ANNUAL PROGRESS REPORT

FISH RESEARCH PROJECT
OREGON

Willamette Valley Projects- Lookout Point- Oregon Chub (2007)

Contract Number: ACOE Task Order FW2007-01 (FY07)

Project Period: 1 October 2006- 30 September 2007

Prepared by: Paul Scheerer and Steve Jacobs
Oregon Department of Fish and Wildlife
28655 Highway 34
Corvallis, Oregon

Mark Terwilliger
Department of Fisheries and Wildlife
Oregon State University
Corvallis, Oregon

This project was financed with funds administered by the U.S. Army Corps of Engineers.

CONTENTS

INTRODUCTION

The Oregon chub *Oregonichthys crameri,* endemic to the Willamette Valley of western Oregon, was listed as endangered in 1993 under the federal Endangered Species Act (Rhew 1993). This species was formerly distributed throughout the Willamette Valley (Markle et al. 1991) in off-channel habitats such as beaver ponds, oxbows, stable backwater sloughs, and flooded marshes. In the past 100 years, these habitats have been drastically reduced because of changes in seasonal flows resulting from the construction of dams throughout the basin, channelization, revetments, diking, and drainage of wetlands. This loss of habitat, combined with the introduction of non-native species to the Willamette Valley, has been implicated in the decline and the restricted distribution of Oregon chub (U.S. Fish and Wildlife Service 1998).

Oregon Department of Fish and Wildlife (ODFW) monitored the effects of water storage and flow management operations at Lookout Point Reservoir from 2000 through 2006 and found that changes in reservoir elevation directly affected water levels, water temperatures, and the availability and suitability of Oregon chub spawning habitat in Hospital Pond (Scheerer and McDonald 2000; 2001; 2003; Scheerer and Terwilliger 2002; 2003; 2004; Scheerer et al. 2005; 2006). Seasonal changes in reservoir and pond elevations were found to affect Oregon chub spawning success and juvenile survival. We found that the filling of the reservoir and flooding of the pond terrace in June and July were necessary to increase pond temperatures (>15^{o}C) that result in successful Oregon chub spawning (Scheerer and McDonald 2000).

In 2000, following the listing of Willamette spring chinook and winter steelhead under the federal Endangered Species Act (NOAA 1999), flow management in the Willamette River was modified. New minimum conservation flows at Albany and Salem were recommended and management of tributary flows was altered to balance the demand for water for recreation in the Willamette subbasins with flows at Albany and Salem (Mamoyac et al. 2000). Because Lookout Point has some of the lowest recreational use and the highest storage volume of the Willamette reservoirs, the demand to draft this reservoir to provide spring flows increased. Under the new management regime, Lookout Point Reservoir was not projected to fill, or if it filled it was not projected to remain full through the chub spawning season (June-July), in most years. In 2000, the U.S. Army Corps of Engineers (Corps) initiated a study to determine the feasibility of modifying Hospital Pond to provide managers the ability to independently regulate pond elevation and contracted with ODFW to collect life history and population data to assess the effects of these modifications on Oregon chub abundance and recruitment (Scheerer and McDonald 2001; Scheerer and Terwilliger 2002; 2003; 2004; Scheerer et al. 2005; 2006).

Pond modifications were made in 2001-2003. In the spring of 2001, the Corps installed a gate on the culvert exiting Hospital Pond. In the spring of 2002, the Corps sealed the western end of the pond with bentonite clay and reconstructed the gate on the culvert. Unfortunately, these modifications did not allow us to maintain the pond elevation above the elevation of the vegetated terrace (921 ft.) except when the reservoir elevation exceeded 917 ft. In 2003, the Corps excavated a shallow alcove in the terrace to provide potential spawning habitat that was available for Oregon chub when pond elevations were less than 920 ft. In 2003-2005, we found that water temperatures in the alcove only exceeded 15^{o}C when the water depth in the alcove was less than 1.5 feet deep ($\leq$918.1 feet elevation). Otherwise the influx of cold spring water resulted in cooler temperatures in the alcove.

This report presents the results of investigations conducted in 2007 at Hospital Pond, including results of monitoring of air and water temperature profiles, monitoring of reservoir and pond level elevations, and the analysis of Oregon chub aging and hatch date data. These data

are provided to the Corps for use in planning near-term and long-range water storage and flow management to protect Oregon chub and their habitat in Hospital Pond. This report also contains results of monitoring of naturally occurring and reintroduced Oregon chub populations located on Corps properties in the Willamette Valley.

METHODS

Monitoring Pond and Reservoir Elevations

Staff gages were installed on the gate structure of the culvert and in the alcove. The staff gage in the culvert was pushed 0.6 meters into the substrate to match the readings on the gage mounted on the gate structure. Water elevations were recorded from April through November. The elevations of culvert and the bottom of the alcove are approximately 916.0 feet and 916.6 feet, respectively. Reservoir elevations were uploaded from the Corps data query website: http://www.nwd-wc.usace.army.mil/perl/dataquery.pl.

Temperature Monitoring

Temperature recorders (Hobo®) were placed at six locations in Hospital Pond (Figure 1). Site locations are described in Scheerer et al. 2006. Recorders were set to record at five hour intervals. The maximum temperature recorded each day was used to determine whether the threshold temperature of approximately 15^0C, necessary for Oregon chub to spawn, was exceeded (Scheerer and McDonald 2000).

Hatch Date Distribution

In mid-October 2007, young-of-the-year Oregon chub were scarce and despite multiple attempts we were only able to collect 5 juveniles from Hospital Pond to determine their hatch date distribution and to relate the onset and duration of spawning with pond temperatures (target sample was 50 juveniles). Otoliths (right lapilli) were removed and prepared, and daily increments were determined according to procedures described in Scheerer et al. 2006. Hatch dates were estimated by subtracting the number of daily increments from the collection date. Otoliths from juvenile fish were read three times by one reader. A final age was assigned that was the median of the three counts. Hatch dates were combined into one-week (7-day) categories.

