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Maps and Geospatial Data for the Shorty's Island and Myrtle Bend Substrate Enhancement Pilot Projects, Kootenai River near Bonners Ferry, Idaho

Data Series 889

U.S. Department of the Interior
U.S. Geological Survey

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Conversion Factors

SI to Inch/Pound

Multiply	By	To obtain
	Length	
millimeter (mm)	0.03937	inch (in.)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
kilometer (km)	0.5400	mile, nautical (nmi)

Datums

Vertical coordinate information is referenced to the North American Vertical Datum of 1988 (NAVD 88).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Elevation, as used in this report, refers to distance above the vertical datum.

Maps and Geospatial Data for the Shorty's Island and Myrtle Bend Substrate Enhancement Pilot Projects, Kootenai River near Bonners Ferry, Idaho

By Ryan L. Fosness

Abstract

The U.S. Geological Survey, in cooperation with the Idaho Department of Fish and Game, conducted a study to characterize the physical habitat occupied by Kootenai River white sturgeon during spawning and early-life phases. The objective was to gain a better understanding of spawning behavior, site selection, and type of habitat used during egg incubation in two sub-reaches of the Kootenai River. Habitat characterizations generated by this study will assist in the design of a substrate enhancement pilot project.

This report presents the methods used to develop georeferenced portable document format maps and geospatial data that describe spawning locations and physical habitat characteristics (including egg mat locations, bathymetry, surficial sediment facies, and streamflow velocity) within the substrate enhancement pilot project study area. The results are presented as two maps illustrating the physical habitat characteristics along with proposed habitat enhancement areas, aerial imagery, and hydrography. The results of this study will assist researchers, policy makers, and management agencies in deciding the spatial location and extent of the substrate enhancement pilot project.

Introduction

In 1994, the U.S. Fish and Wildlife Service (USFWS) listed the Kootenai River population of white sturgeon (*Acipenser transmontanus*) as an endangered species under the provisions of the Endangered Species Act (ESA) of 1973, as amended. The listing was the result of decreasing population numbers and a lack of juvenile recruitment that was first noted in the mid-1960s (Federal Register, 1994; U.S. Fish and Wildlife Service, 1999). Many researchers attributed the decreasing numbers and lack of recruitment to the degradation of white sturgeon habitat, particularly the habitat used for spawning (Paragamian and others, 2001, 2002; Kock and others, 2006). A 29-km reach extending from river kilometer (rkm) 257, downstream of the Moyie River confluence, to rkm 228 in the meander reach downstream of Shorty's Island, was designated as Kootenai River white sturgeon critical habitat (Federal Register, 2008; fig. 1). Most sturgeon spawn in the lower part of the critical habitat (rkm 228–240.5), with preference given to five primary spawning sub-reaches, including Lower Shorty's Island (rkm 228.7–229.6), Middle (also referred to as South) Shorty's Island (rkm 230.0–231), Myrtle Creek (rkm 233.5-234.7), Kootenai National Wildlife Refuge (rkm 235.2–235.9 and rkm 236.1–236.9), and Deep Creek (rkm 238.9–239.9) (Paragamian and others, 2002).

Because of the lack of suitable spawning and early-life substrate in the lower meander reach, one recommendation from the Kootenai River White Sturgeon (KRWS) Recovery Implementation Plan proposed "add rock to substrate in current spawning areas to evaluate its role in providing suitable spawning and incubation conditions" (Anders and others, 2007). In April 2010, under the authority provided by the Continuing Authorities Program, Section 1135, the U.S. Army Corps of Engineers, in cooperation with the Kootenai Tribe of Idaho, initiated a feasibility study to "identify and implement cost-effective, self-sustaining ecosystem restoration actions to improve ecosystem function and habitat attributes for the early life stage survival of the ESA-listed KRWS" (U.S. Army Corps of Engineers, 2012). The U.S. Army Corps of Engineers feasibility study recommended a substrate enhancement pilot project (SEPP) at two locations, Shorty's Island South and Myrtle Creek. In 2013, the Kootenai Tribe of Idaho continued the implementation of the SEPP at two sites in the meander reach. The objective of the SEPP is to test "the sustainability and effectiveness of placing rock substrate over existing clay surfaces in two sub-reaches of the river where wild KRWS currently spawn" (Kootenai Tribe of Idaho, 2013).

