QUARTERLY WILDLIFE MORTALITY REPORT
October 1994 to December 1994

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Western Region						
Mono Lake	CA	11/20/94-11/20/94	Eared Grebe	600 (e)	Trauma: weather suspect	NW
Lower Klamath NWR	CA	11/21/94-12/12/94	Mallard Northern Pintail White-fronted Goose	300 (e)	Lead poisoning	NW
Gray Lodge WMA	CA	12/01/94-01/06/95	American Wigeon Northern Pintail American Coot Northern Shoveler Gadwall	1,050 (e)	Avian cholera	CFG
Sacramento NWR Complex	CA	12/08/94-01/06/95	American Wigeon American Coot Northern Pintail Gadwall Snow Goose	5,000 (e)	Avian cholera	NW
Humbolt County	CA	12/02/94-12/31/94	American Coot Unidentified Duck Northern Shoveler Ruddy Duck Gadwall	625 (e)	Avian cholera	HS/CFG
Lower Klamath NWR	CA	12/01/94-02/01/95	Mallard White-fronted Goose American Wigeon Northern Pintail	4,370 (e)	Avian cholera	NW
Salton Sea NWR	CA	11/08/94-11/08/94	Snow Goose	2	Avian cholera	NW
Butte Sink	CA	10/15/94-12/08/94	Northern Pintail	100 (e)	Lead poisoning	NW
Ashland	OR	07/07/94-07/16/94	American Kestrel Red-tailed Hawk Western Bluebird American Robin Osprey	8	Deformities: etiology undetermined	NW
Ankeny NWR	OR	10/23/94-10/31/94	Canada (Cackling) Goose	50 (e)	Aspergillosis	NW

continued.....

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LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Update/correction						
College Station/Bryan	TX	07/01/94-09/01/94	Cattle Egret	600 (e)	Metabolic Bone Disease	TA&M
Multiple Counties	NY, NJ, PA VA, DE, MD CT, NC, NH VT, MA, WV SC	03/21/94-ongoing	House Finch Purple Finch Blue Jay Lincoln Sparrow Junco	1,000's (e)	Conjunctivitis/sinusitis	NW+

(e) = estimate

* National Wildlife Health Center (NW); Maryland Department of Agriculture (MDA); New York State Department of Environmental Conservation (NYS); Southeastern Cooperative Wildlife Disease Study (SC); Wisconsin Department of Natural Resources (WI); California Department of Fish and Game - Wildlife Investigations Laboratory (CFG); Humbolt State University (HS); Texas A&M (TA&M).

Written and compiled by Gregory Kidd, NWHC. To report wildlife mortality or if you would like specific information on these mortalities, contact the following Resource Health Team Members: Western Region - Lynn Creekmore; Mid-continent Region - Linda Glaser; Eastern Region - Kathryn Converse; Southern Region - Kimberli Miller; Hawaiian Islands - Thierry Work. (608) 271-4640 FAX (608) 264-5431 National Wildlife Health Center, 6006 Schroeder Road, Madison, WI 53711.

Quarterly Wildlife Mortality Report. The following highlights mortality reported to the National Wildlife Health Center (NWHC) from January through March, 1995.

In early January, NWHC received a report of significant mortality in wild migratory birds using the Presa de Silva Dam in the state of Guanajuato in central Mexico. An estimated 20,000 migratory birds including ducks, shorebirds, and wading birds died. Personnel from Mexico's National Water Commission (CNA) initially traveled to the site in mid-December. They speculated most of the mortality occurred in a short time period in late November or early December based on the post mortem condition of carcasses. Mortality continued at a low level until the third week in February when the reservoir, used to store irrigation water, was almost empty and the birds started migrating north. A "hospital" was constructed and people from a local environmental group provided supportive care for sick birds. Many of the hospitalized birds did recover and were released. Chemical analyses performed on sediments and water samples detected endosulfan, a chlorinated pesticide, present in low levels. Endosulfan was also detected in a pooled sample of livers from 20 birds. There is no known agricultural use of this pesticide in the area. In March, NWHC received a sample of pooled livers and gizzards from necropsied birds and type C botulinum toxin was detected in the sample. However, the significance of this finding as a contributory factor in the mortality event remains unknown.

In Sauk and Columbia Counties of Wisconsin, three dead bald eagles and eight moribund bald eagles were found within several miles of the Wisconsin River. Six of the eight sick eagles subsequently died. All of the birds were in good physical condition and had no gross lesions indicative of a particular toxin or infectious agent at necropsy. Microscopic examination of tissues indicated diffuse hepatocellular changes consistent with many types of toxic and/or metabolic insults. Brain lesions were also observed and included changes in blood vessel walls. Numerous tests were undertaken, including tests for infectious diseases, cholinesterase inhibiting compounds, lead, strychnine, cyanide, organochlorines, heavy metals as well as gas chromatography/mass spectrometry scans. All of the tests were negative. Clinical signs in the sick eagles included seizures and muscle tremors. The two that survived received supportive care for a month and were later released.

Storm related mortality was reported from two areas in Arkansas this spring. In the first event, near Eudora in Chicot County, over 300 dead and injured geese were found in a farmer's pasture following a storm with golf ball sized hail. In the second event, near Altus, a storm may have been responsible for the death of geese found dead on top of shrubs as if they had "fallen out of the sky." Necropsy revealed massive internal hemorrhages in both of the cases.

Avian cholera was diagnosed from only five areas this quarter. The largest avian cholera outbreak occurred in the Rainwater Basin Wetland Management District. The Rainwater Basin is area in southeastern Nebraska which covers roughly eighteen counties and its unique topography provides habitat for migrating waterfowl. Avian cholera is endemic in the area and losses in a single year have topped 80,000. This year habitat conditions were drier than they have been in the last two years and water was pumped into several wetlands to provide additional habitat for the birds. A total of 2,112 birds were picked up on twenty-eight different areas of the Basin. At Rita Blanca Lake in Texas, avian cholera and shotgun crippling caused the death of an estimated 200 Canada geese. A mild winter may have helped to alleviate losses by allowing the wintering population of 30-40,000 Canada geese to migrate north early. Three areas in California also reported mortality, the most noteworthy being the San Joaquin NWR which reported the death of 37 Aleutian Canada geese.

Salton Sea NWR, California, reported mortality in wigeon on a freshwater unit of the Refuge. Toxicosis was suspected because Furadan had recently been sprayed on adjacent alfalfa fields. Necropsy revealed gizzards full of an alfalfa-like vegetation. Only one of three wigeon necropsied showed brain cholinesterase depression with subsequent reversal. This pattern can be consistent with exposure to a carbamate pesticide such as Furadan since brain cholinesterase levels can return to normal after death.

QUARTERLY WILDLIFE MORTALITY REPORT
January 1995 to March 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Eastern Region						
Chicago	IL	02/22/95-02/27/95	Mute Swan	2	Open	IL
Hurlock	MD	01/06/95-02/14/95	Tundra Swan Snow Goose	20 (e)	Gout	NW
Ocean City	MD	01/23/95-02/22/95	Herring Gull Ring-billed Gull Great Black-backed Gull	200 (e)	Open	NW
Hawthorne	NJ	09/27/94-10/01/94	Mallard	40 (e)	Botulism type C	NW
Kettering	OH	12/25/94-01/05/95	Canada Goose	14	Open	NW
Frederick County	VA	01/07/95-01/07/95	European Starling Common Grackle	20	Toxicosis suspect	SC
Sauk & Columbia Counties	WI	01/01/95-02/19/95	Bald Eagle	9	Open	NW
Clark County	WI	02/03/95-02/06/95	Herring Gull	20 (e)	Open	NW
Milwaukee	WI	03/09/95-03/09/95	Lesser Scaup	14	Emaciation	WI
Southern Region						
Chicot County	AR	01/27/95-01/27/95	Snow Goose Ross' Goose White-fronted Goose Northern Shoveler Canada Goose	300 (e)	Trauma: storm	NW
Altus	AR	03/07/95-03/07/95	Snow Goose	21	Trauma: storm	NW
Florida Coast	FL	12/15/94-02/01/95	Common Loon Northern Gannet	78	Emaciation	NW
Beverly Hills	FL	02/13/95-02/27/95	American Robin	60	Toxicosis: Dursban	SC
Gulf Coast	FL	11/15/94-04/01/95	Double-crested Cormorant	50 (e)	Emaciation	NW
Rita Blanca Lake	TX	12/23/94-02/01/95	Canada Goose	200 (e)	Avian cholera/crippling	NW

QUARTERLY WILDLIFE MORTALITY REPORT
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LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Mid-Continent Region						
Maricopa County Golf Course	AZ	03/14/95-03/28/95	Mallard	15 (e)	Toxicosis: organophosphorus compound	NW
Burleigh County	ND	01/18/95-01/25/95	Mallard	60	Aspergillosis	NW
Lincoln County private refuge	NE	01/20/95-01/31/95	Canada Goose	35	Gunshot/aspergillosis/avian cholera	NW
Rainwater Basin WMD	NE	02/23/95-03/24/95	Snow Goose White-fronted Goose Northern Pintail Mallard Canada Goose	2,112	Avian cholera	NW
Hall County	NE	03/20/95-03/20/95	Sandhill Crane	4	Trauma: powerline collision	NW
National Elk Refuge	WY	01/19/95-04/05/95	Elk	100 (e)	Open/secondary pasteurellosis	NW
Guanajuato	MEXICO	11/01/94-02/20/95	Northern Pintail Northern Shoveler Green-winged Teal Blue-winged Teal American Coot	20,000 (e)	Open	
Western Region						
San Joaquin River NWR	CA	12/31/94-02/27/95	Canada (Aleutian) Goose	37	Avian cholera	NW
Kings County	CA	01/08/95-01/12/95	American Coot	150	Avian cholera	CFG
Salton Sea NWR	CA	01/13/95-04/30/95	Eared Grebe	2,000 (e)	Open	NW
Colusa, Delevan and Sacramento	CA	01/10/95-02/06/95	Black-tailed Jackrabbit	400 (e)	Emaciation	NW
San Luis Obispo, Monterey, Mendicino & El Dorado Counties	CA	01/21/95-03/02/95	Band-Tailed Pigeon	2,000 (e)	Trichomoniasis	CFG
Salton Sea NWR, Freshwater Unit	CA	02/27/95-02/27/95	American Wigeon	63	Toxicosis: carbamate suspect	NW
Tule Lake NWR	CA	02/22/95-03/31/95	Snow Goose Ross' Goose White-fronted Goose Northern Pintail Mallard	90	Avian cholera	NW

QUARTERLY WILDLIFE MORTALITY REPORT
January 1995 to March 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Western Region cont.						
Sacramento NWR Complex	CA	03/24/95-03/31/95	Cliff Swallow	5	Open	NW
Hermiston	OR	11/01/94-02/15/95	House Finch American Goldfinch	3	Avian pox	NW
Corvallis	OR	01/07/95-01/07/95	Mallard Unidentified Duck Green-winged Teal Lesser Scaup	4	Trauma: gunshot	NW
Aberdeen	WA	11/25/94-12/27/94	Herring Gull	7	Trauma/bacterial infection	NW
Update/Correction						
Palo Verde Nuclear Generating Plant	AZ	11/29/94-01/31/95	Ruddy Duck Northern Shoveler Unidentified Shorebird Eared Grebe	880	Open	NW
Tulsa	OK	11/15/94-03/01/95	American Robin	10 (e)	Parasitism: *Knemidocoptes* mite	NW

(e) = estimate

* Illinois Department of Conservation (IL); National Wildlife Health Center (NW); Southeastern Cooperative Wildlife Disease Study (SC); Wisconsin Department of Natural Resources (WI); California Department of Fish and Game - Wildlife Investigations Laboratory (CFG).

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Quarterly Wildlife Mortality Report. The following highlights wildlife mortality reported to the National Wildlife Health Center (NWHC) from April through June, 1995. This report is now also available on the internet through NWHC's WorldWideWeb home page at http://www.emtc.nbs.gov./nwhchome.html/

Duck plague was seen at several locations this spring. In late March, duck plague was reported in two out of nineteen exotic waterfowl species in a private waterfowl collection in San Diego. The diagnosis was based on histopathology. All unaffected birds were immediately moved into quarantine, the pond drained and disinfected, and the only free-flying birds present on the pond were euthanized. Duck plague was diagnosed in a muscovy duck from a private collection in Cambridge, Maryland by the Maryland Department of Agriculture with virus confirmation by the NWHC. Duck plague was confirmed in one of 13 muscovy collected in Virginia Beach, Virginia. Mortality in muscovy ducks was reported from several additional sites in Virginia Beach but no suitable carcasses were submitted for evaluation. There have been several outbreaks of duck plague in the Virginia Beach area in recent years. Duck plague was diagnosed by the Michigan Roselake Wildlife Research Center in domestic ducks on a farm in Onsted, Michigan; an estimated 35 ducks died and no wild birds were known to use the area. The Texas Veterinary Medical Diagnostic lab reported the presence of gross and microscopic lesions consistent with duck plague in muscovy carcasses collected on a residential pond in Garland, Texas; NWHC isolated duck plague virus. Duck plague occurred at this site in 1994. Texas Parks and Wildlife requested homeowners collect and dispose of carcasses and monitor the site for further mortality.

Maine Inland Fisheries and Wildlife reported the death of 3 muskrats on a residential lake in Kennebunk County. Several muskrats were seen dead in the same area last fall. There was concern that this mortality was linked to contamination from a nearby Superfund cleanup site. Necropsy evaluation of the muskrats revealed tissue changes consistent with a bacterial infection. Tyzzer's disease was confirmed by examination of specially stained tissues that contained Bacillus piliformis.

The Purple Martin Conservation Association reported mortality in purple martin colonies in three states, Kansas, Indiana, and Pennsylvania. At the Indiana site, there were two peaks of mortality. Between June 22 and June 25, 60 adults and 107 young died and during the second peak, July 23 to July 27, 40 adults and several young died. Over 90 % of the adults in the colony died. Two shipments of purple martins were examined by NWHC. The adults were in good body condition with no significant lesions. Young birds were emaciated and were presumed to have died of dehydration and starvation following the death of their parents. Botulism type C toxin was confirmed in three birds, cholinesterase levels appeared normal, and there were no significant bacterial or viral isolations. Additional tests are pending.

Trichmonas gallinae was isolated from esophageal lesions in house finches and a mourning dove collected from a residential area of Phoenix, Arizona and mourning doves from a larger mortality event in southwestern New Mexico. Trichomoniasis is common in doves but is rarely reported in house finches. In New Mexico, doves congregate at cattle watering tanks and drink overflow water from the ground. Doves were found sick or dead at roosting sites and near cattle watering tanks. Transmission of this parasite is usually associated with concentrations of birds in an area where ground feeding occurs.

QUARTERLY WILDLIFE MORTALITY REPORT
April 1995 to June 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Eastern Region						
Crab Orchard NWR	IL	04/09/95-04/09/95	Double-crested Cormorant	20	Trauma	NW
Island Lake	IL	05/24/95-05/25/95	Canada Goose	8	Botulism suspect	IL
Dupage County	IL	04/06/95-04/10/95	Canada Goose	2	Open	IL
Schaumburg	IL	06/23/95-06/25/95	Mallard	6	Botulism suspect	IL
Nappanee	IN	06/23/95-07/27/95	Purple Martin	215 (e)	Botulism type C Starvation	NW
Brockton	MA	04/23/95-04/24/95	Mallard Canada Goose	33	Open, no submission	NW
Cambridge	MD	04/24/95-04/30/95	Muscovy Duck	12	Duck plague	MD
Suffolk County	MD	06/21/95-06/25/95	Northern Gannet	6	Aspergillosis	TS
Green Island	ME	06/05/95-07/13/95	Great Black-backed Gull Herring Gull	7	Emaciation	NW
Winthrop	ME	05/31/95-06/05/95	Muskrat	3	Tyzzer's Disease	NW
Lenawee County	MI	05/24/95-06/23/95	Muscovy Duck Unidentified Domestic Duck Unidentified Domestic Goose	35	Duck plague	RL
Rice Lake NWR	MN	04/27/95-05/18/95	Double-crested Cormorant Ring-billed Gull American White Pelican Lesser Scaup Pied-billed Grebe	184	Open	NW
Blackduck	MN	03/01/95-04/01/95	Pine Siskin	7	Salmonellosis	NW
Nett Lake	MN	05/25/95-05/25/95	Beaver	15 (e)	Open, no submission	
Kingston, Dallas	PA	06/20/95-06/21/95	Gray Catbird Turkey	3	Open	NW
Charlestown	RI	05/20/95-07/13/95	Canada Goose Domestic Turkey	14	Conjunctivitis	NW
Virginia Beach	VA	05/15/95-06/01/95	Muscovy Duck	13	Duck plague	NW

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QUARTERLY WILDLIFE MORTALITY REPORT

April 1995 to June 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Eastern Region cont.						
Sterling	VA	04/08/95-04/12/95	European Starling Gray Squirrel	14	Trauma: gunshot	SC
DePere	WI	05/04/95-05/04/95	Mallard	2	Toxicosis: Avitrol	WI
Southern Region						
Florida Keys	FL	02/20/95-03/15/95	Double-crested Cormorant	25 (e)	Emaciation	NW
Warner Robins	GA	02/10/95-02/14/95	American Robin Blue Jay	24	Toxicosis: chlorpyrifos (Dursban)	SC
Augusta	GA	02/13/95-02/14/95	American Robin Common Grackle	20 (e)	Toxicosis: chlorpyrifos (Dursban)	SC
Outer Bank Islands	NC	06/24/95-07/17/95	Greater Shearwater Great Black-backed Gull Cory's Shearwater	150 (e)	Emaciation	NW
Hale County Playa	TX	12/05/94-02/01/95	Northern Pintail Canada Goose Snow Goose Mallard	27	Avian cholera suspect	NW
Garland	TX	05/26/95-06/21/95	Muscovy Duck Pekin Duck Hybrid Mallard	58	Duck plague	NW
Mid-Continent Region						
Sun City West	AZ	06/05/95-06/19/95	House Finch Mourning Dove	5	Parasitism: trichomoniasis	NW
Ninepipe NWR	MT	04/28/95-05/01/95	Common Raven	3	Toxicosis: organophosphorus compound	NW
McIntosh County	ND	06/15/95-07/20/95	Eared Grebe	138	Predation	NW

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QUARTERLY WILDLIFE MORTALITY REPORT

April 1995 to June 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Mid-Continent Region cont.						
Kulm WMD	ND	06/26/95-ongoing	Franklin's Gull Northern Pintail Green-winged Teal American Avocet Mallard	500 (e)	Botulism type C	NW
Alliance	NE	04/25/95-05/05/95	Yellow-headed Blackbird Common Grackle European Starling	30	Toxicosis: strychnine	NW
Deming	NM	05/16/95-07/20/95	Mourning Dove	300 (e)	Parasitism: trichomoniasis	NW
Bristow	OK	03/26/95-03/26/95	American White Pelican	39	Trauma: storm	NW
Swan Lake, Walworth County	SD	04/15/95-04/20/95	Lesser Scaup	20	Open	NW
Western Region						
San Diego	CA	03/25/95-03/29/95	Ringed Teal Falcated Teal	2	Duck Plague	NW
San Mateo, San Francisco	CA	04/01/95-07/15/95	Surf Scoter	100 (e)	Parasitism: acanthocephaliasis	NW;CA
Mono Lake	CA	04/29/95-04/30/95	Eared Grebe	683	Open	NW
Lower Klamath NWR	CA	06/01/95-06/30/95	American White Pelican Western Grebe	60 (e)	Botulism type C	NW
Oahu	HI	11/01/94-01/03/95	Wedge-tailed Shearwater	1,100 (e)	Weather suspect	NW-HF
Kootenai County	ID	06/08/95-06/12/95	Violet-green Swallow	12	Open	NW
Corvallis	OR	04/01/95-04/30/95	Pine Siskin	10 (e)	Salmonellosis (*S. typhimurium*)	NW
Ridgefield NWR	WA	04/12/95-04/12/95	Canada Goose Cackling Canada Goose Taverner's Canada Goose	5	Trauma: impact	NW

(e) = estimate

*National Wildlife Health Center (NW); Illinois Department of Conservation (IL); Maryland Department of Agriculture (MD); Tri-State Bird Rescue and Research - Newark, Deleware (TS); Southeastern Cooperative Wildlife Disease Study (SC); Wisconsin Department of Natural Resources (WI); Rose Lake Wildlife Disease Laboratory - Michigan (RL); California Department of Fish and Game - Wildlife Investigations Laboratory (CA); National Wildlife Health Center - Hawaiian Field Station (NW-HF).

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Quarterly Wildlife Mortality Report. The following highlights wildlife mortality reported to the National Wildlife Health Center (NWHC) **from July to September 1995.** Seventy two epizootics were reported this quarter; botulism accounted for 63% with losses of more than 249,000 birds.

The Canadian Province of Alberta's Natural Resource Service reported that an estimated 200,000 ducks, shorebirds, raptors, herons and gulls, died from botulism type C on Pakowki Lake (native for "bad water") in southeast Alberta. Botulism caused the death of 31,000 waterfowl on this shallow lake in 1994. This is the largest reported loss of waterfowl in Alberta. It is speculated that blue-green algae poisoning may have been a contributing factor. Despite regular carcass pickup, mortality remained very high (5,000 birds/day) throughout August. A task force is being set up to examine options for management to attempt to deter such losses in future years.

In late July, NWHC received a report of gull mortality on Lake Sakakawea in North Dakota along the shore of a recreational area. Over 200 sick or dead gulls were collected around a boat ramp, fish cleaning station and picnic area. Clinical signs included lethargy, hunched stance, droopy wings and crusty eyes. Chlamydiosis was suspected in the gulls because an outbreak of chlamydiosis occurred in 1986 in gulls nesting on islands in this lake. Two of thirteen carcasses necropsied at NWHC had gross lesions suggestive of chlamydiosis, however, *Chlamydia* was not isolated by the USDA, National Veterinary Services Laboratory. Salmonellosis and botulism type C were diagnosed in two gulls. Approximately 280 carcasses were collected and incinerated using precautions to reduce the potential of exposure to chlamydia, a human pathogen.

The California Department of Fish and Game, Wildlife Investigation Laboratory reported mortality in desert bighorn sheep in the Old Dad Mountains, San Bernardino County, California. Twenty five sheep were found dead in the vicinity of a guzzler (a water catchment system for the sheep) and thirteen decomposing lambs were found inside the water tank. Type C botulism toxin was detected in the heart blood of the one sheep suitable for necropsy. Type C toxin was also detected in fly larvae collected from dead lambs inside the tank, although all water samples were negative. Investigators speculate that *Clostridium botulinum* toxin was produced in the lambs that drowned. Toxin present in either the water or fly larvae was then consumed by adult sheep using the guzzler. This is the largest documented mortality event in desert bighorn sheep and the first report of type C botulism in this species.

Steatitis was confirmed in immature great blue and black-crowned night herons that died between April and September, 1995 in Los Angeles and Orange Counties, California. Despite extensive field investigations by the US Fish and Wildlife Environmental Contaminants personnel and personnel from the Long Beach Naval Station, the etiology of this disease remains unknown. The cause of steatitis diagnosed in herons submitted from Point Loma, California in 1993 and 1994 also remains a mystery.

In mid-July 1995, a research scientist from NWHC traveled to Banks Island, Northwest Territories, Canada as part of an ongoing avian cholera project. Collaborating Saskatchewan graduate students on site reported that an estimated 15,000 snow geese and a few jaegars, cranes and gulls died between June 15 and July 5. Research personnel submitted bones of decomposed geese to NWHC. *Pasteurella multocida*, serotype 1, was isolated from 12/40 bone marrow samples.

Tri-State Bird Rescue and Research reported mortality associated with a spill of approximately 500 barrels of a relatively light, highly paraffinic crude oil, at a dock in Westville, New Jersey. Of the 65 oiled birds collected and treated, only five died from oil exposure. Successful treatment of oiled birds was due to the type of oil spilled and rapid response by Tri-state, the owners of the dock, the US Fish and Wildlife Service and concerned citizens.

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Eastern Region						
Carol Stream	IL	07/06/95-09/07/95	Mallard Unidentified Shorebird Lesser Yellowlegs Spotted Sandpiper	144	Botulism type C	NW
Bloomington	IL	08/08/95-08/11/95	Unidentified Duck	52	Toxicosis: diazinon	UIL
Orland Park	IL	07/22/95-07/25/95	Mallard Canada Goose	10	Botulism suspect	IL
Arlington Heights	IL	07/12/95-07/13/95	Mallard	40 (e)	Botulism suspect	IL
Evanston	IL	08/08/95-08/08/95	Ring-billed Gull	25 (e)	Open	IL
Orland Park	IL	08/05/95-08/07/95	Mallard	12	Botulism suspect	IL
Wheeling	IL	08/03/95-08/03/95	Mallard	5	Botulism suspect	IL
Willowbrook	IL	08/07/95-08/07/95	Mallard	20 (e)	Botulism suspect	IL
Arlington Heights	IL	08/08/95-08/08/95	Mallard	15	Botulism suspect	NW
Bensenville	IL	09/19/95-10/10/95	Mallard	40 (e)	Botulism type C	NW
Indiana Lakeshore	IN	07/10/95-08/03/95	Ring-billed Gull	24	Open	NW
Boston	MA	08/19/94-08/26/94	Mallard	13	Botulism type C	NW
Wyoming	MI	09/12/95-09/16/95	Mallard	40	Botulism type C	RL
Troy	MI	08/17/95-08/21/95	Mallard	16	Botulism type C	RL
Rockwood	MI	06/27/95-06/28/95	Mallard	2	Botulism type C	RL
Middle River	MN	09/21/95-10/12/95	Mallard Unidentified Duck American Wigeon Ring-necked Duck Redhead Duck	758	Botulism type C	NW
Sherburne NWR	MN	09/06/95-09/20/95	American White Pelican	8	Trauma	MN

continued.....

QUARTERLY WILDLIFE MORTALITY REPORT
July 1995 to September 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Eastern Region cont.						
Westville	NJ	07/22/95-08/01/95	Canada Goose Laughing Gull Mourning Dove Rock Dove Mallard	5	Toxicosis: petroleum (oil)	TS
Suffolk County	NY	08/02/95-08/17/95	Canada Goose Mallard Pekin Duck	47	Emaciation	NW
Big Prairie, Odell Lake	OH	08/10/95-08/10/95	Domestic Duck Mallard	30	Toxicosis: organophosphorus compound	NW
Clermont County	OH	09/22/95-09/26/95	Brown-headed Cowbird House Finch	16	Toxicosis: carbamate compound	NW
Sydney	OH	07/13/95-07/14/95	Canada Goose	26	Open	NW
Union	OH	09/08/95-09/10/95	Mallard	18	Botulism type C	NW
Grand Lake	OH	08/17/95-08/17/95	Mallard	12	Open	NW
Fountain Hill	PA	07/30/95-07/30/95	Domestic Hybrid Duck Mallard	11	Open	NW
John Heinz NWR	PA	08/08/95-08/30/95	Wood Duck Mallard American Black Least Bittern Green-winged Teal	124	Botulism type C	NW
Mechanicsville	VA	09/17/95-09/20/95	Mallard Muscovy Duck Pekin Duck	10	Botulism type C	NW
Little Lake Butte des Mort	WI	08/22/95-09/03/95	Mallard Wood Duck Double-crested Cormorant Domestic Duck Canada Goose	384	Botulism type C	WI
Onieda	WI	08/18/95-08/18/95	Unidentified Gull	9	Salmonellosis	WI
Milwaukee	WI	09/08/95-09/20/95	Mallard	35	Septicemia	WI

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QUARTERLY WILDLIFE MORTALITY REPORT
July 1995 to September 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Southern Region						
Lake Tachukaluka	GA	07/27/95-07/28/95	Canada Goose Mallard Unidentified Duck	21	Toxicosis: diazinon	SC
Plaquemines Parish	LA	08/01/95-09/10/95	Laughing Gull	100	Botulism type C	NW
Nueces County	TX	04/28/95-05/16/95	Brown Pelican	6	Emaciation	NW
Galveston County	TX	09/09/95-ongoing	Black-necked Stilt Snowy Egret Tricolored (Louisiana) Heron Blue-winged Teal Mottled Duck	4,250	Botulism type C	NW
Mid-Continent Region						
Pakowki Lake	ALB	07/10/95-10/01/95	Green-winged Teal Northern Pintail Mallard Unidentified Shorebird Unidentified Heron	200,000 (e)	Botulism type C	ALB
Banks Island	NWT	06/15/95-07/05/95	Snow Goose Pomarine Jaegar Sandhill Crane Glaucous Gull Black Brant Goose	15,000 (e)	Avian cholera	NW
Shawnee County	KS	06/02/95-06/13/95	Common Grackle European Starling	10	Fat depletion	NW
Cheyenne Bottoms WMA	KS	08/19/95-09/25/95	American Coot Redhead Gadwall Northern Shoveler White-faced Ibis	260	Botulism type C	NW
Viking Lake	MO	07/06/95-07/07/95	Canada Goose	17	Toxicosis: organophosphorus compound	NW
Medicine Lake NWR	MT	07/12/95-09/27/95	American Coot Mallard Green-winged Teal Gadwall Northern Pintail	1,304	Botulism type C	NW

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QUARTERLY WILDLIFE MORTALITY REPORT
July 1995 to September 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Mid-continent Region cont.						
Bowdoin NWR	MT	07/13/95-10/11/95	Green-winged Teal Mallard Gadwall Northern Pintail Blue-winged Teal	2,701	Botulism type C	NW
Lake Sakakawea	ND	07/10/95-08/10/95	Ring-billed Gull	280 (e)	Salmonellosis/Botulism type C/ Chlamydiosis suspect	NW
Devil's Lake WMD	ND	07/10/95-08/01/95	Franklin's Gull	200 (e)	Open	NW
Long Lake Complex	ND	08/15/95-10/01/95	American Coot Mallard Gadwall Blue-winged Teal	30 (e)	Botulism type C	NW
Lake Alice NWR	ND	08/25/95-10/01/95	Green-winged Teal Gadwall Wilson's Phalarope American Coot Short-billed Dowitcher	200 (e)	Botulism type C	NW
Robinson, Horsehead Lake	ND	08/01/95-10/01/95	Green-winged Teal Sandhill Crane Unidentified Shorebird Canada (Giant) Goose Blue-winged Teal	16,600 (e)	Botulism type C	NW
Reno	NV	08/25/95-09/30/95	Mallard Green-winged Teal Blue-winged Teal Ruddy Duck Northern Shoveler	400 (e)	Botulism type C	NW
Lowry, Swan Lake	SD	07/10/95-09/26/95	Unidentified Duck Mallard Northern Pintail American Coot Green-winged Teal	3,584	Botulism type C	NW
Waubay, Bitter Lake	SD	08/11/95-09/05/95	Blue-winged Teal Mallard Gadwall Northern Shoveler Unidentified Shorebird	3,933	Botulism type C	NW

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QUARTERLY WILDLIFE MORTALITY REPORT

July 1995 to September 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Mid-continent Region cont.						
Roberts County, Mud Lake	SD	08/23/95-08/25/95	Blue-winged Teal American Wigeon Mallard	50 (e)	Botulism type C	NW
Sand Lake NWR	SD	07/30/95-09/01/95	Franklin's Gull Gadwall Blue-winged Teal Mallard	10	Botulism type C	NW
Huron WMD	SD	09/01/95-10/10/95	Unidentified Teal Northern Pintail Mallard Wood Duck Unidentified Duck	275	Botulism type C	NW
Watertown, Long Lake	SD	09/05/95-09/29/95	Blue-winged Teal Northern Shoveler Green-winged Teal Mallard American Coot	3,564	Botulism suspect	NW
Bear River Mig. Bird Refuge	UT	07/27/95-09/26/95	Green-winged Teal Northern Shoveler Northern Pintail White-faced Ibis American Coot	1,058	Botulism type C	NW
Western Region						
Camp Pendleton	CA	07/08/95-07/31/95	Least California Tern	900 (e)	Emaciation	NW
Point Reyes Area	CA	07/07/95-08/10/95	Common Murre Cassin's Auklet	1,500 (e)	Emaciation	NW
Lower Klamath NWR	CA	07/19/95-09/15/95	Mallard Gadwall American Coot Green-winged Teal	10,000 (e)	Botulism type C	NW
Long Beach Naval Station	CA	08/11/95-09/09/95	Black-crowned Night Heron Great Blue Heron	30 (e)	Steatitis	NW
Riverside County	CA	07/24/95-09/09/95	Mallard Black-necked Stilt	60	Open	NW

QUARTERLY WILDLIFE MORTALITY REPORT

July 1995 to September 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Western Region cont.						
Salton Sea NWR	CA	08/22/95-10/26/95	American White Pelican Black-necked Stilt Brown Pelican Great Blue Heron Ring-billed Gull	10 (e)	Botulism type C	NW
Monterey Harbor	CA	07/16/95-07/22/95	Southern Sea Otter	10	Open	NW
Sacramento NWR	CA	09/02/95-10/31/95	Northern Pintail Green-winged Teal Cinnamon Teal Northern Shoveler Mallard	45	Botulism suspect	NW
Old Dad Mountains San Bernardino	CA	08/15/95-09/05/95	Bighorn Sheep	38	Botulism suspect/Botulism type C Drowning	CFG
Concord, Ellis Lake	CA	07/18/95-08/28/95	Mallard Hybrid Mallard	30 (e)	Botulism type C	CFG
Fresno, Roeding Park	CA	08/09/95-08/24/95	Hybrid Mallard	50 (e)	Botulism type C	CFG
Lamar Naval Base	CA	07/18/95-07/18/95	Mallard Ruddy Duck Cinnamon Teal Unidentified Shorebird	91	Botulism suspect	CFG
Orange County, Anaheim Lake	CA	07/28/95 07/31/95	Mallard Double-crested Cormorant Black-necked Stilt Snowy Egret Hybrid Mallard	32	Botulism type C	CFG
Kern County	CA	08/02/95-08/02/95	Northern Pintail	2	Botulism type C	CFG
Cassia, Lake Walcott	ID	08/12/95-09/08/95	Mallard Unidentified Duck American Coot Gadwall Green-winged Teal	161	Botulism type C	ID
Ada County, Indian Creek Reservoir	ID	07/12/95-07/13/95	Killdeer American Bittern Wilson's Phalarope Common Snipe Long-billed Dowitcher	39	Open	NW

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QUARTERLY WILDLIFE MORTALITY REPORT

July 1995 to September 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Western Region cont.						
Lake County, Summer Lake WMA	OR	07/28/95-08/01/95	American Avocet	34	Botulism type C	NW
Multnomah, Smith/Bybee Lakes	OR	09/12/95-09/26/95	Mallard Domestic Goose	26	Aspergillosis	NW

(e) = estimate

* National Wildlife Health Center (NW); University of Illinois (UIL); Illinois Department of Conservation (IL); Rose Lake Wildlife Disease Center - Michigan (RL); Minnesota Department of Natural Resources (MN); Tri-State Bird Rescue & Research Inc. - Newark, Delaware (TS); Wisconsin Department of Natural Resources (WI); Southeastern Cooperative Wildlife Disease Study (SC); Alberta Natural Resources Service (ALB); California Department of Fish and Game - Wildlife Investigations Laboratory (CFG); Idaho Department of Fish and Game - Wildlife Health Laboratory (ID).

Written and compiled by Gregory Kidd and Kathryn Converse, NWHC. To report mortality or if you would like specific information on these mortalities, contact the following Resources Health Team Members: Western Region - Lynn Creekmore; Mid-continent Region - Linda Glaser; Eastern Region - Kathryn Converse; Southern Region - Kimberli Miller; Hawaiian Islands - Thierry Work; Phone (608) 271-4640, FAX (608) 264-5431 or Email kathy_converse@nbs.gov. National Wildlife Health Center, 6006 Schroeder Road, Madison, WI 53711.

Quarterly Wildlife Mortality Report. The following highlights wildlife mortality reported to the National Wildlife Health Center (NWHC) from October through December, 1995. Twenty nine die-offs were reported to NWHC this quarter.

As is typical for this time of year, avian cholera epizootics accounted for the greatest losses. The largest die-off occurred at the Sacramento National Wildlife Refuge Complex in California and involved over 5,000 waterfowl. Mortality began at Butte Sink NWR in early November and later in the year occurred on the other Sacramento Complex refuges (Colusa, Delevan, Sutter, Sacramento River, and Sacramento). Mortality continued into early February. NWHC research personnel have been on site collecting environmental data as part of an avian cholera research project. Avian cholera also caused the death of an estimated 1,000 eared grebes and Canada geese using the Great Salt Lake in Utah. Avian cholera occurred for the first time on this area last year with losses estimated at 10,000 eared grebes and ruddy ducks. In Scotts Bluff County, Nebraska, approximately 800 waterfowl, primarily mallards, died on an open creek and a nearby ten acre pond. Low level mortality is ongoing. This site is within 1/2 mile of an area where avian cholera occurred in 1985. Avian cholera mortality has not been reported again until this year.

Conjunctivitis in house finches continued in several Eastern states this quarter. Sick birds were reported from a new location in Kenton County, Kentucky. At that site, approximately 50% of the birds visiting a backyard feeder were noted with red, crusty eyes. A single bird that was collected and necropsied, showed lesions typical of the conjunctivitis in house finches from previously documented sites. *Mycoplasma* cultures were positive, however, the fragile organism could not be maintained so typing was not possible.

