Documentation for the Mapping of Anadromous Fish-Related Habitat Projects and Long-Term Monitoring Efforts in Selected Columbia River Subbasins

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1 Introduction, History and Scope

Research, monitoring and evaluation (RM&E) in support of an adaptive management framework is called for in The Northwest Power Planning Council's Fish and Wildlife Program (F&WP; NPPC 2000), the Federal Columbia River Basinwide Fish Recovery Strategy, the National Marine Fisheries Service's (NMFS) and USFWS 2000 Biological Opinion (BO) on the operation of the Federal Columbia River Power System (FCRPS; NMFS 2000), and the subsequent Action Agencies' (Bonneville Power Administration (BPA), US Army Corps of Engineers (COE) and US Bureau of Reclamation (BOR)) Research, Monitoring & Evaluation Plan for the NOAA-Fisheries 2000 Federal Columbia River Power System Biological Opinion (Anon. 2003). There is a well-documented need to compile information on historical and current anadromous fish distribution, land use activities including habitat restoration/remediation, biological and environmental monitoring, stream characteristics, and many other suites of anthropogenic and environmental data in order to support this large RM&E planning effort.

This project began in 2002 as a task to assist NOAA Fisheries (S. Katz and K. Barnas, Northwest Fisheries Science Center, Seattle WA) with compiling anadromous fish habitat remediation/restoration project locations in selected subbasins for the purpose of establishing a database and GIS coverages of all habitat restoration efforts in the Columbia River basin (CRB). The primary tasks for this submission were to locate historical, current, and proposed, "likely to be funded" or "already funded", habitat modification projects that effect salmon and/or steelhead ESUs in the Clearwater River basin; to locate current and proposed projects in the area used by the LCR chum salmon ESU, and to locate current and proposed projects in the John Day basin. The area considered accessible to chum was every stream in the CRB below Bonneville Dam and below barrier falls, excluding the Willamette subbasin.

I documented BPA and non-BPA sponsored fish habitat remediation/restoration activities in these first three subbasins and submitted a CD of location maps generated from USGS 7.5' topographic maps and Excel spreadsheets to NOAA Fisheries (K. Barnas). Subsequent to that effort, Charlie Paulsen (Paulsen Environmental Research, Ltd., Lake Oswego, OR) and I developed models to attempt to explain the relationship between habitat and survival of PIT tagged juveniles from selected Snake River Chinook stocks (Paulsen and Fisher 2003, 2004 and 2005). In order to support the models, I further developed the project location datasets in the subbasins where sufficient numbers of PIT tagged Chinook parr (PTAGIS; Grande Ronde/Imnaha, Clearwater, and Upper Salmon) had been released in order to model juvenile overwintering survival. Parallel to that effort were several requests from Jim Geiselman at BPA Division of Fish and Wildlife to update the John Day and Lemhi subbasins for the respective CSMEP work groups and add the Upper Columbia (including British Columbia) BOR priority subbasins. This effort was expanded in 2004/05 to include all anadromous accessible areas in the above subbasins (except the LCR Chum ESU which was not updated and therefore is not included in this project) and to include documentation of long-term anadromous fish-related monitoring sites as well.

The habitat project location dataset is a series of Excel spreadsheets (one for each of the five areas above) which contain the details, i.e. responsible parties, contract numbers, geographic coordinates, action types, years implemented, stream segment, watershed, short descriptions, etc. I assigned each action a unique ID which I then located on 7.5' topographic maps and mapped in GIS. The GIS coverages are in the form of ESRI SHP files which contain most of the information from the spreadsheets. I generated PNG format map images from the GIS coverages and other publicly available coverages (i.e. HUCs, streams, land ownership, etc.). Each area has a map index and overview maps as well as many detailed maps showing individual project locations identified by the unique ID.

The monitoring locations exist as GIS SHP files only, with the exception of Snake River spring/summer Chinook redd survey and PIT tag release locations, for which I have developed detailed datasets as part of our modeling efforts. I extracted general information (i.e. years, type of monitoring, location details) from readily available sources of monitoring data (i.e. state, federal, and tribal monitoring programs) and mapped the sites which had:

- long term (10 years or planned for >10 years),
- consistent (i.e. monitored in most years),
- ongoing (i.e. not discontinued), and
- readily available,

datasets. I generated similar index, overview, and detailed location maps for the monitoring locations as for the habitat projects.

2 Data

In order to document anadromous fish-related habitat restoration or remediation projects and monitoring locations, I used publicly available sources such as F&WP program projects and proposals; the FCRPS BiOp projects database (BPA) for other AA projects (i.e. COE, BOR); WA Salmon Recovery Fund (SRF) Board and Oregon Watershed Enhancement Board (OWEB) databases; state, federal, and tribal agency websites; Soil and Water Conservation District (SWCD), NRCS, and USFS websites; I also wrote and phoned many agencies requesting information. I sent an introduction letter and survey, followed up with phone calls, and interviewed many project sponsors. I documented compliance and the source of the information presented. Table 1 presents a fairly comprehensive list of websites that contain relevant project information for the areas of interest.

Generally, I searched for projects from the mid-1980s through the present. This time period coincides with the first projects that were funded by BPA under the NPPC's F&WP. However, if I located projects that were carried out before this period, I included them as well. I considered any project that stated as a goal the restoration or remediation of anadromous fish habitat. I included projects tracked by NGOs (e.g. OWEB, GRMWP) and sponsoring agencies (e.g. BPA, COE, BOR) unless they clearly were not related to nor could effect anadromous fish habitat (i.e. upland wildlife habitat projects in areas not hydrologically connected to anadromous spawning or rearing streams). Conversely, I did include projects that were not identified by the proponents as aimed at restoring anadromous fish habitat or access but that I judged to potentially benefit streams that support or could support anadromous fish. The best example of this type of project are the various land acquisition programs sponsored by Federal and State wildlife agencies for wildlife habitat protection (i.e. National and State Wildlife Refuges, the wildlife mitigation component of the F&WP); many of these acquisitions benefit anadromous fish as well. I did not exclude projects that were removed from anadromous accessible streams if they could benefit streams via tributaries, for example, road obliterations that took place on ridgetops remote from anadromous streams were always included since they potentially could reduce sediment delivery to anadromous streams.

I did not exclude projects that were located in areas inaccessible to anadromous fish because passage barriers have been and no doubt will continue to be modified to be made passable to some or all species of anadromous salmonids. Therefore, I did consider projects above the dams that have been or are being considered for removal or fish passage facilities (e.g., Enloe Dam). Conversely, I did not consider projects above major manmade barriers such as Dworshak Dam on the North Fork Clearwater River. The six major areas of interest as described in the introduction and shown in Figures 1 through 7 are:

1. John Day (Oregon) – the entire John Day River subbasin, including anadromous-inaccessible areas (i.e., South Fork John Day River above Izee Falls) – Figure 2.
2. Northeast Oregon (Oregon & Washington) – the entirety of both the Grande Ronde & Imnaha subbasins (excluding the mainstem Snake River between the two) – Figure 3.
3. Clearwater and **4.** Salmon (Idaho) - the entirety of both subbasins (excluding the mainstem Snake River between the two), which constitutes all of Idaho that is accessible to anadromous fish below the Hells Canyon mainstem dam complex (excluding the mainstem Snake River), including anadromous-inaccessible areas (e.g., Little Salmon River watershed above the barrier falls) but excluding the North Fork Clearwater River upstream from Dworshak Dam – Figures 4 and 5.
5. Upper Columbia Salmon Recovery Area (as defined by the state of WA) – The entirety of the Columbia River and tributaries within the United States from Skookumchuck Creek in the Wanapum Dam pool upstream to the downstream face of Chief Joseph Dam (no fish passage) – Figure 6. Major subbasins (aka 4th field Hydrologic Units or HUCs) in the area include the following:

    1) Upper Columbia – Entiat River (Entiat River subbasin and the mainstem Columbia River and tributaries from Skookumchuck Creek upstream to the mouth of the Chelan River)
    2) Moses Coulee
    3) Wenatchee River

4) Chief Joseph (the mainstem Columbia River and tributaries from above the mouth of the Chelan River upstream to the downstream face of Chief Joseph Dam except the Methow and Okanogan subbasins)
5) Methow River
6) Okanogan River
7) Similkameen River

6. Canadian (British Columbia) portion of the Upper Columbia Salmon Recovery Area – that portion of the Okanagan and Similkameen River basins within BC, including anadromous-inaccessible areas above Enloe Dam (Similkameen) and McIntyre Dam (Okanagan) – Figure 7.

Anadromous fish-related monitoring locations were researched through publicly available sources (generally on the internet). Again, only long-term monitoring sites with a reasonably complete record over the past 10 years, or those that are planned to be monitored for 10 or more years in the future, were documented in the GIS coverage. In rare cases where I was able to obtain a GIS coverage that included the monitoring data, I left the original data in the coverage. Table 2 presents the websites where I was able to locate monitoring datasets; not all the datasets were located on the internet. I developed datasets for the remainder of the monitoring efforts from various sources, generally as follows:

- Redd count transects: generally from state fish and game agencies (BC Fisheries, WDFW, ODFW, IDFG), and tribal fisheries departments (Nez Perce, Shoshone-Bannock Tribes, and others). Almost all the redd count datasets I was able to locate on the internet were incomplete or lacked endpoint locations. A reasonably complete redd count dataset for the Snake River AOIs (through 2004) is available on request.
- Anadromous Fish Hatchery Facilities: generally from state fish and game agencies (BC Fisheries, WDFW, ODFW, and IDFG), NPPC Subbasin Plans, and NOAA Fisheries. Almost all the hatchery facility location datasets I was able to locate on the internet were incomplete or outdated.
- Anadromous Fish Monitoring Locations: generally from state fish and game agencies (WDFW, ODFW, and IDFG), NPPC Subbasin Plans, and NOAA Fisheries. Idaho general parr monitoring sites were obtained from E. Brown, IDFG Boise. Almost all the datasets I was able to locate on the internet were incomplete or outdated. I could not locate any monitoring sites in BC.

Ancillary coverages I used to generate maps and describe habitat project locations (i.e., assign a 6th field HUC) are generally available from the sources in Table 3. I modified datasets and GIS coverages where I found mistakes or needed additional detail (i.e. named streams that were excluded from the PNW Reach File or NHD datasets for unknown reasons; unnamed or erroneous HUCs in the draft 6th field HUC datasets). I requested some coverages from state agencies (i.e., Chinook and steelhead distribution) since data on the internet was outdated or inaccurate (this has since been remedied).

3 Methods

I documented habitat restoration actions in Excel spreadsheets; one for each area of interest. In order to characterize actions, I developed 17 "habitat action types" that correspond to NOAA Fisheries' habitat action categories (supplied by K. Barnas) in the "RPA 183 project data" spreadsheet (Table 4; spreadsheet available on request). The filled-out responses (survey sheets) with other supporting maps, documents, and raw data received from the project proponents are available upon request. Where possible I grouped projects funded by multiple sources (if known) under larger umbrella projects such as the F&WP. An action was defined as a single element or a group of discrete actions (whether they be restoration or enhancement, instream or off-channel, upland or riparian, etc.) that were defined as a "project" by the project proponent(s) and which took place in a definable area during a known period of time. This was done to keep the number of entries in the spreadsheets below the tens of thousands. Where possible, I subdivided projects by individual actions, stream reaches affected (if known), and/or 6th field HUC.

Projects locations were described by the sponsors or proponents in an almost infinite variety of ways. Many projects were located by MTRS (meridian-township-range-section) or GPS coordinates. I had to locate a large proportion of the projects on USGS 7.5' topo maps using descriptions from the sponsors or proponents. In a few cases I was able to use GIS coverages or interactive mapping

websites provided by the sponsors or proponents (e.g., USFS IRDA, OWEB, WA SRFB, GRMWP, NOAA PCSRF, and many recent BPA-sponsored projects). Therefore, the datasets reflect varying degrees of precision in locating projects and determining individual project actions, from precisely mapped project boundaries in GIS coverages to vague descriptions of watersheds. For example, a single riparian fence on a ¼ mile streamside property could constitute a project, as could a combination of fencing, stream crossing improvements, and riparian revegetation on a discrete reach of a river and the mouth of a tributary stream, as could 100 miles of road obliteration that took place on 20 different roads in a large watershed (i.e., the project was not sufficiently described by the proponents to locate individual road segments). Table 5 shows the column assignments in the accompanying habitat project spreadsheets (one for each AOI, except the UCR and BC areas are combined). Each row represents a "project" and the columns represent various project and location information that I entered for each.

