# California Tribes Fish-Use

## *Final Report*

California tribes have used fish for ceremony, diet, and as a part of culture for far longer than California has existed. Because of concern expressed by members of California tribes, the State Water Resources Control Board and the US Environmental Protection Agency supported the collection of information about the current and traditional use of fish by members of tribes across the state, to inform draft water regulations. We found that tribes use fish in similar patterns (fish types and source-waters) as they did traditionally, but not in terms of amounts. Tribes used 29 freshwater/anadromous fin-fish species, 23 marine fin-fish species, and 18 other invertebrate, and plant species and groups of species. Current 95$^{th}$ percentile rates of consumption of caught-fish varied by tribe and ranged between 30 g/day (Chumash) and 240 g/day (Pit River). The rate of fish use (frequency and consumption rate) was suppressed for many tribes, compared to traditional rates, which most tribes attributed primarily to water quantity and quality issues. This report describes the surveying approach and findings about tribes' use of fish.

July, 2014

# California Tribes Fish-Use: Final Report

A Report for the State Water Resources Control Board and the US Environmental Protection Agency

Agreement # 11-146-250 between SWRCB and UC Davis

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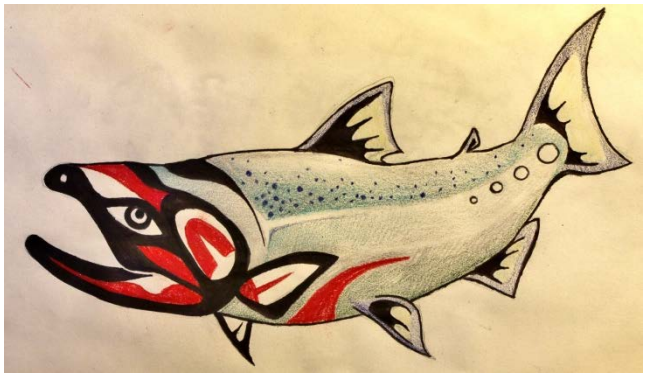

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## Summary

Tribes have been concerned that water quality and other water-related decisions tend to lack consideration of tribes' use of water and fish. The State Water Resources Control Board and the USEPA provided funding to collaborate with tribes in discovering what the patterns of fish use were historically and are currently. UC Davis researchers worked with partner tribes to establish an appropriate approach to interviewing tribe members about fish use. Members of 40 CA tribes and tribe groups were surveyed directly at 24 locations and staff from 10 tribes were surveyed online using standard questionnaires. Traditional uses of fish were assessed using literature review and surveying of tribe members and staff. Contemporary uses were assessed using tribe member interviews. We found that tribes use fish in similar patterns (fish types and source-waters) as they did traditionally, but not in terms of amounts. Tribes used 26 freshwater/anadromous fin-fish species, 23 marine fin-fish species, and 18 other invertebrate, and plant species and groups of species. The single most commonly caught and/or eaten fish species group among all tribes was "salmon", which could include chinook or coho salmon. 95$^{th}$ percentile rates of consumption of caught-fish varied by tribe and ranged between 30 g/day (Chumash) and 240 g/day (Pit River). The rate of fish use (frequency and consumption rate) was suppressed for many tribes, compared to traditional rates, which most tribes attributed primarily to water quantity and quality issues.

## Background

California Tribes have been fishing and eating fish for far longer than California has existed. Although practices, fishing areas, fished species, and amounts of fish eaten may have changed over time, the cultural and dietary importance of fish has not. Anglo-American anthropologists have estimated that for certain California tribes, fish consumption was at least one pound per day, which for certain coastal tribes may have been mostly salmon (Hewes, 1973; Hewes, 1942 and Hewes 1947, cited in Swezey and Heizer, 1977). This rate is similar to other reported rates in Northern California, for example, Harper and Harris (2008) report that a review of the literature reveals that Columbia River Tribes consumed about a pound of fish per day (620 gpd) before contact with Europeans led to suppression of fish populations and fish consumption.

The Karuk tribe and academic collaborators have studied their own fish use practices and health consequences of fish use (Karuk Tribe, 2004; Reed and Norgaard, 2005). They have demonstrated that the loss of salmon led to a decline in fish consumption by tribe members, and this was linked to health declines, including an increase in an incidence in diabetes, heart disease and hypertension. Because of the direct linkage between dam construction blocking salmon runs, which led to cultural, diet, and health problems for the Karuk, a case could be established that the dams should be removed.

Suppression of fish use and consumption is an important concept in the regulation of water management and problems related to development and extraction activities. Because many of these activities are permitted by state and federal agencies, there is an opportunity to reverse

the harm being caused to a use of aquatic systems, once it has been identified. Harper and Harris (2008) make the case that although fish consumption by Columbia River Tribes has been suppressed, a subset of the Tribes' members still practice original subsistence rates and that the subsistence practice should form the basis for regulatory and other means of protecting a recovered use of fish.

Aquatic organism use by California Tribes has been previously studied primarily by analyzing shell and bone fragments in middens associated with traditionally-settled areas, both before and after European colonization. Studies by Gobalet et al. (1990a, 1990b, 1992, 2004) demonstrated that tribes used at least 76 species and groups of species of marine and freshwater fish throughout California. Since colonization and displacement of tribes from most of their traditionally-fished areas, the pattern (fish targeted), geographic distribution, and rate of fish use may have changed.

## Policy Framework

Water and aquatic ecosystems are protected by a number of different state and federal laws, such as the state and federal Clean Water Acts. Fish populations are further protected from endangerment and extinction by the state and federal Endangered Species Acts. Fish use by members of the public is protected as a beneficial use (when applicable) under the Clean Water Act, as a recreational use by the Fish and Game code and administratively protected on most public lands. Fish use by tribes is further protected for certain tribes with treaty rights, but not for most tribes. There is an increasingly-recognized gap between the traditional practices of many tribes to use fish for various reasons and the protection of these practices in state and federal law.

Previous studies of fish use by specific California tribes (e.g., Reed and Norgaard, 2005) and the current study suggest that new, or reformation of existing policies are needed that protect the various ways that fish use is important to tribes. These ways include health, sovereignty, culture, environment, economy, and moral/legal. Responsive policies from state and federal agencies will explicitly take these ways of use into account. Being responsive could mean developing new policies, such as SWRCB's proposed beneficial use designation for cultural and traditional use. It could also mean articulating the various ways that fish use is important in new state and federal statutes. Finally, it could mean identifying and protecting these uses in re-negotiated or new treaties between the US and tribes, or in new agreements between California and tribes.

A key component of water policy in California is the development of water quality criteria based upon standard fish consumption rates. These criteria are usually related to fish contamination (e.g., by mercury) and vary inversely with fish consumption rates. The USEPA recommends using a 90$^{th}$ percentile rate of consumption to protect the general population and a 99$^{th}$ percentile rate to protect anglers who consume their catch (USEPA, 2000). In California, both the San Francisco Bay Regional Water Quality Control Board (SFRWQCB, 2006) and the Central Valley Water Quality Control Board (CVRWQCB, 2010) have used the 95$^{th}$ percentile rate of consumption from regional studies to protect fish consumers. Subsistence fishing was considered in one alternative (Alternative 5) of the Delta methylmercury TMDL (CVRWQCB, 2010) as follows: "*Some people are subsistence consumers; because of tradition or need, these people have high consumption rates of locally caught fish, represented by a rate of 142.4 g/day (four to five fish meals per week). This rate is the 99th percentile consumption rate identified in a national food intake survey and recommended by USEPA for subsistence anglers and their families… Therefore, Alternative 5 is protective of (a) people who eat a very high amount of TL4 fish species*." (CVRWQCB, 2010). These various sources of guidance and policy findings support the use of a 95$^{th}$ or 99$^{th}$ percentile rate of consumption by tribes as the basis for local and regional water quality criteria, fish tissue criteria, and other water policies promulgated by the state to protect tribes' use of fish.

## Methods

The sections below describe how partnerships were developed with tribes, how interviews were conducted, literature retrieval and analysis, and methods of statistical analysis.

## Project Locations and Times

There were two primary types of locations where interviews were conducted: 1) tribal offices and 2) tribal or inter-tribal events. The tribes and event locations were distributed widely across California (Figure 1). Interviews were conducted between 1 and 3 times for each tribe between May/2013 and June/2014 (Table 1).


**Figure 1.** **Tribe and interview locations in California.**

**Table 1** **Tribe locations and identities (in parentheses) and month when interviewing was carried out.**

| Partner Tribes/Locations | Interview Months |
|---|---|
| Upper Lake Rancheria (Habematolel Band Pomo) | 5,7/2013 |
| North Coast Campout (Inter-Tribal) | 6/2013 |
| Bridgeport Indian Colony (Paiute) | 6/2013 |
| Big Valley Rancheria (Big Valley Band Pomo) | 7/2013 |
| Sugar Bowl Rancheria (Scotts Valley Band Pomo) | 7,11,12/2013 |
| Stewarts Point Rancheria (Kashia Band Pomo) | 8/2013 |
| Buena Vista Rancheria (Me-Wuk) | 8/2013 |

| | |
|---|---|
| Blue Lake Rancheria (Wiyot & Yurok) | 8/2013 |
| Round Valley Rancheria (Yuki, Pit, Pomo, Nomlacki, Concow, Wailaki) | 9/2013 |
| Bear River Rancheria (Mattole & Wiyot) | 9/2013 |
| Fort Bidwell Reservation (Northern Paiute) | 9/2013 |
| Big Pine Indian Reservation (Paiute) | 10/2013 |
| Wiyot Tribe Reservation (Wiyot) | 11/2013 |
| Bishop Reservation (Paiute) | 12/2013 |
| Death Valley (Timbisha Shoshone) | 12/2013 |
| Mechoopda Indian Tribe of Chico Rancheria (Maidu) | 3/2014 |
| North Fork Rancheria (Mono) | 4/2014 |
| Big Sandy Rancheria (Mono/Monache) | 4/2014 |
| Grindstone Indian Rancheria (Wintun-Wailaki) | 4/2014 |
| Manchester/Pt. Arena (Pomo) | 4/2014 |
| Santa Ynez Rancheria (Chumash) | 5/2014 |
| Chemehuevi Reservation (Chemehuevi) | 5/2014 |
| Fort Mojave (Mohave) | 5/2014 |
| Pit River (Achomawi & Atsugewi) | 6/2014 |

## Collaboration with Tribes

The project was inspired by tribes expressing the need for the state and federal agencies to use information about tribes' use of fish in setting water quality standards and thresholds. Tribes were also consulted about appropriate techniques to use to approach tribes and individual tribe members, appropriate questions to ask individuals, and the types of information that would be important to collect. This consultation led to the development and refinement of the questionnaires and the methods used in the field. Tribes suggested collecting information about historical uses of fish, traditional and customary uses of fish, contemporary uses of fish, and threats and causes of fish use reduction (if any).

## Contact with Tribes

All 146 federally-recognized and state-recognized tribes and one tribe that has neither recognition (Winnemem-Wintu) were contacted twice by email and letter-mail to solicit their participation in the project. About two-dozen tribes responded by email, phone, or in-person at meetings that they would be interested in further discussion and possible participation. Of these, 12 participated and the remainder changed their position about participating. After

learning about the project in various ways (e.g., word-of-mouth), another 12 tribes wanted to participate.

Various reasons were given for not wanting to participate in the project. One major concern was that the federal and state governments and the University of California had all violated trust in various ways in the past and that regulatory, trust, and land management agencies were inconsistent in their consideration of tribes' needs, interests, and indigenous rights and uses of land and water. It is important to consider non-participation in this project NOT as lack of interest in fish use, but rather some combination of lack of time/resources to participate, political resistance to governmental intrusion, and knowledge of past failure of government to act to protect tribal interests.

## Interview instruments

Two questionnaires were used to interview tribe members in the field, one focused on traditional uses and threats to uses (Appendix 1) and the other focused on contemporary uses and threats to use (Appendix 2). The traditional use questionnaire included questions about tribe's traditional fishing dependence, fishing areas, and traditionally-used fish. The questionnaire also included questions about past rates of consumption of traditionally-used fish and whether and why current fish use might have been impaired compared to traditional patterns. The contemporary use questionnaire included questions based on 30-day recall about the frequency of fishing and consumption of particular locally-caught and store-bought fish species. It also included questions about reasons that fish use may be less than desired or anticipated, as well as basic household and demographic information.

Tribes were also surveyed using an online instrument focused on tribes' traditional and customary use of fish (Appendix 3). The questionnaire contained questions focused on whether tribes used and still use fish, the types of fish used, the frequency tribes traditionally ate fish, and the barriers to fish use. Tribe staff were contacted via email and provided a link to the survey. This online questionnaire was used to reach additional tribes that were not involved in the two field surveys.

## Field interviews

Field interviews were carried out in two primary ways: 1) working with tribes to organize tribe members on certain days when UC Davis staff could come and interview them and 2) working with tribes to find out how to engage in specific tribe events where interviewing tribe members was feasible. This approach is different from the method that an epidemiological study might use of randomly sampling a population, based on tribe rolls, and conducting in-person or phone interviews. The demographic mix (income, age, and gender) that resulted from our approach led us to believe that we had incidentally interviewed a random subset of each tribe. To encourage tribe members to come on certain days to be interviewed, staff would announce to the tribe members via email list-serves, newsletter announcements, and posted fliers (on notice boards) that interviews were going to take place. All tribe members were invited and no attempt was made to target anglers and users of fish specifically. Tribe cultural and community events were assumed to attract a cross-section of each tribe. People were approached opportunistically at these events, or sometimes people approached the interviewers at the UC Davis project booth.

