

California Fish Passage Assessment Database Project

METHODOLOGY AND DOCUMENTATION

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CONTACT

Anne Elston, Data Management Specialist for the PAD/PAD Administrator
Pacific States Marine Fisheries Commission (PSMFC)
830 S Street, Sacramento, CA 95814, Anne.Elston@wildlife.ca.gov, 916-327-3937

Introduction

The Passage Assessment Database (PAD) has been developed to provide a common framework for the collection, management and analysis of known and potential barriers to fish passage in California streams. It is intended to capture a set of basic information about each potential barrier to aid in inventorying and assessing fish passage issues on a statewide scale, and aid in restoration efforts. The set of data fields included in the PAD were chosen to meet the needs of [California Fish Passage Forum](#) (Forum), an association of public, private and government organizations, and its member organizations.

The PAD is an ongoing map-based inventory of known and potential barriers to anadromous fish in California. It compiles currently available fish passage information from more than two hundred data sources and references, and allows past and future barrier assessments to be standardized and stored in one place. The inventory is to be used to identify barriers suitable for removal or modification, to restore spawning and riparian habitat, and reduce stream fragmentation.

All original sources and references are indexed and archived. Most of the references were converted to an electronic format and provided to number of digital libraries including the [StreamNet library](#) and the University of California Berkeley Water Resources Center Archives. PAD references are also available for searching and downloading under the [CDFW document library](#).

The PAD is intended to be compatible with a variety of other data sources related to anadromous fish issues. All PAD records are saved with geographic location information (coordinates) with a small number of exceptions explained in the [Data Quality and Limitations](#) section of this document. Datasets with geographic locations are aligned to streams in which they are located on. Because each potential barrier is referenced to standardized hydrography, it is very easy to combine the PAD data with other fisheries data tied to the same hydrography. For a more detailed description of the digitizing process and the hydrography used, please refer to the [Passage Locations](#) section of this document.

The PAD database is available to the public via the CalFish website at www.calfish.org/pad/, where the data can be accessed in a map viewer, in a tabular query system or downloaded as a geospatial file compatible with GIS software or Google Earth via the “data access” tab. These applications are updated quarterly with new barrier entries and updates.

To address needs for custom-built reports and queries of the fish passage barrier data, the PAD was enabled on the CDFW [data portal](#), where users define search criteria, view tabular data summaries and reports, export tables, map individual PAD records in an online map viewer, as well as link to site photographs and source documentation (i.e., assessment reports) from the daily updated PAD database. Coordinates are also available for download. The PAD data portal is updated daily as new information is received.

A [PAD data review](#) and new barrier mapping application was developed by California Department of Fish and Wildlife (CDFW) and is available online on CalFish. The application allows users to review existing barrier records in a map-based interface, submit corrections, and add new barrier records. The PAD Administrator reviews submissions, and corrects and updates the PAD accordingly. This application contains tools for users to navigate the map interface, including zooming to specific coordinates, address, township and range, city, county or watershed, and utilize several base maps including imagery, road map, and topographic map. [Instructions](#) for using this tool are available on the PAD program page of CalFish.

The PAD still needs more information, including:

- natural limits to anadromy,
- barrier assessments,
- species and life stages blocked by the barrier, and
- barrier removal project data.

Database Structure

In an assessment of fish passage issues on a statewide basis, the most important data collected about barriers are those related to their status and type. The status of a structure or site refers to the degree to which it is impassable. The PAD has 14 categories of passage status:

- *Total*: A complete barrier to fish passage for all anadromous species at all life stages at all range of flows.
- *Partial*: Only a barrier to certain species or life stages.
- *Temporal*: Only a barrier at certain flows.
- *Temporal and partial*: Only a barrier to certain species or life stages and only at certain flows.
- *Temporal and total*: Total barrier only at certain flows.
- *Not a barrier*: Structure/site has been determined not to be a barrier to any species or life stages, and is passable at all range of flows.
- *Remediated, fish response unconfirmed*: The structure has been removed; however, there is no evidence of fish presence above the remediated site.
- *Structure may not still be in existence*: Data were obtained from an old dataset, and are likely to have been removed or washed away.
- *Unknown*: Structure/site has been visited or surveyed; however, dataset has no conclusive information about barrier status.
- *Unassessed*: The structure/site hasn't been visited and/or surveyed for fish passage.
- *Screened*: Fish screen is present on a water diversion and meets CDFW and/or National Oceanic and Atmospheric Administration's (NOAA) Fisheries screening criteria for salmon, steelhead or delta smelt.
- *Unscreened*: Water diversion without a fish screen.
- *Offstream/Unrated*: Water pond or a reservoir located off-stream.
- *Unknown/Diversion*: Water diversion with an unknown presence of a fish screen.

