LAKE COMANCHE
DISSOLVED NITROGEN STUDY

Prepared for

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Nitrogen gas in the deep water of a reservoir may be slightly super-saturated due to the hydro-static pressure of the overlying water (Wetzel, 1975). Therefore water flowing from a dam with a deep intake may contain a super-saturated concentration of nitrogen. If this excess nitrogen gas is not rapidly released into the atmosphere, it may cause nitrogen gas bubble disease in fish residing below the dam outfall (Conroy and Herman, 1970).

A study was conducted at Lake Comanche Dam, Mokelumne River, California, to determine the efficiency of the Howell-Bunger Valve in removing super-saturated dissolved nitrogen (N_2) from the dam's tailwater.

The valves spray outfall water into concrete conduits before releasing the water to the stream. This was observed and photographed at Lake Comanche Dam on 28 May, 1981, at a flow of 4000 cfs into the Mokelumne River (see accompanying photos). This creates a turbulent and aerated flow with the purpose of facilitating nitrogen gas release to the atmosphere.

By sampling nitrogen gas in the reservoir near the intake, and at several locations below the outfall valves, the efficiency of the valve was obtained.

METHODS

In order to determine nitrogen gas concentrations at various depths in the reservoir, water samples were collected in Lake Comanche approximately 50 m from the dam directly over the river channel on 28 May 1982. A Van Dorn Bottle was lowered from a boat to collect water samples at depths of 0, 10, 20, 30, and 38.4 m. As reported by East Bay Municipal Utility District the dam intake was at a depth of 38.4 m (126 ft) at the time of the sampling.

Once taken aboard, each sample was poured with minimum turbulence into an airtight bottle and capped in a manner that left no air bubbles in the bottle. Bottles were placed in a cooler for transportation to the lab. Studies conducted by Steve Wilhelms of the Hydraulic Laboratory, U.S. Army Waterway Experiment Station, Vicksburg, Mississippi (personal communication) indicate that brief exposure of deep water samples to atmospheric conditions has little effect on nitrogen gas concentrations. However, he has found that periods of exposure to atmospheric

air bubbles during transportation can cause significant changes in nitrogen gas concentrations, hence the need for removing all air bubbles before transportation. Excess water remaining in the Van Dorn Bottles was measured for temperature. The atmospheric pressure measured on site at the time of sampling was 753 mm.

At the tailwater below the dam, water was collected by immersing the sample bottles under the water and capping them in a manner that left no air bubbles in the bottles. Samples were taken at the outfall, 100 m below the outfall, and 200 m below the outfall. Water temperatures were taken at each of these locations. Bottles were placed in a cooler for transportation to the lab. At the time of sampling, the outfall flow was 4,000 cfs. The atmospheric pressure was 753 mm.

The water collected was analyzed for nitrogen gas (N_2) and oxygen (O_2) in a California State Certified Water lab using a Carle Model 8700 Basic Gas Chromatogram with a thermal conductivity conductor several hours after collection.

RESULTS

Location	Depth (m)	Temperature (°C)	N_2 (mg/l)	N_2 % Saturation	O_2 (mg/l)	O_2 % Saturation
Reservoir	0	22.0	14.9	101	9.2	105
	10	14.5	17.0	100	9.3	90
	20	13.2	17.3	99	10.0	94
	30	11.0	17.9	99	10.2	93
	38.4	10.0	18.5	101	9.3	82
Dam Tailwater						
At Valve	0	10.2	17.7	97	11.1	94
100 m downstream	0	10.5	17.3	95	11.2	98
200 m downstream	0	11.5	17.9	97	10.9	98

References

Conroy, D.A., and R. L. Herman. Textbook of Fish Diseases. 1970. T.F.H. Publications, Jersey City, New Jersey. 302 pp.

Wetzel, R. G. 1975. Limnology. W.B. Saunders Company, Philadelphia. 743 pp.