# Reference Database for Wild Salmon Populations and Land Cover Data.

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# Background

- Wild Pacific Salmon populations are under substantial threat throughout the North Pacific.

- The causes of this are as widespread. Pressure is placed upon these populations from poaching and overfishing, but the most substantial challenge to them is habitat loss due to human land use.

- A recent study by the non-profit Wild Salmon Center found that "on the Oregon Coast, salmon are relatively more dependent on freshwater habitat than marine" and that "modeling has shown that better freshwater habitat conditions lower extinction probabilities for Oregon coastal Coho." (Miewald 9)

# Background (cont.)

- Because of high intensity of human development and industrial land use along the western US and Oregon in particular, this area contains some of the greatest threats to wild Pacific salmon in the form of habitat loss and degradation.

- On the North Oregon coast, where there are six distinct salmon species/populations, "only 8% of the forest of the North Coast is managed with a high emphasis on natural resource conservation" and "over 50% of the forest area is dominated by industrial forestry." (Miewald 5).

- These types of statistics indicate that there is a very serious need to examine the habitat of the existing populations here in Oregon.

# Design Objectives

- The primary objective of this database design is to allow the examination of salmon population statistics based upon a variety of sources of interest.

- The database should allow for statistical analysis of a variety of factors and at several different scales.

- While the focus of this project will be upon the use of the database in Oregon, available data will easily allow the database to be expanded into the entire western US portion of the wild Pacific salmon range

# Design Objectives (cont.)

- A main feature and focus of this project will be upon using available land cover data to seek a relationship between land cover and status or health of salmon populations in Oregon.

- The database will store, query and calculate statistics at the Hydrologic Unit Code 6 (HUC6) area level.

- It will be possible to summarize the HUC6 land cover data for salmon populations present within any given HUC6 area.

- This information will also be readily accessible for different species areas, species run timing, and HUC6 areas intersecting a given river, stream or waterbody.

- This data will also be available at the county and eventually the state level.

# Data Layer Specifications and Geographic Extent

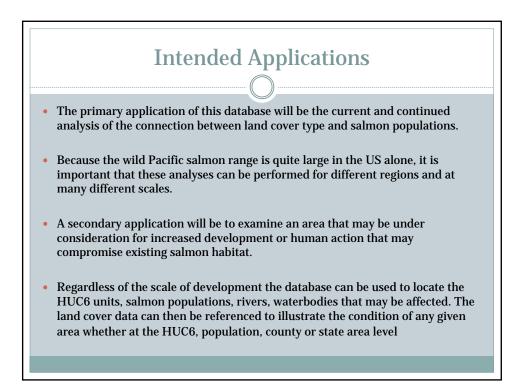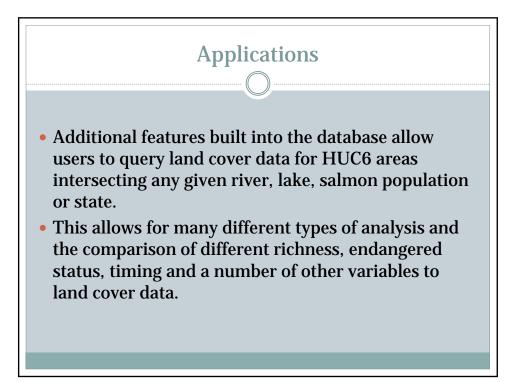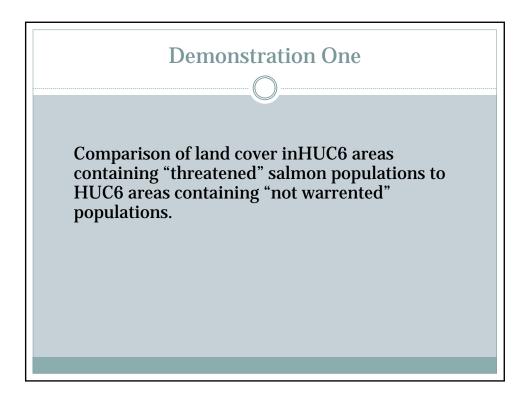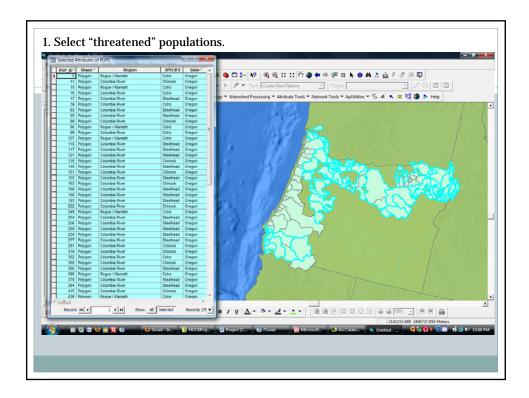| Layer Name | Data Type | Brief Description | Source |
|---|---|---|---|
| Counties | Polygon | Compiled from US Census website. Includes all counties from states which intersect the HUC6 areas under study. 2008 | http://www2.census.gov/cgi-bin/shapefiles/national-files |
| HUC_cnty | Polygon | HUC6 areas w/countyID field | Wild Salmon Center provided original HUC6 shapfile. |
| POPS | Polygon | Areas representing salmon populations throughout the western US. Data from Wild Salmon Center Pacific assesment project. | Wild Salmon Center |
| States | Polygon | Polygon derived from dissolved counties shapefile. 2008 | Original shapefile:http://www2.census.gov/cgi-bin/shapefiles/national-files |
| Or_Rivers | Polyline | Dataset representing rivers and water features in OR. 2002 | http://www.oregon.gov/DAS/EISPD/GEO/alphalist.shtml |
| Waterbodies | Polygon | Dataset representing waterbodies in OR. 1980 | http://www.oregon.gov/DAS/EISPD/GEO/alphalist.shtml |
| ca_nv_lc | Raster | Raster data grid showing land cover in areas of CA and NV. Grid derived from NLCD data. 2001, 30m resolution | http://www.mrlc.gov/nlcd_multizone_map.php |
| or_wa_lc | Raster | Raster data grid showing land cover in areas of OR and WA. Grid derived from NLCD data. 2001, 30m resolution. | http://www.mrlc.gov/nlcd_multizone_map.php |