There are 14 types of structures or sites in the PAD:

- *Dam*: A barrier built across a stream or river to obstruct the flow of water. Includes debris, earth, rock, flashboard, drop structure, arch, weir, gravity, wing gabion, etc.
- *Road crossing*: A structure crossing a creek or stream that allows water underneath or over the road. Includes culvert, bridge, low-flow, etc.
- *Utility crossing*: Some type of utility line, water, gas, etc. that crosses a creek or stream and impedes passage of fish.
- *Diversion*: A place where the flow of water has been diverted from one course to another or directed in order to control the drainage from a section of ground. Includes screened and unscreened water diversions.
- *Flood control channel*: Any partially or completely excavated channel intended to convey above-normal discharges.
- *Grade control*: Stabilizing weirs constructed in the streambed to prevent lowering of the channel bottom. This includes man-installed bedrock chutes.

- *Flow measurement weir*: A notch or depression in a levee, dam, embankment or other barrier across or bordering a stream, through which the flow of water is measured or regulated.
- *Gravel/borrow pits*: Excavated area where materials have been removed for use as fill elsewhere.
- *Fish passage facility*: Provide fish passage past obstructions that would otherwise prevent or hinder their upstream progress. Fishways include Step-and-pool, Denil ladders, and Alaskan steep-pass types.
- *Non-structural*: Anything naturally occurring that restrains or obstructs passage. Includes waterfall, grade, temperature, subterranean flows, landslide, velocity, etc.
- *Tidegate*: A structure at a stream ocean mouth that limits the tidal flow within the estuary.
- *Fish trap*: A trap set up to catch fish usually for counting and monitoring purpose; should always be only a temporal barrier.
- *Other*: Any structure type not included in the above list (type is noted in the site/passage name or site comments/notes).
- *Unknown*: Dataset does not specify the structure/site type.

The PAD incorporates the barrier ranking criteria recommended in [Section IX](#) of the California Salmonid Stream Habitat Restoration Manual published by the Department of Fish and Game. Terminology used for the passage status is also consistent with Section IX (Table IX-1, page IX-1).

NHD Tracing Barrier Analysis:

To assist with coarse filtering of large number of barriers for restoration consideration and to enable the [optimization model](#) being developed by the Forum, additional fields were added into the PAD geospatial file. These fields were derived from tracing the high-resolution National Hydrography Dataset upstream and downstream from a barrier. These fields are periodically updated, with the most recent update on July 30, 2013. The fields include the number of downstream and upstream barriers, the order of the barrier on a stream network (“1” would be the most downstream barrier), and miles upstream and downstream to the next barrier or limit of anadromy, if applicable.

Only known barriers were used for the analysis; barriers with unknown passage status, unassessed structures, non-barriers, diversions and sites where remediation occurred but fish presence is unconfirmed were excluded from the analysis.

Barriers outside of the NOAA’s [Steelhead Distinct Population Segment boundary](#) as of January 2013, and those areas that were determined to be anthropogenically blocked by NOAA, were excluded from this analysis.

Passage Locations

All PAD records are stored with geographic location information with a small number of exceptions. Each barrier record is indexed to the High-resolution National Hydrography Dataset (NHD) developed by United States Geological Survey at a 1:24,000 or finer scale. The NHD was used to assign a stream address to a PAD record. Using the 'Locate feature along route' command (ArcGIS 9.3 and later), each barrier was assigned a position along the measured stream network by capturing the unique identifier for each line segment (ComID) and the measure (feet) along the segment that represents the barrier location.