## Literature review

Available literature about tribes' fish use was searched from tribal and academic library resources. Several kinds of information were retrieved from these sources: 1) narrative descriptions of traditionally-fished areas, 2) narrative or quantitative description of rates of fish use and consumption, 3) narrative description of fish species used, and 4) descriptions of and threats to and changes in fish use. This information was important in understanding what fish tribes had traditionally relied upon and is important context for reports of current fish use.

## Data management

Data from the questionnaires were entered into Excel spreadsheets by the field interview staff and the project lead. Photocopies of the questionnaires were kept by the field staff until safe delivery of the originals to UC Davis, then destroyed. Original questionnaire forms were kept in a locked file cabinet inside a locked office at UC Davis. Data entered into Excel spreadsheets were kept in password-protected computers. Incomplete questionnaire responses were retained as blanks in the spreadsheet. Any questions about individual responses were resolved

by discussions between the field staff and the project lead. All tribes were informed that they had the right to refuse sharing of the data after it had been collected. No tribe used this right.

## Coding of interview responses

Narrative responses to questions were recorded as either one of the existing possible answers to questions, or as a new type of answer to the question. One of the questions referred to why a certain fish that had been eaten in the past was not consumed in the last 30 days. Answers were grouped by type of response, for example many respondents to this example questions said that they had not been fishing for the fish, or it was out of season. These types of answers were grouped as response types. If too few people responded with particular answer-types, then these more individual responses were retained, but not coded and therefore lumped together.

## Mapping waterways for fishing

Tribe members were asked to list waterways where they had traditionally/historically caught fish and waterways where fish originated that they had consumed in the last 30 days. This list of waterway names was used to select hydrologic unit code-10 (HUC-10) watersheds from a standard USGS HUC map using ArcGIS 10. The HUC-10 scale was chosen because it was the smallest HUC scale that captured full waterways, such as specific creeks. For each tribe, 2 maps were created: 1) core traditionally-fished watersheds (identified by 2 or more respondents), and 3) watersheds where currently-consumed fish were obtained.

## Statistical Analyses

State regulatory processes typically use the 95$^{th}$ percentile rate of fish consumption to calculate target contaminant concentrations that will protect most users (CVRWQCB, 2008). In order to represent as many native fish-users as possible, we calculated 95$^{th}$ and 99$^{th}$ percentile fish use rates. The mean use rate was not calculated or reported, because it has no meaning in policies intended to be protective of most or all users. The measures examined included frequency of fish consumption, fish portion sizes and fish consumption rates.

Frequency of traditional fish consumption was reported in one of 6 categories (>1 meal/day, 1/day, 2-3/week, 1/week, 1/month, <1/month). Frequency of contemporary consumption was reported as # meals in last 30 days and for comparison with traditional frequencies was converted to the frequency categories used for the traditional interviews. Traditional and contemporary frequency distributions among all tribe respondents were tested for significant differences using a Chi-test R (a statistical package; R Core Team, 2013) for two independent sample frequency distributions.

Traditional fish consumption rates were calculated by multiplying individually-reported frequencies of consumption by an estimated portion size of fin-fish. Meal portion sizes were estimated using the average and 95$^{th}$ % portion size from the contemporary survey. The assumption of a similar portion size in the past and current consumption could be questionable, it was a conservative approach considering the lack of data on fish meal portion size from the past. The average consumption rate obtained was then multiplied by the traditional frequency numbers to get estimates of traditional consumption rates (grams per day).The comparison of traditional and contemporary fish consumption rates was carried out using the Wilcoxon-Mann-Whitney test, which is a suitable non-parametric test for two independent samples for which the dependent variable is not normally-distributed.

Fish consumption rate comparisons were also tested at more specific levels: at the tribe level and the regional level. For tribe comparisons, only those with samples sizes of 10 or more respondents were used. The regional level comparisons have been based on the Water Board region classification for California.

# Results

## Traditionally Fished Watersheds

Tribes traditionally used most or all streams in their national territories. This traditional use has been reduced in most cases to a set of streams and watersheds that are still used, or were used by recent generations (Figure 3). When present, ancillary areas were often at least as large as the core areas. In some cases, nearby tribes fished the same watersheds.

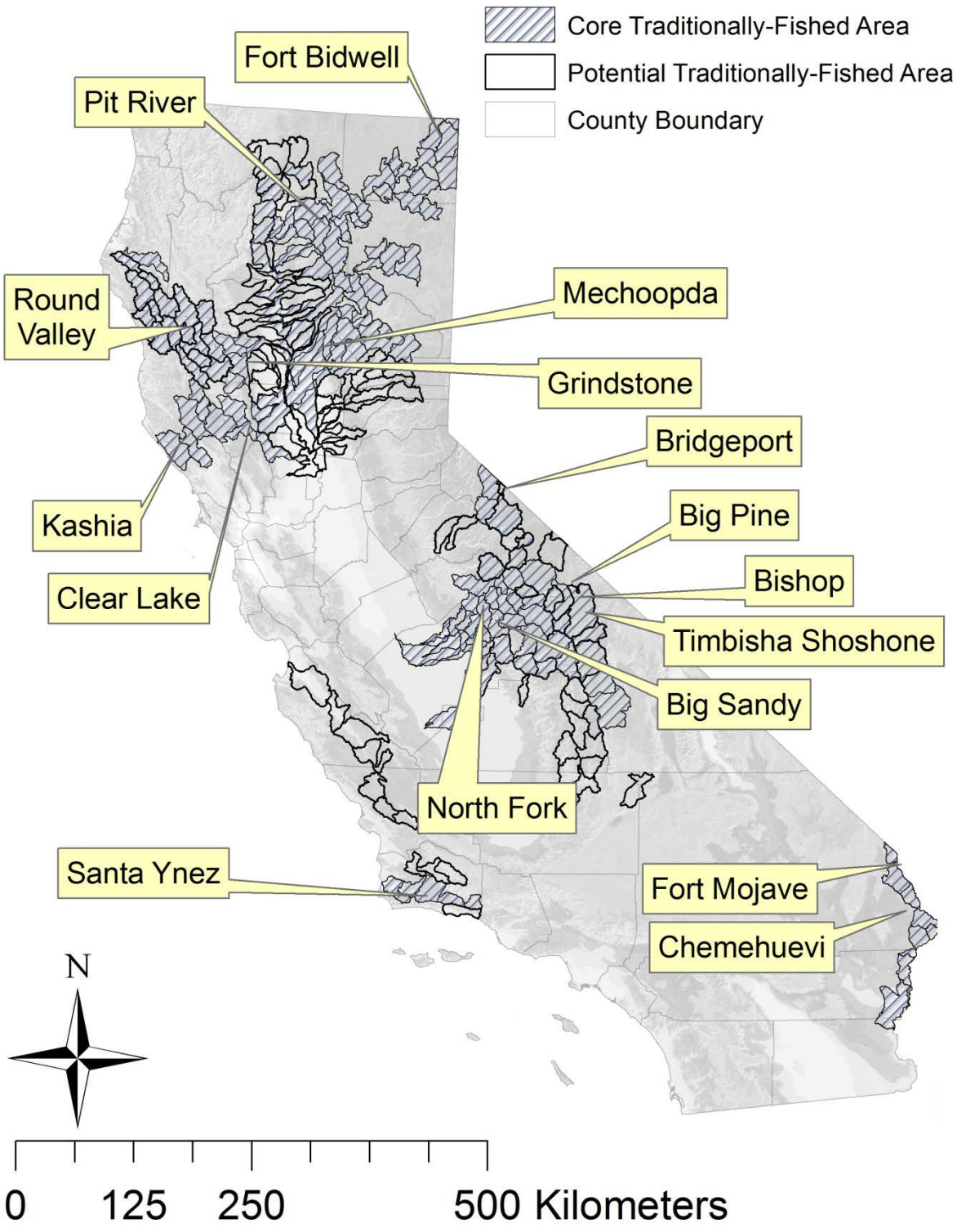


**Figure 3. Traditionally-fished watersheds (hydrologic unit code HUC-10). Areas with darker color represent areas where fishing areas of more than one tribe overlapped.**

## Traditional Reliance of California Tribes on marine, estuarine, and freshwater aquatic organisms

California tribes have longed relied on bony and cartilaginous (e.g., sharks) fish. Much of this reliance has been recorded by the tribes by themselves and by archaeologists who have investigated midden piles at pre- and post-contact village sites (Table 2).

**Table 2. Fish species relied upon historically/traditionally by California tribes.**

| Region | Tribe(s) | Marine, estuarine, freshwater | Fish Species/Groups | Top 5 (Marine, estuarine, freshwater) |
|---|---|---|---|---|
| North Coast (Karuk Tribe, 2009) | Karuk | All | Salmon, steelhead, sturgeon, trout, lamprey, suckers | *(list not prioritized) Salmon, steelhead, lamprey, sturgeon, trout, suckers |
| San Pablo Bay (Gobalet, 1990a) | Ohlone | Marine | Shark, rays, skates, herring, sardine, anchovy, midshipman, smelt, white seabass, surfperch, shiner perch, seaperch, pile perch, monkeyface prickleback, rockfish, sanddab | Sturgeon, sardine/herring, salmon, bat ray, topsmelt/jacksmelt |
| | | Estuarine | Sturgeon, threadfin shad, salmon, striped bass, surfperch, gobies, longjaw mudsucker, sculpin, flounder | |
| | | Freshwater | Minnows, splittail, hitch, hardhead, Sacramento sucker | |
| Delta, Cache Ck (Gobalet, 1990b) | Ohlone, Pomo, Patwin | Estuarine | Sturgeon, salmon, delta smelt, | |
| | | Freshwater | Carp/minnow, thicktail chub, hitch, California roach, hardhead, Sacramento blackfish, splittail, Sacramento pikeminnow, speckled dace, Sacramento sucker, threespine stickleback, prickly sculpin, perch | Carp/minnow, perch, Sacramento sucker, salmon/steelhead, thicktail chub |
| South Bay, Central Coast (Gobalet, 1992) | Coastanoan | Marine | Shark, ray, longjaw mudsucker, anchovy, rockfish, pile perch, cabezon, rock prickleback, silverside, topsmelt, jacksmelt, herring/shad/sardine | Silverside, carp/minnow, Sacramento perch, Sacramento sucker, sturgeon |
| | | Estuarine | Sturgeon, steelhead, salmon | |

| | | | | |
|---|---|---|---|---|
| | | Freshwater | Sacramento perch, Sacramento sucker, carp/minnow, thicktail chub, hitch, hardhead, Sacramento blackfish, splittail, Sacramento pike minnow | |
| | Chumash | Marine | Shark, ray, skate, herring/sardine, anchovy, jacksmelt, white sea bass, white croaker, corbina, black croaker, drum/hardheads, senorita, sheephead, kelp bass, sea bass/grouper, skipjack tuna, bonito, mackerel, albacore, yellowtail, barracuda, shiner perch, rubberlip seaperch, pile perch, surfperch, opaleye, lingcod, rockfish, halibut, flatfish | herring/sardine, shark, anchovy, ray, senorita |
| | | Estuarine | Steelhead | |
| | | Freshwater | Arroyo chub | |
| Sacramento Valley watershed (Gobalet et al., 2004) | Maidu, Wintu, Nomlacki, Wailaki, Pomo, Me-Wuk | | Sturgeon, thicktail chub, hitch, California roach, hardhead, Sacramento blackfish, splittail, Sacramento pike minnow, speckled dace, Sacramento sucker, steelhead, chinook salmon, delta smelt, longfin smelt, threespine stickleback, sculpin, Sacramento perch, tule perch | Sacramento perch, Sacramento sucker, thicktail chub, Oncorynchus spp., Sacamento blackfish |
| San Joaquin Valley watershed | Mono, Yokuts | Freshwater | Sturgeon, thicktail chub, hitch, hardhead, Sacramento blackfish, splittail, Sacramento pikeminnow, Sacramento sucker, Chinook salmon, Sacramento perch, tule perch | Sacramento perch, Sacramento sucker, Sacramento blackfish, hitch, tule perch |
| | | Marine | Shark, ray, yellowtail, barracuda | |
| Central Coast (near SB) | Chumash | Marine | Shark, smoothhound, skate, guitarfish, ray, herring/shad/sardine, anchovy, midshipmen, northern clingfish, silverside, rockfish, lingcod, sculpin, sea bass, yellowtail, jack mackerel, drum/croaker/hardhead, white sea bass, white croaker, queenfish, opaleye, shiner perch, perches, pile perch, barracuda, senorita, sheephead, kelpfish, longjaw mudsucker, bonito, chub mackerel, swordfish, flatfish, ocean sunfish | |
| | | Freshwater | Steelhead, threespine stickleback | |

## Fish Historically Present in Traditionally-Fished Watersheds

Freshwater fish historically present in waterways fished traditionally by tribes were derived from the PISCES database (http://pisces.ucdavis.edu). According to this database, the number of species historically available in traditionally-fished areas varied between 2 (Fort Bidwell Paiute) and 12 (Mechoopda) species. This range is likely a function of the size of the area, the fish species diversity of the bioregion within which the tribe fishes, and the thoroughness of surveys of fish presence.

| Tribe/Region | Fish Species |
|---|---|
| Bishop Paiute | Owens sucker, Owens speckled dace, Long Valley speckled dace, Kern River rainbow trout, Central California roach, Sacramento pikeminnow, |
| Bridgeport Paiute | Mountain sucker, Lahontan redside, Lahontan speckled dace, Lahontan cutthroat trout, mountain whitefish |
| Big Pine Paiute | Owens sucker, Owens speckled dace, Long Valley speckled dace |
| North Fork | Central California roach, hardhead, Sacramento pikeminnow, Sacramento hitch, Sacramento perch, Sacramento tule perch |
| Grindstone | Sacramento hitch, hardhead, Sacramento pikeminnow, Pacific lamprey, Chinook salmon, Central California roach, Central Coast coho salmon |
| Mechoopda | Hardhead, Sacramento pikeminnow, Pacific lamprey, Chinook salmon, Central California roach, Sacramento perch, Sacramento tule perch, Sacramento hitch, riffle sculpin, Lahontan redside, Lahontan speckled dace, mountain sucker |
| Fort Bidwell Paiute | Pacific lamprey, Northern (Pit) roach, |
| Clear Lake Pomo | Sacramento perch, Sacramento hitch, hardhead, Sacramento pikeminnow, Sacramento tule perch, Pacific lamprey, Chinook salmon, Central California roach, Central Coast coho salmon, coastal cutthroat trout |
| Kashia Pomo | Pacific lamprey, coastal cutthroat trout, Central Coast coho salmon, Sacramento pikeminnow, hardhead |

## Traditional Pattern of Fish Use

Traditional fish use among tribes varies geographically, based on a combination of local fish availability and trade with other tribes. We found that tribes used a wide range of aquatic species and organism types (Table 3). Salmon was reported as traditionally-used by all tribes except Timbisha Shoshone (Table 3). There was a tendency for the number of types of aquatic organism to increase based on the number of people interviewed (Figure 2), suggesting that it would be useful in the future to interview at least 20 to 30 people per tribe about traditionally-used organisms.

