Appendix 1: Spatial Analysis

**Data Import**

Shorezone, spawn observation, survey path and bathymetry datasets were acquired, imported and integrated into a common spatial context for analysis. Spawn observations and survey path data for Kamishak Bay and Prince William Sound (PWS) were collected from the Homer and Cordova Alaska Department of Fish & Game offices. Bathymetry (ocean depth) data for this analysis was acquired from Steve Lewis at NOAA. The bathymetry data subset was extracted from the Bering Sea and Gulf of Alaska 50-1000 meter resolution multi-beam vector bathymetry dataset. The Shorezone datasets were acquired directly from Coastal and Ocean Resources in Sydney, BC.

All datasets were imported into SQL Server 2008 and spatial objects were converted to native SQL Server spatial data types, which are Open Geospatial Consortium Simple Feature Specification compliant. Data was re-projected to the EPSG 4326, WGS 84 decimal degrees projection from the various base projections. Data was then imported into the SQL Server 2008 geography data type in order to exploit the spherical awareness and meter based metric of that data type.

The acquired Shorezone and bathymetry datasets covered larger expanses of the coastline than were needed for the analysis efforts of this project; data was cropped per study area guidelines. Views were created for the Kamishak and PWS study areas from the Shorezone tables. These bounding boxes were determined by creating a spatial envelope around the herring spawn aerial survey effort in both regions. This was done to limit all Shorezone data and bathymetry used in the analysis to areas which had been observed for herring spawn in Kamishak and PWS. The bounding boxes are listed below.

**Kamishak Bounding Box:** POLYGON ((-154.202606329185 59.0474927687318, -152.984323192776 59.0474927687318, -152.984323192776 59.8, -154.202606329185 59.8, -154.202606329185 59.0474927687318))

**PWS Bounding Box:** POLYGON ((-147.925280380395 60.1382376306546, -145.734767532512 60.1382376306546, -145.734767532512 61.0972408406746, -147.925280380395 61.0972408406746, -147.925280380395 60.1382376306546))

Two distinct database views of the Shorezone and bathymetry data were created for Kamishak and PWS data based upon the above spatial bounding boxes and were utilized for further spatial analysis.

**Simplification of Shorezone Geometric Objects**
Shorezone unit lines were converted from complex geometries to simple geometries. Certain spatial features in the source Shorezone Unit_Lines table are actually multi-geometries (i.e., single fields which contain multiple geometric instances). These instances include groups of small islands and other small distinct landforms. Shorezone researchers used these compound spatial objects as single Shorezone entities to simplify the process of classifying complex geographies that had homogenous features and habitat. Though this simplified the process of classifying habitat it proved very problematic when attempting to utilize the source information for spatial proximity analysis. The “atomic unit” of Shorezone classification is the physical identity or PHY_IDENT field which forms the base unit for classification. After introspection of the Kamishak sub layer (a small subset of the entire Shorezone dataset) it was determined that single PHY_IDENT segments could be composed of from 1 to 28 separate simple geometric instances. The following figure portrays a single Shorezone segment (PHY_IDENT 04/07/1335) that it is composed of 28 separate single simple geometries.

![Figure 1. Shorezone unit 04/07/1335 that was composed of 28 separate simple geometric instances but was classified with a single Shorezone description.](image)

It was determined that there were 60 instances in Kamishak Bay alone where Shorezone units were actually multi-geometries with two or more embedded simple geometries. These multi-geometry (multi-linestrings) Shorezone units were broken into distinct single geometric instances (linestrings) with the fields and characteristics from the original multi-geometry propagating to the new simplified geometries. This process was accomplished through the use of Open Geospatial Consortium spatial manipulation libraries which are packaged with SQL Server 2008. The original Kamishak dataset contained 797 Shorezone segments. Once simplified into single geometric instances the number of distinct Shorezone units increased to 959.

**Normalization of Shorezone Unit Lengths**

Once Shorezone units were simplified into single non-compound geometric instances the resulting units were further prepared for spatial analysis by normalizing unit sampling length. It was determined that though the units were of geometrically equivalent form (simple geometries), and the high variability of their segment length was causing problems in spawn buffer analyses (described later). The lengths of the simplified units ranged from 61.5 meters to 6110.8 meters.
Because investigators were planning on using a buffer analysis around spawn observations to determine the types of habitat selected for spawn, it was quickly determined that large variability in segment length would drastically skew the resulting resource selectivity function in addition to not providing an accurate description of habitat selection by herring. It was determined that Shorezone unit lengths would need to be normalized to a target length of 50 meters to provide a suitable basis for the subsequent spatial buffer analysis and development of a resource selection function. Shorezone segments were sheared into multiple sub-segments normalized to a target length of 50 meters by first diving each segment length by 50 meters and rounding the resulting floating point value to an integer, which provided a fractioning index value. The segment was then split into a number of segments quantified by the fractioning index value. For example, the longest segment in the simplified Kamishak dataset had a length of 6110.8 meters. By applying the method described above this segment was transformed into 122 sub-segments, each approximately 50.08 meters in length. Each segment transformation produced a set of sub-segments with varying lengths that were highly clustered around the 50 meter target length. This spatial extrapolation increased the sampling unit number from 959 to 9325. Additionally, the methodology for the development of the resource selectivity function was adapted to accommodate the minor variability in sample size.

**Shorezone Sampling Unit Spawn Observation Buffer Analysis**

A 200 meter buffer was applied to spawn event polylines, based on a review of the spawn occurrence data in Kamishak Bay and the spawn events’ proximity to the shoreline. The resulting buffer was tested for the inclusion of normalized Shorezone segments. The above spatial analysis created a table which documented the co-location of spawn events, normalized Shorezone segments, and provided the foundation for the development of the resource selection function.

**Shorezone Sampling Unit Localized Bathymetry Profile Buffer Analysis**

A generalized description of localized bathymetry profiles surrounding the normalized Shorezone segments was needed for the resource selection function. To obtain this data, spatial analysis was performed to determine bathymetric measurement averages and numbers of data points within 100, 200, and 300 meter buffers surrounding each normalized segment. The above spatial analysis created a table which documented localized bathymetric profiles around each sampling unit (normalized segment) and provided the foundation for the development of the resource selection function.