

# California Fish Passage Assessment Database Project



## METHODOLOGY AND DOCUMENTATION

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### CONTACT

Martina Koller, Pacific States Marine Fisheries Commission  
830 S Street, Sacramento, CA 95814, [mkoller@dfg.ca.gov](mailto:mkoller@dfg.ca.gov), 916-327-3938

## **Introduction**

The Passage Assessment Database (PAD) was developed to provide a common framework for the collection, management and analysis of 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. The set of data fields included in the PAD were chosen to meet the needs of California Fish Passage Forum members.

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 one hundred data sources, 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.

The PAD is intended to be compatible with a variety of other data sources related to anadromous fish issues. All potential barriers are saved with geographic location information (GIS). With a small number of exceptions (see Data Quality and Limitations discussion below), all locations are stored in a shapefile. This file can be used to represent the potential barriers on maps or to provide latitude/longitude coordinates. The shapefile is created by digitizing the potential barriers along the streams in which they are located. 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, see Passage Locations (GIS) below.

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: <http://www.fishlib.org/> and the University of California Berkeley Water Resources Center Archives.

The PAD database is available to the public via the Calfish website: [www.calfish.org](http://www.calfish.org) where the data can be accessed in a map viewer ('Fish Maps'), in a tabular query system ('Fish Data') or downloaded to individual desktops ('Data Downloads') as a zipped file.

An online tool allows to review the PAD records in a map format and to send comments and edits back to PAD administrators. The PAD Online Review Tool is accessible under the Calfish website at: <http://eris.dfg.ca.gov/padreview>.

## **Database Structure**

In an assessment of fish passage issues on a statewide basis, some of the most important data collected about potential 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 eight categories of passage status:

- *Total*: A complete barrier to fish passage for all anadromous species at all life stages at all times of year.
- *Partial*: Only a barrier to certain species or life stages.
- *Temporal*: Only a barrier at certain times of year.
- *Temporal and partial*: Only a barrier to certain species or life stages and only at certain times of year.
- *Temporal and total*: Total barrier only at certain times of year.
- *Not a barrier*: Structure/site has been determined not to be a barrier to any species or life stages, and is passable year-round.
- *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*: Dataset had no information about barrier status.

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.
- *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 scouting 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 name or site comments).
- *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. The database also captures barrier prioritization results (e.g., very high, high, fair, medium, low, none) in the field '**Priority**' if that information was provided from the original source. This prioritization is however limited only to a single dataset, usually one structure owner (e.g., county-owned culverts, Caltrans road crossings) or a single spatial extent (e.g., one county or one watershed).

To fully utilize the potential of PAD, two data categories have been added to help guiding prioritization of barriers: the first most downstream man-made complete barrier is marked as a '**Keystone**' barrier. '**PADPriority**' field identifies additional barrier priorities not previously identified, based on review of all PAD records, across all structure and ownership types. Additional data categories helping to navigate among the records and to identify basic priorities are: Stream Miles to Next Barrier ('**MilesToBar**') and Stream Miles to Anadromy Limits ('**MilesUpstr**').

## **Supporting Data Modules**

The **Fish Species Module** was built into the PAD main form to track passage information specific to fish such as details about fish species, life stages and upstream downstream direction. This allows to record multiple fish specifications for a single PAD record (one-to-many relationship). This information is currently mostly based on modeling of stream flows and swimming and leaping characteristics of individual salmonid species and life stages.

In addition, the PAD also tracks details about fish observed in streams and reaches with passage sites. Two distribution datasets were used for an overlay of PAD records and coho and steelhead presence. The datasets are based on points of positive observations of the fish and were compiled from numerous sources. The observation-based distribution data show current distribution of the two fish species, they may underestimate the actual fish distribution. Two new data fields were added into the PAD to display results from the spatial overlay of the point PAD shapefile and linear coho distribution and steelhead distribution: **'Stream\_Coh'**, **'Stream\_SH'**.

