

# Fishing Activity Analysis in the Sacramento/San Joaquin Rivers Delta Region

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for

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**To add/change:** Figure 3 – separate out shore and boat creel survey maps; other figures, possibly change line thickness or separate components

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## *Summary*

Understanding fishing activity is a critical component to establishing a fish consumption surveying program, an education and outreach program for fish consuming families, and to guide future fish tissue monitoring programs. In this case, fishing activity includes where angling occurs, what species are targeted, how many people are fishing, and when they are fishing. This report describes the state of knowledge for fishing activity in the Sacramento and San Joaquin Rivers Delta, based on creel survey information and expert knowledge from California Department of Fish and Game staff.

## *Approach Taken*

### Study Area

For this project, the San Francisco Bay-Delta is defined as the area south of Highway 80, west of Highway 99, north of Highways 580, 205, and 120, and east of Highway 680. Certain data occur outside this area and are shown incidentally.

### Data and Analysis Methods

All fishing activity data were from the California Department of Fish and Game (DFG) creel surveys (Department of Fish and Game, 1999 & 2000), as well as anecdotal information on fishing activities obtained through interviews by the California Department of Health Services – Environmental Health Investigations Branch. DFG staff Tom Schroyer, Laurie Knowles, and Dennis DeAnda were asked to identify areas, fishing populations and activities on a map of the Bay-Delta in 2003 and 2004. Fishing license data were obtained from the Department of Fish and Game License Division.

The following data analysis was conducted:

- Fishing intensity was described (number of anglers present and number of fish kept) by river mile and/or river sections, using a combination of anecdotal and creel survey data.
- Fish species caught and targeted along river reaches were mapped.
- Seasonal variation in fishing intensity and species targeted was described.
- Data gaps were identified where no fishing activity data are available, fishing activity is believed to be moderate to high, and mercury concentrations in fish tissue are known to be high.

### Spatial Data Creation, Analysis, and Presentation

All mapping was done using the geographic information system (GIS) ArcView 3.2 because this software is commonly available and easy to use. Original spatial data came from a variety of sources, indicated in the “Metadata” section (Appendix). Hydrology was mapped using the “River Reach File” from the Environmental Protection Agency. Anecdotal data for fishing activity were attributed to waterways in this map. Sites where fish tissue Hg had been previously measured were mapped by the Central Valley Regional Water Quality Control Board. Roads,

county boundaries and other features are described in the Metadata. Creel survey data (e.g., angling effort and fish kept) were attributed to a coverage of the major rivers in California, which was amended to include the Sacramento River downstream of its confluence with the San Joaquin River to the Carquinez Straits.

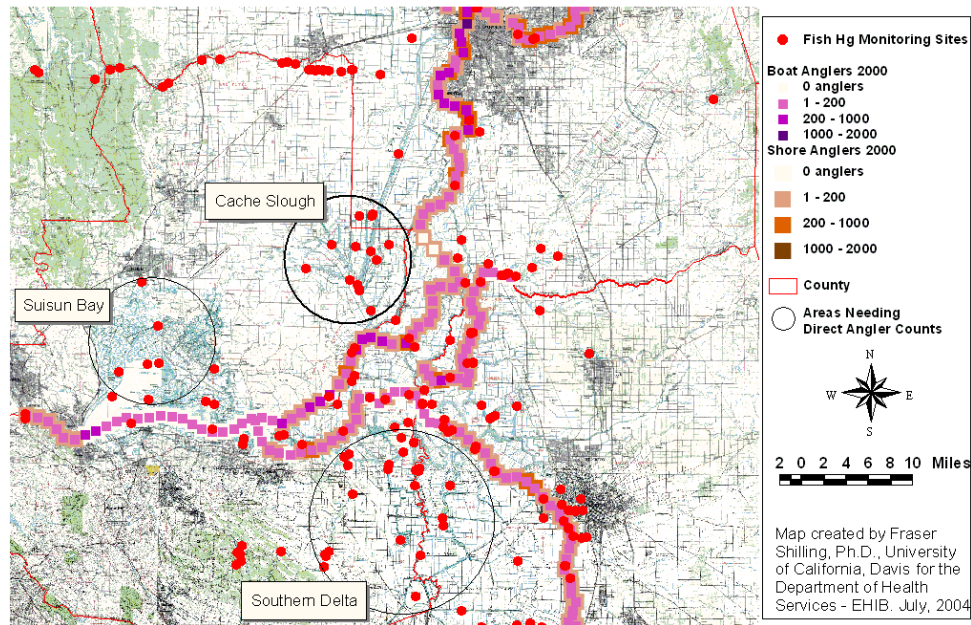
## Findings

### 1. Licensed anglers constitute 1 in 17 adults in the Delta counties.

County fishing license sales (all license types) for the counties bordering the Delta, Sacramento (79,634), San Joaquin (41,875), Contra Costa (37,656), Solano (22,531), and Yolo (9,498) totaled 191,194 for 2001. This represents 5.8% of the 3.31 million adults living in these counties (US Census Bureau, Census2000). According to all DFG accounts, there are also significant numbers of unlicensed anglers who may fish in out-of-the-way backwaters and at night.

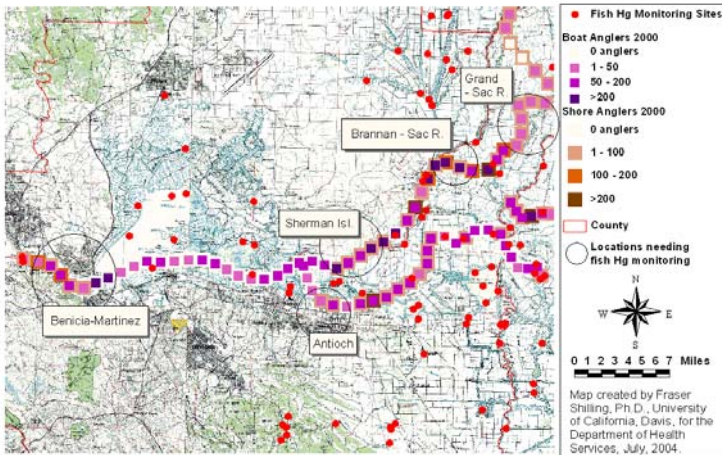
### 2. There are large areas where fish tissue concentrations of mercury have been measured and formal creel surveying has not been carried out.

## Delta Region Angling and Fish Hg Monitoring



These data show that formal creel surveying should be expanded into areas where mercury monitoring can show us whether detailed fishing advice should be given to anglers and whether areas can be described as having low mercury concentrations in fish.

### West Delta Anglers and Fish Hg Monitoring Sites

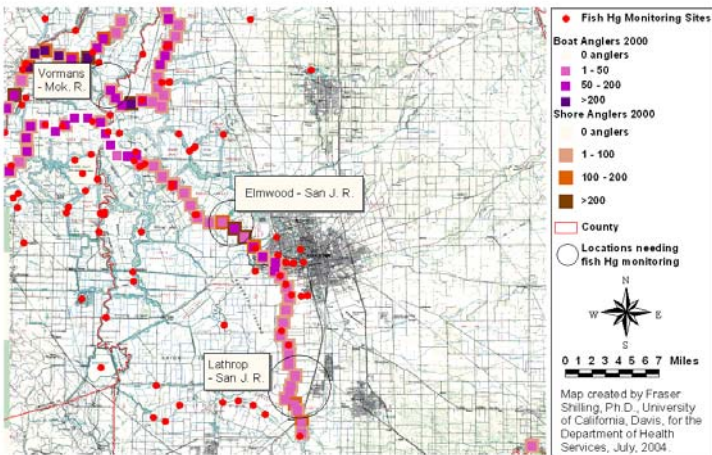


3. There are areas where fishing activity has been measured to be high (DFG Creel Survey data), but no measurements have been conducted of mercury concentrations in fish tissue.