Adult Aging

In April 2007, we collected a sample of 74 adult Oregon chub from Hospital Pond using baited minnow traps. The fish were collected to determine the age structure of the population. To reduce the probability of collecting a biased sample for aging, a total of 200 fish were measured during the marking phase of the mark-recapture estimate to determine the size distribution of chub in the pond. Total lengths were measured to the nearest millimeter and were separated into 5 mm categories. Then, based on this size distribution, we collected similar proportions from each 5 mm category for the aging sample. The fish were sacrificed and placed in 95% ethanol. Samples were taken back to the lab to be processed. Otoliths (right lapilli) were removed and prepared, and annuli were determined according to procedures

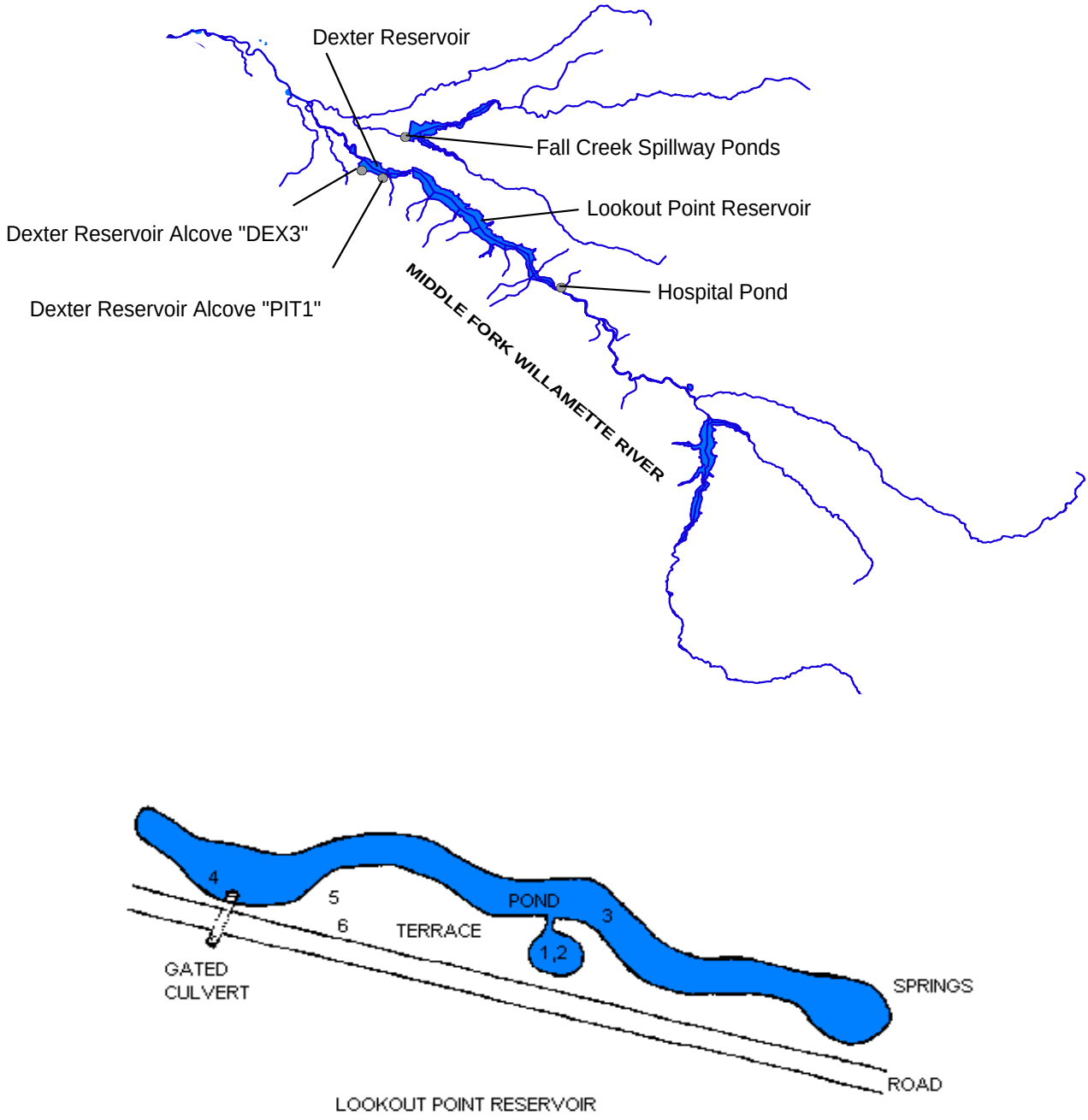

Figure 1. Map (top) showing the locations of Oregon chub sites located on Corps properties in the Middle Fork Willamette River drainage. Diagram of Hospital Pond (bottom) showing locations of temperature monitors placed in the alcove (1-surface, 2-substrate), the pond (3-surface, 4-substrate), the terrace (5-substrate), and in a tree located on the terrace (6-air temperature). The springs that feed the pond are located at the east end and the gated culvert is located at the west end. The terrace is located between the pond and the North Shore Road. Lookout Point Reservoir is located south of the road.

described in Scheerer et al. 2006. Adult otoliths were read twice by one reader. If there was a discrepancy, a third reading was made. In this sample, the difference between the first two reads never exceeded one year, and the third read matched one of the previous two. Therefore, the age determined in the majority of reads was assigned to the fish. Precision of age determinations was determined by an index of average percent error (Beamish and Fournier 1981).

Population Estimates

In 2007, we obtained population estimates for naturally occurring Oregon chub populations at Hospital Pond and the Dexter Reservoir alcoves and for introduced Oregon chub populations in the Fall Creek Spillway Ponds and Foster Pullout Pond based on methods described in Scheerer et al. 2007. Fish smaller than 40 mm in length (all age 0 and some age 1 as established by Scheerer and McDonald 2000) were not captured by the minnow traps and were not included in the estimates.

RESULTS

Pond and Reservoir Elevations

In 2007, Lookout Point reservoir did not fill. The maximum elevation of 913.4 ft was reached on May 6, 2007 (full pool elevation is 926 ft). Reservoir elevations during the typical chub spawning period (June-July) were less than 900 ft. We closed the gate on the pond's outflow culvert on 2 April and opened the gate on 30 November. The pond depth fluctuated between 2.5 and 3.8 feet (918.5 and 919.8 feet elevation) (Figure 2). The pond terrace did not flood. The alcove depth ranged from 1.9 to 3.2 feet.

Temperature Monitoring

Water temperatures in Hospital Pond varied substantially depending on the location of the temperature monitor (Figure 3). From April 2 through September 30, changes in water temperature measured near the surface of the pond (mean 16.9^{o}C; range 9.6-22.3^{o}C) and on the substrate in the alcove (mean 14.8^{o}C; range 10.6-18.3^{o}C) closely paralleled changes in air temperature (mean 18.7^{o}C; range 7.0-29.9^{o}C). Alcove temperatures peaked on June 1 (17.0^{o}C). Water temperatures were substantially cooler and remarkably constant on the bottom of the pond during this period (mean 10.9^{o}C; range 10.2-11.3^{o}C). Cold dense spring water enters the pond at the eastern end, flows through the pond, and exits the pond through the culvert at the southwestern end. A warmer surface stratum covers the cold stratum and extends ~0.1 m down from the surface.

