

ANNUAL PROGRESS REPORT
FISH RESEARCH PROJECT
OREGON

PROJECT TITLE: Population and Habitat Assessments for Oregon Chub on the
William L. Finley National Wildlife Refuge (2004)

CONTRACT NUMBER: Order no. 1448-13420-03-M194

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INTRODUCTION

Oregon chub are endemic to the Willamette River drainage of western Oregon (Markle et al. 1991). This species was formerly distributed throughout the Willamette River Valley (Snyder 1908) in off-channel habitats such as beaver ponds, oxbows, stable backwater sloughs, and flooded marshes. These habitats usually have little or no water flow, have silty and organic substrate, and have an abundance of aquatic vegetation and cover for hiding and spawning. In the last 100 years, these habitats have disappeared because of changes in seasonal flows resulting from the construction of dams throughout the basin, channelization of the Willamette River and its tributaries, and agricultural practices. This loss of habitat combined with the introduction of non-native species to the Willamette Valley resulted in a sharp decline in Oregon chub abundance. Oregon chub were listed as "endangered" under the federal endangered species act in 1993 (Markle and Pearsons 1990; Rhew 1993).

The naturally occurring population of Oregon chub located in the Gray Creek drainage on the Finley National Wildlife Refuge has been of particular concern because of recent unexplained population declines. Oregon Department of Fish and Wildlife started monitoring Oregon chub and their habitats on Finley Refuge in 1992. Oregon chub population abundance was relatively low (460-720 adults) but stable in Gray Creek from 1994 through 2001. From 2001 to 2003, the population declined from 630 fish to 230 fish (Scheerer et al. 2004).

A multi-year habitat enhancement project was completed in 2003 in the Muddy Creek drainage on Finley National Wildlife Refuge. The goal was to move portions of the Gray Creek chub population to suitable locations on the refuge to reduce their risk of extinction and expand their numbers. The project involved habitat restoration of two ponds in the Gray Creek drainage (Display and Beaver Ponds) and the creation of another isolated pond (Cheadle Pond). Display Pond was drained in 1996 to remove the non-native fish. Oregon chub from Gray Creek Swamp were introduced into Display Pond in 1998 (n=60), 1999 (n=45), and 2001 (n=49). The chub population abundance was estimated at 1,750 fish in 2000, but has subsequently. Recruitment failure is the suspected cause of this decline. Smaller size-classes of fish (<50 mm) have not been collected in the past two years. Surveys for juvenile chub (<25 mm) during the summer of 2003 found very few individuals. In 2002, we introduced 50 chub from Display Pond into Cheadle Pond (created in 1998). In 2004, we estimated the chub abundance in Cheadle Pond at 220 fish. In 2003, the U.S. Fish and Wildlife Service completed the Beaver Pond habitat project. They replaced the spillway and water control structure and deepened the pond to prevent the pond from completely drying up on an annual basis. Native fish colonized the fish in 2004. We will continue to monitor the site to determine whether Oregon chub colonize this pond from Gray Creek Swamp, which is located upstream. Oregon chub will be introduced into the pond, if they do not colonize on their own.

Water quality has been a concern in the Gray Creek drainage on Finley National Wildlife Refuge for many years. Dead fish, with their mouths open and gills flared (indicating respiratory stress), were found in certain minnow traps set in Gray Creek Swamp in the mid-1990's. In the summer of 1999, water levels in the creek were particularly low and orange colored water was prominent throughout the beaver ponds and channels in upper Gray Creek. Analyses of water samples collected by USFWS and USGS in September 1999 found high iron levels in the water and the presence of iron bacteria. Dissolved oxygen levels were very low (2.3 mg/l). Conditions of high iron and low oxygen are typical of waters with substantial spring water influx. These conditions appear to occur in Gray Creek when the stream flow drops during the summer and the proportionate contribution of spring water increases. Intensive timber harvest on private lands in the upper watershed (upstream of the refuge) may be contributing to the reduced stream flow entering the refuge. Water quality monitoring conducted by ODFW in 1999-2000 showed that dissolved oxygen levels in the creek were lowest in the large beaver ponds, and

these levels decreased during the late summer months. Dissolved oxygen levels were recorded as low as 1.9 mg/l (<20% saturation) in 2000.

Objectives of this study were to assess Oregon chub population trends and habitat conditions on Finley National Wildlife Refuge. The results of these investigations will improve the understanding of recent declines in chub numbers and assist in guiding protection, restoration, and enhancement efforts on the refuge. The monitoring of contaminants levels (forestry related herbicides) was planned for 2004, however the spraying planned on private headwater lands in the Gray Creek drainage did not occur in 2004. This monitoring will occur in 2005. In addition, the refuge had hoped to install a stream gauge in 2004 to monitor stream inflow to the refuge from the private lands located upstream. Installation of the stream gauge was delayed.

METHODS

We evaluated physical and biological habitat parameters at three locations on Finley Refuge (Gray Creek, Display Pond, and Cheadle Pond). Habitat parameters that were recorded included substrate type, type and abundance of aquatic vegetation, mean depth, and total surface area. Water quality parameters were recorded at three locations in Gray Creek, one location in Display Pond, and one location in Cheadle Pond. Parameters measured include water temperature (°C), pH, and dissolved oxygen (mg/l). Water depth was recorded using fixed staff gauges that were calibrated in tenths of feet.

We used minnow traps, measuring 23 by 46 cm with 64 mm mesh, to obtain mark-recapture population estimates of all fish species at each site. We baited the traps with a half slice of bread and fished them for 3-4 hours. We measured total lengths (TL) of a subsample of the Oregon chub we collected in the traps (N=50). We marked all fish with a partial caudal fin clip and returned them to the water. We estimated population abundance using single-sample mark-recapture procedures (Ricker 1975). To calculate population abundance, we used the total number of marked fish, and the catch and recaptures from a second sample date. We calculated 95% confidence intervals using a Poisson approximation (Ricker 1975). Because we did not capture fish smaller than ~35 mm (TL) in the minnow traps, these fish were not included in our estimates. Excluded were young-of-the-year Oregon chub (Scheerer and McDonald 2003).

RESULTS

Population Monitoring

Oregon chub were present in Gray Creek, Display Pond, and Cheadle Pond. The chub population abundance trends for these locations are shown in Figure 1. Population abundance increased to 520 chub in Gray Creek in 2004, following two years of decline. The Gray Creek populations has had a stable 5-year abundance trend (Scheerer et al. 2004). Chub abundance in Display Pond continued to decline in 2004 (estimate: 70 fish), a trend that began in 2001. Population abundance increased in Cheadle Pond to 220 fish; 50 fish were introduced in 2002.

Habitat Evaluation

The physical habitat characteristics of Gray Creek, Display Pond, Cheadle Pond, Beaver Pond, Brown Creek Ponds, and lower Field 22 pond are shown in **Appendix A**. Gray Creek, Display Pond, and Cheadle Pond all have suitable depth, substrate type, aquatic vegetation, and sufficient surface area to support sizeable Oregon chub populations. The Brown Creek and Field 22 Ponds are potential chub introduction sites. Because of a limited water supply, only

one of the Brown Creek Ponds can be supplied with adequate water throughout the year. Currently the North Pond has the best habitat aquatic vegetative cover and is the preferred option. The Field 22 pond has adequate water levels but has limited aquatic vegetation; plantings of submerged vegetation would improve the habitat suitability for Oregon chub.

Fish and Amphibians

Gray Creek contained a variety of native fish species in addition to Oregon chub, including threespine sticklebacks, reticulate sculpins, redbreast shiners, speckled dace, and cutthroat trout. Bluegills were the only nonnative fish species collected in 2004. Yellow bullheads and bluegills have been collected during previous years sampling. These nonnative fish may be limiting chub abundance and may be an obstacle to chub recovery in Gray Creek. Native amphibians collected during fish sampling included northwestern salamanders and roughskinned newts. Nonnative bullfrogs were abundant and widespread. An occasional western pond turtle has been observed in previous years. Details of the numbers and types of fish and amphibian species collected at each site are shown in Appendix A.

Beaver Pond dried up during most summers prior to completion of the habitat restoration project. In 2004, native fish colonized the site including threespine sticklebacks, redbreast shiners, and speckled dace. No Oregon chub were collected. Amphibians collected from this pond included native roughskinned newts and northwestern salamanders and nonnative bullfrogs.

Display Pond and Cheadle Pond both contained Oregon chub, native roughskinned newts, and nonnative bullfrogs. Prior to restoration, Display Pond contained nonnative yellow bullheads and western mosquitofish. The Brown Creek Ponds and lower Field 22 Pond did not contain fish. Bullfrog tadpoles and roughskinned newts were present in both ponds.

