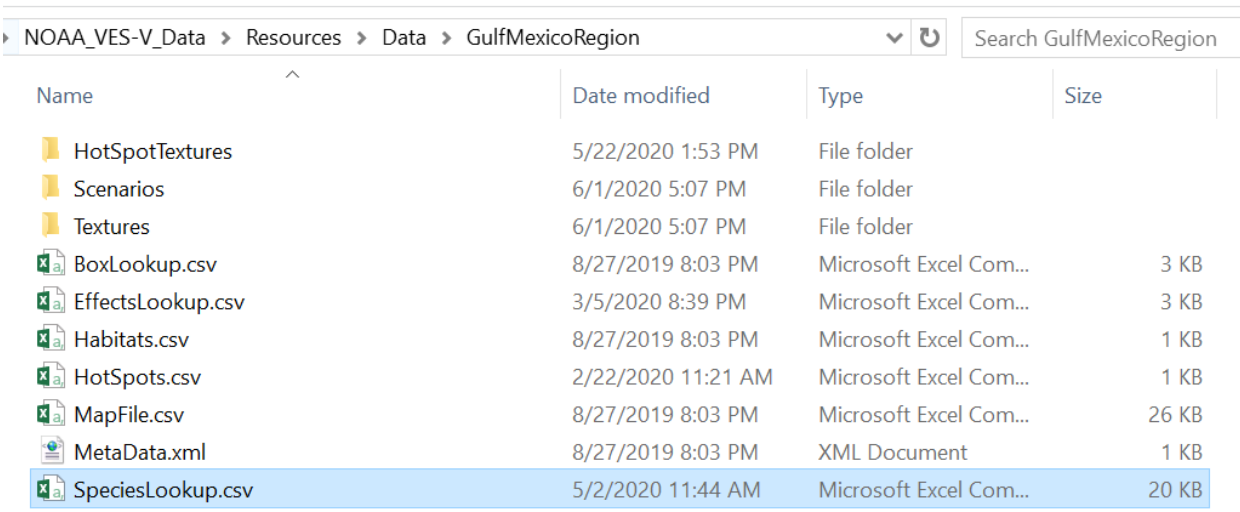
6) If the document is to be compared to the baseline (Baseline.xml), then it must have the same number of lines, same starting time, and same time units as that file.

7) Test the scenario by opening it in NOAA VES-V.

Creating Scenarios – Advanced Technques

Read the previous section (Creating Scenarios – Simplified) before moving on to Advanced Techniques. The simplified instructions are based on a user's need to simply change the biomass time series for one or more organisms in an existing scenario. However a use may need to make additional changes to an existing scenario to create a new scenario – such as changing which organisms are displayed or changing habitats where species are located. Most of these changes can be made in the "SpeciesLookup.csv" file.

Each model region has a Species Lookup file found in the data folder for that region.



The SpeciesLookup.csv file cross-references the species abundance time series (in the scenario.xml file) to the proper 3-D animated creature or species. The Species Lookup file also assigns each species a habitats preference and spatial distribution across the map. It also describes their behavior, such as swim speed, to the animation engine. NOTE

- The spatial distribution of each species does not vary through time or across scenarios – it is set only by the SpeciesLookup file. This is a major caveat when viewing scenarios of marine protected areas, for instance.
- The column "CodeRevised" in SpeciesLookup identifies an animated creature available in VES-V, and "CodeInAbundanceFile" links that to a column header in the Scenario file (.xml). In one Scenario file you can 'borrow' creatures from multiple regions (Gulf of Mexico, Northeast US, or West Coast).