Hatch Date Distribution

Despite substantial sampling effort (~10 hours), only 5 juvenile chub were collected in the fall of 2007, suggesting near complete recruitment failure. Approximate hatch dates, determined from the 5 juvenile chub (19-24 mm) extended from 6 July through 17 July. The 2007 hatch date distribution was narrow and within the range of past hatch date distributions observed at Hospital Pond (Figure 4).

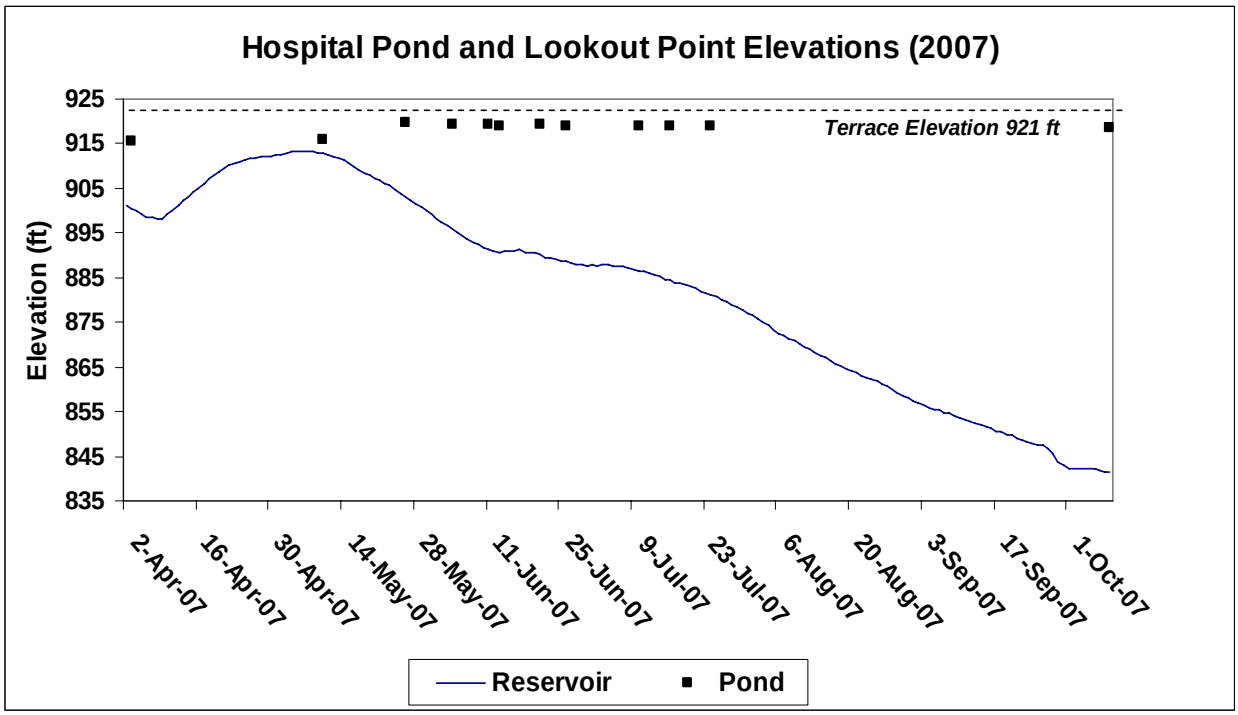

Figure 2. Water elevations recorded in Hospital Pond and Lookout Point Reservoir in 2007. The elevations of the alcove and the pond's culvert are 916.6 feet and 916 feet, respectively. The elevation of the pond terrace (921 feet) is represented by a dotted horizontal line.

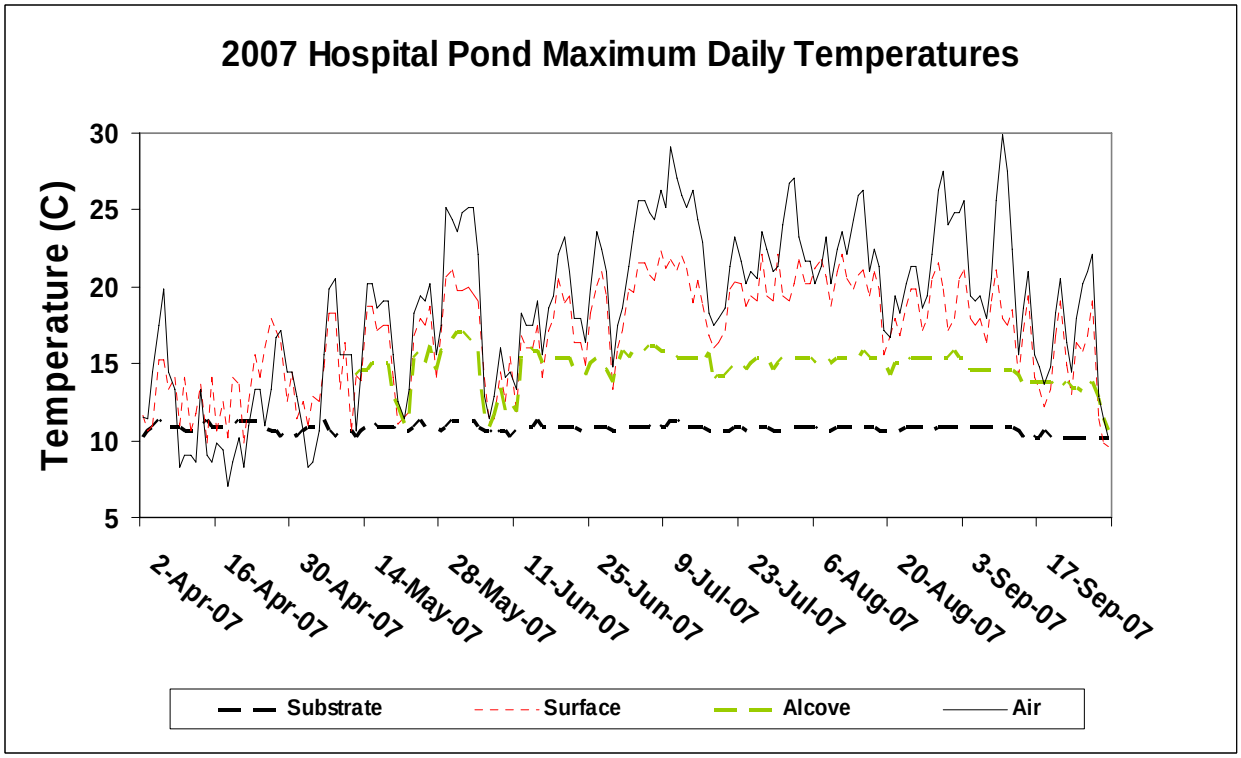

Figure 3. Maximum daily water and air temperatures recorded at Hospital Pond in 2007.