**Table 3. Aquatic species and species groups historically used by tribe-members interviewed.**

| Tribe | Aquatic spp. (#) | Aquatic species (types) |
|---|---|---|
| | | |
| Me-Wuk (1) | 5 | Striped bass, catfish, clams, mussels, salmon |
| Nomlacki (12) | 20 | Catfish, sucker, pike, salmon, steelhead, Sacramento pike minnow, hitch, surf-fish, black bass, trout, perch, carp, bluegill, crayfish, mussels, clams, abalone, seaweed, kelp, tule |
| Maidu (10) | 17 | Bluegill, bass, carp, catfish, trout, eel, salmon, perch, rainbow trout, pike, sturgeon, steelhead, crayfish, clams, mussels, tule, seaweed |
| Paiute (35) | 17 | Tui chub, speckled dace, sucker, pupfish, rainbow trout, salmon, catfish, Lahontan cutthroat, brook trout, brown trout, perch, brine fly larvae, freshwater clams, snails, watercress, tule |
| Timbisha Shoshone (9) | 8 | Brook trout, golden trout, rainbow trout, brown trout, carp, bass, catfish, pupfish |
| Mojave (4) | 14 | Trout, striped bass, catfish, humpback catfish, carp, bullhead, steelhead, rainbow trout, bluegill, sturgeon, black bass, bonytail chub, minnows, crayfish |
| Washoe (2) | 3 | Trout, salmon, catfish |
| Mono (13) | 16 | Rainbow trout, brown trout, salmon, steelhead, black bass, perch, sucker, bluegill, eel, carp, minnows, crayfish, mussels, clams, water cress, cattails |
| Chemehuevi (24) | 15 | Black bass, catfish, striped bass, bonytail chub, razorback sucker, humpback chub, bluegill, red-ear sunfish, Colorado humpback chub, Sacramento pike minnow, trout, carp, crappie, crayfish, clams |
| Pit River (13) | 17 | Salmon, trout, sucker, red-band trout, steelhead, catfish, sturgeon, eel, black bass, bluegill, perch, crab, crayfish, mussels, clams, water cress, water lily |
| Wiyot (1) | 2 | Salmon, sturgeon |
| Wailaki (2) | 6 | Salmon, trout, surf fish, crab, mussel, seaweed |
| Pomo (56) | 27 | Catfish, carp, bluegill, crappie, blackfish, perch, sucker, cod, shark, tuna, surf fish, salmon, trout, cabezon, rockfish, bullhead, crab, crayfish, barnacles, mussels, abalone, snails, sea urchins, sea anemone, kelp, seaweed, tule |

| | | |
|---|---|---|
| **Pomo/Wailaki (5)** | 16 | Catfish, surf fish, salmon, blackfish, night fish, cod, abalone, hitch, bass, carp, bluegill, perch, eel, crab, mussels, seaweed |
| **Chumash (7)** | 30 | Salmon, trout, black bass, catfish, rockfish, steelhead, swordfish, sailfish, shark, sardine, tuna, halibut, perch, sea bass, surf-fish, mackerel, smelt, eel, crayfish, lobster/crab, abalone, snails, oyster, mussels, clams, urchin, cattails, seaweed, kelp |

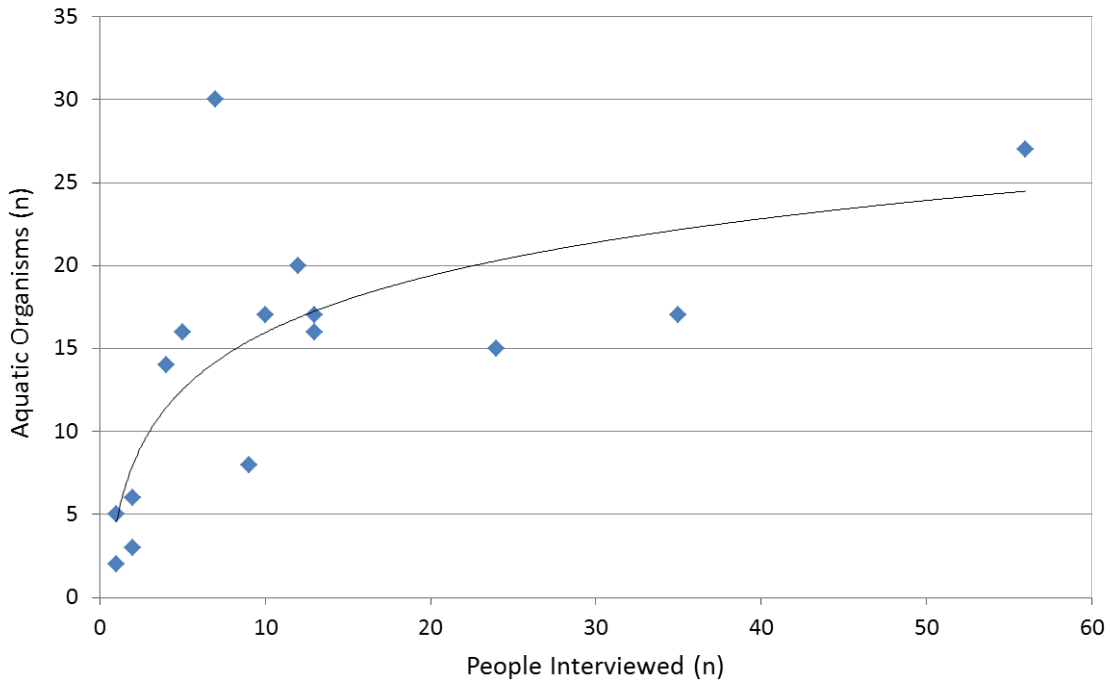


**Figure 2. Comparison of number of aquatic organisms reported used by a tribe and the number of people interviewed. The log curve fit better than a linear regression (based on R).**

The patterns of traditional fish use by tribes in different regions varied considerably (Table 4). Fish species used in certain regions were not used in others, most likely because of lack of availability. For commonly-used species and species groups (e.g., trout and black bass), the proportions varied among regions. The overall effect was that patterns varied among tribes and among regions.

**Table 4. Fish species and groups historically used by tribe-members within each Region. Black bass includes both largemouth and smallmouth bass.**

| | Water Board Region | | | | |
|---|---|---|---|---|---|
| **Species** | **Central Coast** | **Central Valley** | **Lahontan** | **North Coast** | **Total** |
| Black bass | 11.1 | 8.3 | 6.7 | 7.9 | 6.4 |
| Black crappie | 0.0 | 3.1 | 0.5 | 0.0 | 1.9 |
| Blackfish | 0.0 | 0.3 | 0.0 | 0.0 | 0.2 |
| Bluegill | 0.0 | 6.7 | 4.6 | 1.6 | 5.4 |
| Brook trout | 0.0 | 0.3 | 3.1 | 0.0 | 1.1 |
| Brown trout | 0.0 | 0.6 | 10.3 | 0.0 | 3.5 |
| Bullhead | 0.0 | 0.3 | 0.0 | 6.4 | 0.8 |
| Carp | 0.0 | 5.3 | 6.2 | 1.6 | 5.1 |
| Catfish | 11.1 | 16.1 | 15.9 | 9.5 | 15.3 |
| Chi/Hitch | 0.0 | 8.0 | 0.0 | 6.4 | 5.3 |
| Chub | 0.0 | 0.0 | 4.1 | 0.0 | 1.3 |
| Cutthroat trout | 0.0 | 0.0 | 4.1 | 0.0 | 1.3 |
| Golden trout | 0.0 | 0.0 | 3.1 | 0.0 | 1.0 |
| Lahontan dace | 0.0 | 0.0 | 0.5 | 0.0 | 0.2 |
| Minnow | 0.0 | 0.3 | 0.5 | 0.0 | 0.3 |
| Native trout | 0.0 | 0.6 | 0.0 | 0.0 | 0.3 |
| Perch | 0.0 | 9.1 | 0.5 | 3.2 | 5.7 |
| Pike | 0.0 | 1.9 | 0.0 | 0.0 | 1.1 |
| Pupfish | 0.0 | 0.0 | 5.1 | 0.0 | 1.6 |
| Quiee | 0.0 | 0.0 | 0.5 | 0.0 | 0.2 |
| Rainbow trout | 0.0 | 1.7 | 11.8 | 0.0 | 4.6 |
| Salmon | 33.3 | 12.7 | 4.1 | 31.8 | 12.3 |
| Shad | 0.0 | 0.3 | 0.0 | 0.0 | 0.2 |
| Shapal | 0.0 | 0.3 | 0.0 | 0.0 | 0.2 |
| Speckled dace | 0.0 | 0.0 | 1.5 | 0.0 | 0.5 |
| Sacramento pike minnow | 0.0 | 0.3 | 2.1 | 0.0 | 0.8 |
| Steelhead | 11.1 | 4.2 | 0.5 | 12.7 | 4.0 |
| Sturgeon | 0.0 | 2.2 | 0.5 | 3.2 | 1.8 |
| Sucker | 0.0 | 6.7 | 4.1 | 0.0 | 5.1 |
| Trout | 33.3 | 11.1 | 9.7 | 15.9 | 11.5 |

## Traditional Rates of Fish Use

Most respondents to traditional-practices surveying (64%) reported eating fish every day, or more than once a day when they were young (Figure 4). About 90% of respondents ate fish more frequently than once per week.

Rates of fish consumption (of any fish species) were calculated for each respondent to the traditional survey (rate = meal size X frequency). For an average meal size of 7.9 oz, 95$^{th}$ % rates were up to 222.9 g/day for Maidu, Paiute, Pomo, Wailaki, and Yurok tribe members. For a 95$^{th}$ % meal size of 17.5 oz, rates were up to 496.1 g/day for Maidu, Paiute, Pomo, Wailaki, and Yurok tribe members.

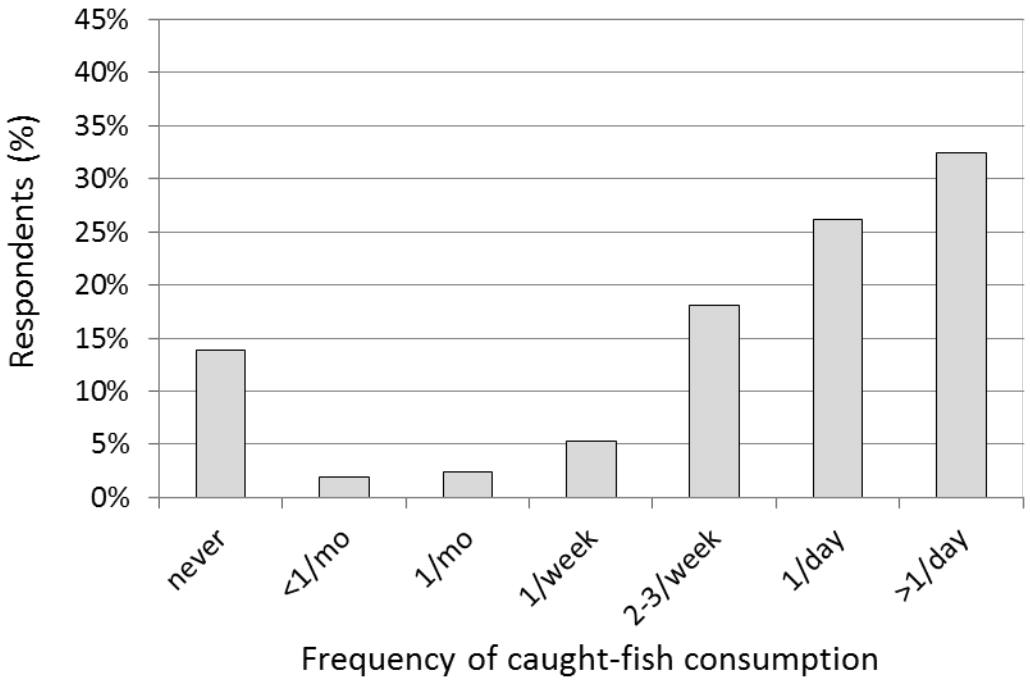


**Figure 4.** **Traditional frequencies of fish consumption.**

The vast majority of respondents reported that fishing and eating fish was culturally and traditionally important to tribes and an important part of tribe members' diet (Figure 5). Conversely, the majority reported that these traditional practices were not maintained now.