Lead poisoning caused the death of an estimated 60 waterfowl in Lassen County, California. The area consists of flooded rice and alfalfa fields. It is speculated that the source of the lead was from lead shot spent in blackbird control operations.

An estimated 1,000 Northern fulmars died along the Pacific coasts of Washington and Oregon. The mortality estimates were based on shoreline surveys and with much of the shoreline inaccessible in this area, the estimate is crude. The definitive cause of mortality is not yet known but diagnostic testing is ongoing. So far there is no evidence that infectious or toxic diseases played a role in the event. It is not uncommon to find groups of dead fulmars and other seabirds following storm events in the months of November and December, however, the magnitude of the mortality in fulmars this year is unusual.

Aspergillosis was determined to be the cause of death for an estimated 750 mallards found along a one mile stretch of Winters Creek in Scottsbluff, Nebraska. Mallards were found in a similar condition 2.5 miles away on Lake Minatare. As many as 27 bald eagles were seen feeding on the carcasses which, in conjunction with the poor ice conditions, hampered collection.

Renal coccidiosis was determined to be the cause of death for 136 double-crested cormorants in Runnells Bottoms, Marion County, Iowa. This is the first time this disease has been reported in Iowa and it has only been documented six times (1-NE; 1-MN; 5-KS) previously in double-crested cormorants. Since the 1992 Newcastle outbreak, cormorant mortality has been monitored closely.

QUARTERLY WILDLIFE MORTALITY REPORT
October 1995 to December 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Eastern Region						
New Haven	CT	10/15/95-11/03/95	Double-crested Cormorant American Black Duck Unidentified Grebe	7	Toxicosis: petroleum (oil)	NW
Marion County	IA	10/29/95-11/06/95	Double-crested Cormorant	136	Parasitism: renal coccidiosis	NW
Westerville	OH	07/24/95-07/26/95	Mallard	11	Toxicosis: organophosphorus compound	NW
Waite Hill	OH	10/09/95-10/09/95	Canada Goose	5	Toxicosis: organophosphorus compound	NW
Allentown	PA	06/08/95-06/15/95	Mallard Canada Goose Domestic Goose	160	Toxicosis: diazinon	NW
Allentown	PA	09/11/95-09/11/95	Mallard	5	Botulism type C	NW
Gloucester	VA	03/20/95-04/10/95	Common Grackle	90 (e)	Open	NW
Friendship	WI	10/19/95-10/23/95	Ruddy Duck	200 (e)	Open	NW
Upper Mississippi NWFR	WI	11/16/95-11/24/95	Lesser Scaup Canvasback Ring-necked Duck Greater Scaup Unidentified Gull	115	Open	NW
Upper Mississippi NWR	WI	10/01/95-10/14/95	Double-crested Cormorant	200 (e)	Open	NW
Quincy	WV	09/01/95-09/01/95	Mourning Dove	2	Avian pox	SE
Southern Region						
Naples	FL	10/25/95-11/20/95	Double-crested Cormorant	12	Emaciation	NW
Kenton County	KY	07/01/95-09/01/95	House Finch	1	Mycoplasma	NW
Moore County	NC	10/30/95-12/31/95	American Coot Mallard	350 (e)	Enteritis	NW
Mid-Continent Region						
Morrill	NE	12/07/95-12/08/95	Black-billed Magpie	4	Toxicosis: organophosphorus compound	NW

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QUARTERLY WILDLIFE MORTALITY REPORT
October 1995 to December 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Mid-continent Region cont.						
Winters Creek, Lake Minatare	NE	12/15/95-12/23/95	Mallard	750 (e)	Aspergillosis	NW
Spring Creek, Scotts Bluff Co.	NE	12/30/95-ongoing	Mallard Canada Goose	800 (e)	Avian cholera	NE
Stillwater NWR	NV	09/20/95-10/06/95	American Coot Northern Pintail Western Grebe Cinnamon Teal Northern Shoveler	543	Botulism type C	NW
McPherson County	SD	07/10/95-09/01/95	Unidentified Duck American Coot Mallard Gadwall	200	Botulism suspect	NW
Edmunds County	SD	07/10/95-08/15/95	American Coot Unidentified Duck	650	Botulism suspect	NW
Pelican Lake, Ouray NWR	UT	09/15/95-10/27/95	Green-winged Teal Mallard American Coot Blue-winged Teal Unidentified Yellowlegs	730	Botulism type C	NW
Great Salt Lake	UT	11/10/95-12/15/95	Eared Grebe Northern Shoveler California Gull Canada Goose	1,000	Avian cholera	NW
Western Region						
Capes Suckling and Yakataga	AK	10/01/95-10/12/95	White-winged Scoter	200 (e)	Open	NW
Tule Lake NWR	CA	11/13/95-12/05/95	Snow Goose	800 (e)	Avian cholera	CA;NW
Sacramento NWR Complex	CA	11/06/95-02/15/96	Snow Goose American Wigeon American Coot Northern Pintail Ross' Goose	5,000 (e)	Avian cholera	NW
Salton Sea NWR	CA	11/12/95-11/29/95	Snow Goose	10 (e)	Open	NW

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QUARTERLY WILDLIFE MORTALITY REPORT
October 1995 to December 1995

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Western Region cont.						
Hayward Shoreline, South San Francisco Bay	CA	11/19/95-01/19/96	Northern Shoveler American Wigeon Ruddy Duck Mallard Northern Pintail	400	Avian cholera	CA
Lassen County	CA	10/31/95-11/08/95	Mallard Northern Pintail Gadwall Green-winged Teal	60 (e)	Lead poisoning	CA
Washington Coast	WA	11/20/95-12/06/95	Northern Fulmar	1,000 (e)	Open	NW

(e) = estimate

*National Wildlife Health Center (NW); Southeastern Cooperative Wildlife Disease Study (SC); University of Nebraska - Lincoln, Veterinary Diagnostic Center (NE); California Department of Fish and Game - Wildlife Investigations Laboratory (CA).

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Quarterly Wildlife Mortality Report. The following highlights wildlife mortality and morbidity events reported to the National Wildlife Health Research Center (NWHC) from January through March, 1996. For ease of agency reporting, the table will be ordered by state rather than flyway or region.

Avian cholera was the predominant disease again this winter, accounting for all six die-offs in California. Salton Sea National Wildlife Refuge (NWR), a past site of avian cholera die-offs, reported that mortality was primarily in ruddy ducks using an area north of the Alamo River. Humbolt Bay NWR, on the coast of northern California, reported that at least 930 of 1,500 coots on the refuge died of avian cholera. Fortunately, only a few of the estimated 10,000 ducks present were affected. There were two distinct peaks of avian cholera mortality at the Lower Klamath NWR in northern California. In early December, avian cholera mortality occurred at low levels throughout the refuge in several species of ducks. As duck mortality subsided in early January, mortality began in swans. Necropsy examination of tundra swans and a few trumpeter swans that were initially suspected to have died from lead poisoning, confirmed avian cholera as the cause of death. Based on past history, refuge staff suspect that some of the swans did die of lead poisoning. Near Kearney, Nebraska, in the Rainwater Basin, 6,170 snow geese, 1,096 northern pintails and 1,561 other ducks and geese were collected on two areas where avian cholera has occurred in the past. At this site, an estimated one million snow geese were crowded into limited open water creating ideal conditions for the transmission of avian cholera.

Scientists from several agencies, headed up by the Florida Marine Research Institute in the Florida Department of Environmental Protection, are seeking clues to the cause of death for 155 manatees found between Englewood and Marco Island, Florida. Their investigation includes evaluation for a biotoxin associated with red tide occurring in the mortality area, infectious disease agents or other toxins.

Storm related trauma was reported in several species following a blizzard that struck the midwest in late March. A rainstorm that quickly changed into a snowstorm with winds in excess of 60 mph contributed to the death of 2,000 sandhill cranes in Nebraska's Rainwater Basin, 7,000 coots and ducks in northern Iowa and 9 Canada geese in Hustisford, Wisconsin. It is speculated that high winds and poor visibility may have caused birds to fly into powerlines, trees and other objects causing their death. There were also unconfirmed reports of storm related mortality of waterbirds and migrating passerines in surrounding states.

The New York State Department of Environmental Conservation (NYDEC) reported several cases of diazinon poisoning that occurred last year. All avian mortality was thought to be inadvertent and associated with the approved application of pesticides. The NYDEC also reported a suspected intentional misuse of carbofuran at a cattle feedlot that resulted in the death of three species of passerines.

The J.B. Hansen NWR, on the Oregon-Washington border, reported mortality in one of four subpopulations of endangered Columbian white-tailed deer. Higher than expected mortality occurred on Tenasillahee Island where deer populations have been increasing. Necropsies performed in the field revealed that most deer were emaciated with no body fat reserves and reduced muscle mass and light to moderate parasite loads. One contributing factor to this emaciation is increasing demands on food resources on the island caused by increasing numbers of migrating waterfowl during winter and an increasing nutria population.

Conjunctivitis, assumed to be caused by a mycoplasmal organism, continues to cause illness in house finches. New observations of conjunctivitis in house finches in Indiana, Illinois, Michigan, Wisconsin and Missouri indicate the disease is slowly spreading westward. In addition to house finches, Maryland and Virginia have reported conjunctivitis in goldfinches and purple finches. Investigation continues into the spread of this disease and the impact on bird populations.

QUARTERLY WILDLIFE MORTALITY REPORT
January 1996 to March 1996

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Pribilof Islands	AK	02/25/96-03/04/96	Common Murre	400 (e)	Emaciation	NW
Lake Point Lodge State Park	AL	07/05/95-07/06/95	Unidentified Duck Mallard	18	Toxicosis: diazinon	SC
Salton Sea NWR	CA	12/25/95-01/08/96	Ruddy Duck Unidentified Gull Northern Shoveler Black-necked Stilt Green-winged Teal	1,000 (e)	Avian cholera	NW
Lower Klamath NWR	CA	12/12/95-01/10/96	American Wigeon Mallard American Coot Northern Pintail Green-winged Teal	900 (e)	Avian cholera	NW
San Joaquin River NWR	CA	01/08/96-03/08/96	Canada (Aleutian) Goose Canada (Cackling) Goose American Coot White-fronted Goose Ruddy Duck	171	Avian cholera	NW
Bouldin Island; near Lodi	CA	12/25/65-01/03/96	Tundra Swan	150 (e)	Avian cholera suspect	CA
Humboldt Bay NWR	CA	01/26/96-02/04/96	American Coot Canada Goose American Wigeon Unidentified Gull Tundra Swan	960 (e)	Avian cholera	NW
Lower Klamath NWR	CA	01/01/96-02/16/96	Tundra Swan Trumpeter Swan	300	Avian cholera	NW
Merced NWR	CA	11/01/95-02/04/96	Snow Goose Ross' Goose	334	Avian cholera suspect	NW
Southwestern coast of Florida	FL	03/01/96-ongoing	Manatee	155	Open	FL
Northern Iowa	IA	03/24/96-03/26/96	American Coot Unidentified Duck	7,000 (e)	Trauma: storm	NW
Bonner County	ID	03/07/96-04/10/96	Evening Grosbeak	20 (e)	Salmonellosis	NW

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QUARTERLY WILDLIFE MORTALITY REPORT
January 1996 to March 1996

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Miami	KS	01/25/96-ongoing	American Goldfinch Pine Siskin Blue Jay Downy Woodpecker	80	Toxicosis: organophosphorus compound	NW
Severn	MD	08/12/88-08/14/88	American Goldfinch Brown-headed Cowbird	20 (e)	Toxicosis: carbofuran	NY
SE Missouri (Duck Creek WMA)	MO	02/19/96-03/15/96	Snow Goose Unidentified Duck Canada Goose	130 (e)	Avian cholera	NW
St. Louis Area	MO	01/01/96-ongoing	House Finch	4	Open: mycoplasmosis suspect	NW
Rainwater Basin	NE	03/03/96-03/22/96	Snow Goose Northern Pintail White-fronted Goose Mallard Redhead	8,827	Avian cholera	NW
Platte River (Grand Island)	NE	03/24/96-03/25/96	Sandhill Crane	2,000 (e)	Trauma: storm	NW
Bosque del Apache NWR	NM	01/15/96-02/25/96	Snow Goose Sandhill Crane Mallard Northern Shoveler Green-winged Teal	78	Avian cholera	NW
Carson Lake	NV	02/29/96-03/27/96	American Coot Snow Goose Ross' Goose Northern Pintail American Wigeon	554	Avian cholera	NW
Florida	NY	02/05/95-02/06/95	European Starling Dark-eyed Junco Blue Jay	27	Toxicosis: carbofuran	NY
Clarence	NY	05/24/95-05/25/95	Canada Goose	14	Toxicosis: diazinon	NY
Rochester (Town of Greece)	NY	08/30/95-08/31/95	Mallard	25	Toxicosis: diazinon	NY
Rochester	NY	09/29/95-09/30/95	Mallard	23	Toxicosis: diazinon	NY
Perinton	NY	08/18/95-08/19/95	Red-winged Blackbird	5	Toxicosis: diazinon	NY
Greece	NY	09/15/95-09/27/96	Mallard	38	Toxicosis: diazinon	NY

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QUARTERLY WILDLIFE MORTALITY REPORT
January 1996 to March 1996

LOCATION	STATE	DATES	SPECIES	MORTALITY	DIAGNOSIS	*REPORTED BY
Cuyahoga Valley	OH	03/13/96-03/28/96	White-tailed Deer	40 (e)	Starvation	NW
Roseburg & Myrtle Creek	OR	01/15/96-02/15/96	Pine Siskin Purple Finch	100 (e)	Salmonellosis suspect	NW
Carty Reservoir	OR	02/01/96-02/20/96	Ruddy Duck American Coot Pied-billed Grebe Northern Shoveler Double-crested Cormorant	100 (e)	Emaciation	NW
J.B.Hansen NWR	OR	02/01/96-03/10/96	White-tailed Deer	50 (e)	Emaciation	NW
Ranch	TX	01/01/96-01/22/96	Snow Goose	50 (e)	Open	NW
Chesterfield County	VA	12/24/95-01/03/96	Common Grackle	40 (e)	Open: toxicosis suspect	SC
McNary NWR	WA	02/01/96-02/16/96	Mallard American Coot Double-crested Cormorant Black-crowned Night Heron Domestic Mallard	266	Avian cholera	NW
Kitsap County	WA	03/17/96-03/17/96	American Wigeon	8	Open: toxicosis suspect	NW
Hustisford	WI	03/24/96-03/24/96	Canada Goose	9	Trauma: storm	NW
Madison	WI	03/25/96-ongoing	House Finch	12	Open: mycoplasmosis suspect	NW

(e) = estimate

*National Wildlife Health Center (NW); Southeastern Cooperative Wildlife Disease Study (SC); California Department of Fish and Game - Wildlife Investigations Laboratory (CA); Florida Marine Research Institute (FL); New York State Department of Environmental Conservation (NY).

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WILDLIFE DISEASE SEMINAR ATTENDANCE

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Brian Anthony	AGFD	7200 E University Dr Mesa, AZ 85207	602-981-9400	
Bray Addison	AGFD	7200 E. University Dr Mesa, AZ 85207	602-981-9400	
Leonard Ordway	AGFD	7200 E. University Mesa, AZ 85207	602-981-9400 ext. 608	
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Warner Howard Doyle Jr	AZ Public Service Palo Verde Nuclear Generation Station	P.O. Box 52034 Mail Station 7626 Phoenix, AZ 85072-2034	602-393-5608	602-393-5879
Gypsy Gooding	Adobe	418 E. College Ave. #36 State College, PA	814-867-9895	
Kevin Fitzsimmons	Univ. of AZ	Environmental Research Lab	520-741-1990	573-0852 KevFitz@og.arizoa.edu
David Moore	Univ. of AZ	Environmental Research Lab	520-741-1990	573-0852
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Craig Levy	AZ Dept. Health	3815 N. Blck Canyon Phoenix, AZ 85015	230-5918	230-5818
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Geni Gellhaus	Adobe Mt Wildlife Center	I 17 & Pinnacle Peak 2234 W Bluefield Phoenix, AZ 85023	602-993-3287	602-436-3131
Kristie Risley	Adobe Mt. Wildlife Ctr.	202 W 5th Ave. Buckeye, AZ 85326	602-386-6930	
Sandy Cate	AGFD Adobe Mt. Wildlife Ctr.	2221 W. Greenway Rd Phoenix, Az 85023	602-582-9806 or pgr: 227-0092	602-789-3903
Brenda Andrews	FWS	2321 W. Royal Palm Rd Suite 103 Phoenix, AZ 85021	602-640-2720	602-640-2730
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Joan C. Morales	Centro Ecologieo De Sonora	CARR. A Guaymas Km. 2.5 Hermosillo, Sonora Mexico	50.12.25 50.11.37	50.12.25 50.10.37
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Sherry Daugherty-Reed	UofA Wildlife Bio	P.O. Box 86063 Tucson, AZ 85754	520-682-8720	Sherryr@CCIT.Arizona.edu
Thomas Hillmer	AZ Public Service PVNGS	P.O. Box 52034 Mail St. 7626 Phoenix, AZ 85072-2034	602-393-5765 FAX 602-393-5879	

ATTACHMENT D

UNIVERSITY OF ARIZONA BIOLOGICAL DATA

Environmental Research Laboratory

THE UNIVERSITY OF
ARIZONA
TUCSON ARIZONA

2601 E. Airport Drive
Tucson International Airport
Tucson, Arizona 85706-6985 U.S.A.
Telephone: (602) 741-1990
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July 17, 1995

Thomas P. Hillmer
Environmental, Health & Safety Department
Palo Verde Nuclear Generating Station
Arizona Public Service Company
P.O. Box 52034, Mail Sta. 7626
Phoenix, Arizona 85072-2034

Dear Thomas,

This is in regard to the algae sampling David Moore and Kevin Fitzsimmons did at the Palo Verde evaporation ponds on July 6, 1995. We are working to fully identify all the algae and invertebrates encountered in the samples and will send you a full report when all the information is available. We are documenting the findings by photographing samples of each species and by culturing the algae in some of the water samples. Some of this work is time consuming.

However, I wanted to give you a preliminary report on what we are finding. Attached are David Moore's sampling notes. As you can see, we are still trying to identify all the species present. We have not seen anything of concern in these samples. The dominant phytoplankton in both ponds was diatoms. The most common type was Chaetoceros. Total cells per ml of water were in the range of 10^4-10^5, which is a moderate level of phytoplankton. The common diatoms we encountered are not toxic, and in fact they are food sources for organisms such as artemia, which were abundant in one of the ponds. There was no sign of dinoflagellate or blue-green algae blooms (possible sources of toxins). As a general rule, when diatoms dominate the phytoplankton community the possibility of a toxic bloom is reduced. Hence, the presence of mainly diatoms at moderate levels is a good preliminary indication that the ponds are not a hazard with respect to algal toxins at the present time.

Normally there is a seasonal turnover in dominant species in these type of ponds, when the water cools. We will be interested in following the progress of the algae community through the rest of the summer and into winter. We will also be looking for other aspects of the pond biology that might pose a risk to waterfowl. We would appreciate your feedback on what we can do further to make sure our sampling and reporting procedures meet your needs.

Sincerely,

Ed Glenn

Prof. Edward P. Glenn

June 28, 1995

1st Meeting: Kevin and David to Phoenix for meeting with APS and Arizona Game and Fish.

Samples: Picked up samples from Tom and Mannie. Samples were from wind accumulation at NE corners of Ponds 1 & 2. Checked samples on June 29, 30. Results showed diatoms, blue green algae, pond bottom detritus, protozoans and invertebrate parts and molts. Set up cultures of samples in 0.22 μ filtered seawater + f/2 for later examination and took photographs from culture tube material.

July 6, 1995

1st Sample Collection: Kevin and David to APS - Palo Verde. Met with Tom Hillmer and Howard Doyle. Sampled evaporation ponds 1 & 2. Last winter, Pond 1 only had a few hundred ducks on it typically, while Pond 2 had an estimated 5,000 or more. There is no data to show if artemia, water boatmen, algae, etc. were similar then to what we saw today.

Pond 1: Sampled center, NE corner wind accumulation, NE corner wind accumulation pond side. Checked samples and took photographic record. Prepared cultures of the center sample; after examination and photographing, made 1 culture tube from all 3 Pond 1 sample bottles. Salinity - 48 ppt.

Large number of water boat men and adult artemia observed. Water was clearer than Pond 2, probably due to grazing by artemia. Water boatmen feeding on some of the artemia which were dead, white. Could not find enough material that could be recognized as algae, rather than debris, to count.

Hemacytometer Count: Various diatoms and what mostly looked like debris = 10,000 c/ml (avg. of 2 counts).

A few young grebes were in the pond.

Pond 2: Sampled center, NE corner, NE side at mid point. Checked samples and took photographic record. Prepared cultures of the center sample; after examination and photographing, made 1 culture tube from all 3 Pond 2 sample bottles. Salinity - 58 ppt.

Unable to see the bottom even in fairly shallow water. Water had greenish brown color; a few water boat men and adult artemia observed but probably less than 1% of what we saw in Pond 1.

Hemacytometer Count:

1. **Various pennate diatoms = 6,250 c/ml.**
2. **Chaetoceros = 21,000 c/ml.**

Total diatom count: 27,250 c/ml.

Debris Accumulation - Comments Apply To North East Corners, Both Ponds, No Counts:

A mix of diatoms, blue-greens, protozoans, invertebrates and their molts, dead insects, artemia cysts, and probably some material from the bottom; bubbles, probably hydrogen sulfide, were seen rising to the surface periodically and there were what looked like small clumps of bottom debris that had floated up with the bubbles. The water in the heavy NE corner accumulations was hot at the surface, and smelled of hydrogen sulfide if mixed. Some bubbles (hydrogen sulfide) were observed rising from the bottom. Some pond bottom debris seen floating throughout the pond.

The Pond 1 artemia and water boat men might serve as a food source, and could act as a bioaccumulator of toxins should there be a toxic bloom of dinoflagellates or blue-greens, but my impression was that this would not be enough to sustain a large population of ducks (5,000 + observed last year) for long. No aquatic weeds or other abundant food sources were observed.

We did not check the cooling water storage reservoir during this trip.

July 10, 1995

Ted Noon - Sample Collection: Need fresh dead, individually packed in plastic bags and immediately iced, or moribund. Healthy ducks probably won't show any disease; old dead will be too badly decomposed and could give a false botulism reading. Samples sent so far to NWHC might or might not have been in good enough shape to be conclusive.

For Toxicology:

1. 1 l of concentrated algal cell material, frozen with dry ice in the field.

2. 50 ml concentrated on ice for culture.

3. 10 ml concentrated and fixed with 50% neutral buffered formalin.

APS Palo Verde - Photomicrograph Magnification

1st Set: Kodak Royal Gold 25

NOTE: Pictures 1 - 20 taken with ISO set at 100. Pictures 21 - 35 taken with correct setting of 25.

Pict.	Mag	Subject
1	40	Stage micrometer
2	100	Stage micrometer
3	200	Stage micrometer
27	300	Stage micrometer
Pond 1 NE Corner - Pond Side		
4	40	Exoskeleton - head
5	40	Exoskeleton - body & head
6	40	Exoskeleton - large, top half
7	40	Same exoskeleton - bottom half
8	100	Brine shrimp cyst with fouling organisms
9	200	Protozoan
10	200	Diatoms
11	300	Diatom
12	300	
13	300	
14	300	
Pond 1 Center		
28	300	
Pond 2 NE Corner		
15	40	Heavy debris area
16	100	Same area
17	200	Same area
18	300	Same area
19	300	
20	300	
Starting with 21, ISO corrected to from 100 to 25.		
21	200	
22	200	
23	250	Blue green
24	300	Different blue green
Pond 2 E Side		
25	300	
26	250	
Pond 2 Center		
29	300	
30	300	
31	300	
32	300	
33	300	
34	200	Chaetoceros
35	200	

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REPLY TO: ENVIRONMENTAL RESEARCH LABORATORY
2601 E. AIRPORT DRIVE
TUCSON INTERNATIONAL AIRPORT
TUCSON, ARIZONA 85706-6985 U.S.A.
Telephone: (602) 741-1990 FAX: 602-573-0852 Telex: 165580

August 24, 1995

Memo to: Tom Hillmer, Arizona Public Services

From: David Moore, Ed Glenn and Kevin Fitzsimmons

Re: APS-Palo Verde Ponds, August 17, 1995 Sampling

This report is preliminary as all the algae are not yet identified to genus and species. Photomicrographs of all species have been taken and samples are being grown under lights to multiply some of the uncommon species in the samples. Cells were counted in natural (unconcentrated) samples using a hemocytometer counting slide.

Summary Conclusions:

Ponds 1 & 2 were different in their algae populations and apparent attractiveness to birds. An active blue-green algae bloom was proceeding in Pond 1 (485,000 cells/ml), which may be responsible for the greater numbers of brine shrimp and water boatmen observed, which, in turn, may be providing feed for the shorebirds using the pond (estimated 500 on day of sampling). The Coccochloris species which is blooming in Pond 1 is a blue-green algae, typical of warm, brine ponds, similar to these ponds. We will conduct a specific literature search to determine if this genus has been implicated in toxic blooms; however, there is no indication from the literature we have surveyed so far that this is an algae of concern, nor is there any indication that birds on Pond 1 were unhealthy. Pond 2 had moderate algae counts (17,000 cells/ml), dominated by the diatom Chaetoceros, fewer brine shrimp and water boatmen, and fewer birds than Pond 1. The fresh water reservoir, which was the only site where any bird mortality was observed on our visit, had low algae counts (1,200 cells/ml), dominated by clean-water species. Birds were submitted for autopsy, which will be reported separately by Dr. Ted Noon.

Pond 1

Gross appearance. The abundant supplies of brine shrimp (Artemia salina) observed on the July 27 sampling visit were no longer present, but small quantities were still observed. Water boatmen insects (suborder Cryptocerata, family Corixidae) were still abundant, estimated at 1 per 10-20 liters in the surface water. The salinity was 52 ppt.

Algae. A green/yellow bloom was observed on sampling. The most common algae seen in the June 27 sampling, the diatom Chaetoceros, was not observed this time. The dominant type was a single-celled blue-green algae, genus Coccochloris; species tentatively identified as stagnina. This species is frequent in brackish and marine habitats and is considered an indicator of high temperatures and brine, since it thrives in water of high NaCl content and at 40° C or above. Also present was a pennate diatom, Campylodiscus, considered an indicator of hydrogen sulfide in the water; Chlamydomonas, species tentatively identified as ehrenbergi, a flagellated green algae associated with brines; an unidentified short chain alga; and a ciliate (a protozoan). The counts of algae in Table 1. Total counts were high, 485,000 per ml, indicating an active bloom was in progress.

Birds. Yellow-leg shorebirds were using Pond 1. We observed 300-500 while sampling and driving the shores of the pond. No dead birds were observed.

Pond 2

Gross appearance. Brine shrimp and water boatmen were estimated to be less than 10% as numerous in Pond 2 as Pond 1. The salinity was 58 ppt, higher than Pond 1.

Algae. A green/yellow tinge in the water suggested that a bloom was present, but actual counts did not show large numbers of algae in the water column. The marine, centric diatom Chaetoceros was the most common species, as it was last sampling date. This is generally considered to be an indicator of non-polluted marine water. The diatom Campylodiscus (hydrogen sulfide indicator) was also present, as well as the chain algae observed in Pond 1. Algae counts in Pond 2 are in Table 2. Total counts were moderate, 17,000 per ml.

Birds. Yellow-leg shorebirds were present but much less abundant than in Pond 1; we estimated 50-100 birds in Pond 2.

Fresh water reservoir

Gross appearance. This is the receiving area for incoming secondary treated sewage effluent to be used in the cooling towers. The salinity was 0 ppt (by refractometer). The water appeared to be clear, in contrast to the green/yellow tinge of Ponds 1 & 2.

Algae. The algae were quite different from Ponds 1 & 2, as expected from the low salinity. The most common species was the Placoderm desmid, Staurastrum, species tentatively identified as *rotula*. This is generally considered a clean-water algae. Two freshwater diatoms, as yet unidentified, were also present, as well as a single cell of the green algae, *Gloecystis*, also a clean-water species. Total algae counts were low, 1,200 per ml. Counts are in Table 3.

Birds. Numerous yellow-leg shore birds were present, as were coots, ducks and other species. Several dead and sick birds were observed and submitted to Dr. Ted Noon for autopsy; he will report separately.

References:

Berk, S. G. and J. H. Gunderson. 1993. Wastewater Organisms. Lewis Publishers, Boca Raton, Florida.

Bold, H. C. and M. J. Wynne. Introduction to the Algae. Prentice-Hall, Inc., Englewood, New Jersey.

Humm, H. J. and S. R. Wicks. 1980. Introduction and Guide to the Marine Bluegreen Algae. Wiley and Sons, New York.

Palmer, C. M. 1959. Algae in Water Supplies. U.S. Dept. of Health, Education and Welfare, Public Health Service, Washington.

Prescott, G. W. 1978. How to Know the Freshwater Algae. Wm. C. Brown Co., Publishers, Dubuque, Iowa.

Table 1. Algae in Pond 1, August 17, 1995.

Site	Coccochloris	Campylodiscus	Chlamydomonas	Cell Chain
	---------------Algae cells/ml---------------			
West	535,000	13,900	1,700	0
Center	465,000	10,000	600	625
East	455,000	2,500	2,200	625
Average:	485,000	8,800	1,500	400

Total cell counts: 495,000 per ml

Table 2. Algae in Pond 2, August 17, 1995.

Site	Chaetoceros	Campylodiscus	Cell Chain
	---------------Algae cells/ml---------------		
West	8,300	3,300	600
Center	4,400	6,100	2,200
East	13,900	7,800	4,400
Average:	8,900	5,700	2,400

Total cell counts: 17,000 per ml

Table 3. Algae in Fresh Water Reservoir, August 17, 1995

Site*	Staurastrum	7.5 micron diatom	6 micron diatom
	---------------Algae cells/ml---------------		
Count 1	1,100	0	0
Count 2	600	555	0
Count 3	0	555	600
Average:	600	400	200

Total cell counts: 1,200 per ml

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DEPARTMENT OF VETERINARY SCIENCE

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September 12, 1995

MR TOM HILLMER
APS/PVNGS
PO BOX 52034, STA 7626
PHOENIX AZ 85072-2034

Reference number: 95-2314
APS/PVNGS (avian necropsy)

PRELIMINARY REPORT

Dear Mr. Hillmer:

This will update my telephone reports of August 23 and August 30, 1995.

A moribund shorebird was presented for necropsy on August 18, 1995 by one of your personnel. It was identified as a "yellowleg".

Necropsy revealed the following: prior to euthanasia it was noted that the bird was unable to stand or fly. Muscle tremors were apparent. The eyelids were half closed.

No gross lesions were noted.

Microscopic examination reveals the following: blood smears made at necropsy were stained and examined for parasites. None were observed.

In lung there is multifocal flooding of air vesicle lumens with eosinophilic fluid that is accompanied by infiltrates of heterophils. Exudation of heterophils into parabronchiolar lumens is sometimes apparent. Occasionally, the heterophils form plugs within parabronchiolar lumens. There are numerous perivascular accumulations of lymphoid cells.

In liver there is mild diffuse cytoplasmic vacuolation of hepatocytes suggestive of fatty change. Sometimes minimal infiltrates of lymphoid cells are present in portal areas. The remaining sections are not remarkable.

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It was reported that light growths of Pseudomonas sp. were isolated in cultures of lung. Cultures of liver yielded no bacterial growth. Cultures of small intestine yielded moderate growths of normal bacterial flora. A swab of heart blood yielded no bacterial growth.

A whole blood sample taken at necropsy was tested for botulinum toxin. This was reported as negative.

It was reported that cultures of lung, liver, and kidney were negative for chlamydia. It was reported that virus isolation attempts using inocula derived from lung, liver, and kidney were negative for hemagglutinating viruses.

It was reported that the brain acetylcholinesterase level was within acceptable limits (3.68 µmole/min/gm). It was reported that brain tissue contained non-diagnostic levels of sodium (1050 ppm). It was reported that liver tissue contained non-detectable (<1 ppm) levels of lead.

Diagnoses: pneumonia, moderate, multifocal, acute, etiology not determined

Additional microbiology is pending.

Sincerely,

T. H. Noon, D.V.M.

ah

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October 6, 1995

MR TOM HILLMER
APS/PVNGS
PO BOX 52034, STA 7626
PHOENIX AZ 85072-2034

Reference number: 95-2314
APS/PVNGS (avian necropsy)

Dear Mr. Hillmer:

A previous report dated September 12, 1995 has been sent to you.

It was reported today that cultures of lung tissue for mycoplasma were negative.

Sincerely,

THN

T. H. Noon, D.V.M.

ea

REPORT OF LABORATORY EXAMINATION

THE UNIVERSITY OF ARIZONA

COLLEGE OF AGRICULTURE DEPARTMENT OF VETERINARY SCIENCE

Arizona Veterinary Diagnostic Lab
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RECEIVED SEP 21 1995

September 12, 1995

MR TOM HILLMER
APS/PVNGS
PO BOX 52034, STA 7626
PHOENIX AZ 85072-2034

Reference number: 95-2321
APS/PVNGS (avian necropsies)

PRELIMINARY REPORT

Dear Mr. Hillmer:

This will update my telephone reports of August 23 and August 30, 1995. Two iced shorebird cadavers were presented for necropsy on August 18, 1995 by Edward Glenn of the Environmental Research Laboratory. The specimens were identified as "yellowlegs".

The following history was provided: the birds were collected sick but still alive on August 17 and August 18 at the PVNGS.

Necropsy revealed the following: the birds were designated A & B.

Bird A: there was a large patch of white discoloration in the liver parenchyma. The lungs were discolored a dark red and seemed to be somewhat consolidated. No other gross lesions were noted.

Bird B: the lungs appear to be darker red than normal. No other gross lesions were noted.

Microscopic examination reveals the following:

Bird A: in liver there is locally extensive coagulation necrosis that is bounded by narrow a zone of swollen, vacuolated hepatocytes. A few minimal to mild infiltrates of lymphoid cells are present in portal areas and adjacent viable areas. In lung there is multifocal flooding of air vesicle lumens with eosinophilic fluid that is accompanied by infiltrates of heterophils. In

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pectoral muscle there is multifocal myocytolysis and degeneration with accompanying sarcolemmal cell proliferation. A few macrophages and heterophils infiltrate affected areas. The remaining sections do not contain any significant lesions.

Bird B: in air sac there are mild infiltrates of heterophils. The remaining sections contain no significant lesions.

It was reported that bacterial cultures of liver, lung, and small intestine from bird A yielded light growths of enteric-type flora. Cultures of liver, lung, and small intestine from bird B also yielded light growths of mixed enteric bacterial flora.

It was reported that cultures of lung from bird A for chlamydia were negative. It was also reported that virus isolation attempts using inocula derived from lung and liver tissue from bird A were negative for hemagglutinating viruses.

It was reported that cultures of lung and liver from bird B for chlamydia were negative. It was also reported that virus isolation attempts using lung and liver-derived inocula were negative for hemagglutinating viruses.

It was reported that brain acetylcholinesterase activity for both birds A & B were within acceptable limits (bird A - 3.41 µmole/min/gm, bird B - 3.44 µmole/min/gm).

It was reported that brain sodium levels were non-diagnostic (bird A - 1100 ppm, bird B - 1450 ppm). It was reported that lead levels were non-detectable (<1 ppm) in liver tissues from both birds A & B.

Diagnoses: **Bird A:**
- necrosis, severe, locally extensive, hepatocellular, etiology not determined
- pneumonia, moderate, multifocal, acute, etiology not determined
- myositis, mild to moderate, multifocal, necrotizing

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Bird B: air sacculitis, mild, diffuse, acute, etiology not determined

Additional microbiology is pending.

Sincerely,

T. H. Noon, D.V.M.

ah

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October 6, 1995

MR TOM HILLMER
APS/PVNGS
PO BOX 52034, STA 7626
PHOENIX AZ 85072-2034

Reference number: 95-2321
APS/PVNGS (avian necropsies)

Dear Mr. Hillmer:

A previous report dated September 12, 1995 has been sent to you.

It was reported that cultures of lung tissue from both birds A and B were negative for mycoplasma.

Sincerely,

T. H. Noon, D.V.M.

ea

REPORT OF LABORATORY EXAMINATION

Environmental Research Laboratory

THE UNIVERSITY OF
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TUCSON ARIZONA

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Tucson, Arizona 85706-6985 U.S.A.
Telephone: (602) 741-1990
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Telex: 165580

DATE: October 6, 1995

MEMO TO: Thomas Hillmer, APS - PVNGS

Re: PVNGS Ponds, September 21, 1995 Sampling

Summary Observations:

Algal counts in each pond are in Table 1. Observations on each pond are below. Evaporation Ponds 1 & 2 both were visited by ducks, grebes and stilts and seagulls but the main bird concentration was in the reservoir on this visit. In general, over the last 3 months both evaporation ponds have supported a moderate bloom of blue-green algae, diatoms and green flagellates and an apparent food chain consisting of algae, artemia, water boatmen and birds. Algal counts in the receiving reservoir have been 5-10 times lower than in the evaporation ponds.

Pond 1

Gross appearance. Because of light variable winds, floating debris, which typically has been found as wind accumulations in the northeast corners of the ponds, had disbursed so that they were less concentrated and covered a broader area of the pond surface. Accumulations of floating debris were developing on the south side of the pond. Some of this material was skimmed off the top and was found to consist of insect exoskeletons, dead algae and some live algae. Salinity in this pond, which is not receiving water in order to lower the water level for a pipe inspection, has increased to 55 ppt.