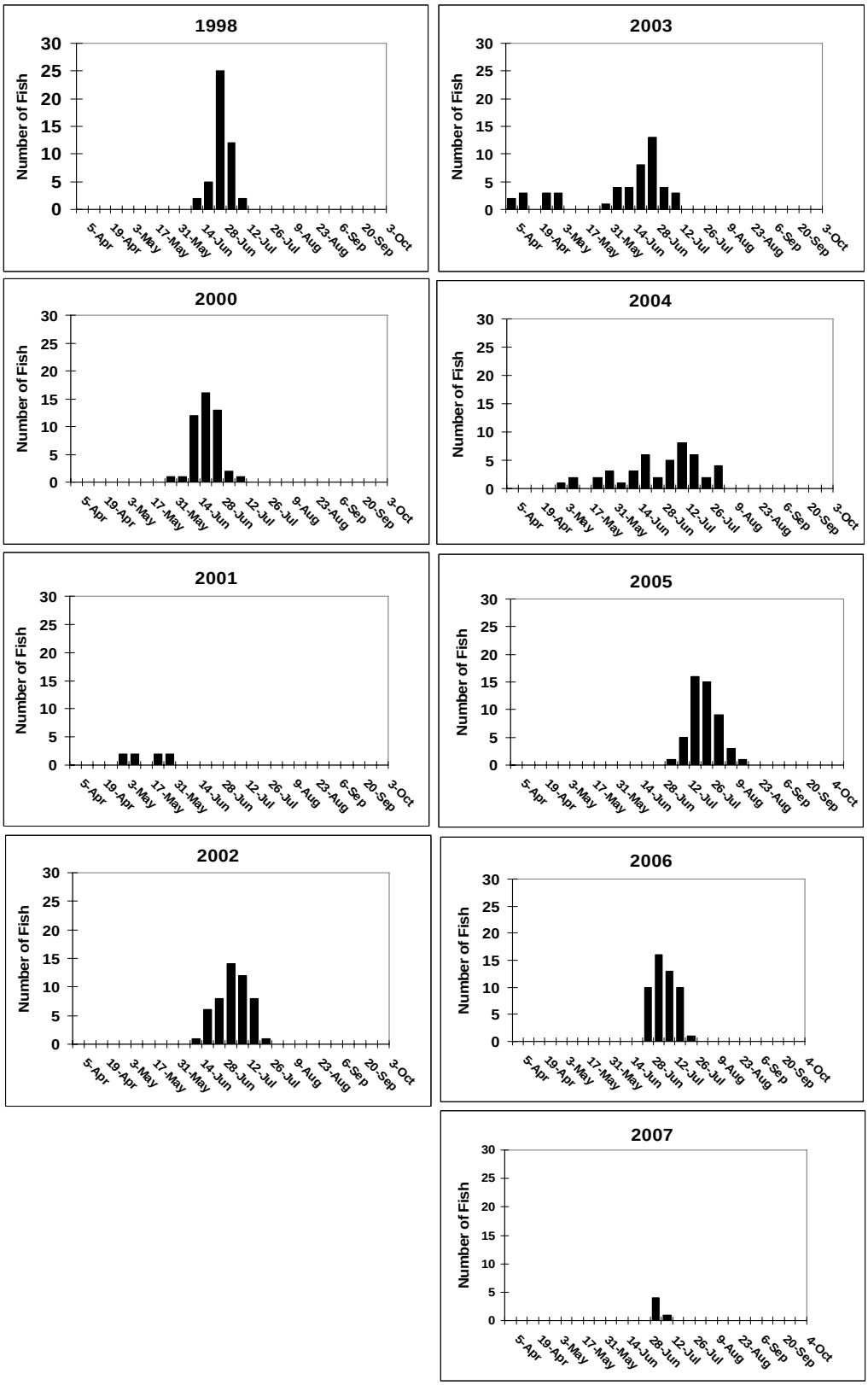

Figure 4. Oregon chub hatch date distributions at Hospital Pond in 1998 and 2000 to 2007.

Adult Age and Growth

In 2007, ages of adult Oregon chub in our sample ranged from 1 to 5 years (Figure 5). The fish collected for aging ranged in size from 38 to 76 mm (TL). There was evidence of recruitment from the 2004 and 2005 year-classes, which was not apparent in the 2004 and 2005 age distributions. Comparison of the mean length-at-age for fish collected in 2007 (ages 1-4) with those from past years shows that mean size has decreased steadily since 2001 (Table 1; Figure 6). Because fish smaller than ~40-45 mm are not completely vulnerable to our sampling gear, this may explain the presence of the 2004 and 2005 year classes in the 2007 sample and absence of these year-classes in the 2005-2006 samples. The sample collected in 2007 was representative of the population in the pond (Figure 7). In addition, the Oregon chub juveniles collected in 2007 for aging were not difficult to age and the average percent error among readings (3.4%) was typical and within the range of agreement of samples from previous years (M. Terwilliger, personal communication). It is possible that the infrequent filling of the reservoir since 2001, which resulted in cooler pond temperatures during the spring and summer months, caused reduced growth rates of Oregon chub in Hospital Pond.

Population Estimates

In 2007, there were five populations of Oregon chub located at sites on U.S. Army Corps of Engineers properties. Naturally occurring populations were found at Hospital Pond and in two Dexter Reservoir alcoves, located in the Middle Fork Willamette River drainage. Introduced populations were found in the Fall Creek Spillway Ponds in the Middle Fork Willamette drainage and in Foster Pullout Pond in the Santiam drainage (Figure 1). Population estimates for these locations are presented in Figure 8.

The 2007 population estimate for Hospital Pond was 1,520 adult chub (95% CI: 1,110-2,080). This population has declined several years in a row. This population has a declining 5-year abundance trend (Scheerer et al. 2007).

The 2007 estimate for the Dexter Reservoir alcove “The Pit” was 1,130 adult chub (95% CI: 960-1,340). This population has fluctuated substantially since 1992 and has an increasing 5-year trend (Scheerer et al. 2007). The 2006 estimate for the western alcove of Dexter Reservoir near the RV park was 4,020 adult chub (95% CI: 3,510-4,610). This population also has an increasing 5-year abundance trend. Nonnative fish have access to the Dexter Reservoir alcoves from Dexter Reservoir, however none were found in either alcove in 2007, which may explain the recent population increases at both locations.