Water Quality Monitoring

Water quality parameters were measured at three locations in Gray Creek in 2004. The sites where data were collected in 2004 were the same as the sites where data were collected in 1999-2000. Results from sampling conducted in 1999-2000 are shown in Appendix Tables B-1 and B-2. Gray Creek site 1, a beaver pond located near the staff gauge where the trail comes closest to the creek, had the lowest dissolved oxygen levels. Gray Creek site 2, a small beaver pond located approximately 400 meters upstream of site 1, had higher dissolved oxygen levels. Gray Creek site 3, a free flowing section of stream located approximately 800 meters upstream of site 2 near the west boundary of the refuge, had the highest dissolved oxygen levels. The 2004 results (Figures 2-4) were similar to those from 1999-2000. As the summer progressed, water levels dropped, water temperatures increased, and dissolved oxygen levels declined. However, in 2004 we had earlier rains (mid-August) and both pond levels and dissolved oxygen levels increased somewhat in the weeks to follow. Starting in mid-July, we recorded dissolved oxygen both near the substrate and near the water surface at sites 1 and 2 (site 3 was too shallow). Dissolved oxygen was 1-2 mg/l lower near the substrate compared to the surface measurements. Measurements of pH varied little during the sampling period or throughout the creek (range: 6.6 to 7.6). We noted orange colored water and iron precipitates at Gray Creek sites 1 and 2 starting in late-June and continuing through September. The timing of these observations (orange water and iron precipitates) was similar to those from 1999 and 2000.

The pond levels at Display Pond dropped approximately 2 feet during the summer of 2004, from a maximum staff reading of over 6.5 feet to a low of 4.3 feet (Figure 5). Dissolved oxygen levels were relatively high throughout the sampling period with a low of 5.4 mg/l recorded in early-June. Dissolved oxygen increasing later in the summer. The dissolved

oxygen measured near the surface was nearly identical to measurements recorded near the substrate. The pH varied little during the sampling period (range: 6.8 to 7.9).

The water levels at Cheadle Pond dropped approximately 4 feet over the sampling period (Figure 6). This large drop may limit the establishment of aquatic vegetation in the deeper areas of the pond. Dissolved oxygen levels ranged from 6.1 mg/l to 9.8 mg/l near the surface and 3.2 mg/l to 6.3 mg/l near the substrate. Dissolved oxygen levels measured near the substrate increased in mid-August, which coincided with the August rains.

DISCUSSION

The status of Oregon chub populations on Finley Refuge has changed little over the past decade, despite substantial recovery efforts. The natural population in Gray Creek remains at moderately low abundance, compared to the chub abundance at similar sized habitats elsewhere in the Willamette Valley (Scheerer et al. 2004). However, this population has had a stable 5-year abundance trend and currently meets the Recovery Plan criteria to count towards downlisting criteria established in the Oregon Chub Recovery Plan (Scheerer et al. 2004; U.S. Fish and Wildlife Service 1997).

The status of Oregon chub introduction on Finley Refuge are uncertain. The introduced population in Display Pond has declined steadily since 2000. Analysis of length frequency histograms from 1999 to 2004 suggests this decline may be the result of recruitment failures in recent years (Figure 7). The introduced population in Cheadle Pond has increased in abundance, but it is too soon to judge whether it will be successful. The low numbers of donor fish in Gray Creek has slowed recovery efforts. To establish new populations, a minimum of 400-500 fish are used to avoid genetic bottlenecks. When a donor population is not very abundant (like the Gray Creek population of 500-700 chub), this target can take 8-10 years to achieve.

Because water quality does not appear to be limiting the Display Pond population, it is possible the population decline may be due to a lack of genetic diversity in the donor population, or the small number of fish used to found this population. Inbreeding depression may be limiting both the Gray Creek and the Display Pond populations. Proposed future genetic analyses by the U.S. Fish and Wildlife Service's Conservation Genetics Lab will help answer this question.

Water quality analyses in 2000 and 2004 suggest that the Gray Creek population may be limited by poor water quality. The U.S. Environmental Protection Agency cites water quality criteria for early life stages and other life stages of warm water aquatic organisms for dissolved oxygen (USEPA 1986). These criteria include a 7-day mean for early life stages (1 March – 31 August) as 6.0 mg/l and a daily minimum of 5 mg/l. For other life stages, the criteria include a 7-day minimum of 4 mg/l and a daily minimum of 3 mg/l. Although our data does not include 7-day continuous samples, the point samples certainly suggest the low dissolved oxygen levels that occur in the larger beaver ponds in Gray Creek, where most of the Oregon chub are captured, are of concern.

Timber harvest and related timber land management activities in the Gray Creek basin over the past decade have been substantial. Records from the Oregon Department of Forestry's Notifications of Operations from 1995 through 2004 were compiled for the three topographic map sections comprising the Gray Creek drainage area (Figure 8). A total of 1,230 acres, or 69% of the area, had some type timber harvest. Partial timber harvest represented 86% of this harvest and 60% of the volume harvested. A total of 180 acres had herbicide applications (9% of the area). In addition, 6,800 feet of logging road was constructed during this 10-year period. These activities may have contributed to the water quality problems in Gray Creek. Timber harvest may have resulted in a reduction in stream flow; herbicide applications may have entered the water course and negatively impacted Oregon chub. A contaminants

study, to be timed shortly after herbicide application, was planned for 2004. The herbicide application was postponed until 2005.

In summary, Oregon chub on Finley National Wildlife Refuge may be limited by several factors, including the presence of nonnative fish in Gray Creek, impaired water quality in Gray Creek, and inbreeding. The population status over the past decade has neither improved nor declined substantially. We have reduced the risk to this population by introducing the chub into new habitats, although the success of these introductions is not yet clear. Future water quality (contaminants) and genetic studies will assist in determining which factors limit chub abundance on the refuge.

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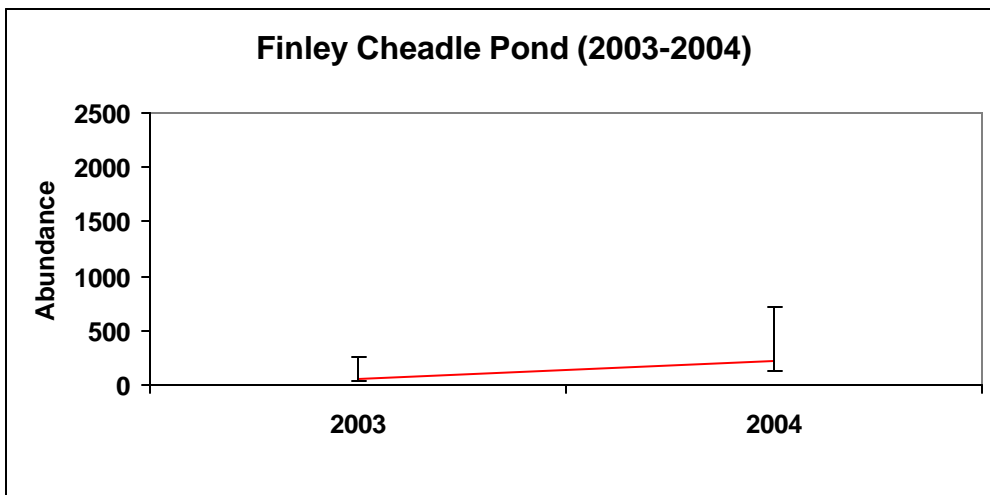
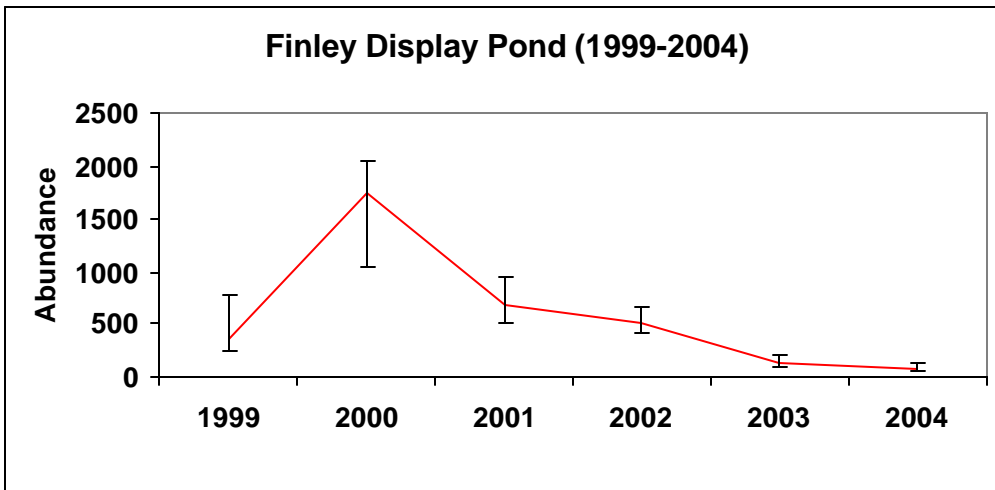
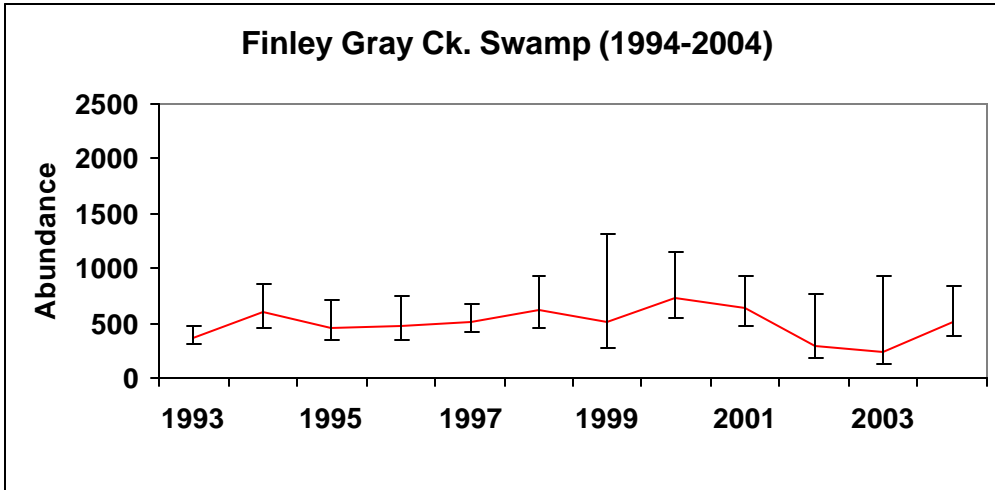