Algae. The water had a relatively low visibility (Secchi disk reading of 144 cm) and a yellow/green color, indicated that a bloom was in progress in the pond. The predominant species was a blue-green algae we have tentatively identified as Coccochloris (possibly stagnina species) which is common in brine wastewaters. The count was approximately 50,000 per ml, which is an active bloom. Since this alga has been in the ponds for the last two site visits, we are gathering all the information on it that is available and will present that in our 3-month summary report. The second most common species is a green, flagellated algae, identified as Chlamydomonas ehrenberghii, another species common in brine waters. An assortment of common diatoms and the green, flagellated algae, Carteria, a pollution indicator, made up the rest of the species composition.

Animals. Brine shrimp (artemia sp.) were not observed although they were present in the August sampling.

Water boatmen, identified as Hemiptera Corixidae Trichocorixa, were still abundant, with an estimated count of 0.5-1.0 per 10 liters in near surface waters, the same as the August sampling. The concentration was much higher, up to 50 per 10 liters, along the south side due to concentration by the wind.

Pond 2

Gross appearance. Some debris had accumulated in the southeast corner but as with Pond 1, debris in general was more spread out over the surface than on the July and August sampling dates. The salinity in Pond 2, which has been receiving all of the water, has dropped to 55 ppt, the same as in Pond 1.

Algae. This pond had the same general species present as Pond 1, but the counts were higher in some cases. The dominant alga was again Coccochloris, with a count of approximately 121,000 per ml, over twice the level in Pond 1. Carteria was also more abundant in Pond 2 than Pond 1. These higher counts may indicate more enrichment in this pond at the present time. This is consistent with the fact that it is the pond receiving the discharge at the moment.

Animals. Pond 2 had a significant increase in the population of water boatmen over the August sampling date, estimated at 3 per 10 liters in near surface water from the center of the pond, and with greater than 100 per liter in the southeast corner. Artemia were not observed.

Fresh Water Reservoir

Gross appearance. The water appeared clean. A large number of birds were observed in and around the reservoir. These included a crane, ducks, grebes, coots and approximately 2,000 stilts.

Algae. The total algae counts were relatively low, only 5,000 per ml. Coccochloris was present as well as several green algae and the blue-green filament, Oscillatoria.

Animals. No significant concentrations of aquatic animals were seen.

Conclusions:

A summary document that assess the ponds over the last three collecting trips (July-September, 1995) will be prepared. It will include as much information as possible on the hazards, if any, associated with the concentrations of specific algal types found in the ponds.

Table 1. Pond 1, September 21, 1995

Site	Coccochloris	Carteria	Chlamydomonas	Chaetoceros	Unidentified algae	Nitzschia	Navicula	Diatoma
	Algal cells/mL							
East	32,500	1,250	22,500	3,750	0	6,250	0	0
Center	87,500	8,750	25,000	3,750	7,500	1,250	2,500	0
West	32,500	5,000	22,500	0	10,000	8,750	0	1,250
Average:	50,833	5,000	23,333	2,500	5,833	5,417	833	417
Total cell count:		94,167						

Table 2. Pond 2, September 21, 1995

Site	Coccochloris	Carteria	Chlamydomonas	Chaetoceros	Staurastrum	Cosmarium	Nitzschia
	Algal cells/mL						
East	131,250	22,500	1,250	16,250	0	0	0
Center	78,750	2,500	2,500	22,500	1,250	1,250	6,250
West	152,500	5,000	0	18,750	0	0	0
Average:	120,833	10,000	1,250	19,167	417	417	2,083
Total cell count:		154,167					

Table 3: Fresh Water Reservoir, September 21, 1995

Site	Coccochloris	Oocystis	Oscillatoria	Staurastrum	Unidentified algae
	Algal cells/mL				
East	3,750	1,250	1,250	1,250	1250
West	0	0	0	1,250	0
Average:	1,875	625	625	1,250	625
Total cell count:		5,000			

Renee Tanner   David Moore   Edward Glenn

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October 6, 1995

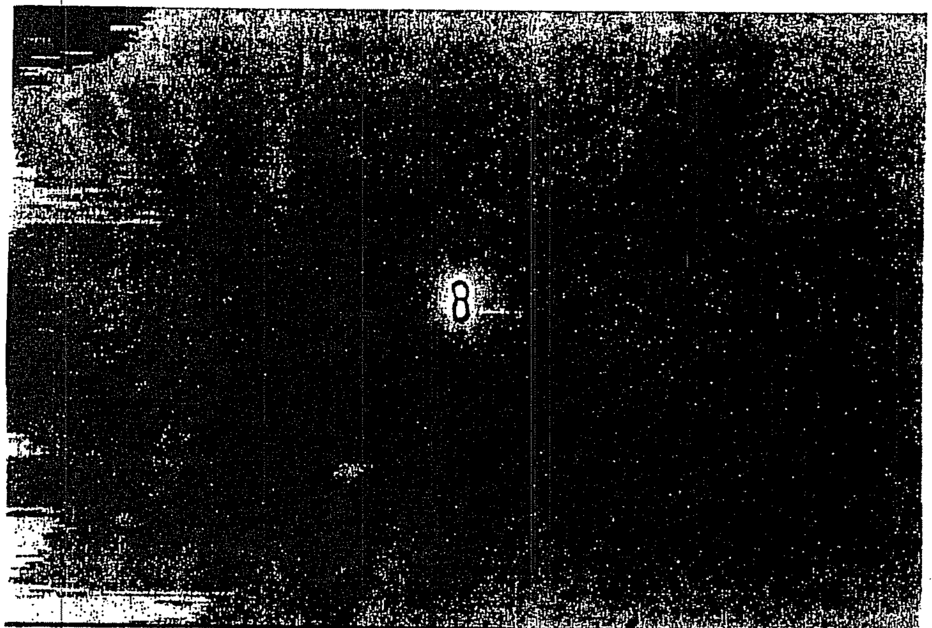
Memo to: Thomas Hillmer

Re: Summary of algae survey results, July-September, 1995

We have completed three surveys of algae and other organisms in Evaporation Ponds 1 & 2 and two surveys of the Receiving Reservoir. The evaporation ponds (salinity 48-58 ppt) have total counts of algae ranging from 20,000 - 500,000 per ml of water. Greater numbers of algae appear to occur when a pond is receiving blowdown water, which adds nutrients. The dominant algae to date is a single-celled blue-green, Coccochloris, which is a normal constituent of brine waters, especially warm brine. Other algae include green flagellates such as Chlamydomonas and Carteria, common in enriched waters, and marine diatoms such as Chaetoceros. Small amounts of filamentous blue-green algae have been found but the overwhelming abundance of algae are single-celled phytoplankton. The Receiving Reservoir is non-saline. It has a much lower algae population (1,200-5,000 cells per ml).

None of the algae encountered so far cause toxicity problems in the numbers encountered. The evaporation ponds support an apparent food chain consisting of algae, brine shrimp, water boatmen and birds. Brine shrimp are filter feeders common in brine water. They are consuming the Coccochloris and other phytoplankton in the water. Water boatmen are predators, feeding on anything smaller than they are, and brine shrimp are their likely food source in these ponds. Some of the birds that visit the ponds are very likely feeding on the water boatmen and perhaps the brine shrimp. The high algal counts in the evaporation pond are due to the nutrient enrichment which is present in the incoming water supply (BOD in the evaporation ponds is approximately 20 mg/l). These algae are supporting a food chain typical of marine or other saline systems. Species composition is likely to change in winter due to temperature changes in the ponds and further monitoring is recommended.

Renee Tanner   Ed Glenn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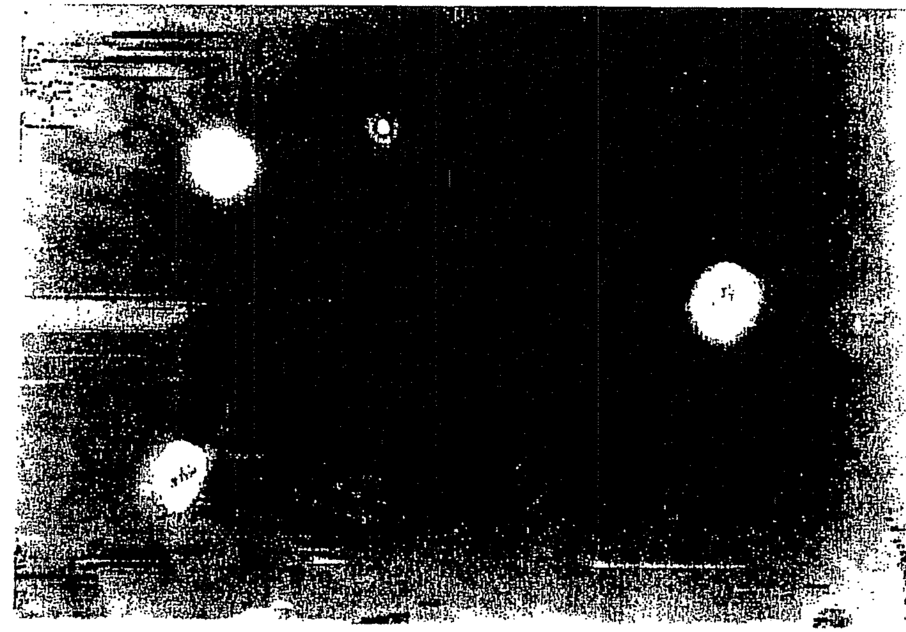
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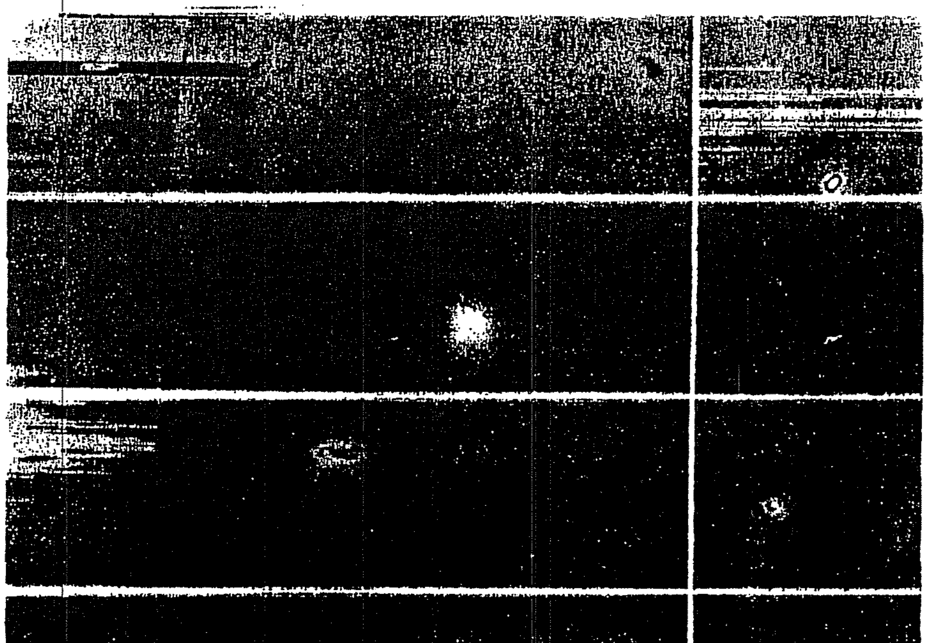
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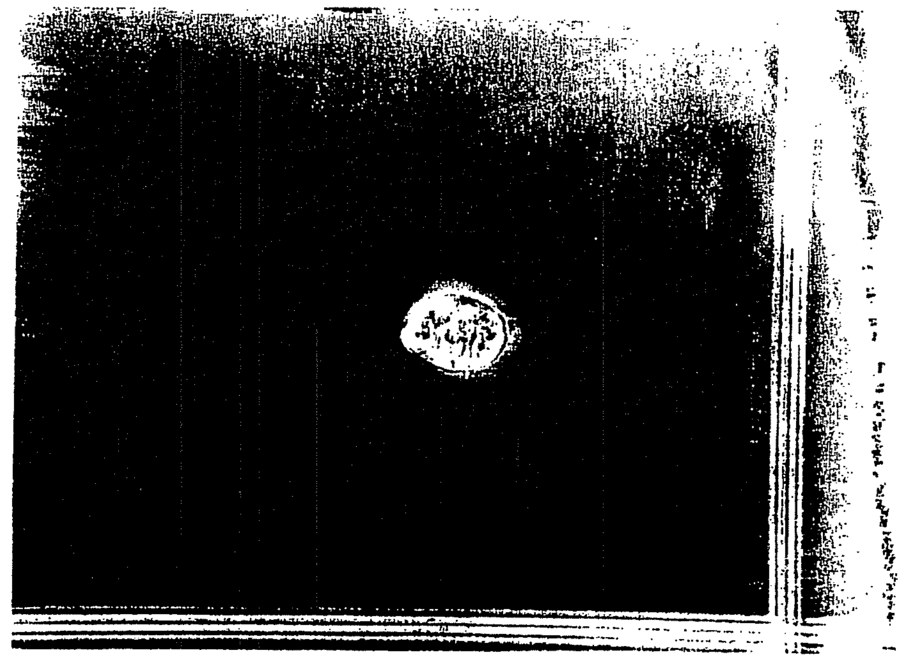
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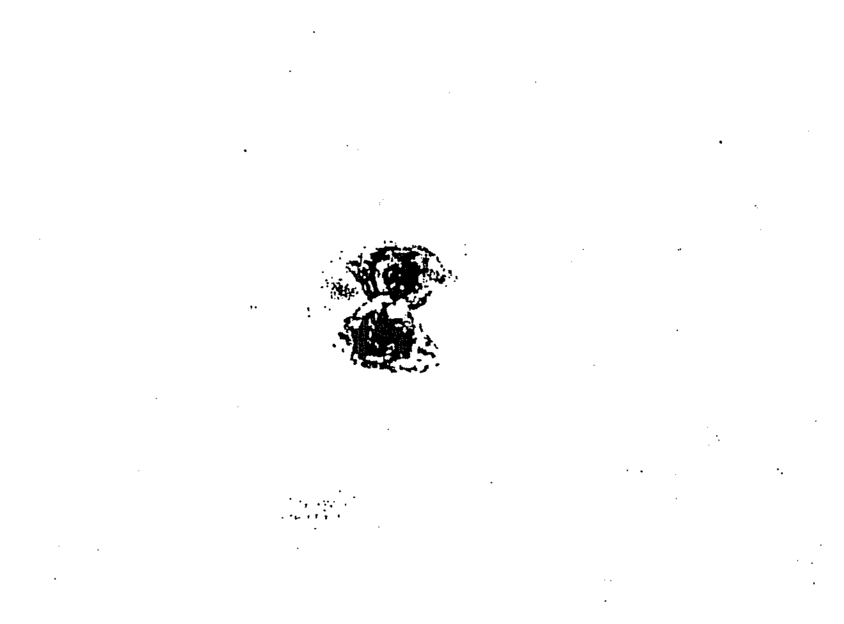
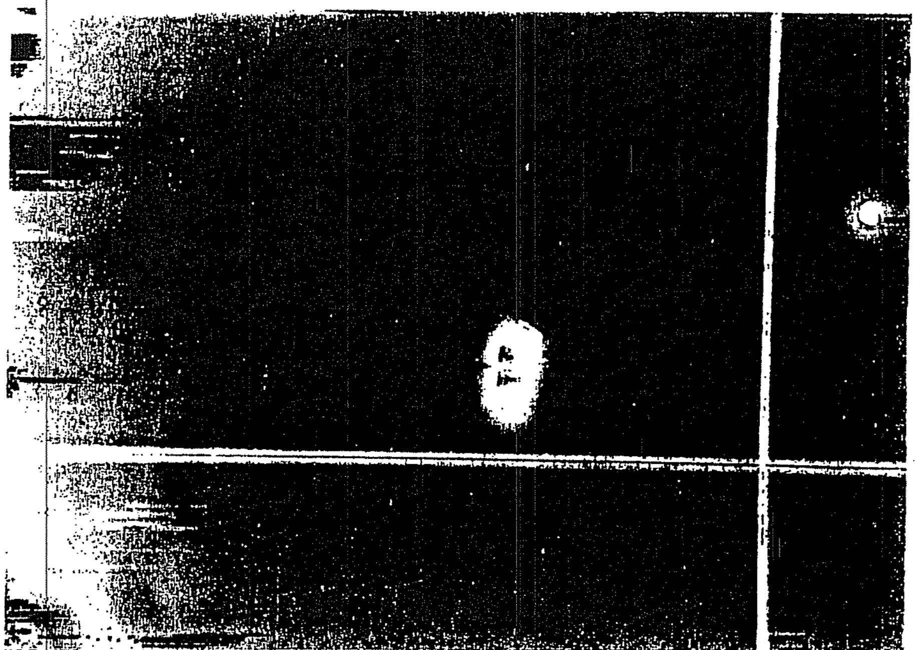
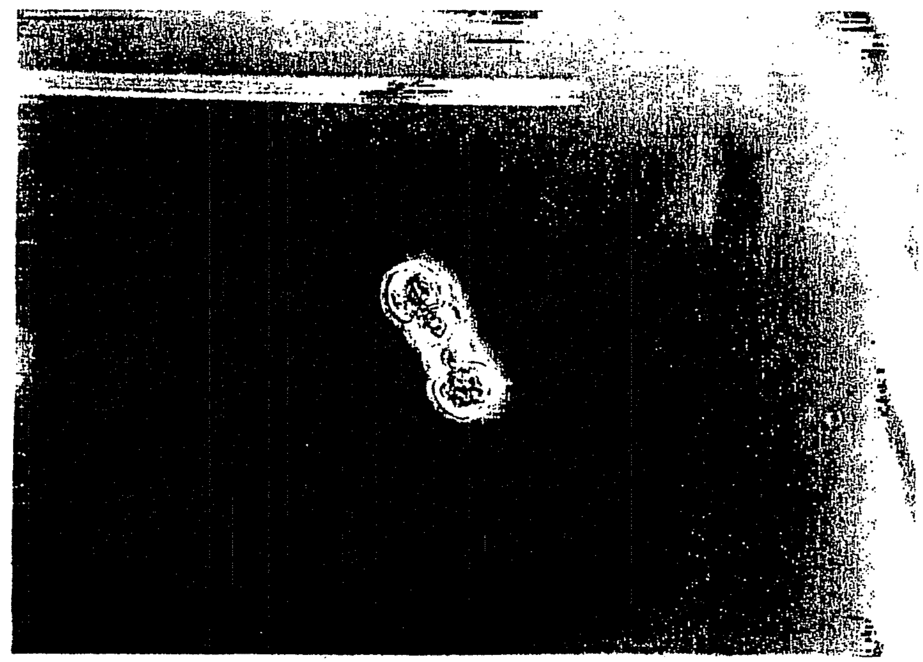


Staurastrum

Navicula



Chaetoceros



Cosmarium

accumulation was sampled and no organisms were found that were not also observed in the other samples from this pond.

Algae. Seichi disk visibility was 69 centimeters compared to 144 centimeters last month. This indicates a denser bloom of algae in the pond. The color was yellow/brown tint, consistent with the high Chaetocerous level. An algae previously identified as Chlamydomonas in the pond has been reidentified as Chlorogonium, a related genus, based on literature descriptions. The predominate alga in Pond 1 has shifted from Coccochloris (then 51,000 c/ml, now 1,500 c/ml) and Chlamydomonas (Chlorogonium)(then 23,000 c/ml, now 19,000 c/ml) to Chaetoceros (then 2,500 c/ml, now 51,000 c/ml). A trace amount of the blue-green alga Oscillatoria was found. None of the algae represent wildlife hazards in the amounts found; they are normal parts of the food chain.

Animals. Water boatmen, Trichocorixa, were much more abundant than last month. The concentration had increased to an estimated 1 per liter, as opposed to 1 per 10 liters last month. This is also consistent with the heavier bloom of algae found in the pond this month, representing a greater food supply at the base of the food chain. The increase biological activity is probably due to the influx of new blowdown water into the pond.

Pond 2

Gross appearance. As in Pond 1, the wind accumulation was along the south wall of the pond, and to a lesser extent, along the east side. No organisms of concern were found in the drift material. Salinity has increased to 60 ppt due to lack of inflow water.

Algae. The predominate algae types in Pond 2 remain the same as last month. The concentration of Coccochloris has dropped from 152,000 c/ml observed last month to 67,000 c/ml (Table 2). The total count of algae dropped from 154,000 c/ml to 109,000 c/ml. A Secchi disk reading of 71 centimeters was recorded in the center of the pond, about the same as in Pond 1. A trace amount of the blue-green alga Oscillatoria was found.

Animals. There was an increase in water boatmen, from an estimated 3 per 10 l in near surface water last month to approximately 1 per 1 this month (same as Pond 1 level).

Fresh Water Reservoir

Gross appearance. Water in the fresh water reservoir appeared clear but the bottom had a green color. There was a fairly large population of birds consisting of several hundred northern shovelers, two hundred ruddys and a few American Avocets.

Algae. Unlike previous months when algae counts were low, the reservoir had 70,000 c/ml of the blue-green alga Anacystis. This might also be growing on the bottom of the pond, attached to the liner, giving it its green tint. This algae can be toxic if it forms mats or scums that can be eaten by ducks.

Animals. No significant concentrations of aquatic insects were seen.

Renee Tanner | David Moore | Edward Glenn

Algae Counts, APS/PVNGS, October 24, 1995

Algal Counts in Cells/Ml

Table 1 Pond 1

Site	Chaetoceros	Chlorogonium	Coccochloris	Cosmarium	Nitzschia	Chlorella	Unidentif. algal cell	Unidentif. Ciliated
North	48,750	48,750	0	0	5,000	31,250	0	5,000
South	46,250	6,250	0	0	0	27,500	0	6,250
East	45,000	10,000	3,750	0	5,000	20,000	2,500	7,500
West	43,750	5,000	3,750	0	1,250	27,500	0	6,250
Center	72,500	25,000	0	2,500	1,250	26,250	2,500	11,250
Average	51,250	19,000	1,500	500	2,500	26,500	1,000	7,250

Total Cell Count: 109,500

Table 2 Pond 2

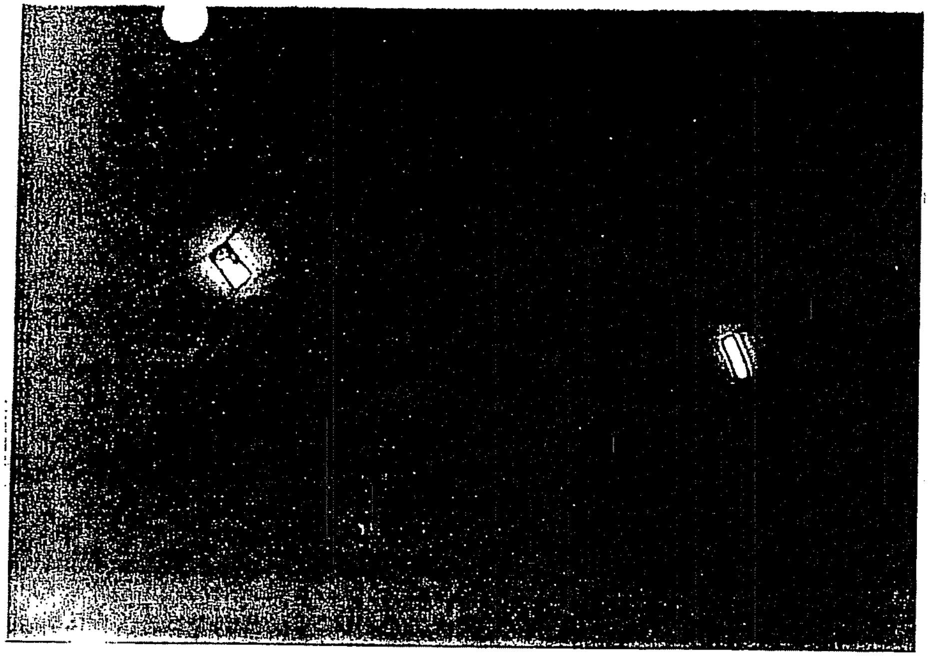
Site	Chaetoceros	Chlorogonium	Coccochloris	Carteria	Nitzschia	Chlorella	Unidentif. algal cell	Unidentif. Ciliated
North	11,250	23,750	53,750	0	6,250	20,000	2,500	0
South	13,750	2,500	72,500	0	13,750	12,500	1,250	0
East	8,750	0	58,750	1,250	6,250	13,750	1,250	0
West	10,000	1,250	47,500	0	6,250	6,250	1,250	0
Center	12,500	2,500	102,500	0	22,500	7,500	0	1,250
Average	11,250	6,000	67,000	250	11,000	12,000	1,250	250

Total Cell Count: 109,000

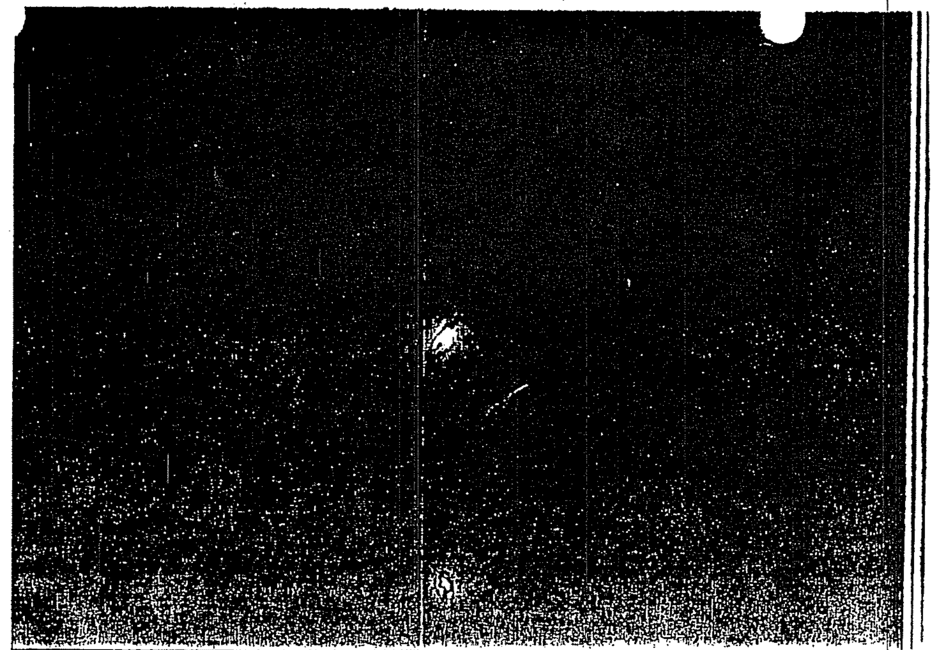
Table 3 Fresh Water Reservoir

Site	Anacystis	Pseudo-staurastrum	Staurastrum
North	53,750	1,250	<1,250
South	70,000	1,250	0
Average	61,875	1,250	0

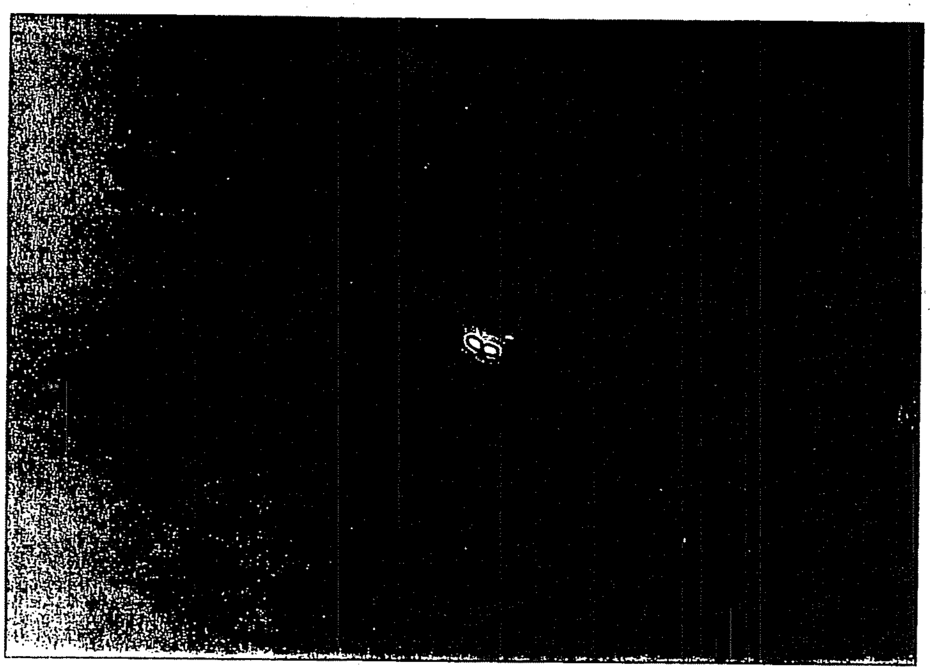
Total Cell Count: 63,125



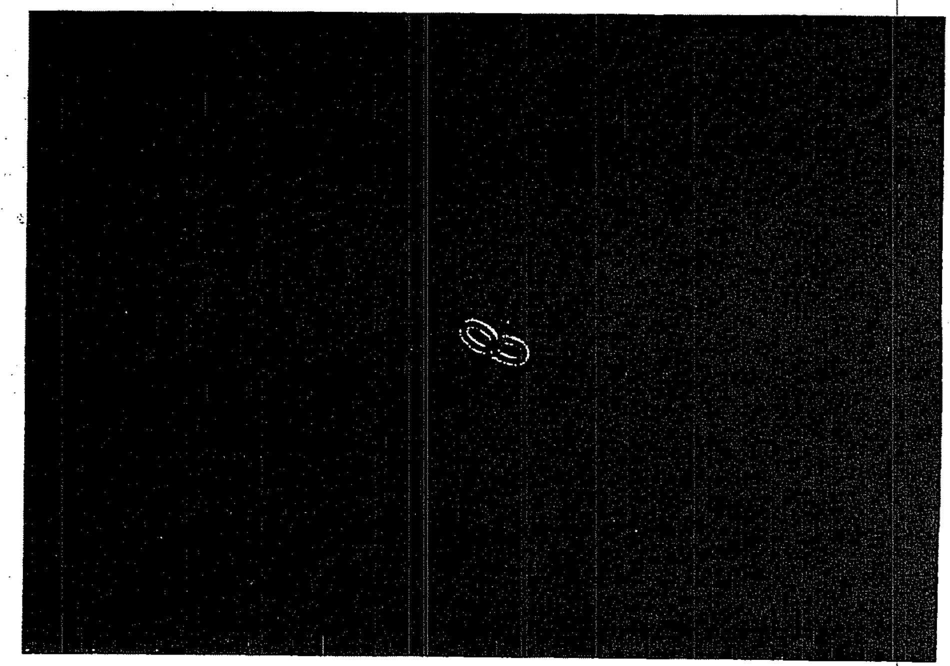
Chaetoceros - Pond 1



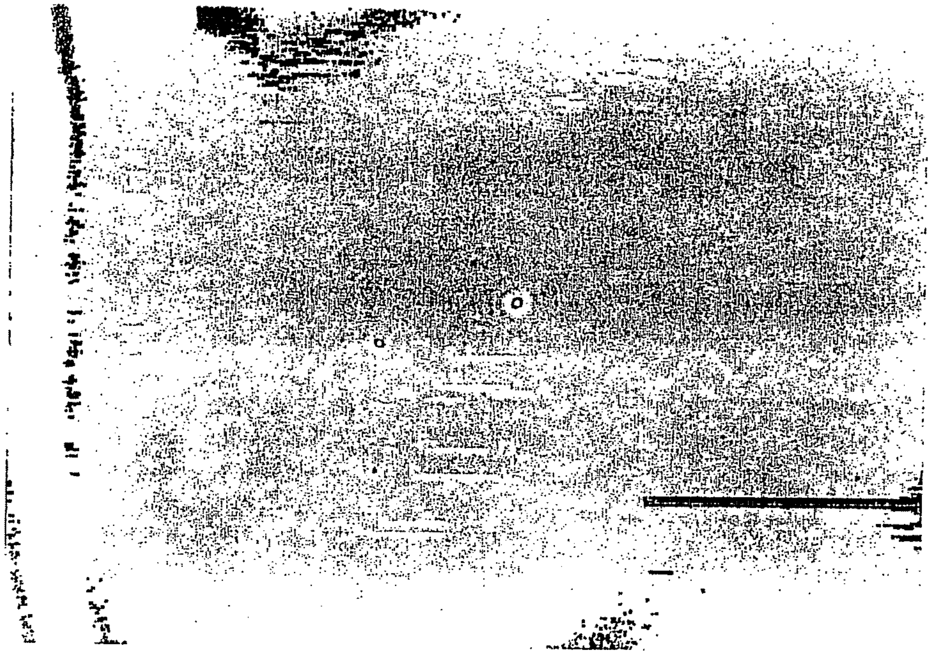
Chlorogonium - Pond 1



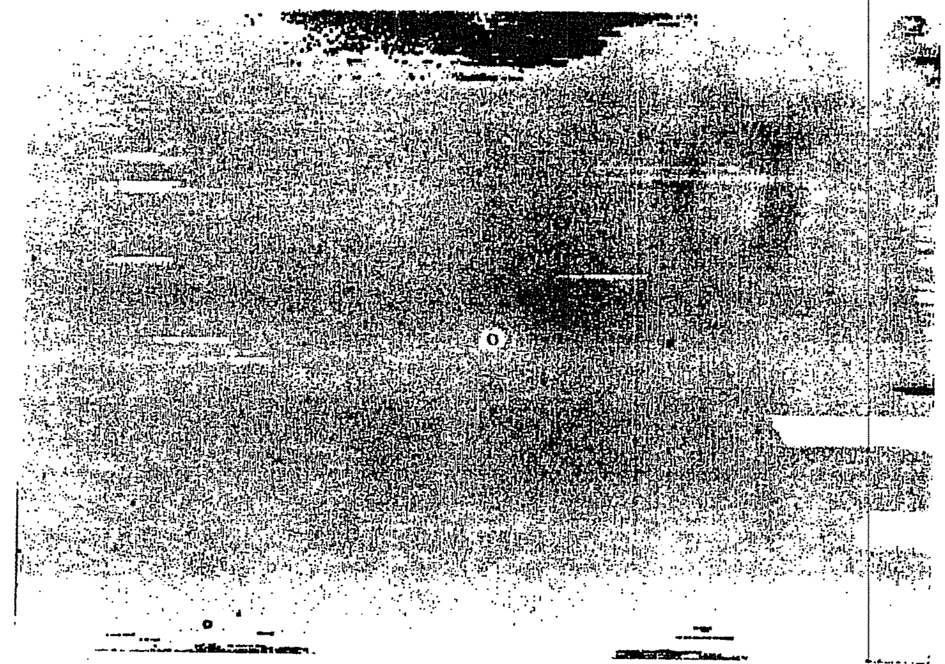
Coccochloris - Pond 2



Coccochloris at 400 X - Pond 2



Anacystis - Fresh Water Reservoir



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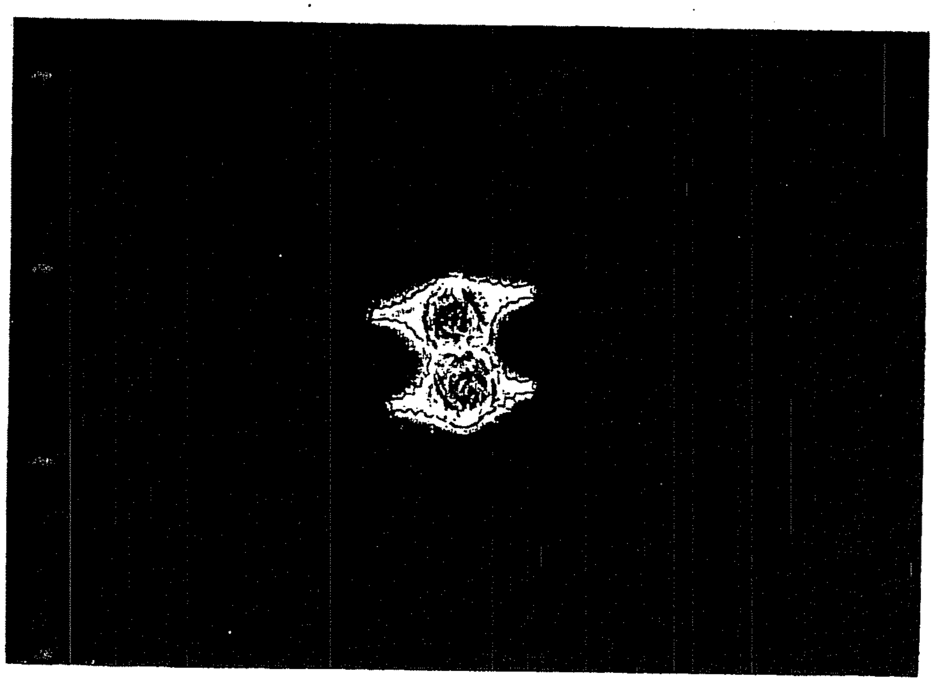
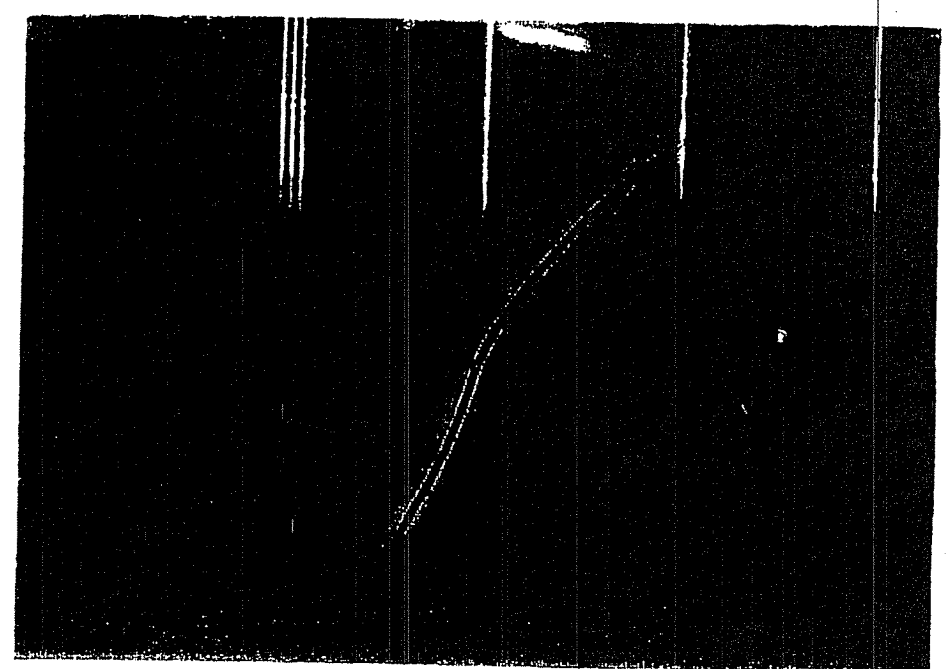


Staurastrum - Trace in Fresh Water Reservoir



Oscillatoria - Trace in Ponds 1 and 2

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DATE: December 4, 1995

MEMO TO: Thomas Hillmer, APS - PVNGS

Re: PVNGS Ponds, November 14, 1995 Sampling

Summary Observations

The blowdown water continues to enter Pond 1 exclusively. Total algal counts have decreased in all ponds sampled, but have decreased most in Pond 1 and the Fresh Water Reservoir. This may be the result of a number of environmental factors: temperature, nutrients, competition, grazing, etc. A decrease in the number of algal cells can be a temporary condition which is followed by an increase due to the recycling of nutrients provided by the dead cells. Lower algal counts means the base of the food chain has been reduced.