In 1996, Oregon chub were introduced into the Fall Creek Spillway Ponds. In 2007, the chub population estimate was 2,740 adults (95% CI: 2,430-3,090). This population has a declining 5-year abundance trend (Scheerer et al. 2007). This decline is a result of the desiccation of the lower pond during the summers of 2006 and 2007.

Foster Pullout Pond is a spring-fed beaver pond located on the north shore of Foster Reservoir in the South Santiam River drainage. Oregon chub were introduced into this pond from Geren Island in the North Santiam drainage from 1999-2004. In 2007, the chub population estimate was 980 fish (95% CI: 860-1,120). This population has a stable 5-year abundance trend (Scheerer et al. 2007).

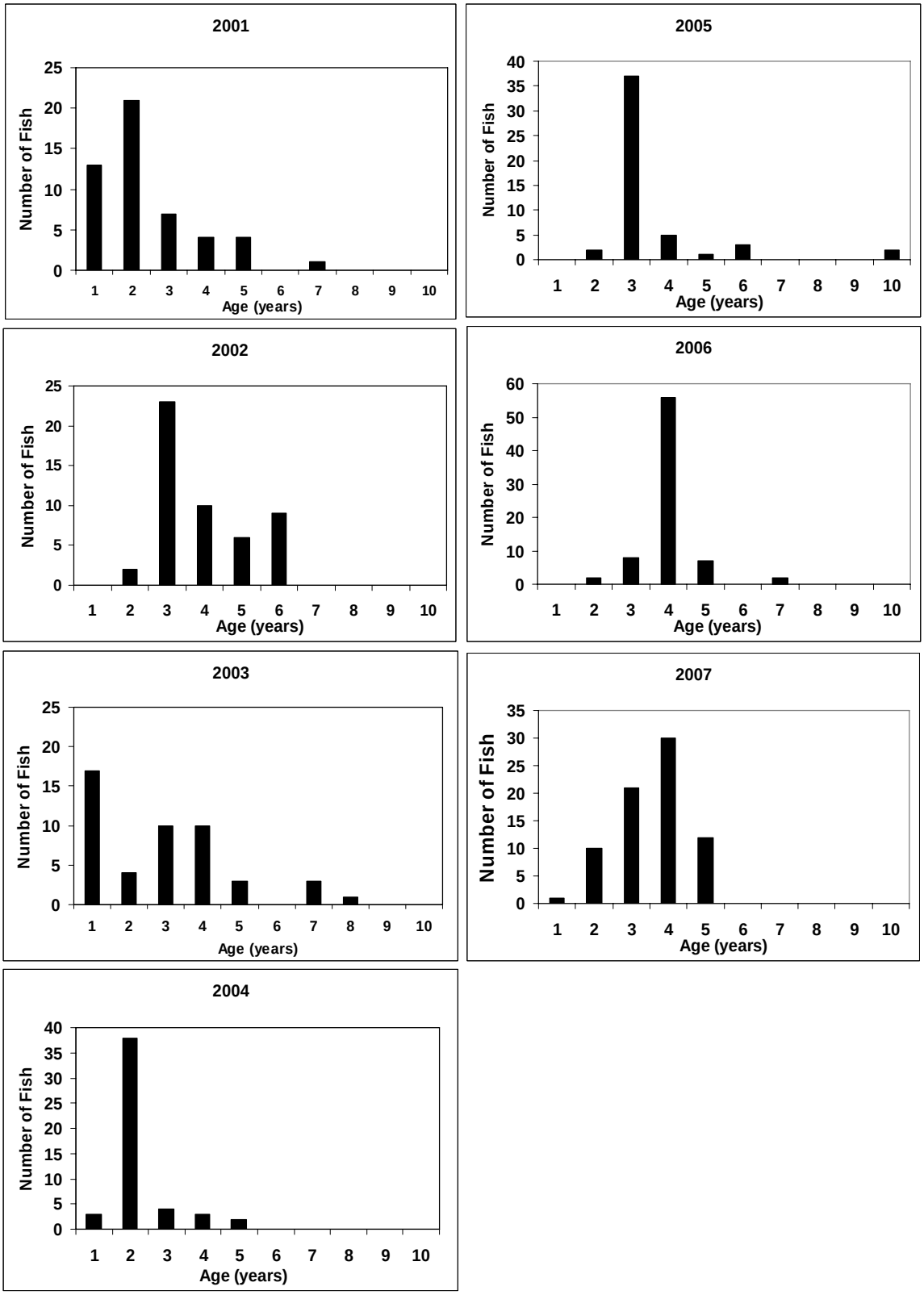

Figure 5. Age structure of the Oregon chub population in Hospital Pond from 2001-2007.

Table 1. Mean lengths at capture and ranges of lengths for Oregon chub from Hospital Pond in 2001 through 2007.

	Age (years)							
	1	2	3	4	5	6	7	8
2001								
Mean total length (mm)	55	63	65	72	72	-	85	-
Range of values	(52-59)	(56-68)	(60-69)	(71-74)	(65-78)	-	(85-85)	-
Number of fish	13	21	7	4	4	0	1	0
Percentage of sample	26	42	14	8	8	0	2	0
2002								
Mean total length (mm)	-	57	67	69	73	77	-	-
Range of values	-	(55-59)	(57-74)	(65-75)	(65-82)	(71-82)	-	-
Number of fish	0	2	23	10	6	9	0	0
Percentage of sample	0	4	46	20	12	18	0	0
2003								
Mean total length (mm)	43	48	62	69	73	-	74	79
Range of values	(39-48)	(42-52)	(58-66)	(64-72)	(69-78)	-	(70-79)	(79-79)
Number of fish	17	4	10	10	3	0	3	1
Percentage of sample	35	8	21	21	6	0	6	2
2004								
Mean total length (mm)	46	53	62	70	78	-	-	-
Range of values	(44-48)	(44-59)	(55-68)	(68-72)	(77-78)	-	-	-
Number of fish	3	39	4	3	2	0	0	0
Percentage of sample	6	78	8	6	4	0	0	0

Table 1 (continued).