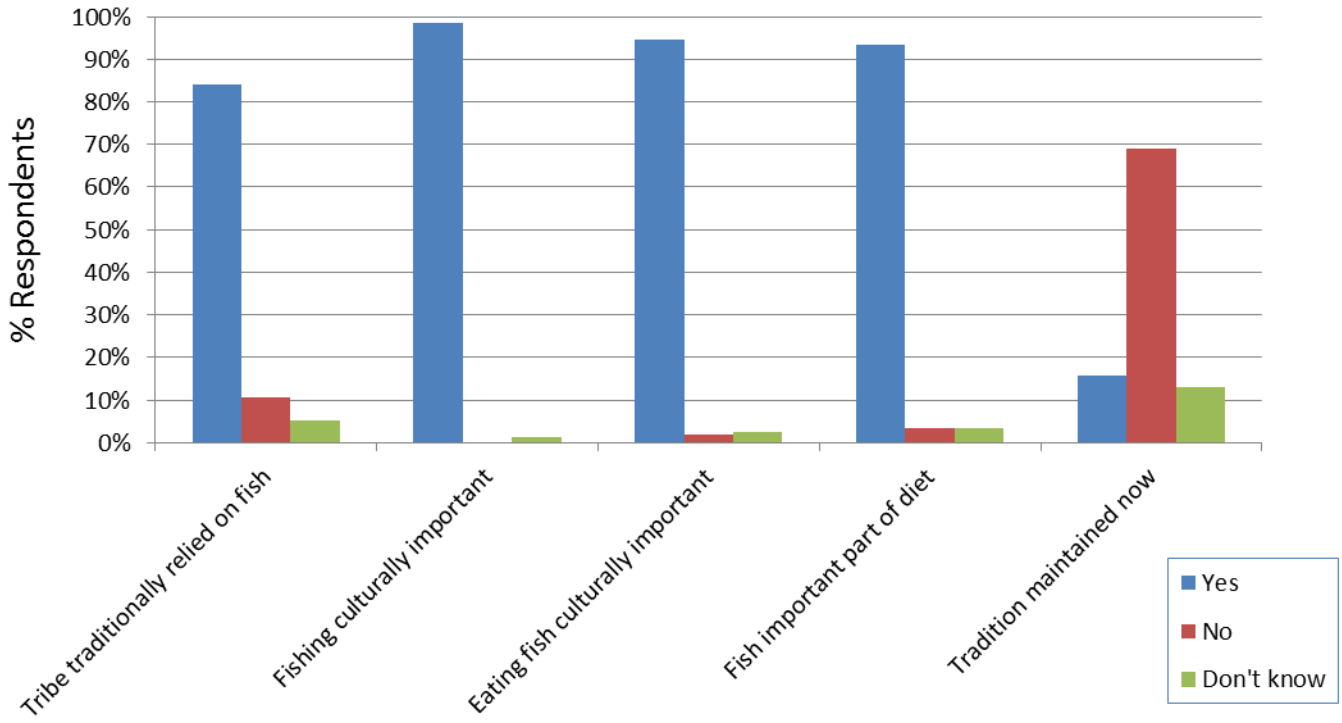


**Figure 5. Fish use traditions and maintenance of traditions today.**

## Contemporary Places for Catching Fish

Where there were sufficient respondents, watersheds were identified from which tribe members had obtained fish in the last 30 days (Figure 6). In most cases, fished areas were adjacent to the tribes' Rancherias or Reservations. Most tribes had received salmon from the lower Klamath River watershed and many had caught fish from the ocean and coastal areas.

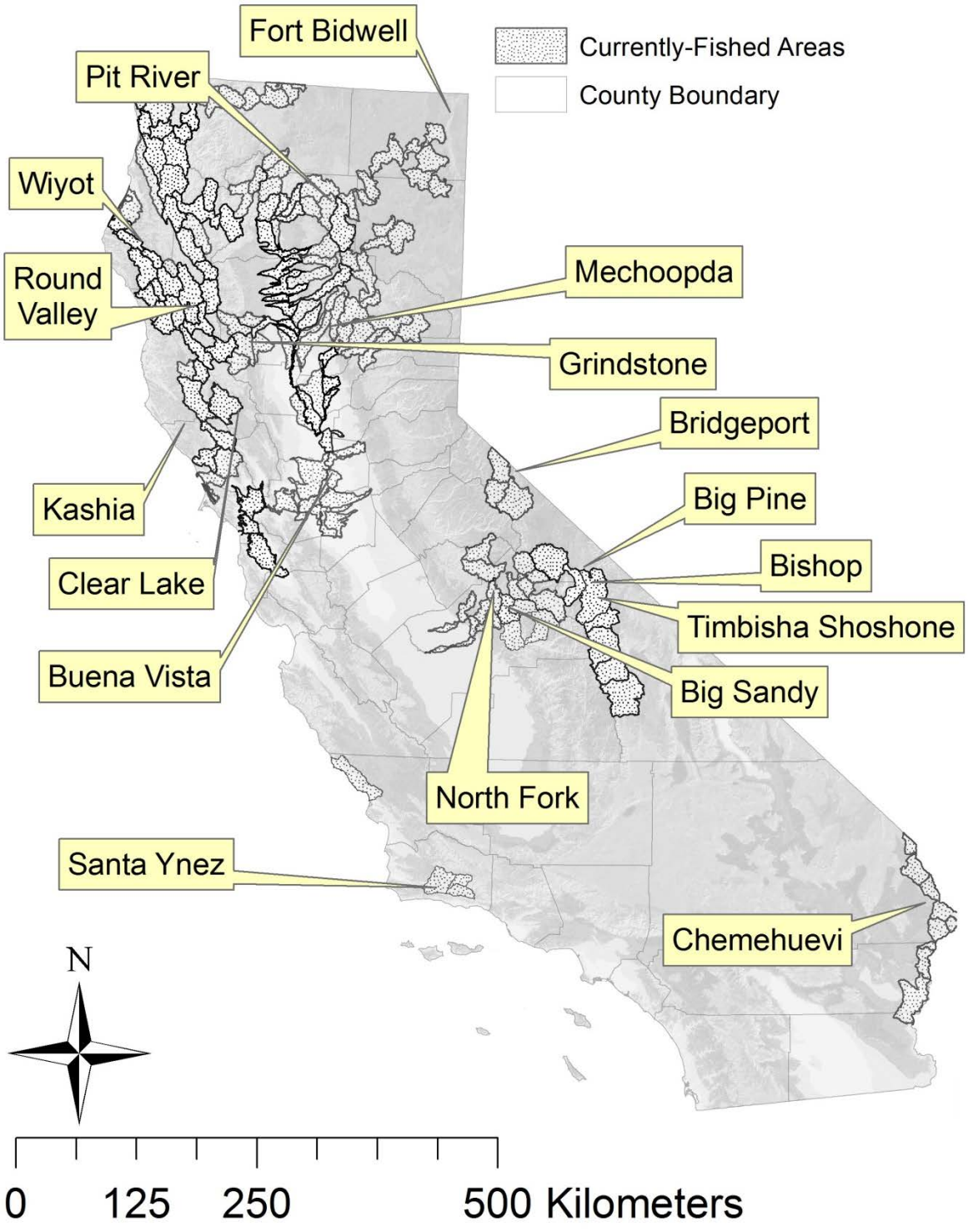


**Figure 6. Currently-fished watersheds (hydrologic unit code HUC-10). Areas with darker color outlines represent areas where fishing areas of more than one tribe overlapped.**

As was the case with the use of different types of aquatic organism, the number of places reported as being sources of fish increased based on the number of people interviewed (Figure 7), suggesting that it would be useful in the future to interview at least 30 people per tribe about places fished.

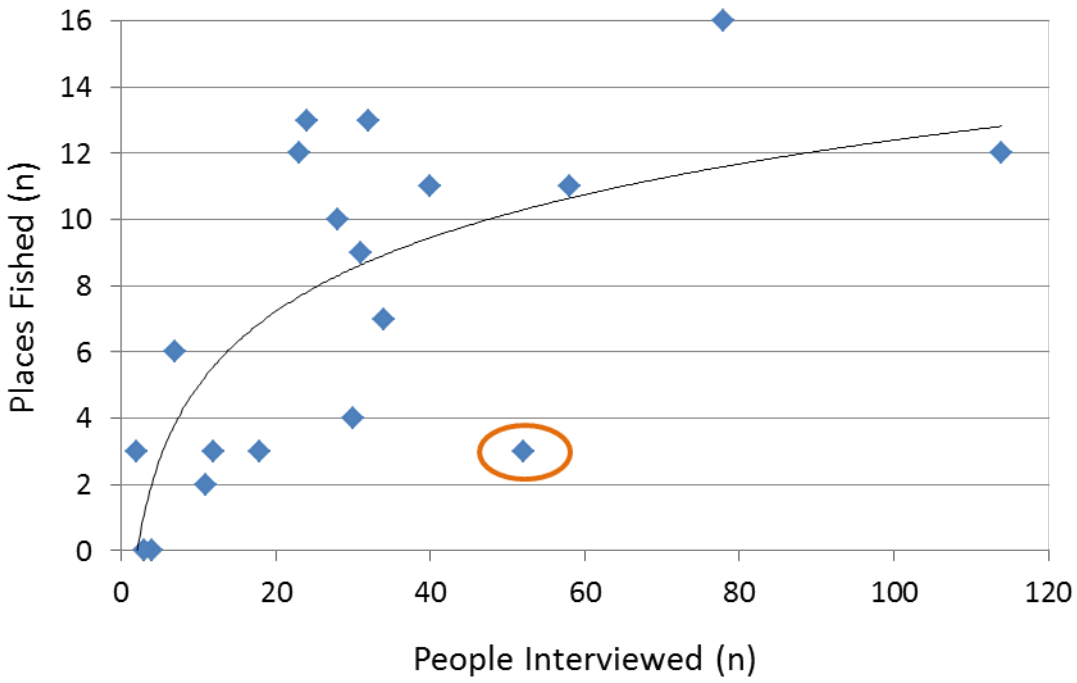


**Figure 7. Relationship between # of people interviewed and number of places from which fish was caught and eaten. The log curve fit better than a linear regression (based on R). The circled point represents a desert tribe where 3 large places were cited as sources of fish.**

## Contemporary Pattern of Fish Use

Contemporary fish use among tribes varies geographically, based upon local native and non-native fish availability. We found that tribes used a wide range of aquatic species and organism types (Table 5). Salmon was reported as currently-used by all tribes and for most tribes was among the top 3 fish species/groups used (Table 5). For most tribes, current fish use was similar to historical use by the same tribe, where similarity was indicated by dividing the number of fish that are currently used that were used historically, divided by the total number historically used. As was the case with traditional use, there was a tendency for the number of types of

aquatic organism to increase based on the number of people interviewed (Figure 8), suggesting that it would be useful in the future to interview at least 30 people per tribe about currently-used organisms.

**Table 5. Aquatic species and species groups used by each tribe interviewed. The number of people from each tribe is indicated in parentheses following the tribe name. Similarity was calculated as the number of currently-fished species/groups divided by the number traditionally-fished (underlined, cf. Table 3).**

| Tribe/Location | Aquatic species /species groups | Similarity (%) |
|---|---|---|
| **Me-Wuk (37)** | Salmon, trout, sturgeon, catfish, striped bass, bivalves, lobster/crab, crayfish, halibut, abalone, carp, sunfish/bluegill, perch, largemouth bass, snapper, cod, rockfish, lamprey/ eel, crappie, smelt, shrimp, squid, steelhead, American shad | 100 |
| **Nomlacki (31)** | Catfish, salmon, trout, abalone, lobster/crab, seaweed, bivalves, striped bass, largemouth bass, shrimp, sunfish/bluegill, carp, surf-fish, perch, sturgeon, kelp, Sacramento pikeminnow, lamprey/ eel, shark, sucker, crappie, hitch, steelhead, halibut, squid | 80 |
| **Mono (6)** | Salmon, trout, striped bass, largemouth bass, catfish, bivalves, smallmouth bass, sunfish/bluegill, sucker, lobster/crab, watercress | 47 |
| **Maidu (32)** | Salmon, trout, catfish, lobster/crab, largemouth bass, striped bass, crayfish, abalone, shrimp, bivalves, seaweed, sunfish/bluegill, sturgeon, carp, halibut, cod, tuna, perch, lamprey/ eel, rockfish, Sacramento pikeminnow, crappie, surf-fish, smallmouth bass, hitch, snapper, lingcod, tilapia, seabass, shark | 47 |
| **Paiute (Bishop, 17)** | Trout, salmon, catfish, crayfish, bivalves, largemouth bass, water cress, sunfish/bluegill, lobster/crab, brine fly larvae, carp, tule, striped bass, codfish, abalone, tuna, rockfish, perch, frog, sturgeon, lingcod, tilapia, haddock, algae, cattails | 50 |
| **Paiute (Big Pine, 24)** | Salmon, trout, crayfish, catfish, lobster/crab, bivalves, shrimp, largemouth bass, carp, sunfish/bluegill, striped bass, triggerfish, swordfish, mahi mahi, | 29 |
| **Paiute (Bridgeport, 18)** | Salmon, trout, catfish, crayfish, striped bass, largemouth bass, sunfish/bluegill, cui cui, tui chub, bivalves, sturgeon, smallmouth bass, perch, carp, pupfish, mountain whitefish, sucker, lobster/crab, abalone | 57 |
| **Northern Paiute (Fort Bidwell, 11)** | Salmon, trout, catfish, crayfish, lobster/crab, bivalves, abalone, largemouth bass, sturgeon, shrimp, cutthroat trout, striped bass, walleye, snapper, squid, scallop | 36 |
| **Timbisha** | Trout, catfish, salmon, crayfish, largemouth bass, lobster/crab, bivalves, | 80 |