For simplicity, all barriers were standardized as point features. Downstream ends of linear barriers such as flood control channels, gradients or low-flow sections were digitized as points, based on the assumption that the adult fish swimming upstream will have to deal with the downstream end of a barrier first. The length of the linear barriers can be found in the site comments/notes for each.

Since some of the fisheries related datasets in California are tied to the LLID-based routed hydrography of a 1:100,000 scale (rather than the NHD), the PAD is also available in a format compatible with the LLID hydrography.

All geographic data that are received for use in the PAD are saved in their original format as well as in their final standardized format. If there are any problems with the PAD data, it will always be possible to return to the original dataset for a solution.

Data Quality and Limitations

The PAD was compiled using information about fish passage from a large number of sources. These datasets were originally created for a number of different purposes, from general stream habitat surveys to rigorous assessments of fish passage barriers. As a result, the datasets vary widely in the type, amount, and quality of data they contain. Following are brief descriptions of the data quality issues and limitations of the data.

1. The data in the PAD are a reflection of the datasets that have been found to date by PAD staff, not the actual state of fish passage in streams. For example, the PAD includes very comprehensive data about passage barriers in some watersheds but not in others. This does not mean that there aren't many barriers in the other watersheds, but rather that the PAD does not yet include comprehensive barrier data for these watersheds.
2. The PAD Administrator strives to keep the data as current and updated as possible, however, there can be a lag between on the ground projects and when that information is entered into the PAD.
3. Many datasets have no assessment of whether the inventoried structures are barriers to fish passage and if and when they were surveyed, and if so, whether the structures are partial, temporal or total barriers. Non-surveyed structures are listed as "unassessed" and may need a formal assessment. Other structures were surveyed for fish passage, but passage status was indeterminate; therefore, many are listed as "unknown" passage status. [FishXing](#) can assist with a passage determination for those determined indeterminate at time of survey.
4. Many datasets are also missing other information that should be included in the database. For example, many datasets do not have species information indicating which species and life stage are blocked by the barrier and the level of blockage (i.e., temporal or total).
5. In some cases, the datasets do not have very precise location information. For example, some stream surveys only mention that there is a barrier or structure within a defined reach of stream, making it impossible to pinpoint the barrier location. Structures described in this way are maintained in the GIS as linear geospatial files. For the purposes of creating one point feature spatial file, all linear locations were converted to a single point at the beginning of the linear stream reach. Location inaccuracies have led to duplicative barrier records.
6. Structure locations are referenced to the hydrography. Some datasets describe locations using the distance of the structure from the stream mouth (i.e., river mile) – these were digitized using this measure on the hydrography. Since the 1: 24,000 hydrography may not follow the exact course of the stream and stream measures may not be precise, measured distances along a stream may not reflect reality. This has

caused location errors and led to duplicate barrier entries. Errors are minimized by referencing structures to other landmarks whenever possible.

7. Datasets with location information in latitude/longitude coordinates were snapped to the hydrography in order to standardize all location data in the PAD. This means that the points were shifted from the coordinates given in the original dataset, and the locations in PAD do not reflect the actual location of the point. Original coordinates are kept with the original data set. Additionally, some locations were snapped to the wrong stream and these were not diligently checked. These will need to be identified and corrected.
8. Because many datasets overlapped in their geographic range, information about the same potential barrier could sometimes be found in several different datasets. In most cases, the duplicates were identified during data entry or in subsequent data quality evaluation. However, the database may still contain a slight overestimate of the numbers of potential barriers.
9. There are some passage records in the database that do not have any spatial information associated with them. This is either due to nonsense locations in the original datasets or because the original dataset did not include any spatial information. There are slightly more passage records in the database than in the spatial files that are displayed on maps.

To remedy the issues identified in #1 through #4 above, outreach efforts are continually being conducted to gather updated and comprehensive data. In an effort to reduce the data quality issues described above in #5 through #8, new [PAD standards](#) were developed in 2013 in collaboration with the CDFW and PSMFC. These standards specify who barrier status is determined by and quality assurance and quality control procedures. The standards have been implemented for all new records, and will be implemented for all existing records as time permits.