Pond 1 had fewer birds than Pond 2 as well as a lower total algal count and fewer water boatmen. This further suggests the operation of a food chain in the ponds. Both ponds had approximately the same secchi disk visibility(107-109 cm)as well as temperature(19-20°C), but varied in salinity readings due to the dilution effect of the blowdown water entering Pond 1.

Pond 1

Gross appearance. There was not as much floating debris as was seen in Pond 2. What was there was concentrated along the south bank. This wind accumulation was sampled and no organisms were found that were not also observed in the other samples from this pond. Surface water temperature in the center of the pond was 20°C. A low flow of water was seen coming into the pond. The salinity for this pond was the same as last month, 56 ppt. There were very few birds on the pond, estimated at less than 100.

Algae. Secchi disk visibility was 107 centimeters compared to 69 centimeters last month. This indicates a lower concentration of algae in the pond. The color was yellow/brown tint, consistent with Chaetoceros, which remains the predominate organism, 38,000 c/ml; the total cell count was 59,000 c/ml. None of the algae observed represent wildlife hazards in the amounts found; they are normal parts of the food chain.

Animals. Water boatmen, *Trichocorixa*, which were very abundant last month, had almost disappeared. Whereas last month we saw an estimated 1/liter, this month we only saw occasional water boatmen, less than 1/20 liters.

Pond 2

Gross appearance. There was a large amount of wind concentrated floating debris along the southern bank. No organisms of concern were found in the drift material. Water temperature at the center of the pond was 19°C. No water was flowing into the pond. The salinity in this pond was up slightly, from 60 ppt last month to 61 ppt this month. Most of the birds in the evaporation pond area were on Pond 2, estimated at 400 - 500, mostly grebes, and many of these young. A small number of ruddys and northern shovelers were seen as well as several of what appeared to be coots.

Algae. The predominate algae types in Pond 2 have remained the same as last month. The concentration of *Coccochloris* has dropped from 67,000 c/ml observed last month to 3,000 c/ml. The total count of algae dropped slightly from 109,000 c/ml to 92,000 c/ml. A Secchi disk reading of 109 centimeters was recorded in the center of the pond, about the same as in Pond 1.

Animals. The concentration of water boatmen remained stable, with an estimated 1/liter in near surface water last month to slightly less than 1/liter this month.

Fresh Water Reservoir

Gross appearance. Water in the fresh water reservoir appeared clear but the bottom had a green color, similar to last month. There was a large population of birds on the water, approximately 1,000 - 1,200, the northern shoveler was observed to be the predominant waterfowl. The temperature of the water, taken from the side, was 24.5°C.

Algae. The total algal count dropped significantly from last month, from 63,000 c/ml to 8,000 c/ml. The predominant algal type was still *Anacystis*, but its numbers decreased and more algal diversity was observed.

Animals. No significant concentrations of aquatic insects were seen.

References:

Palmer, C. M. 1959. Algae in Water Supplies. U.S. Dept. of Health, Education and Welfare, Public Health Service, Washington.

Prescott, G. W. 1978. How to Know the Freshwater Algae. Wm. C. Brown Co., Publishers, Dubuque, Iowa.

Round, F. E. 1981. The Biology of the Algae. Edward Arnold, Publishers, Bedford Square, London.

Renee Tanner   David Moore   Edward Glenn

Algae Counts, APS/PVNGS, November 14, 1995

Algal Counts in Cells/Ml

Table 1: Pond 1

Site	Chaetoceros	Chlorogonium	Coccochloris	Nitzschia	Chlorella	Protozoan	Navícula	Unident.	Staurastrum
Center	32,500	0	5,000	2,500	13,750	0	0	0	0
NW	33,750	0	6,250	3,750	10,000	0	0	0	0
SE	31,250	0	6,250	0	10,000	0	0	0	0
North	63,750	0	10,000	3,750	8,750	0	0	0	1,250
South	18,750	8,750	0	1,250	13,750	0	0	0	0
East	52,500	1,250	12,500	1,250	8,750	0	0	1,250	0
West	31,250	1,250	11,250	2,500	1,250	1,250	1,250	0	0
Average	37,679	1,607	7,321	2,143	9,464	179	179	179	179

Total Cell Count: 58,929

Table 2: Pond 2

Site	Chaetoceros	Chlorogonium	Coccochloris	Carteria	Nitzschia	Chlorella	Protozoan	Unident.
Center	16,250	0	3,750	0	5,000	53,750	0	0
NE	13,750	1,250	3,750	0	6,250	67,500	0	0
SW	12,500	3,750	2,500	0	3,750	62,500	0	0
North	26,250	1,250	5,000	0	11,250	62,500	0	0
South	12,500	1,250	2,500	1,250	2,500	62,500	0	1,250
East	15,000	1,250	1,250	0	3,750	78,750	0	0
West	8,750	2,500	3,750	0	10,000	73,750	1,250	2,500
Average	15,000	1,607	3,214	179	6,071	65,893	179	536

Total Cell Count: 92,143

Table 3: Fresh Water Reservoir

Site	Anacystis	Cosmarium	Staurastrum	Tetraedron	Nitzschia	Chlorella
North	0	1,250	0	1,250	0	1,250
South	3,750	0	0	2,500	1,250	2,500
East	8,750	0	0	0	0	2,500
West	10,000	0	1,250	2,500	0	0
Average	5,625	313	313	1,563	313	1,563

Total Cell Count: 7,813

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December 12, 1995

Memo to: Thomas Hillmer, APS-PVNGS

Re: PVNGS Ponds, October 24 - December 5, 1995

Summary Observations

This report covers a 7 week period during which water samples were collected and analyzed weekly, in preparation for the expected arrival of migratory birds. During this period almost all of the blowdown water was entering Pond 1 although a small flow also entered Pond 2. Site visits were made on October 24, November 14 and December 5 and additional water samples were collected by APS personnel and sent to ERL for analysis on October 31, November 7, November 21 and November 29, 1995. Multiple water samples from the Receiving Reservoir, Pond 1 and Pond 2 were analyzed for algae content, nitrate, nitrite, ammonia, phosphate, pH and salinity. Data from each sampling period are in the attached tables and figures and are discussed in the sections below.

No algae levels of concern as hazards to wildlife were found at any of the sampling dates. Total counts of algae in the Receiving Reservoir ranged from approximately 8,000 - 53,000 cells per ml, dominated by the blue-green algae Anacystis. This algae can be a problem when it grows in thick mats in ponds but we have not observed negative effects on birds at the moderate levels in the Receiving Reservoir nor are there reports of it being a hazard at these levels. Anacystis is a fresh water algae and was not found in the evaporation ponds. The evaporation ponds had counts ranging from approximately 50,000 - 160,000 cells per ml and were dominated by marine diatoms (Chaetoceros and Nitzschia) and a marine species of the green algae, Chlorella. These are common algae that form the base of the food algae for marine animals in natural ecosystems. Moderate but fluctuating levels of water boatmen (an aquatic animal) were found in the ponds. Water boatmen are a food source for visiting birds, which were present in moderate numbers (200-500 per pond) on our site visits. No bird mortality was observed on our visits.

The Receiving Reservoir has a low salinity and moderate levels of N and P. By contrast, Ponds 1 and 2 are hypersaline and have high levels of nitrate and moderate levels of ammonia. The levels are not so high that they would be toxic to wildlife by direct contact.

Chemical Analyses of Water Samples

Water quality data by sampling date are in Tables 1-7. Data are summarized in Figures 1-3. The Receiving Reservoir had low salinity (approximately 0.5 ppt by refractometer, but this is not an accurate method at these low salinity levels). It had moderate levels of nitrate (10-20 ppm as N), low ammonia levels (< 0.1 ppm as N) and a high pH (>9.0). Phosphate levels were less than 0.12 ppm as P in the Receiving Reservoir.

The salinity of Pond 1 was stable at approximately 56 ppt but was lower at the north end where blowdown water entered. The salinity of Pond 2 gradually increased due to evaporation and lack of dilution with blowdown, reaching 63 ppt by December 5. These salinity changes are potentially important in controlling the type of algae in the ponds, because the ponds are already above normal ocean salinity (35 ppt) and some of the marine species can be expected to decrease under hypersaline conditions, while more specialized stenohaline forms may be expected to dominate.

Nitrate levels were very high in the evaporation ponds, ranging from 250-600 ppm as N. They were higher in Pond 1, receiving blowdown, than in Pond 2. These nitrate levels, while high, are not reported to be directly (acutely) toxic to wildlife. Nitrate levels as high as 1,000 ppm have been observed in intensive aquaculture systems without harm to aquatic organisms (Arbiv & van Rihn, 1995). Ammonia levels in the Ponds were also higher than in the Receiving Reservoir, ranging from 1-2 ppm and nitrite levels were in the range of 2-8 ppm. These are also not reported to be directly toxic to wildlife by contact. The pH of Pond 1 was lower than Pond 2 but both were high (approximately 9.0). Phosphate was somewhat higher in Pond 1 than 2 but within the same range that was in the Receiving Reservoir.

Algae and Other Organisms in the Water

Algae counts for each sampling date are in Tables 8-13 and data are summarized for total counts and predominant types in each pond in Figures 4-7. As noted under **Summary Observations** (above), the Receiving Reservoir had moderate algae levels dominated by a blue-green algae whereas marine diatoms and Chlorella dominated in Ponds 1 and 2. Despite the difference in water chemistry between Ponds 1 and 2 due to blowdown entering mainly in Pond 1, there was no obvious effect on the algae types or levels. The algae types are different than were found in the summer in these ponds, however. The blue-green algae Coccochloris, which is reported to favor high temperature brine ponds, is no longer prominent in the evaporation ponds. Water temperatures are now in the range of 11-22° C, much cooler than when Coccochloris dominated in the ponds.

Water boatmen, which are at the top of the aquatic food chain in the evaporation ponds, were much more numerous in October and early November (approximately 1 per liter) than on December 5, when there were only 1 per 20 liters. Brine shrimp were not found on any site visit. The food chain in the ponds appears to have slowed down with cooler water temperature.

Recommendations

The water chemistry is what is expected in an evaporation pond, but the high nitrate levels suggest that further monitoring will be necessary. The algae populations are also high, due to the nutrient enrichment of the blowdown water, and the species composition tends to flucuate with the seasons. The algae support a food chain which also flucuates, but is an attraction to birds. Further monitoring of the biological components of the Receiving Reservoir and Ponds 1 and 2 is recommended on a monthly basis to determine the annual cycle of events in these water bodies, establish baseline levels, and to detect any organisms that might represent hazards to wildlife.

References

Arbiv, R. and J. van Rijn. 1995. Performance of a treatment system for inorganic nitrogen removal in intensive aquaculture systems. Aquacultural Engineering 14: 189-203.

Edward Glenn | Rene Tanner | David Moore

Table 1: Water Quality

PVNGS PONDS 10/24/95 Sampling

Pond 1	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	570.0	56.0	1.35	0.036	8.80	n/a
South	492.0	56.0	1.20	0.029	8.82	n/a
East	402.0	56.0	0.83	0.026	8.81	n/a
West	543.0	56.0	0.93	0.039	8.81	n/a
Center	540.0	55.0	1.00	0.029	8.80	6.93
Average	509.4	55.8	1.06	0.032	8.81	

Pond 2	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	360.0	60.0	1.68	0.036	9.14	n/a
South	290.0	60.0	1.89	0.055	8.98	n/a
East	350.0	60.0	1.23	0.023	9.08	n/a
West	320.0	60.0	1.55	0.039	9.11	n/a
Center	370.0	58.0	1.58	0.016	9.18	8.91
Average	338.0	59.6	1.59	0.034	9.10	

Fresh Water	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	13.9	0	0.050	0.049	9.31	n/a
South	10.0	0	0.075	0.049	9.35	0.1518
Average	11.95	0	0.063	0.049	9.33	

Table 2: Water Quality

PVNGS PONDS 10/31/95 Sampling

Pond 1	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	388.0	56.0	1.73	0.055	8.66	1.98
South	480.0	56.0	1.25	0.072	8.67	2.03
East*	376.0	55.0	8.50	0.068	8.15	1.40
West	402.0	56.0	1.43	0.036	8.67	2.11
Average	411.5	55.8	3.23	0.058	8.54	1.88

*This sample had approximately 1/2 inch of soil on the bottom. This must have affected the reading.

Pond 2	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	272.0	60.0	1.80	no data	9.04	2.75
South	266.0	60.0	1.50	no data	9.08	2.87
East	304.0	60.0	1.40	no data	9.09	2.75
West	232.0	60.0	1.90	no data	9.05	2.70
Average	268.5	60.0	1.65		9.07	2.77

Fresh Water Reservoir was not sampled.

Table 3: Water Quality

PVNGS PONDS 11/7/95 Sampling

Pond 1	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	380.0	49.0	0.83	0.419	8.63	1.59
South	492.0	56.0	1.00	0.072	8.74	2.16
East	504.0	56.0	0.80	0.055	8.74	2.09
West	528.0	55.0	0.94	0.052	8.75	2.21
Average	476.0	54.0	0.89	0.150	8.72	2.01

Pond 2	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	226.0	61.0	1.40	0.046	9.10	2.96
South	270.0	60.0	1.60	0.078	9.08	2.97
East	230.0	62.0	1.40	0.029	9.11	2.83
West	254.0	60.0	1.30	0.033	9.11	2.84
Average	245.0	60.8	1.43	0.047	9.10	2.90

Fresh Water	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	9.2	1	0.050	0.091	8.93	0.033
South	12.2	0	0.050	0.072	8.94	0.032
East	9.9	1	0.030	0.072	8.87	0.033
West	10.4	0	0.030	0.068	8.82	0.033
Average	10.43	0.5	0.040	0.076	8.89	0.033

Table 4: Water Quality

PVNGS PONDS 11/14/95 Sampling

Pond 1	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	458.0	55.0	1.65	0.059	8.90	2.13
South	558.0	56.0	1.78	0.039	8.91	2.14
East	452.0	56.0	1.45	0.029	8.91	2.16
West	494.0	56.0	1.38	0.033	8.92	2.22
Central	486.0	56.0	1.18	0.049	8.91	2.13
Average	489.6	55.8	1.49	0.042	8.91	2.16

Pond 2	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	268.0	62.0	1.83	0.029	9.27	2.86
South	230.0	60.0	1.70	0.065	9.27	2.86
East	300.0	62.0	1.78	0.052	9.28	3.00
West	298.0	62.0	1.70	0.029	9.27	2.91
Central	238.0	60.0	1.58	0.033	9.29	2.93
Average	266.8	61.2	1.72	0.042	9.28	2.91

Fresh Water	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	14.0	1	0.030	0.023	9.29	0.033
South	13.9	1	0.030	0.010	9.32	0.032
East	13.9	0.5	0.030	0.029	9.34	0.034
West	14.6	1	0.030	0.029	9.09	0.027
Average	14.10	0.875	0.030	0.023	9.26	0.032

Table 5: Water Quality

PVNGS PONDS 11/21/95 Sampling

Pond 1	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	424.0	48.0	1.33	0.518	8.86	1.56
South	588.0	56.0	1.38	0.114	8.93	2.13
East	486.0	56.0	1.20	0.095	8.93	2.12
West	444.0	56.0	0.93	0.121	8.94	2.01
Average	485.5	54.0	1.21	0.212	8.92	1.96

Pond 2	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	322.0	62.0	1.22	0.117	9.33	2.70
South	256.0	62.0	1.53	0.072	9.30	2.79
East	332.0	62.0	1.40	0.134	9.33	2.69
West	248.0	60.0	1.65	0.085	9.33	2.69
Average	289.5	61.5	1.45	0.102	9.32	2.72

Fresh Water	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	12.8	0.5	0.000	0.101	9.35	0.051
South	11.9	0	0.000	0.095	9.33	0.045
East	12.3	0	0.080	0.101	9.34	0.046
West	12.0	0.5	0.030	0.173	9.30	0.046
Average	12.25	0.25	0.028	0.117	9.33	0.047

Table 6: Water Quality
PVNGS PONDS 11/29/95 Sampling

Pond 1	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	646.0	54.0	1.25	0.137	8.97	2.34
South	638.0	57.0	1.08	0.124	8.97	2.43
East	476.0	56.0	0.90	0.069	8.98	2.38
West	640.0	57.0	0.85	0.150	9.01	2.34
Average	600.0	56.0	1.02	0.120	8.98	2.37

Pond 2	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	372.0	62.0	1.53	0.104	9.35	3.12
South	424.0	63.0	1.55	0.108	9.32	3.34
East	430.0	63.0	1.80	0.101	9.31	3.20
West	376.0	63.0	1.45	0.075	9.38	3.22
Average	400.5	62.8	1.58	0.097	9.34	3.22

Fresh Water	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	17.8	1	0.000	0.062	9.39	0.065
South	19.0	1	0.000	0.082	9.30	0.059
East	17.9	1	0.000	0.068	9.29	0.062
West	17.0	1	0.000	0.078	9.19	0.057
Average	17.93	1	0.000	0.072	9.29	0.061

Table 7: Water Quality

PVNGS PONDS 12/5/95 Sampling

Pond 1	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	604.0	57.0	1.63	0.111	9.01	2.14
South	418.0	57.0	1.25	0.088	9.01	2.16
East	606.0	56.0	2.10	0.091	9.01	2.14
West	660.0	56.0	1.50	0.108	9.04	2.22
Central	586.0	57.0	1.68	0.121	9.02	2.18
NW	544.0	57.0	1.53	0.117	9.01	2:11
SE	642.0	57.0	1.25	0.124	9.01	2.18
Average	580.0	56.7	1.56	0.109	9.02	2.16

Pond 2	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	350.0	62.0	2.05	0.075	9.34	3.33
South	320.0	62.0	2.13	0.059	9.34	3.41
East	386.0	63.0	2.08	0.075	9.35	3.36
West	368.0	63.0	2.20	0.062	9.35	3.30
Central	386.0	63.0	2.15	0.078	9.34	3.34
NE	412.0	63.0	2.13	0.078	9.35	3.43
SW	379.0	63.0	2.00	0.088	9.35	3.32
Average	371.6	62.7	2.10	0.074	9.35	3.36

Fresh Water	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	18.3	0.5	0.350	0.101	9.26	0.088
South	15.4	0.5	0.325	0.124	9.18	0.092
East	16.2	0.5	0.325	0.078	9.28	0.086
West	17.6	0.5	0.400	0.091	9.31	0.109
Average	16.88	0.5	0.350	0.099	9.26	0.094

Table 8: **Algae Counts, APS/PVNGS, October 31, 1995**

Algal Counts in Cells/Ml

Pond 1

Site	Chaetoceros	Chlorogonium	Coccochloris	Nitzschia	Chlorella	Protozoan	Green Filament	Unident.
North	81,250	13,750	10,000	15,000	22,500	0	1,250	0
South	76,250	10,000	7,500	8,750	31,250	0	0	0
East	42,500	3,750	4,900	5,000	40,000	3,750	0	0
West	80,000	6,250	1250	28,750	23,750	2,500	0	2500
Average	70,000	8,438	5,913	14,375	29,375	1,563	313	625

Total Cell Count: 130,600

Pond 2

Site	Chaetoceros	Chlorogonium	Coccochloris	Carteria	Nitzschia	Chlorella	Protozoan	Cyclotella
North	7,500	10,000	7,500	1,250	45,000	35,000	0	0
South	7,500	21,250	7,500	0	12,500	42,500	1,250	0
East	7,500	10,000	11,250	0	60,000	33,750	0	1,250
West	7,500	5,000	11,250	0	73,750	35,000	1,250	0
Average	7,500	11,563	9,375	313	47,813	36,563	625	313

Total Cell Count: 114,063

Fresh Water Reservoir

NO DATA COLLECTED

Total Cell Count: 0

Table 9: **Algae Counts, APS/PVNGS, November 7, 1995**

Algal Counts in Cells/Ml

Pond 1

Site	Chaetoceros	Chlorogonium	Coccochloris	Nitzschia	Chlorella	Protozoan	Cyclotella	Unident.	Crysochromulina
North	81,250	1,250	28,750	10,000	33,750	1,250	0	2,500	0
South	98,250	7,500	1,250	18,750	21,250	0	0	1,250	1250
East	110,000	6,250	13,750	13,750	32,500	0	0	0	0
West	73,750	7,500	13750	10,000	16,250	0	1250	0	1250
Average	90,313	5,625	14,375	13,125	25,938	313	313	938	625

Total Cell Count: 151,563

Pond 2

Site	Chaetoceros	Chlorogonium	Coccochloris	Carteria	Nitzschia	Chlorella	Protozoan
North	3,750	2,500	1,250	0	47,500	70,000	0
South	3,750	0	7,500	2,500	141,250	45,000	2,500
East	10,000	0	5,000	0	40,000	37,500	0
West	5,000	1,250	6,250	0	27,500	58,750	0
Average	5,625	938	5,000	625	64,063	52,813	625

Total Cell Count: 129,688

Fresh Water Reservoir

Site	Anacystis	Cosmarium	Staurastrum	Unident.
North	7,500	1,250	0	2,500
South	22,500	2,500	0	1,250
East	6,250	0	0	1,250
West	16,250	0	1,250	3,750
Average	13,125	938	313	2,188

Total Cell Count: 16,563

Table 10: **Algae Counts, APS/PVNGS, November 14, 1995**

Algal Counts in Cells/Ml

Pond 1

Site	Chaetoceros	Chlorogonium	Coccochloris	Nitzschia	Chlorella	Protozoan	Navicula	Unident.	Staurastrum
Center	32,500	0	5,000	2,500	13,750	0	0	0	0
NW	33,750	0	6,250	3,750	10,000	0	0	0	0
SE	31,250	0	6,250	0	10,000	0	0	0	0
North	63,750	0	10,000	3,750	8,750	0	0	0	1,250
South	18,750	8,750	0	1,250	13,750	0	0	0	0
East	52,500	1,250	12,500	1,250	8,750	0	0	1,250	0
West	31,250	1,250	11,250	2,500	1,250	1,250	1,250	0	0
Average	37,679	1,607	7,321	2,143	9,464	179	179	179	179

Total Cell Count: 58,929

Pond 2

Site	Chaetoceros	Chlorogonium	Coccochloris	Carteria	Nitzschia	Chlorella	Protozoan	Unident.
Center	16,250	0	3,750	0	5,000	53,750	0	0
NE	13,750	1,250	3,750	0	6,250	67,500	0	0
SW	12,500	3,750	2,500	0	3,750	62,500	0	0
North	26,250	1,250	5,000	0	11,250	62,500	0	0
South	12,500	1,250	2,500	1,250	2,500	62,500	0	1,250
East	15,000	1,250	1,250	0	3,750	78,750	0	0
West	8,750	2,500	3,750	0	10,000	73,750	1,250	2,500
Average	15,000	1,607	3,214	179	6,071	65,893	179	536

Total Cell Count: 92,143

Fresh Water Reservoir

Site	Anacystis	Cosmarium	Staurastrum	Tetraedron	Nitzschia	Chlorella
North	0	1,250	0	1,250	0	1,250
South	3,750	0	0	2,500	1,250	2,500
East	8,750	0	0	0	0	2,500
West	10,000	0	1,250	2,500	0	0
Average	5,625	313	313	1,563	313	1,563

Total Cell Count: 7,813

Table 11: **Algae Counts, APS/PVNGS, November 21, 1995**

Algal Counts in Cells/Ml

Pond 1

Site	Chaetoceros	Chlorogonium	Coccochloris	Carteria	Navicula	Chlorella	Tetraedron	Cosmarium
North	21,250	0	6,250	0	3,750	6,250	2,500	2,500
South	33,750	1,250	10,000	1,250	3,750	0	0	0
East	33,750	0	8,750	0	0	16,250	0	0
West	32,500	1,250	12,500	0	3,750	11,250	0	1,250
Average	30,313	625	9,375	313	2,813	8,438	625	938

Total Cell Count: 53,438

Pond 2

Site	Chaetoceros	Chlorogonium	Coccochloris	Unident.	Nitzschia	Chlorella	Chrysococcus	Phyla/Euglenophyta
North	43,750	2,500	0	1,250	7,500	103,750	0	3,750
South	33,750	1,250	3,750	0	7,500	83,750	1,250	1,250
East	38,750	2,500	0	0	7,500	72,500	3,750	0
West	48,750	2,500	0	0	12,500	68,750	0	1,250
Average	41,250	2,188	938	313	8,750	82,188	1,250	1,563

Total Cell Count: 138,438

Fresh Water Reservoir

Site	Anacystis	Cosmarium	Staurastrum	Chlorella
North	15,000	0	1,250	2,500
South	17,500	0	0	1,250
East	22,500	0	1,250	0
West	21,250	1,250	0	1,250
Average	19,063	313	625	1,250

Total Cell Count: 21,250

Table 12: **Algae Counts, APS/PVNGS, November 29, 1995**

Algal Counts in Cells/Ml

Pond 1

Site	Chaetoceros	Chlorogonium	Coccochloris	Carteria	Nitzschia	Chlorella	Filamentous Blue-green	Unident.
North	90,000	0	0	1,250	5,000	25,000	0	1,250
South	77,500	0	0	6,250	6,250	17,500	3,750	0
East	91,250	0	0	0	10,000	13,750	0	1,250
West	82,500	3,750	0	2,500	6,250	15,000	2,500	0
Average	85,313	938	0	2,500	6,875	17,813	1,563	625

Total Cell Count: 115,625

Pond 2

Site	Chaetoceros	Chlorogonium	Coccochloris	Navicula	Nitzschia	Chlorella	Filamentous Blue-green	hyla/Euglenophyt	Unident.
North	85,000	6,250	1,250	0	7,500	1,250	0	5,000	3,750
South	93,750	0	3,750	1,250	37,500	3,750	0	1,250	1,250
East	61,250	3,750	1,250	2,500	30,000	5,000	0	0	2,500
West	81,250	1,250	0	0	10,000	1,250	0	0	0
Average	80,313	2,813	1,563	938	21,250	2,813	0	1,563	1,875

Total Cell Count: 111,250

Fresh Water Reservoir

Site	Anacystis	Cosmarium	Staurastrum	Chlorella	etraedro	Nitzschia	Filamentous Blue-green	Unidentified
North	32,500	0	1,250	0	0	0	1,250	0
South	41,250	1,250	0	0	0	0	0	2,500
East	62,500	0	0	1,250	1,250	1,250	0	5,000
West	52,500	0	1,250	0	0	0	0	5,000
Average	47,188	313	625	313	313	313	313	3,125

Total Cell Count: 52,500

Table 13: **Algae Counts, APS/PVNGS, December 5, 1995**

Algal Counts in Cells/Ml

Pond 1

Site	Chaetoceros	Chlorogonium	Coccochloris	Carteria	Nitzschia	Chlorella	Filamentous Blue-green	Unident.
Center	126,250	0	7,500	0	5,000	11,250	2,500	0
NW	122,500	1,250	8,750	0	1,250	8,750	0	0
SE	123,750	0	7,500	2,500	0	20,000	0	0
North	145,000	1,250	10,000	2,500	5,000	10,000	0	0
South	156,250	0	0	6,250	1,250	21,250	0	0
East	116,250	0	0	1,250	5,000	10,000	0	1,250
West	156,250	3,750	3,750	0	3,750	7,500	0	6,250
Average	135,179	893	5,357	1,786	3,036	12,679	357	1,071

Total Cell Count: 160,357

Pond 2

Site	Chaetoceros	Chlorogonium	Coccochloris	Nitzschia	Chlorella	Unident.
Center	108,750	6,250	0	10,000	8,750	2,500
NE	116,250	5,000	0	7,500	16,250	0
SW	102,500	10,000	0	15,000	15,000	0
North	103,750	3,750	0	7,500	0	2,500
South	115,000	5,000	0	37,500	1,250	6,250
East	127,500	1,250	0	30,000	0	5,000
West	77,500	6,250	0	10,000	0	1,250
Average	107,321	5,357	0	16,786	5,893	2,500

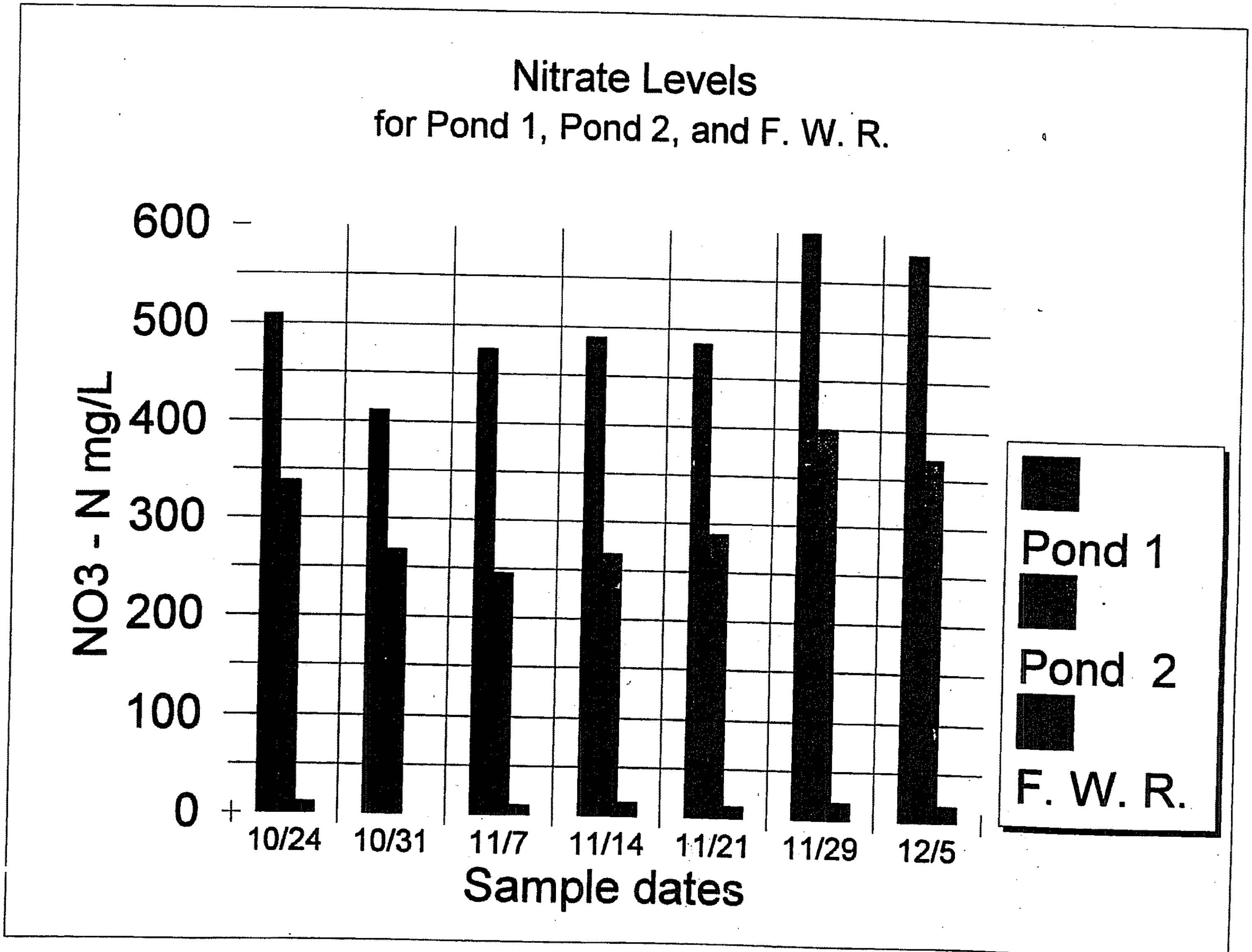
Total Cell Count: 137,857

Fresh Water Reservoir

Site	Anacystis	Staurastrum	Rhodomonas	nidentifie
North	52,500	0	0	1,250
South	42,500	1,250	2,500	3,750
East	33,750	0	0	1,250
West	31,250	0	0	2,500
Average	40,000	313	625	2,188

Total Cell Count: 43,125

FIGURE 1: Water Quality



* No sampling of F. W. R. on 10/31.