#### West Delta

- Benicia-Martinez
- Sherman Island
- Antioch
- Brannan Island (Sacramento R)
- Grand Island (Sacramento R)

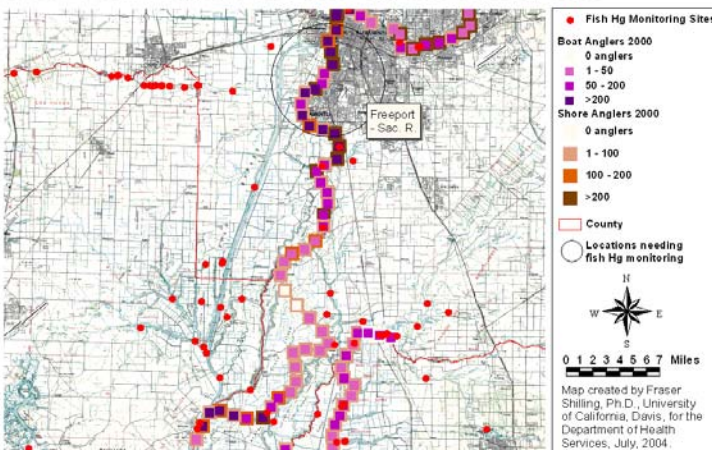
### South-East Delta Anglers and Fish Hg Monitoring Sites



#### South-East Delta

- Vormans (Mokelumne R)
- Elmwood (San Joaquin R)
- Lathrop (San Joaquin R)

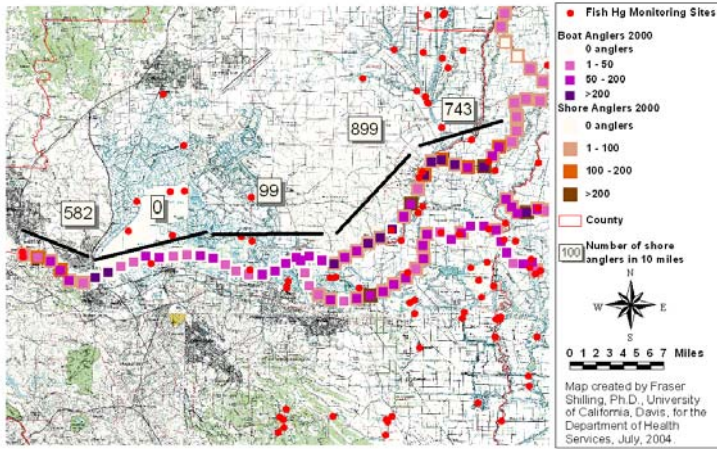
### North Delta Anglers and Fish Hg Monitoring Sites



#### North Delta

- Freeport (Sacramento R)

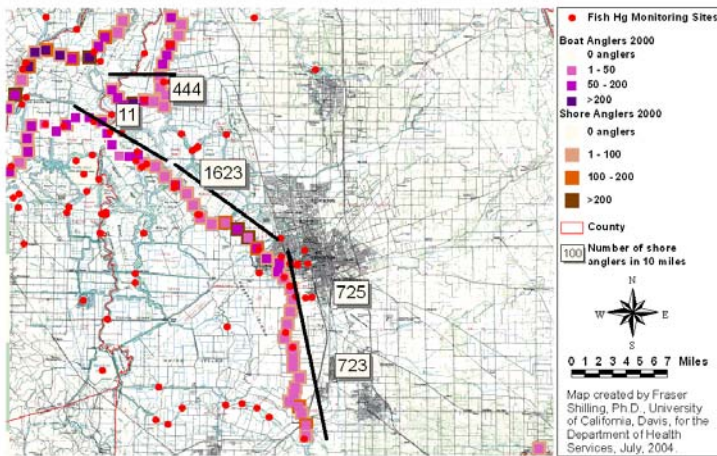
**West Delta Number of Anglers and Fish Hg Monitoring**



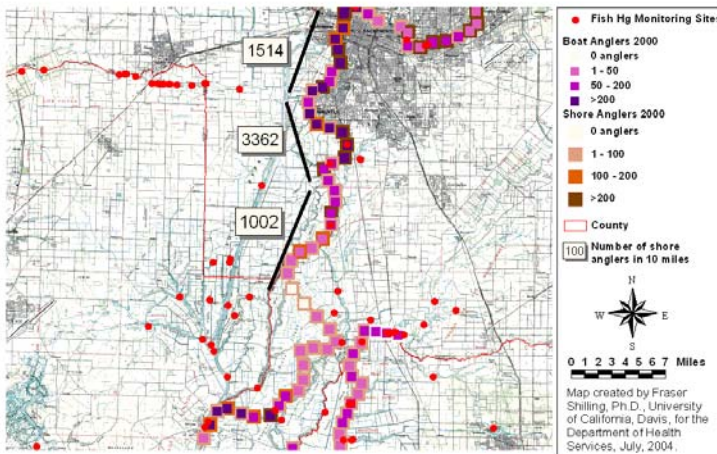
**4. There are certain reaches of the rivers where shore angling is more concentrated.**

Data from DFG creel survey, number of anglers summed for year by section.