	A	B	C	D	E	F	G	H
1	Species	CodeRevised	Description	CodeInAbundanceFile	Length(cm)	DepthCeilingNorm	DepthFloorNorm	BurstSpeedMS
2	Gag grouper	GagGrouper	Gag grouper	GAG	60	0.8	0.99	1.5
3	Red grouper	RedGrouper	Red grouper	RGR	60	0.8	0.99	1.5
4	Red snapper	RedSnapper	Red snapper	RSN	60	0.8	0.99	2
5	Lutjanidae	Lutjanidae	Lutjanidae	LUT	20	0.1	0.99	2
6	Red drum	RedDrum	Red drum	RDR	30	0.1	0.99	1.5
7	Flatfish	DoverSole	Flatfish	FLT	30	0.8	0.99	1
8	Spanish mackerel	AtlanticMackerel	Spanish mackerel	SMK	50	0.01	0.1	4
9	Spanish sardine	Sardine	Spanish sardine	SAR	12	0.01	0.1	3
10	Menhaden	Menhaden	Menhaden	MEN	12	0.01	0.1	2
11	Blacktip shark	SpinyDogfish	Blacktip shark	TIP	60	0.5	0.99	5
12	Large sharks	Hammerhead	Large sharks	LGS	200	0.05	0.2	5
13	Skates and rays	WinterSkate	Skates and rays	RAY	30	0.9	0.99	1
14	Surface feeding birds	Shearwater	Surface feeding birds	SBR	30	0	0.05	0.5
15	Mysticeti	RightWhale	Mysticeti	MYS	2000	0	0.5	5
16	Dolphins and porpoises	BottlenoseDolphin	Dolphins and porpoises	DOL	300	0.01	0.3	5
17	Blue crab	DungenessCrab	Blue crab	BCR	15	0.95	0.99	0.5
18	Oyster	Oyster	Oysters	OYS	6	1	1	0
19	Large zooplankton	GelatinousZooplankton	Jellyfish	JEL	6	0.01	0.5	0.2
20	Loggerhead	Loggerhead	Loggerhead	LOG	100	0.01	0.3	1
21	Manatee	Manatee	Manatee	MAN	150	0.01	0.2	2
22	Seatrout	SeaTrout	Seatrout	SEA	30	0.01	0.5	1.5

If a user wanted to, for example, remove a species from being displayed in a scenario, the user could look up the species code in the Species look up file, then delete the associated species code and time series data from the appropriate column of a scenario file. Multiple characteristics of species in a scenario can be changed within the Species Look up file. The table below describes all the fields in the Species Lookup file.

One common issue with new scenarios is populations with low density. If a population of a particular species is consistently low, very few individuals may be available to be viewed in a given scenario. Some viewers will want to see at least a few individuals of each species that they know visits a region -- .e.g. expect to see at least 5 Red Drum on the screen, even though a randomly dropped camera on the seafloor might not see many Red Drum at their average density. For each species individually, you can adjust the FrequencyMultiplier field in the Species Lookup file. The end result is the that you may amplify the number of fish of a species within the field of view, but by keeping the FrequencyMultipler the same across scenarios and time periods, you can still see the relative change in abundance (i.e. 5 Red Drum in field of view with high fishing, vs 10 Red Drum in field of view for scenario with low fishing).

Species Lookup File Data Layout

Field	Type	Description
Species	String	The Species Name (can contain spaces). Will be shown on Icon
CodeRevised	Enumeration	The string code that applies to this real time asset, across all regions.
Description	String	A more detailed note about this species, up to a sentence. May describe what the group contains using a representative species.
CodeInAbundanceFile	Enumeration	The exact code for this species in abundance files / scenario files applied to this region.
Length(cm)	Floating Point	Typical Length of Adult