Each project in the habitat project location spreadsheets is assigned a Project ID (Table 5) which I then located on USGS 7.5' topographic maps using software to determine precise latitude and longitude as well as MTRS (meridian-township-range-section), where possible (All Topo Maps V7 Professional). If I could not locate a project other than by watershed (e.g., a named stream), then I placed a point near the mouth of the stream to represent the project. If I could not locate a project within the watershed of a named stream, I did not map the project. These projects are noted as not locatable in the spreadsheets (yellow highlighting in column "A"). In rare cases where I received a GIS coverage from project sponsors or proponents (e.g., OWEB, GRMWP, SRFB), I exported the coverage to All Topo Maps to verify and refine project locations. I then transferred all project locations to GIS (Manifold System 7x) as either points, lines, or areas, depending on the amount of detail I received from the sponsors or proponents. These coverages are provided in the form of SHP files which contain most of the information from the spreadsheets. I generated maps (PNG format) from the GIS and ancillary coverages (e.g., HUCs, streams, land ownership, etc.). Each AOI has a map index and overview maps as well as many detailed maps showing individual project locations identified by the Project ID.

The monitoring locations exist as GIS SHP files only, with the exception of Snake River spring/summer Chinook redd survey and PIT tag release locations, for which I have developed detailed Excel spreadsheets as part of our modeling efforts (Paulsen and Fisher 2003, 2004, and 2005). I used similar procedures to locate monitoring sites on USGS 7.5' topo maps and transferred them to GIS. Similar index, overview, and detailed maps were then generated for the monitoring locations as for the habitat projects.

4 Results and Discussion

4.1 Habitat Project Datasets

I was able to obtain at least rudimentary location information concerning 6,486 habitat restoration or remediation projects in the six areas of interest, which are broken out by AOI below. The actual number of projects that has taken place in these basins is likely far greater than these totals would suggest (based on my experience, at least double or triple the total number reflected in the spreadsheets). Reasons for this include:

- Many (but not all) projects located by "watershed" in the spreadsheets (Column Q; Table 5) were not possible to precisely locate on a 7.5' topo map, or the project had no specific near-stream actions (i.e. road obliterations, upland conservation projects). Therefore, a "project" that took place in a stream's watershed could actually consist of tens of discrete actions, but without more specific location information or better project documentation, I had no way of knowing this.
- Many projects were implemented but are undocumented in readily available form; project proponents that I interviewed suggested many times that if one had the time to search their archived records, more projects could be found that were carried out before current computerized records were kept, by now-retired employees, under defunct funding programs, that had been archived in a central location, etc. Conversely, a very few projects that I found were documented but never carried out (these are not included in the spreadsheets or on the maps). The majority of the public and private agencies and organizations implementing habitat restoration in the AOIs (i.e., proponents) do not publish specific project information on a routine basis.
- Some project information is not generally publicly available due to legal or other reasons. For example, all USDA Farm Service Agency Conservation Programs (i.e. CREP, CRP) include agreements to protect the privacy of participating landowners; therefore detailed location information is almost never available for these projects. This issue has affected large databases of projects, which are still not publicly available (i.e., the aforementioned NOAA NFSC habitat project database). Note that randomization of

coordinates for sites located on private property is routinely performed by the USFS in reporting results from the Forest Inventory and Analysis program, thus providing valuable data to the public while preserving both accuracy of the information and anonymity of the cooperating landowners.

- Most project funding agencies (sponsors) began tracking project implementation only very recently (generally, the late 1990s to as late as 2000). Documentation of projects that took place before tracking systems were in place at these agencies is very poor to non-existent. Also, many funding agencies had poor and/or unenforced reporting requirements before this time, so determining exactly what was done under an "umbrella" project was sometimes impossible. For example, BPA funded many habitat projects during the early years of the F&WP (about 1984 through the mid-1990s) which were never adequately documented. The proponents did not submit progress or completion reports, and BPA did not enforce requirements to do so. Similarly, the USFS carried out scores of habitat restoration activities using funds from timber sales (e.g., the Knutson-Vandenberg Fund and the Forest Service Salvage Fund) that were undocumented except in archived personal files of employees. Most of the information I located concerning these projects was incidental or reported by third parties (e.g., habitat restoration evaluation reports). Regrettably, knowledge of these and no doubt many other projects rests mainly with retirees now, or has been lost due to employee turnover, making documentation of what was done very time-consuming or impossible today.

Therefore, the numbers in the summary table below represent a combination of my ability to subdivide broad-ranging projects down into discrete actions and the level of documentation available to me about the projects that actually took place over the past few decades. For example, I suspect that many more projects were implemented in the BC portions of the Okanagan basin than are reflected in the table below, simply because virtually my only source of project information was the Fish Passage Register (Table 1). It seems likely that many projects took place before the FPR was established and are thus not reflected in the database, and furthermore that at least some projects that took place since that time were not reported by the proponents for inclusion in the FPR (e.g., despite numerous withdrawals in the basin for fruit orchard irrigation, virtually no irrigation diversion screening projects are represented in the FPR). At the opposite end of the scale, so to speak, is the NE Oregon AOI (Grande Ronde and Imnaha basins), where the Grande Ronde Model Watershed Program (GRMWP) has kept a database of project information for the great majority of anadromous fish-related habitat restoration projects in the two basins since its inception in 1992. For projects that the GRMWP generally does not track, i.e. diversion screening and USFS projects with no funding from outside the agency, I was able to obtain relatively detailed location information from ODFW screen shop records and USFS and BLM environmental documents and reports.

AOI & Abbreviation	# of Projects	Area (mi²)	Projects / 100 mi²
BC - BC Upper Columbia	130	6,014	2
UCR - WA Upper Columbia	828	8,234	10
JDA - John Day	1,331	7,912	17
NE OR - Northeast Oregon Basins	1,618	4,945	33
CLW - Clearwater	992	6,920	14
SAL - Salmon	1,587	13,955	11
All	6,486	47,980	14

Interesting statistics about the projects I found are presented above, in Tables 6 through 11, and in Figures 8 through 10. The table above shows the density of projects per 100 square miles in each AOI. As discussed above, these numbers reflect both real data and errors and omissions in locating projects. The density also reflects geography and land use in the AOIs. Much of the land area in the WA & BC Upper Columbia basin is inaccessible to or is not suitable habitat for anadromous fish (i.e. above dams and other barriers, or in watersheds that are unsuitable for anadromous fish reproduction), so there is lesser impetus to carry out habitat restoration in these areas. Anadromous fish have also been extirpated from a few of these subbasins in historical times. Large tracts of land in the Clearwater and especially the Salmon basins are within federally protected wilderness or relatively large roadless areas, where very few projects have been implemented due to both legal and logistical constraints and the general lack of need to restore habitat already in "pristine" condition. Therefore, the density of habitat projects in these AOIs appears to be lower than if these areas were to be excluded from consideration.

Generally, project types correspond closely with both dominant land use activities and perceived "limiting factors" to anadromous fish stock productivity in the basins in which they took place (Tables 6 and 7 and Figure 8; see the Subbasin Plans for summaries of limiting factors). For example, fish passage through culverts is acknowledged as a common problem in most areas in the Pacific Northwest,

therefore it is unsurprising that hundreds of "Fish Passage Improvement" projects have taken place in many of the AOIs. In basins where irrigated agriculture is prevalent (i.e., John Day, NE Oregon and Salmon AOIs), hundreds of diversion screening projects have been implemented (Table 7). Similarly, riparian fencing and replanting are other common project types in heavily agricultural areas in these AOIs. In BC, one of the perceived limiting factors in the Okanagan Lakes area is limited or degraded spawning habitat for kokanee salmon and other adfluvial salmonids; thus many projects involving rehabilitation of spawning areas are captured in the "Habitat Features" category (Table 6). In the WA Upper Columbia AOI, WDFW, the Methow Conservancy, and other NGOs have established aggressive land buying programs to acquire private property with high wildlife habitat values and place it in State Wildlife Areas or other protected status that indirectly and directly benefits anadromous fish (e.g., through curtailing water withdrawals, prohibiting grazing in riparian areas, and providing riparian protection); therefore "Land Acquisition" is a proportionally prevalent project type in this AOI (Figure 8). Similarly, ODFW and other state and tribal agencies in the John Day basin have a coordinated program to eventually fence and restore most major stream corridors that support anadromous fish spawning, rearing, and migration, such that Restore Riparian Function is the dominant category in the JDA (Figure 8). A major focus in the Clearwater basin is improving water quality through remediation of increased rates of sediment delivery to streams from agricultural runoff and timber harvest activities and associated roads; thus "Improve Water Quality" is the dominant category in this AOI (Table 7).

Tables 8 through 10 show projects broken out by landowner and subbasin (i.e., 4th field HUC) for each AOI. These statistics should be taken with a few grains of salt since a few projects in a small area or subbasin can greatly distort the percentages (e.g., the BC Conservancy purchases conservation properties and therefore each property counts as a project; consequently the density of projects is artificially high). The general pattern is one of high density of projects on USFS and private land, with moderate to low densities on BLM, Tribal, and state lands. The number of projects implemented per mile of anadromous-accessible stream is remarkably consistent across AOIs, with the notable exception of high densities of projects on streams that cross WA state, USFS and BLM lands in the WA Upper Columbia AOI (although this may be due to conservative estimates by WDFW of where anadromous fish, especially steelhead, spawn and rear in the AOI). The distribution of projects across subbasins (Table 9) follows predictable patterns, given the patterns of land ownership and land use in the subbasins. For example, the mainstem and South Fork Clearwater subbasins have high densities of projects both by area and anadromous stream miles; the mainstem subbasin is mostly in private lands where SWCDs, the Nez Perce Tribe, and other agencies are implementing wide-ranging habitat restoration/protection programs, and the South Fork is virtually all USFS land that has experienced heavy industrial timber harvest, roading, and placer/dredge mining for over 100 years. In contrast, most of the land in the Lochsa and especially the Selway subbasins is in USFS roadless or wilderness areas, where only a handful of projects have been implemented. A similar pattern is evident in the Salmon AOI, where the Middle Salmon – Chamberlain and Middle Fork subbasins are virtually all in the Frank Church – River of No Return Wilderness Area and thus have a very low density of projects per unit area and per anadromous stream mile, whereas the land in the Lemhi and Pahsimeroi valley bottoms is virtually all in private agriculture and associated BLM grazing allotments, with associated high densities of projects. Finally, Table 10 shows the distribution of projects adjacent to anadromous accessible streams and lakes (occurred within 50 meters of the shoreline) and those removed from the stream, for each AOI.

Table 11 and Figure 9 show the implementation of projects over time; it is interesting to note that habitat remediation/restoration projects were practically nonexistent before BPA and NPPC began implementing the F&WP in 1985, and also that the number of projects implemented peaked in 2001 and subsequently declined between 2002 and 2005/06 (the last years that I am confident I have reasonably complete information), presumably due to budget constraints imposed by the various sponsoring agencies. Figure 10 shows the pattern of implementation over time by Habitat Project Type. The early prevalence of the Restore Stream Complexity can be explained by the large number of "Habitat Features" installed in anadromous streams during the 1980s and early 1990s; as new information about the relative inefficacy of these projects became available, the focus shifted to riparian protection/restoration and sediment abatement. Although many diversions were screened as early as the 1950s, programs that tracked screening (and with them fully effective fish screens) didn't appear until around 1990 with NMFS-sponsored screening programs. Land acquisition, removal of barriers to migration, and water quality focused projects have greatly increased in number in recent years, while riparian projects are decreasing as large contiguous stream segments have been replanted and/or are now protected by riparian fencing and/or conservation easements in the AOIs. Surprisingly, restoration of instream flows appears to be declining; one would expect that much flow could still be gained by increasing efficiency and consolidating points of diversion in heavily diverted stream reaches.

4.2 Maps and GIS Coverages

I generated numerous maps in Manifold for each AOI that depict the habitat project locations and relevant features such as 5th and 6th field HUCs, watercourses, waterbodies, and land ownership. Commonly mapped features such as roads, cities and towns are not displayed to keep clutter to a minimum. Each map is accompanied by a "standard", identically named XML format file which can be used by many GIS software packages to georeference the map, and also provides projection information. I tried to use "standard" state projections for all the maps in each AOI as follows (state projection standards are explained on the various states' GIS websites linked to each projection):

- **BC** – BC Albers
- **Idaho** – Idaho IDTM (NAD83)
- **Oregon** – Oregon Lambert
- **Washington** – custom Lambert Conformal Conic projection equivalent to Washington State Plane South

The overview maps in this document are all in BPA's custom Lambert projection for consistency between AOIs. I selected the area to display in each Habitat Project Map based on how many habitat projects would fit on a map, and still be decipherable, not by another other criteria (i.e. subwatersheds). Therefore the maps are displayed at varying scales and the image sizes also vary. On a PC they should be viewed at full scale with Windows Picture and Fax Viewer, which is the default application for the PNG image file format in Windows XP. Each AOI has several overview and index maps and numerous habitat project maps; naming conventions are as follows.

Overview, Index and Legend Images:

- *{AOI name} Habitat Project Map Index* – A map of the AOI showing general features and the outline of each Habitat Project Map. Each is numbered and the number corresponds to a map name in the Habitat Project Index Map Key image (below).
- *{AOI name} Habitat Project Index Map Key* – An image showing the numbers from the Habitat Project Index Map along with the map name below.
- *{AOI name} Habitat Project Map Legend* – The legend for all of the Habitat Project Maps below.
- *{AOI name} Habitat Project Overview* – A map of the AOI showing all of the habitat projects and general features. Useful for getting a sense of the distribution of projects across the entire AOI.