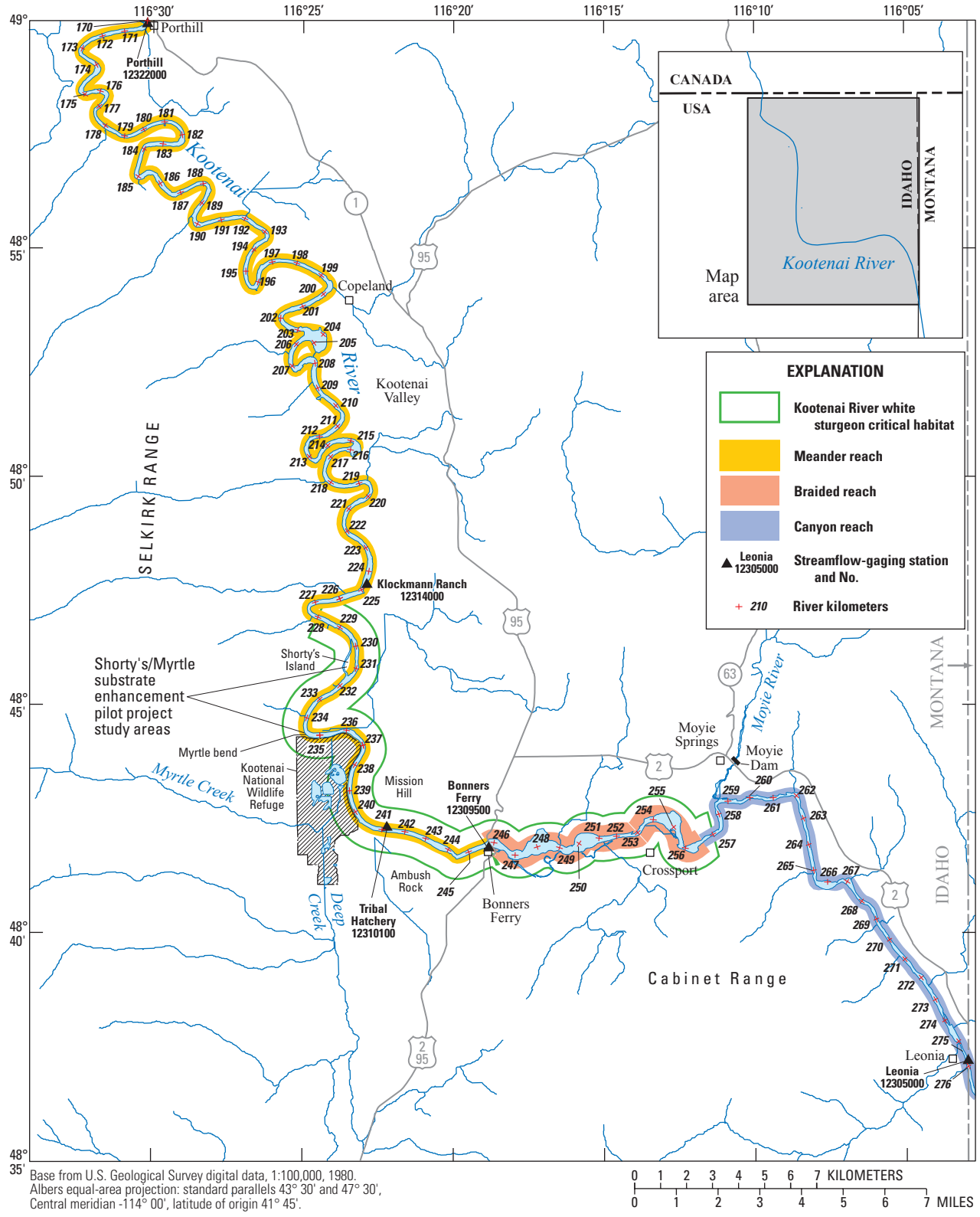


Figure 1. Kootenai River white sturgeon critical habitat in the study reach, near Bonners Ferry, Idaho.

