Metadata for Chinook salmon and Steelhead Density Shapefiles
BPA Project, FDAT Phase II

Citation

Originator

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Title

Modeled juvenile Chinook salmon and steelhead density estimates for northeast Oregon and Idaho at a 250-m mapping resolution on 1:100,000 scale NHDPlus stream line data.

Abstract

These geospatial data were generated by the USDA Forest Service, Rocky Mountain Research Station, Boise Aquatic Sciences Lab in association with the Analysis of Spatial Stream Networks for Salmonids project that was funded by the Bonneville Power Administration. These data represent modeled Chinook salmon and steelhead juvenile density estimates for the period 2000-2018. The data extent comprises portions of the Lower Snake, Salmon, Clearwater, and John Day six-digit Hydrologic Unit Codes, in Oregon and Idaho. Reach density estimates were predicted from geospatial covariates of stream habitat using spatial statistical network (SSN) models fit to sampling datasets of juvenile fish surveys for Chinook salmon (n = 6,757) and steelhead (n = 7,436). The final model for Chinook salmon juvenile densities included statistically significant relationships for seven covariates (reach slope, mean summer flow, mean August stream temperature, baseflow index, riparian canopy density, brook trout density, and inter-annual variation in juvenile densities) and explained 57% of the variation in densities at the survey sites across a potential habitat network of 9,064 km. The final model for steelhead accounted for 48% of the variation in densities at the survey sites across a larger potential habitat network of 18,064 km. The steelhead model included six of the same seven covariates as the Chinook salmon model (watershed conifer coverage replaced baseflow index) but response curves indicated different density-habitat relationships between the two species. The final models were used to create 24 scenarios of juvenile densities throughout the potential habitat

networks, which included a baseline composite scenario representing average juvenile densities for 2000-2018 (S1), annual density scenarios from 2000 through 2018 (S2-S20), standard errors of the density predictions (S21), and three future density scenarios associated with increases in mean August stream temperature of 1°C, 2°C, and 3°C (S22-S24).

Supplemental Information

The ArcGIS shapefiles in this dataset are comprised of feature classes for two species (Chinook salmon and steelhead) and three themes (fish density observation data, model predicted fish densities at 250 m prediction points for 24 scenarios, and model predicted fish densities for 250 m stream line segments for 24 scenarios).

Observation point shapefiles are named:
FDAT_Phase2_Chinook_ObservationPoints.shp
FDAT_Phase2_Steelhead_ObservationPoints.shp
Prediction point shapefiles are named:
FDAT_Phase2_Chinook_PredictionPoints_DensityResults.shp
FDAT_Phase2_Steelhead_PredictionPoints_DensityResults.shp
Prediction segment shapefiles are named:
FDAT _Phase2_Chinook_StreamSegmentScenarios_DensityResults.shp
FDAT _Phase2_Steelhead_StreamSegmentScenarios_DensityResults.shp

The GIS framework for these products is the 1:100,000 scale medium resolution NHDPlus Version 2 dataset (https://nhdplus.com/NHDPlus/NHDPlusV2_home.php). The NHDPlus was edited to remove braids, diversions, and other non-dendritic features and incorporated into the National Stream Internet (NSI) dataset (https://www.fs.fed.us/rm/boise/AWAE/projects/NationalStreamInternet.html). Chinook and steelhead range extents were determined from the SteamNet fish dataset for the Pacific Northwest (https://www.streamnet.org/) and both fish species ranges were extracted from the NSI to generate the Chinook salmon and steelhead stream line shapefiles. The stream lines were segmented into 250 m reaches for modeling purposes. A midpoint was generated for each 250 m segment and juvenile fish densities were predicted at these midpoints. Densities are attributed to both the prediction points and the stream line shapefiles. A 1:1 relationship exists between features in these point and line shapefiles.

The observation point shapefiles represent the midpoint of instream fish survey reaches. Where surveys were conducted during multiple years at the same location, point features are spatially coincident in the shapefile, with the number of overlapping points representing the number of sample years.

Fish density estimates in the attribute tables are represented by fields named with the prefixes S1-S24. Other fields in the shapefiles represent internal codes, NHDPlus attributes, and modeling covariates.

