6.0 MONITORING AND RESEARCH NEEDS

Monitoring is needed to determine the success of the adopted plan, to implement the real time management measures of the plan, and to demonstrate that prescribed measures are met. Monitoring is required to evaluate the success of the proposed management measures in meeting the management goals of the plan. Many of the management recommendations are based on complex simulation models with inherent assumptions based on the present state of knowledge. Although there have been numerous studies of the system, the information available on limnology, limiting factors, and fisheries biology in the Mokelumne River system is incomplete. Therefore, the LMRMP includes monitoring, research, and adaptive management to address uncertainty.

In some cases innovative measures are prescribed that require monitoring and the flexibility to make changes as it becomes clear that changes are necessary. The proposed intensive use of yearlings does not parallel the "natural" chinook life history, and may have unforeseen effects on the fishery. Monitoring provides the needed feedback for the development of fishery management in the Mokelumne River system.

Monitoring is also needed to provide flexibility in managing the resource. For example, continued monitoring of Camanche Reservoir outfall and river temperatures in the fall is required to determine when to release spawning flows to assure temperatures will be below 15.0°C. Camanche release temperatures also need to be monitored to determine when alternative cooling or other measures are needed to regulate the hatchery water supply. Monitoring will guarantee that management measures prescribed in the plan are put into place in a timely manner. This type of monitoring is required by law (CEQA) for the WSMP EIR.

Continued research will increase our knowledge about the Mokelumne River system. For example, steelhead runs in the Mokelumne have been poor as long as records have been kept, but little data are available on why. Research may be needed to determine why these runs are depressed.

The thermal/hydrologic dynamics of Pardee Reservoir also should be studied further, because the proposed management is based on a limited amount of information. Continued research in those areas where our knowledge is limited or uncertainty exists will result in more efficient utilization of water resources and wiser fishery and reservoir management practices. Research may also be needed to improve the models used. SNTEMP and WQRRS models may be revised or replaced by ones that better represent the range of actual conditions and/or are easier to use.

Fisheries' needs in the Mokelumne River will change over time as the result of changes in the status of a species or management changes in parts of the system (in-river diversions, Delta, and ocean) beyond EBMUD's control. Monitoring and research will assist EBMUD and the resource agencies to be prepared for these contingencies.

As demonstrated by this report and its appendices, EBMUD has an active, ongoing research and monitoring program in place.

We propose that:

- Monitoring and research activities should be agreed to in general by the agencies responsible for the river. At a minimum, these agencies would include: SWRCB, FERC, NMFS, CDFG, USFWS, WID, EBMUD.

- The Mokelumne River Technical Advisory Committee (MRTAC) should be responsible for approving detailed protocols for monitoring and research adopted and the specifics of each participant's contributions.

The MRTAC was formed in 1988 to assist in the development and coordination of fishery and water quality studies on the river. We suggest that MRTAC continue with its current responsibilities and that the addition of FERC and WID be considered. The principal responsibility of the Committee should be to assure the quality of science and minimize the "dueling experts" syndrome.

The following section outlines monitoring and research needs identified by BioSystems, beginning with the up-river reservoirs and paralleling the organization of the LMRMP. Detailed protocols will be developed once a program is accepted by EBMUD and others. Water quality issues involving metals are not discussed here because they will be addressed in a separate forum.

6.1 UP-RIVER RESERVOIRS

6.1.1 Pardee Reservoir and Pardee to Camanche River Reach

6.1.1.1 Water Quality

- Monitor water quality of Pardee Reservoir inflow at Highway 49.

- Monitor temperature of Pardee Reservoir releases over a wide range of hydrologic and operating conditions.[1]

- Monitor dissolved oxygen and temperature profiles in Pardee Reservoir monthly, beginning in spring and continuing through reservoir turnover, during dry and critical dry conditions at three stations in the reservoir.[1]

- Monitor temperature from April through November on the river reach between Pardee and Camanche for two years in dry or critically dry years (or a range of calibration flows).[1]

[1] Similar monitoring studies are currently being performed by EBMUD.

- Modify the existing Pardee meteorological monitoring station to include air temperature, evaporation, solar radiation, wind speed and direction, and relative humidity.

- Develop and calibrate a WQRRS model for Pardee Reservoir.

- Develop and calibrate a temperature simulation model for the Pardee to Camanche reach.

6.1.1.2 Fisheries

- Establish and implement creel surveys to verify the returns of angler fish catch information.

- Conduct bi-annual electroshocking surveys.[1]

- Establish a protocol for monitoring kokanee spawning runs out of the system in the river above and below Pardee.