| | | |
|---|---|---|
| **Shoshone (14)** | sunfish/bluegill, striped bass, carp, watercress, shrimp, tuna, halibut, squid, shark, perch, crappie, rooster fish, cod, abalone, brine shrimp larvae, snail | |
| **Washoe (6)** | Salmon, trout, catfish, smelt, abalone, striped bass, largemouth bass, smallmouth bass, perch, sunfish/bluegill, sturgeon, steelhead, bivalves, crayfish | 100 |
| **Chemehuevi (46)** | Striped bass, catfish, largemouth bass, salmon, trout, sunfish/bluegill, crayfish, bivalves, lobster/crab, carp, abalone, tuna, smallmouth bass, sturgeon, shark, swordfish, tilapia, perch, halibut, sea bass, cod, orange roughy, squid, seaweed | 60 |
| **Mojave (5)** | Catfish, trout, striped bass, largemouth bass, salmon, crayfish, smallmouth bass, sunfish/bluegill, sturgeon, carp, steelhead, tuna, tilapia, bivalves, lobster/crab | 64 |
| **Pit River (27)** | Salmon, trout, catfish, bivalves, lobster/crab, sturgeon, largemouth bass, crayfish, abalone, striped bass, squid, seaweed, sunfish/bluegill, sucker, lamprey/ eel, smallmouth bass, shrimp, carp, tule, watercress, perch, cabezon, cod, split-tail, Sacramento pike minnow, halibut, lingcod, snapper, tuna, surf-fish, rockfish | 88 |
| **Wiyot (32)** | Salmon, lobster/crab, trout, bivalves, sturgeon, lamprey/eel, abalone, surf perch, smelt, cod, catfish, rockfish, largemouth bass, halibut, sunfish/bluegill, steelhead, striped bass, night fish, perch, cabezon, snapper, crayfish, carp, tuna, sand dabs, | 100 |
| **Hoopa (Blue Lake/Bear River 4)** | Salmon, sturgeon, trout, steelhead, lamprey/eel, lobster/crab, bivalves, abalone, crayfish | ND |
| **Karuk (Bear River, 3)** | Salmon, sturgeon, trout, lamprey/eel, snapper, ling-cod, halibut, lobster/crab, bivalves, abalone, crayfish, seaweed, catfish, striped bass, largemouth bass, perch, steelhead, smelt, rockfish, surf fish, cod, tuna, flounder, ray, squid, snail | ND |
| **Pomo (Clear Lake, 164)** | Salmon, catfish, trout, abalone, lobster/crab, bivalves, largemouth bass, hitch, crayfish, striped bass, carp, seaweed, sturgeon, perch, surf-fish, smelt, crappie, lamprey/eel, halibut, shrimp, squid, tilapia, tuna, snapper, kelp, snail, blackfish, sea slug, rockfish, American shad | 63 |
| **Pomo (Kashia, 23)** | Salmon, abalone, bivalves, trout, seaweed, lobster/crab, striped bass, largemouth bass, surf-fish, crayfish, sunfish/bluegill, catfish, bullhead, snail, tilapia, carp, sturgeon, split tail, perch, cabezon, kelp, rock cod, rock fish | 63 |
| **Pomo-Wailaki (12)** | Split-tail, carp, lobster/crab, seaweed, striped bass, salmon, kelp, largemouth bass, smallmouth bass, trout, Sacramento pike minnow, abalone, cod, catfish, sunfish/bluegill, blackfish, bivalves, crayfish, smelt, sea anemone | 69 |
| **Wailaki (16)** | Salmon, trout, catfish, abalone, lobster/crab, striped bass, smelt, carp, crayfish, largemouth bass, split-tail, sturgeon, bivalves, seaweed, sunfish/bluegill, steelhead, cabezon, cod, halibut, shrimp, kelp | 83 |
| **Round Valley (35)** | Salmon, trout, abalone, smelt, striped bass, catfish, lobster/crab, steelhead, sturgeon, bivalves, crayfish, largemouth bass, sunfish/bluegill, | ND |

| | | |
|---|---|---|
| | lamprey/eel, cod, snapper, carp, seaweed, tuna, hitch, nightfish, rockfish, surf-fish, crappie, halibut, squid | |
| **Yurok (15)** | Salmon, sturgeon, trout, lobster/crab, cod, steelhead, lamprey/eel, bivalves, surf-fish, abalone, halibut, striped bass, largemouth bass, catfish, sunfish/bluegill, rockfish, crayfish, perch, carp, smelt, tuna, crappie, Sacramento pike minnow, nightfish, walleye, snapper, seaweed | ND |
| **Chumash (12)** | Trout, salmon, catfish, crayfish, largemouth bass, lobster/crab, halibut, bivalves, sunfish/bluegill, sturgeon, striped bass, abalone, shrimp, snapper, perch, carp, smelt, rockfish, cabezon, tuna, flounder, lingcod, snail | 71 |

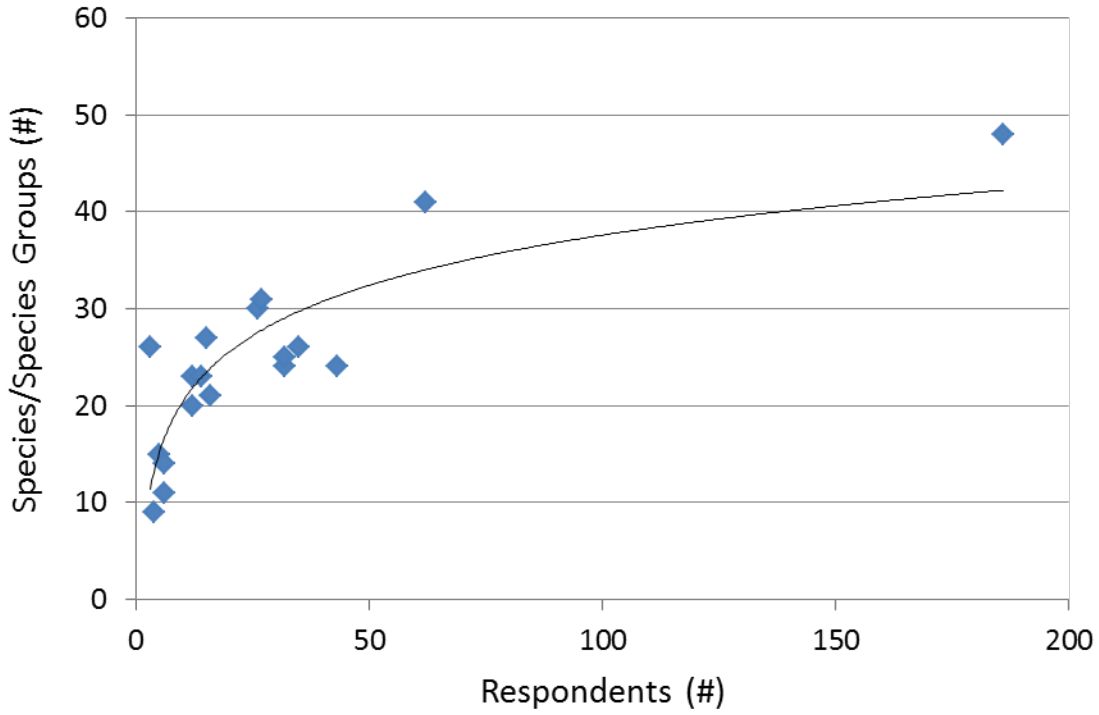


**Figure 8. Relationship between # of people interviewed and number of aquatic organisms species and species groups caught and eaten. The log curve fit better than a linear regression (based on R).**

## Tribe and Region Standard Rates of Fish Consumption

Where there was sufficient information, the contemporary frequency of fish use was compared to the frequency of traditional fish use. For all tribes as a group, there was a significant difference ($P<0.001$) between contemporary and traditional frequencies of using fish. This is

reflected in the distributions of frequencies (Figure 9), with contemporary frequencies of eating fish skewed toward low frequencies (never to once per month) and traditional frequencies skewed toward high frequencies (once per day).

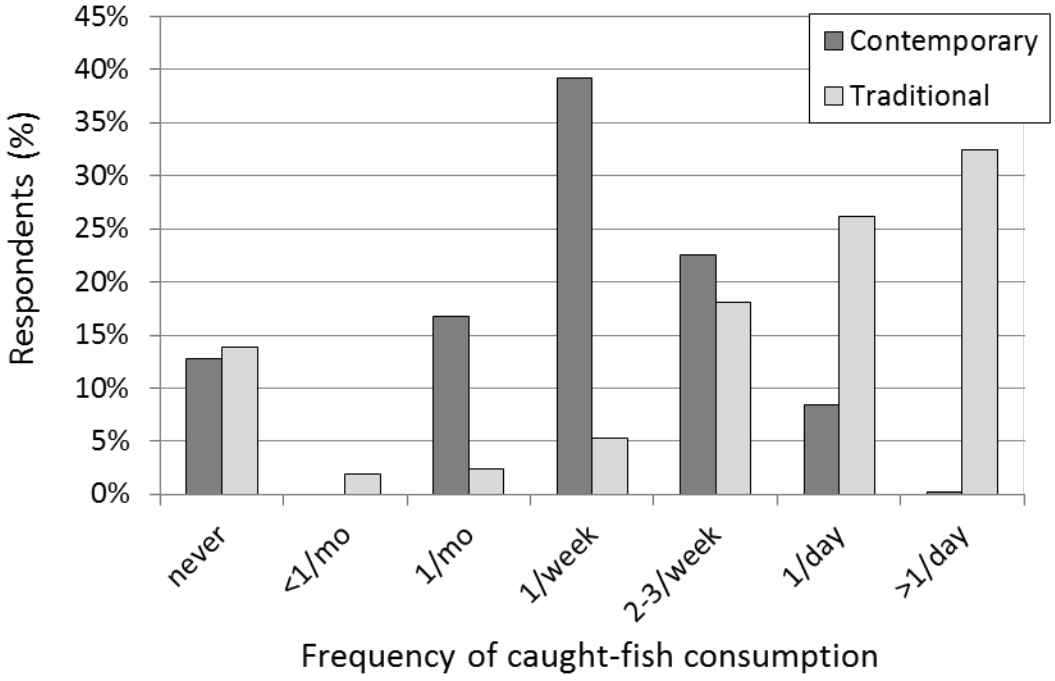


**Figure 9. Comparison of contemporary and traditional frequencies of fish use**

Tribe-specific rates of fish use were calculated for individual species, groups of species, for all caught finfish, and for all aquatic organism use. Of particular interest for state water policy formulation is the rate of use of caught-fish (all finfish retrieved from state waters). The 95$^{th}$ percentile rate of contemporary caught-fish consumption for all tribes as a group was 141.8 g/day (Table 6). This rate was significantly different from the traditional rate, which was estimated as frequency per individual times average portion size from contemporary consumption. The estimated 95$^{th}$ percentile traditional consumption rate was at least 222.9 g/day (one 7.88 oz average portion size per day) for all tribes interviewed.

**Table 6. Contemporary rates of fish and other aquatic organism consumption for all interviewed tribe members.**

| Component | Min (g/day) | Max (g/day) | 95$^{th}$ % (g/day) | 99$^{th}$ % (g/day) |
|---|---|---|---|---|
| **Salmon** | 0 | 382.7 | 72.6 | 179.9 |
| **All caught fish** | 0 | 623.7 | 141.8 | 240.2 |
| **Bought fish** | 0 | 255.1 | 60.8 | 152.1 |

| | | | | |
|---|---|---|---|---|
| **Other aquatic organisms** | 0 | 402.6 | 27.7 | 96.8 |
| **Total fish** | 0 | 623.7 | 181.9 | 333.2 |
| **Total aquatic organisms** | 0 | 708.7 | 200.0 | 400.0 |

## Importance of Salmon

Salmon was reported as being currently consumed by almost every tribe member interviewed, regardless of tribe and was the most common single type of fish consumed by tribes individually and collectively (Tables 6 & 7). North Coast tribes generally consumed more salmon and a larger proportion of caught fish as salmon than interior tribes (Central Valley, mountains, and desert). This pattern held when tribes' fish uses were grouped by Water Board Region: Lahontan, Central Valley, North Coast, and Central Coast (Table 8).

**Table 7. Proportion of consumed caught-fish composed of salmon for each tribe.**

| Tribe Name (n) | Salmon (95$^{th}$ % g/day) | Caught fish (95$^{th}$ % g/day) | Total fish (95$^{th}$ % g/day) | % Caught = Salmon |
|---|---|---|---|---|
| **Me-Wuk (32)** | 22.4 | 57.2 | 99.7 | 39 |
| **Maidu (26)** | 69.1 | 133.6 | 183 | 52 |
| **Pit River (17)** | 196.2 | 240.4 | 277.3 | 82 |
| **Paiute (52)** | 28.3 | 59.5 | 81.5 | 48 |
| **Northern Paiute (11)** | 37.6 | 63.1 | 99.9 | 60 |
| **Timbisha Shoshone (14)** | 39.8 | 104 | 257.8 | 38 |
| **Mono (6)** | 29.8 | 42.2 | 52.1 | 70 |
| **Chemehuevi (43)** | 0 | 110.3 | 178.6 | 0 |
| **Pomo (183)** | 28.3 | 59.2 | 101.8 | 48 |
| **Pomo-Wailaki (12)** | 28.9 | 34.8 | 59.2 | 83 |
| **Wailaki (16)** | 19.8 | 81.5 | 85.8 | 24 |
| **Round Valley Tribes (35)** | 57.8 | 70.3 | 81.6 | 74 |
| **Wiyot (30)** | 132.5 | 139.1 | 144.2 | 95 |
| **Yurok (15)** | 115.1 | 170.2 | 170.2 | 68 |
| **Chumash (12)** | 8.2 | 29.8 | 55.4 | 28 |
| **Total** | 72.6 | 141.8 | 181.9 | 51 |

**Table 8. Proportion of caught fish composed of salmon within each region.**

| Water Board Region (n) | Salmon (95$^{th}$ % g/day) | Caught fish (95$^{th}$ % g/day), (99$^{th}$% g/day) | Total fish (95$^{th}$ % g/day) , (99$^{th}$% g/day) | % Caught = Salmon |
|---|---|---|---|---|
| **Central Valley (288)** | 42.5 | 83.1, 203.8 | 125.1, 264.3 | 51 |
| **Lahontan (135)** | 20.4 | 71.9, 126.1 | 122.6, 206.8 | 28 |
| **North Coast (107)** | 119.1 | 162.2, 374.1 | 180.3, 374.8 | 74 |
| **Central Coast (12)** | 8.2 | 29.8, 47.9 | 55.4, 56.8 | 27 |

## Barriers to Traditional Fish Use

Tribe members were asked why traditional fishing and fish use practices were not maintained. Responses ranged widely, but centered around two main themes – aquatic ecosystem conditions and being able to fish. Degraded stream/water conditions and the loss of fish populations were the most commonly cited barriers to traditional fish use, followed by regulatory and access restrictions (Table 9).