Habitat Project Maps:

Maps are generally named for the 5th field HUCs visible on each map (e.g., "Big Canyon - Lapwai - Cottonwood Crs."), or in many cases the specific area depicted (e.g., "McComas Meadows - Meadow Creek"). As the maps were generated over a period of months, conventions vary slightly between the AOIs (i.e. the layers displayed, line and area formats, image size, point symbols and colors, etc.). It is helpful when viewing the maps to print the Habitat Project Map Legend for each AOI first. Finally, although I tried to represent the location of each habitat as accurately as possible, problems with mapping superimposed lines (i.e., several projects along a stream segment and the line representing the stream itself), dictated that most projects described as occurring along a stream segment or mapped as lines in GIS coverages I received be converted to a pair of points, one at each endpoint of the line. Therefore many projects along streams appear to be duplicated on the Habitat Project Maps, when in fact these are the endpoints of a single project.

The GIS coverages, one for each AOI, were exported in ESRI SHP file format from Manifold. There is a set of files for each type of location (areas, points, and lines). They contain most of the columns from the Excel spreadsheets (Table 5), along with a few unique fields I added for mapping or data analysis purposes which are usually redundant and self-explanatory.

4.3 Monitoring Locations

I was generally able to locate datasets or GIS coverages of long-term monitoring programs related to anadromous fish in the AOIs. The few exceptions are noted below. The Subbasin Plans are very good sources of lists of long-term monitoring programs. However, the plans rarely give specific details of monitoring sites and years of data. Some long-term programs are not covered in the plans, for reasons unknown to me. I requested, but did not receive, several long-term monitoring datasets that I know to exist. These include steelhead redd survey reaches for all AOIs except the Idaho AOIs and BC Upper Columbia (steelhead redd surveys were conducted for the first time in 2006).

The PIT tag release locations were compiled from PTAGIS release files. I queried the database for tagging files of all anadromous fish parr and smolts (I excluded fish tagged as adults) tagged in the AOIs through 2005. I then tabulated the information in the tagging files by release site, river kilometer, and year. Sites with more than 5 years of releases in the past 10 years are included in the GIS coverages and shown on the maps. New sites with only a few years of data that are part of long-term monitoring efforts are also shown. Many sites were distributed along more than one river kilometer according to the tagging files; these are represented by lines along the stream or river. Hundreds of sites where parr or smolts were tagged only once, only in a few years, or not tagged in recent years were not mapped; sites that I could not locate on a 7.5' topo map also were not included. The dataset is available on request (extremely large Excel spreadsheet). Redd survey transects for Idaho were provided by IDFG in GIS and spreadsheet formats (E. Brown, Boise). Redd survey transects for Oregon were provided in spreadsheet format by P. Keniry and others (ODFW LaGrande). I did not map transects that were only surveyed infrequently or are no longer surveyed. I did not include sockeye lake spawning surveys as these are infrequently conducted (i.e., counts in Lake Wenatchee and Redfish Lake). I obtained BC Okanagan River sockeye redd surveys from here.

All other datasets were mapped as-is using the GIS coverage or coordinates in the dataset. Mistakes were corrected where possible but some sites were not mapped since I could not locate them. I generated maps for the monitoring locations from the GIS coverages in the exact same format as the habitat project maps, including the overview and map index images.

5 Acknowledgements

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6 Tables

Table 1. Agency websites that contain individual habitat project information (URLs current as of 01/2007). Many other agencies have websites; however I could not locate project-specific information on them. Agency type acronyms: IGO – intergovernmental agency; NGO – non-governmental agency.

Area	Agency Type	Agency Name	Agency Website(s)
All	IGO	Columbia Basin Fish & Wildlife Authority (CBFWA)	Fish & Wildlife Program Budget Tracking
			Fish & Wildlife Resources in the Columbia River Basin
		Northwest Power & Conservation Council (NPPC)	Fish and Wildlife
	Federal	Bonneville Power Administration	Fish and Wildlife Project Publications
			Watershed Management Program
			FCRPS BiOp Implementation Plans
			Bonneville Environmental Foundation
		Bureau of Land Management	National Project Database
		Bureau of Reclamation	Programs & Activities: Endangered Species
			News Releases
		Environmental Protection Agency (EPA)	Abandoned Mine Lands
			5 Star Restoration Program
		EPA Region 10	Environmental Cleanup Sites
			Region 10 Brownfields
			River Corridor and Wetland Restoration
		Federal Emergency Management Administration (FEMA)	Pre-Disaster Mitigation Grant Program
		National Biological Information Infrastructure	National River Restoration Science Synthesis
		NOAA Fisheries	Pacific Coastal Salmon Recovery Fund
		NOAA Habitat Program	Restoration Portal
			Community-based Restoration Program
		Regional Ecosystem Office	Interagency Restoration Database
		US Army COE Walla Walla District	Planning Branch
			Regulatory Division
		US Fish & Wildlife Service	Grants
			ESA Consultations
			Fishery Resources
		US Forest Service	Resource Advisory Councils (all)
	NGO	National Fish & Wildlife Foundation	Funded Projects
		Trout Unlimited	Watershed Restoration
Idaho	Federal	Idaho BLM	Abandoned Mine Lands
			NEPA Projects
			Resource Advisory Councils
		US Forest Service Region 4	Mine Cleanup Program
	NGO	Idaho Fish & Wildlife Foundation	Statewide Projects
		Trout Unlimited	Press Releases
	State/County	Idaho Dept. of Environmental Quality	Remediation Sites
			Nonpoint Source Management (§319 Grant) Reports
			Subbasin Assessments, Total Maximum Daily Loads (TMDLs), and Implementation Plans
Oregon	Federal	Oregon BLM	Burns District Planning
			Vale District Planning
		USFS Northeast Oregon Forests RAC	Projects
		COE Portland District	Regulatory Program Permits
	State/County	Oregon Watershed Enhancement Board	OGMS
		Oregon Dept. of Fish & Wildlife	Natural Resources Information Management Program
			Fish Programs: Restoration and Enhancement
		Oregon Dept. of Environmental Quality	Environmental Cleanup Site Information
Washington	Federal	COE Seattle District	Regulatory Branch Actions
		WA Natural Resource Conservation Service (NRCS)	Washington Success Stories
		EPA Region 10	National Priorities List Sites in Washington
	NGO	WA Wildlife & Recreation Coalition	Washington Wildlife and Recreation Program
		Washington Water Trust	Projects

Area	Agency Type	Agency Name	Agency Website(s)
		Methow Salmon Recovery Foundation	Projects
		WA Council Trout Unlimited	Council and Chapter Projects
	State/County	Washington Dept. of Ecology	Water Quality Grants & Loans
			Water Quality Improvement Projects
			Cleanup Sites -- Information by County
		Office of the Interagency Committee	Washington Wildlife and Recreation Program
		Salmon Recovery Funding Board (SRFB)	SRF Board Projects
			PRISM - PRoject Information SysteM
		WA Dept. of Fish & Wildlife	Salmon Recovery
			State Environmental Policy Act
			Washington State Fish Screening
		Washington State Uniform Environmental Project Reporting System	Search Projects
Clearwater	Federal	USFS North Central Idaho Resource Advisory Committee	Projects
		Clearwater National Forest	Schedule of Proposed Actions
			Projects
		Nez Perce National Forest	Schedule of Proposed Actions
			Projects
		St. Joe National Forest	Schedule of Proposed Actions
			Projects
	NGO	Palouse-Clearwater Environmental Institute	Restoration Projects
	State/County	Nez Perce Soil & Water Conservation District	Projects
		Clearwater Resource Conservation & Development Assoc.	Projects
Grande Ronde & Imnaha	Federal	Umatilla National Forest	Schedule of Proposed Actions
			Projects
		Wallowa-Whitman National Forest	Schedule of Proposed Actions
			Projects
	IGO	Grande Ronde Model Watershed	Projects and Monitoring
	NGO	Wallowa Resources	Projects
John Day	Federal	Malheur National Forest	Schedule of Proposed Actions
			Projects
		Ochoco National Forest	Schedule of Proposed Actions
			Projects
		Umatilla National Forest	Schedule of Proposed Actions
			Projects
		Wallowa-Whitman National Forest	Schedule of Proposed Actions
			Projects
Salmon	Federal	Boise National Forest	Schedule of Proposed Actions
			Projects
		Nez Perce National Forest	Schedule of Proposed Actions
			Projects
		Payette National Forest	Schedule of Proposed Actions
			Projects
		Salmon-Challis National Forest	Schedule of Proposed Actions
			Projects
		Sawtooth National Forest	Schedule of Proposed Actions
			Projects
	NGO	Upper Salmon Basin Watershed Project	Projects
	State/County	West-Central Highlands Resource Conservation & Development Assoc.	Projects
		High Country Resource Conservation & Development Assoc.	Projects
		Southwest Idaho RAC	Home Page

Area	Agency Type	Agency Name	Agency Website(s)
WA Upper Columbia	Federal	Okanogan and Wenatchee National Forests	Respect The River - Forest Programs Methow Valley Habitat Restoration Schedule of Proposed Actions
		Okanogan National Forests	Projects
		Wenatchee National Forests	Projects
	NGO	Methow Conservancy	What We Do
		Upper Columbia Regional Fisheries Enhancement Group (RFEG)	Project News & Reports
		Pacific Biodiversity Institute	Arrowleaf Conservation Buyout
	State/County	Chelan County Conservation District	Home Page
		Chelan-Douglas Land Trust	Projects
		Chelan County Natural Resources	Home Page
BC Upper Columbia	Federal	Fisheries and Oceans Canada (DFO)	Habitat Restoration and Salmon Enhancement Program Stewardship and Community Involvement
	Provincial	Royal BC Museum	Living Landscapes
	IGO	Canadian Okanagan Basin Technical Working Group	Habitat
		Habitat Conservation Trust Fund	Projects
	NGO	British Columbia Conservation Foundation	Southern B.C. Region
		The Land Conservancy of British Columbia	Conservation & Agriculture
		Nature Trust of British Columbia	South Okanagan
		Pacific Salmon Foundation	Community Salmon Program

Table 2. Agency websites that contain long-term anadromous fish-related environmental and biological monitoring site information (URLs current as of 01/2007).

Area	Agency Type	Agency Name	Agency Website(s)
All	Federal	Bureau of Reclamation (USBR)	Hydromet
		Environmental Protection Agency (EPA)	STORET
		US Fish and Wildlife Service	National Wild Fish Health Survey Database
		US Forest Service	Aquatic & Riparian Effectiveness Monitoring Program (AREMP) [1]
		US Forest Service & BLM	PACFISH/INFISH Biological Opinion Effectiveness Monitoring Program (PIBO)
	IGO	NPPC	Subbasin Planning
		Pacific Northwest Water Quality Data Exchange	Data Access Application
		Pacific States Marine Fisheries Commission (PSMFC)	Pit Tag Information System (PTAGIS) Data
Idaho	Federal	US Geological Survey (USGS)	USGS Water-Data Site Information for Idaho
	State/County	Idaho Dept. of Environmental Quality	Beneficial Use Reconnaissance Program (BURP)
Oregon	Federal	US Geological Survey (USGS)	USGS Water-Data Site Information for Oregon
	State/County	Oregon Dept. of Fish & Wildlife	Natural Resources Information Management Program
			Aquatic Inventory Projects
		Oregon Dept. of Environmental Quality	Laboratory Analytical Storage and Retrieval (LASAR)
			Oregon DEQ macroinvertebrate database [5]
Washington	Federal	US Geological Survey (USGS)	USGS Water-Data Site Information for Washington
	State/County	Washington Dept. of Ecology	Ecology's Statewide Data Sets
Clearwater	State/County	Nez Perce Soil & Water Conservation District	Stream temperature data [6]
WA Upper Columbia	State/County	WA Dept. of Fish & Wildlife	Wild Salmon Population Monitoring
		WA Dept. of Ecology	River and Stream Water Quality Monitoring
			Flow Monitoring Network
			Intensively Monitored Watersheds [2]
	Tribal	Colville Tribes Fish & Wildlife Dept.	Okanogan Basin Monitoring and Evaluation Project [7]
BC Upper Columbia	Federal	Fisheries and Oceans Canada (DFO)	British Columbia and Yukon Environmental Monitoring Networks Station Information Centre [4]

[1] One AREMP site was not included in the monitoring datasets (Gold Creek – Methow River subbasin). No other sites inside the AOIs were mapped by the USFS.
[2] Program has not yet generated data and monitoring site locations are unclear.
[3] HGMPs contain location information for many hatchery facilities not documented elsewhere (e.g., adult traps).
[4] Station network current as of 2002. Newer information was not located.
[5] Not mapped for this project; sites in the McCoy Cr. watershed (NE Oregon) are the only long term sites in the AOIs.
[6] Some sites appear to be long-term but agency did not respond to emails requesting location information.
[7] OBMEP sites were not included in the GIS coverage due to time constraints. They are documented on the linked website.

Table 3. Ancillary datasets used to describe and map habitat projects and monitoring locations available on the internet (URLs current as of 01/2007).

