

Lummi Intertidal Baseline Inventory

Appendix K: GIS Projects

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March 2010

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Executive Summary

Spatially located results and analyses from the LIBI surveys are presented in four Geographic Information System (GIS) projects that are provided on the LIBI DVD. This report briefly describes the data layers in each project, and provides instruction on their intended use.

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1.0 Introduction

Geographic Information System (GIS) software is often used to analyze, manage, and present data that are linked to a spatial location. This technology allows spatial patterns to be mapped and allows data from different sources to be objectively associated based on spatial relationships.

One of the primary goals of the Lummi Intertidal Baseline Inventory (LIBI) is to provide data in a format that can be used to rapidly assess the potential impacts of oil spills and other disasters. For this purpose, a GIS-based mechanism that could be used to map the results was needed. Accordingly, there are four ArcMap GIS projects on the LIBI DVD that can be used to display the spatially-located survey results and other GIS work products.

The purpose of this appendix is to give a brief overview of the GIS projects, to describe the data layers within them, and to assist an experienced GIS user with exploring the survey data in conjunction with the use of the Access database export tools discussed in Appendix J.

2.0 Methods

ArcMap 9.3 GIS software (ESRI) was used to create all GIS projects provided on the LIBI DVD. ArcMap version 9.3 or higher is required to use these projects. All supporting data files in the projects are located on the DVD and require that the directory structure within the LIBI folder remain unchanged.

For reference, all of the GIS projects use a background photo mosaic that was made from orthographic aerial photographs taken in 2006 as part of the National Agricultural Imagery Program (USDA 2006). This photo-mosaic is stored as an image in the geodatabase 'NAIP2006.mdb', which is present in the LIBI folder on the DVD.

Attempting to operate the Access databases and GIS projects directly from the DVD rather than from a computer hard drive will result in problems stemming from lack of file-writing ability for the software. Please copy the DVD contents onto the root directory of the C: drive before attempting to use them.

3.0 Results

There are four GIS projects on the LIBI DVD in the folder LIBI\GISProjects\

- BenthicInvertebrates.mxd
- BirdsMarineMammals.mxd
- Finfish.mxd
- GISAnalysis.mxd

3.1 BenthicInvertebrates.mxd

The Benthic Invertebrates GIS project contains data layers arising from the surveys outlined in Appendix A (Intertidal Biota Survey) and Appendix B (Large Bivalve Survey) of this report. The data layers saved in this project are:

Intertidal Biota Survey Data (Appendix A)

- DigSurveySitePhotos Events
- RockSurveyGISOutput Events
- DigSurveyGISOutput Events
- UserSelectedGISOutput Events
- thiessen_locations

Large Bivalve Survey Data (Appendix B)

- HorseClam_topmostbiased_obs
- HorseClam_unbiased_obs
- Geoduck_locations
- HorseClam_ThiessenPolygons

Data Layer: 'DigSurveySitePhotos Events'

The DigSurveySitePhotos Events layer shows the location of sites where photographs were taken of the substrate (orthographic) and the surrounding areas (arrows). If the user selects the Hyperlink tool on the Tools Toolbar and then clicks on a site of interest, a list of the available photographs for that site will appear (Figure K.1).

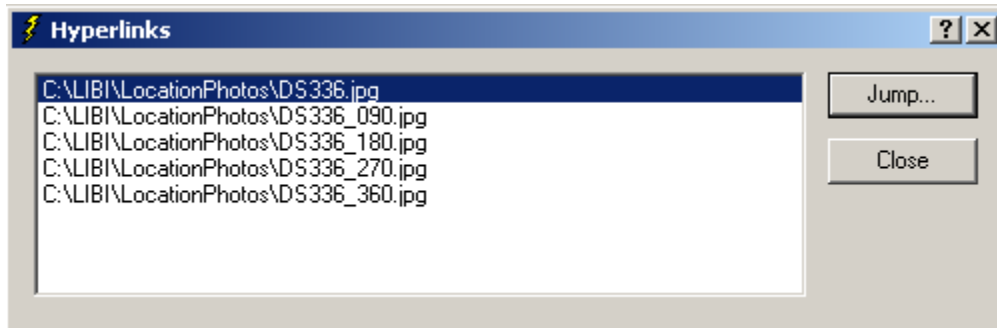


Figure K.1. A List of Photographs Available for Site DS336

The file names of the photographs indicate the site name (e.g., DS336) and the compass bearing of the photo (the number following the underscore). If the file name does not include a bearing, the photograph is an orthographic photograph of the substrate at the site (the photograph was taken with the camera facing vertically down). To open the desired photograph from the list, the user selects the filename and clicks 'Jump'.

