

SALTON SEA FISH EVALUATIONS

Two draft sampling plans are described below to address different aspects dealing with chemical concentrations in fish from the Salton Sea. Objectives and needs of each dictated that two separate sampling plans be developed for 1) a fish advisory update and 2) fish meal and fish fertilizer assessment.

FISH ADVISORY EVALUATION

Background: States, U.S. territories, and Native American tribes issue fish consumption advisories in order to protect their residents from health risks associated with consumption of contaminated fish caught non-commercially. In May 1986, a public health advisory on fish consumption was issued by the State of California Department of Health Services (California Department of Health Services, 1986) for the Salton Sea and is still in effect. The California Environmental Protection Agency's Office of Environmental Health Hazard Assessment (OEHHA), Pesticides and Environmental Toxicology Section, provides specific consumption advice and makes recommendations to state and county health departments, California's Department of Fish and Game (CDFG) and the State Water Resources Control Board (SWRCB) with regard to sport and commercial fishing advisories. The following advisory appears in the 1999 California Sport Fishing Regulations:

COLORADO RIVER DISTRICT

Salton Sea (Imperial and Riverside Counties)

Because of elevated selenium levels, no one should eat more than four ounces of croaker, orangemouth corvina, sargo and tilapia taken from the Salton Sea in any two week period. Women who are pregnant or who may soon become pregnant, nursing mothers and children age 15 and under should not eat fish from this area. (An additional warning for the New River has been published and posted by the Imperial County Health Department for people to avoid physical contact with the waters of the New River and to avoid eating any fish of any variety taken from the river) (California Department of Fish and Game, 1999).

According to the U.S. Environmental Protection Agency (USEPA), from 1993 to 1997, the number of fish and wildlife advisories issued has increased five percent nationwide. This is thought to be due primarily to an increase in the number of assessments of chemicals in tissues of fish and wildlife (USEPA, 1998). There are five major types of advisories and bans to protect the general public and sensitive subpopulations (usually pregnant women, nursing mothers, and young children): (1) A no-consumption advisory for the general population [NCGP]; (2) a no consumption advisory for the sensitive

subpopulation [NCSP]; a recommendation of restricted consumption by either (3) the general public [RGP] or (4) the sensitive subpopulation [RSP]; or (5) a commercial fishing ban [CFB] which, by inference, bans consumption of all species identified in the ban from that waterbody (USEPA, 1998). The Salton Sea advisory covers types 3 and 4 above and is issued for waterbodies where chemical contamination is thought to be less severe than areas where other types of advisories are issued.

The fish advisory for the Salton Sea was issued in 1986 for selenium only, based on limited whole fish data (concentrations ranged from 1.7 to 3.8 parts per million) from the SWRCB. The SWRCB contracts the CDFG to carry out the state's Toxic Substances Monitoring (TSM) program, which has two monitoring sites at the Sea (North and South) in addition to one site each on the Alamo and New Rivers. The focus of TSM chemical analyses at these sites is selenium. Information collected for the TSM program also may be used by OEHHA to provide information for fish advisories where appropriate; however, data from this program is collected for water quality assessment purposes and not for public health purposes. The sampling methods used for the TSM preclude use of some of the data for fish consumption advisory evaluations (Margy Gassel, OEHHA, oral communication, 6/4/99).

A graduate student of Dr. Richard Gersberg of San Diego State University has recently conducted a study of chemicals in fish from the Salton Sea. Fish muscle tissue samples, mostly from tilapia but with limited sampling of other fish species, were analyzed for selenium and arsenic for the purposes of conducting a risk assessment. Fish were sampled mostly from the north part of the Sea. Results have not yet been published and sampling was not coordinated with the state. Preliminary data from this work suggest that arsenic in Salton Sea fish also may be a concern in addition to selenium.

The Salton Sea Science Subcommittee (SSC) is charged with a variety of tasks associated with the Environmental Impact Report/Environmental Impact Statement for the Salton Sea Restoration Project. These tasks include synthesis of existing ecological information, identification of important data gaps, and developing requests for proposals to address those gaps. For this reason, the fish advisory at the Salton Sea has been identified as an important data gap due to the perceived age and nature of the data used for the original fish advisory.