Area	Agency Name	Dataset Name	Available From Website
All	Regional Ecosystem Office	OR & WA 6th Field HUCs	PNW Hydrography Framework Clearinghouse
	USGS and EPA	National Hydrography Dataset [1]	NHD Data
	StreamNet	Anadromous Fish Distribution [2]	STREAMNET GIS DATA
Idaho	BLM	Land Status for Idaho, GCDB-based [3]	Bureau of Land Management, Idaho office Geospatial Resources
	Idaho Dept. of Environmental Quality	Idaho Watersheds - 5th and 6th Field	Watersheds
		Idaho Dams	Dam Safety
Oregon	Oregon Dept. of Forestry	Public Ownership	Commonly Requested GIS Data Sets
	ODFW	Spring Chinook Salmon Distribution	Natural Resources Information Management Program
		Oregon Barriers (including dams and culverts)	Fish Barrier Data
		Spring Chinook Salmon Distribution	Fish Distribution Data
		Summer Steelhead Distribution	Fish Distribution Data
		Oregon Fish Hatcheries	Hatchery Data
	Oregon Geospatial Enterprise Office (GEO)	Dams	Oregon Geospatial Data Clearinghouse
Washington	Washington Dept. of Natural Resources (DNR)	Major Public Lands	Cadastre Jurisdiction Boundaries
	WA DOE	Dams in Washington State	Ecology's Statewide Data Sets
BC Upper Columbia	Ministry of Environment	BC WATERSHED ATLAS 50K	ILMB Discovery Service
		FADM - Provincial Forest	ILMB Discovery Service
	Natural Resources Canada	Canada Lands Administrative Boundary	ILMB Discovery Service

[1] Many Pacific NW hydrography coverages exist on the Internet and some are even being updated at regular intervals. After examining most of them, I found the NHD data to be most consistent between Pacific NW states and the high resolution files to be extremely accurate compared to the USGS 1:24000 scale topos. The Pacific NW Hydrography data is presumably the source for the NHD data in OR and WA, but lacks ID, MT, and NV streams. The PNW Reach Files are both outdated and much less accurate.

[2] I used the states' anadromous distribution coverages since these were outdated at the time I obtained coverages for the maps. I believe that the current versions on StreamNet reflect a similar distribution to that used for the maps.

[3] I used a land ownership coverage produced by the ID Dept. of Water Resources and one produced by the USFS (National Forests). These coverages have been pulled from the internet as far as I can determine and replaced by the BLM coverage, which does not include land status (i.e. no wilderness areas, Wild & Scenic River Corridors, etc.) and lumps some ownership (i.e. makes no distinction between Bureau of Indian Affairs Tribal Trust land and land owned by the Tribes).

Table 4. Habitat project type categories used in the habitat project spreadsheets. Specific indicators and examples of project impact types are from NOAA Fisheries; action types were developed subsequently. Note that a much more detailed habitat project data dictionary was also subsequently developed by NOAA Fisheries (available from S. Katz, NOAA Fisheries NFRC, Seattle WA).

Specific Indicators	Examples of Project Impact Types	Habitat Action Type
Diversion Screens	agricultural diversion fish exclusion screens	Diversion Screening
Barrier Removal	dam removal; natural barrier modification	Barrier Removal
	culvert repair / replacement	Fish Passage Improvement
Sediment Reduction	sediment control, erosion control	Reduce Sediment Input
	road closings / decommissioning	Road Obliteration
Water Quality Improvement	toxic clean up, water temperature controls	Improve Water Quality
Nutrient Enrichment	carcass addition, fertilization, bear placement, land use changes	Improve Water Quality
Restore Instream Flows	acquisition of water rights, water quantity	Restore Instream Flows
Restore Riparian Function	establishing riparian buffers	Restore Riparian Function
	riparian fencing / grazing controls	Riparian Fencing/Grazing Management
	riparian buffer rehabilitation	Riparian Revegetation
Restore Stream Complexity	active channel course modification	Channel Lengthening
	active channel course modification	Floodplain Creation / Reconnection
	large woody debris placement, bottom constituent alteration	Habitat Features
	active channel course modification	Increase Channel Complexity
	active channel course modification	Off-channel Habitat Creation / Reconnection
	bank stabilization and rehabilitation	Streambank Stabilization
None	acquisition of property, conservation easements	Land Acquisition

Table 5. Column descriptions for the basin habitat project spreadsheets. Note that some spreadsheets are missing a few of these columns.

Column	Variable Name	Description
A	Project ID	Unique identifier number for each project; prefixed by the abbreviation for each AOI. Actions within a project follow the period in the ID; no particular numbering convention was used here.
B	Project #	Project identifier assigned by the funding or sponsoring agency, if known. Numbers in the format YYYY-XXX-XX are BPA F&WP project numbers.
C	Agency	Project proponent agency or agencies
D	Project Title	Title given by the project proponent or sponsor, or assigned if unknown
E	Project Summary	Brief summary, if available
F	Subbasin	Arbitrary subbasin designation for sorting projects. Not present in the John Day spreadsheet.
G	Subbasin 2	Arbitrary subbasin designation for sorting projects. Not present in the John Day spreadsheet.
H	Model Action Type	Habitat action type (originally for our PIT tag survival models)
I	Fish Passage Improvement	A "Y" in these columns denotes that project actions fall into one or more of these broad habitat action type categories. In the NE Oregon Basins spreadsheet, the number of individual actions associated with a project was entered in these columns.
J	Habitat Features	
K	Improve Water Quality/ Quantity	
L	Restore Riparian Function	
M	Acquisition / Protection	
N	Year Start	Year that project implementation began
O	Year End	Year that project implementation ended
P	Location	Project location as given by the project proponent
Q	Location Type	Lists what type of location; stream reach, point, or watershed
R	Location Name	Lists the name of the location; almost always a stream name
S	7.5' Topo Map Name (downstream point)	Name of the USGS 7.5' Topographic Quad that the downstream or point location is found on
T	Downstream or Point PLS	Meridian, township, range, section, quarter section, and quarter-quarter section
U	Downstream or Point N degrees (tenths)	Latitude Degrees (tenths) of downstream or point location
V	Downstream or Point W degrees (tenths)	Longitude Degrees (tenths) of downstream or point location
W	Datum	Coordinate system for lat/lon; almost always North American Datum 1983 (mean for CONUS)
X	Upstream PLS	MTRS of upstream-most point
Y	Upstream N degrees (tenths)	Latitude Degrees (tenths) of upstream-most point
Z	Upstream W degrees (tenths)	Longitude Degrees (tenths) of upstream-most point
AA	Lower Bound LLID	LLID from PNW river reach file of stream nearest the lower bound or point location
AB	Lower Bound Trib Name	From PNW river reach file
AC	Lower Bound Mile	From PNW river reach file
AD	Upper Bound LLID	LLID from PNW river reach file of stream nearest the upper boundary
AE	Upper Bound Trib Name	
AF	Upper Bound Mile	
AG	Stream LLID	LLID of stream the project is on or effects
AH	Stream Name	From PNW river reach file
AI	Trib To LLID	Project stream is a tributary to this stream
AJ	Trib To Name	
AK	Trib Mile	Project stream joins the trib to stream at this mile
AL	Trib to 2	Trib to stream is a tributary to this stream
AM	Trib to Name 2	
AN	Stream HUC	6th field HUC number of the stream segment where the downstream-most point of the project is located

Column	Variable Name	Description
AO	Subbasin	4th field HUC name
AP	Watershed	5th field HUC name
AQ	Subwatershed	6th field HUC name

Table 6. Breakdown of habitat projects by AOI and habitat project type (columns I-M in Table 5). Note that totals are inflated since many projects included actions that fell under multiple project types.

Habitat Project Type	Area of Interest						
	BC	CLW	JDA	NE OR	SAL	UCR	Total
Fish Passage Improvement	23	200	389	301	598	175	1,686
Habitat Features	66	185	190	437	88	73	1,039
Improve Water Quality / Quantity	52	619	413	718	758	389	2,949
Restore Riparian Function	46	265	644	992	579	197	2,723
Land Acquisition / Protection	17	3	66	21	14	156	277
Total	204	1,272	1,702	2,469	2,037	990	8,674

Table 7. Breakdown of habitat projects by AOI, specific indicators (Table 4), and habitat action types (column "H" in Table 5). Note that totals are inflated since many projects included multiple action types.

Specific Indicator	Habitat Action Type	Area of Interest						
		BC	CLW	JDA	NE OR	SAL	UCR	Total
Diversion Screens	Diversion Screening	4	7	218	151	391	34	805
Barrier Removal	Barrier Removal	0	2	3	0	12	5	22
	Fish Passage Improvement	21	191	173	151	282	142	960
Sediment Reduction	Reduce Sediment Input	18	345	214	451	455	306	1,789
	Road Obliteration	0	260	1	94	71	85	511
Water Quality Improvement / Nutrient Enrichment	Improve Water Quality	1	138	43	25	91	23	321
Restore Instream Flows	Restore Instream Flows	2	1	126	64	86	48	327
Restore Riparian Function	Restore Riparian Function	3	84	77	274	154	55	647
	Riparian Fencing / Grazing Management	9	106	437	703	272	71	1,598
	Riparian Revegetation	33	105	233	391	62	87	911
Restore Stream Complexity	Channel Lengthening	3	3	4	13	3	5	31
	Floodplain Creation	0	4	14	12	14	5	49
	Habitat Features	61	106	133	367	69	60	796
	Increase Channel Complexity	14	6	37	33	15	7	112
	Off-channel Habitat	7	6	8	15	8	24	68
	Streambank Stabilization	30	94	261	170	165	23	743
None	Land Acquisition	17	3	63	21	14	159	277
	None	0	0	1	4	12	2	19
	Unknown	3	47	0	0	2	2	54
Total		226	1,508	2,046	2,939	2,178	1,143	10,040

Table 8. Breakdown of habitat projects by AOI and landowner. Area is the land area owned by each major landowner in the AOI (minor landowners are not shown). Therefore area does not reflect total land area in the AOI. Anadromous stream miles are the number of miles of anadromous fish-accessible streams (as defined by each state) including major migration corridors (i.e., the Columbia River) and lakes. Note that lakes default to private ownership.

Area of Interest	Landowner	No. of Projects	% of Projects	Area (Mi.²)	% of Area	Projects / 100 Mi.²	Anadromous Stream Mi.	% of Anadromous Mi.	Projects / Mi.
Clearwater	BLM	38	4.2%	55	0.8%	69	60	2.9%	0.6
	Private	260	28.7%	2,250	32.4%	12	533	26.0%	0.5
	State of Idaho	17	1.9%	205	3.0%	8	36	1.8%	0.5
	Tribal	40	4.4%	167	2.4%	24	37	1.8%	1.1
	USFS	550	60.8%	4,260	61.4%	13	1,382	67.5%	0.4
	Clearwater Total	905		6,937		13	2,048		0.4
John Day	BLM	37	3.0%	664	8.4%	6	223	7.6%	0.2
	Other Govt.	8	0.6%	49	0.6%	16	60	2.0%	0.1
	Private	807	64.8%	4,653	58.7%	17	1,583	53.8%	0.5
	State of Oregon	7	0.6%	67	0.8%	10	38	1.3%	0.2
	USFS	387	31.1%	2,499	31.5%	15	1,036	35.2%	0.4
	John Day Total	1,246		7,932		16	2,940		0.4
Salmon	BLM	137	9.1%	1,749	12.5%	8	159	4.9%	0.9
	Private	675	45.0%	1,191	8.5%	57	538	16.5%	1.3
	State of Idaho	13	0.9%	266	1.9%	5	21	0.6%	0.6
	USFS	676	45.0%	10,757	77.0%	6	2,537	77.9%	0.3
	Salmon Total	1,501		13,963		11	3,255		0.5
WA Upper Columbia	BLM	11	1.4%	210	2.5%	5	1	0.1%	17.7
	Other Govt.	4	0.5%	14	0.2%	28	483	57.5%	0.0
	Private	333	43.1%	3,680	44.7%	9	56	6.7%	5.9
	State of Washington	58	7.5%	254	3.1%	23	4	0.5%	14.5
	Tribal	30	3.9%	473	5.7%	6	266	31.6%	0.1
	USFS	337	43.6%	3,609	43.8%	9	31	3.7%	10.9
	WA Upper Columbia Total	773		8,240		9	841		0.9
BC Upper Columbia	BC Conservancy	3	2.3%	15	0.3%	20	1	1.2%	5.0
	Private	87	66.9%	1,053	17.6%	8	45	94.4%	1.9
	Province of BC	40	30.8%	4,932	82.2%	1	2	4.4%	19.0
	BC Upper Columbia Total	130		6,000		2	48		2.7
Northeast Oregon	BLM	19	14.6%	45	0.9%	42	28	1.4%	0.7
	Other Govt.	4	3.1%	12	0.2%	33	9	0.4%	0.4
	Private	804	618.5%	2,311	46.5%	35	1,040	51.7%	0.8
	State of Oregon	5	3.8%	28	0.6%	18	13	0.6%	0.4

Area of Interest	Landowner	No. of Projects	% of Projects	Area (Mi.²)	% of Area	Projects / 100 Mi.²	Anadromous Stream Mi.	% of Anadromous Mi.	Projects / Mi.
	State of Washington	8	6.2%	23	0.5%	35	16	0.8%	0.5
	USFS	606	466.2%	2,546	51.3%	24	905	45.0%	0.7
	Northeast Oregon Total	1,446		4,965		29	2,011		0.7
Grand Total		6,001		48,037		12	11,143		0.5

Table 9. Breakdown of habitat projects by AOI and subbasin (4th Field HUC). Area is the land area in each subbasin in the AOI. Anadromous stream miles are the number of miles of anadromous fish-accessible streams including major migration corridors and lakes.