Data Layer: 'RockSurveyGISOutput Events'

The RockSurveyGISOutput Events data layer provides the total count of only those organisms that were observed and counted on up to five rocks from the substrate surface. This count does not include the individuals that were recorded from the excavated samples. The underlying data values do not depend on user-input.

To display the total counts of a particular taxon, the user may open the symbology tab of the layer properties window and select the relevant taxon from the value drop-down list (e.g., the action shown in Figure K.2 would select the results for plate limpets). Depending on the range of result values, the user may elect to increase or decrease the number of display classes shown in the map. If necessary, the classify button can be used to set the display class boundaries based on the frequency distribution of the results.

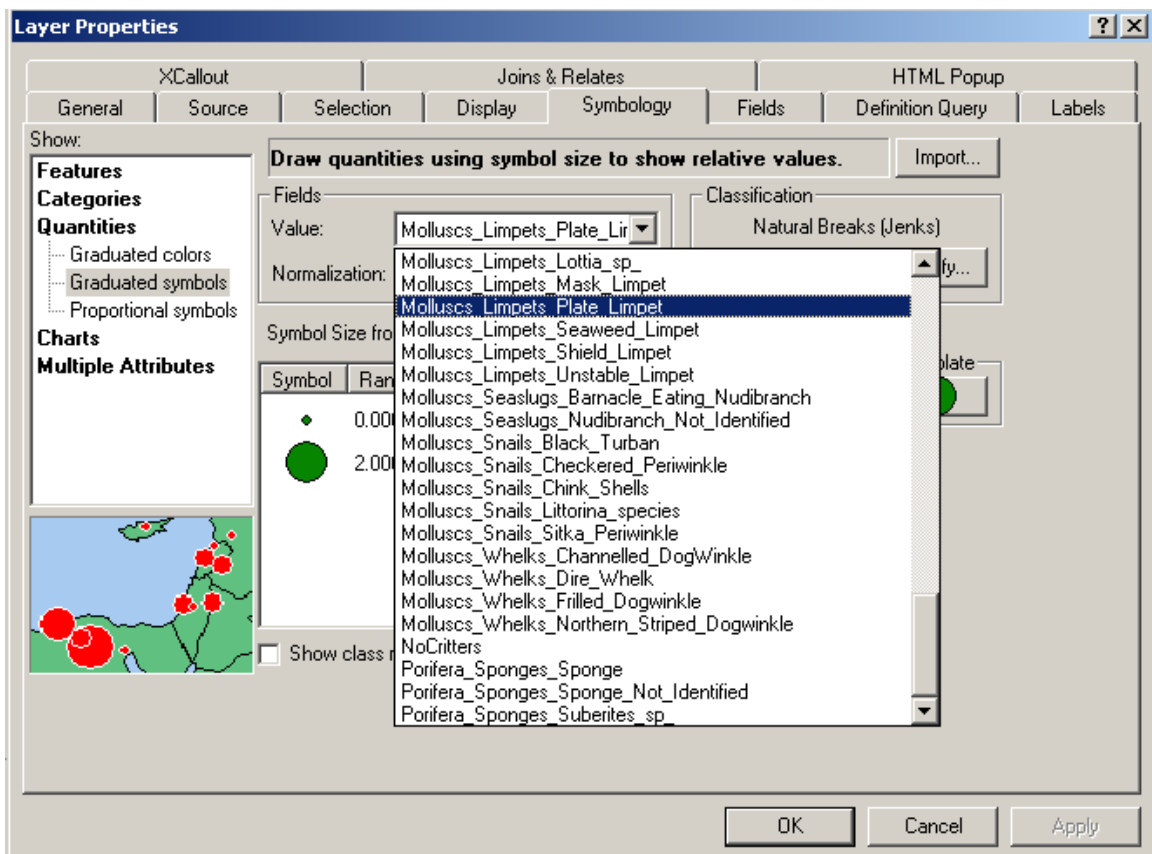


Figure K.2. Choosing to Display the Rock Survey Counts of Plate Limpets

Data Layer: 'DigSurveyGISOutput Events'

The DigSurveyGISOutput Events data layer is a summary data layer that provides the total count of the organisms observed and counted in the samples that were excavated from each site. This number does not include any attached organisms that were encountered only on the rocks and that were examined prior to excavating the sample. The underlying data values in this layer do not depend on user-input.