**South-East Delta Number of Anglers and Fish Hg Monitoring**

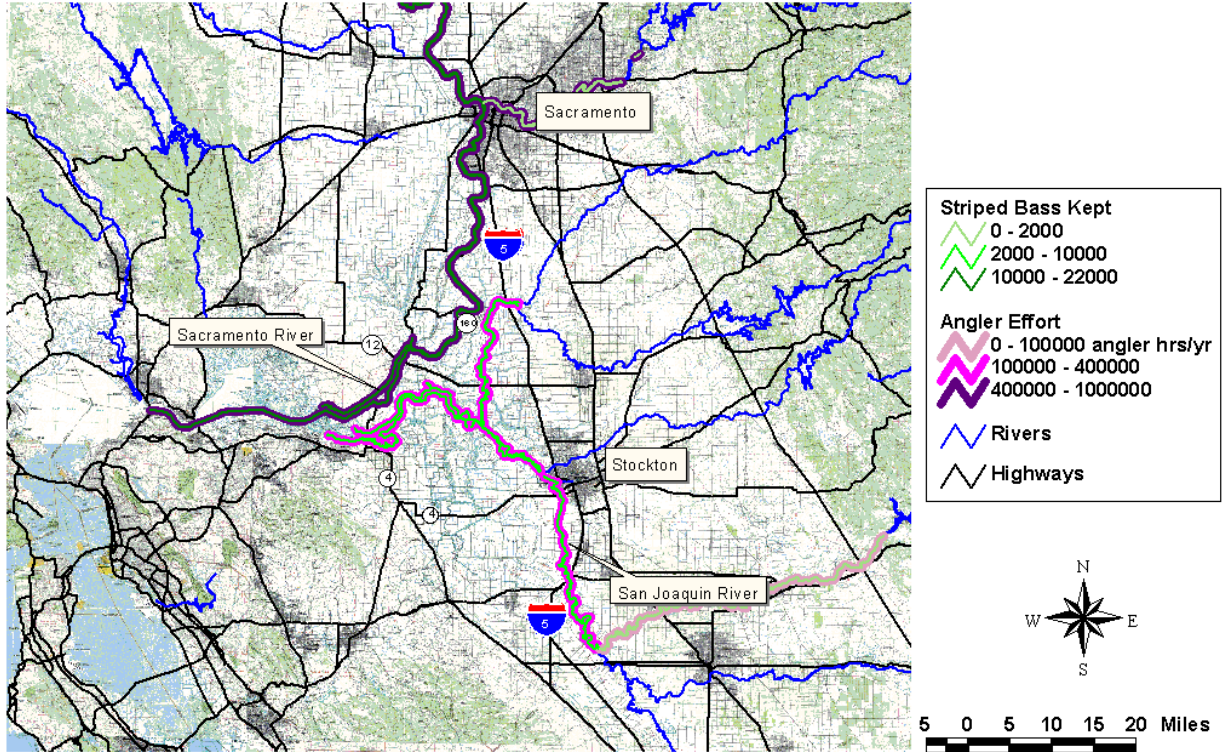


**North Delta Number of Anglers and Fish Hg Monitoring**



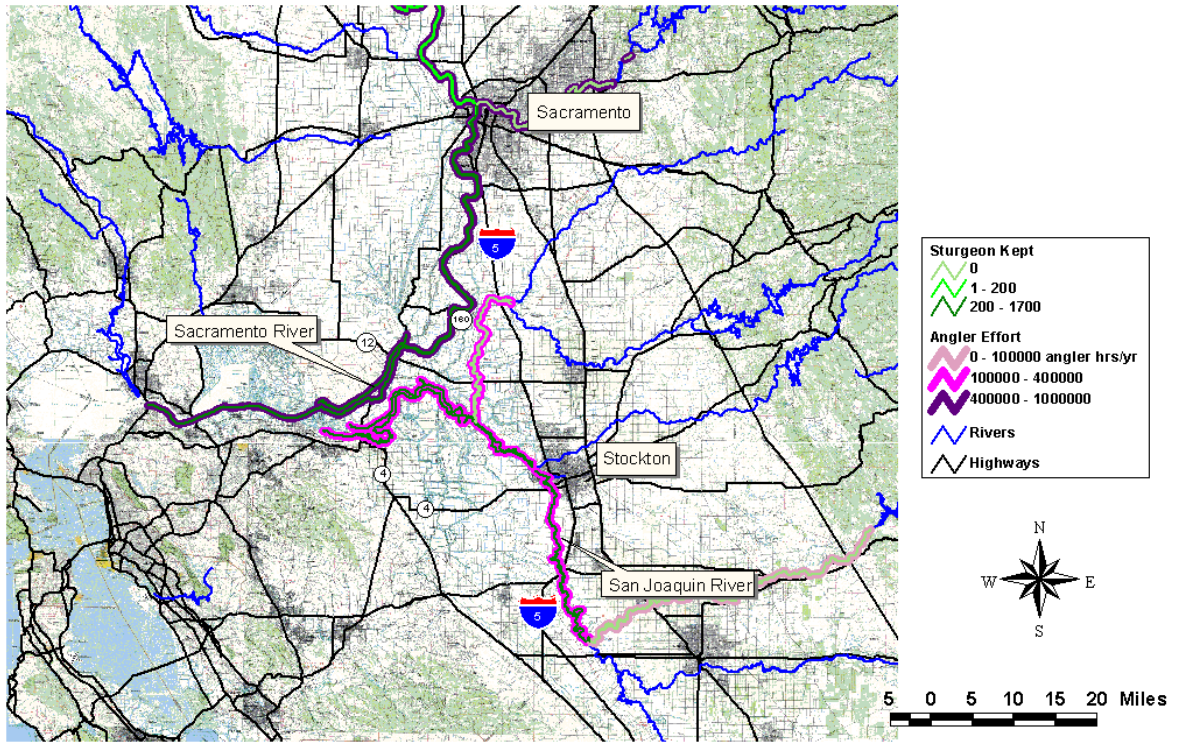
5a. Because many anglers are targeting striped bass, there is spatial correlation between the angling effort (angler hours/year) and the number of striped bass caught and kept. The mainstem of the Sacramento River between Carquinez and Sacramento is the primary striped bass angling location.

### Angling Effort and Striped Bass Kept in Delta



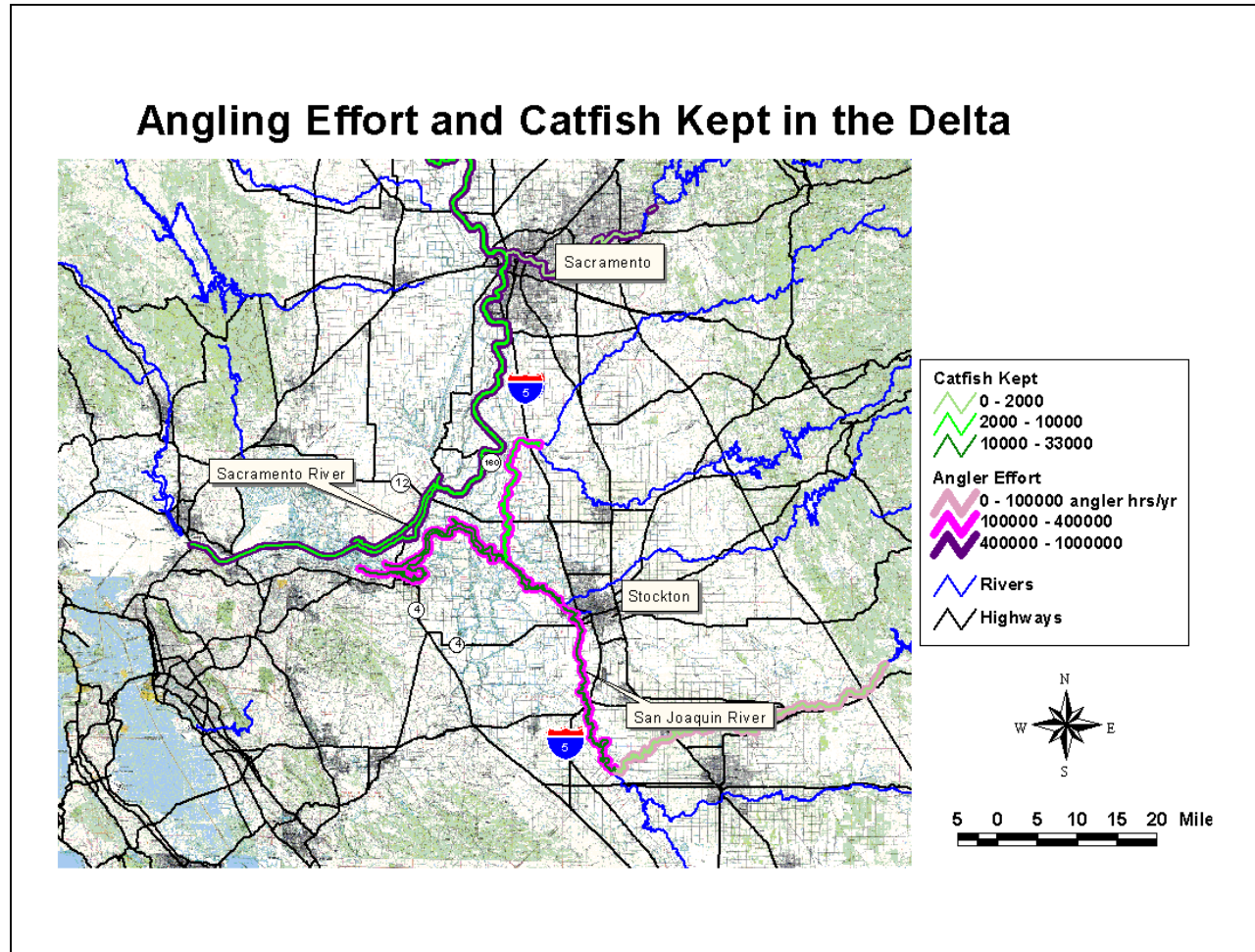
5b. Because many anglers are targeting striped bass and salmon, there is low spatial correlation between the angling effort (angler hours/year) and the number of sturgeon caught and kept. The mainstem of the Sacramento River between Carquinez and Sacramento and the mainstem of the San Joaquin River are the primary sturgeon angling locations.