Area of Interest	Subbasin	No. of Projects	% of Projects	Area (Mi.²)	% of Area	Projects / 100 Mi.²	Anadromous Stream Mi.	% of Anadromous Mi.	Projects / Mi.
Clearwater	Clearwater	349	38.6%	2,351	34%	15	587	29%	0.6
	Middle Fork Clearwater	27	3.0%	218	3%	12	80	4%	0.3
	South Fork Clearwater	410	45.3%	1,178	17%	35	434	21%	0.9
	Lochsa	97	10.7%	1,181	17%	8	373	18%	0.3
	Lower Selway	19	2.1%	1,026	15%	2	263	13%	0.1
	Upper Selway	3	0.3%	983	14%	0	312	15%	0.0
	Clearwater Total	905		6,937		13	2,049		0.4
John Day	Lower John Day	258	20.7%	3,155	40%	8	831	28%	0.3
	Upper John Day	470	37.8%	2,138	27%	22	801	27%	0.6
	North Fork John Day	329	26.4%	1,848	23%	18	928	32%	0.4
	Middle Fork John Day	188	15.1%	792	10%	24	381	13%	0.5
	John Day Total	1,245		7,933		16	2,941		0.4
Salmon	Lower Salmon	81	5.4%	1,180	8%	7	298	9%	0.3
	Little Salmon	81	5.4%	577	4%	14	79	2%	1.0
	South Fork Salmon	148	9.9%	1,310	9%	11	425	13%	0.3
	Middle Salmon - Chamberlain	73	4.9%	1,712	12%	4	466	14%	0.2
	Lower Middle Fork Salmon	18	1.2%	1,375	10%	1	377	12%	0.0
	Upper Middle Fork Salmon	49	3.3%	1,501	11%	3	570	18%	0.1
	Middle Salmon - Panther	225	15.0%	1,820	13%	12	323	10%	0.7
	Lemhi	313	20.9%	1,260	9%	25	111	3%	2.8
	Pahsimeroi	69	4.6%	830	6%	8	47	1%	1.5
	Upper Salmon	444	29.6%	2,423	17%	18	561	17%	0.8
	Salmon Total	1,501		13,988		11	3,257		0.5
WA Upper Columbia	Wenatchee	154	19.9%	1,328	16%	12	241	28.6%	0.6
	Upper Columbia - Entiat	148	19.1%	1,236	15%	12	176	20.9%	0.8
	Moses Coulee	2	0.3%	925	11%	0	1	0.1%	2.0
	Chief Joseph	19	2.5%	673	8%	3	43	5.1%	0.4
	Methow	355	45.9%	1,817	22%	20	237	28.1%	1.5
	Okanogan	82	10.6%	1,614	20%	5	140	16.6%	0.6
	Similkameen	13	1.7%	645	8%	2	4	0.5%	3.3
	WA Upper Columbia Total	773		8,238		9	842		0.9
BC Upper Columbia	Okanagan	106	81.5%	3,079	51%	3	48	100%	2.2
	Similkameen	24	18.5%	2,923	49%	1	0	0%	0.0

Area of Interest	Subbasin	No. of Projects	% of Projects	Area (Mi.²)	% of Area	Projects / 100 Mi.²	Anadromous Stream Mi.	% of Anadromous Mi.	Projects / Mi.
	BC Upper Columbia Total	130		6,002		2	48		2.7
Northeast Oregon	Lower Grande Ronde	281	19.4%	1,519	31%	18	596	30%	0.5
	Wallowa River	300	20.7%	954	19%	31	264	13%	1.1
	Upper Grande Ronde River	601	41.6%	1,636	33%	37	797	40%	0.8
	Imnaha River	264	18.3%	851	17%	31	354	18%	0.7
	Northeast Oregon Total	1,446		4,960		29	2,011		0.7
Grand Total		6,000		48,058		12	11,148		0.5

Table 10. Breakdown of habitat projects by AOI, subbasin, and proximity to anadromous fish-accessible streams including major migration corridors and lakes. Projects adjacent to streams are defined as those within 50 meters of the stream as mapped, which includes some projects mapped as location type "watershed" (column "Q" in Table 5) in an anadromous-accessible watershed but which may not actually be within 50 m of an anadromous stream.

Area of Interest	Subbasin	Projects Adjacent to Anadromous Streams	Projects Remote from Anadromous Streams	% Adjacent to Streams
Clearwater	Clearwater	122	227	35%
	Middle Fork Clearwater	6	21	22%
	South Fork Clearwater	127	283	31%
	Lochsa	49	48	51%
	Lower Selway	8	11	42%
	Upper Selway	3	0	100%
	Clearwater Total	315	590	35%
John Day	Lower John Day	119	139	46%
	Upper John Day	312	158	66%
	North Fork John Day	221	108	67%
	Middle Fork John Day	123	65	65%
	John Day Total	775	470	62%
Salmon	Lower Salmon	29	52	36%
	Little Salmon	35	46	43%
	South Fork Salmon	84	64	57%
	Middle Salmon - Chamberlain	19	54	26%
	Lower Middle Fork Salmon	10	8	56%
	Upper Middle Fork Salmon	36	13	73%
	Middle Salmon - Panther	122	103	54%
	Lemhi	193	120	62%
	Pahsimeroi	36	33	52%
	Upper Salmon	326	118	73%
	Salmon Total	890	611	59%
WA Upper Columbia	Wenatchee	77	77	50%
	Upper Columbia - Entiat	56	92	38%
	Moses Coulee	0	2	0%
	Chief Joseph	2	17	11%
	Methow	168	187	47%
	Okanogan	30	52	37%
	Similkameen	0	13	0%
	WA Upper Columbia Total	333	440	43%
BC Upper Columbia	Okanagan	5	101	5%
	Similkameen	0	24	0%
	BC Upper Columbia Total	5	125	4%
Northeast Oregon	Upper Grande Ronde River	389	212	65%
	Imnaha River	136	128	52%
	Wallowa River	180	120	60%
	Lower Grande Ronde	206	75	73%
	Northeast Oregon Total	911	535	63%
Grand Total		3,229	2,771	54%

Table 11. Breakdown of habitat projects by year first implemented and Habitat Project Type and Project Action Type from Tables 6 and 7. Note that if the year of implementation was unknown, it was assigned to the earliest year the project could have taken place, and that many projects in 2006 and all projects after 2006 are "planned".

Year	Habitat Project Types / Project Action Types																
	Diversion Screens	Barrier Removal		Sediment Reduction		Water Quality Improve. / Nutrient Enrich.	Restore Instream Flows	Restore Riparian Function			Restore Stream Complexity						None
	Diversion Screens	Barrier Remove	Fish Passage Improve	Red. Sed. Input	Road Oblits	Improve Water Quality	Restore Instream Flows	Restore Riparian Function	Riparian Fencing/ Grazing Manage.	Riparian Reveg.	Channel Lengthen	Floodplain Creation	Habitat Feature	Increase Channel Complex	Off-channel Habitat	Stream-bank Stabilize	Land Acquire
< 1975	11	0	4	1	0	0	0	1	4	1	0	1	1	1	0	1	1
1975	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	6
1977	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
1978	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	1
1979	0	0	0	5	0	3	0	5	2	4	0	3	6	5	3	6	0
1980	0	0	0	0	0	1	0	0	3	0	0	0	1	0	0	1	0
1981	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	2	0
1982	2	0	1	4	0	0	1	0	2	0	0	0	4	0	0	1	0
1983	1	0	0	0	0	0	0	0	2	2	0	0	9	0	0	5	1
1984	2	0	6	4	0	0	0	1	2	4	0	0	12	1	1	9	0
1985	3	2	2	4	0	0	0	0	13	15	0	2	20	1	6	14	0
1986	4	0	7	3	0	2	0	2	9	3	0	0	21	4	0	14	1
1987	1	3	7	5	0	0	1	1	23	6	0	0	25	0	3	15	0
1988	11	0	5	14	7	0	1	1	6	5	0	0	10	3	0	10	0
1989	3	1	3	8	30	2	0	1	11	4	0	0	14	2	0	14	1
1990	6	0	5	23	0	0	2	3	24	10	0	0	22	2	0	21	9
1991	3	1	14	48	6	2	1	9	33	10	3	0	31	2	1	20	7
1992	22	0	17	25	0	1	4	5	28	10	0	0	18	1	0	7	3
1993	32	0	10	62	4	7	1	9	58	14	0	2	10	2	1	14	4
1994	63	0	12	58	4	11	6	10	79	32	0	0	20	0	5	10	11
1995	81	1	30	76	23	26	16	27	112	40	0	10	34	2	7	34	0
1996	52	0	41	75	13	4	11	39	79	42	3	1	41	11	6	47	10
1997	75	0	44	75	24	7	25	42	99	47	3	3	52	17	7	76	1
1998	51	1	48	161	32	7	21	32	85	54	6	1	57	12	3	50	8
1999	44	2	30	92	24	19	19	31	100	54	2	5	65	4	1	34	13
2000	38	0	55	99	23	6	41	53	131	101	0	2	93	9	3	54	21
2001	28	0	86	148	25	40	32	80	180	123	2	3	74	5	2	57	34
2002	42	1	58	72	7	14	24	47	121	55	0	2	15	2	2	38	21
2003	31	3	94	167	3	21	32	51	106	75	0	2	16	6	1	48	23

Year	Habitat Project Types / Project Action Types																
	Diversion Screens	Barrier Removal		Sediment Reduction		Water Quality Improve. / Nutrient Enrich.	Restore Instream Flows	Restore Riparian Function			Restore Stream Complexity						None
	Diversion Screens	Barrier Remove	Fish Passage Improve	Red. Sed. Input	Road Oblits	Improve Water Quality	Restore Instream Flows	Restore Riparian Function	Riparian Fencing/ Grazing Manage.	Riparian Reveg.	Channel Lengthen	Floodplain Creation	Habitat Feature	Increase Channel Complex	Off-channel Habitat	Stream-bank Stabilize	Land Acquire
2004	35	0	110	84	2	34	33	50	110	64	4	3	31	7	1	56	20
2005	50	2	64	139	21	25	27	78	87	40	3	2	34	4	4	37	15
2006	21	1	110	97	77	45	19	28	41	27	3	3	16	5	4	21	56
2007	21	3	54	44	47	20	3	8	19	29	1	1	18	1	1	11	1
> 2007	3	1	30	58	5	8	6	17	2	23	1	2	10	3	3	5	7

Table 12. Long-term monitoring projects and datasets mapped by AOI. Note that not all AOIs have long-term sites for some statewide, and many regional and national datasets. Links to web sites containing most datasets can be found in Table 2.