DepthCeilingNorm	Floating Point	The normalized 'ceiling' of this species within the habitat. 0=Surface, 1=Bottom.
DepthFloorNorm	Floating Point	The normalized 'floor' of this species within the habitat. 0=Surface, 1=Bottom.
BurstSpeedms	Floating Point	The maximum burst or thrust speed in meters per second.
CruiseSpeedMs	Floating Point	The typical swimming speed in meters per second.
Movement	Enumeration	The Movement Type Enumeration. LooseSchool TightSchool Clustering ClusteringMostlySedentary MostlySedentary Solitary
SchoolSize	Integer	Number of Fish per School, Minimum of 1
PropulsionType	Enumeration	The type of propulsion for this species. Burst NormalFish Float Bird Walking SinusoidalWings SinusoidalLongitudinal Whale Seal JetPropulsionBackwards
FilterFeedingFish	Boolean	Does the fish filter feed (simple behavior)
AverageWeightPerIndividualGrams	Floating Point	Weight in Grams (Average)
Habitat0Preference	Floating Point	Preference to Habitats 0-3, id based
FrequencyMultiplier	Floating Point	Global scale adjustment for this region, to population useful for edge cases.
Habitat1Preference	Floating Point	
Habitat2Preference	Floating Point	
Habitat3Preference	Floating Point	
ProportionInBox1	Floating Point	Proportion of this species in the first box. (This and the following n fields must add up to 1)

ProportionInBox2	Floating Point	
…	Floating Point	
ProportionInBoxN	Floating Point	

For the most part changes to the scenarios can be accomplished by creating new scenario (.xml) files and Species Lookup files as described above. Additional changes to the visualizations can be made by modifying other regional metadata files. For example, habitat appearances can be modified using the Habitat.csv file. For more information on these other options consult the Data Layout file VES-V documentation folder (\NOAA_VES-V-v118_Docs).

References

The VES-V software is pre-loaded with model output and summary data from a vaiety of sources. The data sources are listed below.

Region	Scenarios	Source	Compare to baseline scenario:
Northeast	Baseline.xml	Olsen et al. (2018)*	(this is a baseline scenario)
Northeast	BaselineToCompareToMPAsOrClimateChange.xml	Olsen et al. (2018)*	(this is a baseline scenario)
Northeast	DoubleFishingInvertebrates.xml	Olsen et al. (2018)*	Baseline.xml
Northeast	DoubleFishingSmallPelagics.xml	Olsen et al. (2018)*	Baseline.xml
Northeast	HalveFishingDemersalFish.xml	Olsen et al. (2018)*	Baseline.xml
Northeast	MarineProtectedAreas.xml	Olsen et al. (2018)*	BaselineToCompareToMPAsOrClimateChange.xm
Northeast	NEFSCassessment.xml	NOAA SIS stock assesssment database, courtesy Jeffrey Vieser, NOAA Office of Science & Technology	none
Northeast	NEFSCsurveytrawlandMammalBird.xml	NEFSC autumn trawl survey, courtesy Sean Lucey NOAA NEFSC, and additional mammal and bird surveys	none
Northeast	OceanAcidification.xml	Olsen et al. (2018)*	Baseline.xml
Northeast	ClimateChange.xml	Test simulation based on 3C temperature increase, based roughly on Olsen et al. (2018) base case. Intended as demo only.	BaselineToCompareToMPAsOrClimateChange.xml

Region	Scenarios	Source	Compare to baseline scenario:
Northeast	NEUSOutBiomIndxEffortDoubled.xml	Link et al. 2010, Nye et al. 2013, R. Gamble pers. comm.	
Northeast	NEUSOutBiomIndxEffortHalved.xml	Link et al. 2010, Nye et al. 2013, R. Gamble pers. comm.	
Northeast	NEUSOutBiomIndx3DegWarmer.xml	Link et al. 2010, Nye et al. 2013, R. Gamble pers. comm.	
West	Baseline.xml	Olsen et al. (2018)*	(this is a baseline scenario)
West	DoubleFishing.xml	Olsen et al. (2018)*	Baseline.xml
West	DoubleFishingInvertebrates.xml	Olsen et al. (2018)*	Baseline.xml
West	DoubleFishingSmallPelagics.xml	Olsen et al. (2018)*	Baseline.xml
West	HalveFishing.xml	Olsen et al. (2018)*	Baseline.xml
West	HalveFishingDemersalFish.xml	Olsen et al. (2018)*	Baseline.xml
West	MarineProtectedAreas.xml	Olsen et al. (2018)*	Baseline.xml
West	NoFishing.xml	Olsen et al. (2018)*	Baseline.xml
West	OceanAcidification.xml	Olsen et al. (2018)*	Baseline.xml
West	WestCoast1910SardineGroundfishAssessments.xml	NOAA SIS stock assesssment database, courtesy Jeffrey Vieser, NOAA Office of Science & Technology	none
West	WestCoastGroundfishTrawlSurvey.xml	NWFSC West Coast groundfish bottom trawl survey, courtesy Beth Horness, NOAA NWFSC	none
Gulf of Mexico	Baseline.xml	Olsen et al. (2018)*	(this is a baseline scenario)
Gulf of Mexico	DoubleFishingInvertebrates.xml	Olsen et al. (2018)*	Baseline.xml

