Development of the Pacific Coast Fisheries GIS Resource Database

Background to the Fisheries Database

In 2008, the Bureau of Ocean Energy Management, Regulation and Enforcement (formally known as the Minerals Management Service) Pacific Outer Continental Shelf Region asked the U.S. Geological Survey's Western Ecological Research Center to update and expand upon an earlier *MMS Fisheries Resource Database* created in 2003 by modeling it after the *Spatial Database for the At-Sea Distribution and Abundance of Seabirds and Marine Mammals off Southern California: 1999-2002* presented in 2009 in a CD-ROM and online database. The primary objective was to create a comprehensive database that would allow resource management personnel unrestricted ability to conveniently extract any combination of environmental, species, fishery, or human-use data according to specified temporal and spatial queries.

Over the course of two years, fisheries and coastal spatial data from various wildlife agencies in California, Oregon, and Washington were collected by the USGS and compiled into a single geographic information system (GIS) database. Custom query tools were developed for use in an ArcMap document to allow novice GIS users to make spatial selections and view associated data quickly and easily. Management scenario tutorials for extracting data with the custom tools were produced along with formatting documentation, metadata, and procedures for implementing future updates to the database tables. In addition to nine commercial, sport, survey, and fish-count databases, the seabird and marine mammal distribution data from Southern California were also included (Takekawa, et al. 2009). The final, fully-integrated GIS database provides a detailed summary of the most up-to-date resource use (fisheries and human-use) and allows coastal and wildlife resource managers the capacity to analyze potential impacts from planned and future projects off the Pacific Coast.

Organization of the Data

Commercial and Sport fishing data in California, Oregon, and Washington are stored as tabular data. Although the data has a spatial component (e.g. catch location), state agencies use the data for statistical analysis outside of a Geographic Information System. In order to tie this data to actual geographic locations, the data was placed inside an ESRI® File Geodatabase. The geodatabase structure allows for catch location identifiers inside the data to be associated with spatial features through the use of relationship classes. All of the feature classes and data tables organized inside the geodatabase can then be displayed inside an ArcMap document, and the data queried through spatial or attribute selections.

Fisheries Reporting Blocks

Fishing block feature classes are used in this database to represent catch locations for the commercial and sport fishing data. Two main files are included in the geodatabase for this purpose (CA_Blks and ORWA_Blks) and linked to the data tables via relationship classes.

California

The catch locations for Commercial and Sport fishing data are reported using a statistical block system originally developed in the 1930's (Clark 1935). Although these blocks are predominantly 10 minutes of longitude by 10 minutes in latitude, their size varies along the coast and further out to sea. There are additional block codes used to represent areas of the entire Pacific Ocean, but those blocks are poorly documented and no digital version could be located. Instead, this project focuses primarily on those blocks used off the coast of California, extending to the U.S. Exclusive Economic Zone 200 mile limit within the time period of the data that is included.

The CA_Blks feature class used in the geodatabase was derived from several source files and edits:

caltrawl: The most currently available California fishing block shapefile from the Department of Fish and Game (DFG) (http://www.dfg.ca.gov/marine/gis/management.asp). This file was edited to remove river blocks (101 and 113). A few 900 blocks (901-904) in the South East of the grid were added based upon a 2001 Southern California Fisheries Chart acquired from the DFG Marine Fisheries Statistical Unit.

CA_LargeOffshoreBlks: This was a shapefile provided by the DFG Marine Region GIS Unit that recreates large long-trawl blocks associated with some of the fisheries data. These large blocks (1032-1042) actually overlap the 10-minute blocks and extend out to the U.S. Pacific EEZ boundary. They were originally created as an answer to complaints by fisherman that the 10-minute blocks were not large enough to describe long-trawl fishing activities. However, the DFG eventually decided that the location resolution for these long-trawl blocks was too large and discontinued their use (J. Eres, DFG Marine Fisheries Statistical Unit, personal communication 2008).

Hundred-series blocks: These fishing blocks are a representation of block codes entered by the DFG that represent general areas of operation rather than specific locations. Occasionally, when block information is missing from landing receipts, the DFG enters a code to represent the area that the vessel was most likely fishing based on its previous activity. For example, a record could be assigned a "200" if a vessel's previous catches were made in 219, 220, and 224 (J. Eres, DFG Marine Fisheries Statistical Unit, personal communication 2008; Hill and Schneider 1999). Since these block areas (100, 200, 300, etc.) don't exist in map form, each hundreds section of the 10-minute blocks were dissolved to create a single large block that encompasses each range and the region IDs assigned to them.