**Table 9. Reasons traditional and contemporary fish use practices were not maintained for all tribes as a group (traditional, n=152 respondents; contemporary, n=394 respondents).**

| Reasons Traditions Not Maintained | % Traditional Respondents | % Contemporary Respondents |
|---|---|---|
| Aquatic ecosystem condition | | |
| Fish declines | 45% | 24% |
| Concerns about water/fish quality | 42% | 11% |
| Streams dried up | 37% | 16% |
| Fish locally extinct | 16% | ND |
| Land/water development | 10% | ND |
| Ability to fish | | |
| Regulation/limits/restrictions | 18% | 18% |

| | | |
|---|---|---|
| Access to traditional fishing areas | 15% | 15% |
| License not affordable | 10% | 5% |
| Racism/hostility toward tribe members | 2% | 0.3% |

## Relationship Between Fish Use and Income

Like all populations of people, there is variation in income within California tribes. The largest income class among respondents (36% of respondents) had an individual annual income in the range $18,000 to $50,000. This is similar to the distribution of income in 2012 among people in the US, where 25% of people interviewed by the US Census Bureau reported an individual annual income between $17,500 and $50,000 (Source: U.S. Census Bureau, Current Population Survey, 2013 Annual Social and Economic Supplement. http://www.census.gov/hhes/www/income/data/incpovhlth/2012/dtables.html, accessed 7/18/2014). Amounts of salmon, caught fish, bought fish, and total fish varied among income classes. For most income classes, caught fish dominated the fish diet, while for the >$100,000 income class, caught and bought fish were eaten in similar proportions. In the >$100,000 income class, the vast majority of fish consumed was salmon, whereas for other income classes, was closer to half of total caught fish consumed. One explanation for the zig-zag pattern in consumption across income classes is that there may be multiple patterns occurring simultaneously. One possibility is that very low income people have less ability to afford fishing equipment, transportation to fishing sites, and time to go fishing, resulting in less fishing. There may be a threshold when more fish can be acquired through fishing (i.e., >$18,000) and higher thresholds where fish can be bought more readily, possibly replacing caught fish. Finally, greater income may also affect peoples' ability to travel to catch salmon, which are only available in a few places in the state.

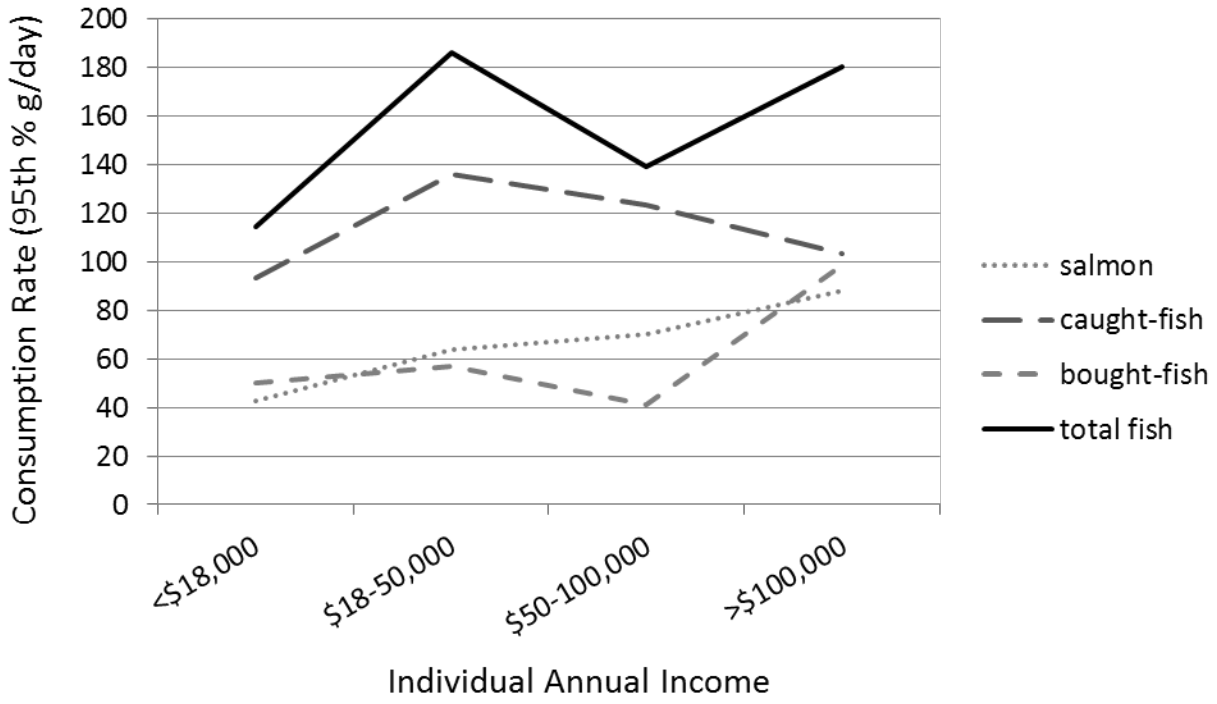


**Figure 9. Comparison of patterns of fish-use and individual annual income.**

## Maintenance of Traditional Practices

Three standards were used for maintenance of traditional fish use by tribes: 1) maintenance of fishing locations, 2) maintenance of fish species range, and 3) maintenance of fish consumption. Comparison of currently-fished areas with traditionally-fished areas revealed that traditional fishing is maintained in most places (Figure 9). Although access was described as a problem (Table 8), tribe members reported that they were able to fish most historically-fished waterways. Similarly, although certain fish species and species groups may have gone locally-extinct or endangered, most tribes reported currently using most species/groups that they traditionally-used (Table 5).

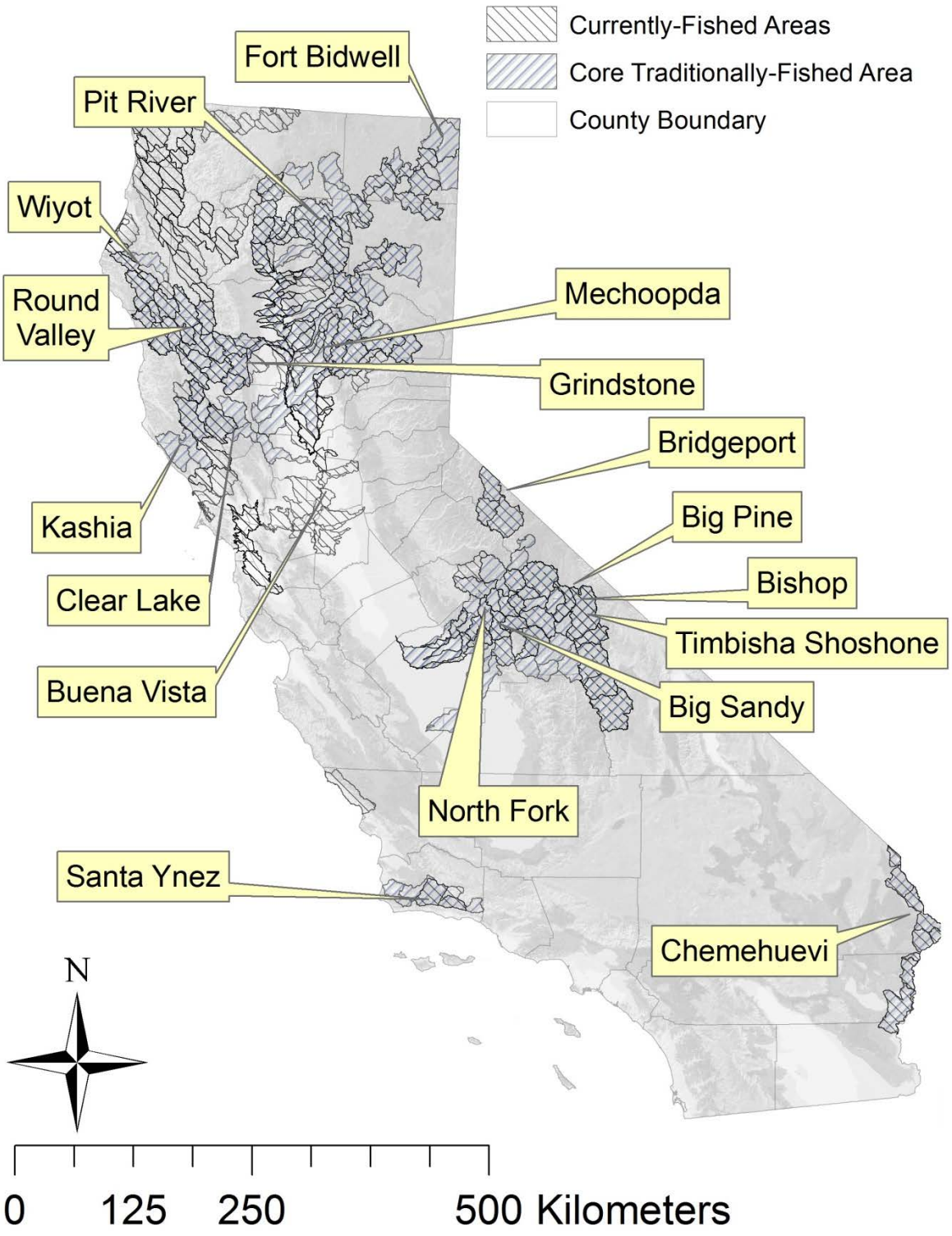


**Figure 9. Comparison of currently-fished and traditionally-fished areas (HUC-10 watersheds). Doubly-hatched ("criss-cross" pattern) watersheds were both historically fished and were recently-fished.**

### Tribe Staff Perspective

Tribe staff were contacted by email and asked various questions about traditional and contemporary fish use. In general their responses were similar to the responses of individual tribe members (see Appendix 4 for more detail). The vast majority of tribe staff responses were consistent with these statements and ideas: fish use was and still is important to tribes for cultural, subsistence, and other reasons; tribe members historically ate fish once per day or more often; aquatic ecosystem conditions and ability to fish (e.g., regulations and access) are barriers to fish use; and tribe members do not eat as much fish as they used to. Tribe staff also expressed the opinion that future projects of this type that rely on interviews of tribe members be conducted and/or led by tribes themselves.

## Discussion and Conclusion

Members of California Tribes use fish in similar patterns compared to traditional and historical uses, but sometimes at suppressed rates. The rates of fish consumptions for tribe members are among the highest recorded in California and for many regions are likely to be the highest and therefore the most policy-relevant. Although there are many exogenous barriers to fish use, such as reduced flows from excessive water withdrawals and water quality issues, tribes still practice the main patterns of fish use in terms of broad use of aquatic organisms and wide geographic spread of waterways used. Protection of tribes' use of fish will require target fish tissue concentrations of contaminants to be near background, recovery of fish populations through recovery of aquatic systems/flows, and recognition of accessibility issues that tribes face.

### Widespread and Broad Tribe Use of Aquatic Ecosystems and Organisms

The watershed area fished by individual tribes increased with the number of tribe members interviewed and for all regions represented a significant proportion of the total watershed area. Based on the area included after interviewing members of only 10 tribes about historically fished areas and members of 24 tribes about currently fished areas, it is likely that if all tribes were interviewed, the majority of California's waterways and watersheds could be considered traditionally and culturally used by tribes.

Tribe members reported traditional and contemporary use 26 freshwater/anadromous fin-fish species, 23 marine fin-fish species, and 18 other invertebrate, and plant species and groups of species. The more people interviewed per tribe, the longer the list of organisms reported as being used, suggesting that the lists are incomplete. Even with potentially incomplete reporting, about half of the fin-fish reported as being used were fish that had been found during archaeological investigations of middens. The other half of fish reported used was primarily composed of non-native fish that had been introduced since the mid-1800s (e.g., catfish in 1874; Dill and Cordone, 1997).

## Importance of Salmon Within and Among Regions

Yoshiyama (1999) provides one of the most exhaustive reviews of the use of salmon by California tribes, particularly in the Central Valley. By his estimate, based on citations, there may have been ~160,000 indigenous people living in the Central Valley and foothills (Cook, 1978; in Yoshiyama, 1999), equaling a density of ~3 people per square mile. Hewes (1947, 1978; in Yoshiyama, 1999) estimated that the per capita consumption rate of salmon among tribes was up to 1 pound (453 g) per day. This rate was likely just part of overall fish consumption, as suggested by archeological investigation suggesting tribes' use of a broad range of fish species (e.g., Gobalet et al., 2004).