Area	Agency Type	Agency Name	Dataset Name
Clearwater & Salmon	Federal	USBR	Hydromet Weather Stations
		USGS	Stream Gauging Stations
			Water Quality Monitoring Sites
		EPA	STORET Water Quality Sampling Sites
		USFWS	Wild Fish Health Monitoring Sites
		USFS & BLM	PIBO Monitoring Reaches
	IGO	PSMFC	PTAGIS PIT Tagging Sites
	State	IDEQ	BURP Macroinvertebrate Monitoring Sites
		IDFG	General Parr Monitoring Sites
		IDFG & Tribal Fisheries Depts.	Spring-Summer Chinook Redd Count Transects
			Summer Steelhead Redd Count Transects
	Various	IDFG, USFWS, Tribal Fisheries Depts., etc.	Anadromous Fish Monitoring Sites
			Anadromous Fish Hatchery Facilities
John Day	Federal	USBR	Hydromet Weather Stations
		USGS	Stream Gauging Stations
		EPA	STORET Water Quality Sampling Sites
		USFS & BLM	PIBO Monitoring Reaches
	IGO	PSMFC	PTAGIS PIT Tagging Sites
	State	ODEQ	Water Quality Monitoring Sites
		ODFW	Aquatic Inventory Habitat Monitoring Reaches
			Aquatic Inventory Fish Monitoring Sites
			Anadromous Fish Monitoring Sites
			Spring Chinook Redd Survey Reaches
	Various	ODFW, USFWS, Tribal Fisheries Depts., etc.	Anadromous Fish Monitoring Sites
Grande Ronde & Imnaha	Federal	USBR	Hydromet Weather Stations
		USGS	Stream Gauging Stations
		EPA	STORET Water Quality Sampling Sites
		USFS & BLM	PIBO Monitoring Reaches
	IGO	PSMFC	PTAGIS PIT Tagging Sites
	State	ODEQ	Water Quality Monitoring Sites
		ODFW	Aquatic Inventory Habitat Monitoring Reaches
			Aquatic Inventory Fish Monitoring Sites
			Anadromous Fish Monitoring Sites
			Spring Chinook Redd Survey Reaches
	Various	ODFW, USFWS, Tribal Fisheries Depts., etc.	Anadromous Fish Monitoring Sites
			Anadromous Fish Hatchery Facilities
WA Upper Columbia	Federal	USBR	Hydromet Weather Stations
		USGS	Stream Gauging Stations
			Water Quality Monitoring Sites
		USFWS	Wild Fish Health Monitoring Sites
		USFS & BLM	PIBO Monitoring Reaches
	IGO	PSMFC	PTAGIS PIT Tagging Sites
	State	WDOE	Ambient Water Quality Monitoring Sites
			Baseflow Monitoring Stations
			Stream Gauging Stations
		WDFW & Tribal Fisheries Depts.	Chinook Redd Survey Reaches
	Various	WDFW, USFWS, Tribal Fisheries Depts., etc.	Anadromous Fish Monitoring Sites
			Anadromous Fish Hatchery Facilities
BC Upper Columbia	Federal/Provincial	Various	Environmental Monitoring Locations
	Provincial	BC Fisheries	Sockeye Salmon Redd Survey Reaches

7 Figures

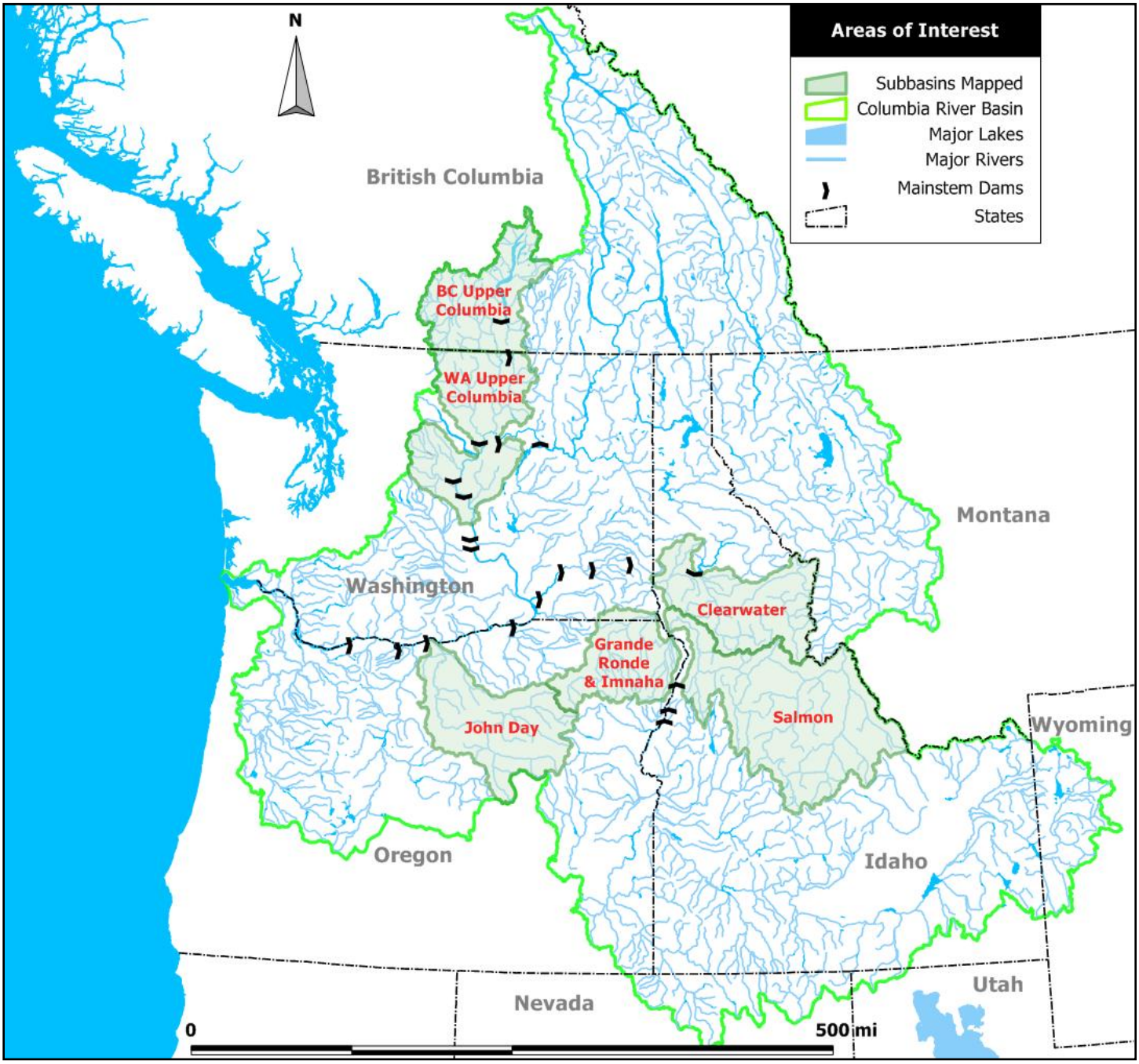

Figure 1. Map of the Columbia River Basin showing the areas of interest (i.e., geographic areas where habitat projects and monitoring locations were mapped).

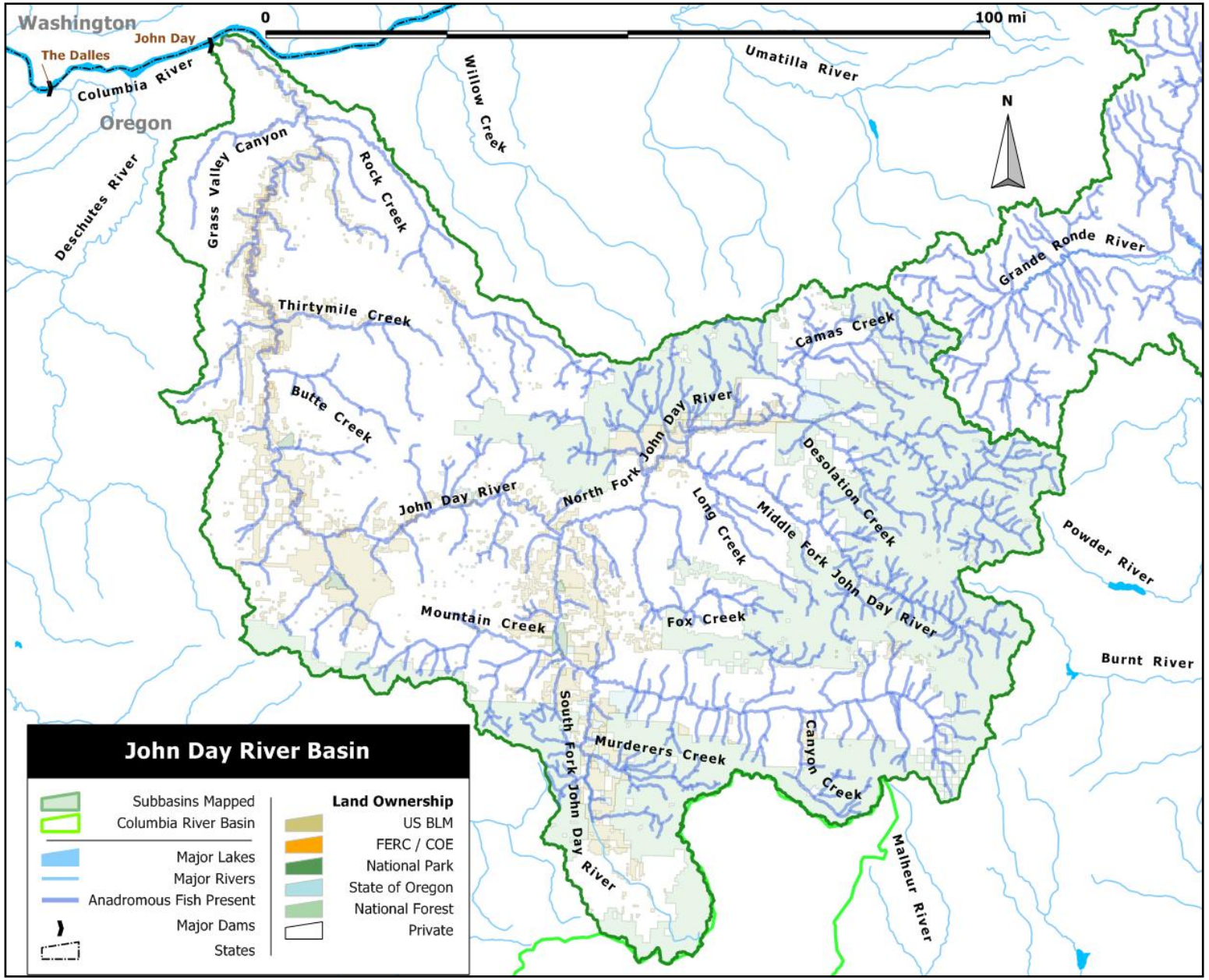

Figure 2. Overview map of the John Day River Basin area of interest.

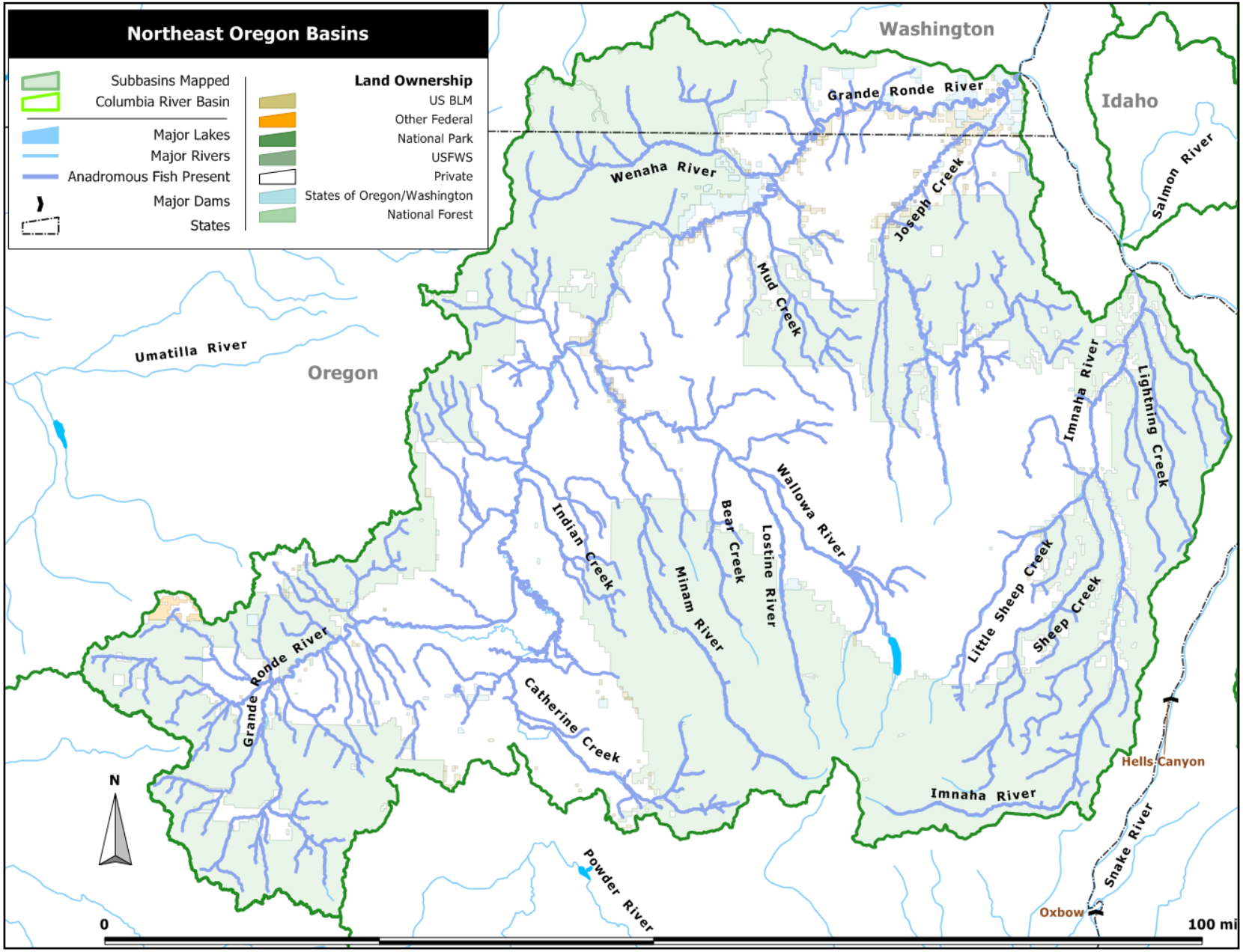

Figure 3. Overview map of the Grande Ronde & Imnaha River Basins (Northeast Oregon) area of interest.