In order to display the results for a specific taxon, the user may open the symbology tab from the properties window of the data layer and select the desired taxon from the list (in the same way as is shown in Figure K.2).

Data Layer: 'UserSelectedGISOutput Events'

The UserSelectedGISOutput Events data layer displays the results exported from the DigSurveyDatabase.mdb based on user-selected export criteria such as specifying a size range, or combining multiple taxa together (described in Appendix J). The raw counts created by the output tool are reported in the *TotalCount* field, and the densities (individuals per square foot) are reported in the *ObservedDensity* field (the values in these two fields may diverge because the area excavated at each site can differ). Similarly, the *BiomassDensity* field contains the estimated weight of the selected taxa/individuals (pounds per square foot [lb/ft²]).

In order to create a new export selection the user should:

1. Open the DigSurvey Database and then open the 'Export Selection' form from the main menu.
2. Choose the site-selection criteria they wish to use (leave defaults to select all sites) and click the '*Apply Filter Selection Button*' to populate the list of sites to be included. Next, they may select one or more taxa to combine, and then set the size limits of individuals that they may elect to include (if applicable) and choose whether to include or exclude unmeasured individuals.
3. Ensure the '*Update GIS selection*' option is checked and then click '*Export Data*'. Once the export process is complete, a notification box will appear to say the process is completed.
4. Click on the Refresh View button in the ArcMap project to reload the source data.
5. Select the desired output field from the symbology tab in the layer properties window and click ok to view the results.
6. If desired, the user may change the number of display classes and class boundary values using the classify button on the symbology tab of the layer's properties window.

Note that there are additional fields in the user selected output data source that include latitude, longitude, estimated elevation, beach slope, wind fetch, and salinity. To create a permanent shapefile that contains the export information for a particular taxon, right-click the data layer and choose Data>Export Data and follow the export wizard instructions.

Data Layer: 'thiessen_locations'

The thiessen_locations polygon data layer shows the size and shapes of the Thiessen polygons associated with each survey point. The attribute field *LocationCo* lists the site number for the associated site. This information has been used to construct a table join with the data from the *UserSelectedGISOutput Events* data layer, which allows the user to use graduated colors to display the user-selected database output across the entirety of the map rather than simply using point data for display.

Data Layer: 'HorseClam_topmostbiased_obs'

The HorseClam_topmostbiased_obs shapefile shows the location of horse clam survey quadrats that were placed on the top-most horse clam that was seen while walking down the transect line. These points were excluded from the population analysis except to define the upper limit of the horse clam population distribution. In portions of Brant Flats, Brant Island, and Lummi Bay there were no comparable points because these areas were surveyed using modified methods that did not deliberately bias the first observation.

Data Layer: 'HorseClam_unbiased_obs'

The HorseClam_unbiased_obs shapefile shows the location of unbiased horse clam density observations that were obtained using either quadrat or transect methods. These observations were used to derive population estimates for horse clams.

Data Layer: 'Geoduck_locations'

The Geoduck_locations shapefile shows the location of the three (3) geoduck clams that were encountered and identified while traversing between formal sampling locations.

Data Layer: 'HorseClam_ThiessenPolygons'

The HorseClam_ThiessenPolygons shapefile shows the Thiessen polygons developed during data analysis. These polygons are limited to beach elevations lower than +1.08 feet Mean Lower Low Water (ft MLLW). The attribute field '*Hcount*' contains the observed density of horse clam siphons in a 9-ft² area.

3.2 BirdsMarineMammals.mxd

The Birds and Marine Mammals GIS project contains data layers resulting from the bird and marine mammal survey described in Appendix D of this report. The data layers saved in this GIS project are:

- Shorebird Survey Sites
- BirdSurveyGISOutput Events

Data Layer: 'Shorebird Survey Sites'

The Shorebird Survey Sites data layer shows the locations from which bird and marine mammal counts were conducted and displays the average count at each site for the taxa selected by the user in the bird survey database (Appendix J). The average counts for each site are stored in the attribute field 'Average'.

Data Layer: 'BirdSurveyGISOutput Events'

The BirdSurveyGISOutput Events data layer displays the monthly counts at each site for the taxa selected by the user in the bird survey database (Appendix J).

Using the 'Update GIS' export tool in the bird survey database, the user can specify one or more taxa to combine for a total count at each site. The raw counts created by the output tool are reported in fields that are named following the convention 'S_YYYY_MM'. The prefix S_ results from a GIS software requirement that field names cannot begin with a number. The remainder of the field name indicates the year (YYYY) and month (MM) of sampling, which ensures that the bars in the chart are ordered correctly.