Within the primary salmon-bearing areas of the Klamath, Sacramento and San Joaquin Rivers and tributaries, access to salmon runs was the object of some conflict, negotiated fishing rights, and trade of the resulting fish products (reviewed in Yoshiyama, 1999). Tribes from the desert east of the Sierra Nevada may have traditionally crossed the range to catch salmon in the Spring (Jackson and Spence, 1970; in Yoshiyama, 1999), suggesting that salmon was important historically to California desert tribes in the same way that tribes report its importance today.

Because so many salmon runs are listed as threatened or endangered or at risk of becoming so, it is challenging for most native people to practice using what may have been the most important fish to them collectively. The reasons that salmon populations are reduced in California rivers varies among regions, ranging from water quality issues (all rivers), to physical barriers (dams, most rivers), to insufficient flows due to withdrawal for agricultural and urban uses (most rivers). The cause of salmon declines is one of the most well-studied of the ecological impacts of Euro-American settlement of the West. Although the reasons vary for salmon declines, the regulatory (for agencies) and statutory (for the legislature) authority exists to solve most of the problems salmon, and by extension tribes, face for recovery to healthy populations that could support restored traditional use. The current problem with salmon

recovery is usually not lack of knowledge, but rather lack of political will to act to protect salmon and their traditional use.

## Tribe and Region Standard Rates of Fish Consumption

The USEPA (USEPA, 2000), San Francisco Bay Regional Water Quality Control Board (SFBWQCB, 2006), and Central Valley Water Quality Control Board (CVRWQCB, 2010) have all supported the use of the 95$^{th}$ or 99$^{th}$ percentile rates of fish consumption to develop water quality criteria and fish tissue criteria that are protective of people catching and eating fish from local waterbodies. These recommendations and actual use of these standards were made without conditioning based on the impact these criteria might have on those responsible for implementing or meeting these criteria, which is consistent with the use of the Clean Water Act as protective of beneficial uses and users without condition.

The standard rates are reported here as 95$^{th}$ percentile rates for individual tribes and for regions. The tribe specific rates presented here are useful in setting water quality criteria and fish tissue criteria at both the local waterbody scale and the region scale. Because tribes reported the waterbodies/HUC-10 watersheds that they had traditionally fished and the waterbodies/HUC-10 watersheds from which they had derived fish in the last 30 days, these criteria can be used at the HUC-10 or more general scale. In order to develop criteria useful at the regional scale, tribes' collective use of fish can be used for all waterbodies in a region, unless absence of use by tribes can be demonstrated.

## Suppression, Maintenance and Recovery of Traditional Fish Use

Compared to estimates from archaeological investigations and recall of elder tribe members, use of fish has been suppressed compared to historical rates. The daily use of fish reported by elders for only a couple of generations ago suggests that the suppression has been most severe in recent years. Elder and younger tribe members observed that fish availability, flows, and water quality may all be barriers to catching and eating fish at historical rates. The preponderance of evidence points toward regulated and restorable environmental conditions as being the primary barriers to recovery of traditional uses by tribes. For most tribes, there are individual and groups of tribe members who consume fish at rates similar to historical rates of fish use. This maintenance of traditional fish use points to the possibility that fish use could be

recovered for the majority of tribe members, as has been described for Columbia River tribes (Harper and Harris, 2008).

Recoverable rates of fish use should be established based on tribe or regional standards, based on quantification of "traditional, cultural and subsistence use" of fish based on tribe members' reporting of historical activities. This has been done here for several tribes, but could be expanded to include more tribes who potentially made greater use of fish than those who were interviewed.

## Barriers to Traditional and Contemporary Fish Use by California Tribes

Almost half of tribe members interviewed reported declines in fish populations as the primary barrier to maintenance or recovery of traditional rates of fish use. Approximately a third of tribe members reported water flows and quality as critical issues, which is highly correlated with fish declines. Lower proportions reported logistical problems with fish access, ranging from physical access to traditional fishing locations to state regulations and limits and cost of fishing.

Similar patterns were seen for barriers to contemporary fish use. Approximately ¼ of respondents reported declines in fish populations as the primary barrier to being able to use fish. Fewer, but sizable proportions of respondents reported water flows, water quality, regulations/limits, access to fishing sites, and costs as barriers.

The state policy nexus with these barriers to both traditional and contemporary fish use includes many state regulatory frameworks and permitting systems for water use and discharge of pollutants. If tribal traditional, customary, and subsistence use is regarded as a "beneficial use" under the Clean Water Act, then restoration of the use will require recovery of the flows and water quality that will permit healthy and less-contaminated fish populations to return and be used by tribes.

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# Appendix 1. Traditional Fish Use Questionnaire

| Survey # | Card # |
|---|---|

# *California Tribes, Traditional Fishing and Fish Use Survey*

**Date: _____ Interviewer name: _____ Time start: _____:_____ am pm**
**end: _____:_____ am pm**

**Location of Interview:**
**Tribe:**

*Hello. My name is _____. Because of concerns expressed by California tribes about fish and fishing, I am conducting a survey for the University of California Davis. We want to learn about the fishing practices and uses of fish by people in your tribe. This will help the tribe and the state set water quality standards to protect your ability to safely eat fish. At the same time, we want to protect your privacy, so I will not be asking your name or collecting personal information. This survey will take about 15 minutes and we are giving this gift to people who participate. Do you agree to let me interview you about your tribe's traditional fishing practices and use of fish?*

**1a.** ☐ **Y agree, proceed**
☐ N (do not proceed)

**1b. [IF INDIVIDUAL DOES NOT WANT TO BE SURVEYED] Please note any known reason that they declined:**

☐ No time
☐ Language barrier
☐ Appeared threatened/uncooperative ☐ Other:_____
☐ Unknown

**1c. [IF NO] Record observed gender:**

☐ Male ☐ Female

**2. Have you ever been interviewed before about fishing or eating fish**
☐ Y (fishing __ eating fish ___ ) Who?
☐ N (proceed)

**3.** Did your tribe traditionally rely on fish as a source of food in the past?
☐ Y
☐ N
☐ Don't know/refused

4. Were subsistence practices such as fishing protected under treaties signed by the tribe?
☐ Y
☐ N
☐ Don't know/refused

5. What major creeks, rivers, lakes, or other water-bodies were traditionally fished by your tribe (possibly use map as aid)?

6. What kinds of fish did you traditionally catch and eat?
[List fish by common name, clarify and/or use visual aid if uncertain]

_____

_____

_____

7. How much of each kind of fish did you traditionally eat?

| | | |
|---|---|---|
| _____ | 1 | > one meal a day |
| _____ | 2 | 1 meal per day |
| _____ | 3 | 2-3 meal per week |
| _____ | 4 | 1 meal per week |
| _____ | 5 | 1 meal per month |
| _____ | 6 | less often than 1/month |

**8.** Was fishing a culturally important activity in the past?
- ☐ Y
- ☐ N
- ☐ Don't know/refused

**9.** Was eating fish an important part of culture in the past?
- ☐ Y
- ☐ N
- ☐ Don't know/refused

10. Was eating fish an important part of the diet in the past?
- ☐ Y
- ☐ N
- ☐ Don't know/refused

**11.** Is this tradition maintained now?
- ☐ Y
- ☐ N
- ☐ Don't know/refused

12. If not, why not?

☐ Fish declines ☐ Fish locally extinct ☐ Streams dried up
☐ Concern about water/fish quality ☐ Don't know/refused

☐ Other: _____

# Appendix 2. Contemporary Fish Use Questionnaire

| Survey # | Card # |
|---|---|

# *California Tribes, Contemporary Fishing and Fish Use Survey*

**Date:** _____ **Interviewer name:** _____ **Time start:** _____:_____ **am pm**
**end:** _____:_____ **am pm**

**Location of Interview:**

*Hello. My name is _____. Because of concerns of California Tribes about fish, I am conducting a survey for the University of California Davis. We want to learn about the fishing practices and uses of fish by people in your tribe. This will help the tribe and the state set water quality standards to protect your ability to safely eat fish. At the same time, we want to protect your privacy, so I will not be asking your name or collecting personal information. We are not concerned with licenses or size limits. This survey will take about 15 minutes and we are giving this gift to people who participate. Do you agree to let me interview you about fishing and using fish?*

**1a.** ☐ **Y agree, proceed**
☐ N (do not proceed)

**1b. [IF INDIVIDUAL DOES NOT WANT TO BE SURVEYED] Please note any known reason that they declined:**

☐ No time
☐ Language barrier
☐ Appeared threatened/uncooperative
☐ Other:_____
☐ Unknown

**1c. [IF NO] Record observed gender:**

☐ Male ☐ Female

**2. Have you ever been interviewed before about fishing or eating fish**
☐ Y (fishing __ eating fish ___ ) Who?
☐ N (proceed)

**3. Do you fish?** ☐ Yes ☐ No

If interviewed while fishing

**4. What are you trying to catch today?**_____

**4b. Are you going to eat the fish you catch today?**

☐ Yes
☐ No
☐ Don't know/Not Sure
☐ Refused

**[If yes] Are you going to feed it to your family?** ☐ Yes ☐ No

If interviewed in office/home

**4c. [IF NO] What do you usually do with the fish you catch?**
☐ Eat it myself
☐ Give it to others to eat
☐ Catch and release it
☐ Other: _____
☐ Refused

**4d. [IF NO] Do you ever eat fish that you or someone you know catches?**

☐ Yes
☐ No [IF NO, SKIP TO **Q7a**]
☐ Don't know/Not Sure [SKIP TO **Q7a**]
☐ Refused [SKIP TO **Q7a**]

**5. About how many times did you go fishing in the last 30 days?**

_____**[ENTER NUMBER] per**

☐ week ☐ Don't know
☐ month ☐ Refused
☐ other_____

| **6a. Do you eat [*NAME OF FISH]* that you or someone you know catches?**<br>*Ask about specific fish listed below, as well as any others not named. Fresh, smoked, canned, etc.*<br>*Do this question first down the column, then come back and do fish by fish for b-d.* | **6b. How many times did you eat *[NAME OF FISH]* in the LAST 30 DAYS?**<br>**>once per day possible**<br>*If zero, skip to next row.* | **6c. If check box in 6a and**<br>**6b = 0, ask why have not eaten in last 30 days** | **6d. How much *[NAME OF FISH]* did you eat in one meal?**<br>*SHOW PICTURE OF FISH PIECES. Circle letter and write number of UNCOOKED models per meal.*<br>*Only ask for types eaten in the **last 30 days.***<br>**A – Small**<br>**C – Medium**<br>**E – Large** | **6e. Where was the *[NAME OF FISH]* caught?**<br>*Only ask for types eaten in the **last 30 days.***<br>*WRITE RESPONSE AND ENTER CODE*<br>1= Local river<br>2= Local reservoirs, ponds, or lakes<br>3 = Coastline, beach<br>4= Oceans or seas<br>5= Other (write response)<br>6= Location of survey |
|---|---|---|---|---|
| ☐ Catfish | | | A B C D E (Circle)<br>____ # of pieces/meal | |
| ☐ Striped Bass | | | A B C D E (Circle)<br>____ # of pieces/meal | |
| ☐ Largemouth bass | | | A B C D E (Circle)<br>____ # of pieces/meal | |
| ☐ Sunfish/bluegill | | | A B C D E (Circle)<br>____ # of pieces/meal | |
| ☐ Salmon | | | A B C D E (Circle)<br>____ # of pieces/meal | |
| ☐ Carp | | | A B C D E (Circle)<br>____ # of pieces/meal l | |
| ☐ Sturgeon | | | A B C D E (Circle)<br>____ # of pieces/meal | |
| ☐ Trout/Rainbow | | | A B C D E (Circle)<br>____ # of pieces/meal | |
| ☐ Other_____ | | | A B C D E (Circle)<br>____ # of pieces/meal | |
| ☐ Other_____ | | | A B C D E (Circle)<br>____ # of pieces/meal | |
| ☐ Other_____ | | | A B C D E (Circle)<br>____ # of pieces/meal | |
| ☐ Other_____ | | | A B C D E (Circle)<br>____ # of pieces/meal | |

| | Do you eat [*NAME OF SHELLFISH]* that you or someone you know catches? | | | |
|---|---|---|---|---|
| ☐ Clams/mussels/ oysters | | | ____ # /meal | |
| ☐ Crawdads/crayfish | | | ____ # of crayfish/meal | |
| ☐ Abalone | | | ____# or amount/meal | |
| ☐ Crab | | | ____ # or amount/meal | |
| ☐ Other | | | ____ # or amount/meal | |

**7a. In the last 30 days, have you eaten fish that came from stores, markets, restaurants, or cafeterias? (examples, tuna, fish sticks)**

☐ Yes
☐ No
☐ Don't know/ Not Sure
☐ Refused

[GO TO Q8a]

**7b. In the last 30 days, how many times did you eat fish that comes from stores, markets, restaurants, or cafeterias?**

*[SHOW PICTURES]. Circle letter and write number of pieces per meal]*

A B C D E (Circle)

_____ times in last 30 days

____ #of pieces/meal

**What kind of fish was it?** _____

**8. Are you able to eat as much fish now as in the past?**
**☐ Yes**
**☐ No**
**☐ Don't know/ Not Sure**
**☐ Refused**

**9. What are the main things that affect how much fish you can catch?**

_____

_____

**10. Are there times of year when you eat more fish? When is that and what kinds of fish**

_____

**11. What are the main things that affect how much fish you can eat?**

_____

_____

## HOUSEHOLD & DEMOGRAPHIC INFORMATION

**12. In the past year, have any children under 18 in your household eaten fish that you or someone you know caught?**

☐ Yes
☐ No
☐ Don't know/ Not Sure
☐ Refused

**13. In the past year, have any women between ages 18 and 49 in your household eaten fish that you or someone you know caught?**