6.1.2 Camanche Reservoir

6.1.2.1 Water Quality

- Monitor dissolved oxygen, hydrogen sulfide, pH, oxygen reduction potential, and temperature at the Camanche valve house over a wide range of hydrologic and operating conditions.[1]

- Continue to monitor dissolved oxygen and water temperature profiles beginning in April and continuing through reservoir turnover for wet, dry, and critical dry conditions at existing stations in the reservoir.[1]

- Develop a monitoring program to evaluate initial operations of the hypolimnetic oxygenation project (CMD).[1]

- Refine and calibrate the existing WQRRS model for Camanche Reservoir.

- Modify the existing Camanche meteorological monitoring station to include air temperature, evaporation, solar radiation, wind speed and direction, and relative humidity.

6.1.2.2 Fisheries

- Establish and implement a standardized protocol for creel surveys to verify the returns of angler fish catch information.

- Develop a protocol and conduct bi-annual electroshocking surveys.[1]

[1]Similar monitoring studies are currently being performed by EBMUD.

6.2 MOKELUMNE RIVER FISH HATCHERY

6.2.1 Water Quality

- Monitor inflow water quality conditions (April-Nov).[1]
- Monitor outflow water quality conditions including water temperature, dissolved oxygen, Biological Oxygen Demand, turbidity, and nutrients.[2]

6.2.2 Fisheries

- Monitor salmon egg/fry survival.
- Monitor salmon juvenile and yearling survival.[1]
- Monitor chinook salmon and steelhead returns to river and to hatchery (abundance, size, sex, coded wire tagging).[1]
- Conduct experiments on rearing river fish in hatchery.
- Conduct experiments on improving imprinting techniques.[1]

6.3 LOWER MOKELUMNE RIVER

6.3.1 Water Quality

- Calibrate the SNTEMP/WQRRS model for the Lower Mokelumne River based on a full range of hydrologic and operating conditions.
- Monitor temperature above the Lake Lodi, at Woodbridge Dam, and at Ray Road through the spring until fall cooling occurs.[1]
- Monitor flow discharge at Camanche Dam, above Lake Lodi inflow, and below Woodbridge Dam.[1]

6.3.2 Fisheries

To monitor the success of the MRFH hatchery program, EBMUD has purchased four coded wire tag machines and sufficient coded wire tags. The first release of 100,000 CWT yearlings salmon is scheduled to occur during the fall of 1992. To evaluate the survival of the Mokelumne natural and hatchery-produced salmon smolts migrating through the central Delta, EBMUD tagged 200,000 smolt sized salmon for release at Thornton (confluence with the Cosumnes River) with recovery expected at Chipps Island near Pittsburg. In 1991 and 1992, EBMUD tagged two groups of 100,000 smolts each. The first group was released in

[1] Similar monitoring studies are currently being performed by EBMUD.

[2] Similar monitoring studies are currently being performed by CDFG.

April and the second group was released in May. The purpose of the ongoing experimental releases is to test the differential survival of Mokelumne origin salmon as they migrate through the central Delta under different Delta export pumping rates.

- Monitor salmon and steelhead escapement.[1,2]
- Monitor salmon and steelhead juvenile and fry out-migration.[1]
- Monitor survival of out-migrants through the Lake Lodi during normal and wet years.
- Conduct entrainment monitoring at Woodbridge diversion and other points of diversion.
- Conduct coded wire tagging program.[1]
- Monitor salmonid fry out-migration survival through the reach of the Mokelumne River below Lake Lodi.
- Analyze population measures with respect to hydrologic and water/air temperature conditions.[1]
- Monitor spawning habitat and habitat enhancement measures.[1]
- Research sources of fine sediments in spawning beds.
- Monitor poaching.
- Monitor aggregation at the base of Woodbridge Dam fish ladders to determine if improvements are needed.
- Monitor habitat use by fry and juvenile salmonids.[1]
- Refine carrying capacity estimates for spawning salmon.
- Refine carrying capacity estimates for fry and juvenile salmon.
- Develop a steelhead research program to determine measures that will assist in establishing a steelhead run.
- Monitor other native species.

6.4 DELTA

6.4.1 Water Quality

- Monitor water temperature.

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[1] Similar monitoring studies are currently being performed by EBMUD.

[2] Similar monitoring studies are currently being performed by CDFG.

6.4.2 Fishery

- Monitor salmon out-migrant survival (fry, smolt and yearling).[1]

[1]Note: Similar monitoring studies are currently being performed by EBMUD.