Figure 1. Abundance trends for Oregon chub populations on Finley National Wildlife Refuge. Horizontal bars represent 95% confidence limits for each estimate.

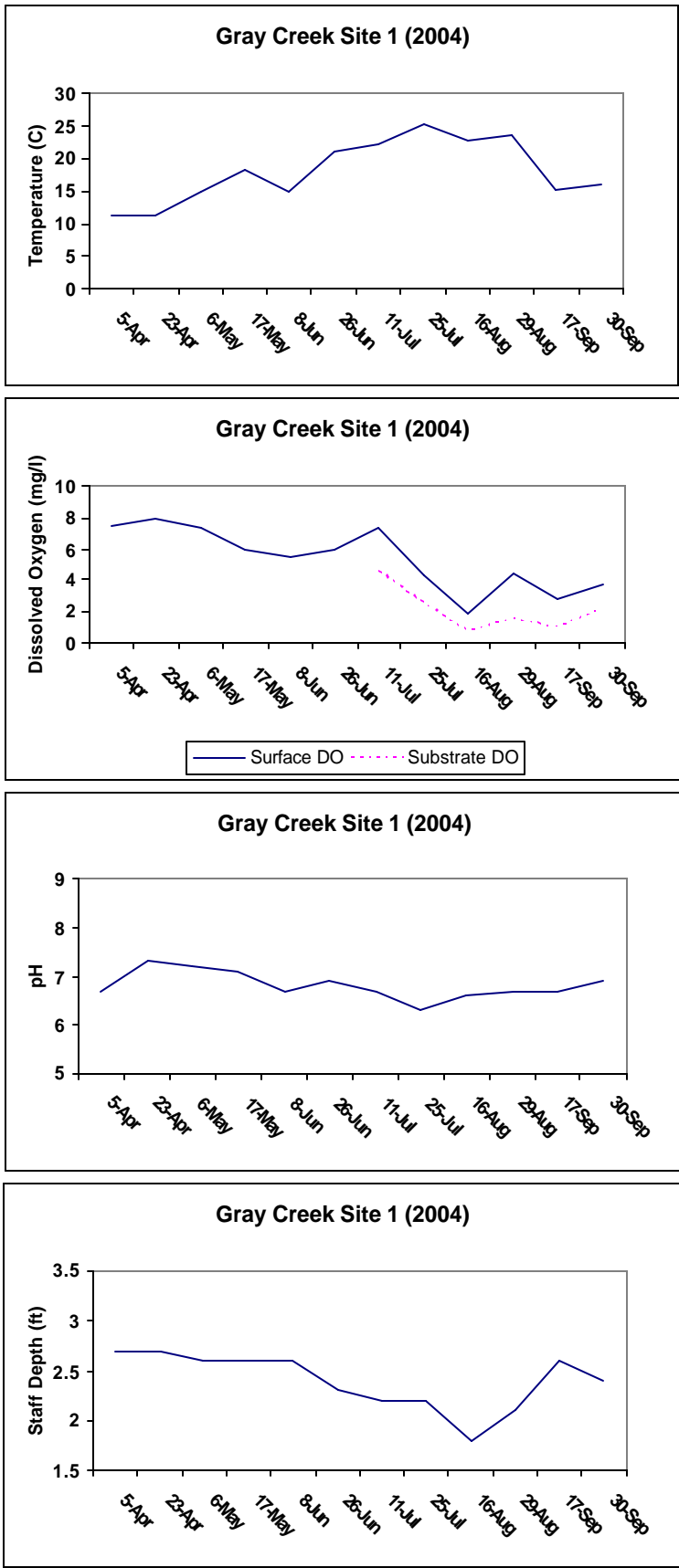


Figure 2. Water temperatures, dissolved oxygen levels, pH, and pond depths recorded in 2004 at Gray Creek site 1.

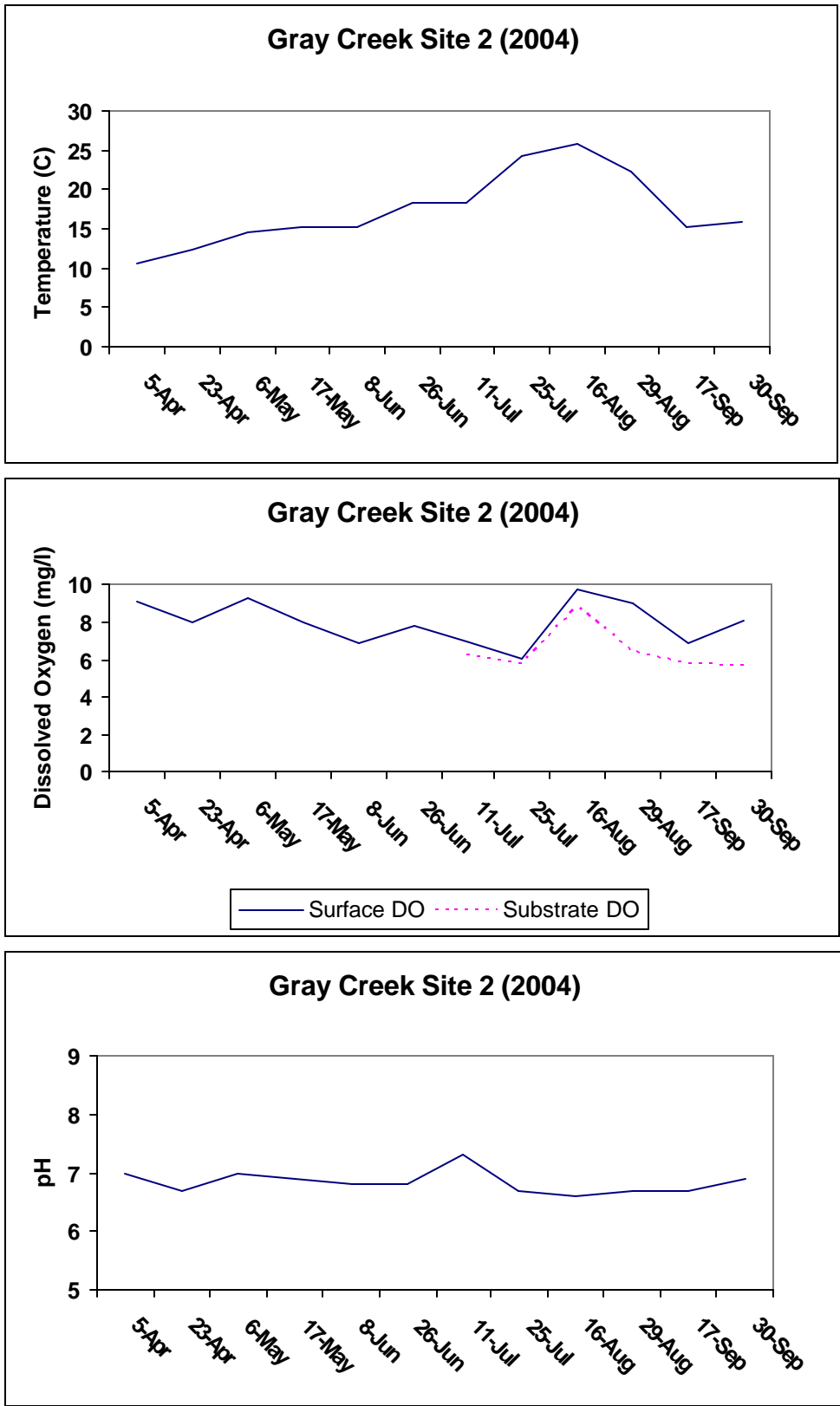


Figure 3. Water temperatures, dissolved oxygen levels, and pH recorded in 2004 at Gray Creek site 2.