Oregon and Washington

Oregon and Washington store specific coordinate locations for their commercial fishing records. However, a block system has also been developed for use in vessel trawl logbooks. To maintain the confidentiality of specific catch locations, the block system is used to represent a generalized catch area.

The ORWA_Blks feature class was originally created by the DFG Office of Spill Prevention and Response (OSPR) in 2003, based on the chart included in the WA-OR-CA Trawl Logbook. For this project, the file was edited to more closely follow the west coast of the geographic feature classes included in the geodatabase and the representation of the logbook chart.

Additionally, there is a Washington Reporting Areas feature class included that pertains to the WA Shrimp data table only. This is a version of the "Marine Fish-Shellfish Management and Catch reporting Areas" shapefile provided by the Washington Department of Fish and Wildlife. The shapefile has been modified to add greater detail to the coastline and to include historical blocks that the shrimp data refers to. These historical blocks are combinations of the most current blocks. For example, block 59 is 59A1, 59A2, and 59B merged together (M. Stanley, ODFW Research Analyst, personal communication 2009). A definition query was also applied to the Washington Reporting Areas feature class so that blocks without data associated with them would not be visible or selectable.

Fisheries Data

CA Commercial Fisheries

The California Commercial Fisheries data is comprised of landing receipt data collected by the DFG from 1972-2009. It is summarized by species per month for each year and includes the pounds of fish caught, their value, the fishing block they were caught in, and the port in which the fish were purchased.

The data is stored in the geodatabase as a stand-alone table (CA_Commercial_data). It was created from three Excel Workbook files received from the DFG Marine Fisheries Statistical Unit in April of 2009 (with an update in 2010). The Excel files were merged together in ArcMap and exported to the geodatabase. All records that had Block Codes that did not match the Block Codes in the CA_Blks feature class were removed from the database (these records were either from outside the focus area or had invalid codes).

CA Sport Fishing

The California Sport Fishing data is comprised of partyboat logbook data collected by the DFG and includes records from 1980-2009. It is summarized by species per month for each year.

Due to the summary process, some effort data was excluded from this database. "Hours" and "Anglers" values were collected as part of the original dataset to estimate effort. However, these values are recorded as a total for each boat trip without specific details for species. There is nothing to indicate how many hours or anglers were dedicated to an individual species of fish

caught during a boat trip. When performing a summary by species, the "Hours" and "Anglers" values simply repeat incorrectly for each species caught in the same block during the same month. Due to this inaccuracy, the effort data was not included in this database. However, the Historical Sport Fishing data, also included as part of this collection, does include some effort values (Hill and Schneider 1999). This dataset extends from 1936 to 2008.

The DFG Sport Fishing data and Historical Sport Fishing data are stored in the geodatabase as stand-alone tables (CA_Sport_Fish_data and CA_Historical_Sport_Fish_data). They were created from multiple tables stored in an Access database provided by the DFG Marine Fisheries Statistical Unit in May of 2009. The Access tables were exported to a temporary geodatabase and merged in ArcMap. All records that had Block Codes that did not match the Block Codes in the CA_Blks feature class were removed from the tables (these records were either from outside the focus area or had invalid/nonexistent codes).

Reefs

The California Reefs data is from a fish survey research project conducted by the UC Santa Barbara Marine Science Institute on the Southern California Bight. These data consist of fish counts and dive information from 1996-2009. The surveys were conducted primarily through the use of manned submersibles predominately at rocky reefs and soft sea floor habitats (Love et al. 2009). This data has been kept as intact as possible and includes counts by species at precise times and dates. The actual survey transect information has been included as well for more detailed analysis, but the locations are stored as the initial dive locations. The final Reefs table used in the geodatabase was created from an Access database acquired from UCSB's Love Labs in November of 2008 (with an update in 2010).

The Reefs feature class depicts the point locations for the beginning of all dives. It was created using the Lat Long coordinates in the original dive table. Dives that took place at Platforms were missing minute data in the coordinate fields, so the coordinate values were replaced with those from an OSPR oil platforms feature class. Some fields containing only null values were removed.

The Reefs data is comprised of data from fish and transect tables in the original database. These tables were joined using ArcMap and dates from the dive table added. Fields containing only null values were removed. A relationship class is used in the geodatabase to tie the Reefs data to the Reefs feature class.

Oil Platforms

The Oil Platforms feature class used in the geodatabase is a 2002 file from OSPR representing the locations of 28 oil production facilities off the coast of Southern California. The attributes include the platform names as well as the jurisdiction that they fall under.

