Draft Biological Monitoring Plan for Lake Elsinore

Prepared for: California Ana Regional Water Quality Control Board
Santa Ana Region

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1.0 Introduction

Lake Elsinore is a shallow, tectonically-formed lake in southwestern Riverside County The lake is situated in a down-faulted trough at the base of the Santa Ana Mountains which form the northernmost range of the Peninsular Ranges Province. As with other lakes in the region, Lake Elsinore is subject to strong variations in lake level as a result of the high evaporation rate for the region (1.4 m/yr) coupled with frequent droughts and occasional El Nino events (Lawson and Anderson, 2007; Kirby et al., 2007).

Lake Elsinore has also been subject to poor water quality that is coupled in a complex way to the hydrologic cycle of the region, and results from external loading of nutrients from the watershed and nutrient recycling from the sediments. The Regional Board first placed Lake Elsinore on the 303(d) list of impair waters in 1994. A Nutrient Total Maximum Daily Load (TMDL) for the lake was developed and incorporated into Amendments to the Basin Plan in 2005. Water quality measurements have been regularly made at the lake for most this decade, quantifying basic characteristics such as temperature, dissolved oxygen (DO), electrical conductance, and pH, as well as concentrations of total and dissolved nutrients and chlorophyll a. These measurements are now part of the In-Lake Nutrient Monitoring Program required by the TMDL.

2.0 Biological Monitoring Requirement

Previous and ongoing monitoring at the lake has substantially improved understanding of the water quality in Lake Elsinore. At the same time, it was recognized in the In-Lake Sediment Nutrient Reduction Plan for Lake Elsinore (Lake Elsinore/Canyon Lake TMDL Task Force, 2007) that additional biological measurements are needed to fully evaluate attainment of the Warm Freshwater Habitat (WARM) beneficial use that includes preservation and enhancement of aquatic habitats, vegetation, fish and wildlife, including invertebrates.

3.0 Biological Monitoring Program

A monitoring program is outlined to assess the biological health and ecological functioning of Lake Elsinore. A series of different types of measurements are proposed that specifically evaluate the fishery, zooplankton and phytoplankton communities in the lake. These measurements are described in detail below. Results from this biological

monitoring will be integrated into an overall ecological assessment and considered in light of the physical, chemical and water quality conditions in the lake.

3.1 Fishery

Lake Elsinore has a highly variable fishery, with periodic fish kills and intervals of low diversity, high densities of benthivorous carp and low abundance of sport fish at some times (EIP, 2004), and at other times increased diversity and much higher densities of sport fish (Anderson, 2008). Much of the information about the fishery is qualitative or anecdotal, however, and no systematic evaluation of the fishery and its relationship to water quality has been conducted.

To address this, hydroacoustic fisheries surveys combined with net measurements will be conducted (Simmonds and MacLennan, 2006). Hydroacoustic surveys involve the emission of a ping of sound and measuring the elapsed time and strength of the returned echo from objects (e.g., fish) within the water column. Since the speed of sound in water is known (~1500 m s^{-1}, dependent upon salinity and temperature of the water column), the elapsed time between the ping and the echo provides information about the depth or distance of the object. Moreover, the strength of the echo is a function of the physical size of the scatterer and the density contrast with water. The swim bladder in fish make them quite efficient scatterers of sound (Simmonds and MacLennan, 2006).

Hydroacoustic surveys will be conducted biannually (fall and spring) to quantify the distribution and abundance of fish in the lake. Fish target strength (proportional to size), as well as distribution and abundance will be determined using a Biosonics DTX echosounder with multiplexed 200-kHz split-beam and 420-kHz single-beam transducers in combined day-night surveys. A JRC differential GPS receiver will be used to provide real-time differentially corrected GPS data with sub-meter horizontal resolution. 8-10 transects will be made across the lake following the basic survey design of Anderson (2008) (Fig. 1). In that study, measurements were made across a series of transects perpendicular to the long axis of the lake exceeding 20 km of total survey length. Data will be collected at a sampling rate of at least 3 pings per second on each of the two different frequency transducers, with a pulse duration of 0.4 ms (BioSonics, Inc. 2008; Simmonds and MacLennan, 2006). The 2nd, higher frequency (420-kHz) transducer provides additional information about the scatterers in the water column and has been

used, e.g., to resolve small fish from zooplankton (Kang et al., 2002) and aquatic insects (Kubecka et al., 2000).

Fig. 1. Proposed hydroacoustic transect locations (following Anderson, 2008) and sampling sites for phytoplankton and zooplankton (same as TMDL lake sampling sites).

The hydroacoustic data will be ground-truthed with multi-panel vertical gill nets that will be deployed concurrent with the surveys. Three or possibly four mesh sizes will be used to reasonably sample the range of size and species of fish in the lake. Proposed sizes are ¾", 1¾" and 3", although slightly different sizes may employed depending upon preliminary trial results. These gill nets will provide direct information about the size, number, and vertical distribution of fish for comparison with hydroacoustic measurements made adjacent to the nets. The gill nets will be deployed for short duration (tentatively <30 mins) at 2-3 sites on the transects. The gill net surveys will also provide direct species information, allowing calculation of Simpson's 1-D diversity indices and condition factors from length-weight measurements made on a subsample of fish. Gut content analysis will be conducted on a small sample of planktivorous, piscivorous and benthivorous fish to estimate their diets.