Problem: OEHHA and Imperial County Department of Health Services have agreed that there is a need for current human-health focused chemical sampling of fish at the Salton Sea in order to update the advisory (Margy Gassel, OEHHA, and Tom Wolf, Imperial County Division of Environmental Health Services, written communications, 1999). In order to be used for this purpose, the data must meet data quality objectives and criteria established by OEHHA and be accepted for use by OEHHA.

Objective: To conduct a human-health based study to determine the concentrations of selected chemicals in harvestable fish from the Salton Sea and assess the status and need of the current fish consumption advisory. Chemical concentrations alone, as opposed to microbial pathogens, are the focus of this study based upon input from OEHHA and other agencies at a workshop on this study plan held by the Science Subcommittee on October 19, 1999.

Approach: The following sampling design is proposed based upon USEPA guidance (USEPA, 1995), background information stated above, input by various agency representatives, and the fish evaluation workshop conducted by the Science Subcommittee on October 19, 1999. Details of methods for sampling and analysis would be those agreed upon by the SSC and OEHHA in order to meet all required data quality objectives for the fish advisory, agreed-upon time frames, sampling logistics, and funding constraints.

Currently, fish of various species including tilapia, orangemouth corvina, sargo, and croaker (*bairdiella*) are being collected at the Sea by Dr. Barry Costa-Pierce, as part of the Salton Sea Reconnaissance Project overseen by the SSC. The objective of this study is an assessment of the fish community and population dynamics of the Salton Sea. If possible, collection of fish for chemical analysis would be coordinated with this project. Otherwise, different arrangements will need to be made for collection of fish for analysis. OEHHA recommends that sampling be coordinated with the Regional Water Quality Control Board (RWQCB) and CDFG in order to provide consistency with the TSM dataset for the Salton Sea. The Science Subcommittee will provide funds for the collection and analysis of chemicals in fish tissues.

The sampling area will be restricted to the Salton Sea and mouths of the major tributaries. Separate samples will be collected from four geographically dispersed areas in the Salton Sea: (1) NORTH: near mouth of Whitewater River, (2) SOUTH: Obsidian Butte/Redhill Marina/Mullet Island, (3) EAST: Salton Sea State Recreation Area, (4) WEST: Desert Shores/Salton City. These are locations where public fishing pressure is determined to be high or where bottom sediments previously sampled by Levine-Fricke Recon found elevated selenium concentrations. Fish will be collected from these areas near shore and from the mixing zone. (Additional input will be needed regarding specific peak public fishing areas). Fish movement is not considered to be significant between these areas so that samples would be representative of the areas (R. Riedel, San Diego State University [SDSU], oral communication, 10/19/99). It is recognized that sargo will not be available in all areas and are not found in significant numbers in the south part of the Sea; however, the other three species of fish should be available throughout the Sea.

The one-time sampling will be done prior to fish spawning in Spring 2000 (exact timing in spring to be confirmed). This provides for sampling during a peak fishing period. In addition, this should provide a worst-case estimate of chemical concentrations as it avoids sampling fish that may have mobilized substantial muscle-sequestered chemicals into spawning products.

Fish species sampled will include all those that are consumed by the general public: tilapia, orangemouth corvina, sargo, and croaker as listed in the current fish advisory. Therefore, samples of 12 to 15 adult individuals of a single species will be collected from each of the four areas listed above based on recommendations by OEHHA (M. Gassel, OEHHA, written communication, 11/12/99). Data on public consumption patterns of Salton Sea fish are not needed as input (R. Brodberg, OEHHA, oral communication, 10/19/99). EPA guidance suggests use of three to ten individuals to assess chemical concentrations for use in fish advisories but states that sample size requirements should be determined based on estimates of variance of chemicals of concern in the fish population, fisheries management and statistical power considerations (USEPA, 1995). The number of fish sampled should provide defensible data for statistical comparison of the four areas with respect to chemical concentrations in these fish species.