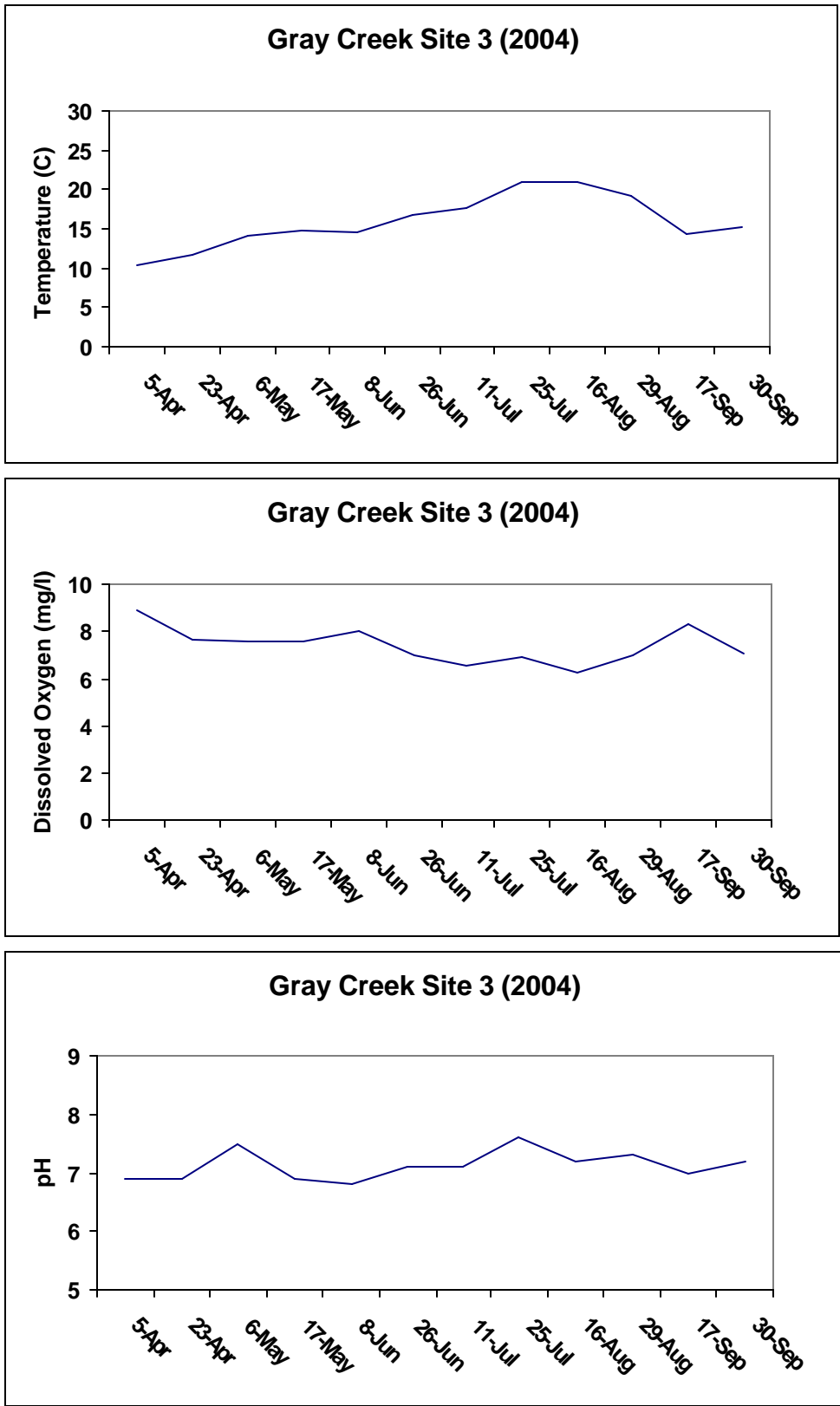


Figure 4. Water temperatures, dissolved oxygen levels, and pH recorded in 2004 at Gray Creek site 3.

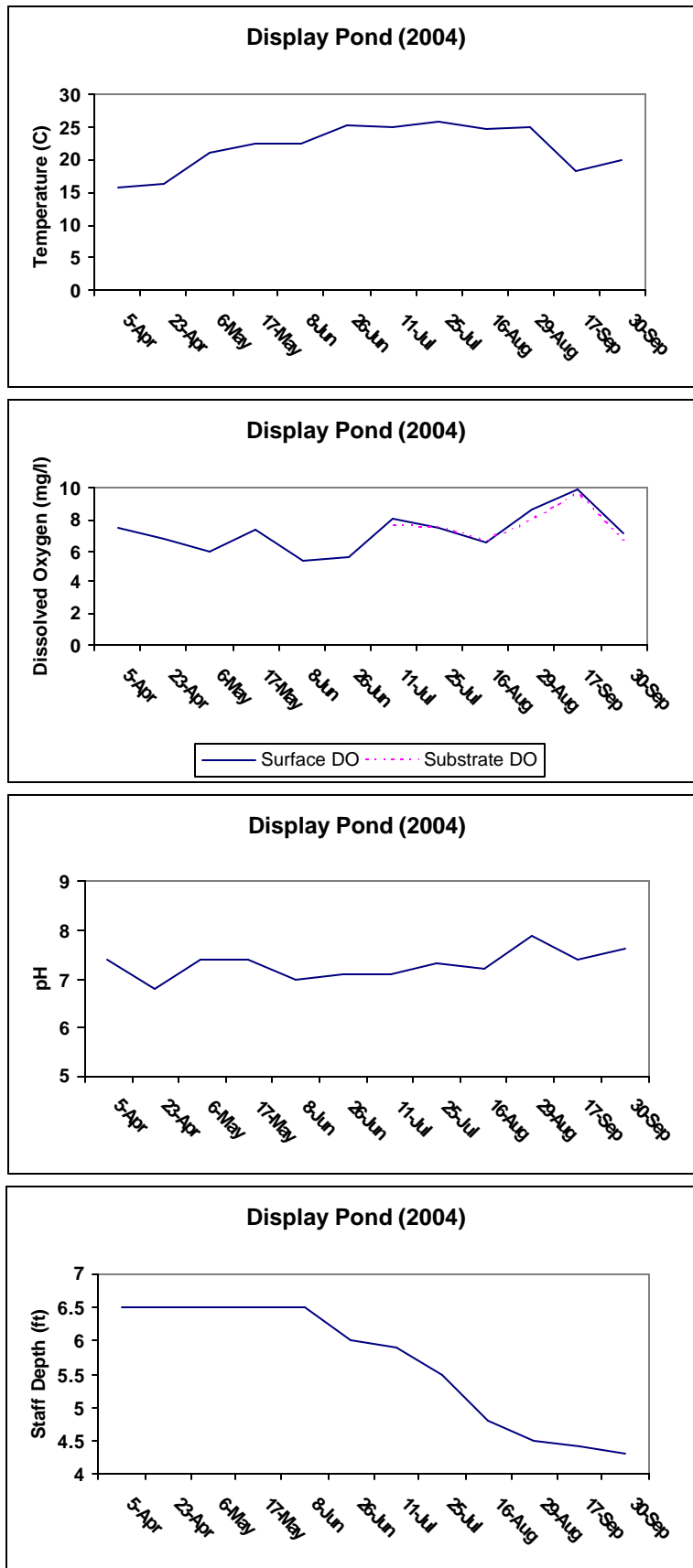


Figure 5. Water temperatures, dissolved oxygen levels, pH, and pond depths recorded at Display Pond in 2004.