3.2 Zooplankton Community

Zooplankton populations will be quantified bimonthly from vertical tows using a 63 μm Wisconsin plankton net dedicated to this monitoring program. Triplicate tows will

be collected and composited at each of the 3 TMDL sampling stations (Fig. 1, yellow squares) (LESJWA, 2006). Total zooplankton biovolume will be measured using the displacement method, while identification and enumeration will made following Veiga-Nascimento (2004) using a Nikon SMZ-800 zoom stereomicroscope and Nikon E600 compound microscope. Cladocerans and rotifers will be classified to the species level where possible, while copepods will be classified only to calanoid and copepoid groups (Veiga-Nascimento, 2004). Copepod nauplii will also be enumerated. Samples will also be inspected for quagga mussel (*Dreissena bugensis*) veligers under cross-polarization on the compound microscope at 100x total magnification.

Samples will be split using a Folsom plankton splitter and periodically sent to PhycoTech, Inc. (St. Joseph, MI) for confirmation and for QA/QC. The diversity of the zooplankton community will be calculated using Simpson's 1-D indices and related measures of species richness. Reproductive fitness of *Daphnia* will be assessed through analysis of the frequency and number of eggs carried in the brood pouch of reproductive-age females (Kirk, 1992). Separately, volume backscatter strength (S_v) from the dual frequency echosounder system, after correction for the contribution of fish targets, will be calculated to provide an estimate of zooplankton abundance and distribution on day-night fishery surveys (Hembre and Megard, 2003). Net tows will be used in conjunction with hydroacoustic measurements to develop empirical relationships between S_v and macrozooplankton densities. Backscatter strength will also be compared with theoretical scattering equations. The hydroacoustically estimated zooplankton abundance will offer much greater information concerning the vertical and lateral distribution of zooplankton in the lake than achievable from net surveys; moreover, behavioral and habitat-use information (e.g., fish avoidance, nocturnal migration) will also be assessed. The presence and relative abundance of larval aquatic insects (e.g., chironomids) will also be evaluated through night-time zooplankton tows and hydroacoustic assessments (Kubecka et al., 2000).

3.3 Phytoplankton Abundance, Productivity and Diversity

The abundance, productivity and diversity of the phytoplankton community in Lake Elsinore will also be quantified bimonthly. Triplicate integrated water column samples will be collected at the 3 TMDL sampling stations (Fig. 1, yellow squares) (LESJWA, 2006) using a tube-sampler. Phytoplankton will be speciated to genus level (and to the species level where possible) and enumerated on a Nikon E600 compound

microscope. Samples will periodically be sent to PhycoTech, Inc. (St. Joseph, MI) for confirmation and QA/QC. Simpson's diversity index 1-D and related measures of species richness will be determined for the samples. Chlorophyll a will be analyzed according to standard method 10200 H.3 (APHA 1998) that involves a six-hour acetone extraction and spectrofluorometric analysis using an excitation wavelength of 430 nm and emission wavelength of 663 nm on a Cary Eclipse spectrofluorometer. In addition, productivity measurements will be made bimonthly using the light-dark bottle method (Wetzel and Likens, 2000). Water samples collected from the middle of the photic zone (taken as the Secchi depth) with a Kemmerer sampler will be transferred to triplicate clear glass BOD bottles and to triplicate BOD bottles wrapped in aluminum foil and/or black electricians tape. The initial dissolved oxygen concentration and temperature will be determined using a small hand-held DO+temperature meter, the bottles sealed without headspace, and suspended at the original sample depth. The bottles will be retrieved after <2 h and the DO concentration measured again.

3.4 Measurement Summary

A summary of the measurements to be made, sampling frequency and number of sampling sites is provided in Table 1.

Table 1. Summary of biological measurements for Lake Elsinore.

Measurement	**Frequency (yr^{-1})**	**# of Sampling Sites**
Fishery		
Total Abundance	2	>20 km total survey
Size Distribution	2	>20 km total survey
Species Composition	2	3[a]
Condition, Diversity, Richness	2	3[a]
Zooplankton		
Total Abundance	6	3
Species Composition	6	3
Fitness, Diversity, Richness	6	3
Phytoplankton		
Total Abundance	6	3
Species Composition	6	3
Diversity, Richness	6	3
1^{o} Productivity, Respiration	6	3

[a]*results from net surveys at the 3 sites will be extrapolated to survey transects*

3.5 Quality Assurance Project Plan

A Quality Assurance Project Plan (QAPP) will be developed prior to commencement of sampling as defined in this Biological Monitoring Plan. Replicate sampling, field and laboratory calibration, and periodic independent analyses for zooplankton and phytoplankton will form the basis for quality assurance and quality control for this project.

3.6 Integration and Assessment

Results from these measurements are to be integrated into a larger ecological framework that will serve as a benchmark for biological conditions in Lake Elsinore. These biological measures of diversity and productivity for Lake Elsinore will be compared with data available for other lakes in the region and within the context of the physical, chemical and water quality conditions found in the concurrent TMDL monitoring. Biological monitoring results will also be compared with previous measurements. Phytoplankton speciation, diversity and abundance in Lake Elsinore will be compared with the findings of Oza (2003), while data concerning the zooplankton community will be compared with measurements of Veiga-Nascimento (2004), and fishery survey results will be considered in light of the recent fishery survey (Anderson, 2008), mark-and-recapture survey of EIP (2004), DFG electrofishing results, and other sources of information.

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