Region	Scenarios	Source	Compare to baseline scenario:
Gulf of Mexico	DoubleFishingSmallPelagics.xml	Olsen et al. (2018)*	Baseline.xml
Gulf of Mexico	GulfMexicoAssessments.xml	NOAA SIS stock assesssment database, courtesy Jeffrey Vieser, NOAA Office of Science & Technology	none
Gulf of Mexico	HalveFishingDemersalFish.xml	Olsen et al. (2018)*	Baseline.xml
Gulf of Mexico	MarineProtectedAreas.xml	Olsen et al. (2018)*	Baseline.xml
Gulf of Mexico	OceanAcidification.xml	Olsen et al. (2018)*	Baseline.xml
Gulf of Mexico	Oil.xml	Oil spill scenario [K1000 B363] based on Ainsworth et al. (2018) *PloS one*, *13*(1). Note that in VES-V impacts of oil spill are spread across model domain rather than being concentrated spatially.	No_oil.xml
Gulf of Mexico	No_oil.xml	Base case (with no oil) to be compared against scenario Oil.xml	(this is a baseline scenario)
Pacifc	Baseline_Am_Samoa_survey.xml	PIFSC ESD RAMP survey data	None
Pacifc	Baseline_Marianas_survey.xml	PIFSC ESD RAMP survey data	None
Pacifc	Baseline_Guam.xml	Olsen et al (2018)	(this is a baseline scenario)
Pacifc	Guam_25perc_MPA.xml	Olsen et al (2018)	Baseline_Guam.xml

Region	Scenarios	Source	Compare to baseline scenario:
Pacifc	Guam_50perc_MPA.xml	Olsen et al (2018)	Baseline_Guam.xml
Pacifc	Guam_DoubleFishing.xml	Olsen et al (2018)	Baseline_Guam.xml
Pacifc	Guam_No_fishing.xml	Olsen et al (2018)	Baseline_Guam.xml
Pacifc	Baseline_HI_EwE.xml	Weijerman et al (in prep)	(this is a baseline scenario)
Pacifc	BottomfishRestrictedFisheryArea_EwE.xml	Weijerman et al (in prep)	Baseline_HI_EwE.xml
Pacifc	LineOnlyFishing_EwE.xml	Weijerman et al (in prep)	Baseline_HI_EwE.xml
Pacifc	NoHerbivoresFishing_EwE.xml	Weijerman et al (in prep)	Baseline_HI_EwE.xml
Pacifc	NoSpearFishing_EwE.xml	Weijerman et al (in prep)	Baseline_HI_EwE.xml
Pacifc	NoNetFishing_EwE.xml	Weijerman et al (in prep)	Baseline_HI_EwE.xml
Pacifc	Baseline_Pelagic.xml	Woodworth-Jefcoats et al 2019	(this is a baseline scenario)
Pacifc	Pelagic_higherFishing.xml	Woodworth-Jefcoats et al 2019	Baseline_Pelagic.xml
Pacifc	Pelagic_lowerFishing.xml	Woodworth-Jefcoats et al 2019	Baseline_Pelagic.xml
Pacifc	Baseline_Pelagic_EwE.xml	Woodworth-Jefcoats et al 2015	this is a baseline scenario)
Pacific	Pelagic_EwE_DoubleFishing.xml	Woodworth-Jefcoats et al 2015	Baseline_Pelagic_EwE.xml

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