The U.S. Geological Survey, in cooperation with the Idaho Department of Fish and Game (IDFG), conducted a 2-year study to characterize the physical habitat occupied by KRWS during spawning and early-life phases. The objective of the study was to gain a better understanding of spawning behavior, site selection, and type of habitat used during egg incubation at the two sub-reaches planned for the SEPP. The study areas included two primary spawning sub-reaches located within KRWS critical habitat. The first study area is located between rkm 234–235 near the mouth of Myrtle Creek confluence, and is referred to as Myrtle Bend. The second study area is located between rkm 230–231.5 near a prominent island known commonly as Shorty's Island.

Purpose and Scope

This report presents two layered georeferenced portable document format (GeoPDF) maps and all geospatial data and metadata that describe spawning locations and physical habitat characteristics within the SEPP study area of the Kootenai River. Spawning locations are represented by the IDFG egg mat network and physical habitat characteristics including bathymetry, surficial sediment facies, and streamflow velocity mapping. Shaded relief imagery and surficial sediment facies data provide a visualization of the habitat characteristics near current KRWS spawning grounds. The bathymetric contours are provided as a reference to the general elevations in the study areas. The streamflow velocity mapping data provide depth-averaged velocity magnitude and direction data intended to provide biological and morphological streamflow information that may be of use for describing habitat conditions.

A brief discussion of the data collection and data processing methods used to develop each dataset is presented. Physical habitat characterizations are presented as two maps illustrating the physical habitat characteristics along with other ancillary information (egg mat locations, substrate enhancement areas, aerial imagery, and other metrics in relation to the egg mats). The results of this study will assist science researchers, policy makers, and management agencies in deciding the spatial location and extent of the SEPP.

Methods

Bathymetry

High-resolution bathymetry data were collected in June 2010 within each of the study areas using a multibeam echosounder (MBES). A description of the methods used to complete the MBES survey is presented in Fosness (2013). Point data from the MBES survey were used to create a surface raster, or digital elevation model (DEM), for each of the study areas. 1-m interval contours were created from the DEM to provide elevation reference for each of the study sites. A shaded relief (or hillshade) was created from the DEM and then applied to the contours as a background hillshade.

Sediment Facies

Surficial bed sediments, herein referred to as sediment facies, were classified into categories based on particle size and, in some instances, color. Sediment facies categories included the following ranges based on the standard Wentworth scale division: gravel (2–64 mm diameter), sand (0.063–2 mm), and silt/clay (<0.063 mm) (Wentworth, 1922). An underwater video monitoring system (UVMS) was used to capture video images of the sediment facies and record the geographical position of the substrate. UVMS data were collected intermittently at each site from 2006 to 2012 using the same methods described in Weakland and others (2011). Underwater video images were captured at discrete points along numerous transects throughout the study areas, allowing for sufficient detail to record distinct differences between each type of sediment facies. The DEM from the bathymetry was used in combination with the sediment facies map to identify sediment category boundaries, and to delineate the sediment features, such as sand dunes, major and minor clay steps, and clay benches. Major clay step features had a vertical face greater than 1.5 m; whereas, minor clay step features were less than or equal to 1.5 m. Clay step features were verified using the UVMS, and the extent and magnitude of the clay step features were mapped using the DEM. ESRI© ArcGIS™ was used to create a geographic information system (GIS) layer defining the dominant sediment facies classifications: gravel, sand, clay, silt, and major and minor clay steps.

Velocity Mapping

Acoustic Doppler current profiling (ADCP) data were collected at the Shorty's Island study area on June 1, 2012, and the Myrtle Bend study area on June 3, 2013. Twenty-nine transects were surveyed at each study area, and each transect was surveyed a minimum of four times following procedures outlined in Mueller and others (2013). ADCP data were post-processed using WinRiverII software, and the velocity data was produced using the Velocity Mapping Toolbox (VMT) software (Parsons and others, 2013). The velocity data were depth-averaged and horizontal spacing was set to 10 m. ADCP data included the coordinates, magnitude, and direction of the depth-averaged velocity vectors and were saved as a GIS layer.

Idaho Department of Fish and Game Egg Mat Network

Artificial substrate mats, herein referred to as egg mats, consist of a weighted frame covered with a material designed to retain and trap sturgeon eggs. The egg mat data from this study were located in the Shorty's Island and Myrtle Bend study areas. Data used for this study are a sub-set of a larger egg mat network operated by the Idaho Department of Fish and Game (Hardy and others, 2014). The egg mat data were provided by IDFG for 2007–13 and included date, number of eggs collected, and the spatial location.