There may be cases where there has not been observed coho fish in the reach however a record in the PAD is marked as being a barrier to coho, and visa versa. Culverts assessed with the FishXing software many times contain details whether they block coho and steelhead. These details are developed from hydraulic modeling and jumping capabilities of each species, and may not overlap with actual presence of the fish in the stream.

The **Water Diversion Module** contains data from two sources: field-based Fish Screen and Fish Passage Program run by the Department Fish and Game, and file-based Water Rights Information System (WRIMS) of the State Water Resource Control Board.

The **Fish Screen and Fish Passage Program** (FSFPP) conducts inventories of all screened and unscreened diversions and fish passage problems via site visits; it gathers information on the size and number of diversions at each site and presence of existing fish protective facilities. The FSFPP covers extensively the California Central Valley streams (Sacramento and San Joaquin Rivers systems) and only the big rivers in the coastal region.

The **State Water Resource Control Board** (SWRCB) maintains database of appropriate water rights applications and related permits and licences. Water rights represent legally permitted water diversions including locations of points of diversion, flow rates, water storage amounts and seasons of operation. Water rights data may not necessary match the actual amounts of diverted water at any given time. For more details about the water rights in California, visit the eWRIMS public url: <http://www.waterboards.ca.gov/ewrims/>.

### **Passage Locations (GIS)**

All PAD record are stored with geographic location information. Each barrier record is indexed to the High-resolution National Hydrography Dataset (NHD) developed by USGS at roughly 1:24,000 scale. The NHD was used to assign a stream address to a PAD record. Using the 'Locate feature along route' command (ArcGIS 9.2), each barrier was assigned a position along the measured stream network by capturing the unique identifier for each line segment and the measure 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.

Since some of the fisheries related datasets in California are tight with 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 encountered during data acquisition and entry into the PAD.

- 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 diversions in some coastal watersheds but not in others. This does not mean that there aren't many diversions in the other watersheds, but rather that the PAD does not yet include diversion data for these watersheds.
- Many datasets have no assessment of whether the inventoried structures are barriers to fish passage, and if so, whether the structures are partial, temporal or total barriers.
- Many datasets are also missing other information that should be included in the database. For example, many datasets do not have any structure or land ownership information.
- 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 shapefiles. 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.
- Structure locations are referenced to the hydrography. Some datasets describe locations using the distance of the structure from the stream mouth – these were digitized using this measure on the hydrography. However, because the 24,000 hydrography may not follow the exact course of the stream, measured distances along a stream do not reflect reality. Errors were minimized by referencing structures to other landmarks whenever possible.
- Datasets with location information in latitude/longitude coordinates were snapped to the hydrography in order to standardize all location data in the PAD. This necessarily means that the points are shifted from the coordinates given in the original dataset, and the standardized locations do not reflect the actual map location of the point. Original coordinates are kept with the original data set.
- 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 surveyed.

- There are some passage records in the database that do not have any spatial information associated. 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.
- In cases where multiple water rights share the same location, only one PAD record has been created. The maximum direct diversion rates were converted to a single unit (cfs) and added together within a single PAD record. Similarly, maximum storage rates were added together if multiple water rights are located at a single location. Only the first issued water rights application number is listed in the attribute table of the PAD spatial file. For seasons of operation, the first start date and latest ending date is provided in the GIS attribute table.
- Maximum direct diversion rates and storage rates recorded at the SWRCD may not represent the actual amounts of diverted water in any given day or a season.
- For corrections, edits and comments, please use the Online PAD Review Tool: <http://eris.dfg.ca.gov/padreview>. Individual PAD records can be selected in a map format of the Review Tool and after reviewing the barrier attribute information, a feedback form can be filled out and sent to PAD administrators who will correct and update the PAD accordingly. The online review tool also also to digitize new barriers not yet in the PAD and to georeference them on a map.