Citations for works referenced in the attributes metadata:

Hill, R.A., Weber, M.H., Leibowitz, S.G., Olsen, A.R., and Thornbrugh, D.J. 2016. The stream-catchment (StreamCat) dataset: a database of watershed metrics for the conterminous United States. Journal of the American Water Resources Association 52: 120–128.

Isaak, D., Wenger, S., Peterson, E., Ver Hoef, J., Nagel, D., Luce, C., Hostetler, S., Dunham, J., Roper, B., Wollrab, S., Chandler, G., Horan, D., and Parkes-Payne, S. 2017. The NorWeST summer stream temperature model and scenarios for the western U.S.: A crowd-sourced database and new geospatial tools foster a user community and predict broad climate warming of rivers and streams. Water Resources Research, 53: 9181-9205.

Olson, J.R. and Cormier, S.M., 2019. Modeling Spatial and Temporal Variation in Natural Background Specific Conductivity. *Environmental science & technology*, *53*(8), pp.4316-4325.

Wenger, S.J., C.H. Luce, A.F. Hamlet, D.J. Isaak, and H.M Neville. 2010. Macroscale hydrologic modeling of ecologically relevant flow metrics. Water Resources Research. 46: W09513.

Wolock, D.M. 2003. "Base-flow index grid for the conterminous United States (Open File Rep. 03–263)." Lawrence, KS: U.S. Geological Survey.

Currentness

April 30, 2020

Progress

Complete

Keywords

Chinook salmon, steelhead, Grand Ronde River, John Day River, Snake River, Clearwater River, Salmon River, juvenile fish density, spatial stream network models.

Access Constraints

Distribution and use constraints are determined by Bonneville Power Administration.

Point of Contact

Daniel Isaak, modeling methods
David Nagel, GIS processing

Dataset Credit

Bonneville Power Administration, Fish and Wildlife Planning Division, Portland, OR.

Native Dataset Environment

Esri shapefile format, version 10.5.1

Attribute Accuracy Report

Juvenile fish density estimates for Chinook explain 57% of the variation in the observation data. Density estimates for steelhead explain 48% of the variation.

Positional Accuracy

Stream line and point locations adhere to 1:100,000 scale USGS standards.

Horizontal Coordinate System

Projection:	Albers
False_Easting:	1500000.00000000
False_Northing:	0.00000000
Central_Meridian:	-114.00000000
Standard_Parallel_1:	43.00000000
Standard_Parallel_2:	47.00000000
Latitude_Of_Origin:	30.00000000
Linear Unit:	Meter

Attributes for shapefiles. Note that some shapefiles will not contain all of these attribute fields.

FDAT_Phase2_Chinook_ObservationPoints.shp,
FDAT_Phase2_Steelhead_ObservationPoints.shp,
FDAT_Phase2_Chinook_PredictionPoints_DensityResults.shp,
FDAT _Phase2_Steelhead_PredictionPoints_DensityResults.shp,
FDAT_Phase2_Chinook_PredictionPoints_DensityResults.shp,
FDAT _Phase2_Steelhead_PredictionPoints_DensityResults.shp

OBSPRED_ID – A unique ID number assigned to each observation instance. An observation instance is a location + year combination. Individual locations may have multiple observation instances when fish density observations were collected from multiple years at the same location.

PERMA_FID – A unique ID number assigned to each observation location. Only one PERMA_FID ID is assigned to each fish density observation location.

YEAR – Year observation data was collected.

POINT_X – X coordinate location of the observation site snapped to the stream line network in the native Albers projection of the observation shapefile.

POINT_Y – Y coordinate location of the observation site snapped to the stream line network in the native Albers projection of the observation shapefile.

SITE_ID – An ID assigned by the agency collecting the fish density observation data.

SOURCE – The collection agency of the fish density observation data.

GNIS_NAME – Stream name where the fish density observation data was collected.

CH_DENSITY – Juvenile Chinook density observed at the point location. Units: fish/100 m.
Or
OM_Density - Juvenile steelhead density observed at the point location. Units: fish/100 m.

WATERBODY – A flag indicating if the observation site was located in a waterbody as defined by the NHDPlusV2 coding system.

COMID – A unique ID assigned to each stream reach in the NHDPlusV2 coding system.

FTYPE – A feature type assigned to each stream reach in the NHDPlusV2 coding system.