### Angling Effort and Sturgeon Kept in the Delta

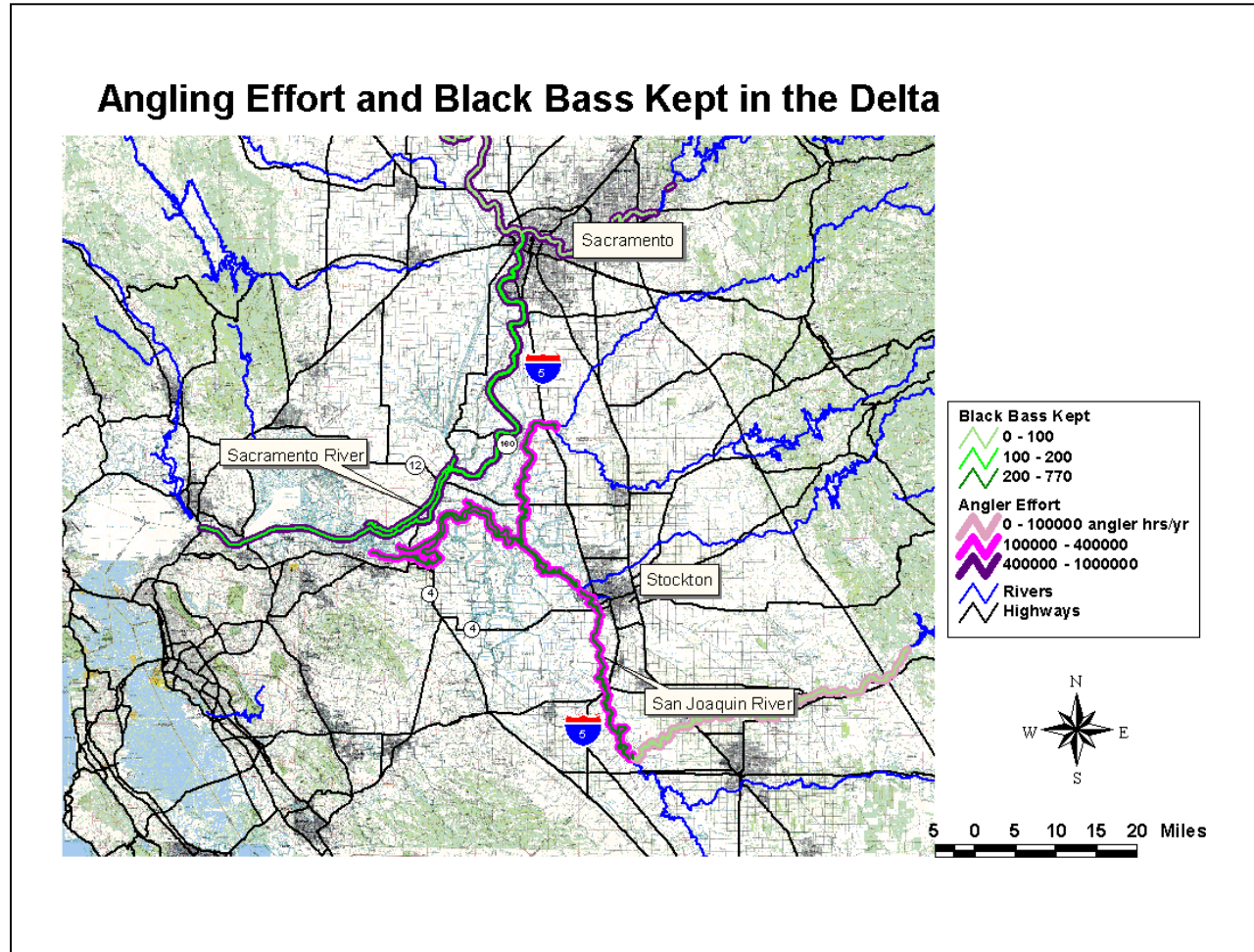




5c. Because many anglers are targeting striped bass and salmon, there is no spatial correlation between the angling effort (angler hours/year) and the number of catfish caught and kept. The mainstem of the San Joaquin River is the primary catfish angling locations.

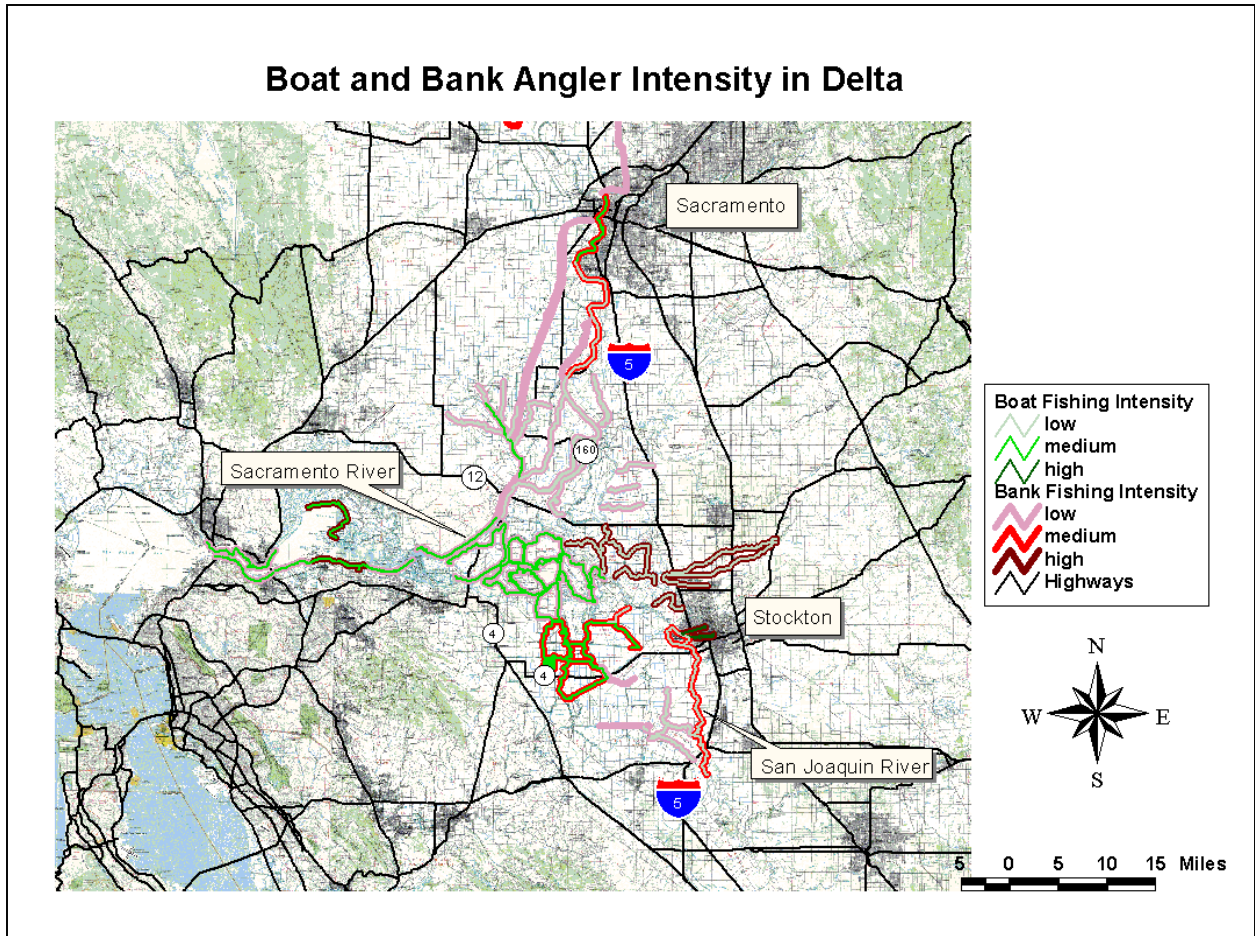


5d. Because many anglers are targeting striped bass and salmon, there is no spatial correlation between the angling effort (angler hours/year) and the number of black bass caught and kept. The mainstems of the Mokelumne and San Joaquin Rivers are the primary black bass angling locations.



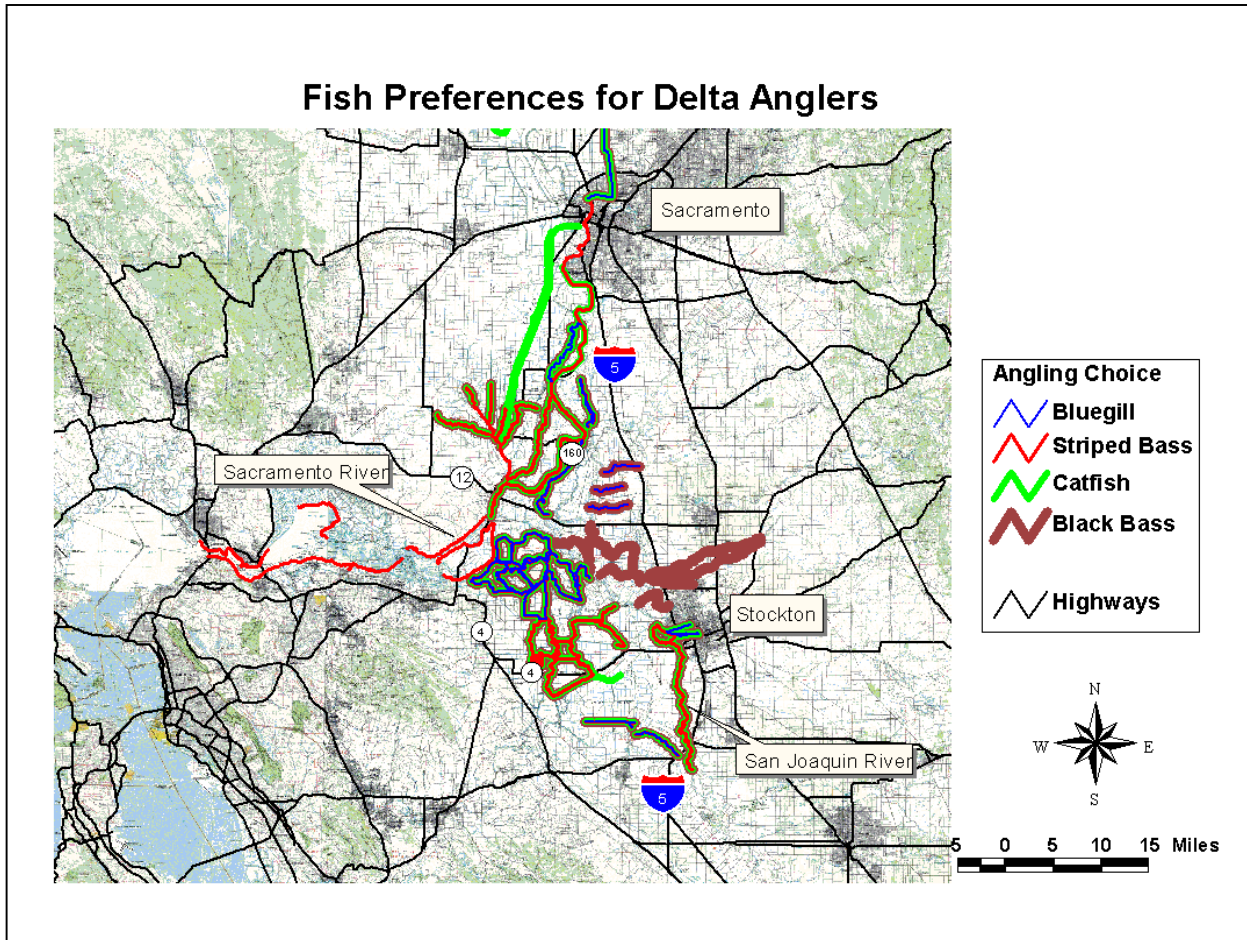
6. Certain areas in the Delta lacking formal creel surveying were identified by DFG staff (anecdotal/interview data) as having high fishing activity.