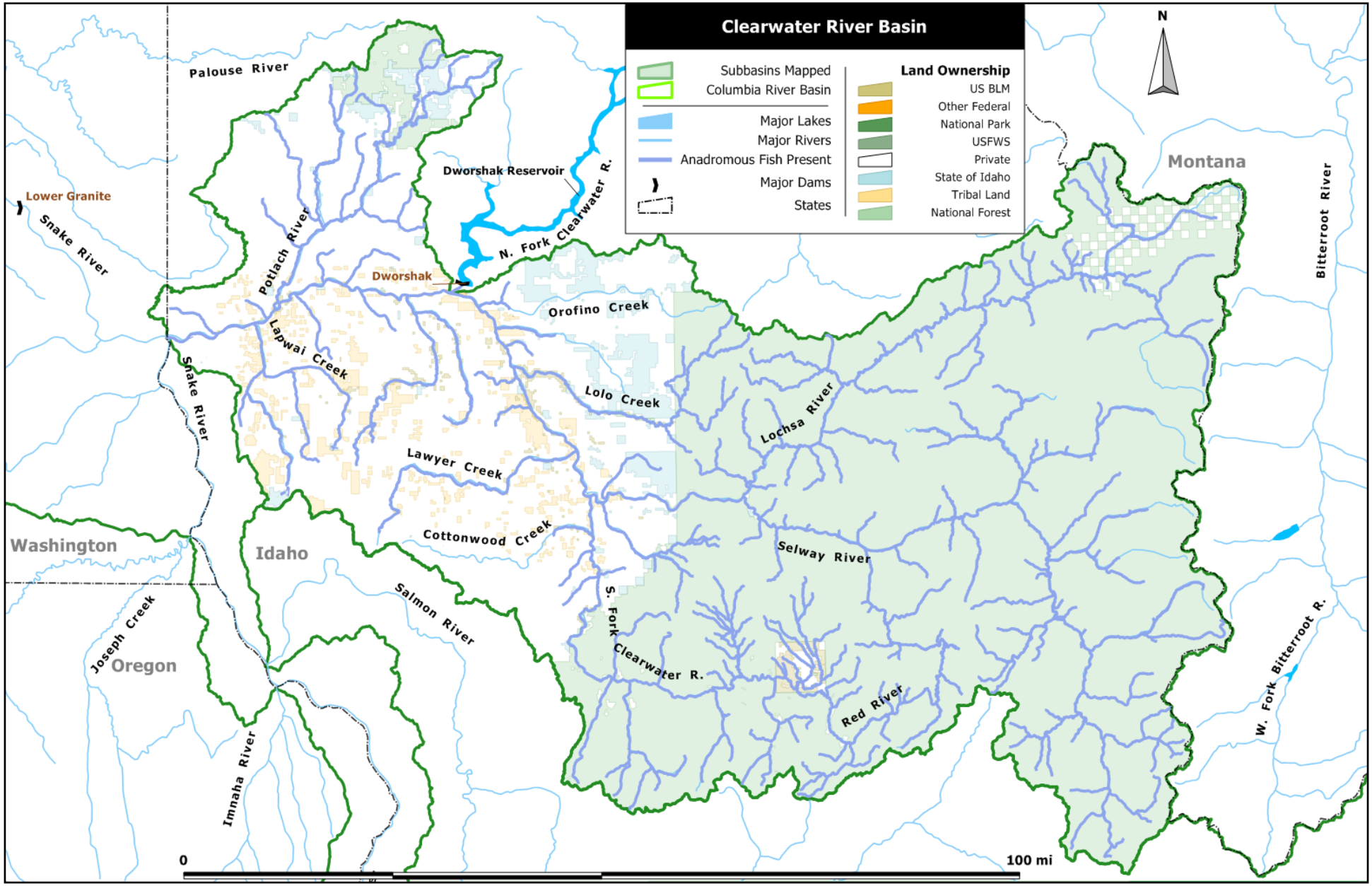

Figure 4. Overview map of the Clearwater River Basin area of interest.

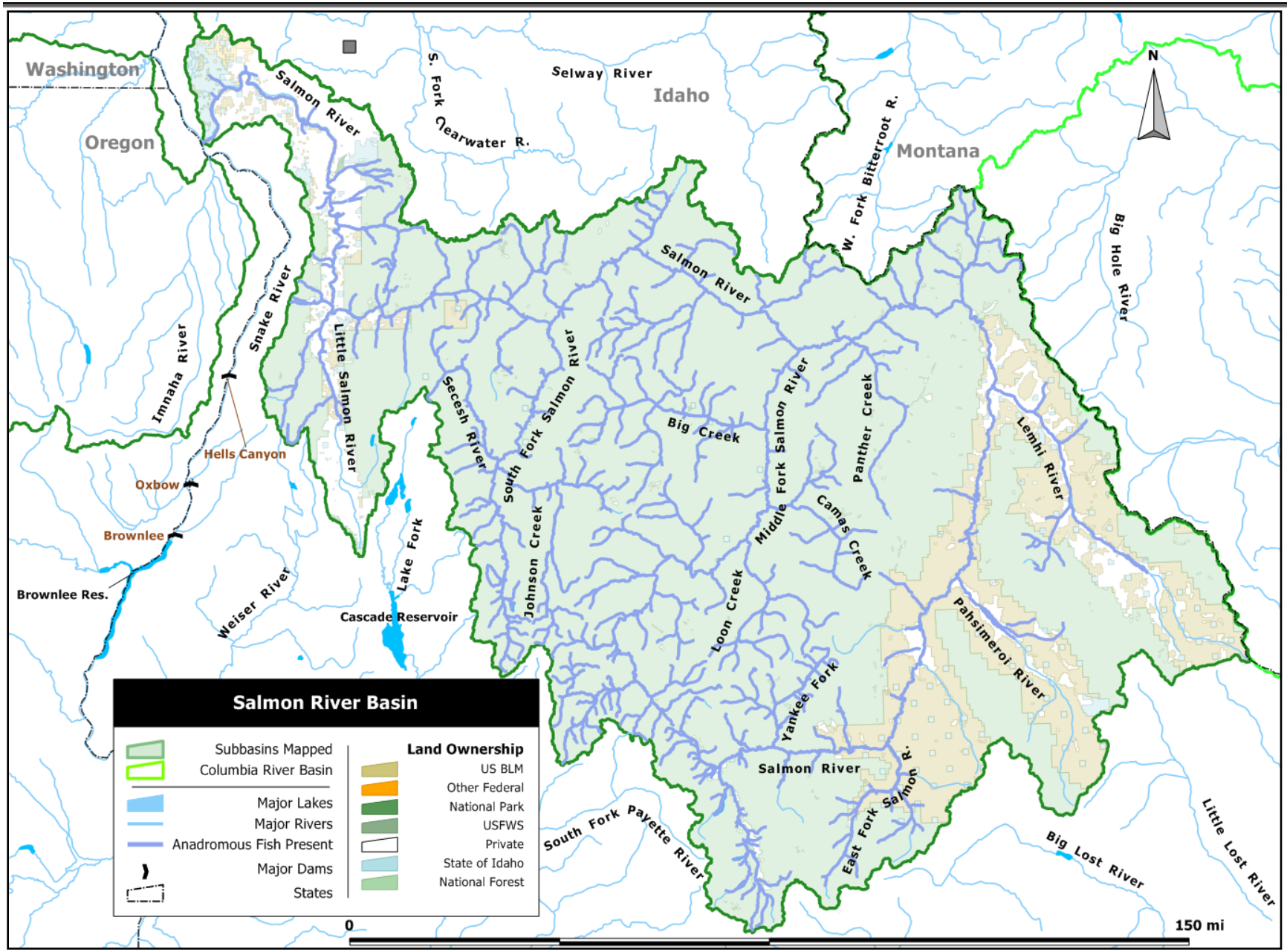

Figure 5. Overview map of the Salmon River Basin area of interest.

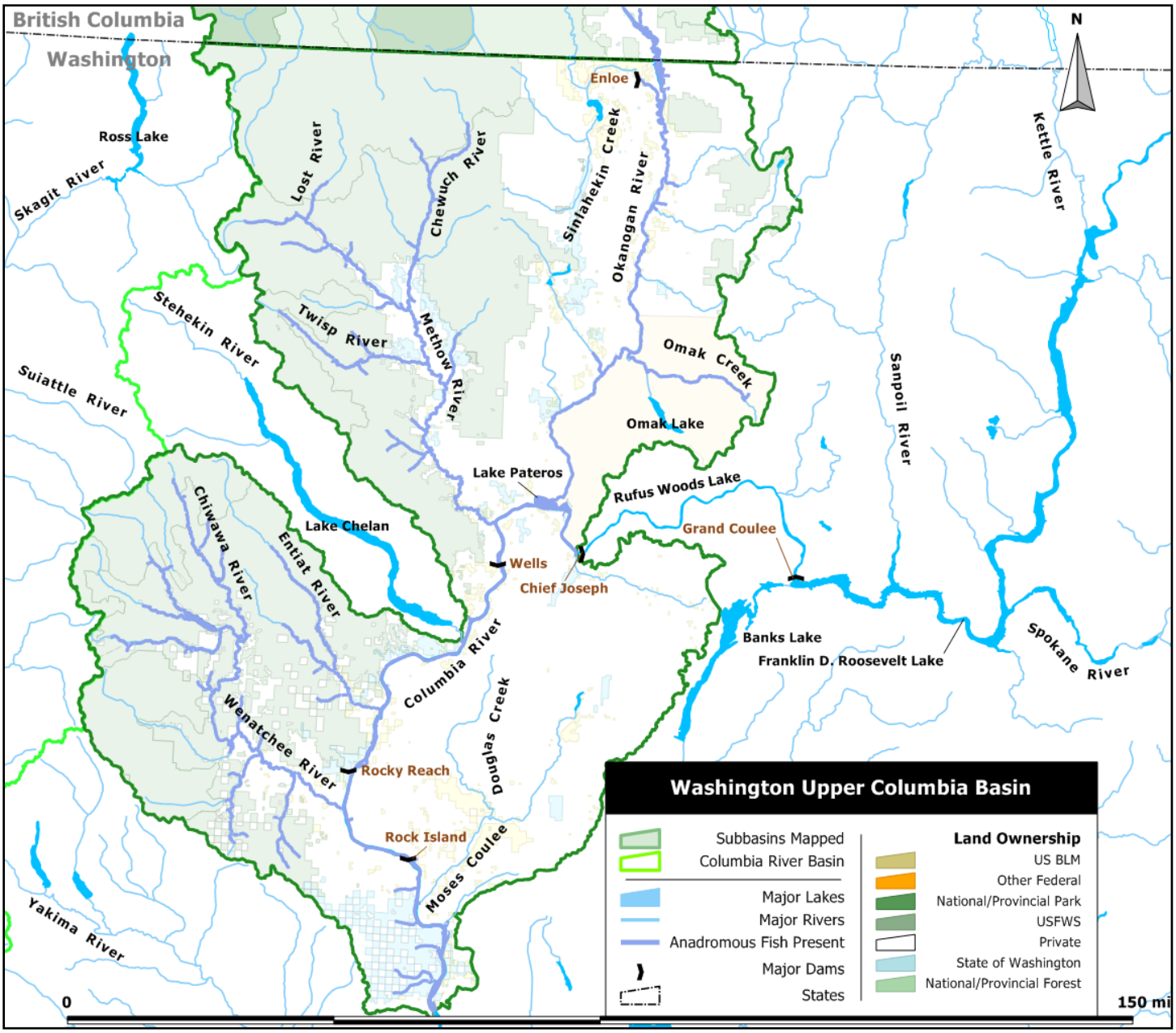

Figure 6. Overview map of the Washington portion of the Upper Columbia River Basin area of interest.