FIGURE 2: Water Quality

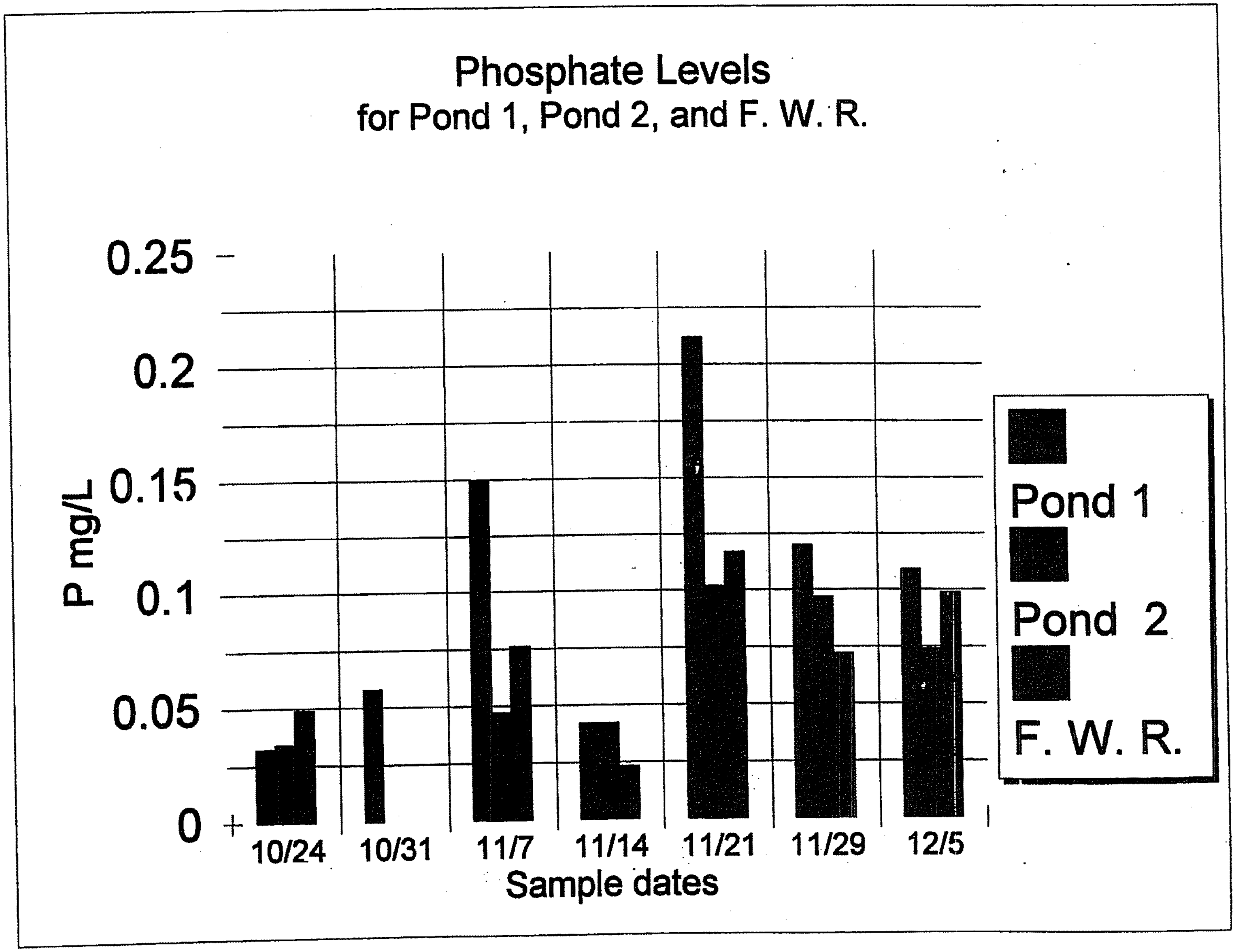


FIGURE 3: Water Quality

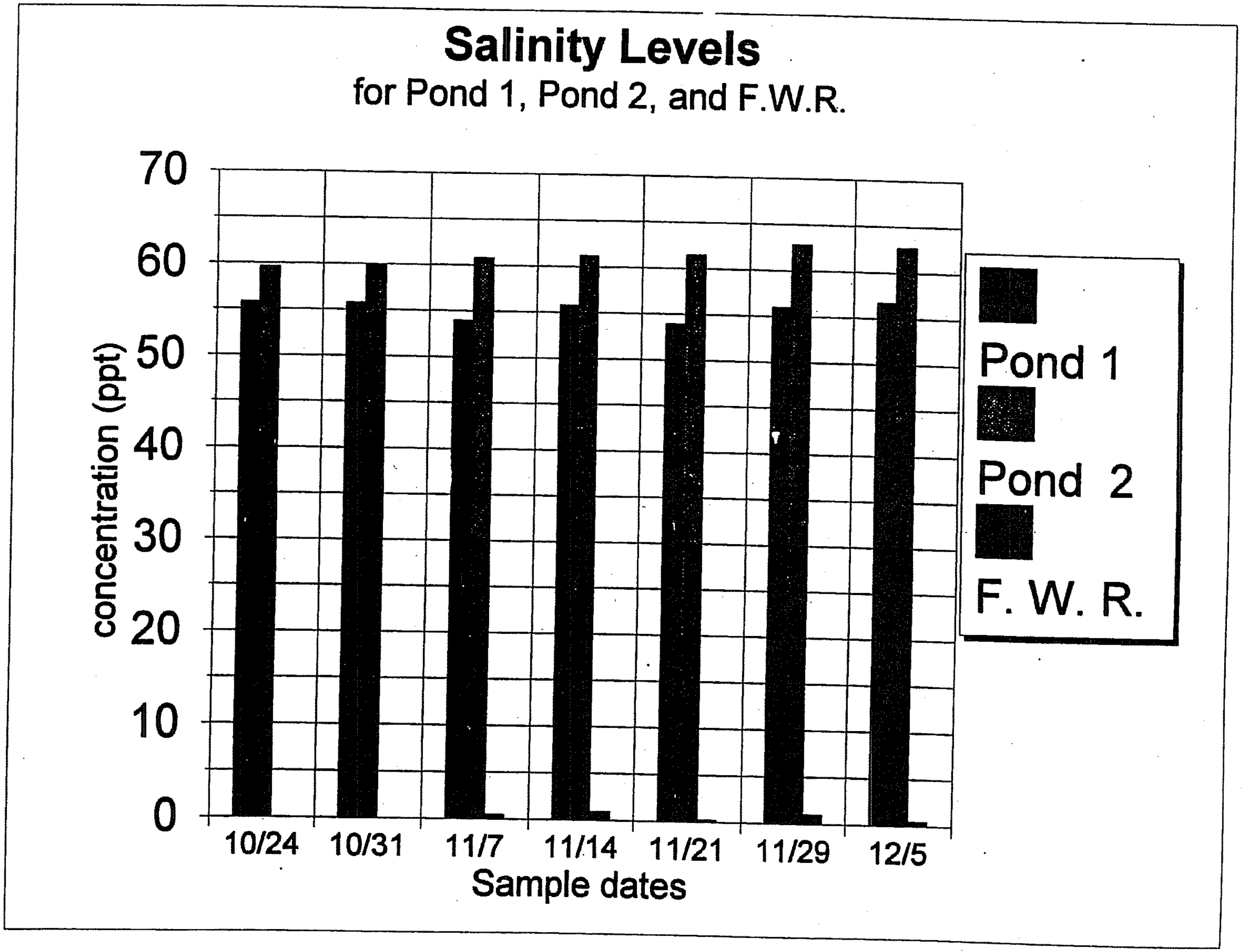
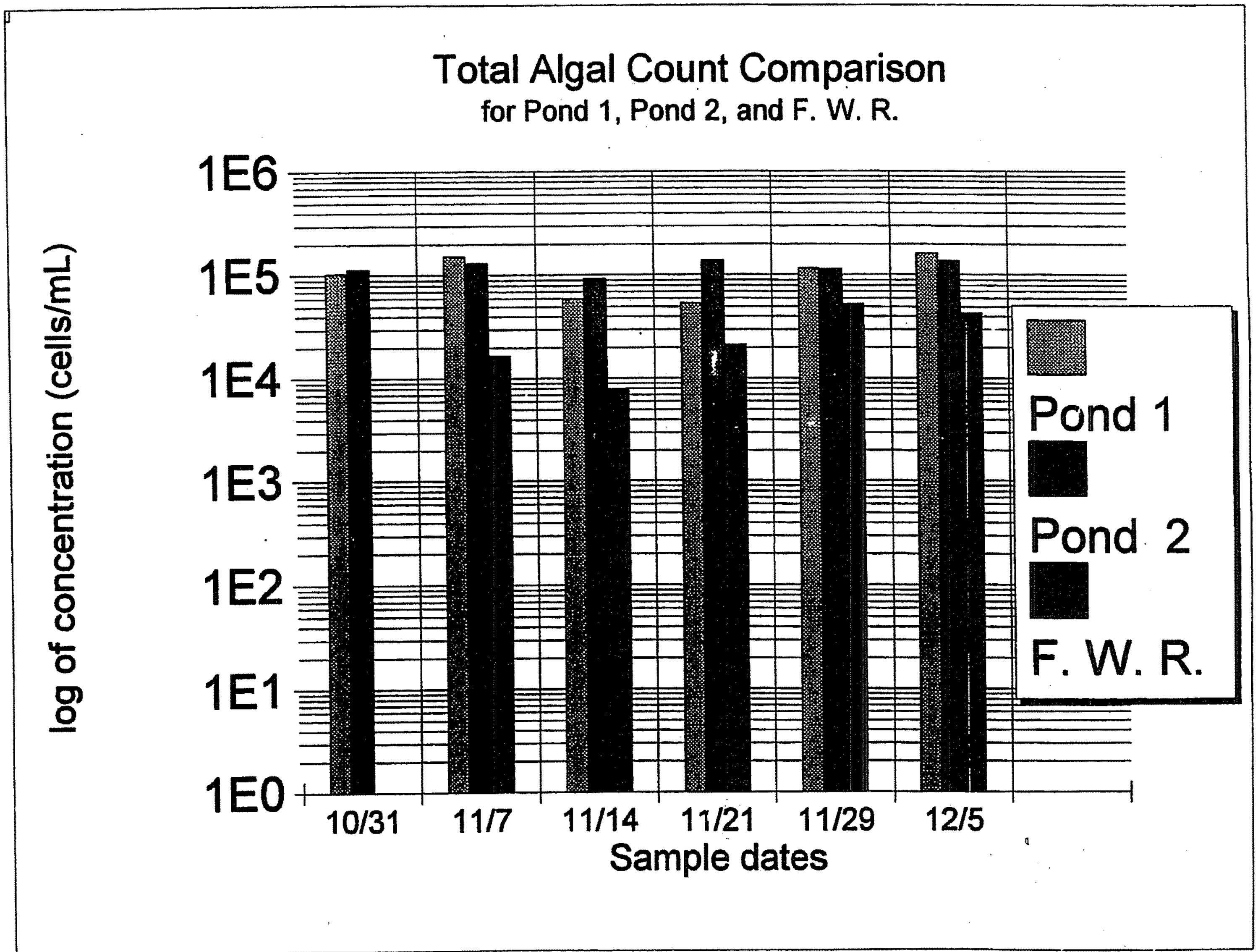


FIGURE 4: Algal Counts



* No sampling of F. W. R. on 10/31.

FIGURE 5: Algal Counts

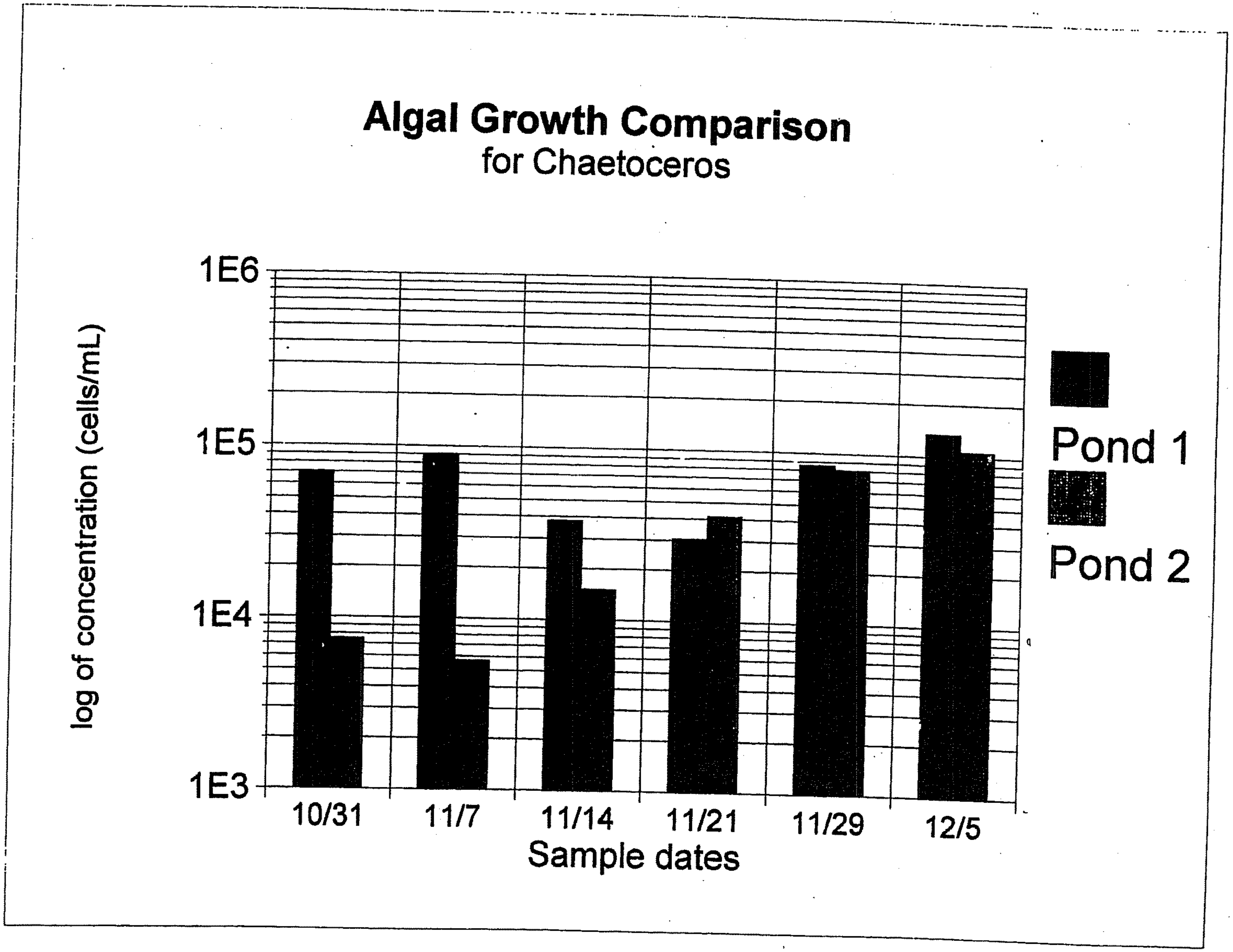


FIGURE 6: Algal Counts

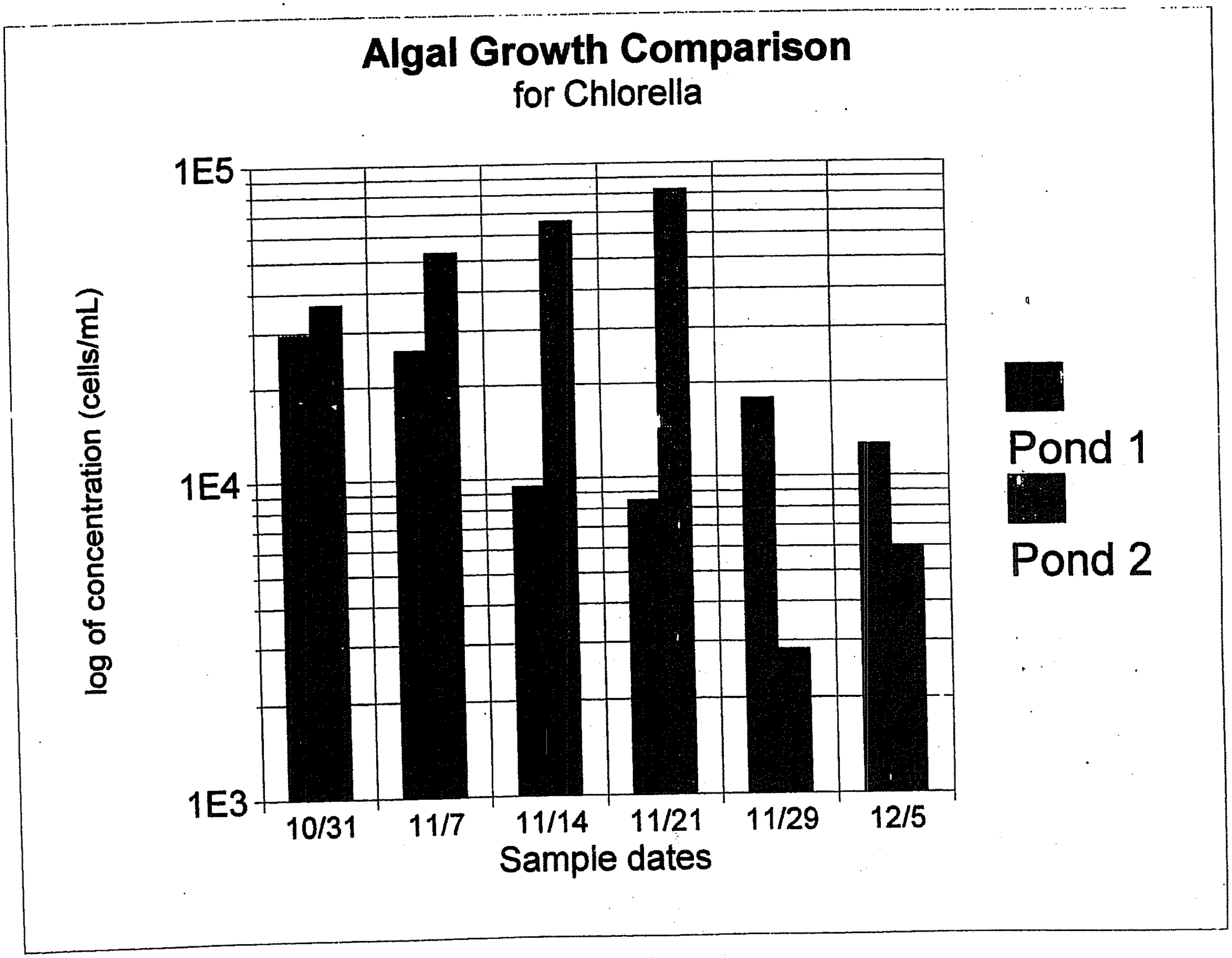
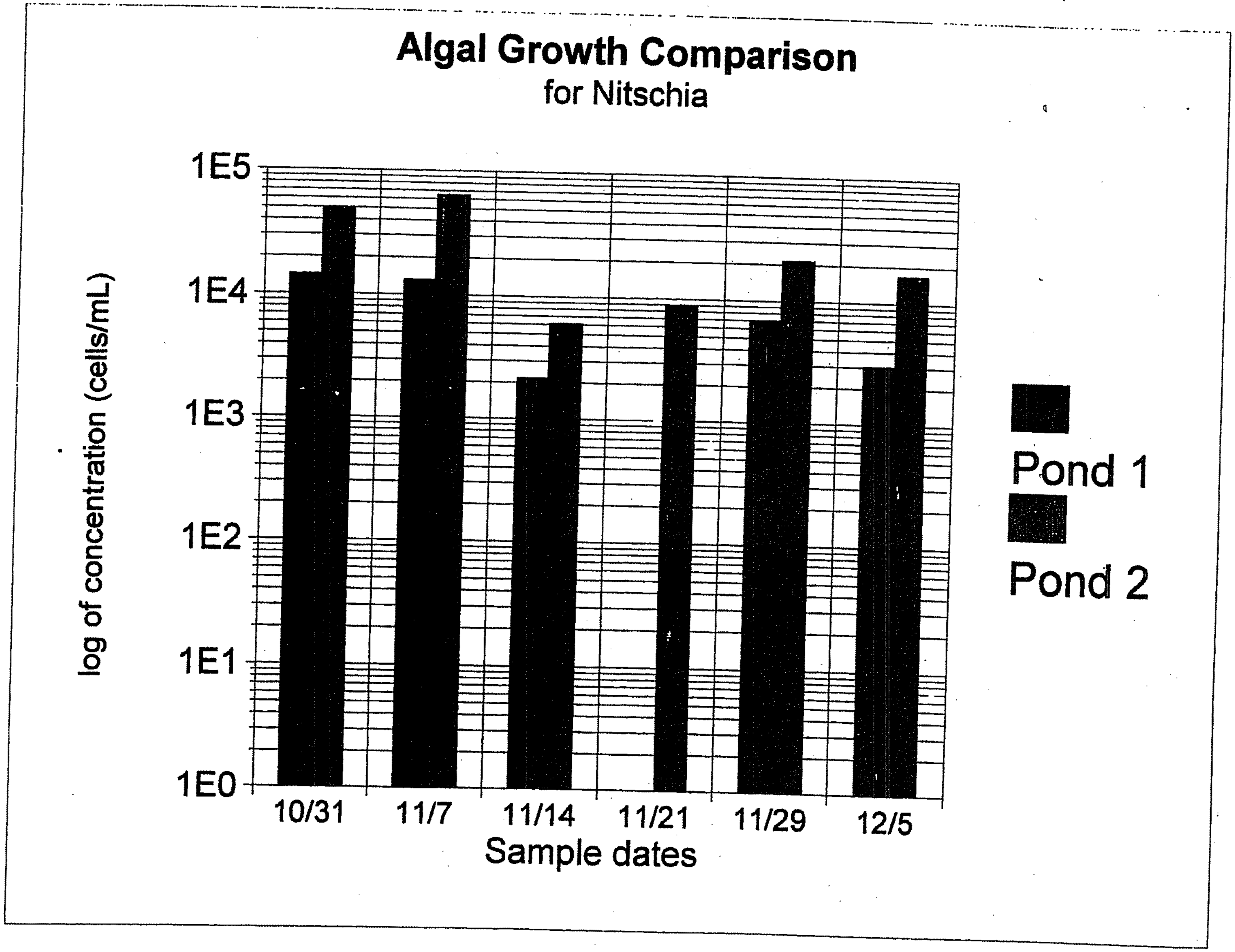


Figure 7: Algal Counts



THE UNIVERSITY OF ARIZONA

REPLY TO: ENVIRONMENTAL RESEARCH LABORATORY
2601 E. AIRPORT DRIVE
TUCSON INTERNATIONAL AIRPORT
TUCSON, ARIZONA 85706-6985 U.S.A.
Telephone: (602) 741-1990 FAX: 602-573-0852 Telex: 165580

DATE: December 20, 1995

MEMO TO: Thomas Hillmer, APS - PVNGS

Re: PVNGS Ponds, December 5, 1995 Sampling

Summary Observations

As was the case last month, water is being put into Evaporation Pond 1. Only a few hundred birds were seen on Evaporation Ponds 1 and 2. Less than 1,000 were seen on the Water Receiving Facility. These numbers are lower than those p__viously recorded. The predominate alga blooming in Ponds 1 and 2 is the diatom, Chaetoceros. The wind accumulations in these ponds, which is primarily in Pond 2, also consists of Chaetoceros, plus a large number of various pennate diatoms. The total algal counts are up from last months sampling and low levels of blue-green algae were observed in Pond 1, but none in Pond 2 during this sampling.

Pond 1

Gross appearance. Pond water had a brown tint consistent with the Chaetoceros bloom which was found. Water boatmen were present but scarce, still estimated at less than 1 per 20 liters. Average water temperature was 15.5°C, down from 20°C last month. The average salinity, measured with a refractometer, was 57 ppt.

Algae. Secchi disk visibility was 70 centimeters compared to 107 centimeters last month and 69 centimeters two months ago, indicating that the algal bloom has once again increased. The predominant alga was Chaetoceros, with a cell count of 135,000 c/ml. The blue-green alga Coccochloris was present at a cell count of 5,000 c/ml. The total cell count was 160,000 c/ml.

Animals. Water boatmen, Trichocorixa, remained the same as last month with a concentration estimated at less than 1 per 20 liters.

Pond 2

Gross appearance. Pond water also had a brown tint consistent with the predominate alga found, the diatom Chaetoceros. Water boatmen were present in the same low amount as was observed in Pond 1. There was much more material in the wind accumulation in Pond 2 than what was seen in Pond 1. This floating material had formed in the south west corner of the pond. The average temperature was 17°C, this down from 19°C last month. The average salinity, measured with a refractometer, was 63 ppt.

Algae. Secchi disk visibility was 87 centimeters compared to 109 centimeters last month and 71 centimeters two months ago. The predominant alga was *Chaetoceros*, with a cell count of 107,000 c/ml. The blue-green alga *Coccochloris* was absent from the water column during this sampling. The total cell count was 138,000 c/ml.

Animals. The water boatmen population has decreased from about 1/liter last month to only an occasional one observed anywhere in the pond.

Fresh Water Reservoir

Gross appearance. Water was clear. There was a green tint to the bottom. Most of the birds had accumulated at this pond, approximately 400 on the water. No sick or dead birds were seen. The temperature measured from the side was 22°C. The salinity, measured with a refractometer, was 0.5 ppt.

Algae. The predominant organism was the blue-green alga *Anacystis*, with a cell count of 40,000 c/ml. Other alga identified were *Staurastrum* and *Rhodomonas*. The total cell count was 43,000 c/ml.

Animals. No significant concentrations of aquatic insects were seen.

References:

Palmer, C. M. 1959. Algae in Water Supplies. U.S. Dept. of Health, Education and Welfare, Public Health Service, Washington.

Prescott, G. W. 1978. How to Know the Freshwater Algae. Wm. C. Brown Co., Publishers, Dubuque, Iowa.

Round, F. E. 1981. The Biology of the Algae. Edward Arnold, Publishers, Bedford Square, London.

Renee Tanner   David Moore   Edward Glenn

Algae Counts, APS/PVNGS, December 5, 1995

Algal Counts in Cells/ml

Table 1: Pond 1

Site	Chaetoceros	Chlorogonium	Coccochloris	Carteria	Nitzschia	Chlorella	Filamentous Blue-green	Unident.
Center	126,250	0	7,500	0	5,000	11,250	2,500	0
NW	122,500	1,250	8,750	0	1,250	8,750	0	0
SE	123,750	0	7,500	2,500	0	20,000	0	0
North	145,000	1,250	10,000	2,500	5,000	10,000	0	0
South	156,250	0	0	6,250	1,250	21,250	0	0
East	116,250	0	0	1,250	5,000	10,000	0	1,250
West	156,250	3,750	3,750	0	3,750	7,500	0	6,250
Average	135,179	893	5,357	1,786	3,036	12,679	357	1,071

Total Cell Count: 160,357

Table 2: Pond 2

Site	Chaetoceros	Chlorogonium	Coccochloris	Nitzschia	Chlorella	Unident.
Center	108,750	6,250	0	10,000	8,750	2,500
NE	116,250	5,000	0	7,500	16,250	0
SW	102,500	10,000	0	15,000	15,000	0
North	103,750	3,750	0	7,500	0	2,500
South	115,000	5,000	0	37,500	1,250	6,250
East	127,500	1,250	0	30,000	0	5,000
West	77,500	6,250	0	10,000	0	1,250
Average	107,321	5,357	0	16,786	5,893	2,500

Total Cell Count: 137,857

Table 3: Fresh Water Reservoir

Site	Anacystis	Staurastrum	Rhodomonas	Unidentified
North	52,500	0	0	1,250
South	42,500	1,250	2,500	3,750
East	33,750	0	0	1,250
West	31,250	0	0	2,500
Average	40,000	313	625	2,188

Total Cell Count: 43,125

Environmental Research Laboratory

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Telex: 165580

DATE: January 8, 1996

MEMO TO: Thomas Hillmer, APS - PVNGS

Re: PVNGS Ponds, January 4, 1996 Sampling

Summary Observations

The bird count continues to drop. Fewer birds were seen on the ponds than in the previous samplings. There is still a dense bloom of algae in Pond 1, with Chaetoceros continuing to predominate. While Chaetoceros is also the main alga in Pond 2, the cell count has dropped considerably. In Ponds 1 and 2, Artemia have not been observed at all in recent months and the population of water boatmen has declined to the point where only a few can be seen from the boat when it is stationary on the pond, as compared to hundreds in earlier months. The salinity in Pond 1 has decreased to 54 ppt (56 ppt Nov., 57 ppt Dec.), while the salinity in Pond 2 has risen to 64 ppt(61 ppt Nov., 63 ppt Dec.); see Table 4 for water quality data. Water in the Water Receiving Facility continues to look clear. There is a light growth of green and brown algae on the bottom. Some of this had been scraped from the bottom, at least on the sloping part of the liner near the surface, in a pattern which suggests that ducks are feeding on the material. Two samples were collected (scraped from the bottom) and were found to consist mostly of the same types of algae which we have identified previously from the water column. It is unlikely that this thin algal mat would cause any health problems to waterfowl feeding on it.

Pond 1

Gross appearance. There were approximately 50 birds on the pond. These were estimated to be about 25 - 30 grebes, 10 - 15 each of northern shovelers and buffleheads, and 2 or 3 seagulls. Average surface temperature across the pond (10:00 a.m.), had dropped to 10.2°C (Nov. 20°C, Dec. 15.5°C). The algal bloom was brown and dense, with a Secchi disk reading of 59 centimeters (Nov. 107 cm, Dec. 70 cm). While Pond 2 had a wind accumulation of floating material, Pond 1 had almost none. There were occasional pieces of floating mat material observed. These flat mat sections looked like they had formed on the liner, probably on the sloping part nearest the surface where adequate light penetration was available. Floating mat pieces were about 5 to 15 centimeters across. A sample was taken. The algal material was only loosely bound and broke up as samples were pulled into sample jars. As described below, this turned out to be a loose conglomeration of diatoms, primarily the predominant water column alga, Chaetoceros.

Algae. The predominant alga in the water column was Chaetoceros with a cell count of 230,000 c/ml. Small floating pieces of algal mat were observed and a sample was collected. The mat was predominantly made up of Chaetoceros with lesser amounts of Nitzschia, Staurastrum, Chlorella, Carteria, blue-green filamentous algae, and ciliated protozoa. The wind accumulation was largely Chaetoceros and lesser amounts of Nitzschia and ciliated protozoa. The total cell count for the water column (not including the floating debris) was 240,000 c/ml, see Table 1.

Animals. Water boatmen, Trichocorixa, while still present, but have become scarcer. With the boat stopped, a few could be seen swimming near the surface but less than on other sampling trips.

Pond 2

Gross appearance. When we first arrived, no birds were seen on Pond 2. When Pond 2 was sampled, six were seen, probably birds which had been scared off of Pond 1 when it was sampled. Surface temperature at 11:00 a.m. was 11°C across the pond (Nov. 19°C, Dec. 17°C). The average Secchi disk reading was 113 centimeters (Nov. 109 cm, Dec. 87 cm). The water had a slightly greener tint than the water in Pond 1. The water level reading in Pond 2 was 926 (926' above sea level).

Algae. The predominant alga was Chaetoceros, with a cell count of 30,000 c/ml. The wind accumulation consisted of Nitzschia, Navicula, ciliated protozoa, and numerous dead water boatmen in various stages of decay. Also present, but in lesser amounts were Chaetoceros, Chlorella, Chlorogonium, Oscillatoria, and Carteria. The total cell count for the water column (not including the wind accumulation) was 68,000 c/ml, see Table 2.

Animals. Aquatic insects were not observed in the pond water. If present, they were in very low numbers relative to other sample periods.

Water Receiving Facility

Gross appearance. There were approximately 300 birds on the pond and its banks. These consisted mostly of northern shovelers with the rest split between ruddys, buffleheads, coots and a few grebes. Water temperature was 17°C, down from 22°C last month.

Algae. The predominant alga was Anacystis, with a cell count of 22,000 c/ml. The samples containing algae scrapped from the bottom of the pond liner consisted of a wide variety of algae, but had a predominance of the alga *Staurastrum*. Some of the other algae observed included *Cosmarium*, *Scenedesmus*, *Chlorella*, *Cymbella*, *Nitzschia*, *Navicula*, *Pediastrum*, *Gloeocystis*, *Chlamydomonas*, *Anacystis*, and *Spirulina*. The total cell count for the water column (not including the bottom scrape samples) was 25,000 c/ml, see Table 3.

The photos included with this report feature the alga of the Water Receiving Facility.

Photo 1: *Staurastrum* (star-shaped alga), *Cosmarium* (lower center) and a grouping of *Cymbella* (right, center).

Photo 2: Cluster of *Staurastrum* with numerous other alga.

Photo 3: Mucilage bound cells of *Gloeocystis*.

Photo 4: *Gloeocystis*.

Photo 5: *Anacystis* cells grouped in a mucilage matrix.

Photo 6: Another view of *Anacystis*; note the yellow cells of *Chlorella* trapped inside the matrix.

Photo 7: *Scenedesmus*.

Photo 8: A filament of the blue-green alga *Spirulina*.

Animals. A larval insect (unidentified) was observed in 1 of the bottom scrapings. No other aquatic insects were seen.

References:

Prescott, G. W. 1978. How to Know the Freshwater Algae. Wm. C. Brown Co., Publishers, Dubuque, Iowa.

Renee Tanner   David Moore   Edward Glenn

Algae Counts, APS/PVNGS, January 4, 1996

Algal Counts in Cells/ml

Table 1: Pond 1

Site	Chaetoceros	Chlorogonium	Coccochloris	Chlorella	Nitzschia	Cosmarium	Staurastrum	Protozoan	Pediastrum
Center	276,250	0	1,250	5,000	2,500	0	0	1,250	0
NW	236,250	2,500	0	7,500	1,250	1,250	0	1,250	0
SE	187,500	0	0	2,500	0	0	1,250	0	1,250
Average	233,333	833	417	5,000	1,250	417	417	833	417

Total Cell Count: 242,917

Table 2: Pond 2

Site	Chaetoceros	Chlorogonium	Coccochloris	Nitzschia	Chlorella	Euglena	Protozoan	Unident.
Center	30,000	17,500	1,250	17,500	7,500	2,500	2,500	2,500
NE	21,250	16,250	2,500	12,500	2,500	0	0	0
SW	37,500	16,250	0	12,500	2,500	0	0	0
Average	29,583	16,667	1,250	14,167	4,167	833	833	833

Total Cell Count: 68,333

Table 3: Fresh Water Reservoir

Site	Anacystis	Staurastrum	Scenedesmus	Euglena	Chlorella	Tetraedron	Unident.
North	27,500	0	0	0	0	1,250	1,250
South	16,250	0	2,500	0	0	0	0
East	28,750	1,250	0	1,250	1,250	0	0
West	15,000	2,500	0	0	0	0	0
Average	21,875	938	625	313	313	313	313

Total Cell Count: 24,688

PVNGS PONDS 1/4/96 Sampling

Table 4: Water Quality Data

Pond 1	Nitrate NO3- -N mg/L	Salinity ppt	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
Central	464	55	1.1	0.18	9.14	2.04
NW	426	56	1.1	0.09	9.15	2.09
SE	450	52	1.3	0.14	9.08	1.77
Average	447	54	1.2	0.14	9.12	1.97

Pond 2	Nitrate NO3- -N mg/L	Salinity ppt	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
Central	266	64	3.2	0.03	9.27	2.68
NE	294	64	3.1	0.03	9.23	2.77
SW	292	64	2.8	0.02	9.22	2.74
Average	284	64	3.0	0.03	9.24	2.73

Fresh Water	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	19.3	0	0.80	0.10	8.97	0.212
South	18.8	0	0.73	0.13	8.87	0.198
East	23.2	0	0.75	0.16	8.82	0.165
West	26.2	0	0.85	0.13	8.90	0.218
Average	21.9	0	0.78	0.13	8.89	0.198

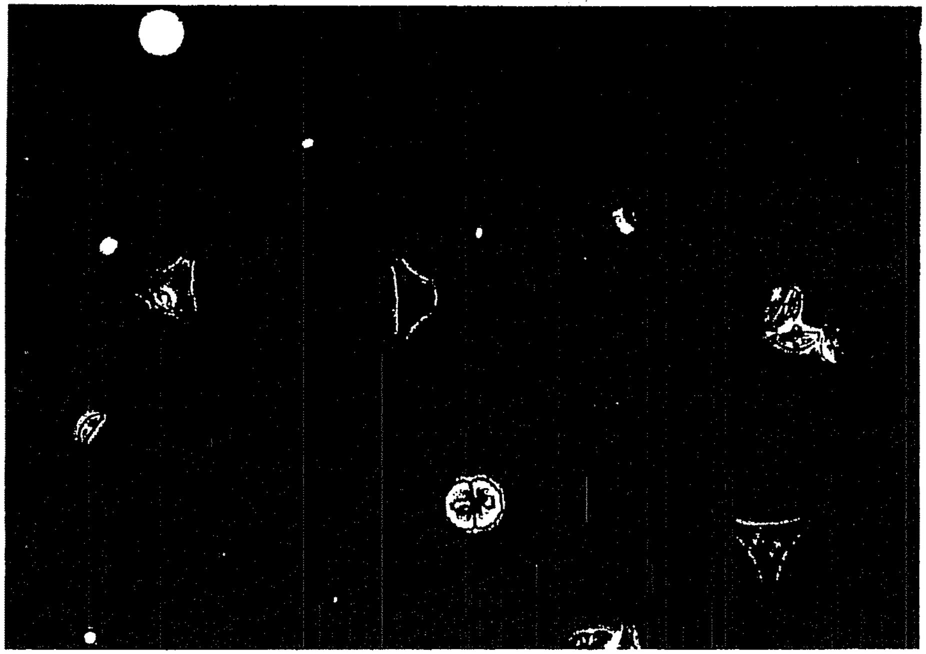
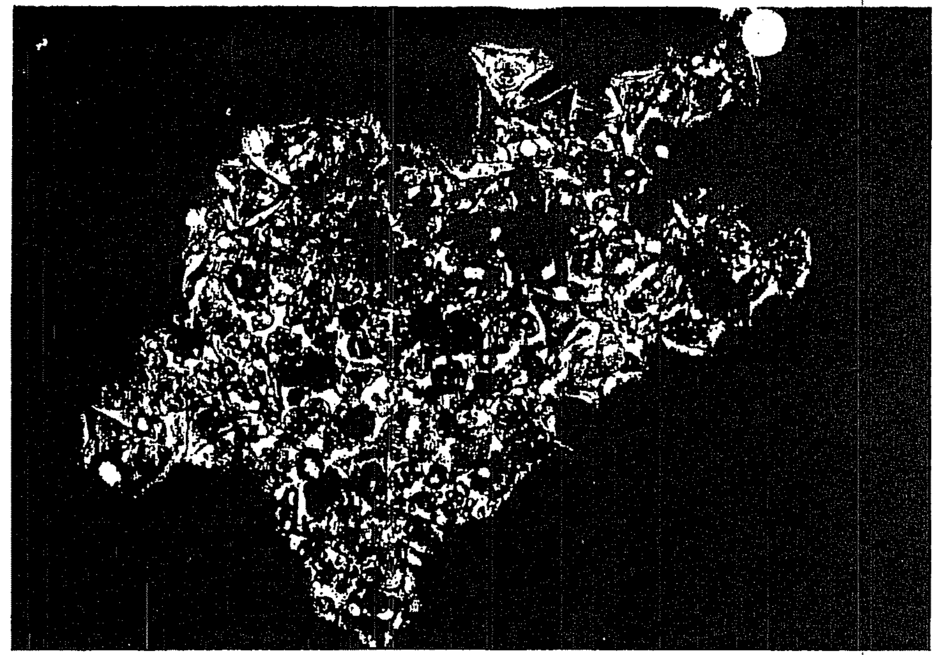