The median age class will be targeted using specific size ranges determined from current fish population studies at the Sea (to be provided by R. Riedel, SDSU). Results of current fish population sampling indicate that the median age for all these species is two years (R. Riedel, San Diego State University [SDSU], oral communication, 10/19/99). Total maximum length (mm) and weight (g) data will be recorded for each fish collected in addition to the sample date, time, location, sampling gear used, field taxonomic identification, and collectors' names. Quality assurance replicate samples will be collected for each species and will constitute a minimum of 10% of the total number of samples collected. Replicate samples should be as similar to each other as possible with regard to fish size. After collection, each fish will be individually wrapped in aluminum foil, labeled, and placed in a sealed plastic bag. Fish from each sampling area will be placed in a sealed plastic bag for that area and placed on dry ice for shipment to the laboratory (wet ice may be used if shipping time does not exceed 24 hours). Sample collection, processing, preservation, and shipping will be conducted in such a way as to ensure sample integrity for the accuracy of chemical analyses.

Samples for analysis will be shipped to a laboratory agreed upon by the SSC and OEHHA following chain-of-custody procedures. It is recognized that consistency of chemical analyses with those of the TSM program are a concern of OEHHA, and this may necessitate the designation of a specific analytical laboratory. Samples of the edible portion of fish, skin-off fillets, will be removed in the laboratory or other sample processing facility by trained personnel and not in the field (Schmidt and Finger, 1987). Use of skin-off fillets is based upon the additional advisory guidance given to the public to eat only fillets and to remove the skin before eating fish from the Sea; however, since it is acknowledged that many individuals may eat fish with the skin on, a subsample of skin-on fillets will be analyzed for comparison.

Individual fish will be analyzed for those chemicals of concern where there are human health standards. Fillet samples will be analyzed for at least arsenic and selenium; OEHHA recommends analysis for the following target analytes listed by USEPA (1995): arsenic-inorganic, cadmium, mercury, selenium, and tributyltin (M. Gassel, OEHHA, written communication, 11/12/99). Individuals will then be composited (4 to 5 individuals in each of three composite samples per M. Gassel, 11/12/99) and the resulting

whole fish composite samples will be analyzed for synthetic organic contaminants such as organochlorine pesticides (total chlordane, total DDT, Dicofol, Dieldrin, Endosulfan I and II, Endrin, Heptachlor epoxide, Hexachlorobenzene, Lindane, Mircex, Toxaphene) and total PCBs using a general screening method. This segregation of individual fillets for inorganic analyses and whole fish composites for organic analyses is due to the primary focus of this study on arsenic and selenium. Synthetic organic compounds are not as likely to be at levels of concern at the Sea. If organic analyses find concentrations at levels of concern, additional sampling or more specific analyses might be done.

Laboratory analyses will use standardized and quantitative analytical methods with limits of detection that allow accurate quantification of the target chemical at or below levels of concern. Data on concentrations of chemicals in the samples will be released by the designated laboratory to OEHHA and upon review to the SSC within 30 days of receipt of data from the laboratory. OEHHA will then make an assessment of whether the fish consumption advisory for the Sea should be kept in place, modified, or withdrawn.

The above method framework may be adjusted by mutual agreement of the SSC and OEHHA in order to meet data quality objectives and other necessary criteria. The specifics of who would carry out this sampling plan are to be determined.

FISH MEAL/FISH FERTILIZER EVALUATION

Background:

Commercial fish harvesting of fish has been proposed as a potential business venture and as a method for reduction of internal nutrient loading at the Salton Sea. Harvested live fish might be used for fish meal, and fish from fish kills might be used for fish fertilizer. In both cases, concentrations of various chemical constituents must be determined to assess the feasibility of such an operation and for permitting purposes where specific standards exist. According to the definition in California commercial feed law and regulations, fish meal is "clean, dried, ground tissues of undecomposed whole fish and/or fish cuttings with or without the extraction of part of the oil" (California Department of Food and Agriculture, 1997). The California Department of Food and Agriculture (CDFA) checks commercial feeds for selected contaminants and can legally condemn and prevent sale of any lots that do not meet regulatory standards for maximum concentrations of heavy metals and pesticides.

The Salton Sea Authority currently plans to fund a pilot study of fish harvesting from the Sea with regard to marketability and potential technique. This pilot study would analyze fish for nitrogen, potassium, phosphoric acid, protein, fat, fiber, and ash as needed for fish meal and fish fertilizer regulatory standards (Tom Kirk, Salton Sea Authority, oral communication, 10/19/99). Therefore, analysis of these constituents would not be necessary for the study described below in order to avoid duplication of effort. It should be noted that a prohibition of commercial fishing of the Salton Sea currently is in effect.