To display results for a new export selection the user should:

1. Open the Bird Survey Database and then open the 'Update GIS' form from the main menu.
2. Choose one or more taxa to combine.
3. Click the 'Update GIS event layer' button. Once the export process is complete, a notification box will appear to say the process is completed.
4. Click on the Refresh View button in the ArcMap project to reload the source data.
5. It may be necessary to reset the symbology of the layer to reflect the new range of data values that can otherwise make the bars of the graph too large or too small. To fix the display issue, the user can open the symbology tab in the layer properties dialog window, and click 'ok'.

To create a permanent shapefile that contains the export information for a particular taxon, the user can right click the data layer and choose Data>Export Data, then follow the export wizard instructions.

3.3 Finfish.mxd

The Finfish GIS project contains data layers resulting from the finfish survey described in Appendix C of this report. The data layers saved in this GIS project are:

- FinfishGISOutput_TaxRich Events
- FinfishGISOutput Events

Data Layer: 'FinfishGISOutput_TaxRich Events'

The FinfishGISOutput_TaxRich Events data layer shows the total number of taxa recorded at each site.

In addition, there are attribute fields that provide summary information for each site such as the average Shannon-Wiener Index score and the Total Abundance of all individuals across all months. Other fields calculate the Shannon-Wiener Index score and total abundance for each site by month.

This data layer can be re-exported from the database by selecting the 'Recalc Diversity' option during data export. Before selecting that option, the user should be aware that the process takes several minutes and the database will appear to be non-responsive during that time.

Data Layer: 'FinfishGISOutput Events'

The FinfishGISOutput Events data layer displays the monthly counts for the taxa selected by the user in the finfish database (Appendix J).

Using the '*GIS Updater*' export tool in the finfish database, a user can specify one or more taxa to combine for a total count at each site. The counts are reported in fields that are named following the convention 'S_YYYY_MM'. The prefix *S* results from a GIS software requirement that field names cannot begin with a number. The remainder of the field name indicates the year (YYYY) and month (MM) of sampling, which ensures that the bars in the chart are ordered correctly.

To display results for a new export selection the user should:

1. Open the Finfish Database and then open the 'GIS Updater' form from the main menu.
2. Choose one or more taxa to combine.

3. Click the '*Update GIS event layer*' button. Once the export process is complete, a notification box will appear to say the process is completed.
4. Click on the Refresh View button in the ArcMap project to reload the source data.
5. It may be necessary to reset the symbology of the layer to reflect the new range of data values that will make the bars of the graph too large or too small. To fix this display issue, the user can open the symbology tab in layer properties dialog and then click 'ok'.

To create a permanent shapefile that contains the export information for a particular taxon, right click the data layer and choose Data>Export Data and follow the export wizard instructions.

3.4 GISAnalysis.mxd

The GIS Analysis GIS project contains raster data layers resulting from a GIS-based spatial analysis of environmental data in Appendix H of this report. The data layers saved in this GIS project are:

- Tideland Elevations
- Salinity_Lower 95% CL
- Tideland Slopes
- Wind Fetch
- Substrate Coarseness Index

The specific methodology used to derive each layer is documented in Appendix H. All data sources are found in the folder LIBI\GISProjects\Rasters on the LIBI DVD.

4.0 Discussion

The combination of Access databases with GIS software is particularly powerful for exploring the large and complex datasets resulting from the LIBI surveys. The GIS software allows users to readily visualize spatially located information in an interactive and easy-to-use format and can be used to rapidly produce informative maps and other spatial displays. The database export tools allow the user to easily change the export criteria so that the GIS maps show results that are of particular interest to the user.

These GIS projects were primarily designed to provide summary information about the diversity and abundance of taxa across the Lummi Reservation tidelands. In addition, the *BenthicInvertebrates.mxd* project and the *Dig Survey Database* allow for the exploration of dig survey results using selected habitat variables, sampling dates, and individual size criteria. These tools create opportunities to explore the dig survey results in ways that can help answer important questions relating to habitat and life history stages.

In the future, these GIS projects could be used to provide information about community structure and abundance in areas that may someday be impacted by adverse events such as oil or chemical spills, or other landscape-scale events.

5.0 References

U.S. Department of Agriculture 2006. *Farm Service Agency National Agricultural Imagery Program*, 2006 coverage,
<http://www.fsa.usda.gov/FSA/apfoapp?area=home&subject=prog&topic=nai>
Website accessed June 2008

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