Photo 1



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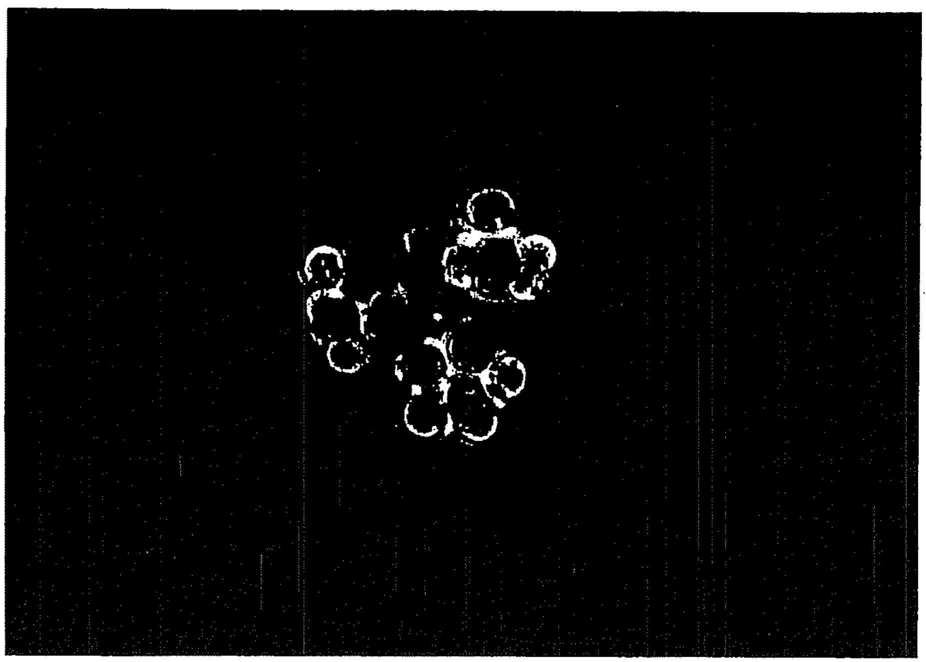

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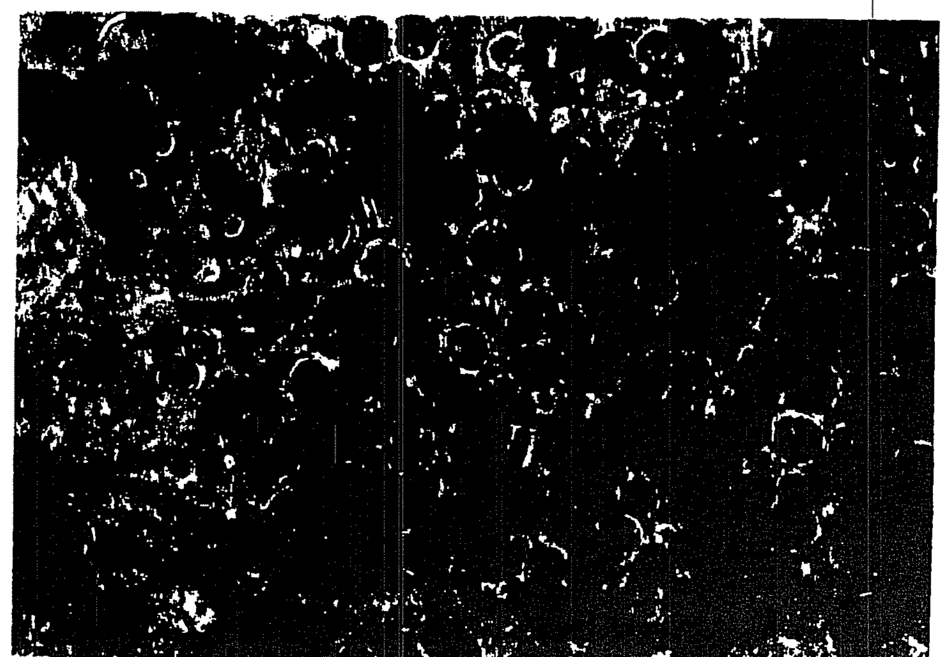
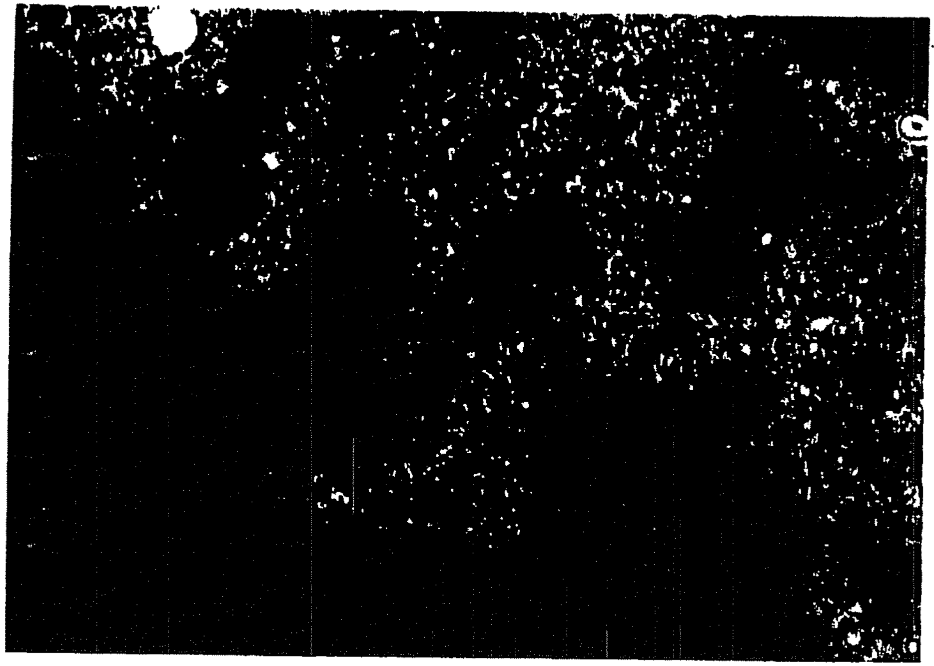


Photo 4



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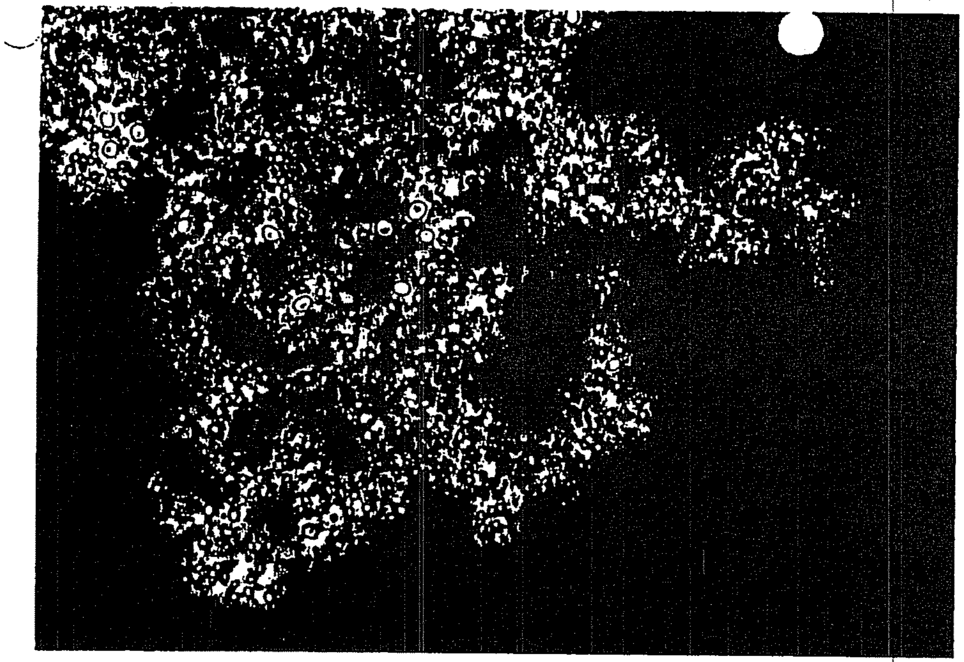

Photo 6

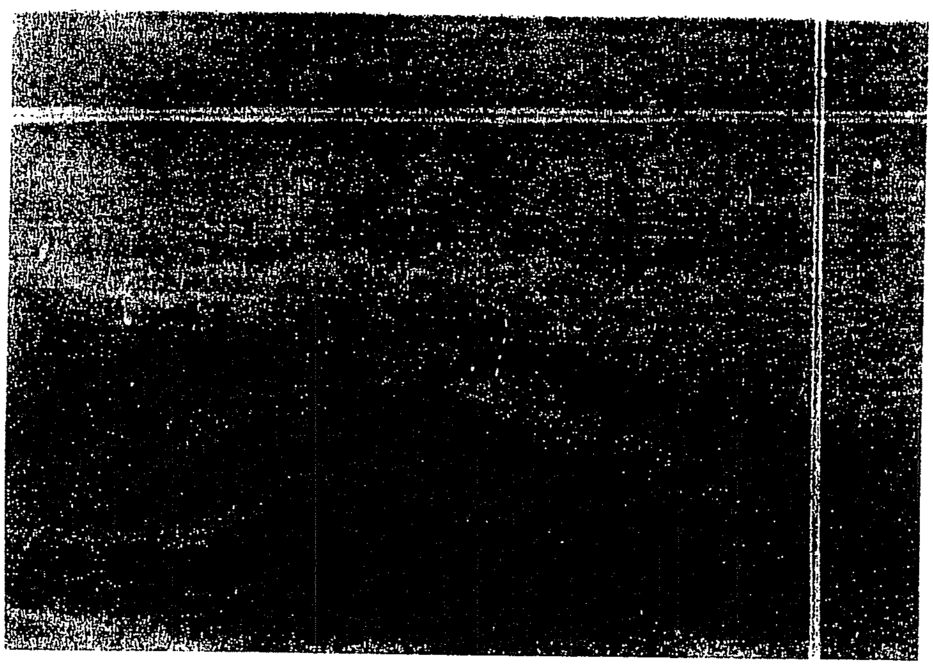

Photo 7

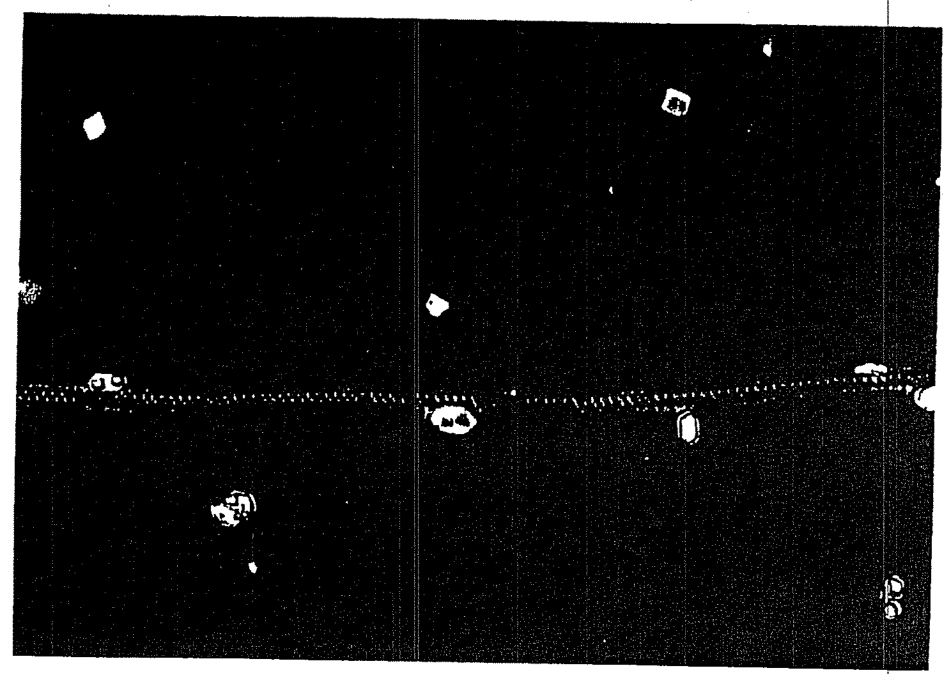

Photo 8

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DATE: February 14, 1996

MEMO TO: Thomas Hillmer, APS - PVNGS

Re: PVNGS Ponds, February 9, 1996 Sampling

Summary Observations

The bird count on the ponds remains low. There were only 1 - 2 dozen birds each on Ponds 1 and 2. The water receiving facility had approximately 500, up from 300 estimated earlier in the week. The dense bloom of *Chaetoceros* noted last month in Pond 1 has increased while the bloom in Pond 2, also predominately *Chaetoceros*, remains relatively low. The populations of water boatmen in Ponds 1 and 2 have all but disappeared. Only a few were seen in the corners near wind accumulations of floating algae and debris. The salinity in Pond 1 has decreased to 50 ppt (56 ppt Nov., 57 ppt Dec., 54 Jan.), while the salinity in Pond 2 has remained at 64 ppt(61 ppt Nov., 63 ppt Dec., 64 Jan.). On the sample date, water was seen flowing into both Ponds 1 and 2. See Table 4 for water quality data.

Pond 1

<u>Gross appearance</u>. There were approximately 12 birds on the pond, mostly grebes and coots. Water temperature has increased to 17.0°C, recorded at 9:00 a.m. (Nov. 20°C, Dec. 15.5°C, Jan. 10.2°C). The dense brown bloom of algae observed last month continues and is even darker with an average Secchi disk reading of 43 centimeters (Nov. 107 cm, Dec. 70 cm, Jan. 59). There was a light wind accumulation of floating debris along the southern bank. As noted last month, scattered throughout the pond were small pieces of algal mat material which were a conglomeration of algae, mainly the diatom *Chaetoceros*. Water was flowing into the pond. The water level in the pond was 927.5 feet above sea level. Approximately 6 liters of water were collected at each of the routine water sample points (southeast, center, northwest) for use in an experiment to be conducted at the Environmental Research Laboratory in Tucson to look at the effects of increasing salinity on survival and growth rates of the various algae present in a grab sample of water from Ponds 1 and 2.

<u>Algae</u>. The predominant alga in the water column was *Chaetoceros* with a cell count of 624,000 c/ml, up from 233,000 c/ml last month. This *Chaetoceros* count, and the total count of 654,000 c/ml for all water column algae in Pond 1, are the highest that we have seen in the sampling period. The wind

accumulation sample consisted of *Chaetoceros*, *Nitzschia*, *Staurastrum*, *Oscillatoria*, *Navicula*, and *Chlorogonium*. The total cell count for the water column was 654,000 c/ml, see Table 1.

Animals. The population of aquatic insects, which has consisted primarily of water boatmen, was at its lowest point since sampling began. Only a few were observed in areas where there were light wind accumulations of floating debris.

Pond 2

Gross appearance. There were 12 - 24 birds on the pond. Water temperature has increased to 16.3°C, recorded at 10:00 a.m. (Nov. 19°C, Dec. 17°C, Jan. 11°C). The Pond 2 algal bloom was much lighter than the Pond 1 bloom with an average Secchi disk reading of 79 centimeters (Nov. 109 cm, Dec. 87 cm, Jan. 113). Water was flowing into the pond. The water level was 924.5 feet above sea level. There was a thick, wide wind accumulation of floating material along the southern bank. As we passed through this in the boat, we checked for a smell of ammonia or hydrogen sulfide but did not notice any.

Algae. The predominant alga was *Chaetoceros*, with a cell count of 156,000 c/ml. The wind accumulation sample consisted of *Chaetoceros*, diatom shells, *Chlorogonium*, *Staurastrum*, and *Oscillatoria*, as well as amoebae and ciliates. The total cell count for the water column was 201,000 c/ml, see Table 2.

Animals. As in Pond 1, aquatic insects have all but disappeared.

Water Receiving Facility

Gross appearance. The count of waterfowl on the pond was approximately 500, up from about 300 noted earlier in the week. Water temperature was 21°C (Dec. 22°C, Jan. 17°C). Water was fairly clear with a light green tint to the bottom.

Algae. The predominant alga was *Anacystis* with a cell count of 3,400 c/ml. The total cell count for the water column was 5,600 c/ml, see Table 3.

Animals. No aquatic insects were observed.

Ed Glenn — David Moore — Renee Tanner

Edward Glenn — David Moore — Renee Tanner

Algae Counts, APS/PVNGS, 02/08/96

Algal Counts in Cells/ml

Table 1 Pond 1

Site	Chaetoceros	Oscillatoria	Micromonas	Staurastrum	Protozoan	Nitzschia
Northwest	611,250	0	17,500	1,250	0	13,750
Southeast	628,750	0	17,500	0	1,250	15,000
Center	632,500	1,250	13,750	2,500	0	5,000
Average	624,167	417	16,250	1,250	417	11,250

Total Cell Count: 653,750

Table 2 Pond 2

Site	Chaetoceros	Chlorogonium	Micromonas	Nitzschia	Chlorella	Unidentif. algal cell
Northeast	170,000	52,500	3,750	7,500	1,250	0
Southwest	137,500	8,750	5,000	1,250	1,250	1,250
Center	160,000	47,500	0	3,750	2,500	0
Average	155,833	36,250	2,917	4,167	1,667	417

Total Cell Count: 201,250

Table 3 Fresh Water Reservoir

Site	Anacystis	Scenedesmus	Staurastrum	Micromonas	Chlorella
North	1,250	1,250	1,250	0	0
South	3,750	0	1,250	0	0
East	2,500	1,250	0	2,500	0
West	6,250	0	0	0	1,250
Average	3,438	625	625	625	313

Total Cell Count: 5,625

Table 4: Water Quality, APS/PVNGS, 02/08/96

Pond 1	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3- -N mg/L	Phosphate P mg/L	pH	Nitrite NO2- -N mg/L
Northwest	288	50	0.95	0.15	9.63	2.63
Southeast	496	50	1.08	0.19	9.57	2.71
Center	524	50	1.10	0.18	9.65	2.77
Average	436	50	1.0	0.17	9.62	2.70

Pond 2	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3- -N mg/L	Phosphate P mg/L	pH	Nitrite NO2- -mg/L
Northeast	330	64	3.40	0.046	9.23	3.17
Southwest	364	64	3.53	0.052	9.22	3.17
Center	300	65	3.55	0.033	9.21	3.09
Average	331	64	3.5	0.044	9.22	3.14

Fresh Water	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3- -N mg/L	Phosphate P mg/L	pH	Nitrite NO2- -mg/L
North	21.6	0	0.58	0.24	9.04	0.208
South	16.9	0.5	0.63	0.25	8.85	0.201
East	23.4	1	1.1	0.25	8.86	0.194
West	21.0	1	0.53	0.27	9.01	0.201
Average	20.7	0.6	0.71	0.25	8.94	0.201

THE UNIVERSITY OF ARIZONA

REPLY TO: ENVIRONMENTAL RESEARCH LABORATORY
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March 8, 1996

Tom Hillmer
Environmental Health & Safety Dept.
Palo Verde Nuclear Generating Station
Arizona Public Services Company

Dear Tom,

I wanted to share some new data with you that Renee Tanner is collecting, and give you a preview of what the University of Arizona might be able to recommend for operation of the ponds next year. We can write up a full report with recommendations if you want us to.

Renee has been looking at what might happen to the ponds in terms of algae content at higher salinities. This is important because both ponds will get saltier over time, and when a pond is not receiving blowdown water it gets saltier very rapidly due to evaporation. She has been taking pond samples and inoculating them into filtered pond water to which salt has been added, to make concentrations of 50, 75, 100, 150, 200 and 250 ppt total salts. She adds 1 ml of pond water containing algae to 10 ml of filtered pond water with added salt plus fertilizers. Then she follows the growth (or die-off) of cells of each type of algae over several weeks.

The attached graph shows the results of the first experiment. The graph shows total algae counts on a log scale, but she also counts how many of each individual species are in each tube. Each data point is the average of 3 separate tubes. The main algae types in the inoculum this time were diatoms because that is what grows in winter.

The graph shows that at 50 and 75 ppt growth was normal, at 100 ppt there was a lag in growth, and at 150-250 ppt the diatoms actually decreased. These tubes had many dead cells at the end of the experiment. The results show that at high salinities diatoms will very likely not be present in the ponds.

She plans to repeat this experiment each sampling period, since the type of algae varies from month to month. The purpose is to find out what algae may be present at the high salinities. We expect to find that only a few types of algae are present at high salinity and that none of these are potential problems. This is known from work on solar salt ponds - when the salinities get above 100 ppt, most of the problem algae disappear. When salinities go above 150 ppt, the brine shrimp can no longer thrive, and the food chain is broken. By inoculating pond water into different salinities each month, we hope to be able to tell you what to expect under different management scenarios for the ponds as they get saltier.

This is all related to the problem you experienced with ducks last winter. We would like to recommend a management strategy that would minimize the growth of algae, brine shrimp and water boatmen, which is the food chain that attracts the ducks to the ponds.

Because the algae population and the brine shrimp and water boatmen fluctuate so widely in the ponds, we recommend that you allow us to continue to monitor these ponds through the next duck season. We would ask you to consider modifying the operation of the ponds (if possible) in a way that will minimize the attractiveness of the ponds to birds and we would evaluate the effectiveness of the strategy by comparing next year's bird visitation to what happened this year. If the visitation to the ponds can be minimized, the possibility of birds ingesting something harmful will be minimized as well.

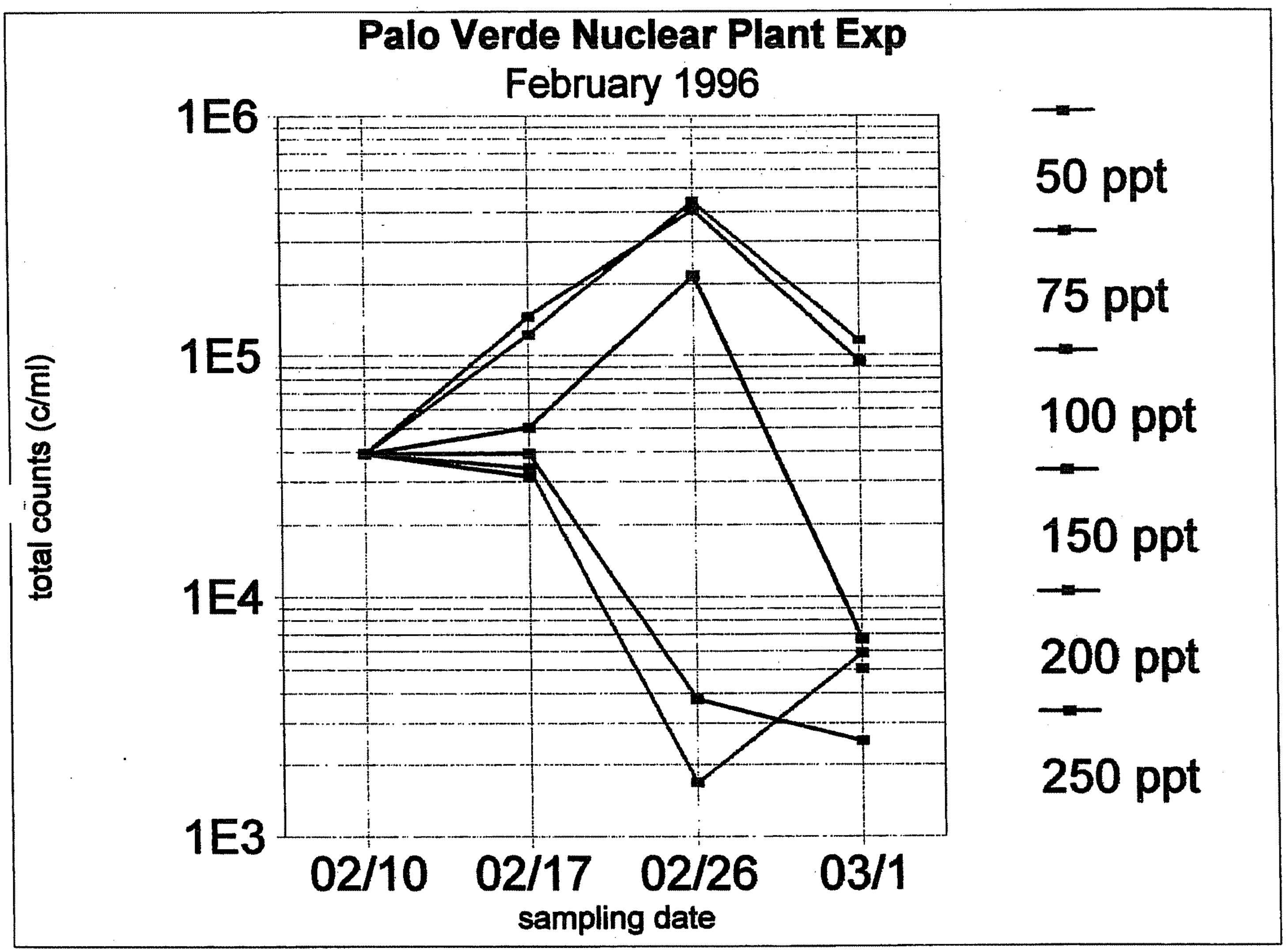
We think there are several ways to minimize the algae prior to ducks arriving. One way would be to allow salinity to build up in one pond through the summer, by discharging to the other pond. This is actually what you are doing now. Then, prior to duck arrival, the flow would be switched from the low salinity to the high salinity pond. The salty pond would be slow to support an algal bloom (see graph). The other pond would not be receiving blowdown, so any bloom present would tend to disappear. Therefore, when the ducks arrived they would find minimal algae and brine shrimp in the ponds. This suggestion is supported by the observations from this year, showing that the algae and brine shrimp (when present) are highest in the pond receiving blowdown.

These are just some thoughts on the ponds that could be developed further if you wish. Our feeling is that by summer we will be able to help you work out a reasonable action plan to deal with all the possibilities and to minimize the attractiveness of the ponds to migratory waterfowl. I will be happy to come up and talk this over with you at your convenience. We are enjoying working with you on this project.

Sincerely,

Ed Glenn

Ed Glenn



Palo Verde Nuclear Plant Exp
February 1996
1E6
1E5
1E4
1E3
total counts (c/ml)
02/10
02/17
02/26
03/1
sampling date
50 ppt
75 ppt
100 ppt
150 ppt
200 ppt
250 ppt

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DATE: March 19, 1996

MEMO TO: Thomas Hillmer, APS - PVNGS

Re: PVNGS Ponds, March 12, 1996 Sampling

Summary Observations

The bird count remains low, with about 2 to 3 dozen each on Ponds 1 and 2, and approximately 200 - 300 on the Water Receiving Facility pond. Birds were mostly grebes and coots with a few ruddies and buffleheads and 1 northern shoveler. A small number of flies were seen on the surface of the water but aquatic insects such as water boatmen were not observed in the water column. See Table 4 for water quality data. Also attached is a graph and summary of the March experiment results.

Pond 1

Gross appearance. Sampling took place from 9:55 to 10:30. The water still had a brownish yellow tint. Average temperature was 18°C (15.5 Dec., 10.2 Jan., 17.0 Feb.). The Secchi disk reading averaged 62.7 cm. Salinity has risen to 52 ppt (57 Dec., 54 Jan., 50 Feb.). There was no water flow into the pond. The water level was at 929' above sea level. Floating detritus has shifted to the northeast corner of the pond. As seen previously, there were floating algal mats, approximately 5 - 10 cm in size dispersed throughout the pond. These were sampled again and were found to consist mostly of *Chaetoceros* and other diatoms.

Algae. *Chaetoceros* is still the predominant alga, but its cell count has decreased to 289,000 c/ml, compared to 624,000 c/ml last month. The floating algal mat and wind accumulation consisted largely of *Chaetoceros* with smaller amounts of *Nitzschia, Carteria, Staurastrum* and invertebrates. The total cell count for the water column was 293,000 c/ml, see Table 1.

Animals. There were approximately 1 to 2 dozen birds on the pond.

Pond 2

Gross appearance. Sampling took place from 9:30 - 9:50. Pond 2 was receiving a strong flow of water. The water level was 926' above sea level. Salinity averaged 64 ppt, with the lowest reading, 62 ppt, occurring on the north, nearest the water inflow. Pond 2 salinity has been holding fairly steady, measured at 63 ppt Dec., 64 Jan. and 64 Feb. Water temperature was 20.2°C (17 Dec., 11 Jan, 16.3 Feb.). Bank samples were taken, rather than boat samples, so there were no Secchi disk readings during this trip for Pond 2.

Algae. *Chaetoceros* was the predominant alga with a cell count of 160,000 c/ml this is very similar to the count last month of 156,000 c/ml. The wind accumulation sample had a dense layer of water boatmen exoskeletons which was not observed in the Pond 1 wind accumulation sample. The algae in the wind accumulation sample were predominantly *Nitzschia* and *Chaetoceros*, with lesser amounts of *Navicula*, *Carteria*, *Staurastrum*, *Chlorogonium* and *Oscillatoria*. The total cell count for the water column was 189,000 c/ml, see Table 2.

Animals. There were approximately 2 to 3 dozen birds on the pond.

Water Receiving Facility

Gross appearance. Sampling took place from 8:35 to 9:00. No changes observed; bottom still has a green film of algae. A bottom scrape was taken and, as seen earlier, algae found in the water column also make up the bottom film. Average water temperature was 20.8°C.

Algae. The predominant alga was *Tetraedron* with a cell count of 3,800 c/ml. The total cell count for the water column was 7,200 c/ml.

Animals. Birds on the pond were estimated at 250, consisting mostly of grebes and coots with a few ruddies and buffleheads and 1 shoveler.

Edward Glenn   David Moore   Renee Tanner

Algae Counts, APS/PVNGS, 03/12/96

Algal Counts in Cells/ml

Table 1 Pond 1

Site	Chaetoceros	Nitzschia	Micromonas	Coccochloris	Protozoan	Chlorella	Unidentif. algal cell
Northwest	336,250	6,250	0	3,750	1,250	2,500	2,500
Southeast	235,000	11,250	0	0	1,250	1,250	0
Center	265,000	10,000	1,250	1,250	0	1,250	0
Average	278,750	9,167	417	1,667	833	1,667	833

Total Cell Count: 293,333

Table 2 Pond 2

Site	Chaetoceros	Nitzschia	Micromonas	Coccochloris	Carteria	Chlorogonium	Chlorella	Staurastrum
North	135,000	20,000	8,750	5,000	0	8,750	0	1,250
South	147,500	7,500	0	2,500	3,750	13,750	0	0
East	152,500	11,250	1,250	0	3,750	6,250	1,250	0
West	205,000	8,750	1,250	0	3,750	3,750	2,500	0
Average	160,000	11,875	2,813	1,875	2,813	8,125	938	313

Total Cell Count: 188,750

Table 3 Fresh Water Reservoir

Site	Tetraedron	Scenedesmus	Micromonas	Rhodomonas
North	5,000	1,250	0	0
South	3,750	2,500	0	0
East	5,000	1,250	3,750	0
West	1,250	3,750	0	1,250
Average	3,750	2,188	938	313

Total Cell Count: 7,188

PVNGS PONDS 03/12/96 Sampling

Table 4: **Water Quality Data**

Pond 1	Nitrate NO3- -N mg/L	Salinity ppt	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
Central	488	52	1.60	0.24	9.75	4.24
NW	480	52	1.40	0.17	9.71	4.20
SE	394	52	1.70	0.24	9.63	4.02
Average	454	52	1.57	0.22	9.70	4.15

Pond 2	Nitrate NO3- -N mg/L	Salinity ppt	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	302	62	3.53	0.24	9.20	2.34
South	264	65	3.65	0.10	9.27	2.68
East	296	65	3.75	0.31	9.24	2.46
West	244	65	3.98	0.17	9.28	2.48
Average	277	64	3.73	0.21	9.25	2.49

Fresh Water	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	21.5	0	0.45	0.29	8.93	0.208
South	21.5	0	0.40	0.25	8.89	0.201
East	21.1	0	0.40	0.24	8.88	0.194
West	20.1	0	0.43	0.32	8.92	0.201
Average	21.1	0	0.42	0.28	8.91	0.201

Salinity Gradient Experiment for March 1996

These trials are run to see what algae might dominate the ponds at higher salinities. Figure 1 represents the data collected for the March experiment. Each tube was inoculated with 1 ml of a composite sample from pond 1 and pond 2, and then 10 ml of treatment solution was added. Treatment solutions were filtered pond water to 0.45 microns to remove algal and bacterial cells and F/2 fertilizer was added to each treatment solution of 50 ppt, 75 ppt, 100 ppt, 150 ppt, 200 ppt, and 250 ppt prior to inoculation. Reagent grade sodium chloride was added to create salinity treatments 75 ppt thru 250 ppt and no salt was added to the 50 ppt control treatment. The salinity was increased step wise in each tube, so the algae would have a chance to regulate osmotically and then the tubes were placed in a climate controlled incubator which was adjusted to the average pond temperature for that sampling. The diurnal cycle was set for 14 hours light and 10 hours dark. After four, six and eight days the algae was counted with the hemocytometer using sterile sampling techniques.

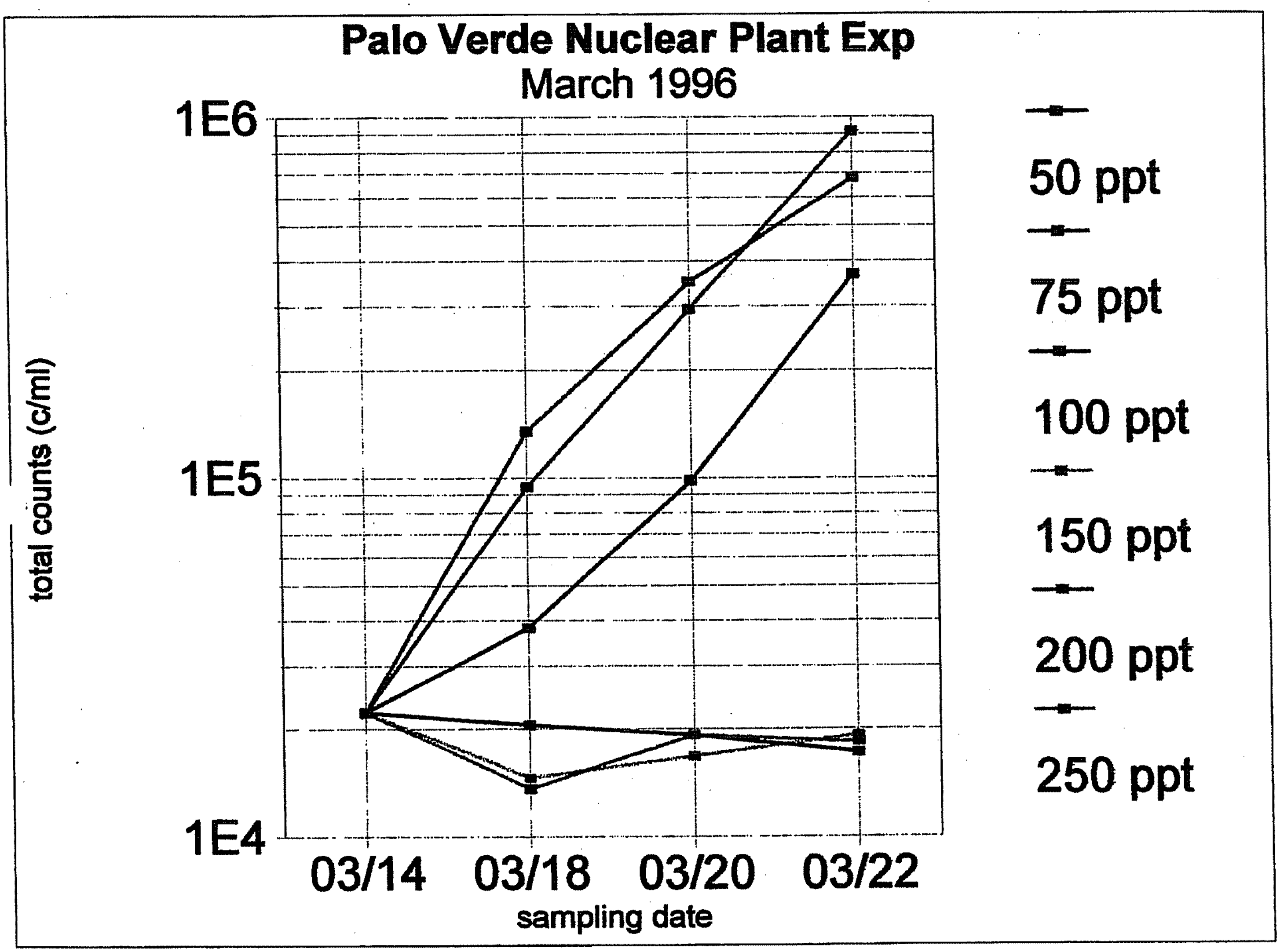
The results demonstrate that the algae in the 50 ppt thru 100 ppt grew exponentially while the algae in the 150 ppt thru 250 ppt did not experience growth beyond the level of the initial inoculum. In fact, the algae in these treatments was very unhealthy looking and after eight days only *Chaetoceros*, *Nitzschia* and *Micromonas* remained. The diatoms (*Chaetoceros* and *Nitzschia*) in the three highest treatments had cells that were only partially filled with cytoplasm and *Micromonas* was only observed in one tube from the 150 ppt treatment. On the sixth day of the experiment I noted that large and small protozoans were present in the 50 ppt thru 100 ppt tubes, but no such organisms were present in the 150 ppt through 250 ppt tubes.

The results of the experiments conducted so far, indicate that the current algae inhabiting the ponds do not grow at salinities of 150 ppt and above. However, this does not mean that microscopic organisms will not be present if the salinity is increased in these ponds. Interestingly, hypersaline environments can be very productive and only the most saline environments with salinities over 300 ppt contain microscopic organisms only (Javor, 1989). This experiment will be continued through the summer so you will have a more complete profile of the algae in these ponds.

René Tanner

Reference:

Javor, B. 1989. Hypersaline Environments. Springer-Verlag, New York.