FCODE – A feature code assigned to each stream reach in the NHDPlusV2 coding system.

TotDASqKM – Total drainage area at the observation location as determined by the NHDPlusV2 coding system. Units: square km.

SLOPE – Slope of stream reaches, provides a measure of physical habitat structure and channel type. Dataset is value added attribute developed in conjunction with NHDPlusV2.

NrWst_S1_C – Average August stream conductivity for the period of 2000-2015. Provides a consistent measure of conductivity among reaches in the study area. Temperature dataset developed by Isaak et al. (2017) for NHDPlus reaches.

MS_Hist – Mean summer flow in stream reaches for a historical climate period of 1976-1997. Provides a consistent measure of stream size among reaches in the study area. Flow value dataset developed by Wenger et al. (2010) for NHDPlus reaches.

W95_Hist – The number of days with flows exceeding the 95th percentile during the winter. Provides a measure of hydrologic flashiness that differentiates between stream reaches with snowmelt and rainfall runoff regimes. Flow value dataset developed by Wenger et al. (2010) for NHDPlus reaches.

S_SLOPE – High-resolution slope of stream reaches, provides a measure of physical habitat structure and channel type. U.S. Forest Service unpublished dataset.

CANOPY - Tree canopy density along stream reaches based on classification of remote sensing imagery. Percent canopy derived from the National Land Cover Database 2011 USFS Tree Canopy Cartographic layer averaged over 1 km stream reaches.

CarbResid – Watershed area underlain by carbonate residual material based on geologic survey maps. Dataset developed by U.S. Environmental Protection Agency for the NHDPlus network by Hill et al. (2016).

AlkIntru – Watershed area underlain by alkaline intrusive volcanic rocks based on geologic survey maps. Dataset developed by U.S. Environmental Protection Agency for the NHDPlus network by Hill et al. (2016).

ExtruVol – Watershed area underlain by volcanic extrusive rocks based on geologic survey maps. Dataset developed by U.S. Environmental Protection Agency for the NHDPlus network by Hill et al. (2016).

Conif2011 – Watershed area classified as conifer land cover from remote sensing imagery. StreamCat dataset developed by U.S. Environmental Protection Agency from the National Land Cover Database 2011 for the NHDPlus network.

Shrb2011 – Watershed area classified as shrub land cover from remote sensing imagery. StreamCat dataset developed by U.S. Environmental Protection Agency from the National Land Cover Database 2011 for the NHDPlus network by Hill et al. (2016).

Grs2011 – Watershed area classified as grass land cover from remote sensing imagery. StreamCat dataset developed by U.S. Environmental Protection Agency from the National Land Cover Database 2011 for the NHDPlus network by Hill et al. (2016).

Hay2011 – Watershed area classified as hay land cover from remote sensing imagery. StreamCat dataset developed by U.S. Environmental Protection Agency from the National Land Cover Database 2011 for the NHDPlus network by Hill et al. (2016).

Crop2011 – Watershed area classified as crop land cover from remote sensing imagery. StreamCat dataset developed by U.S. Environmental Protection Agency from the National Land Cover Database 2011 for the NHDPlus network by Hill et al. (2016).

RdDens – Density of roads within a watershed. StreamCat dataset developed by U.S. Environmental Protection Agency from 2010 Census Tiger Lines for the NHDPlus network by Hill et al. (2016).

RdDensRp – Density of roads within a watershed that is also within a 100 meter stream buffer. StreamCat dataset developed by U.S. Environmental Protection Agency from 2010 Census Tiger Lines for the NHDPlus network by Hill et al. (2016).

RdCrsWs – Density of road and stream intersections within a watershed. StreamCat dataset developed by U.S. Environmental Protection Agency from 2010 Census Tiger Lines for the NHDPlus network by Hill et al. (2016).

WCF_USFS – U.S. Forest Service Watershed Condition Framework rating. Index of watershed integrity for HUC12 basins with more than 5% ownership by the U.S. Forest Service. Dataset developed by the U.S. Forest Service.

WCF_AQHAB – U.S. Forest Service Watershed Condition Framework rating of road and trail network densities. Index of aquatic habitat integrity for HUC12 basins with more than 5% ownership by the U.S. Forest Service. Dataset developed by the U.S. Forest Service.