The Platforms data table is a subset of platform-specific information from the Reefs database. All records from the Reefs data table that took place at platforms were copied into this table. A field was added to include platform names formatted to match those used in the Oil Platforms

feature class. A relationship class was then created to tie the Platforms data to the feature class via that name. This allows for more flexibility in spatial selections as a user can select individual platforms and access the related data.

Oregon/Washington Commercial Fisheries

The Oregon and Washington Fisheries data is comprised of commercial receiving ticket data collected by the Oregon Department of Fish and Wildlife (ODFW) and the Washington Department of Fish and Wildlife (WDFW) from 1987-2009. There are two separate summary tables included—one summarized by management group and complex each month and one summarized by species per year. Both the ODFW and WDFW use a "three-minimum-vessel rule" to maintain fishing location confidentiality when releasing data to the public. During data summary, any information from a block that did not contain records from three separate fishing vessels was excluded. The monthly summary was generalized to management group and complex categories to minimize the number of records that were excluded in this way. The summary table by year was included with species information, but clearly has a more course temporal resolution.

The data is stored in the geodatabase as two stand-alone tables (ORWA_Commercial_Month_data and ORWA_Commercial_Year_data). After the permission for the data was secured from ODFW and WDFW, the data request was processed by the Pacific Fisheries Information Network (PacFIN). The final geodatabase tables were created from Excel worksheets provided by PacFIN in January of 2010. The Excel worksheet files were merged together in ArcMap for each summary type (month and year) and exported to the geodatabase. Locations were provided as coordinates representing the center of the nearest fishing block to the actual catch location. These coordinates were used to generate points which were then intersected with the ORWA_Blks feature class so that block IDs could be used in the final table instead of the latitudes and longitudes.

Oregon Commercial Shrimp, Nearshore, and Sardine Fisheries

The Oregon shrimp, nearshore, and sardine data is comprised of logbook data collected by ODFW from 1996-2009. There are two separate summary tables included—one summarized by month, and one by year. Both tables are summarized to the species level, but due to the three-minimum-vessel rule, there was a larger amount of data excluded when summarized by month than by year, so both were included.

Like the OR/WA commercial fisheries information, this data is stored in the geodatabase as two stand-alone tables. The data was received as .dbf tables from ODFW in June of 2010. Locations were provided as coordinates representing the center of the nearest fishing block to the actual catch location. These coordinates were used to generate points which were then intersected with the ORWA_Blks feature class so that block IDs could be used in the final table instead of the latitudes and longitudes.

Washington Commercial Shrimp

The Washington commercial shrimp data is comprised of receiving ticket data collected by ODFW from 1970 to 2009. It is summarized by Month and consists of only Pink Shrimp weight by catch area. For shrimp catch locations, Washington uses larger "Marine Fish-Shellfish Management and Catch reporting Areas" to track fishing activity.

The data is stored in a stand-alone table inside the geodatabase. It was received in .csv format from ODFW in July of 2009. It did not require any further modification other than being converted to the geodatabase table format.

California CRFS/MRFSs and Oregon MRFSS

These datasets were derived from California Recreational Fisheries Survey (CRFS) and Marine Recreational Fisheries Statistics Survey (MRFSS) data collected through onboard surveys from 1999-2009. It is summarized by Month and Species, with locations generalized to the California and Oregon/Washington fishing blocks.

The data is stored in the geodatabase as two summarized tables: a California CRFS/MRFSS table and an Oregon MRFSS table (location information for Washington surveys was not available). After permissions were secured from Oregon and California, the initial data request was processed by the Recreational Fisheries Information Network (RecFIN). Text files containing the raw data were provided via digital download from RecFIN in September of 2009.

The raw form of these data required a large amount of formatting to create the summarized versions of the data tables used in the geodatabase. The raw data was stored in three general regions (Southern California, Northern California, and Oregon), each divided into three tables (Locations, Catch Counts, and Boat Information). Location information had been recorded in multiple coordinate formats, and contained start and stop coordinates representing fishing activity transects. To summarize the data to the fishing block system, transects were generated, mid-points calculated, and the points intersected with the fishing blocks. These locations were then summarized by block, month and species. Unfortunately, many coordinates and transects were found to be invalid (unreasonably long, on land, outside the probable area, etc.) and uncorrectable. Data associated with these incorrect locations were excluded from the final summarized tables. All data associated with California blocks were saved as one table, and all data associated with OR/WA blocks were saved as the other table.

Literature Cited

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