These areas were ranked from low to high. The ranking can be compared to actual angler counts in the creel surveys (see figures above). These data could be used to prioritize future creel and fish consumption surveys, fish tissue Hg measurements, and angler education activities.



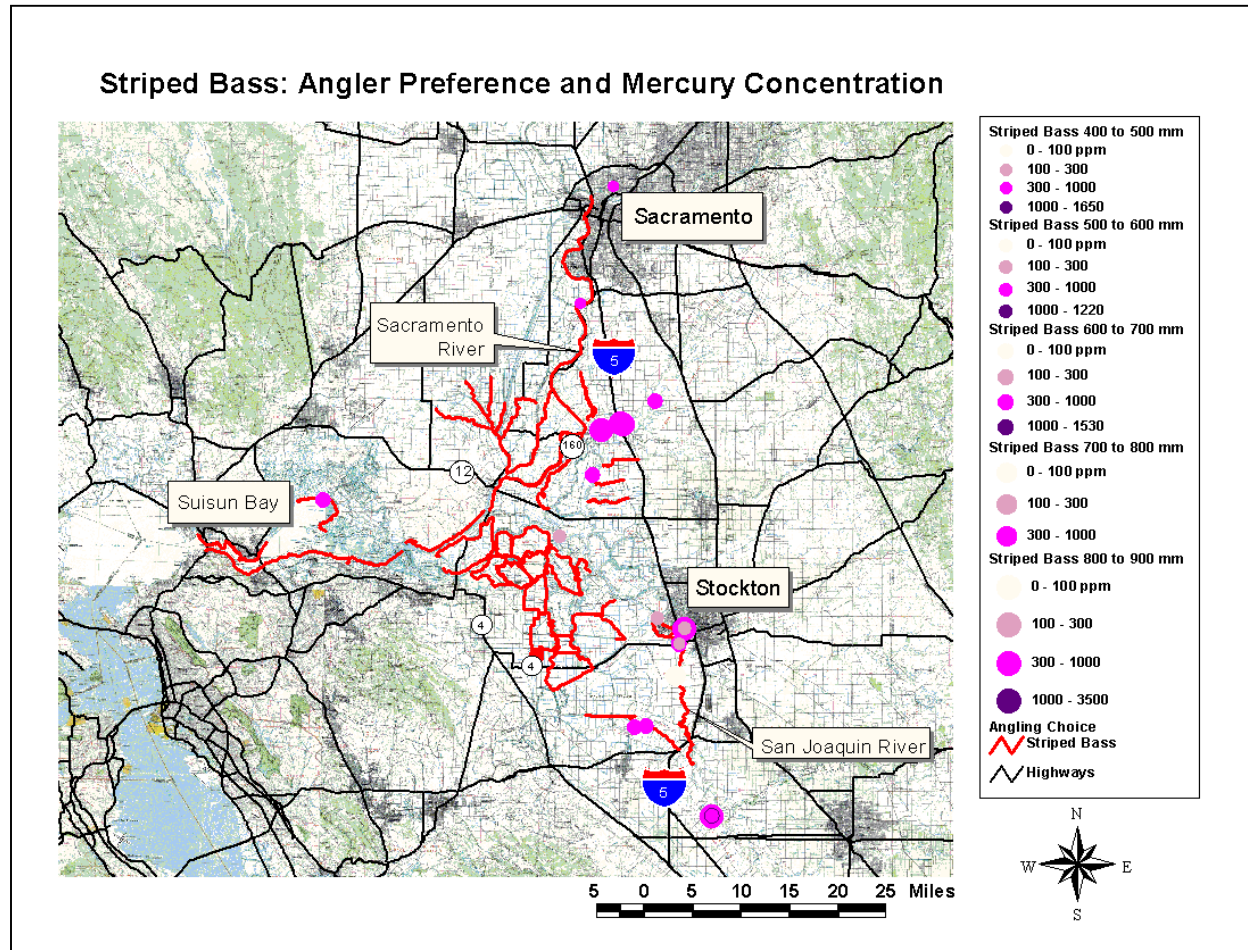
**7. Certain fish species were targeted in specific places in the Delta. Catfish and striped bass were most widely targeted.**

The four fish species listed are popular sport fish that have also been found to contain mercury. These data can be used with the mercury concentration data for specific fish species to inform fish consumption/education activities. Anecdotal data were collected from DFG staff in interviews.



**8. Striped bass are a popular angling choice throughout the Delta. There are few measurements of mercury in striped bass throughout much of the Delta**

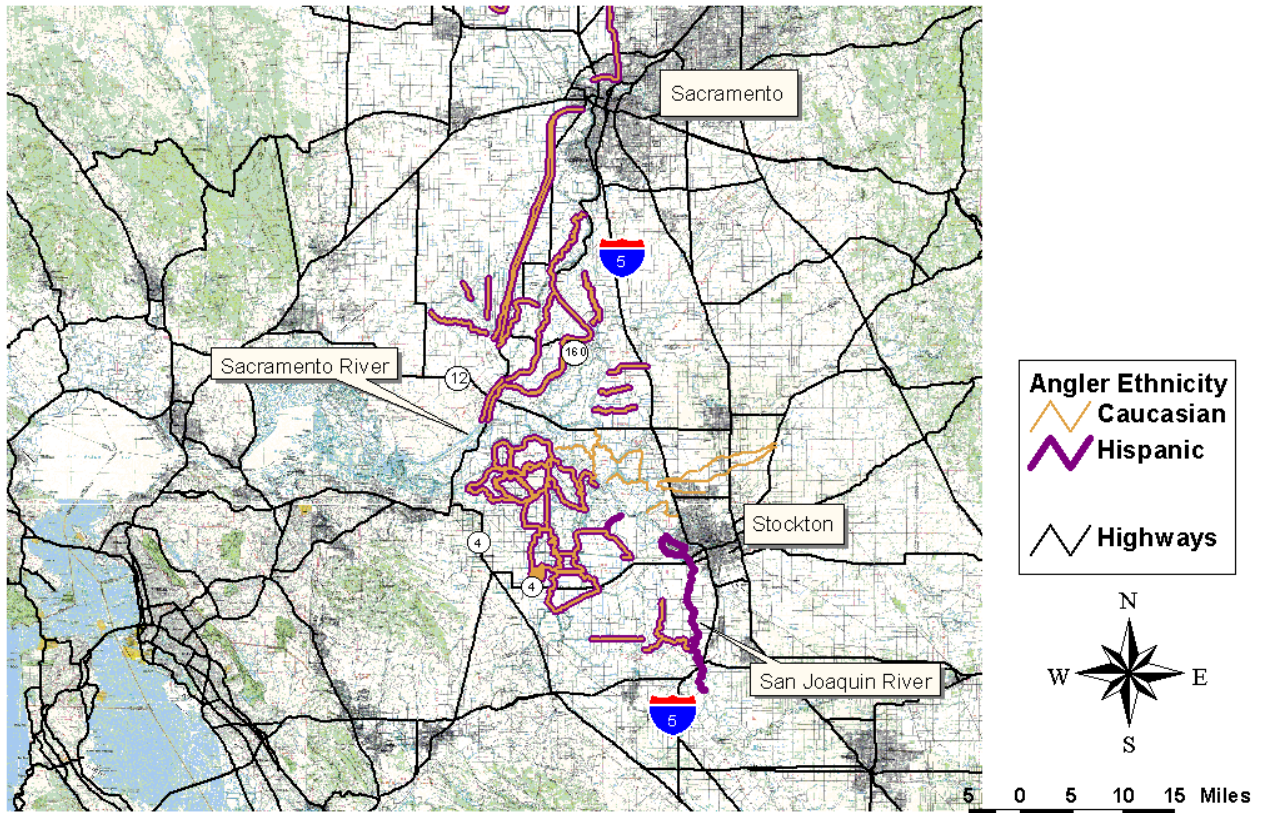
Striped bass are highly mobile, making mercury measurements in particular locations less meaningful for that location. However, because of the possibility of populations that migrate less or migrate to and from particular places in the Delta and tributaries, it makes sense to monitor mercury in a wide variety of locations.