Idaho Fish and Game personnel installed and retrieved the egg mats on a 24–48 hour rotation during the spawning season. The egg mat spatial locations were recorded using a mapping-grade GPS unit, and the date and time were recorded for both the installation and retrieval. If eggs were present upon retrieval, the number of eggs and the date and time of retrieval were recorded and entered into a database for each year. An ESRI© shapefile was created in ArcMap containing all of the egg mat data from 2007 to 2013. Attributes were created for the date, number of eggs collected, and spatial location.

Substrate Enhancement Pilot Project Extent

GIS layers for the Myrtle Bend and Shorty's Island SEPP study areas represent the areal extent for placement of artificial substrate. The SEPP extent was created by analyzing the egg mat network, bathymetric features, surficial sediment facies, and streamflow characteristics. The egg mat data describe where sturgeon eggs were captured in previous years, indicating a preference of spawning location. The bathymetry and surficial sediment facies data were used to delineate relatively flat areas located entirely within the lacustrine clay outcroppings. The streamflow data, consisting of acoustic Doppler current profiles, were used to determine areas where streamflow velocity is sufficient to maintain transport of sand and fine-grained sediment, and to prevent deposition of sediment. The completed SEPP extent GIS layers represent locations where sturgeon have historically spawned. These areas are on a low sloped and predominantly lacustrine clay surface with relatively high streamflow velocities.

Substrate Enhancement Pilot Project Maps

Using the geospatial data from each component of the study, two digitally formatted GeoPDF study area maps (table 1) were created for the Kootenai River SEPP near Myrtle Bend (plate 1) and Shorty's Island (plate 2) study areas on the Kootenai River near Bonners Ferry, Idaho. Geospatial data included in the maps are ADCP data, IDFG egg mat network information, surficial sediment facies, proposed substrate patch, and digital elevation model data including high-resolution shaded relief and elevation contours. Additionally, orthoimagery, grids, geographic names, hydrography, and other selected geospatial data in this map are from selected National Map data holdings and other government sources (Dollison, 2010).

Table 1. GeoPDF map plates, preview illustrations, and metadata for the Myrtle Bend and Shorty's Island substrate enhancement pilot projects, Kootenai River near Bonners Ferry, Idaho.

[GeoPDF map plates and metadata are available for download at http://pubs.usgs.gov/ds/0889/. Links to metadata are embedded in the PDF; click on view the attachments in the PDF to access the metadata link]

GeoPDF map plates	
Plate 1. Kootenai River substrate enhancement pilot project near Myrtle Bend	
Plate 2. Kootenai River substrate enhancement pilot project near Shorty's Island	

The GeoPDF maps were created for general viewing purposes using Adobe® Reader® and intended for users who may not have access to or experience with geographical information systems. Each map was produced using TerraGo Publisher® for ArcGIS® software, which adds a geospatial reference along with an option to turn individual layers on and off. A metadata file is embedded within the GeoPDF document to provide detailed information for each of the layers in the map.

ESRI© shapefiles were created for each dataset and can be used in various types of geospatial software applications. A hyperlink to the metadata and GIS data is included for each dataset (table 2).

Table 2. Metadata, preview illustrations, and compressed geospatial data sets for the Myrtle Bend and Shorty's Island substrate enhancement pilot projects, Kootenai River near Bonners Ferry, Idaho.