☐ Yes
☐ No
☐ Don't know/ Not Sure
☐ Refused

**14. In the past year, have any women expecting a child or who have a baby in your household eaten fish that you or someone you know caught?**

☐ Yes
☐ No
☐ Don't know/ Not Sure
☐ Refused

**15. If you don't mind, could you tell me how best to describe your tribal affiliation and ethnicity:**

**16. If you don't mind me asking, what is your age: [READ CHOICES. CHECK APPROPRIATE BOX.]**
1 ☐ Under 18?
2 ☐ between 18 and 34?
3 ☐ between 35 and 49?
4 ☐ over 49?
5 ☐ Refused

**17. What city, town or zip code do you live in? _____**

**18. [RECORD APPARENT GENDER]**
☐ male
☐ female

**19. I am going to show you a list with some income levels on it, please pick the category that best describes your annual household income from all sources.**

☐ Less than $18,000
☐ $18,000 to less than $50,000
☐ $50,000 to less than $100,000
☐ $100,000 or more
☐ Don't know / Not sure
☐ Refused

# Appendix 3. Online Surveying Questionnaire

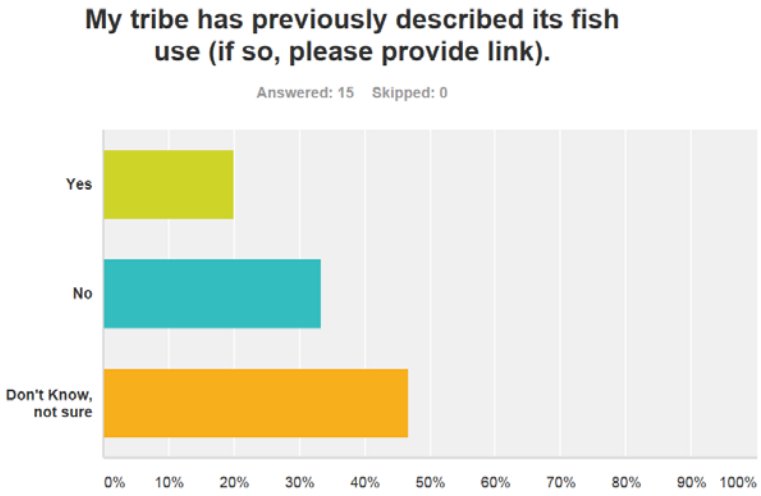
## Online Surveying Questionnaire

1. What is your tribe?
2. My tribe has previously described its fish use (if so, please provide link).
3. Would you consider fish important to your tribe for cultural, subsistence, or other reasons?
4. Historically, were fish important to your tribe for cultural, subsistence, or other reasons?
5. What types of fish did your tribe rely on in the past? (Please write in order of importance)
6. What types of fish does your tribe rely on now? (Please write in order of importance)
7. How often did tribe members eat fish in the past?
8. What are the primary impacts or barriers to your tribe's fish use?
9. Do tribe members eat as much fish as they would traditionally?
10. In the future, studies of tribes' fish use should be conducted by...?

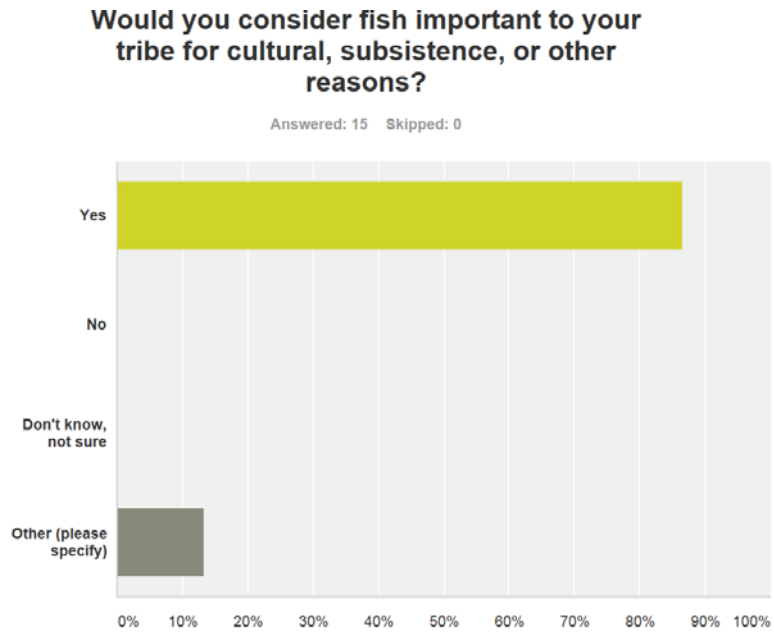
# Appendix 4. Tribe Staff Responses to Survey

**Question 1.** Tribe staff responding: Wilton Rancheria, Karuk, Wintu, Round Valley Tribes, Big Valley Band of Pomo, Noyo River, Bear River Band of Rohnerville Rancheria, North Fork Rancheria of Mono Indians, Pala Band of Mission Indians, Mechoopda Indian Tribe

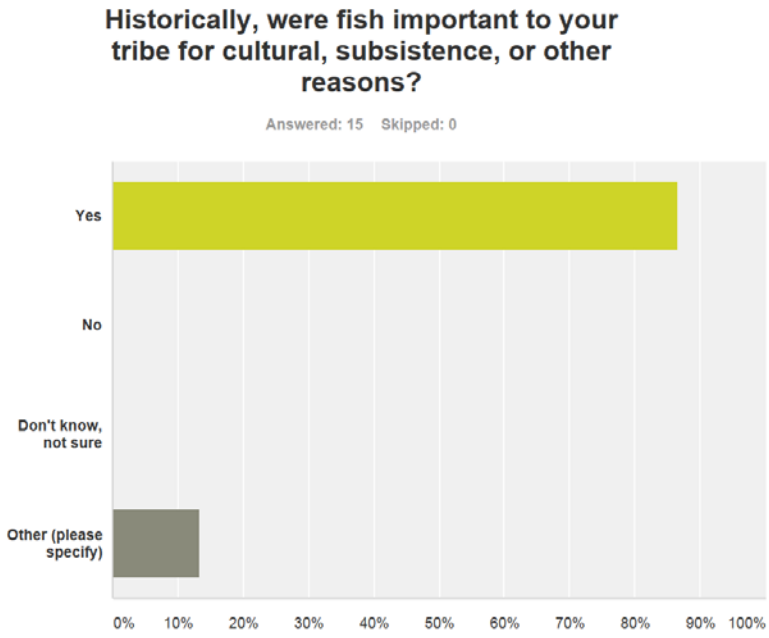
**Question 2.**




**Question 3**.



**Question 4.**

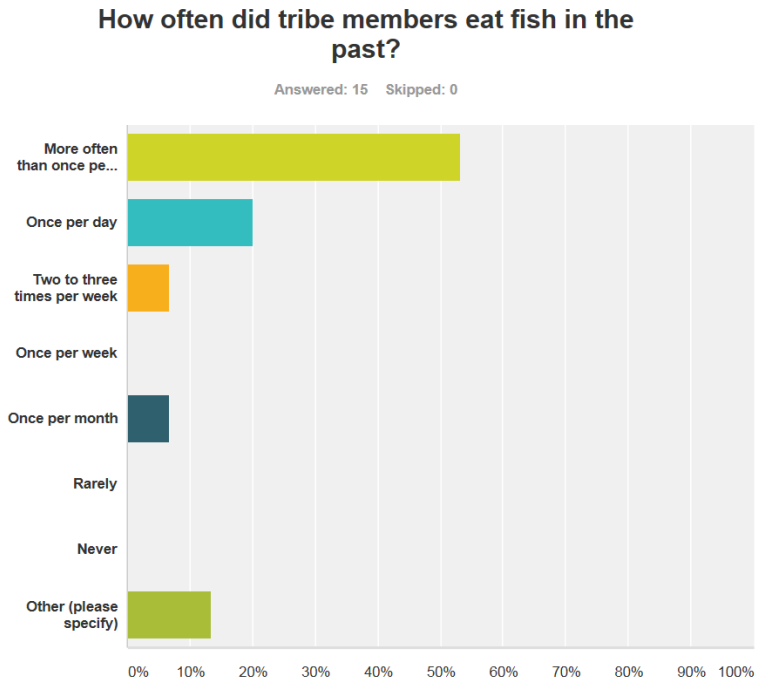



**Questions 5 & 6.**

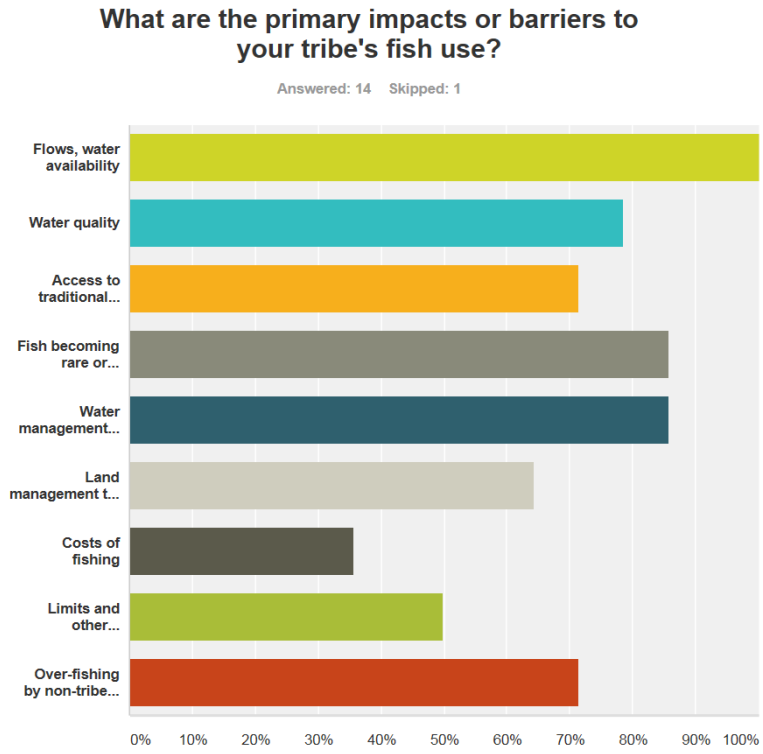
What types of fish did your tribe rely on in the past? (Please write in order of importance) What types of fish does your tribe rely on now? (Please write in order of importance)

| Tribe | Past Fish Species/Groups | Current Fish Species/Groups |
|---|---|---|
| **Wilton Rancheria (Me-Wuk)** | Chinook salmon, sturgeon, fresh water eel | Chinook salmon |
| **Karuk (2)** | Chinook and coho salmon, sturgeon, eel | Chinook, eel |
| **Wintu** | Salmon, trout, sturgeon, eel | Salmon |
| **Round Valley Indian Tribes (5)** | Salmon, steelhead, trout, eel | Salmon, steelhead, trout |
| **Big Valley Band of Pomo Indians** | Sha (blackfish), hitch, ah-ah-sha (yellow catfish), sha-pal (sim. steelhead), dee-tah (sim. crappie), sun perch, bluegill, trout, black bass, catfish, clams | Store-bought fish, catfish and crappie from lake, clams and crayfish from lake, hitch from creeks, gifted salmon |
| **Noyo River** | Salmon, perch, surf fish & all other types of fish from the ocean | Salmon, surf fish, cod, cabazon, & anything else we can catch |
| **Bear River Band of Rohnerville Rancheria** | Salmon, lamprey/eel, steelhead, trout | Salmon, lamprey/eel |
| **North Fork Rancheria of Mono Indians** | Salmon | Trout |
| **Pala Band of Mission Indians** | Trout, bass, ocean shore fish | none |
| **Mechoopda Indian Tribe** | "Its not the type of fish, but what is in season and what is needed." | "It is up to the Tribe and the season of fish that are available." |

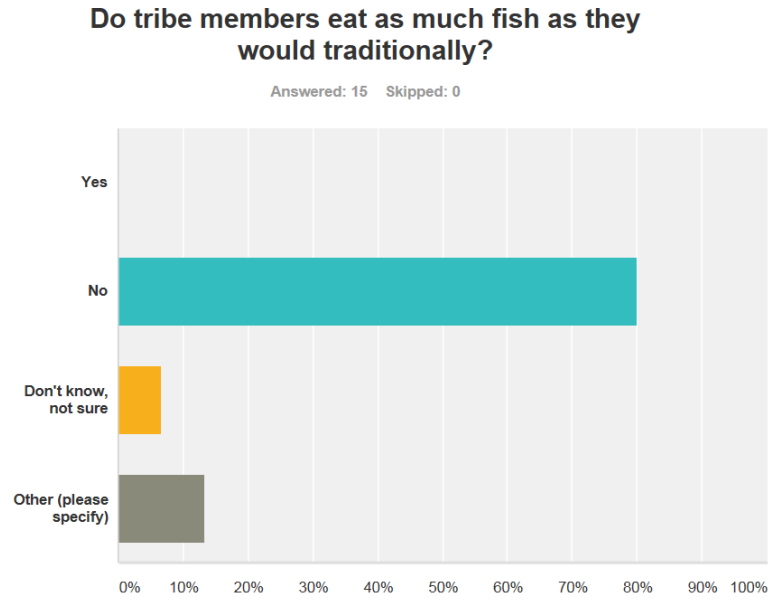
**Question 7.**




**Question 8.**



**Question 9.**




**Question 10. In the future, studies of tribes' fish use should be conducted by...?**

| Type of Entity | Percent of responses |
|---|---|
| Tribes | 40% |
| State agencies | 0 |
| Federal agencies | 0 |
| Academia | 0 |
| Non-governmental organizations | 6.7% |
| Private consultants | 0 |
| Combination of above | 53% |