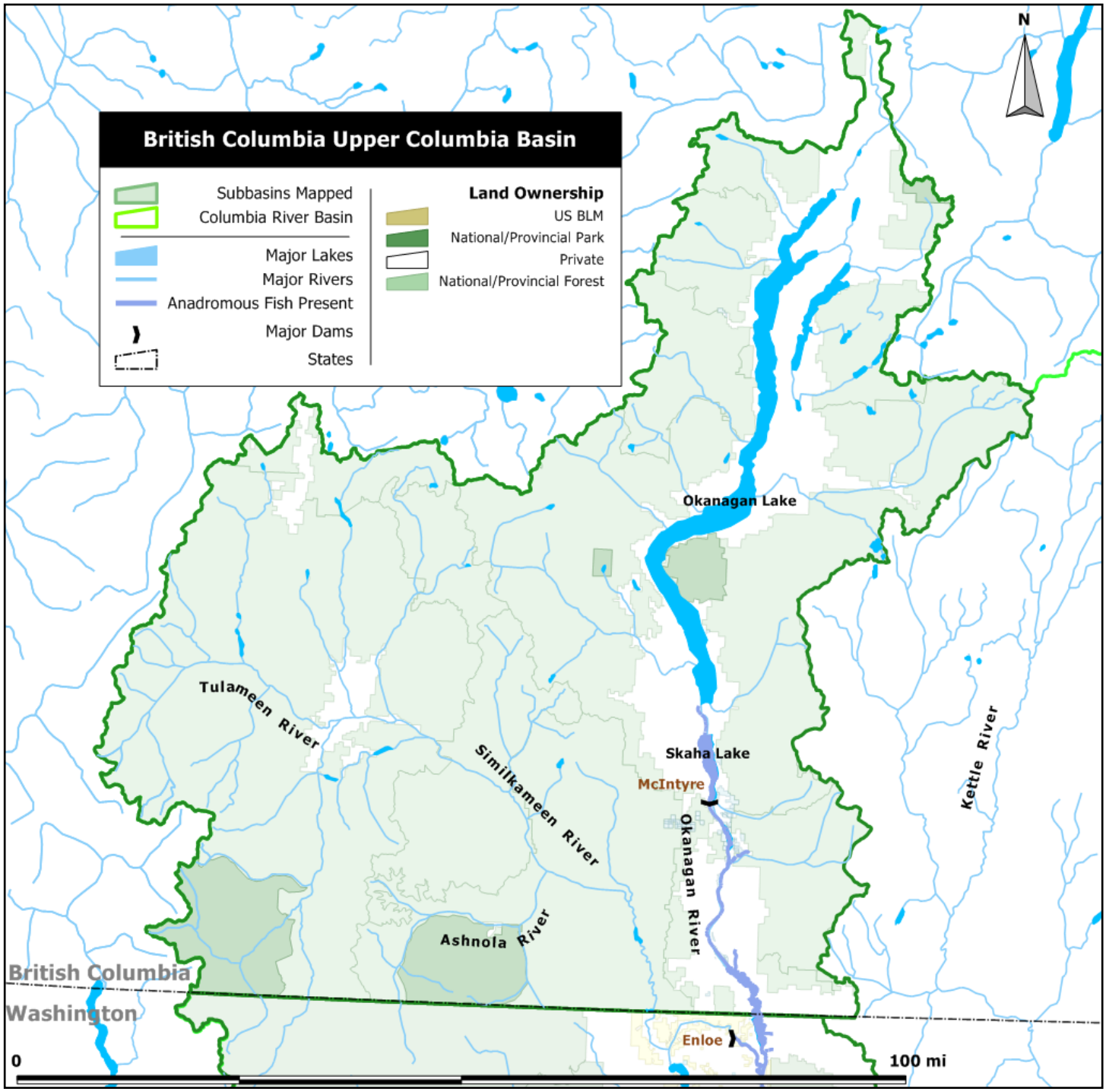

Figure 7. Overview map of the British Columbia portion of the Upper Columbia River Basin area of interest.

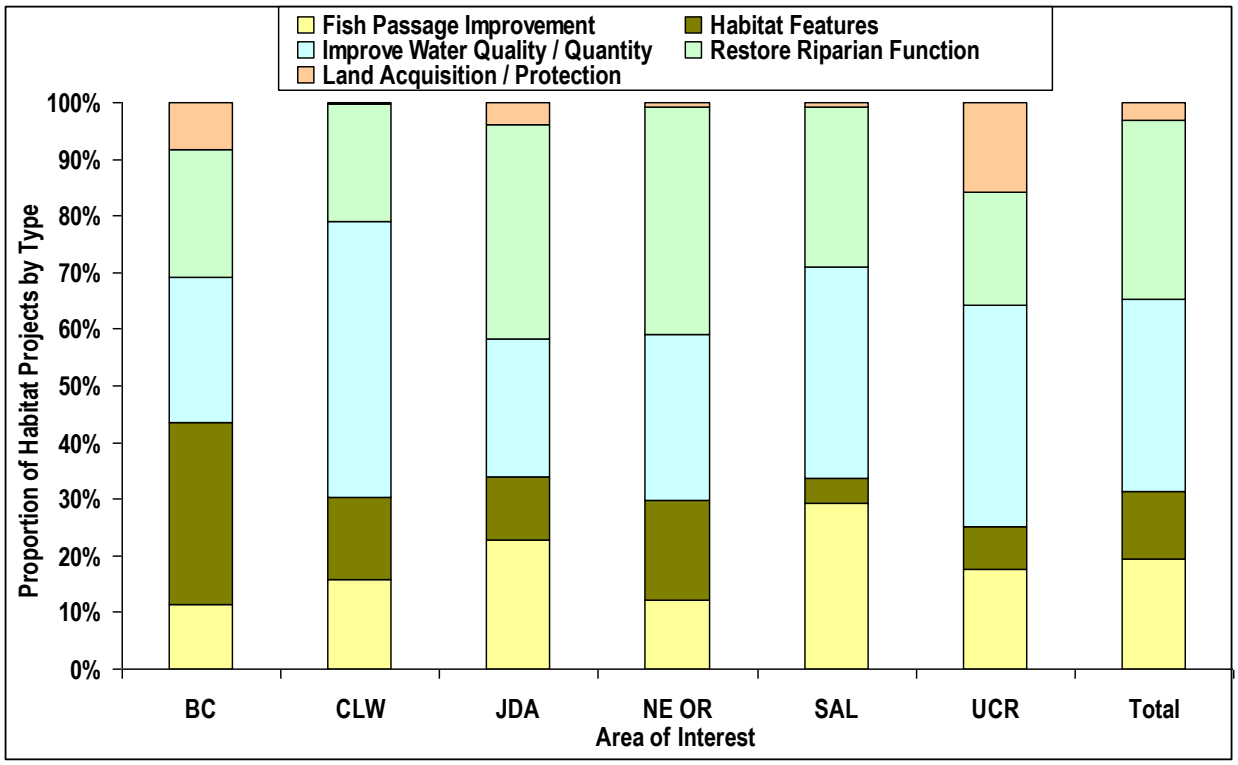

Figure 8. Proportion of habitat projects located by type for each of the areas of interest.

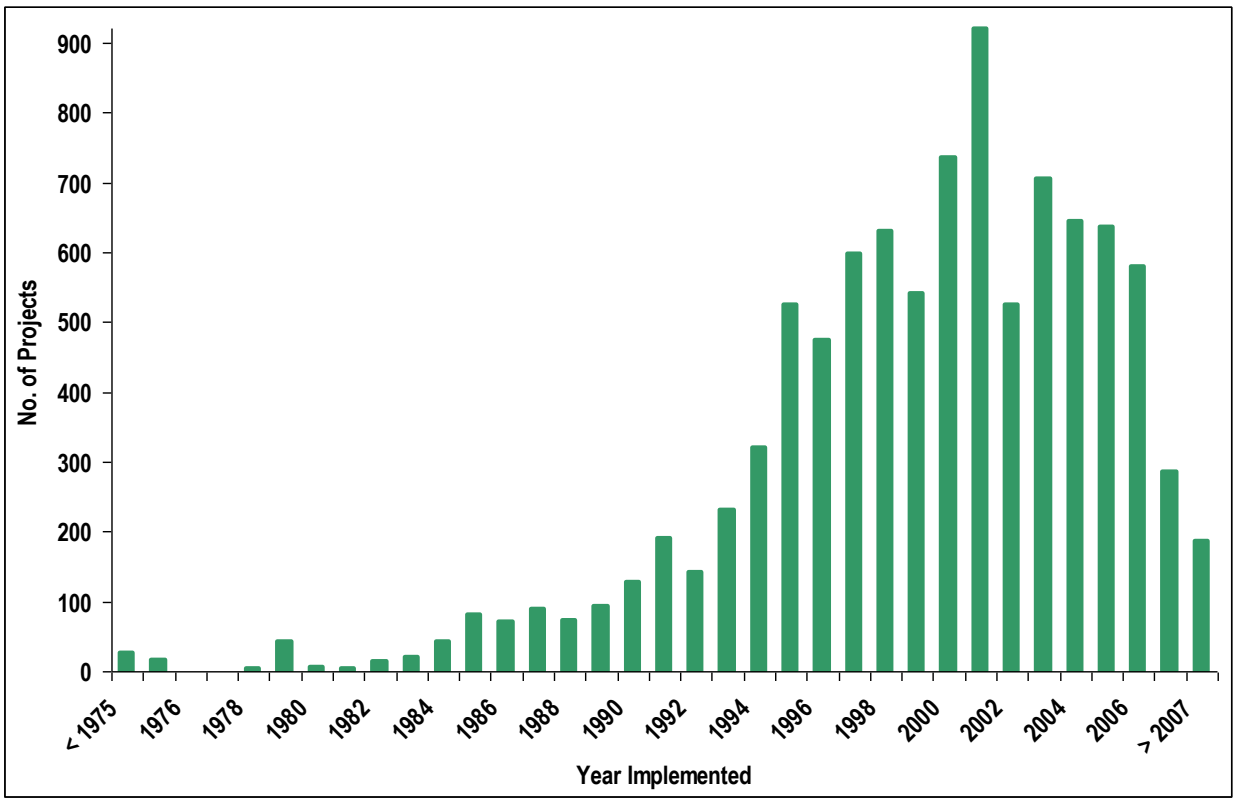

Figure 9. Number of habitat projects implemented by year of first activities. Note that the paucity of projects before about 1990/92 and after 2004/05 is a reflection of the lack of documentation of both early projects and planned or recently implemented projects as much as a true increase and subsequent decrease in the number of projects being implemented in the AOIs.

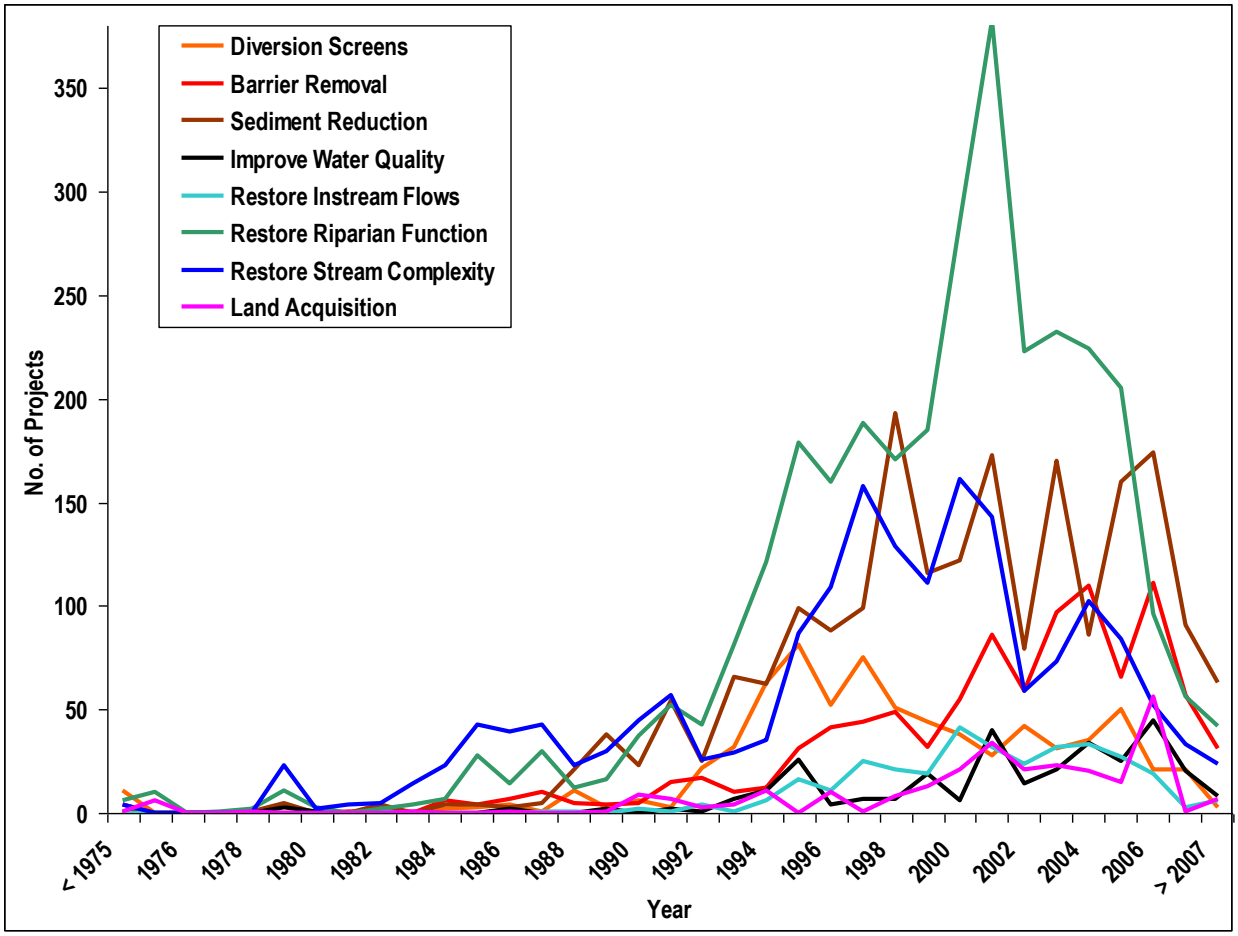

Figure 10. Number of habitat projects implemented by Habitat Project Type and year of first activities.

8 References

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