# Projection

- Projection type: Albers conical equal area
- Spheroid name: GRS 1980
- Datum name: NAD83
- Latitude of 1st parallel: 29:30:00 N
- Latitude of 2nd parallel: 45:30:00 N
- Longitude of central meridian: 96:00:00 W
- Latitude of origin of projection 23:00:00 N
- False easting at central meridian: 0 Meters
- False northing at origin: 0 meters.

# Methods and Techniques

- After creating a raster grid from the downloaded NLCD raster image, I eliminated the no-value areas using the raster calculator.

- The NLCD data for regions 1, 2 and 3 was processed to cover a large portion of Oregon, Washington, Idaho and California.

- Hawth's Tools was used to create a table of land cover values for each polygon in the HUC6 dataset.

- The values generated in the land cover table represent the number of 900m$^2$ areas in each polygon for a given land cover type.

ArcCatalog - ArcEditor - E:\HUC_LC_mcrowell\HUC_LC.mdb\LandUseTable

File Edit View Go Tools Window Help

Location: E:\HUC_LC_mcrowell\HUC_LC.mdb\LandUseTable

Stylesheet: FGDC ESRI

Contents  Preview  Metadata

| OBJECTID * | ID | PolyFID | TRS_11 | TRS_12 | TRS_21 | TRS_22 | TRS_23 | TRS_24 | TRS_31 | TRS_41 | TRS_42 | TRS_43 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3492 | 3491 | 0 | 0 | 0 | 0 | 0 | 0 | 732 | 0 | 0 | 0 |
| 2 | 3493 | 3492 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33711 | 0 |
| 3 | 3494 | 3493 | 116 | 0 | 2034 | 64 | 13 | 0 | 190 | 21 | 69993 | 1251 |
| 4 | 3495 | 3494 | 0 | 0 | 99 | 1309 | 5 | 0 | 78 | 0 | 0 | 0 |
| 5 | 3497 | 3496 | 88 | 0 | 4316 | 3663 | 831 | 142 | 222 | 62 | 24372 | 7215 |
| 6 | 3498 | 3497 | 0 | 0 | 458 | 0 | 0 | 0 | 246 | 0 | 24608 | 0 |
| 7 | 3500 | 3499 | 47 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3063 | 0 |
| 8 | 3502 | 3501 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 9 | 3503 | 3502 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 10 | 3504 | 3503 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11 | 3505 | 3504 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 396 | 0 |
| 12 | 3507 | 3506 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 11219 | 0 |
| 13 | 3508 | 3507 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 3509 | 3508 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7352 | 0 |
| 15 | 3510 | 3509 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 16 | 3511 | 3510 | 17 | 0 | 0 | 0 | 0 | 0 | 1358 | 0 | 60122 | 0 |
| 17 | 3513 | 3512 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 18 | 3514 | 3513 | 30 | 0 | 4115 | 1777 | 737 | 101 | 0 | 48 | 28371 | 11982 |
| 19 | 3516 | 3515 | 6 | 0 | 0 | 0 | 0 | 0 | 100 | 0 | 85952 | 0 |
| 20 | 3518 | 3517 | 0 | 0 | 0 | 0 | 0 | 0 | 174 | 5 | 33813 | 944 |
| 21 | 3519 | 3518 | 0 | 0 | 0 | 0 | 0 | 0 | 116538 | 0 | 0 | 0 |
| 22 | 3520 | 3519 | 2 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 36219 | 0 |
| 23 | 3522 | 3521 | 0 | 0 | 0 | 0 | 0 | 0 | 39144 | 0 | 0 | 0 |
| 24 | 3523 | 3522 | 2717 | 0 | 4585 | 560 | 30 | 0 | 861 | 0 | 89100 | 0 |
| 25 | 3524 | 3523 | 213 | 0 | 2299 | 950 | 222 | 33 | 12 | 68 | 3624 | 1825 |
| 26 | 3525 | 3524 | 1472 | 0 | 1003 | 97 | 0 | 0 | 124 | 0 | 0 | 0 |
| 27 | 3527 | 3526 | 440 | 0 | 551 | 247 | 0 | 0 | 26473 | 0 | 4075 | 0 |
| 28 | 3530 | 3529 | 547 | 0 | 2258 | 513 | 98 | 0 | 55 | 148 | 5202 | 88 |
| 29 | 3531 | 3530 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 30 | 3532 | 3531 | 114 | 0 | 300 | 208 | 0 | 0 | 288 | 0 | 6198 | 0 |
| 31 | 3533 | 3532 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 32 | 3534 | 3533 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 655 | 0 |
| 33 | 3536 | 3535 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 34 | 3538 | 3537 | 0 | 0 | 0 | 0 | 0 | 0 | 5957 | 0 | 0 | 0 |
| 35 | 3539 | 3538 | 0 | 0 | 1244 | 12 | 11 | 0 | 0 | 127 | 64699 | 4609 |