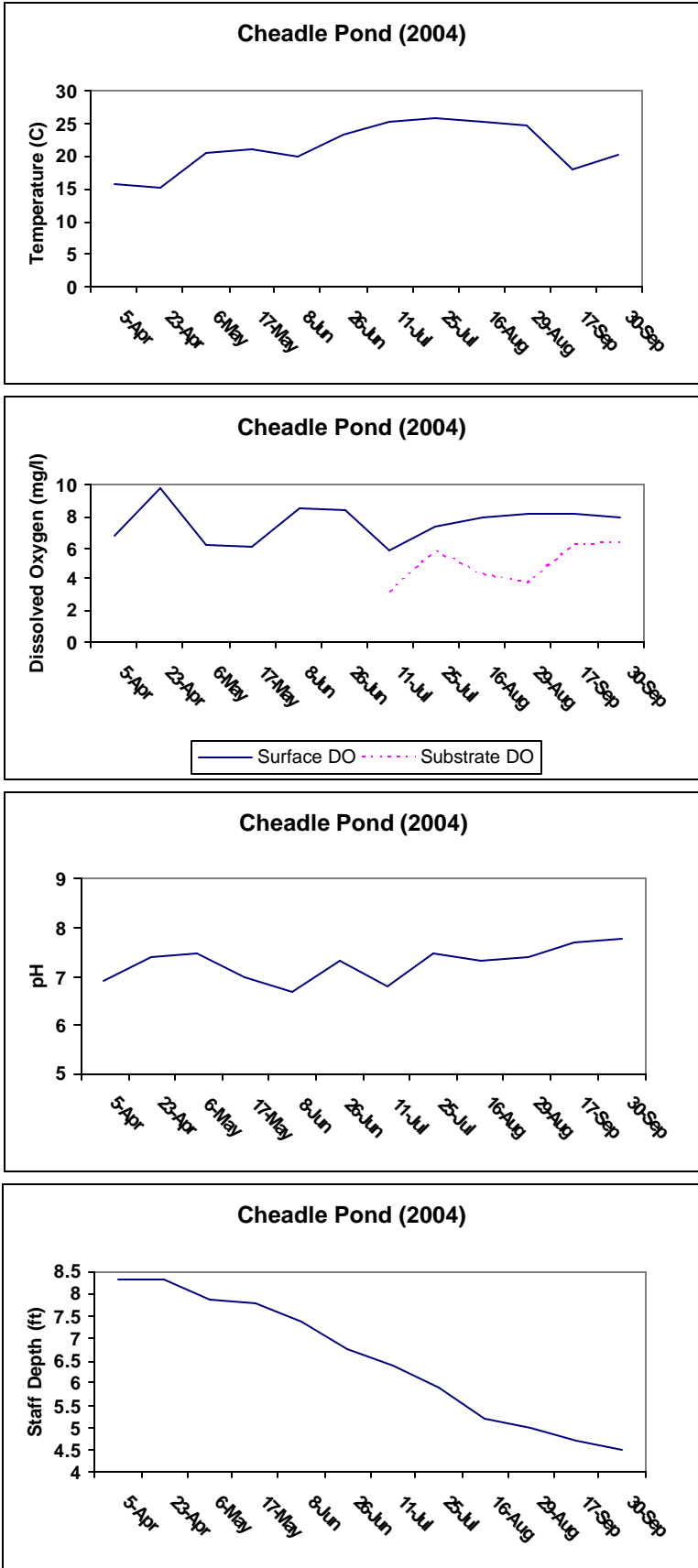


Figure 6. Water temperatures, dissolved oxygen levels, pH, and pond depths recorded at Cheadle Pond in 2004.

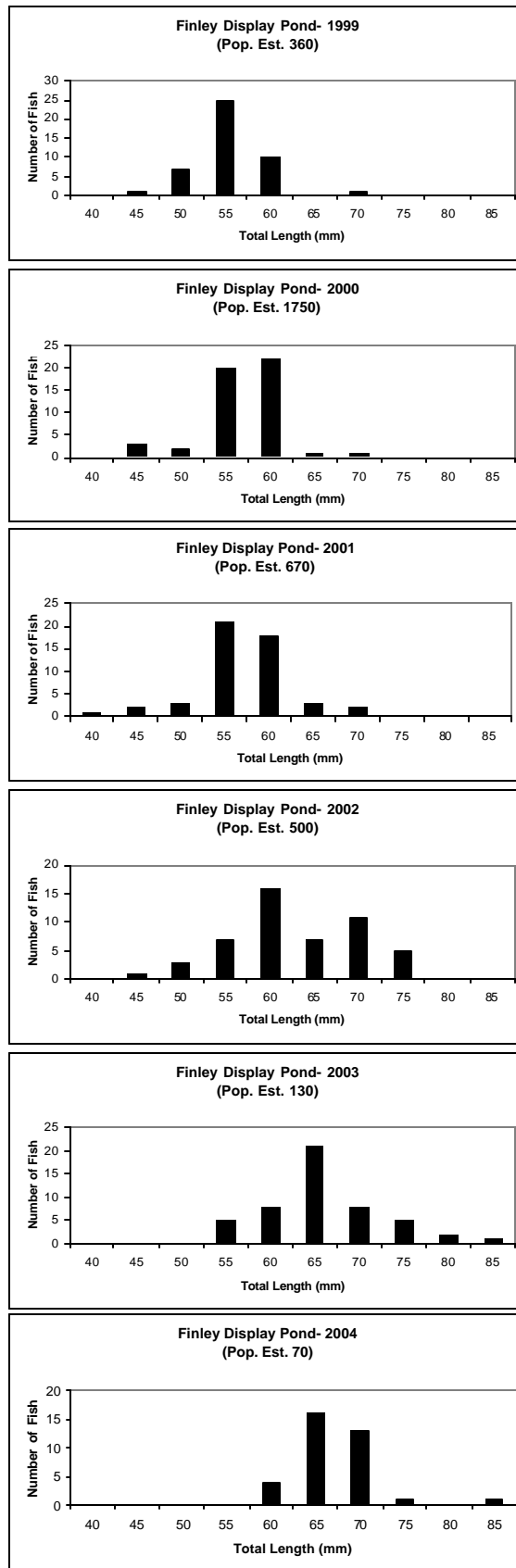


Figure 7. Length frequency histograms for Oregon chub from Display Pond from 1999 through 2004, illustrating the absence of the younger size classes (recruitment failure) in recent years.

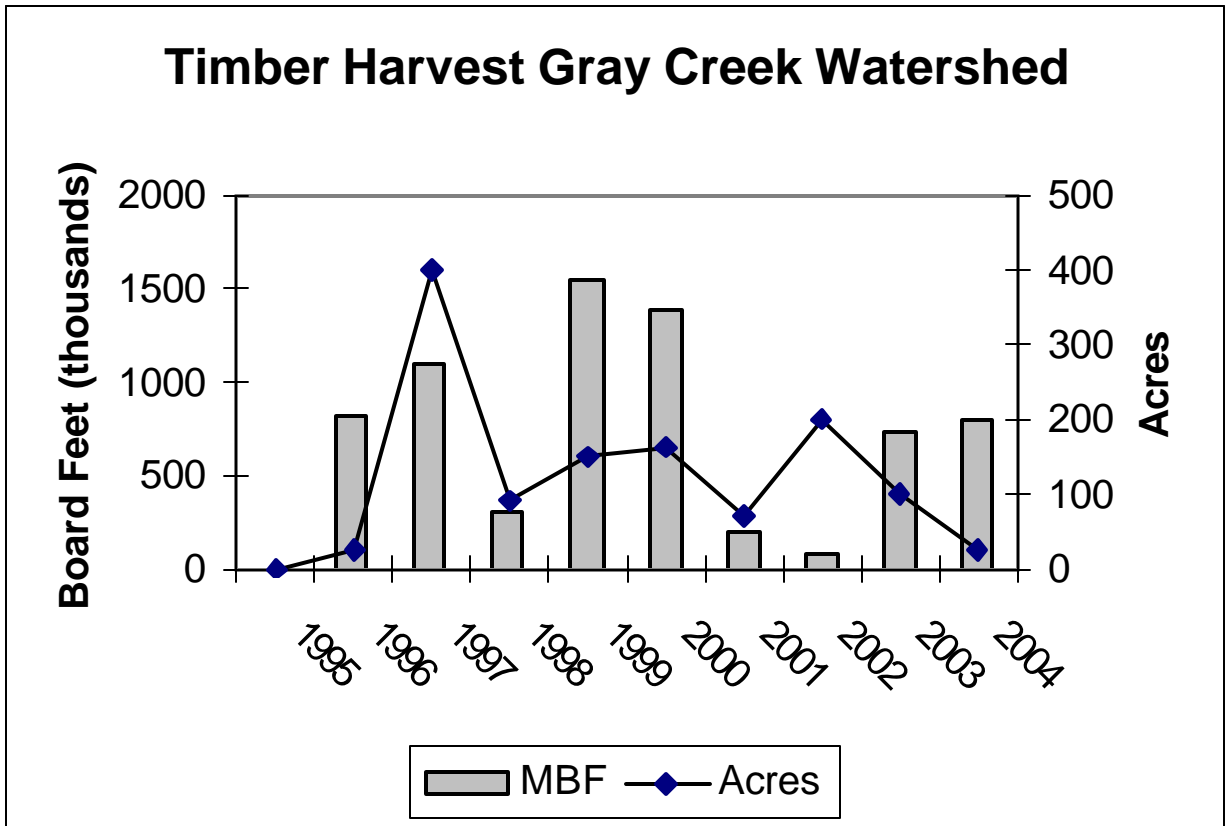


Figure 8. Timber harvest in the Township 13 South, Range 6 West, Sections 25 and 36, and Township 13 South, Range 5, Section 31 in the Gray Creek drainage from 1995-2004.