	Age (years)							
	1	2	3	4	5	6	7	10
2005								
Mean total length (mm)	-	47	57	56	75	76		85
Range of values	-	(46-48)	(46-70)	(52-53)	(75-75)	(74-77)		(83-86)
Number of fish	0	2	37	5	1	3		2
Percentage of sample	0	4	74	10	2	6		4
2006								
Mean total length (mm)	-	49	61	63	65		76	
Range of values	-	(47-51)	(53-70)	(55-71)	(58-72)		(71-80)	
Number of fish	0	2	8	56	7		2	
Percentage of sample	0	3	11	75	9		3	
2007								
Mean total length (mm)	38	43	54	58	69			
Range of values	(38-38)	(42-45)	(47-59)	(50-62)	(64-76)			
Number of fish	1	10	21	30	12			
Percentage of sample	1	14	28	41	16			

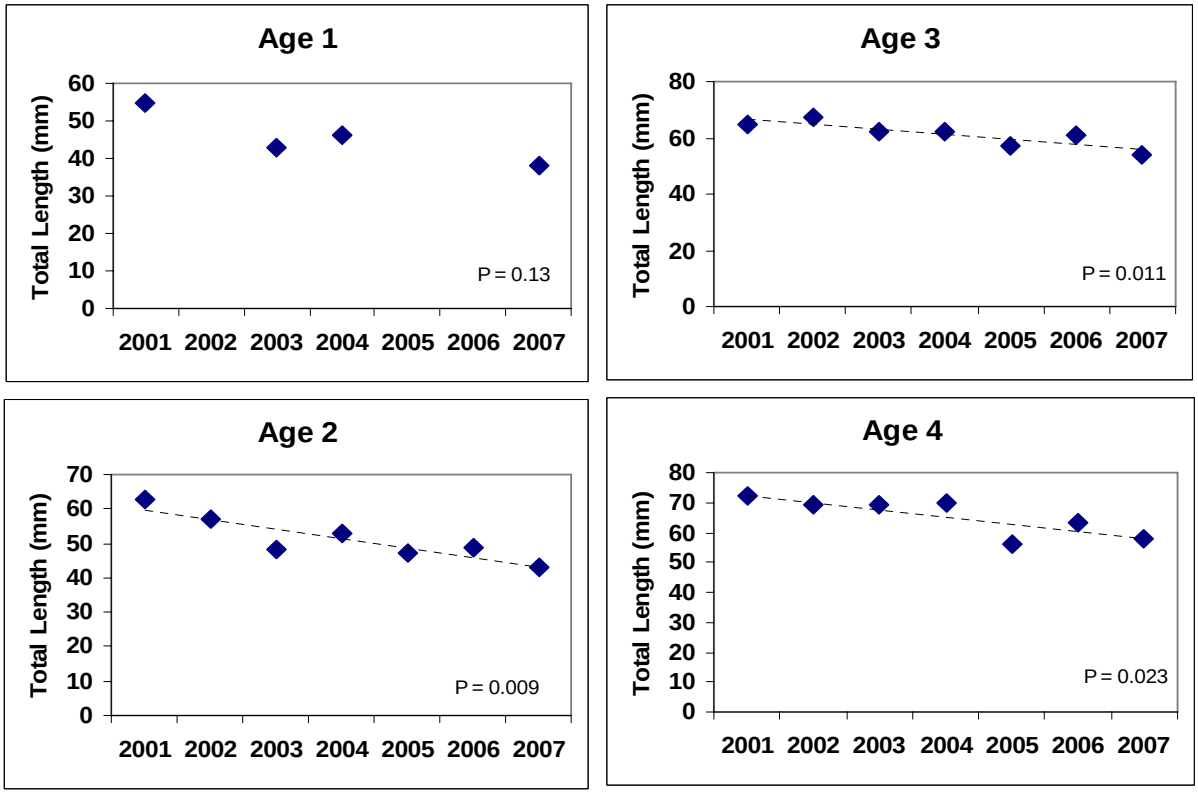

Figure 6. Changes in mean length-at-age for Oregon chub collected from Hospital Pond, 2001-2007. Fitted regression lines (dotted lines) are shown where significant slopes occur.

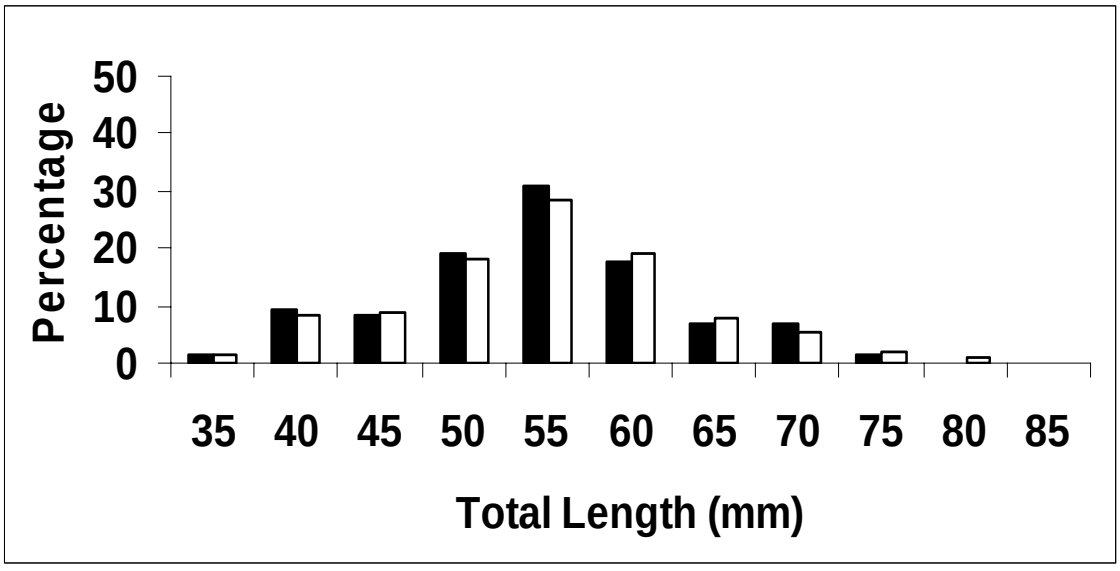

Figure 7. Comparison of length-frequency histograms of the 74 fish collected for aging (open bars) and the 200 fish measured (solid bars) in Hospital Pond, 2007.