9. **Caucasian and Hispanic anglers are widely distributed throughout the Delta.**

According to DFG staff, many Delta waterways are frequented by Caucasian and Hispanic anglers.

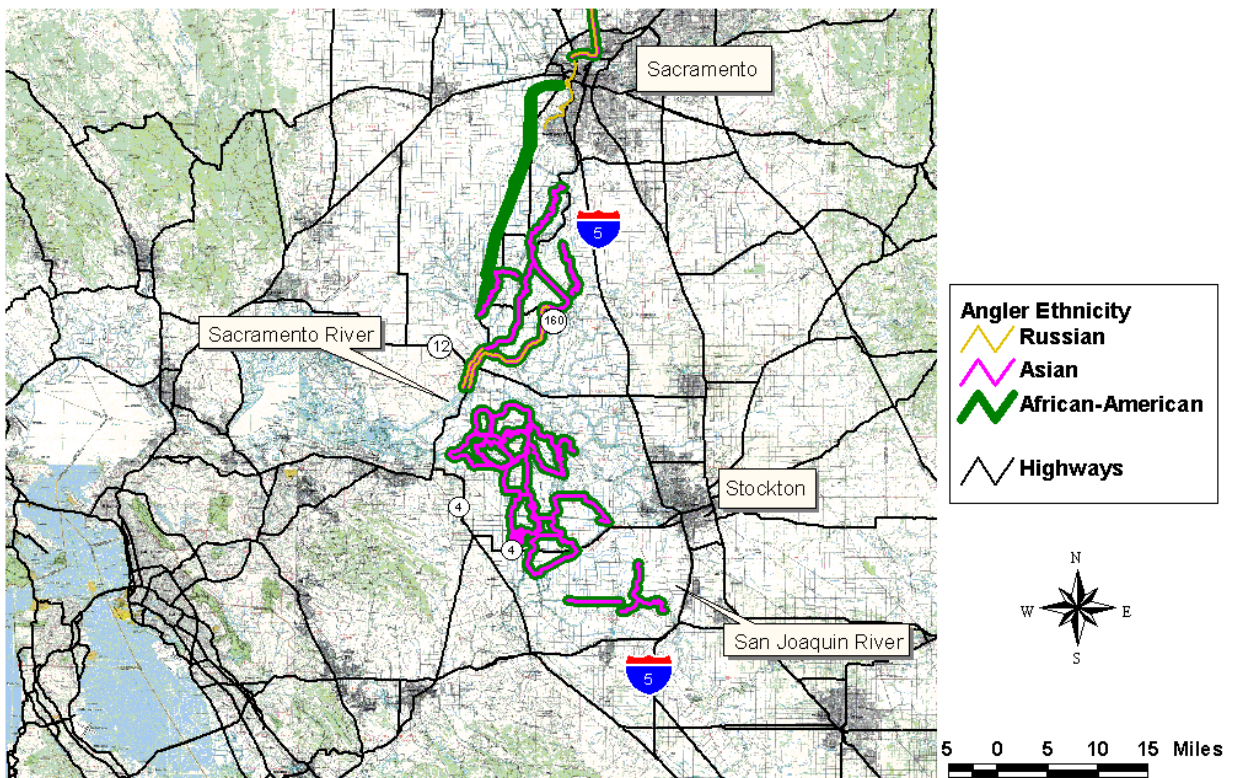
### Angler Demographics in Delta: Caucasian and Hispanic



**10. African-American and Asian anglers are widely distributed throughout the Delta, Russian anglers are more localized.**

According to DFG staff, many Delta waterways are frequented by African-American and Asian anglers, fewer by Russians, which may be related to the types of fish preferred by the Russians.

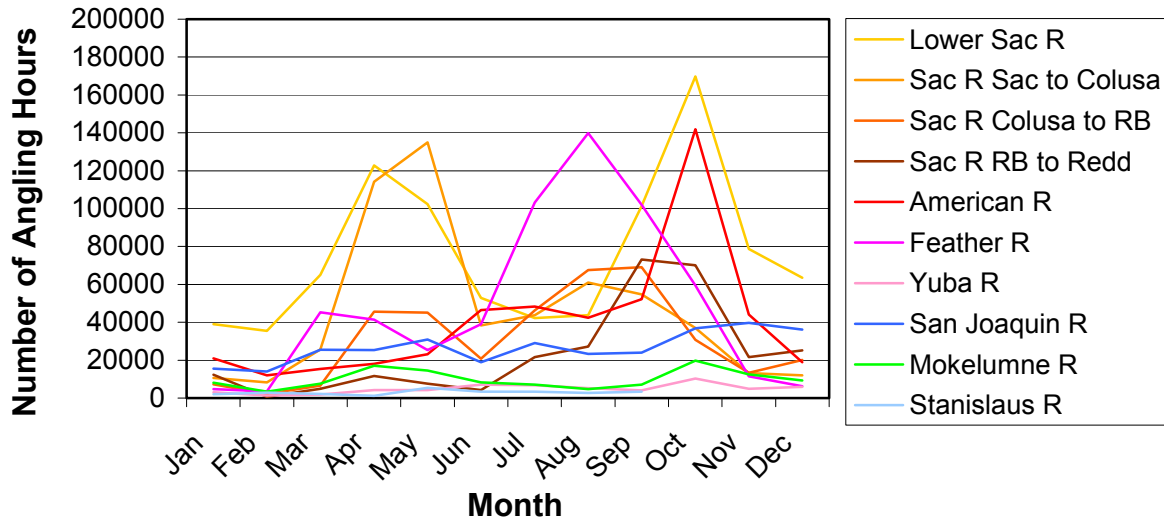
**Angler Demographics in Delta: African-American, Asian, and Russian**



**11a. For certain reaches there is strong seasonality in the angling intensity.**

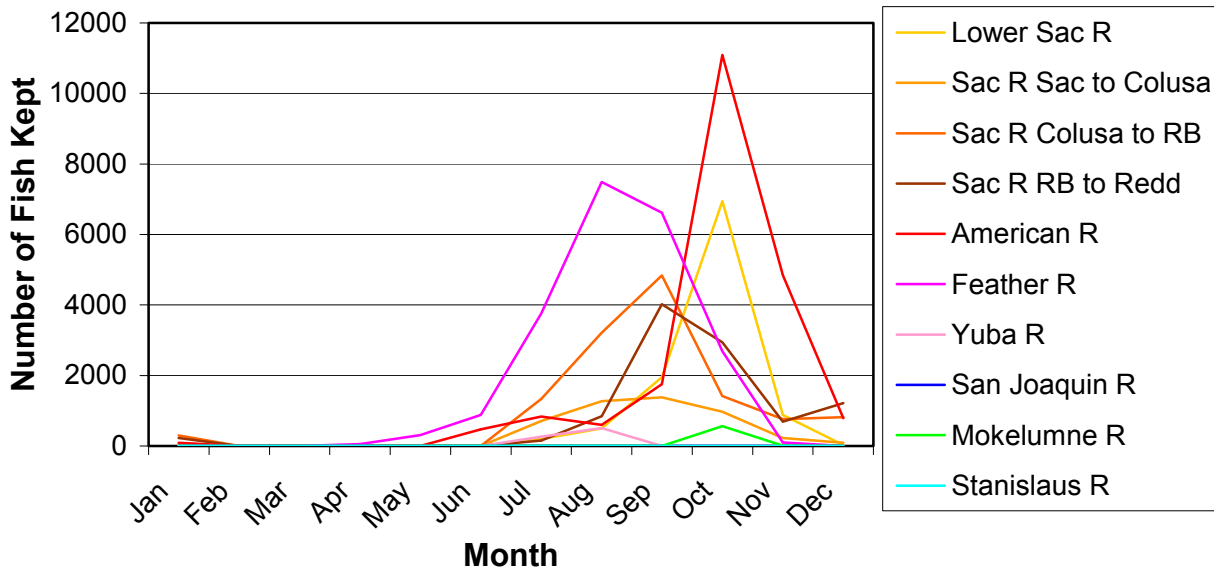
Lower Sacramento River peaks in Spring and Fall, Sacramento River between Sacramento and Colusa peaks in Spring, Mokelumne River peaks in Spring and Fall.