APPENDIX A

Fish Species and Habitat Characteristics at Each Survey Location

¹ Vegetation types are expressed as a percentage of the total surface area of the site.

² Vegetation codes:

ACER	Big leaf maple (<i>Acer macrophyllum</i>)
ALIS	Water plantain (<i>Alisma</i> sp.)
ALNU	Alder (<i>Alnus</i> sp.)
ATRO	Nightshade (<i>Atropa belladonna</i>)
AZOL	Water velvet (<i>Azolla</i> sp.)
BIDE	Beggars tick (<i>Bidens</i> sp.)
CABO	Fanwort (<i>Cabomba</i> sp.)
CALI	Water starwort (<i>Callitriche</i> sp.)
CARE	Sedge (<i>Carex</i> sp.)
CERA	Coontail (<i>Ceratophyllum</i> sp.)
CHAR	Stonewort (<i>Chara</i> sp.)
CORN	Red osier dogwood (<i>Cornus sericea</i>)
DOWN	Box elengia (<i>Downingia elegans</i>)
ELEO	Spike rush (<i>Eleocharis</i> sp.)
ELOD	Waterweed (<i>Elodea</i> sp.)
EQUI	Horsetail (<i>Equisetum</i> sp.)
FILA	Filamentous Algae
FONT	Water moss (<i>Fontinalis</i> sp.)
FRAX	Oregon ash (<i>Fraxinus latifolia</i>)
GRAM	Grasses (<i>Gramineae</i>)
IRIS	Yellow iris (<i>Iris pseudacorus</i>)
JUNC	Rush (<i>Juncus</i> sp.)
LEMN	Duckweed (<i>Lemna minor</i>)
LOTU	Birdsfoot trefoil (<i>Lotus corniculatus</i>)
LUDW	False loosestrife (<i>Ludwigia palustris</i>)
LYSI	Skunk cabbage (<i>Lysichiton americanum</i>)
MENT	Mint (<i>Mentha</i> sp.)
MYRI	Water milfoil (<i>Myriophyllum</i> sp.)
NONE	No aquatic vegetation
NUPH	Yellow water lily (<i>Nuphar</i> sp.)
NYMP	White water lily (<i>Nymphaea</i> sp.)
OENA	Water celery (<i>Oenanthe</i> sp.)
POLY	Smartweed (<i>Polygonum</i> sp.)
POTA	Pondweed (<i>Potamogeton</i> sp.)
RANU	Buttercup (<i>Ranunculus</i> sp.)
RUBU	Blackberry (<i>Rubus</i> sp.)
SALI	Willow (<i>Salix</i> sp.)
SAGI	Arrowhead or wapato (<i>Sagittaria latifolia</i>)
SCIR	Bullrush (<i>Scirpus</i> sp.)
SCOT	Scot's broom (<i>Cytisus scoparius</i>)
SOLA	Nightshade (<i>Solanum</i> sp.)
SPAR	Burr reed (<i>Sparganium</i> sp.)
TYPH	Cattail (<i>Typha</i> sp.)
ULTR	Bladderwort (<i>Utricularia</i> sp.)
VALI	Tapegrass (<i>Vallisneria</i> sp.)
VERO	Speedwell (<i>Veronica</i> sp.)

³ Salmonid codes: CO= coho salmon *Oncorhynchus kisutch*, CH= chinook salmon *O. tshawytscha*; CT= cutthroat trout *O. clarki*; RB= rainbow trout *O. mykiss*, TF= unknown trout fry .

⁴ Centrarchid codes: BG= bluegill *Lepomis macrochirus*; C= crappie *Pomoxis* spp., LB= largemouth bass *Micropterus salmoides*; SB= smallmouth bass *M. dolomieu*, PK= pumpkinseed *L. gibbosus*, and WM= warmouth *Chaenobryttus gulosus*.

Oregon Chub Sampling Summary

SITE NAME	FINLEY NWR DISPLAY POND	MAP CODE	FIN16L
BASIN	MID-WILLAMETTE RIVER	SAMPLE DATE	5/14/2004
SUBBASIN	MARYS RIVER	LOCATION (T-R-S)	T13S-R5W-30SE
USGS TOPO MAP	GREENBERRY	GIS ID #	1098
ACCESS	HIGHWAY 99W		

Habitat Characteristics:

SURFACE AREA (m2)	6400	WATER TEMPERATURE (C)	16
AVERAGE DEPTH (m)	1.5	PERCENT SILT AND ORGANICS	100
COMMENTS:	POPULATION ESTIMATE- REINTROD. SITE		

AQUATIC VEGETATION:

SUBMERGENT	30
EMERGENT	45
FLOATING	
ALGAE	
TOTAL	75

AQUATIC VEGETATION (GENERA):

MYRI	20
ELEO	20
POTA	10
GRAM	10
TYPH	10
SPAR	5

BEAVER ACTIVITY: YES

COMMENT: POPULATION ESTIMATE- REINTROD. SITE

Amphibians and Reptiles:

W. POND TURTLES (#)

RED-LEGGED FROGS (E=eggs, T=tadpoles, J=juveniles, A=adults)

BULLFROGS TA

SALAMANDERS RSN (RSN= roughskin newt, NWS=northwest salamander)

Native Fish Species Present:

OREGON CHUB **72**

LARGESCALE SUCKERS

COTTIDS

SANDROLLER

SPECKLED DACE

THREE SPINE STICKLEBACKS

REDSIDE SHINERS

SALMONIDS

N. PIKEMINNOW

LAMPREY

Non-native Fish Species Present:

W. MOSQUITOFISH

BULLHEADS

CENTRARCHIDS

COMMON CARP

Other:

Oregon Chub Sampling Summary

SITE NAME	FINLEY NWR BEAVER POND	MAP CODE	FIN1H
BASIN	MID-WILLAMETTE RIVER	SAMPLE DATE	5/12/2004
SUBBASIN	MARYS RIVER	LOCATION (T-R-S)	T13S-R5W-32NW
USGS TOPO MAP	GREENBERRY	GIS ID #	1099
ACCESS	HIGHWAY 99- FINLEY REFUGE		

Habitat Characteristics:

SURFACE AREA (m2)	31559	WATER TEMPERATURE (C)	16
AVERAGE DEPTH (m)	1.2	PERCENT SILT AND ORGANICS	100

COMMENTS: POTENTIAL INTRODUCTION SITE

AQUATIC VEGETATION:

SUBMERGENT	10
EMERGENT	70
FLOATING	0
ALGAE	5
TOTAL	85

AQUATIC VEGETATION (GENERA):

ELEO	50
POTA	10
GRAM	20
FILA	5

BEAVER ACTIVITY: NO

COMMENT: POTENTIAL INTRODUCTION SITE

Amphibians and Reptiles:

W. POND TURTLES (#)

RED-LEGGED FROGS (E=eggs, T=tadpoles, J=juveniles, A=adults)

BULLFROGS TA

SALAMANDERS RSN (RSN= roughskin newt, NWS=northwest salamander)

Native Fish Species Present:

OREGON CHUB

LARGESCALE SUCKERS

COTTIDS

SANDROLLER

SPECKLED DACE 1

THREESPINE STICKLEBACKS

REDSIDE SHINERS

SALMONIDS

N. PIKEMINNOW

LAMPREY

Non-native Fish Species Present:

W. MOSQUITOFISH

BULLHEADS

CENTRARCHIDS

COMMON CARP

Other:

Oregon Chub Sampling Summary

SITE NAME	FINLEY NWR BEAVER POND	MAP CODE	FIN11*
BASIN	MID-WILLAMETTE RIVER	SAMPLE DATE	9/30/2004
SUBBASIN	MARYS RIVER	LOCATION (T-R-S)	T13S-R5W-32NW
USGS TOPO MAP	GREENBERRY	GIS ID #	1147
ACCESS	HIGHWAY 99- FINLEY REFUGE		

Habitat Characteristics:

SURFACE AREA (m2)	4514	WATER TEMPERATURE (C)	16
AVERAGE DEPTH (m)	0.5	PERCENT SILT AND ORGANICS	100

COMMENTS: POTENTIAL INTRODUCTION SITE

AQUATIC VEGETATION:

SUBMERGENT	57
EMERGENT	38
FLOATING	0
ALGAE	0
TOTAL	95

AQUATIC VEGETATION (GENERA):