WCF_RDTRL – U.S. Forest Service Watershed Condition Framework rating of road and trail network densities. Index of watershed integrity based on road and trails densities for HUC12 basins with more than 5% ownership by the U.S. Forest Service. Dataset developed by the U.S. Forest Service.

CHINRATE - Chinook salmon Intrinsic Potential ratings for stream reaches. Dataset provided by the Bonneville Power Administration.
Or
STHDRATE - Steelhead Intrinsic Potential ratings for stream reaches. Dataset provided by the Bonneville Power Administration.

HUC_8 – 8-digit hydrologic unit code from the USGS Watershed Boundary Dataset.

HUC_12- 12-digit hydrologic unit code from the USGS Watershed Boundary Dataset.

AREA_SQKM – Area of the 12-digit HUC used for computing brook trout density (BRK_DENS). Units: square kilometers.

BRK_DENS – Number of fish survey sites with brook trout present divided by the area of HUC_12 basins where survey sites occurred. Calculated by U.S. Forest Service using the fish survey datasets published in Isaak et al. (2017).

SMTH_PRED – Probability that smallmouth bass occur within a stream reach. Dataset developed by Rubenson and Olden (2019) for NHDPlus streams within the Pacific Northwest based on predictions from a species distribution model fit to a large fish survey database.

CH_POP_ID – Designated distinct Chinook population ID number.
Or
SH_POP_ID - Designated distinct Steelhead population ID number.

CH_POP – Designated distinct Chinook population name.
Or
SH_POP - Designated distinct steelhead population name.

BFI – Base-flow ratio for stream reaches calculated as the ratio of summer low flows to total annual flow and expressed as a percentage. Sites with larger baseflow values have more stable hydrographs and groundwater contributions. Dataset developed by Wolock (2003).

AvgConduct – Average August stream conductivity for the period of 2000-2015. Provides a consistent measure of conductivity among reaches in the study area. Conductivity dataset developed by Olson and Cormier (2019) for NHDPlus reaches.

S1_00_18 – Predicted average juvenile fish density for years 2000-2018. Units: fish/100 m.

S2_2000 – Predicted juvenile fish density for year 2000. Units: fish/100 m.

S3_2001 – Predicted juvenile fish density for year 2001. Units: fish/100 m.

S4_2002 – Predicted juvenile fish density for year 2002. Units: fish/100 m.

S5_2003 – Predicted juvenile fish density for year 2003. Units: fish/100 m.

S6_2004 – Predicted juvenile fish density for year 2004. Units: fish/100 m.

S7_2005 – Predicted juvenile fish density for year 2005. Units: fish/100 m.

S8_2006 – Predicted juvenile fish density for year 2006. Units: fish/100 m.

S9_2007 – Predicted juvenile fish density for year 2007. Units: fish/100 m.

S10_2008 – Predicted juvenile fish density for year 2008. Units: fish/100 m.

S11_2009 – Predicted juvenile fish density for year 2009. Units: fish/100 m.

S12_2010 – Predicted juvenile fish density for year 2010. Units: fish/100 m.

S13_2011 – Predicted juvenile fish density for year 2011. Units: fish/100 m.

S14_2012 – Predicted juvenile fish density for year 2012. Units: fish/100 m.

S15_2013 – Predicted juvenile fish density for year 2013. Units: fish/100 m.

S16_2014 – Predicted juvenile fish density for year 2014. Units: fish/100 m.

S17_2015 – Predicted juvenile fish density for year 2015. Units: fish/100 m.

S18_2016 – Predicted juvenile fish density for year 2016. Units: fish/100 m.

S19_2017 – Predicted juvenile fish density for year 2017. Units: fish/100 m.

S20_2018 – Predicted juvenile fish density for year 2018. Units: fish/100 m.

S21_SE – Standard error of the predicted density estimates.

S22_1C – Predicted future juvenile fish density assuming a 1 degree Celsius increase in mean August stream temperature. Units: fish/100 m.

S23_2C – Predicted future juvenile fish density assuming a 2 degree Celsius increase in mean August stream temperature. Units: fish/100 m.

S24_3C – Predicted future juvenile fish density assuming a 3 degree Celsius increase in mean August stream temperature. Units: fish/100 m.