Seasonal Angling Intensity in Sacramento and San Joaquin River Basins (DFG creel survey data 1999 & 2000, calculated average number of angling hours per year)



**11b. For Chinook (king) salmon there is strong seasonality in angling.**

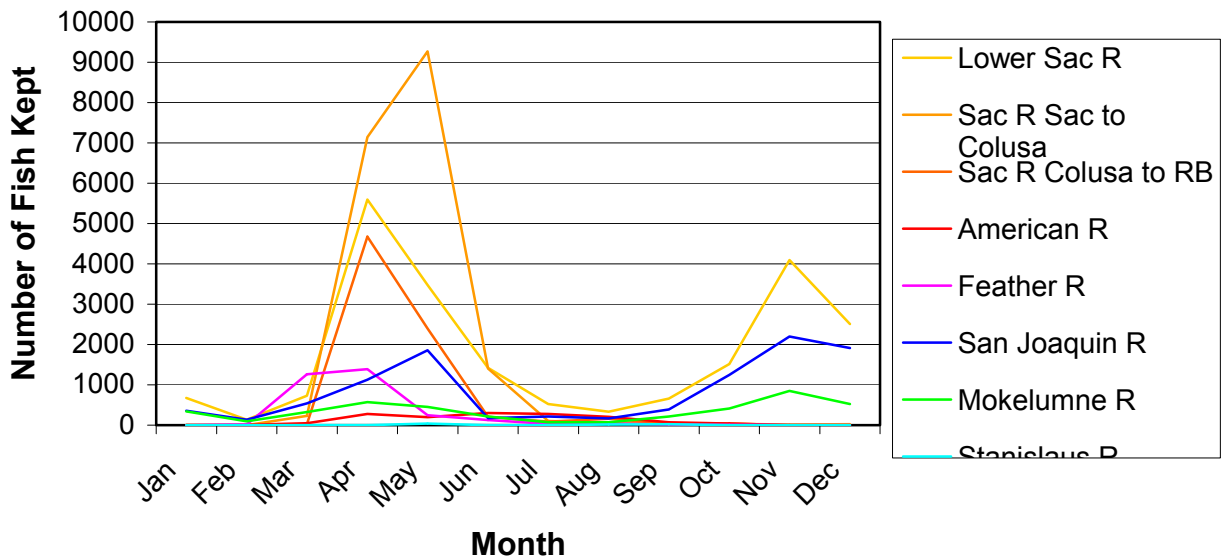
For all waterways, the late summer through late fall is the peak season for salmon fishing.





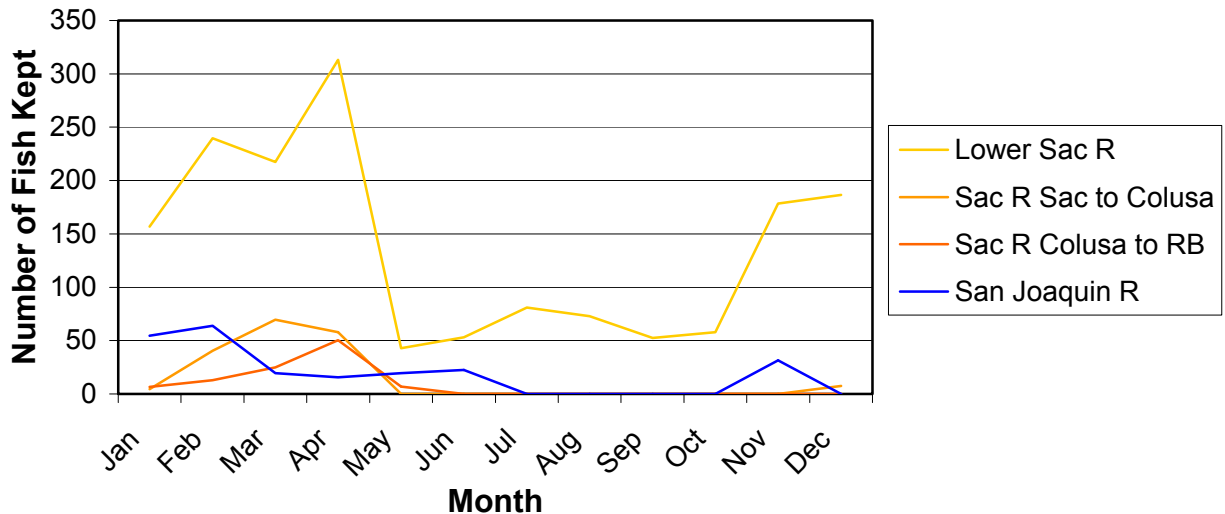
**11c. For striped bass there is strong seasonality in angling.**

For the Sacramento River between the Carquinez Straits and Red Bluff and the lower San Joaquin River, the peak season for striped bass is late spring/early summer. For the Mokelumne River, the lower San Joaquin, and lower Sacramento River there is a secondary peak in early winter.



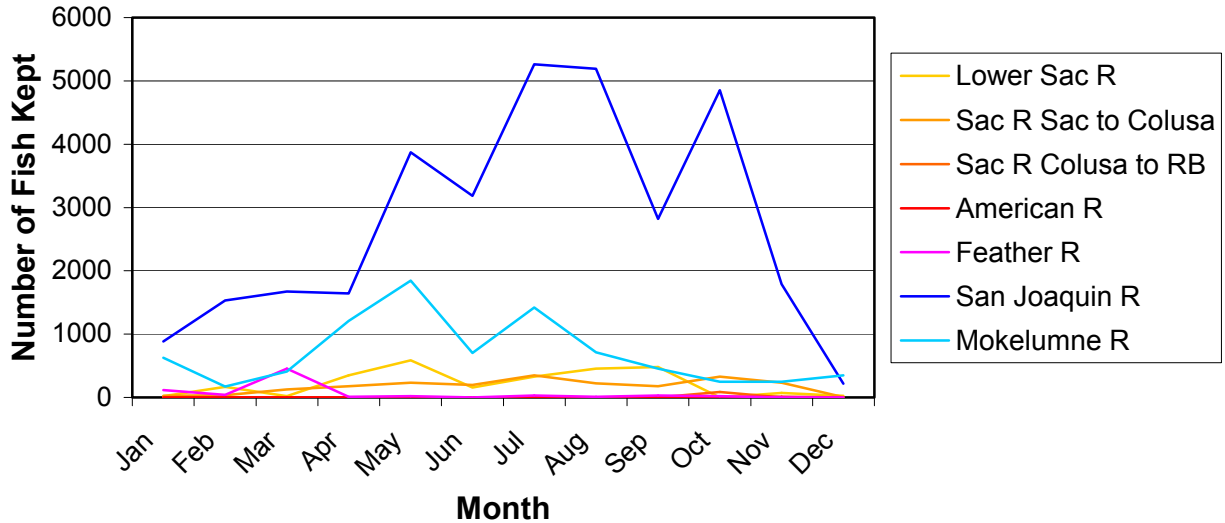
**11d. For sturgeon there is strong seasonality in angling.**

For the lower Sacramento and San Joaquin Rivers, there are two peaks in activity – spring and early winter.