Record: 1  Show: All  Selected  Records (of *2000)  Options ▾

Preview: Table

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# Methods and Techniques

- The values generated in the land cover table represent the number of 900m² areas in each polygon for a given land cover type.
- To the right are the different land cover classifications from the NLCD.

NLCD 2001 Land Cover Classification Legend
11 Open Water
12 Perennial Ice/Snow
21 Developed, Open Space
22 Developed, Low Intensity
23 Developed, Medium Intensity
24 Developed, High Intensity
31 Barren Land
41 Deciduous Forest
42 Evergreen Forest
43 Mixed Forest
51 Dwarf Scrub*
52 Shrub/ Scrub
71 Grassland/ Herbaceous
72 Sedge/ Herbaceous *
74 Moss *
81 Pasture Hay
82 Cultivated Crops
90 Woody Wetlands
95 Emergent Herbaceous Wetlands
* Alaska Only

## Methods and Techniques

- Next all the relationships between different feature classes and tables were defined.

- The most time consuming portion of the project lay in populating the link tables between features which have a many-to-many relationship.

- The method used required manually populating the table one feature at a time which for Oregon alone was over 900 polygon features.

- The land cover data is then easily accessed, and in the case of the demonstration was exported to Microsoft Excel for further calculations and graph production.

## Intended Applications

- The primary application of this database will be the current and continued analysis of the connection between land cover type and salmon populations.

- Because the wild Pacific salmon range is quite large in the US alone, it is important that these analyses can be performed for different regions and at many different scales.

- A secondary application will be to examine an area that may be under consideration for increased development or human action that may compromise existing salmon habitat.

- Regardless of the scale of development the database can be used to locate the HUC6 units, salmon populations, rivers, waterbodies that may be affected. The land cover data can then be referenced to illustrate the condition of any given area whether at the HUC6, population, county or state area level

# Applications

- Additional features built into the database allow users to query land cover data for HUC6 areas intersecting any given river, lake, salmon population or state.
- This allows for many different types of analysis and the comparison of different richness, endangered status, timing and a number of other variables to land cover data.

# Demonstration One

Comparison of land cover inHUC6 areas containing "threatened" salmon populations to HUC6 areas containing "not warrented" populations.

**1. Select "threatened" populations.**



# Producing Data

- After opening the related HUC table and Land Cover table, we can export the land cover data for these threatened populations and create the following graph of land cover types shown in square kilometers (y axis)

"Not Warranted"

"Threatened"

# Selected Results

- Evergreen land cover is the highest for both populations

- Shrub type is significantly higher for threatened populations.

- Whether this scrub land cover is the result of logging activity or not would need to be comfirmed with additional spatial data for Oregon logging activities.

- Developed land cover is not nearly as significant of factor as may have been supposed.