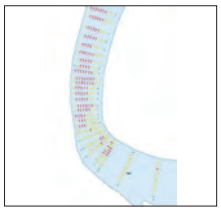
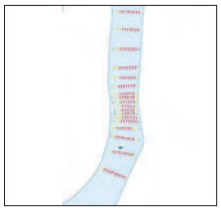
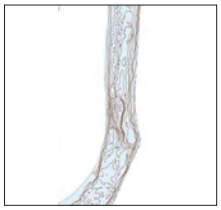
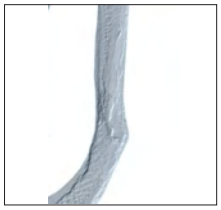
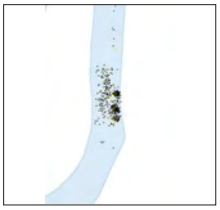
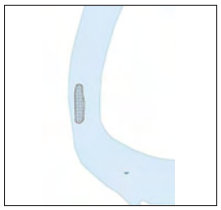
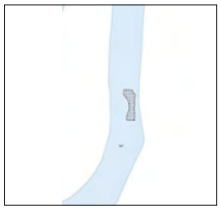
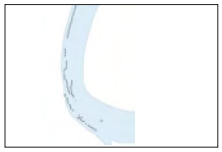
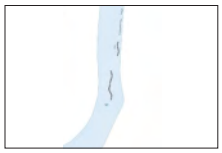
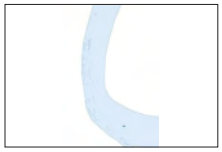
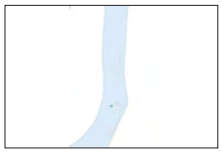
Geospatial data type	Preview images and metadata		
Acoustic Doppler current profile	Acoustic Doppler Current Profiling near Myrtle Bend, June 3, 2013		[GIS data]
			[GIS data]
Digital elevation model	Elevation Contours of the Bathymetry near Shorty's Island and Myrtle Bend		[GIS data]
	Shaded Relief of the Bathymetry near Shorty's Island and Myrtle Bend, 2010		[GIS data]
Idaho Fish and Game egg mat network	White Sturgeon Egg-Mat Network near Shorty's Island and Myrtle Bend		[GIS data]
Substrate enhancement pilot project extent	Myrtle Bend Substrate Enhancement Pilot Project Extent		[GIS data]
	Shorty's Island Substrate Enhancement Pilot Project Extent		[GIS data]

Table 2. Metadata, preview illustrations, and compressed geospatial data sets for the Myrtle Bend and Shorty's Island substrate enhancement pilot projects, Kootenai River near Bonners Ferry, Idaho.—Continued

Geospatial data type	Preview images and metadata		
Surficial sediment facies	Major Clay Step features near Myrtle Bend		[GIS data]
	Major Clay Step features near Shorty's Island		[GIS data]
	Minor Clay Step features near Myrtle Bend		[GIS data]
	Minor Clay Step features near Shorty's Island		[GIS data]
	Surficial Sediment Facies features near Myrtle Bend		[GIS data]
	Surficial Sediment Facies features near Shorty's Island		[GIS data]

Summary

The U.S. Geological Survey, in cooperation with Idaho Department of Fish and Game, conducted a 2-year study to characterize the physical habitat occupied by Kootenai River white sturgeon (KRWS) during spawning and early-life phases. The objective of the study was to gain a better understanding of spawning behavior, site selection, and type of habitat used during egg incubation at the two sub-reaches of the KRWS critical habitat planned for the substrate enhancement pilot project (SEPP). The basic data and habitat characterizations generated by this study will assist in the design of the SEPP near Myrtle Bend and Shorty's Island.

This report presented the methods used to develop two layered GeoPDF maps that describe spawning locations and physical habitat characteristics within the SEPP study area. Spawning locations are represented by Idaho Department of Fish and Game egg mat network data. Physical habitat characteristics include bathymetry, surficial sediment facies, and streamflow velocity. Bathymetric contours, shaded relief imagery, and surficial sediment facies data provide a visualization of the habitat characteristics near current KRWS spawning grounds. The bathymetric contours provide a reference to the general elevations in the study area. The streamflow velocity mapping data provides depth-averaged velocity magnitude and direction data intended to provide biological and morphological streamflow information that may be of use for describing habitat conditions.

The results are presented as two maps that illustrate the physical habitat characteristics along with supporting geospatial data and metadata. The results of this study will assist researchers, policy makers, and management agencies in deciding the spatial location and extent of the SEPP.

References Cited

Anders, P., Ireland, S., and Kootenai River white sturgeon recovery team, 2007, Kootenai River White Sturgeon Recovery implementation plan and schedule, 2005–2010: Bonneville Power Administration, Technical Report, Project No. 200200200 (BPA Report DOE/BP-00019398-1), 52 p.

Dollison, R.M., 2010, The National Map—New viewer, services, and data download: U.S. Geological Survey Fact Sheet 2010–3055, 2 p. (Also available at http://pubs.usgs.gov/fs/2010/3055/.)