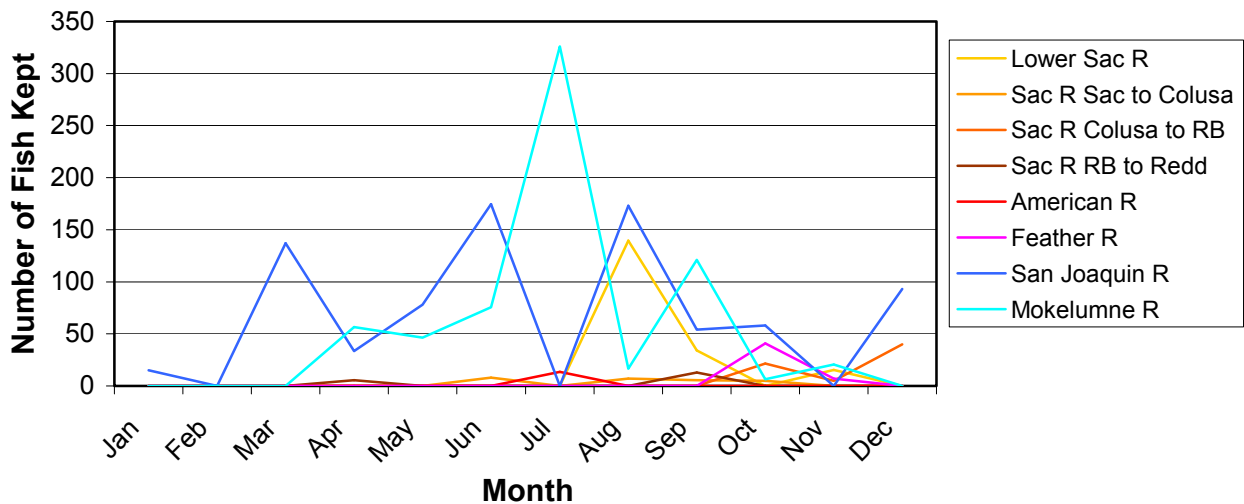
**11e. For catfish there is moderate seasonality in angling.**

On the lower San Joaquin River and Mokelumne River, most catfish are caught from late spring through fall.



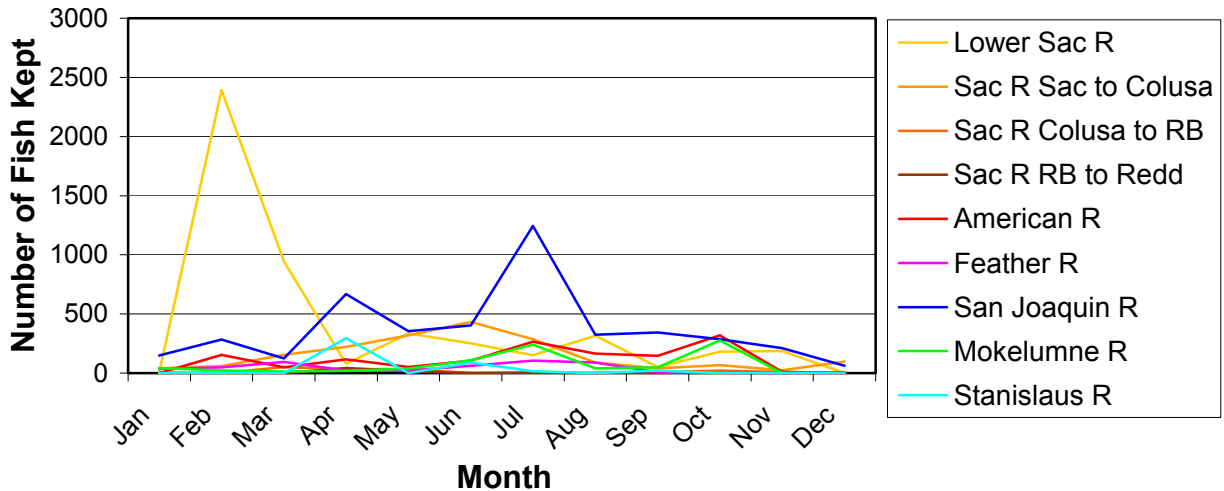
**11f. For black bass there is weak seasonality in angling.**

There may be no general rule for black bass caught, except that generally there is less in the winter. On most waterways, late winter through late fall shows activity.



**11b. For “any species” there is variable seasonality in angling.**

This class of creel fish includes anything not listed above and several species not analyzed (e.g., American Shad). For the lower Sacramento River and the lower San Joaquin River there seems to be some seasonality in activity, which may be associated with catching a seasonally-available fish not listed in the creel survey.



*Conclusions*

- There are a variety of gaps in our knowledge about fishing practices and mercury concentration in fish that would be useful to inform future education/outreach activities and fish consumption surveys.
- The demography of anglers is a moderately useful piece of information for geographically-targeted education and angler surveys. However, more precise information about ethnicity is essential for efficient and effective communication of risk and surveying of consumption because of cultural and language barriers.
- There are strong locational and seasonal peaks for certain places and species of concern for mercury. There are also species that are generally targeted (many times and places) and information gaps that complicate targeted education and outreach.
- A rational integration of the following public-health and wildlife-health relevant indicators is needed: widely-dispersed mercury monitoring, with emphasis on heavily-fished areas; widely-dispersed creel surveys, with multiple languages; identification of areas heavily-used by single ethnicities/language groups (e.g., Mayan migrant farm workers) to facilitate effective risk communication; targeted fish consumption surveys in multiples languages in areas known to have high mercury concentrations in fish (e.g., Delta periphery).

## *References*

Department of Fish and Game. (1999). Central Valley salmon and steelhead harvest monitoring project. The Resources Agency. 26 pp.

Department of Fish and Game. (2000). Central Valley salmon and steelhead harvest monitoring project. The Resources Agency. 26 pp.

# Appendix

## Metadata

The following are metadata for the spatial data included in the Arc View project ("fish.apr") developed for this project. These metadata refer to the original spatial data file obtained from the source listed. Any modifications (i.e., attribution of fishing data) did not affect the spatial part of the file, with the exception of the river coverage, where the lower Sacramento River to Carquinez Straits was added with on-screen digitizing using a DRG map as a base layer.

## County Boundaries

From Teale Data Center: The 'COUNTY' layer contains county lines and features (usually shorelines). The county outline was digitized from 1:100,000 scale mylar USGS quad sheets. Users can draw this layer instead of using the tile boundary (which is also a county line). Users can display shorelines or legal county lines or both by employing the BAY and DISPLAY items. This is a polygon layer; users should be prepared for counties with multiple polygons.

## Highways

From Teale Data Center's "Roads" layer - derived from 1:100k Digital Raster Graphics. The Roads layer is based on the USGS DLG transportation linework derived from the DLG-3 digital series. The library layer contains DLG linework as it came from USGS, plus edited and new linework. Edits included corrections of coding and additions, deletions and alterations of linework. This layer contains a second-generation arc attribute table derived from the DLG major/minor pair scheme. DLG coding is documented in "Digital Line Graphs From 1:100000-Scale Maps, Data Users Guide 2, 1985" available from the U.S. Department of the Interior, U.S. Geological Survey, Reston, Virginia.

The roads layer contains several classes of transportation features including jeep trails, city streets, thoroughfares, unpaved roads, state highways, and interstates. Some of the data is 20 years old. All major highways were updated in 1993 through a joint project with CALTRANS. There were various types of updates, such as recoding former thoroughfares as highways, or vice-versa. These roads were digitized at 1:24,000 scale. All post 1994 updates may be found by selecting the item "updinfo" not equal to zero. To find digitized roads, select for class equal to 90.

## Hydrology

**EPA River Reach File--RF3 Rivers (Description from Information Center for the Environment, ICE, UC Davis; [www.ice.ucdavis.edu](http://www.ice.ucdavis.edu))**

The hydrography layer originally came from the USGS in digital line graph (DLG-3) data format. DLG-3 data were captured from 1:100,000-scale maps by manual digitizing and raster scanning. There are approximately 3200 DLG files represented in the statewide hydrography

data layer. The hydrography layer consists of all flowing waters, standing waters, and wetlands--both natural and manmade. The coverages contain two separate feature types: polygons (areas) and lines. Polygon features have attribute codes that identify water bodies such as lakes, wide river segments, or swamps. Line features have attribute codes that represent streams or shorelines. RF3 Rivers are those watercourses included on 1:100,000K quads excluding the major rivers (RF1) and the major tributaries to these rivers (RF2).

## **Lakes**

[California Department of Fish and Game](#) data layer: This lakes coverage was created by integrating the USGS 1:100,000 scale Digital Line Graph hydrography polygons of standing water with a Department of Fish and Game internal document describing lake characteristics and the USGS Geographic Names Information System data base. This is the most comprehensive lake coverage of the entire state, at 1:100,000.