Palo Verde Nuclear Plant Exp
March 1996
1E6
1E5
1E4
total counts (c/ml)
03/14
03/18
03/20
03/22
sampling date
50 ppt
75 ppt
100 ppt
150 ppt
200 ppt
250 ppt

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REPLY TO: ENVIRONMENTAL RESEARCH LABORATORY
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DATE: April 3, 1996

MEMO TO: Thomas Hillmer, APS - PVNGS

Re: PVNGS Ponds, April 2, 1996 Sampling

Summary Observations

The bird population has increased slightly from last month but is still relatively low. Water was being added to Evaporation Pond 2, none to Evaporation Pond 1. See Table 4 for water quality data.

Pond 1

Gross appearance. Sampled 9:05 - 9:50. Water was brown with an average Secchi disk reading of 71.1 cm, up from 62.7 cm last month, indicating less algae. Average temperature was 20.7°C (wind accumulation 23.5°C), up from 18°C last month. There was no water flow into the pond and the level had dropped to 928' above sea level, from 929' last month. Floating debris was in the northeast corner of the pond, and there were still floating algal mats throughout the pond, but mostly concentrated in the northern half by wind.

Algae. Diatoms are still the predominant algae with a cell count of 134,000 c/ml for *Chaetoceros* and 143,000 c/ml for *Nitzschia*. This represents a decrease in *Chaetoceros* cells and an increase in *Nitzschia* cells from last month. The floating algal mat consisted largely of diatoms with lesser amounts of green and blue-green algae. The wind accumulation had the same composition of algae as the floating algal mat, but the sample also contained a layer of water boatmen exoskeletons. The total cell count for the water column was 292,000 c/ml, see Table 1.

Animals. There were an estimated 50 birds on the pond, consisting mostly of grebes with a few buffleheads. As was the case last month, aquatic insects were not observed.

Pond 2

Gross appearance. Sampled 10:00 - 10:35. Water was brown with an average Secchi disk reading of 48.3 cm. Secchi disk readings were not taken from Pond 2 last month because bank samples were collected, however the February reading was 79 cm. The increased turbidity found this month indicates a considerably stronger algal bloom. The average temperature was 21.0°C, up from 20.2°C last month. There was a strong flow of water into the pond. The water level in the pond was 925' above sea level (926', March).

Algae. Diatoms were the predominant algae with a cell count of 35,000 c/ml for *Chaetoceros* and 319,000 c/ml for *Nitzschia*. This represents a decrease in *Chaetoceros* cells and an increase in *Nitzschia* cells from last month. The wind accumulation sample consisted largely of diatoms with lesser amounts of green and blue-green algae. The total cell count for the water column was 388,000 c/ml, see Table 2.

Animals. As in Pond 1, there were approximately 50 birds on the pond. Mostly grebes with a few buffleheads. No aquatic insects were seen.

Water Receiving Facility

Gross appearance. Sampled 11:20 - 11:45. No changes in gross appearance of water column or bottom. Water temperature averaged 23.8°C, compared to 20.8°C last month.

Algae. The predominant alga was *Tetraedron* with a cell count of 4,000 c/ml. A sample of cloudy, grey water was also collected and it consisted largely of green algae and only a small number of diatoms. The total cell count for the water column was 9,000 c/ml, see Table 3.

Animals. The estimated bird population had increased from about 250 last month to 400 - 500 this month. These were mostly grebes and coots, with a few shovelers and 1 or 2 mallards observed. In addition, there were avocets and a few egrets. One larval aquatic insect, unidentified, was collected from a bank sample but no significant numbers of insects were observed.

Edward Glenn   David Moore   Renee Tanner

Algae Counts, APS/PVNGS, 04/02/96

Algal Counts in Cells/ml

Table 1 Pond 1

Site	Chaetoceros	Nitzschia	Micromonas	Coccochloris	Carteria	Chlorella	Oscillatoria
Northwest	147,500	127,500	8,750	0	0	1,250	1,250
Southeast	128,750	155,000	16,250	0	1,250	2,500	0
Center	126,250	145,000	5,000	7,500	1,250	1,250	0
Average	134,167	142,500	10,000	2,500	833	1,667	417

Total Cell Count: 292,083

Table 2 Pond 2

Site	Chaetoceros	Nitzschia	Micromonas	Coccochloris	Carteria	Chlorogonium	Chlorella	Unidentified algal cell
Northeast	38,750	308,750	12,500	0	7,500	1,250	0	1,250
Southwest	23,750	298,750	20,000	0	10,000	2,500	1,250	0
Center	43,750	348,750	30,000	8,750	5,000	1,250	0	1,250
Average	35,417	318,750	20,833	2,917	7,500	1,667	417	833

Total Cell Count: 388,333

Table 3 Fresh Water Reservoir

Site	Tetraedron	Scenedesmus	Gloeocystis	Chlorella	Anacystis	Rhodomonas
North	2,500	1,250	1,250	0	0	0
South	2,500	2,500	1,250	0	1,250	0
East	2,500	1,250	0	560	0	0
West	10,000	3,750	3,750	0	1,250	1,250
Average	4,375	2,188	1,563	140	625	313

Total Cell Count: 9,203

PVNGS PONDS 04/02/96 Sampling

Table 4: Water Quality Data

Pond 1	Nitrate NO3- -N mg/L	Salinity ppt	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
Central	364	54	1.83	0.03	9.65	5.52
NW	500	54	1.83	0.04	9.60	5.58
SE	384	55	1.70	0.05	9.64	5.82
Average	416	54	1.78	0.04	9.63	5.64

Pond 2	Nitrate NO3- -N mg/L	Salinity ppt	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
Central	258	65	1.45	0.05	9.79	2.80
NE	296	65	1.55	0.04	9.75	2.80
SW	246	65	1.45	0.04	9.73	2.90
Average	267	65	1.48	0.04	9.76	2.83

Fresh Water	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	18.7	0	0.35	0.23	9.44	0.345
South	22.1	0	0.15	0.17	9.35	0.322
East	19.0	0	0.15	0.18	9.40	0.337
West	14.3	1	0.13	0.17	9.47	0.335
Average	18.5	0.25	0.19	0.19	9.42	0.335

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College of Agriculture

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TO: Tom Hillmer

DATE: April 22, 1996

RE: Biological Monitoring at Palo Verde Evaporation and Receiving Ponds, 1995-1996

SUMMARY OBSERVATIONS

Background

The three main ponds at Palo Verde have been monitored monthly starting July 7, 1995, to determine if toxic algae or other organisms could present a hazard to visiting waterfowl. This monitoring program was a response to a die-off of migratory waterfowl that took place at Palo Verde in 1994. The monitoring is designed to provide information on the following questions:

1) Are there seasonal occurrences of toxic algae?

2) Is there a biological food chain that may act as an attractant to migratory waterfowl and other birds?

3) What management options are available to reduce any identified hazards or to make the ponds less attractive to visitation by waterfowl?

The monitoring program has the following elements:

1) algae counts and species identification;

2) approximate numbers of aquatic animals feeding on the algae;

3) abundance of birds at each visit;

4) determination of pH, salinity, nitrate, ammonia and phosphate levels in surface water samples from each pond (these factors are then correlated with algae abundance).

Pond Chemistry

The two evaporation ponds are hypersaline (50-70 ppt total salts) whereas the receiving pond is non-saline (under 1 ppt)(Figure 1). The salinity in the evaporation ponds fluctuates due to the inflow of blowdown water (approximately 20 ppt). Pond 2, which has received less blowdown than Pond 1 during the monitoring period, has a higher salinity.

Both evaporation ponds have very high nitrate levels (250-600 ppm)(Figure 2) but these levels should not be directly toxic to wildlife, from published studies. Pond 1, which receives the most blowdown, has higher nitrate levels than Pond 2 while the receiving reservoir never exceeded 22 ppm. Nitrite levels in the evaporation ponds varied from 4-8 ppm while the receiving pond was below detection limits (Figure 3). Ammonia levels were 1-4 ppm in the evaporation pond surface water (Figure 4). These levels are not directly toxic to birds. Bottom samples reportedly have levels 10 times higher and this ammonia could be a hazard if it were released to the surface, for example by a water turnover. Whether these ponds undergo a seasonal water turnover through temperature inversion is unknown. The receiving pond had low ammonia levels. Phosphate levels were low in all ponds (Figure 5). pH ranged from 8.5-9.9 in the ponds and tended to increase in spring with the increase in algae activity (Figure 6).

Algae

During the summer months (August, September) the blue-green alga *Coccochloris* bloomed in both evaporation ponds (Figures 7,8). Levels began to decline in both ponds after October and by February this algae was not detected in samples from either pond. In March it began to make a comeback and has continued to increase in abundance into April. This is a heat-loving algae so its prevalence during the warm months is expected *Coccochloris* is part of the *Synechococcus* group which is a provisional group which can be defined as unicellular coccoid to rod-shaped cyanophyceans which divide in a single plane by binary fission (Skulberg et al., 1993). Toxigenic strains of *Synechococcus* have been isolated from the marine environment. Mitsui (1987) found that some of the toxins exhibited strong hemolytic properties. However, his experiments also demonstrated that toxin production was unpredictable. Toxic activity varied from one batch culture to another, so in some high toxic activity was present and in others it was absent. Katherine Campbell, a student of Mitsui, was contacted for further information. She informed us that toxic strains of *Synechococcus* are very rare.

Diatoms, which are rarely toxic, were blooming in both ponds at all sampling dates and were highest in the winter months (Figures 7,8). The total levels of algae in the evaporation ponds were generally in the range of 100,000-500,000 cells/ml, which are higher than occur in most natural water bodies or in the receiving pond (Figure 9). The high levels of nutrients in the blowdown water undoubtedly stimulated the algae blooms in the evaporation ponds.

Food chain in the evaporation ponds

During summer and fall the evaporation ponds supported a brine shrimp/water boatman food chain that is very characteristic of hypersaline waters. The brine shrimp (a small crustacean) grazes the algae and are fed upon by the waterboatmen (an aquatic insect). Both organisms tended to disappear with cool weather (Figures 10,11). However, the peak abundance of waterboatmen partially overlapped the migratory bird season during 1995. The boatmen were observed to be an attractant to birds which fed on the insects, and perhaps also on the artemia.

Summary observations and recommendations

In terms of potential toxins due to an algal bloom, the summer and fall periods most likely present the greatest hazard, due to the predominance of blue-green algae in warm water and also because the ponds are most biologically active during these periods. A literature search has not revealed if water boatmen bioconcentrate algal toxins, but it is known that selenium can be bioconcentrated in these organisms to dangerous levels. The most crucial part of bioaccumulation is not the concentration of toxins in the water, but the biological activity of the water body (Presser et al., 1994) and these ponds do have high biological activity in summer and fall.

Biological activity tended to be highest in Pond 1 which received most of the blowdown water during the monitoring period. It was noticed during the previous year as well as this year that birds tend to concentrate on the pond receiving the blowdown water. This suggests a possible management strategy to attempt to reduce the attraction of birds during the migration season. The blowdown could be split between the ponds more evenly during the season of maximum risk, to lessen the concentration of algae, artemia, waterboatmen and birds visiting one pond. It is also possible that as the ponds become more saline they will present less risk. Artemia are not active in water above 200 ppt. The number of algae species will also be reduced at higher salinities, hence the change of a toxic bloom may be reduced. The diversity of species in the evaporation ponds was less than in the receiving pond but was still high compared to solar salt ponds, which at 200 ppt or above tend to have just 1 or 2 species present.

In summary, at the present range of salinities the ponds support high biological activity and a complete food chain which partly overlaps the migration season of waterfowl, and is an attractant. During 1995-1996 no bird dieoff occurred and the cause of the 1994 dieoff remains unknown. It would probably be prudent for APS to monitor the biology and water chemistry of the ponds, at least during the seasons of maximum risk.

References:

Presser, T. S., M. A. Sylvester, and W. H. Low. 1994. Bioaccumulation of Selenium in Western States. *Environmental Management* 18:423-436.

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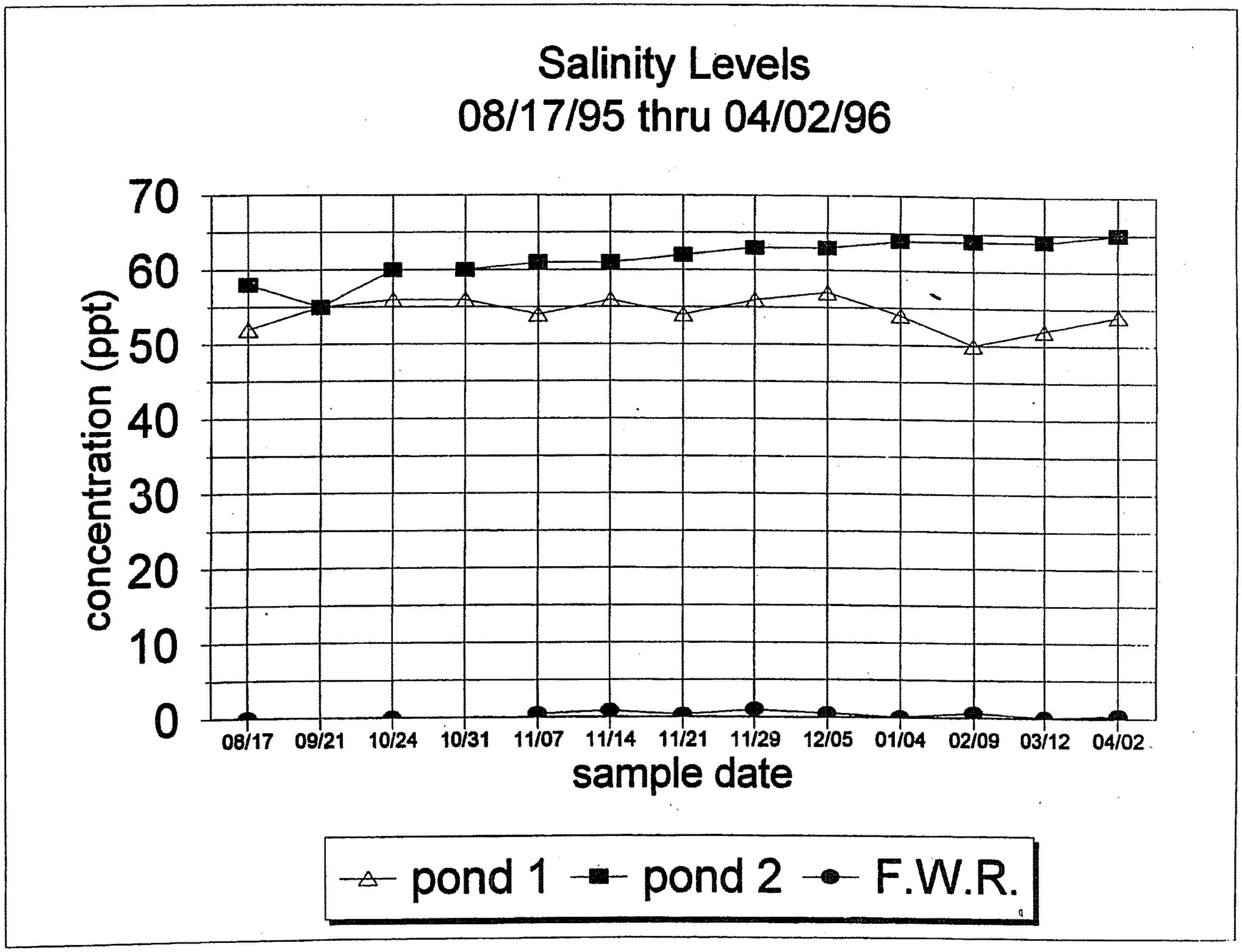
Mitsui, A., D. Rosner, A. Goodman, G. Reyes-Vasquez, T. Kusumi, T. Kodama, and K. Nomoto. 1987. Hemolytic toxins in marine cyanobacterium *Synechococcus sp.*. *In* Red Tides: Biology, Environmental Science, and Toxicology (Eds. T. Okaichi, D.M. Anderson, and T. Nemoto), pp.367-370.

Rene Tanner | David Moore | Ed Glenn

Rene Tanner   David Moore   Ed Glenn

Figure 1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50
40
30
20
10
0
08/17
09/21
10/24
10/31
11/07
11/14
11/21
11/29
12/05
01/04
02/09
03/12
04/02
sample date
pond 1
pond 2
F.W.R.

Figure 2

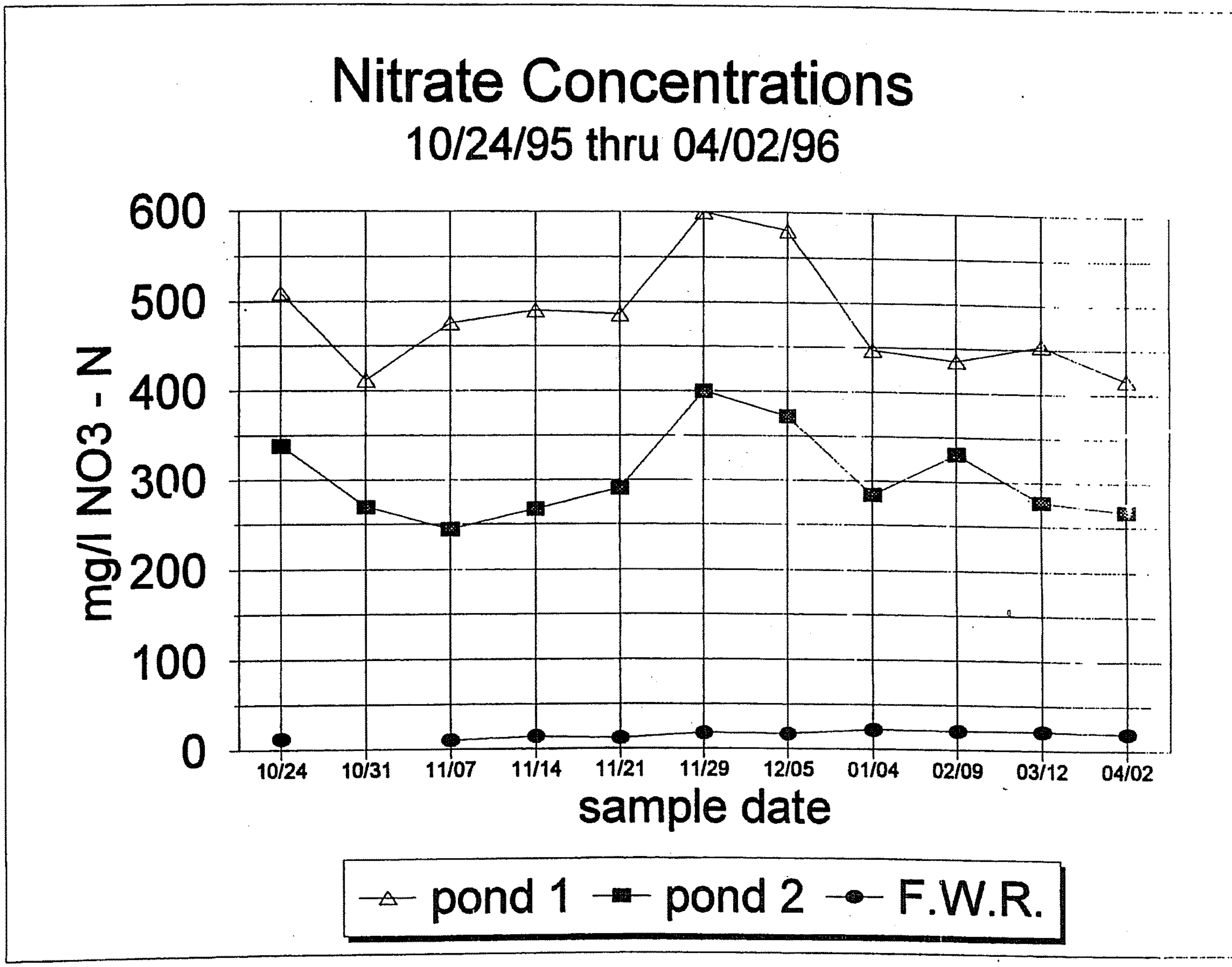

Nitrate Concentrations
10/24/95 thru 04/02/96
mg/l NO3 - N
600
500
400
300
200
100
0
10/24
10/31
11/07
11/14
11/21
11/29
12/05
01/04
02/09
03/12
04/02
sample date
pond 1
pond 2
F.W.R.

Figure 3

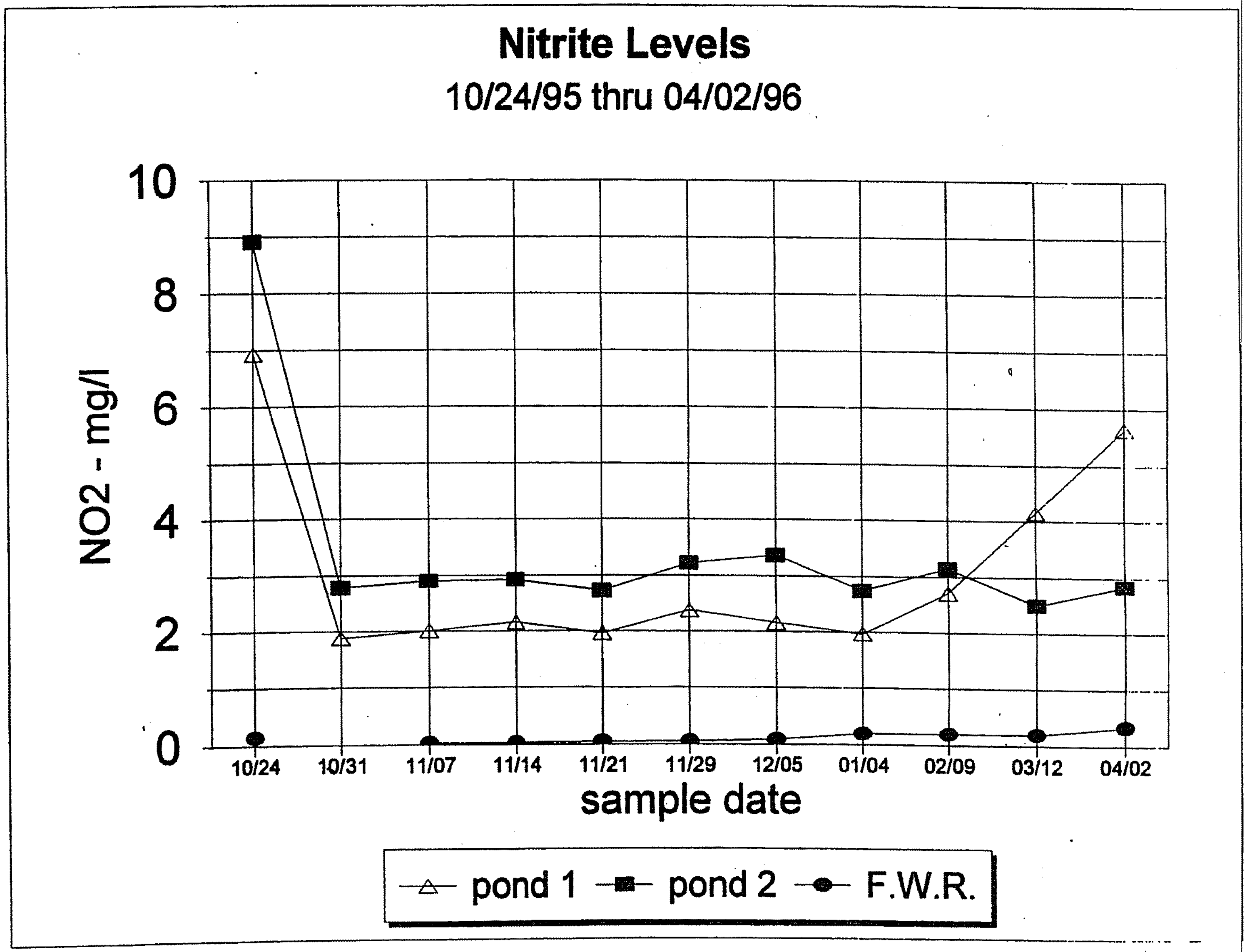

Nitrite Levels
10/24/95 thru 04/02/96
NO2 - mg/l
10
8
6
4
2
0
10/24
10/31
11/07
11/14
11/21
11/29
12/05
01/04
02/09
03/12
04/02
sample date
pond 1
pond 2
F.W.R.

Figure 4

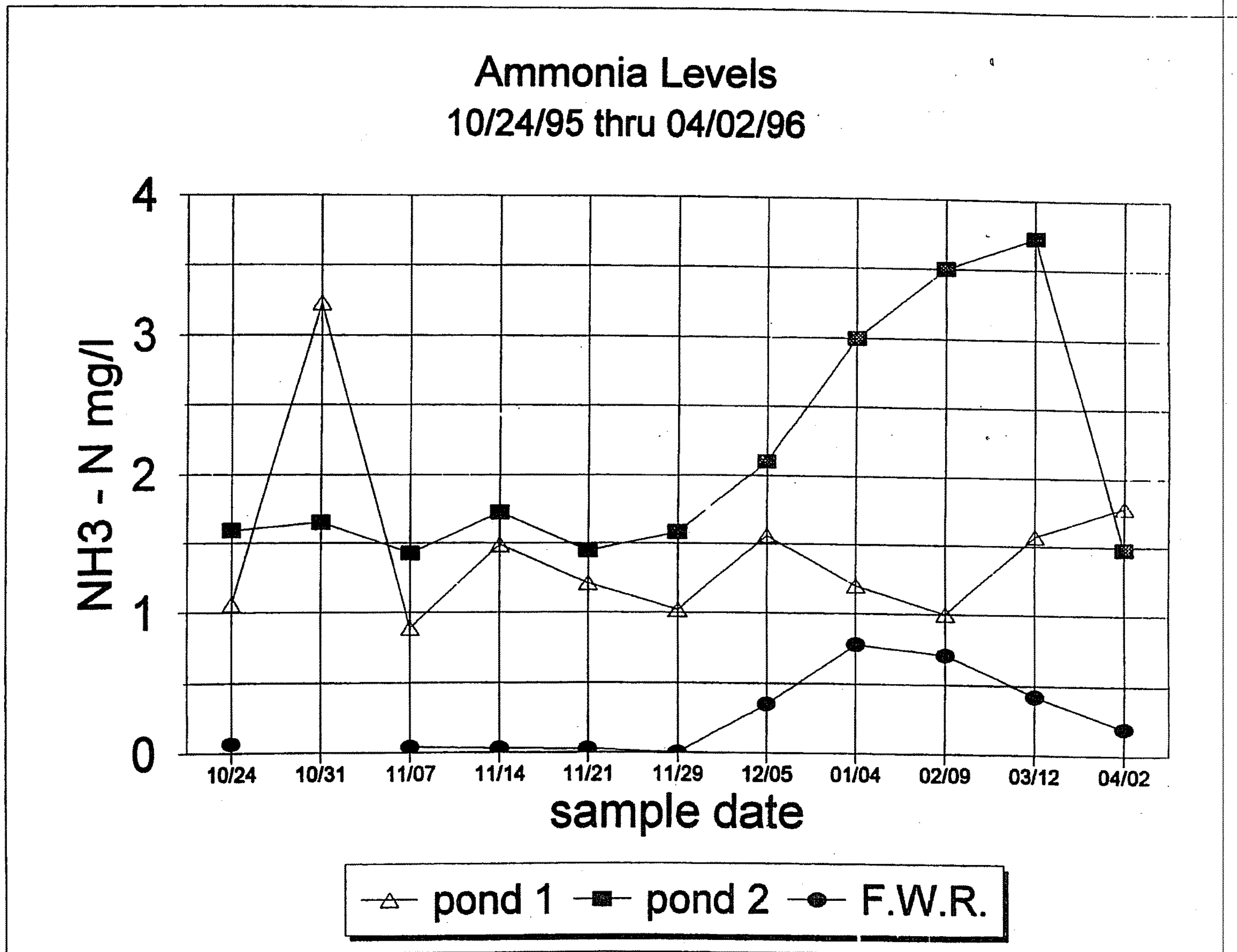
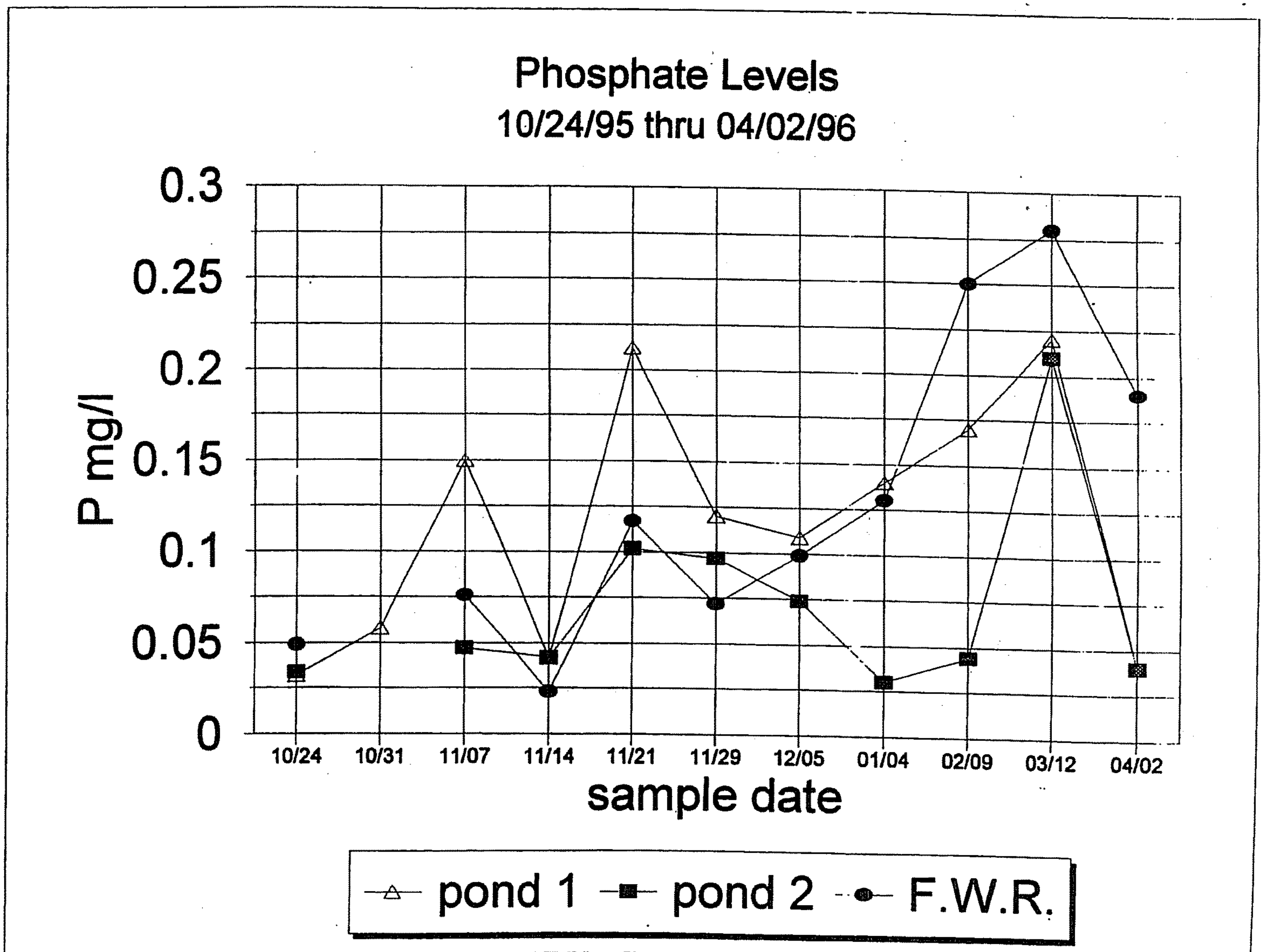

Ammonia Levels
10/24/95 thru 04/02/96
NH3 - N mg/l
4
3
2
1
0
10/24
10/31
11/07
11/14
11/21
11/29
12/05
01/04
02/09
03/12
04/02
sample date
pond 1
pond 2
F.W.R.

Figure 5



Phosphate Levels
10/24/95 thru 04/02/96
P mg/l
0.3
0.25
0.2
0.15
0.1
0.05
0
10/24
10/31
11/07
11/14
11/21
11/29
12/05
01/04
02/09
03/12
04/02
sample date
pond 1
pond 2
F.W.R.

Figure 6

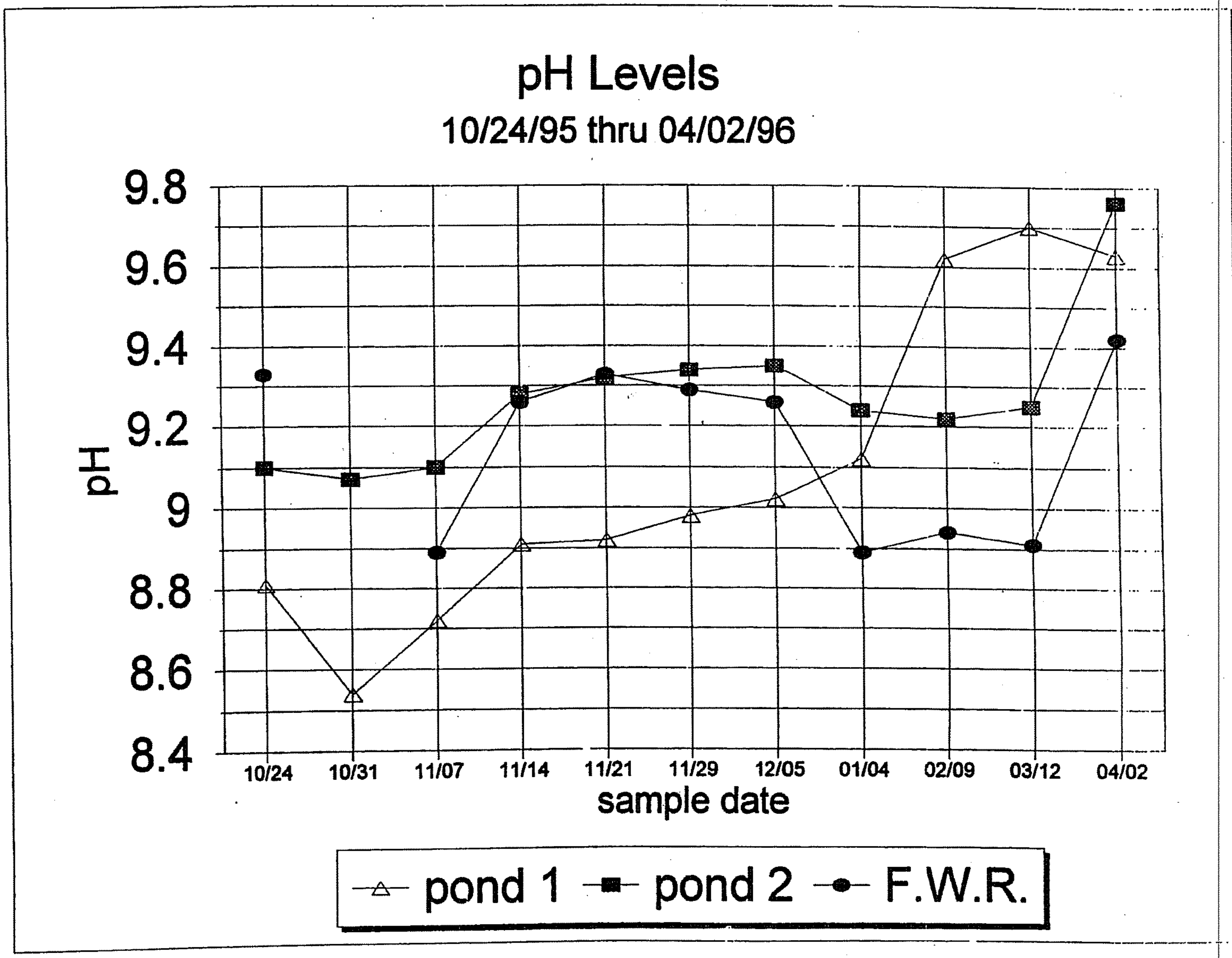

pH Levels
10/24/95 thru 04/02/96
9.8
9.6
9.4
9.2
9
8.8
8.6
8.4
pH
10/24
10/31
11/07
11/14
11/21
11/29
12/05
01/04
02/09
03/12
04/02
sample date
pond 1
pond 2
F.W.R.