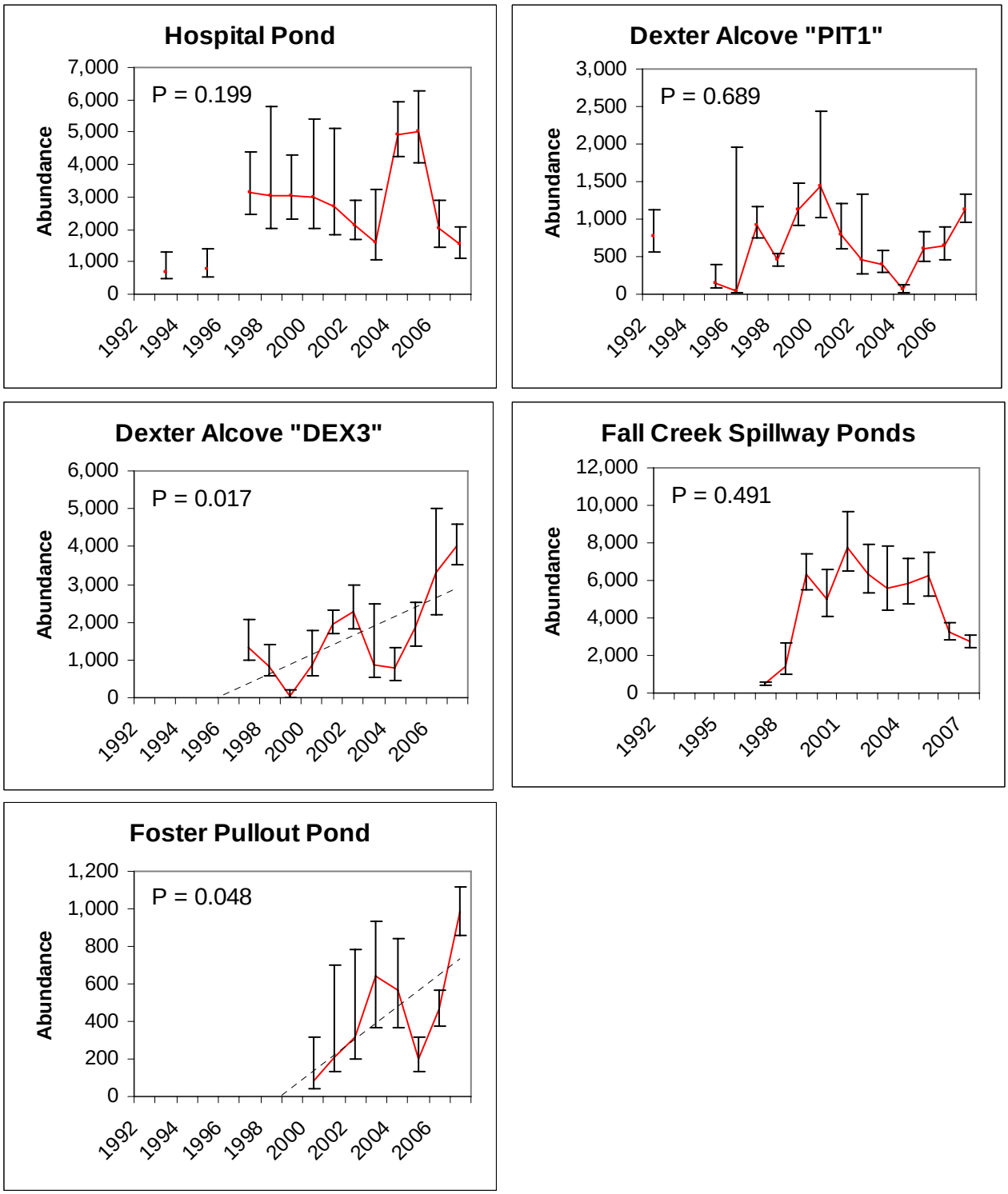

Figure 8. Abundance trends for Oregon chub populations located on Corps properties. Horizontal bars represent 95% confidence intervals for each estimate. Fitted regression lines (dotted lines) are shown where significant slopes occur.

DISCUSSION & RECOMMENDATIONS

Previous investigations established links between water elevations of Lookout Point Reservoir, water levels and water temperatures in Hospital Pond, and Oregon chub spawning and recruitment (Scheerer and McDonald 2001, Scheerer and Terwilliger 2002; 2003; 2004; Scheerer et al. 2005; 2006). In 2001-2003, ODFW and the Corps initiated habitat projects designed to provide managers the ability to regulate pond elevations independently of Lookout Point Reservoir elevations. It appears from recent data that none of these efforts has been successful in substantially increasing Oregon chub spawning success in Hospital Pond.

These modifications have allowed managers to raise water levels in Hospital Pond and flood the constructed alcove; however, there is little evidence that this has resulted in improved recruitment. Flooding of the alcove rarely created conditions where water temperatures were suitable for chub spawning to occur. Water temperatures in the alcove infrequently exceeded 15^{o}C, and these temperatures only occurred for brief periods when the pond elevation was between 916.6 and 918.0 feet (alcove depth <1.4 feet). Limited spawning may occur in the alcove at these times, but it appears to be insufficient to provide recruitment necessary to maintain a stable trend in population abundance.

Oregon chub population abundance in Hospital Pond peaked in 2004 and 2005 and was dominated by the 2002 year-class for many years. The population abundance has decreased steadily in recent years. Density dependent mechanisms, specifically competition for food and cover with the abundant 2002 year-class, may have limited recruitment for several years. In addition, cooler spring pond temperatures that occurred during years when the reservoir did not fill may have acted to slow egg maturation and/or limit food abundance, resulting in reduced survival of early life stages. Our data indicates that strong year-classes only occurred when the reservoir filled and flooded the pond terrace for a substantial period during the spring and summer months (Figure 9).

In 2005, the Lookout Point Reservoir filled within 2.5 feet of full pool (~923.5 ft). The pond terrace was flooded for approximately five weeks from mid-June through July and water temperatures on the terrace exceeded 15^{o}C during this period. Successful spawning was documented from mid-June to early-August 2005. Recent aging data indicates that these conditions resulted in successful recruitment.

We recommend that monitoring efforts continue at Hospital Pond. It is doubtful that current pond water level management is sufficient to produce adequate Oregon chub recruitment to maintain a stable trend in population abundance. It does not appear that the spawning alcove can provide much benefit to Oregon chub, unless water levels in the alcove are maintained at depths less than ~1.4 feet. Even under these conditions, it is uncertain whether the alcove is of sufficient size to provide adequate suitable spawning and rearing habitat. Installation of a self-regulating mechanism on the culvert gate to fine tune water level management in the pond, excavation to increase the area of the alcove, and/or the excavation of additional alcoves or low terraces may create conditions that will promote successful chub spawning in years when Lookout Point Reservoir does not fill. If the Hospital Pond chub population continues to decline and the suggested modifications are not implemented, or do not result in increased chub recruitment, then we recommend that Lookout Point Reservoir is filled, and remains full during the months of May-July every 2-3 years, to provide the recruitment needed to maintain a stable, abundant chub population in Hospital Pond.