Federal Register, 1994, Endangered and threatened wildlife and plants—Determination of endangered status for the Kootenai River population of the white sturgeon: Federal Register, v. 59, no. 171, p. 45,989–46,002, accessed April 27, 2012, at http://ecos.fws.gov/docs/federal_register/fr2678.pdf.

Federal Register, 2008, Endangered and threatened wildlife and plants—Critical habitat revised designation for the Kootenai River population of the white sturgeon (*Acipenser transmontanus*): Federal Register, v. 73, no. 132, p. 39,505–39,523, accessed March, 2014, at http://www.gpo.gov/fdsys/pkg/FR-2008-07-09/pdf/E8-15134.pdf#page=1

Fosness, R.L., 2013, Bathymetric surveys of the Kootenai River near Bonners Ferry, Idaho, water year 2011: U.S. Geological Survey Data Series 694, 26 p.

Hardy, R.S., Rust, P., Gidley, C., Hughes, J, Maiolie, M., Paragamian, V., Wakkinen, D., and Laude, C., 2013, Kootenai River resident fish mitigation—White sturgeon burbot native salmonid monitoring and evaluation, report: Idaho Department of Fish and Game Annual Report for 5/1/2009-4/30/2012, 1988-065-00, 125 p.

Kock, T.J., Congleton, J.L., and Anders, P.J., 2006, Effects of sediment cover on survival and development of white sturgeon embryos: North American Journal of Fisheries Management, v. 26, no. 1, p. 134–141.

Kootenai Tribe of Idaho, 2013, Kootenai River Habitat Restoration Program: Kootenai Tribe of Idaho, 4 p., accessed March 15, 2014, at http://www.restoringthekootenai.org/resources/Flyers/KRHRP_July_2013.pdf.

Mueller, D.S., Wagner, C.R., Rehmel, M.S., Oberg, K.A., and Rainville, Francois, 2013, Measuring discharge with acoustic Doppler current profilers from a moving boat (ver. 2.0, December 2013): U.S. Geological Survey Techniques and Methods, book 3, chap. A22, 95 p., http://dx.doi.org/10.3133/tm3A22.

Paragamian, V.L., Kruse, Gretchen, and Wakkinen, Virginia, 2001, Spawning habitat of Kootenai River white sturgeon, post-Libby Dam: North American Journal of Fisheries Management, v. 21, no. 1, p. 22–33.

Paragamian, V.L., Wakkinen, V.D., and Kruse, Gretchen, 2002, Spawning locations and movement of Kootenai River white sturgeon: Journal of Applied Ichthyology, v. 18, p. 608–616.

Parsons, D.R., Jackson, P.R., Czuba, J.A., Engel, F.L., Rhoads, B.L., Oberg, K.A., Best, J.L., Mueller, D.S., Johnson, K.K., and Riley, J.D., 2013, Velocity Mapping Toolbox (VMT)—A processing and visualization suite for moving-vessel ADCP measurements: Earth Surface Processes and Landforms, v. 38, p. 1,244–1,260, doi: 10.1002/esp.3367.

U.S. Army Corps of Engineers, 2012, Draft continuing authorities program section 1135 detailed project report and integrated environmental assessment, Shorty's Island/Meander Reach ecosystem restoration Kootenai River, Idaho: U.S. Army Corps of Engineers, Seattle District, 260 p. plus appendixes, accessed April 14, 2014, at http://www.nws.usace.army.mil/Portals/27/docs/civilworks/projects/1._Shorty's_Draft_Report_03July2012_small[1].pdf.

U.S. Fish and Wildlife Service, 1999, Recovery plan for the white sturgeon (*Acipenser transmontanus*)—Kootenai River population: Portland, Oreg., U.S. Fish and Wildlife Service, 96 p. plus appendixes, accessed April 27, 2012, at http://ecos.fws.gov/docs/recovery_plan/990930b.pdf.

Weakland, R.J., Fosness, R.L., Williams, M.L., and Barton, G.J., 2011, Bathymetric and sediment facies maps for China Bend and Marcus Flats, Franklin D. Roosevelt Lake, Washington, 2008 and 2009: U.S. Geological Survey Scientific Investigations Map 3150, 1 sheet.

Wentworth, C.K., 1922, A scale of grade and class terms for clastic sediments: Journal of Geology, v. 30, p. 377–392.

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