ELEO	3
POTA	50
GRAM	5
CALI	5
SPAR	25
POLY	2
JUNC	5

BEAVER ACTIVITY: NO

COMMENT: POTENTIAL INTRODUCTION SITE

Amphibians and Reptiles:

W. POND TURTLES (#)

RED-LEGGED FROGS (E=eggs, T=tadpoles, J=juveniles, A=adults)

BULLFROGS TA

SALAMANDERS RSN NWS (RSN= roughskin newt, NWS=northwest salamander)

Native Fish Species Present:

OREGON CHUB	LARGESCALE SUCKERS
COTTIDS	SANDROLLER
SPECKLED DACE 1	THREESPINE STICKLEBACKS 381
REDSIDE SHINERS 2	SALMONIDS
N. PIKEMINNOW	LAMPREY

Non-native Fish Species Present:

W. MOSQUITOFISH	BULLHEADS
CENTRARCHIDS	COMMON CARP

Other:

Oregon Chub Sampling Summary

SITE NAME	FINLEY NWR BROWN CK NORTH PON	MAP CODE	FIN25A*
BASIN	MID-WILLAMETTE RIVER	SAMPLE DATE	9/30/2004
SUBBASIN	MARYS RIVER	LOCATION (T-R-S)	T13S-R5W-20NE
USGS TOPO MAP	GREENBERRY	GIS ID #	1182
ACCESS	HIGHWAY 99 FINLEY REFUGE		

Habitat Characteristics:

SURFACE AREA (m2)	2000	WATER TEMPERATURE (C)	18
AVERAGE DEPTH (m)	0.5	PERCENT SILT AND ORGANICS	100
COMMENTS:	POTENTIAL REINTRODUCTION SITE		

AQUATIC VEGETATION:

SUBMERGENT	10
EMERGENT	20
FLOATING	10
ALGAE	<u>10</u>
TOTAL	40

AQUATIC VEGETATION (GENERA):

CALI	10
ELEO	10
GRAM	10
FILA	10

BEAVER ACTIVITY: NO

COMMENT: POTENTIAL REINTRODUCTION SITE

Amphibians and Reptiles:

W. POND TURTLES (#)

RED-LEGGED FROGS (E=eggs, T=tadpoles, J=juveniles, A=adults)

BULLFROGS

SALAMANDERS (RSN= roughskin newt, NWS=northwest salamander)

Native Fish Species Present:

OREGON CHUB

LARGESCALE SUCKERS

COTTIDS

SANDROLLER

SPECKLED DACE

THREESPINE STICKLEBACKS

REDSIDE SHINERS

SALMONIDS

N. PIKEMINNOW

LAMPREY

Non-native Fish Species Present:

W. MOSQUITOFISH

BULLHEADS

CENTRARCHIDS

COMMON CARP

Other: NO FISH

Oregon Chub Sampling Summary

SITE NAME	FINLEY NWR BROWN CK SOUTH POND	MAP CODE	FIN26A*
BASIN	MID-WILLAMETTE RIVER	SAMPLE DATE	9/30/2004
SUBBASIN	MARYS RIVER	LOCATION (T-R-S)	T13S-R5W-20NE
USGS TOPO MAP	GREENBERRY	GIS ID #	1183
ACCESS	HIGHWAY 99 FINLEY REFUGE		

Habitat Characteristics:

SURFACE AREA (m2)	500	WATER TEMPERATURE (C)	18
AVERAGE DEPTH (m)	0.1	PERCENT SILT AND ORGANICS	100

COMMENTS: POTENTIAL REINTRODUCTION SITE

AQUATIC VEGETATION:

SUBMERGENT	0
EMERGENT	16
FLOATING	0
ALGAE	<u>20</u>
TOTAL	36

AQUATIC VEGETATION (GENERA):

JUNC	5
GRAM	10
FILA	20
ELEO	1

BEAVER ACTIVITY: NO

COMMENT: POTENTIAL REINTRODUCTION SITE

Amphibians and Reptiles:

W. POND TURTLES (#)

RED-LEGGED FROGS (E=eggs, T=tadpoles, J=juveniles, A=adults)

BULLFROGS

SALAMANDERS RSN (RSN= roughskin newt, NWS=northwest salamander)

Native Fish Species Present:

OREGON CHUB

LARGESCALE SUCKERS

COTTIDS

SANDROLLER

SPECKLED DACE

THREE SPINE STICKLEBACKS

REDSIDE SHINERS

SALMONIDS

N. PIKEMINNOW

LAMPREY

Non-native Fish Species Present:

W. MOSQUITOFISH

BULLHEADS

CENTRARCHIDS

COMMON CARP

Other: NO FISH

Oregon Chub Sampling Summary

SITE NAME	FINLEY NWR CHEADLE POND	MAP CODE	FIN27C
BASIN	MID-WILLAMETTE RIVER	SAMPLE DATE	5/12/2004
SUBBASIN	MARYS RIVER	LOCATION (T-R-S)	T14S-R5W-5NE
USGS TOPO MAP	GREENBERRY	GIS ID #	1101
ACCESS	HIGHWAY 99W- FINLEY REFUGE		

Habitat Characteristics:

SURFACE AREA (m2)	8142	WATER TEMPERATURE (C)	18.5
AVERAGE DEPTH (m)	1.5	PERCENT SILT AND ORGANICS	100
COMMENTS:	50 FISH INTRODUCED IN 2002		

AQUATIC VEGETATION:

SUBMERGENT	15
EMERGENT	71
FLOATING	
ALGAE	
TOTAL	86

AQUATIC VEGETATION (GENERA):

CARE	5
GRAM	20
TYPH	25
ELOD	10
ELEO	20
ALIS	1
CALI	5

BEAVER ACTIVITY: YES

COMMENT: 50 FISH INTRODUCED IN 2002

Amphibians and Reptiles:

W. POND TURTLES (#)

RED-LEGGED FROGS (E=eggs, T=tadpoles, J=juveniles, A=adults)

BULLFROGS TA

SALAMANDERS RSN (RSN= roughskin newt, NWS=northwest salamander)

Native Fish Species Present:

OREGON CHUB **217**

COTTIDS

SPECKLED DACE

REDSIDE SHINERS

N. PIKEMINNOW

LARGESCALE SUCKERS

SANDROLLER

THREESPINE STICKLEBACKS

SALMONIDS

LAMPREY

Non-native Fish Species Present:

W. MOSQUITOFISH

CENTRARCHIDS

BULLHEADS

COMMON CARP

Other:

Oregon Chub Sampling Summary

SITE NAME	FINLEY FIELD 22 LOWER POND	MAP CODE	FIN28
BASIN	MID-WILLAMETTE RIVER	SAMPLE DATE	5/12/2004
SUBBASIN	MARYS RIVER	LOCATION (T-R-S)	T13S-R5W-29NW
USGS TOPO MAP	GREENBERRY	GIS ID #	1100
ACCESS	HIGHWAY 99- FINLEY REFUGE		

Habitat Characteristics:

SURFACE AREA (m2)	14222	WATER TEMPERATURE (C)	17
AVERAGE DEPTH (m)	0.8	PERCENT SILT AND ORGANICS	100

COMMENTS: POTENTIAL INTRODUCTION SITE

AQUATIC VEGETATION:

SUBMERGENT	3
EMERGENT	24
FLOATING	
ALGAE	
TOTAL	27

AQUATIC VEGETATION (GENERA):

ELEO	15
POTA	2
CARE	2
SPAR	4
MENT	1
GRAM	1
CALI	2

BEAVER ACTIVITY: NO

COMMENT: POTENTIAL INTRODUCTION SITE

Amphibians and Reptiles:

W. POND TURTLES (#)

RED-LEGGED FROGS (E=eggs, T=tadpoles, J=juveniles, A=adults)

BULLFROGS T

SALAMANDERS RSN (RSN= roughskin newt, NWS=northwest salamander)

Native Fish Species Present:

OREGON CHUB

LARGESCALE SUCKERS

COTTIDS

SANDROLLER

SPECKLED DACE

THREESPINE STICKLEBACKS

REDSIDE SHINERS

SALMONIDS

N. PIKEMINNOW

LAMPREY

Non-native Fish Species Present:

W. MOSQUITOFISH

BULLHEADS

CENTRARCHIDS

COMMON CARP

Other: NO FISH

Oregon Chub Sampling Summary

SITE NAME	FINLEY NWR- GRAY CREEK SWAMP	MAP CODE	FIN4K
BASIN	MID-WILLAMETTE RIVER	SAMPLE DATE	5/14/2004
SUBBASIN	MARYS RIVER	LOCATION (T-R-S)	T13S-R5W-31
USGS TOPO MAP	GREENBERRY	GIS ID #	1097
ACCESS	HIGHWAY 99W		

Habitat Characteristics:

SURFACE AREA (m2)	22872	WATER TEMPERATURE (C)	14
AVERAGE DEPTH (m)	1	PERCENT SILT AND ORGANICS	100

COMMENTS: POPULATION ESTIMATE

AQUATIC VEGETATION:

SUBMERGENT	35
EMERGENT	65
FLOATING	
ALGAE	
TOTAL	100

AQUATIC VEGETATION (GENERA):

POTA	55
JUNC	5
CARE	5
TYPH	5
GRAM	15
SPAR	5
SALI	10

BEAVER ACTIVITY: YES

COMMENT: POPULATION ESTIMATE

Amphibians and Reptiles:

W. POND TURTLES (#)

RED-LEGGED FROGS (E=eggs, T=tadpoles, J=juveniles, A=adults)

BULLFROGS TA

SALAMANDERS NWS RSN (RSN= roughskin newt, NWS=northwest salamander)

Native Fish Species Present:

OREGON CHUB	523	LARGESCALE SUCKERS	
COTTIDS	6	SANDROLLER	
SPECKLED DACE	1016	THREESPINE STICKLEBACKS	169
REDSIDE SHINERS	1117	SALMONIDS CT	1
N. PIKEMINNOW		LAMPREY	

Non-native Fish Species Present:

W. MOSQUITOFISH		BULLHEADS	
CENTRARCHIDS	1 BG	COMMON CARP	

Other:

Appendix Table B-1. Water quality measurements from Gray Creek, Finley National Wildlife Refuge. Site 1 is a beaver pond where the staff gauge was located. Site 2 is a small beaver pond located ~400 meters upstream of site 1. Site 3 is in the creek channel ~800 meters upstream of site 2. Dissolved oxygen (DO) is shown in milligrams per liter.

Date		Site 1	Site 2	Site 3	weather/staff
9-23-99	temp pH DO		12.2 - 13.5 7.1 2.3 - 4.5		sunny
10-13-99	temp pH DO	14.4 6.9 2.3	13.8 7.1 2.6	15.8 7.2 5.6	staff=1.35' sunny
10-27-99	temp pH DO	9.0 7.7 4.0	8.1 7.8 2.9	8.0 8.1 6.3	staff=1.45' rainy
11-10-99	temp pH DO	10.9 7.1 5.2	10.9 7.8 6.6	10.9 8.1 7.4	staff=2.60' rainy
11-24-99	temp pH DO	9.4 7.1 5.5	9.3 7.5 6.4	9.4 7.6 6.3	staff=2.70' rainy
12-9-99	temp pH DO	10.0 7.3 6.8	10.1 7.4 6.2	10.1 7.3 5.9	staff=2.80' rainy
12-24-99	temp pH DO	7.3 7.3 6.2	7.1 7.5 6.6	7.2 7.4 6.5	staff=2.75' cloudy
1-4-00	temp pH DO	8.5 6.9 6.8	8.5 7.1 6.7	8.5 7.2 6.8	staff=2.80' rainy
1-21-00	temp pH DO	8.7 7.3 6.6	8.6 7.1 7.1	8.7 7.8 7.6	staff=2.80' rainy
2-2-00	temp pH DO	9.3 7.1 6.4	9.2 7.3 7.3	9.1 7.2 6.3	staff=2.80' clear
2-19-00	temp pH DO	8.0 7.4 7.2	8.0 7.5 6.9	8.3 7.3 6.7	staff=2.75' rainy
3-2-00	temp pH DO	10.3 6.6 6.6	10.2 7.2 6.8	10.1 6.9 6.3	staff=2.75'
3-17-00	temp pH DO	8.4 7.1 5.6	8.5 7.4 6.4	9.4 7.4 5.9	staff=2.70' rainy
4-1-00	temp pH DO	15.1 6.5 5.6	13.0 6.9 7.2	11.2 6.5 6.8	staff=2.70' sunny

Appendix Table B-1. (continued).

Date		Site 1	Site 2	Site 3	weather/staff
4-14-00	temp	13.4	11.4	11.9	staff=2.75' clear
	pH	6.6	7.4	7.5	
	DO	5.1	5.7	6.4	
4-28-00	temp	11.9	12.1	12.1	staff=2.75' showers
	pH	7.0	7.1	7.3	
	DO	5.0	7.2	6.8	
5-11-00	temp	8.9	8.8	8.9	staff=2.80' showers
	pH	6.4	7.3	6.8	
	DO	5.9	6.8	6.3	
5-22-00	temp	16.5	16.3	16.3	staff=2.80' sunny
	pH	7.4	7.4	7.2	
	DO	3.2	3.8	4.2	
6-8-00	temp	15.1	14.9	13.6	staff=2.85' showers
	pH	7.0	7.2	7.0	
	DO	2.7	4.0	5.9	
6-22-00	temp	19.3	19.6	18.2	staff=2.80' sunny & warm
	pH	7.3	7.5	7.4	
	DO	3.5	5.4	6.3	
7-9-00	temp	22.5	22.5	18.2	staff=2.70' cloudy, rain prior
	pH	7.2	7.2	7.2	
	DO	3.0	5.6	5.9	
7-25-00	temp	22.4	20.4	17.3	staff=2.55' sunny, dry, warm
	pH	7.3	7.4	7.4	
	DO	3.2	4.6	4.7	
8-7-00	temp	25.7	24.3	19.8	staff=2.50' sunny, dry, warm orange at site #2
	pH	7.1	7.1	7.4	
	DO	3.2	3.0	4.2	
8-24-00	temp	23.5	21.9	18.4	staff=2.10' sunny, warm orange at site #1
	pH	6.7	7.1	7.3	
	DO	3.6	3.8	5.0	
9-7-00	temp	19.8	17.5	16.1	staff=2.30' sunny, (rain week before) orange at sites #1 and #2
	pH	7.4	7.3	7.1	
	DO	2.0	2.1	1.9	
9-20-00	temp	23.2	20.3	18.1	staff= 2.00' partly cloudy orange at sites #1 and #2
	pH	7.5	7.7	7.8	
	DO	-	4.5	4.9	
10-11-00	temp	13.8	14.1	12.7	staff=2.70' cloudy, light rain no orange color
	pH	8.0	8.1	8.1	
	DO	5.0	7.4	7.9	

Appendix Table B-2. Hourly temperature and dissolved oxygen measurements at Gray Creek, Finley National Wildlife Refuge, on August 23-24, 2000 and September 20-21, 2000.

Date: August 23-24, 2000				Date: September 20-21, 2000			
Time	Temperature (C)	Dissolved Oxygen		Time	Temperature (C)	Dissolved Oxygen	
		% saturation	mg/l			% saturation	mg/l
3:00 PM	21.4	44.1	3.9				
4:00 PM	22.8	34.3	2.9				
5:00 PM	23.5	40.7	3.4				
6:00 PM	23.3	49.9	4.2	6:00 PM	18.9	67	6.2
7:00 PM	22.9	52.6	4.5	7:00 PM	19.0	61	5.5
8:00 PM	22.2	47.3	4.1	8:00 PM	19.0	55	5.0
9:00 PM	21.3	50.2	4.4	9:00 PM	18.7	49	4.5
10:00 PM	20.5	43.8	3.9	10:00 PM	18.6	45	4.1
12:00 PM	19.9	36.9	3.3	12:00 PM	18.4	41	3.8
12:00 AM	19.4	35.0	3.2	12:00 AM	18.2	38	3.6
1:00 AM	19.0	30.6	2.8	1:00 AM	17.9	35	3.3
2:00 AM	18.6	29.5	2.7	2:00 AM	17.6	32	3.0
3:00 AM	18.2	27.1	2.5	3:00 AM	17.4	29	2.8
4:00 AM	17.9	27.4	2.6	4:00 AM	17.2	26	2.5
5:00 AM	17.6	28.5	2.7	5:00 AM	17.0	23	2.2
6:00 AM	17.4	26.9	2.6	6:00 AM	16.8	20	1.9
7:00 AM	17.3	28.3	2.7	7:00 AM	16.7	22	2.2
8:00 AM	17.2	27.5	2.6	8:00 AM	16.7	25	2.4
9:00 AM	17.1	26.4	2.5	9:00 AM	16.6	30	2.9
10:00 AM	17.1	26.4	2.5	10:00 AM	16.6	31	3.0
11:00 AM	17.4	27.3	2.6	11:00 AM	16.6	34	3.3
12:00 PM	17.8	33.3	3.1	12:00 PM	16.7	38	3.7
1:00 PM	18.7	38.5	3.6	1:00 PM	16.8	40	3.9
2:00 PM	19.8	43.6	3.9	2:00 PM	17.0	44	4.2
3:00 PM	20.6	45.0	4.0	3:00 PM	17.3	49	4.7
4:00 PM	21.2	44.5	3.9	4:00 PM	17.6	57	5.5
				5:00 PM	17.8	63	6.1