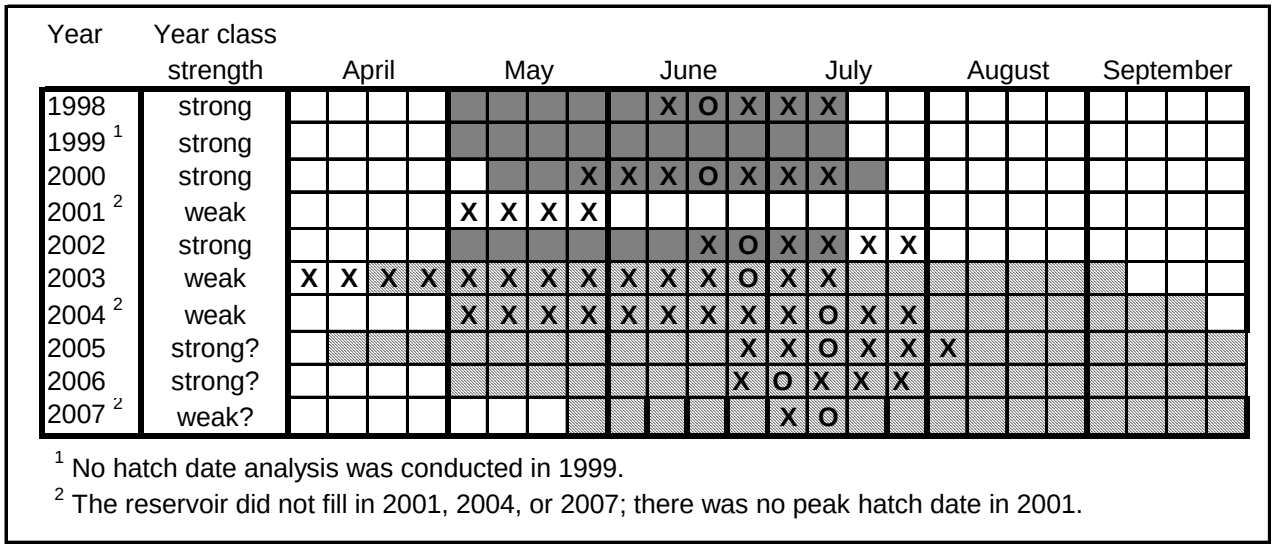

Figure 9. Relationships between year-class strength, time periods when reservoir levels exceeded 921 feet and the pond terrace was flooded (gray boxes), time periods when reservoir levels exceeded 916.6 feet and the pond alcove was flooded (hatched boxes), hatch date distributions (X's), and peak hatch dates (O's) at Hospital Pond, 1998-2007.

ACKNOWLEDGEMENTS

We acknowledge the assistance of Greg Taylor and Greg Gauthier of the U.S. Army Corps of Engineers and Peggy Kavanagh and Brian Bangs of Oregon Department of Fish and Wildlife.

REFERENCES

Beamish, R.J., and D.A. Fournier. 1981. A method for comparing the precision of a set of age determinations. Canadian Journal of Fisheries and Aquatic Sciences 38: 982-983.

Mamoyac, S., M. Buckman, and E. Tinus. 2000. Biological and technical justification for the Willamette River flow proposal of the Oregon Department of Fish and Wildlife. ODFW, Portland. 20 p.

Markle, D. F., T. N. Pearsons, and D. T. Bills. 1991. Natural history of *Oregonichthys* (Pisces: Cyprinidae), with a description of a new species from the Umpqua River of Oregon. Copeia 1991(2):277-293.

NOAA (National Oceanic and Atmospheric Administration). 1999. Endangered and threatened species: threatened status for two ESU's of steelhead in Oregon and Washington. Federal Register 64:14517-14528.

Rhew, R. 1993. Endangered and threatened wildlife and plants: determination of endangered status for the Oregon chub. Federal Register 58: 53800-53804.

Scheerer, P. D., G. D. Apke, and P. J. McDonald. 1998. 1998 Oregon chub research: Middle Fork Willamette and Santiam River drainages, Fish Research Project E96970022, Annual Progress Report, Corvallis. 53 p.

Scheerer, P. D., and P. J. McDonald. 2000. Oregon chub research (2000): Santiam and Middle Fork Willamette River drainages, Fish Research Project W66QKZ93345985, Annual Progress Report, Corvallis. 85 p.

Scheerer, P. D., and P. J. McDonald. 2001. Monitoring of Hospital Pond: Willamette Basin Oregon Chub Investigations, Monitoring, and Management, Fish Research Project W66QKZ93345985, Annual Progress Report, Corvallis. 9 p.

Scheerer, P. D., and M. Terwilliger. 2002. Monitoring of Hospital Pond (2001): Willamette Basin Oregon Chub Investigations, Monitoring, and Management, Fish Research Project W66QKZ10230433, Annual Progress Report, Corvallis. 20 p.

Scheerer, P. D., and M. Terwilliger. 2003. Monitoring of Hospital Pond (2002): Willamette Basin Oregon Chub Investigations, Monitoring, and Management, Fish Research Project W66QKZ13186771, Annual Progress Report, Corvallis. 19 p.

Scheerer, P. D., and P. J. McDonald. 2003. Age, growth, and timing of spawning of an endangered minnow, the Oregon chub (*Oregonichthys crameri*), in the Willamette basin, Oregon. Northwestern Naturalist 84:68-79.

Scheerer, P. D., and M. Terwilliger. 2004. Monitoring of Hospital Pond (2004): Willamette Basin Oregon Chub Investigations, Monitoring, and Management, Fish Research Project W66QKZ13304328, Annual Progress Report, Corvallis. 19 p.

Scheerer, P. D., M. Terwilliger, and S. E. Jacobs. 2005. Monitoring of Hospital Pond (2005): Willamette Basin Oregon Chub Investigations, Monitoring, and Management, Fish Research Project W66QKZ13304328, Annual Progress Report, Corvallis. 20 p.

Scheerer, P. D., M. Terwilliger, and S. E. Jacobs. 2006. Willamette Valley Projects- Lookout Point- Oregon Chub (2006), Fish Research Project FW2006-02, Annual Progress Report, Corvallis. 21 p.

Scheerer, P. D., P.S. Kavanagh, B. Bangs, and S. E. Jacobs. 2007. 2007 Oregon chub investigations. Oregon Department of Fish and Wildlife, Fish Research Project EF-07, Annual Progress Report, Salem.

U.S. Fish and Wildlife Service. (Brown, C., R. Rhew, A. Bentivoglio, and P. D. Scheerer). 1998. Oregon Chub (*Oregonichthys crameri*) Recovery Plan. Portland, Oregon. 69+ p.