Figure 7

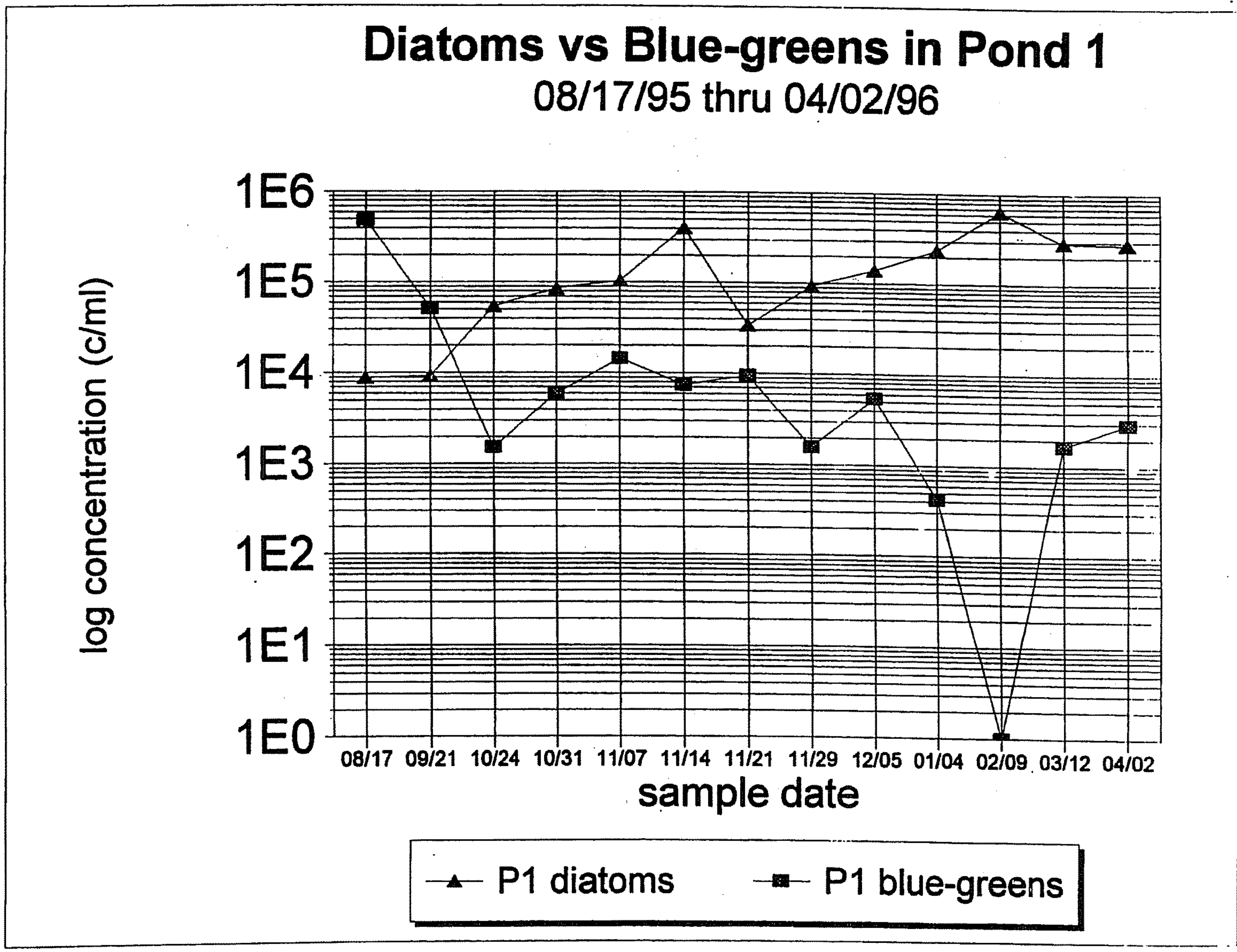
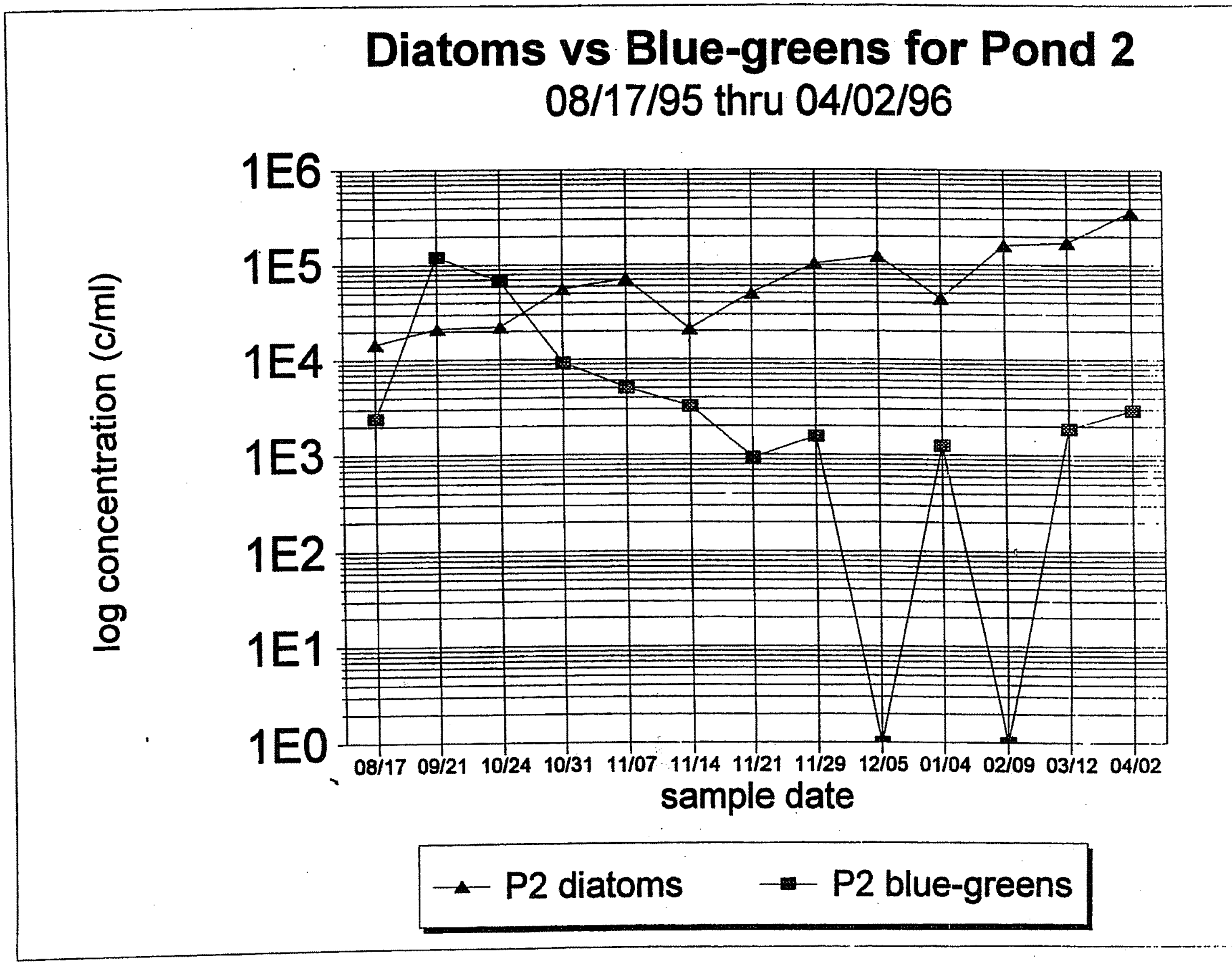
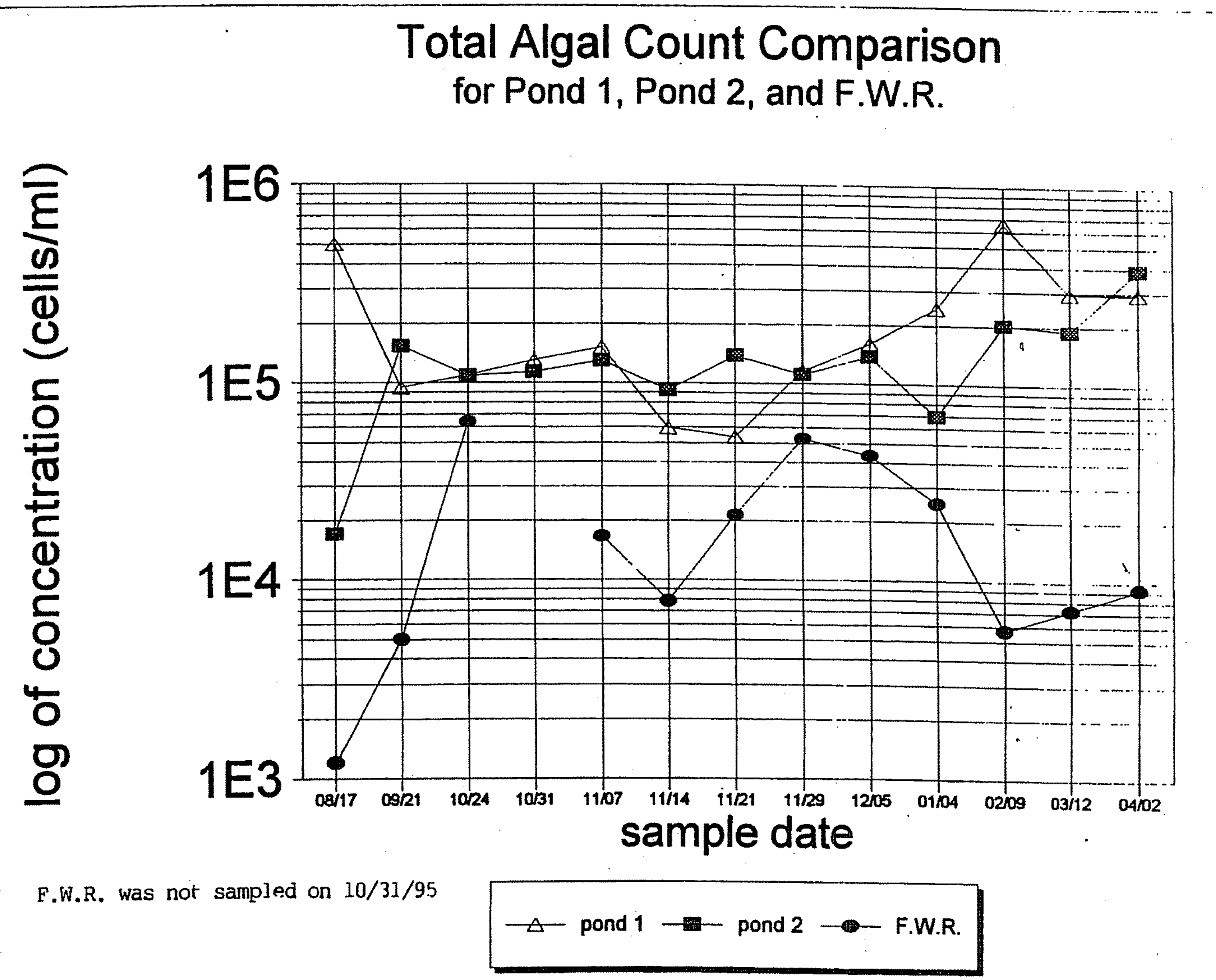

Diatoms vs Blue-greens in Pond 1
08/17/95 thru 04/02/96
1E6
1E5
1E4
1E3
1E2
1E1
1E0
log concentration (c/ml)
08/17 09/21 10/24 10/31 11/07 11/14 11/21 11/29 12/05 01/04 02/09 03/12 04/02
sample date
P1 diatoms
P1 blue-greens

Figure 8



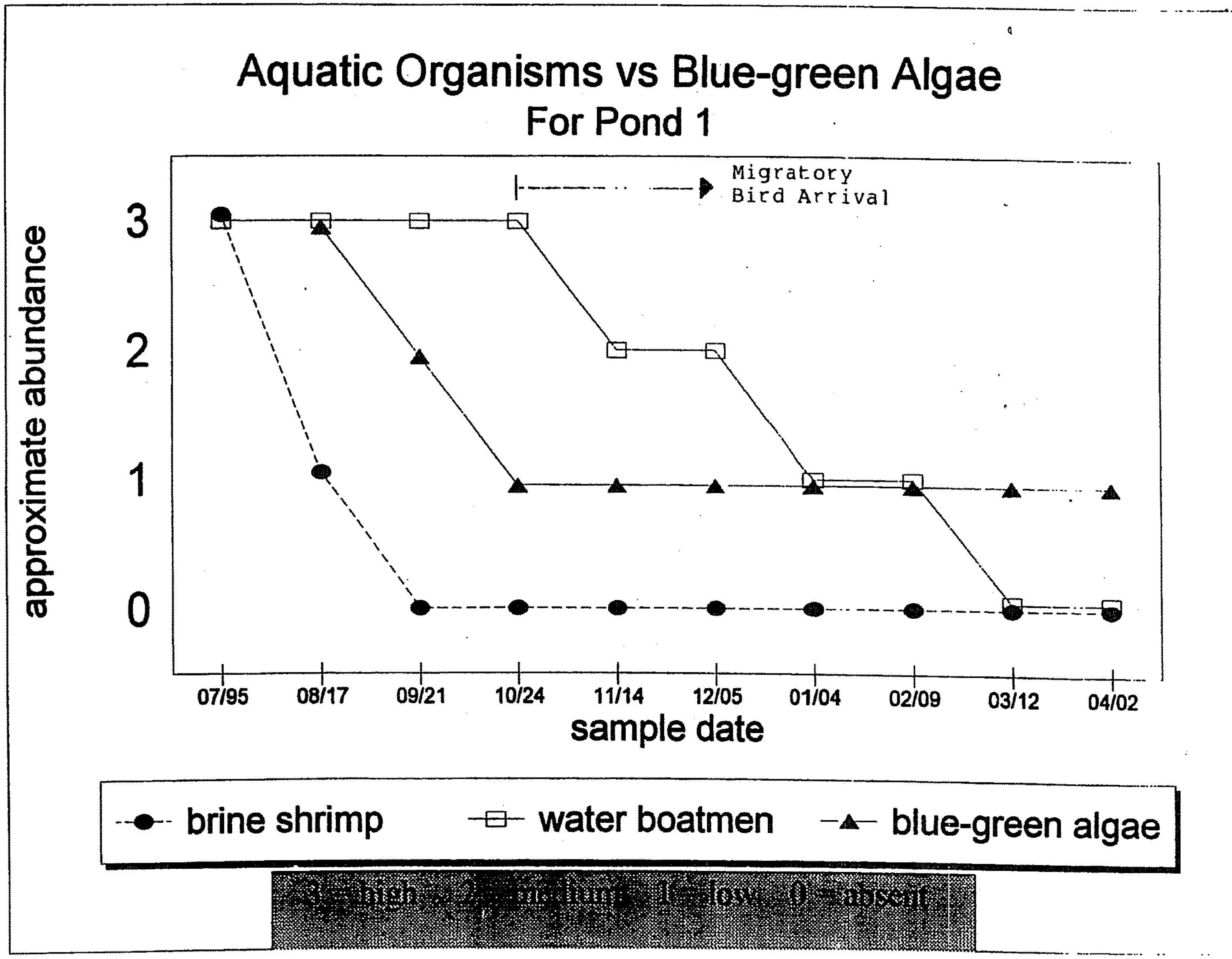
Diatoms vs Blue-greens for Pond 2
08/17/95 thru 04/02/96
1E6
1E5
1E4
1E3
1E2
1E1
1E0
log concentration (c/ml)
08/17 09/21 10/24 10/31 11/07 11/14 11/21 11/29 12/05 01/04 02/09 03/12 04/02
sample date
P2 diatoms
P2 blue-greens

Figure 9



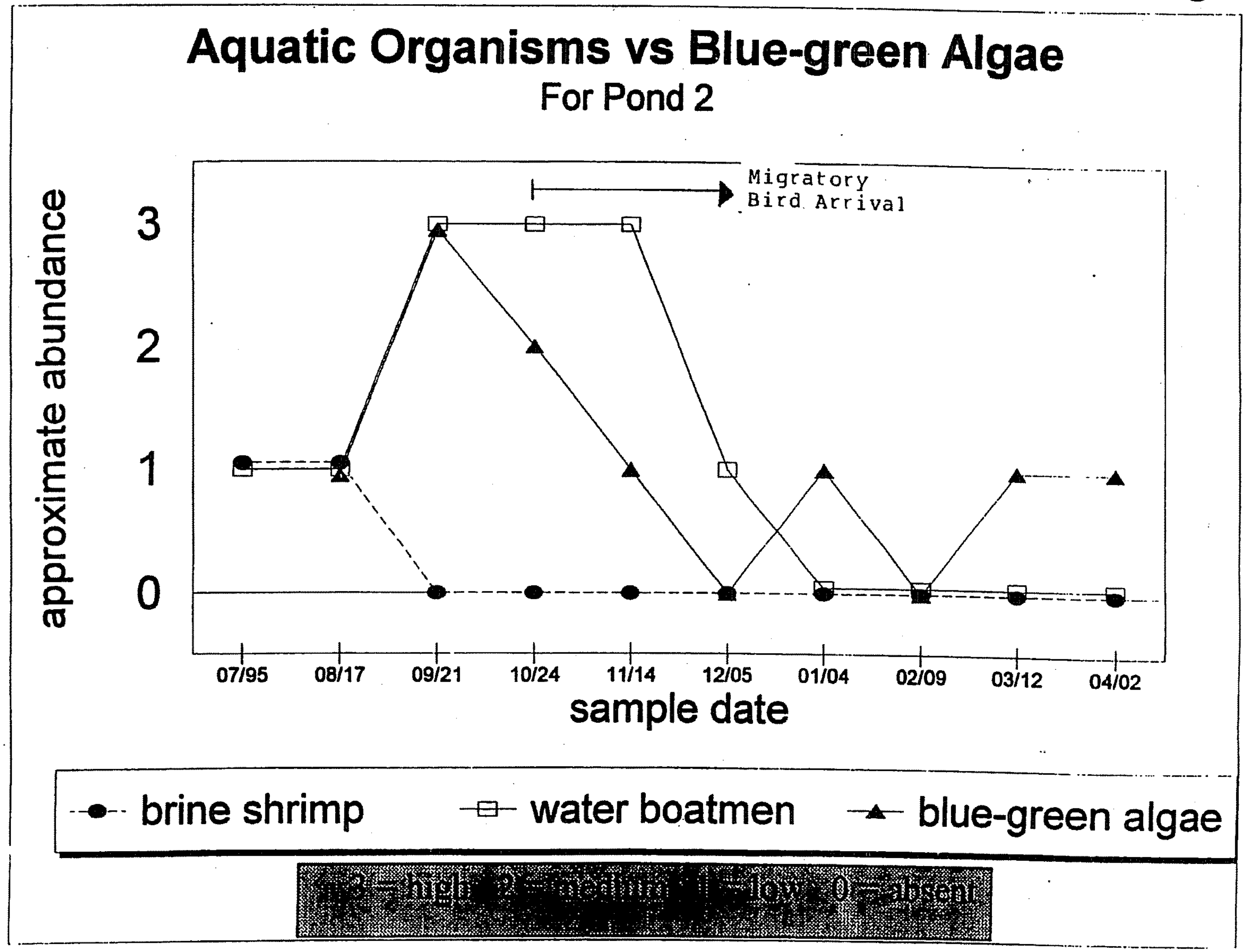
* F.W.R. was not sampled on 10/31/95

Figure 10



Aquatic Organisms vs Blue-green Algae
For Pond 1
Migratory
Bird Arrival
approximate abundance
3
2
1
0
07/95
08/17
09/21
10/24
11/14
12/05
01/04
02/09
03/12
04/02
sample date
brine shrimp
water boatmen
blue-green algae
3 = high, 2 = medium, 1 = low, 0 = absent

Figure 11


Aquatic Organisms vs Blue-green Algae
For Pond 2
Migratory Bird Arrival
approximate abundance
3
2
1
0
07/95
08/17
09/21
10/24
11/14
12/05
01/04
02/09
03/12
04/02
sample date
brine shrimp
water boatmen
blue-green algae
3 = high, 2 = medium, 1 = low, 0 = absent

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DATE: May 20, 1996

MEMO TO: Thomas Hillmer, APS - PVNGS

Re: PVNGS Ponds, May 14, 1996 Sampling

Summary Observations

Both Evaporation Ponds were receiving water, but only Pond 1 was receiving blowdown. There has been a reappearance of brine shrimp in both ponds with the greatest concentration in Pond 1 at an average concentration of 30 per liter. The dense populations of *Artemia* in Pond 1 have grazed the algae so heavily that the Secchi disk visibility reading was > 10 ft (300 cm). A low algal count for Pond 1 was also noted and *Coccochloris* was the predominant alga with a cell count of 12,500 c/ml. Water boatmen were noted at all sampling sites in Pond 1 and an average concentration of 1 per 10 liters was estimated, however the greatest population density was seen in the center of the pond where they were resting on a vertical fold in the liner. Pond 2 had fewer *Artemia* than Pond 1, but still a considerable population, with an average concentration of 5 per liter. The Secchi disk visibility in Pond 2 was 60.1 cm and the predominant alga was *Chaetoceros* with a cell count of 75,000 c/ml. See Table 4 for water quality data.

Also included with this report is a brief summary on the brine shrimp life cycle and mode of reproduction.

Pond 1

Gross appearance. Water was clear with an average Secchi disc reading > 300 cm (the limit of the Secchi disk line is 300 cm which was also the depth to the bottom of the pond at most sampling sites). This is the highest pond clarity seen during our monitoring and is over 4 times last months reading of 71.1 cm. However, this is not unusual for hypersaline waterbodies when *Artemia* populations are at a peak. Mono Lake in California experiences dense populations of *Artemia* in the summer and can have Secchi disk readings as high as 1000 cm in the summer and as low as 70 cm in the winter (Javor, 1987). The average temperature was 26.0°C, up from 20.7°C last month. The pond was receiving blowdown water and the water level was 928.5' above sea level, up from 928' last month. Small bubbles rising to the surface could be seen at all sampling points, but no floating debris was noted.

Algae. The predominant alga was *Coccochloris* with a cell count of 12,500 c/ml. The total cell count for the water column was 14,600 c/ml this is the lowest cell count observed so far. See Table 1 for individual and total counts.

Animals. There were approximately 37 birds on the pond, which consisted of 26 grebes and 11 stilts. *Artemia* brine shrimp are back in large numbers with an average concentration of 30 per liter. The largest population of *Artemia* was seen at the water inlet at approximately 100 per liter, and many dead *Artemia* were also noted at this site giving the water a fishy smell. Water boatmen were seen throughout the pond with an average population density of 1 per 10 liters.

Pond 2

Gross appearance. Water was a yellow brown color with an average Secchi disk reading of 60.1 cm, up from 48.3 cm last month. Floating debris was noted throughout the pond. The average temperature was 27.0°C, up from 21.0°C last month. There was a strong flow of water into the pond which is receiving non-blowdown water (wastewater from the plant which does not include the circulating water system). The water level in the pond was 925' above sea level, identical to last month.

Algae. Diatoms were the predominant algae with a cell count of 75,000 c/ml for *Chaetoceros* and 7,900 c/ml for *Nitzschia*. The total cell count for the water column was 97,083 c/ml. See Table 2 for individual and total counts.

Animals. There were approximately 58 birds on the pond which consisted of 6 grebes, 14 avocets, 8 Wilson fullerops and 30 unidentified waterfowl. *Artemia* brine shrimp were seen at an average concentration of 5 per liter and unlike Pond 2, their concentrations did not increase near the water inlet. Water boatmen were not observed in this pond. However, a cluster of rotifers, genus *Brachionus*, were noted at the southwest corner at a concentration of 40 per ml.

Water Receiving Facility

Gross appearance. The water column had a heavy green tint and the liner bottom had a film of green algae. The east collection site had a wind accumulation of aquatic fly larvae and exoskeletons. Water temperature at the north collection site was 29.0°C, up from 23.8°C last month.

Algae. The predominant alga was *Rhodomonas* with a cell count of 124,000 c/ml. The wind accumulation sample consisted largely of green algae and aquatic insects, family Chironomidae. The total cell count for the water column was 134,000 c/ml, This is the highest count for the reservoir thus far. See Table 3 for individual and total counts.

Animals. There were approximately 60 birds on the pond which consisted of 9 coots, 1 mallard, 20 stilts, 12 northern shovelers, 2 cranes, 12 buffleheads and 4 sandpipers. Aquatic larval insects were collected and identified as midges, family Chironomidae (approximately 1000 species exist). These insects are an ecologically important group with short life cycles and high densities. The larvae are known to feed on a wide variety of organic substrates: coarse detrital particles, medium detrital particles, fine detrital particles, algae and animals to name a few. Because there are so many species and because they can be both consumers and prey their presence is presumed to enhance the biotic stability of aquatic ecosystems (Merritt and Cummings, 1984).

Brine Shrimp: Life Cycle and Reproduction

Artemia brine shrimp are crustaceans and obligate filter feeders which live on salt-tolerant microscopic algae and bacteria. The typical life cycle of *Artemia* in natural, temperate lakes begins in the early spring and is completed before winter. In such environments they emerge from winter eggs (cysts) in the early spring when the temperature is between 15 and 25°C and quickly develop into adults and are most abundant in summer months. In preparation for adverse conditions adults may deposit overwintering eggs (cysts) to ensure the continuity of the species. However, female *Artemia* may deposit offspring ovoviviparously or oviparously during the season (D'Agostino, 1980).

Ovoviviparous reproduction is defined as the production of eggs which are hatched within the body, so that the young are released alive but unattached by a placental membrane. The first brood of offspring from adult females is invariably ovoviviparous. And the full reproductive cycle from ovulation to the release of young is usually 4 to 5 days (D'Agostino, 1980).

Oviparous reproduction is defined as the production of eggs that mature and hatch after being expelled from the body, as in birds and most reptiles. Reproduction by dormant cysts is elective and in fact *Artemia* kept under optimal culture conditions may postpone reproduction by cysts indefinitely. However, under conditions of starvation which coincide with ovulation, females will deposit cysts (D'Agostino, 1980). Other authors have observed that there are two types of cysts: ones that release young shortly after being deposited; and ones that remain dormant until "activated". The precise factor or factors which terminate dormancy are not known, however one of the most successful treatments is dehydration followed by rehydration in an aqueous environment of suitable osmotic pressure and dissolved oxygen (Clegg and Conte, 1980).

Brine shrimp are a valuable commodity, used as fish and shrimp food for aquarium fish and aquaculture ponds.

References:

Clegg, J.S., and F.P, Conte. 1980. A review of the cellular and developmental biology of *Artemia*. p. 11-54. *In:* The Brine Shrimp *Artemia*. Vol 2. Physiology, Biochemistry, Molecular Biology. Persoone G., P. Sorgeloos, O. Roels, and E. Jaspers (Eds). Universa Press, Wetteren, Belgium. 664 p.

D'Agostino, A. 1980. The vital requirements of *Artemia*: physiology and nutrition. p. 55-82. *In:* The Brine Shrimp *Artemia*. Vol 2. Physiology, Biochemistry, Molecular Biology. Persoone G., P. Sorgeloos, O. Roels, and E. Jaspers (Eds). Universa Press, Wetteren, Belgium. 664 p.

Javor, B. 1989. Hypersaline Environments. Springer-Verlag, New York.

Merritt, R.W. and K.W. Cummins. 1984. An Introduction to the Aquatic Insects of North America, Second Edition. Kendall/Hunt Publishing Company, Dubuque, Iowa. 722 p.

Edward Glenn   David Moore   Renee Tanner

Algae Counts, APS/PVNGS, 05/14/96

Algal Counts in Cells/ml

Table 1 Pond 1

Site	Nitzschia	Coccochloris	Nannochloris
Northwest	2,500	13,750	2,500
Southeast	0	5,000	0
Center	1,250	18,750	0
Average	1,250	12,500	833

Total Cell Count: 14,583

Table 2 Pond 2

Site	Chaetoceros	Nitzschia	Nannochloris	Micromonas	Coccochloris	Carteria	Chlorella	Unidentified algal cell
Northeast	86,250	20,000	1,250	0	8,750	2,500	1,250	0
Southwest	55,000	2,500	0	1,250	5,000	1,250	5,000	1,250
Center	83,750	1,250	0	3,750	0	10,000	0	1,250
Average	75,000	7,917	417	1,667	4,583	4,583	2,083	833

Total Cell Count: 97,083

Table 3 Fresh Water Reservoir

Site	Synechocystis	Coelastrum	Kirchneriella	Rhodomonas	Scenedesmus	Pediastrum
North	7,500	1,250	3,750	0	0	0
South	0	0	0	27,500	1,250	0
East	11,250	6,250	0	468,750	0	0
West	2,500	1,250	1,250	0	0	2,500
Average	5,313	2,188	1,250	124,063	313	625

Total Cell Count: 133,750

PVNGS PONDS 05/14/96 Sampling

Table 4: Water Quality Data

Pond 1	Nitrate NO3- -N mg/L	Salinity ppt	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
Central	492	58	3.23	0.17	9.00	4.80
NW	474	58	3.20	0.15	8.95	4.60
SE	412	58	3.28	0.18	8.93	4.40
Average	459	58	3.23	0.17	8.96	4.60

Pond 2	Nitrate NO3- -N mg/L	Salinity ppt	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
Central	332	65	1.83	0.08	9.67	5.10
NE	254	65	1.75	0.06	9.63	2.40
SW	270	63	2.40	0.16	9.54	5.10
Average	285	64	1.99	0.10	9.61	4.20

Fresh Water	Nitrate NO3- -N mg/L	Salinity	Ammonia NH3-N mg/L	Phosphate P mg/L	pH	Nitrite NO2- mg/L
North	13.3	0	0.78	0.05	9.47	0.340
South	14.1	0	0.73	0.06	9.48	0.338
East	23.4	0	1.08	0.13	8.97	0.440
West	12.5	0	0.75	0.05	9.40	0.360
Average	15.8	0	0.83	0.07	9.33	0.370

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DATE: June 21, 1996

MEMO TO: Thomas Hillmer, APS - PVNGS

Re: PVNGS Ponds, June 6, 1996 Sampling

Summary Observations

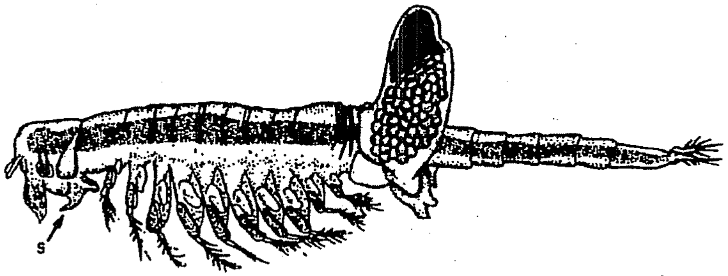
Brine shrimp were abundant in both ponds with an average concentration of 20 per liter in Pond 1 and 12 per liter in Pond 2. The dense populations of *Artemia* in Pond 1 and now Pond 2 have grazed the algae so heavily that the Secchi disk visibility reading for both ponds was > 10 ft (300 cm). A low algal count was also noted for both ponds. Water boatmen were observed at all sampling sites in Pond 1 and an average concentration of 1 per 15 liters was estimated. Only an occasional water boatmen was seen in Pond 2 making it difficult to estimate the concentration. See Table 4 for water quality data.

Pond 1

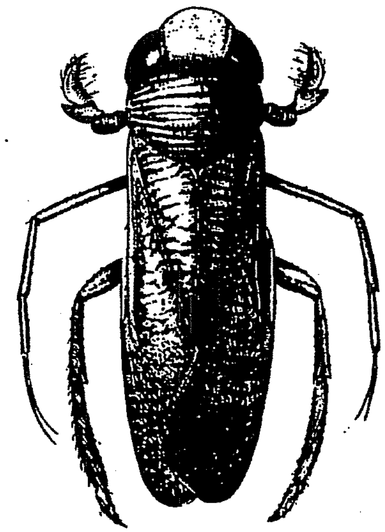
<u>Gross appearance</u>. Water was clear with an average Secchi disc reading > 300 cm (the limit of the Secchi disk line is 300 cm which was also the depth to the bottom of the pond at most sampling sites). This is the same pond clarity as seen last month. The average temperature was 30.0°C, up from 26.0°C last month. The pond, which was scheduled to receive blowdown, was not receiving much water. This is most likely due to the summer heat which would increase evaporation from the towers. The water level was 928' above sea level, down from 928.5' last month. Small bubbles rising to the surface could be seen at all sampling points, and floating debris was noted in all corners with the heaviest accumulation in the northwest corner.

<u>Algae</u>. The only alga observed was *Nitzschia* with a cell count of 1,250 c/ml. This is the lowest cell count observed during our monitoring. The wind accumulation was composed of *Navicula*, *Nitzschia* and *Chlorogonium*. See Table 1 for individual and total counts.

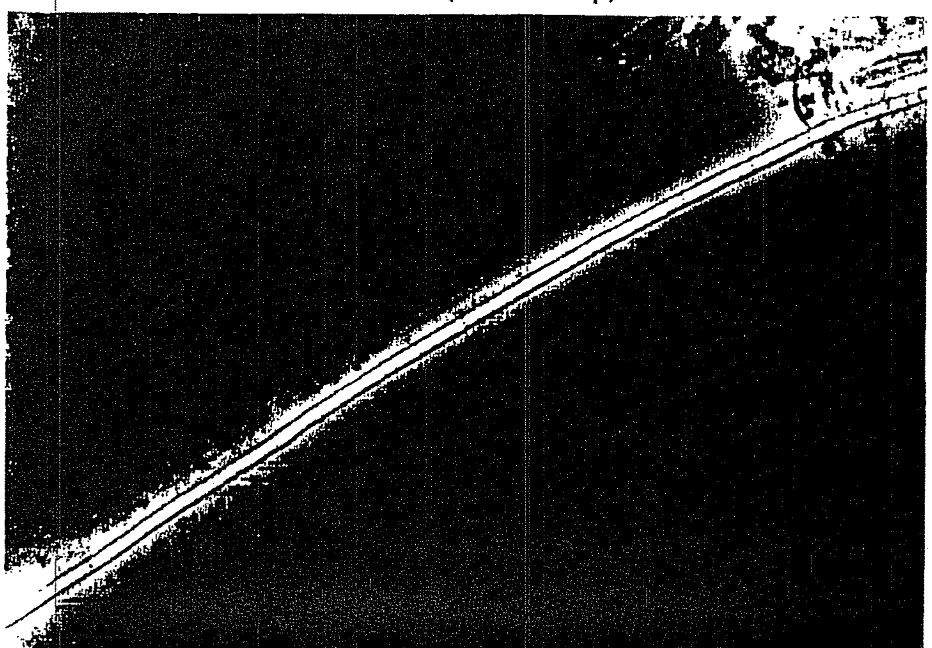
<u>Animals</u>. Approximately 12 grebes were seen on the pond. *Artemia* brine shrimp were at an average concentration of 20 per liter down from 30 per liter last month. The densest populations of *Artemia* were seen in the center of the pond where at least three pink clusters, approximately 3 feet in diameter and



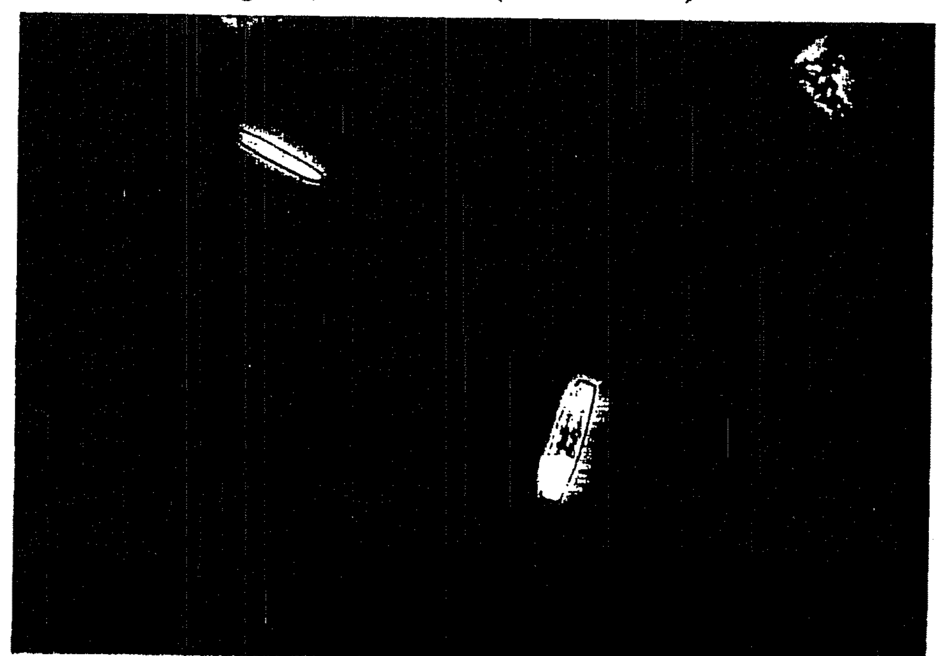
Artemia (brine shrimp)



genus, *Trichocorixa* (water boatman)



Oscillatoria



Diatoma

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DATE: November 8, 1995

MEMO TO: Thomas Hillmer, APS - PVNGS

Re: PVNGS Ponds, October 24, 1995 Sampling

Summary Observations

The blowdown water is currently entering Pond 1. Following the October 20 meeting at Arizona Game and Fish, a decision was made to continue this for about a month then to split incoming water about equally between Evaporation Ponds 1 and 2 in an effort to maintain pond stability. This policy should minimize the variability which might occur otherwise in the ponds and that might bring about sudden change in pond biota. We have added a weekly sampling protocol to document algal populations and specific water quality parameters that are important to algal development, to establish conditions before and following the modified management practices. The Water Receiving Facility has also been added in the weekly monitoring.

Significant changes have occurred over the last month in the types and amounts of algae growing in both ponds. Pond 1 has had a shift in the predominate alga from the blue-green Coccochloris to the diatom Chaetoceros. Coccochloris is a warm-water algae while Chaetoceros grows best in cooler water. Hence, a seasonal change of species may be occurring in this pond. Pond 1 also had an increase in the water boatman population. Pond 2 algae types have remained similar while the overall count dropped somewhat, but the water boatman population has increased. The Receiving Reservoir now has a bloom of the blue-green Anacystis, which can be toxic to wildlife if it occurs in such high concentrations that it forms surface scums or floating mats which can be eaten. However, it is only growing in moderate levels in the reservoir and is not present as aggregates, so it is not a hazard at present (it is a common algae in water supplies).

Pond 1

<u>Gross appearance</u>. Floating debris had been concentrated by wind along the south side of the pond, mostly towards the west end. Salinity in this pond, which has recently begun to receive blowdown water again, has risen 1 ppt to 56 ppt. The wind