Problem: Before any commercial harvest operation could begin at the Sea, the concentrations of chemicals that would be contained in fish meal or fish fertilizer produced from the Sea must be assessed. Data on concentrations of selected chemicals is required for state regulatory standards governing commercial feed. It is not known whether concentrations would exceed any regulatory standards and thus preclude harvest. A quality database of chemical concentrations in potential fish products from the Sea does not currently exist).

Objective: To conduct a study to determine the concentrations of chemicals of concern for fish meal or fish fertilizer produced from Salton Sea tilapia.

Approach: Three to five large, pooled composite samples of tilapia will be collected from the Sea from geographically dispersed areas in a manner similar to that for any potential harvest operation. Additional seasonal sampling is necessary since harvesting is anticipated to be year-round and seasonal variation of chemical concentrations could be large. Therefore, sampling would be conducted at two time periods: pre-spawning and post-spawning. The median fish age class of 2 years will be targeted for sampling; however, data on younger age classes may ultimately be needed if younger fish also are to be harvested commercially. Quality assurance replicate samples will be collected and will constitute a minimum of 10% of the total number of samples collected. The following information will be recorded sample date, time, location, sampling gear used, number of individuals in composite, field taxonomic identification, and collectors' names. The composite samples would be wrapped in foil and placed in labeled plastic bags, placed on dry ice for shipment to the laboratory (wet ice may be used if shipping time does not exceed 24 hours).

Analyses will be conducted on composite samples of undecomposed, whole, ground-up fish. This is the final form that any potential commercial processing method would render the fish for fish meal or fish fertilizer. There are regulatory tolerances or standards for the following heavy metals and pesticides in fish meal: arsenic, lead, mercury, DDT, DDD (TDE), DDE, toxaphene, kelthane (1,1-bis (p-chlorophenyl)-2,2,2-trichloro-ethanol), DEF (S,S,S, tributyl phosphorotrithioite), folex (tributyl phosphorotrithioite). Selenium is a particular concern for the CDFA. Therefore, these chemicals must be included in the list of analytes. CDFA also recommends first completing a general screening of the samples for organophosphates, chlorinated hydrocarbons, and carbamates in addition to total PCBs and dioxin; however, surrogate analyses for dioxin are acceptable (S. Wong, CDFA, written communication, 11/4/99). The following chemicals also specifically should be included based on recommendations from the State Department of Health Services (R. Brown, CDHS, written communication, 11/12/99): BHC (benzene hexachloride isomers), aldrin, dieldrin, endosulfan I, endosulfan II, and endosulfan sulfate, endrin, heptachlor, heptachlor epoxide, hexachlorobenzene, and chlordane, and it is anticipated that a general analysis for synthetic organic compounds would include these. Analytical requirements for fish meal are more stringent than for fish fertilizer and so no additional analyses are required for fish fertilizer compared to fish meal.

Laboratory analyses will use standardized and quantitative analytical methods with limits of detection that allow accurate quantification of the target chemical at or below levels of concern.

References Cited:

- California Department of Fish and Game, 1999. 1999 California Sport Fishing Regulations. Fish and Game Commission, California Department of Fish and Game, Sacramento, CA, page 51.
- California Department of Food and Agriculture, 1997. Commercial Feed Law and Regulations. Agricultural Commodities and Regulatory Services Branch, Department of Food and Agriculture, 57 p.
- California Department of Health Services, 1986. Health Advisory on Selenium in Salton Sea Fish. New Release No. 39-86, Department of Health Services, Sacramento, CA, May 1986.
- U.S. Environmental Protection Agency, 1995. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories – Volume 1 – Fish Sampling and Analysis, 2nd Edition, EPA 823R95007, U.S. Environmental Protection Agency.
- U.S. Environmental Protection Agency, 1998. Update – Listing of Fish and Wildlife Advisories, 1997 Updates. Fact Sheet EPA-823-F-98-009, Office of Water, U.S. Environmental Protection Agency, 6 p.