# Demonstration Two

Finding Fish Populations and HUC6
Land Cover for the Illinois River, OR

# Illinois River Reaches Selected.

# Related Table shows HUC6 that intersect the Illinois



# From the HUC table you can access land cover data

# Fish Population data



**Selected Attributes of POPS**

| POP_ID * | Shape * | Region | SPECIES | State * | State_Pops | |
|---|---|---|---|---|---|---|
| 10 | Polygon | Rogue / Klamath | Chinook | Oregon | 38 | S. Oregon |
| 90 | Polygon | Rogue / Klamath | Coho | Oregon | 36 | Southern |
| 107 | Polygon | Rogue / Klamath | Coho | Oregon | 36 | Southern |
| 146 | Polygon | Rogue / Klamath | Chinook | Oregon | 38 | S. Oregon |
| 249 | Polygon | Rogue / Klamath | Coho | Oregon | 36 | Southern |
| 260 | Polygon | Rogue / Klamath | Steelhead | Oregon | 46 | Klamath M |
| 401 | Polygon | Rogue / Klamath | Steelhead | Oregon | 20 | Klamath M |
| 439 | Polygon | Rogue / Klamath | Coho | Oregon | 36 | Southern |
| 490 | Polygon | Rogue / Klamath | Chinook | Oregon | 38 | S. Oregon |
| 564 | Polygon | Rogue / Klamath | Steelhead | Oregon | 46 | Klamath M |
| 574 | Polygon | Rogue / Klamath | Chinook | Oregon | 38 | S. Oregon |
| 624 | Polygon | Rogue / Klamath | Steelhead | Oregon | 46 | Klamath M |
| 641 | Polygon | Rogue / Klamath | Coho | Oregon | 36 | Southern |
| 723 | Polygon | Rogue / Klamath | Steelhead | Oregon | 46 | Klamath M |
| 869 | Polygon | Rogue / Klamath | Chinook | Oregon | 38 | S. Oregon |
| 880 | Polygon | Rogue / Klamath | Steelhead | Oregon | 46 | Klamath M |

Record: 1  Show: All Selected  Records (16 out of 198 Selected)

# Even County and State Data



**Attributes of States**

| OBJECTID * | Shape * | STATEID * | State * | Shape_Length | Shape_Area |
|---|---|---|---|---|---|
| 5 | Polygon | 41 | Oregon | 2352390.130827 | 254800397164.516 |

Record: 1  Show: All Selected  Records (1 out of 1)

**Selected Attributes of counties**

| COUNTYID | Shape * | STATEID * | NAME | NAME_FULL | Shape_Length | Shape_Area | COUNTY_ID * |
|---|---|---|---|---|---|---|---|
| 136 | Polygon | 41 | Douglas | Douglas County | 685659.86755 | 13296392946.818 | 136 |
| 137 | Polygon | 41 | Coos | Coos County | 341723.831614 | 4678464172.76778 | 137 |
| 142 | Polygon | 41 | Curry | Curry County | 440627.676209 | 5149852977.33686 | 142 |
| 150 | Polygon | 41 | Josephine | Josephine County | 331478.541841 | 4252268029.47275 | 150 |
| 151 | Polygon | 41 | Klamath | Klamath County | 618046.69802 | 15891002398.0678 | 151 |
| 161 | Polygon | 41 | Jackson | Jackson County | 379422.480152 | 7256277972.28811 | 161 |

Record: 1  Show: All Selected  Records (6 out of 36 Selected)  Options

# Finally. Demonstration Three

Finding attributes for a given fish population.

# Select a population of interest.

The related HUC table shows attributes of HUC6 areas that intersect with the population range.



From the HUC table you can access all other data, including land cover....

# Limits and Quality Statement

- Areas with no data were not included in demonstration, and areas with no value (-999) were also removed.
- Significant problem with LandCoverTable, many duplicate polygon entries. This is due to the fact that the raster data was processed in multiple steps.
- The LandCoverTable will be repopulated in a single process to ensure the integrity of the HUC relationships.
- The LandCoverTable should also be converted to square km

- Because the many-to-many relationships had to be populated manually only the Illinois River was included for demonstration purposes. A more complex relationship should eliminate the need for excessive, tedious manual labor.

# More Limits

- Due to the HUC6 scale the volume of data for this database is enormous, particularly bearing in mind that the initial project goal consisted of all western states within the range of wild Pacific Salmon.

- A solution for this problem would be to program a tool to populate these tables, or to devise an additional link table so the relationship becomes two one-to-many relationships rather than a single many-to-many. This problem also exists for linking the rivers dataset to that of the HUC6 data.

- Looking towards future maintenance, additions and alterations to this database would be rather straight forward and could be made within ArcMap editor or larger changes would likely be easier made in Excel or preferably Access.

- The most challenging update will be when new land cover data becomes available, because at this point Hawth's tools would need to once again process the large raster grid for the HUC6 polygons to create an updated land cover table.

# Literature Cited

- Miewald, Tom. Oregon North Coast Salmon Conservation Assessment. Wild Salmon Center 2008.

- Data sourced from public internet sources, and provided by the Wild Salmon Center.