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# Descaling and orifice passage efficiency studies at McNary Dam, 1995

**Estuarine Studies Division** 

Northwest Fisheries Science Center

**National Marine Fisheries Service**  by R. Lynn McComas, Benjamin P. Sandford, and Douglas B. Dey

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Seattle, Washington



### DESCALING AND ORIFICE PASSAGE EFFICIENCY STUDIES AT MCNARY DAM, 1995

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by

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and

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Report of Research

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## **OBJECTIVE 1: EVALUATE THE EFFECTS OF TWO ALTERNATIVE BEAM** EXTENSION DESIGNS (WITH NEWLY DESIGNED VERTICAL

EXECUTIVE SUMMARY

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#### **EXECUTIVE SUMMARY**

Extended-length submersible bar screens (ESBSs) have been tested at McNary Dam since

1991 as alternatives to standard-length submersible traveling screens (STSs) for guiding downstream

migrating juvenile salmonids out of turbine intakes. During the 1995 spring and summer

outmigration periods, the National Marine Fisheries Service conducted studies to evaluate the gatewell

orifice passage efficiency (OPE) for chinook salmon and steelhead using an ESBS with a newly

designed vertical barrier screen and an inlet flow vane. An auxiliary study compared juvenile fish descaling associated with two beam extension modifications in gatewells equipped with these new guidance devices.

Two methods were used to compare OPE between north and south orifices for each of the outmigration periods. First, orifice traps provided an absolute measure of the proportion of migrants passing through the test slot during a 22-hour period. Second, a mark/recapture method furnished an estimate of marked chinook salmon egress from the gatewell over 22 hours. Mean orifice passage efficiency was >70% (range: 43-100%) for all salmonids using either method. Mark/recapture OPE

estimates were significantly higher than orifice trap estimates for both yearling and subyearling chinook salmon.

There was no significant difference in OPE between north and south orifices for either yearling or subyearling chinook salmon using orifice traps, or for yearling chinook salmon using the mark/recapture method.

There was no significant difference in descaling for any species between gatewell and orifice

traps, or between beam extension types in ESBS test slots. Descaling in the gatewell of the STS

control slot (11.2% for yearling chinook salmon and 13.9% for steelhead) was significantly higher

than in either ESBS test slot for yearling chinook salmon (7.2 and 8.9%) and steelhead (9.1 and

9.3%). There were no statistical differences in descaling for subyearling chinook salmon among the

three test slots.

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#### INTRODUCTION

The National Marine Fisheries Service (NMFS) has been evaluating extended-length

screens for guiding juvenile salmonids (Oncorhynchus sp.) out of turbine intakes at McNary

Dam since 1991 (Brege et al. 1992;, McComas et al. 1993, 1994, 1995). Based on the

results of these studies, the extended-length submersible bar screen (ESBS), combined with a

newly designed vertical barrier screen (VBS), was chosen as the guidance system to replace

standard-length submersible traveling screens (STSs) and modified balanced-flow vertical

barrier screens (MBFVBSs).

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The two VBS systems evaluated as replacements for the MBFVBS have been

described in detail by McComas et al. (1995). Briefly, VBS1 uses a turning vane, or inlet

flow vane, to change the flow of water up into the gatewell which results in a reduction of

flow separation and turbulence in the gate slot. However, use of the inlet flow vane requires

lowering the guidance device into the turbine intake 0.61 m (2 ft) below the standard

elevation, which creates a comparable increase in the gap between the intake ceiling and the downstream end of the guidance screen. For testing in 1994, a beam extension was bolted to the ceiling of the intake to eliminate the increased gap (McComas et al. 1995). In 1995 NMFS, in partnership with the COE, conducted tests to determine whether an analogous device mounted on the frame of the guidance screen would function similarly without adversely affecting juvenile chinook salmon condition. The two alternative beam extension designs were compared using descaling as the evaluation criterion.

#### The juvenile fish bypass system at McNary Dam is typical of most facilities on the

Snake and Columbia Rivers (Fig. 1). Migrant fish are guided into an upstream gatewell

#### **McNary Dam cross section**



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Figure 1. Cross section of turbine unit at McNary Dam with extended-length bar screen, inlet flow vane, outlet flow control device, beam extension, and orifice trap in

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from which an egress path to the juvenile fish bypass channel is provided through submerged

orifices in the upstream wall of the gatewell. Two 30.5-cm (12-in)-diameter orifices have

been shown to provide effective orifice passage efficiency (OPE) for chinook salmon (O.

tshawytscha) and steelhead (O. mykiss) at most facilities (Long et al. 1977, Harmon and Park

1980, Swan et al. 1984, Krcma et al. 1986). Backlighting orifices also improves OPE

(Krcma et al. 1978, Krcma et al. 1983), and vertical barrier screen modifications that allow

flow attraction near the orifices have been shown to aid fish passage (Swan et al. 1984, Krcma et al. 1985). Orifice submergence below the gatewell water surface may also affect OPE. For example, Gessel et al. (1986) found that OPE values of up to 85% could be obtained with an orifice submergence of 0.76 m (2.5 ft) at Bonneville Dam First Powerhouse. An OPE value of about 75% was attained at John Day Dam with 1.8-m (7.1-ft) orifice submergence (Krcma et al. 1986). Brege et al. (1987) described variable OPE for orifices in test gatewells at John

Day Dam (ranging from 45 to 89%) with a mean submergence of 1.2 m (4.0 ft). At

McNary Dam, Krcma et al. (1985) reported mean subyearling chinook salmon OPE values

 $\geq$  79% with 1.8 to 2.43-m (6 to 8-ft) orifice submergence.

Several methods have been used to evaluate OPE. Where space permits, an orifice trap can provide the absolute number of fish exiting within a specified time period. However, in addition to construction and installation constraints, traps require constant

monitoring during the sample period to ensure fish safety, and not all bypass facilities are

large enough to accommodate traps and the necessary access to them. One alternative that

#### has been used as a direct estimate of OPE involves releasing a known number of marked fish

#### into the test gatewell, and recapturing those remaining after a given time interval

(Krcma et al. 1986, Brege et al. 1987). This mark/recapture technique is easier to employ

than an orifice trap, but OPE values obtained using the two methods are not directly comparable.

Extended-length guidance screens create higher gatewell flows from the turbine intake into the gatewell than STSs. Mean fish guidance efficiency is also higher with the ESBS and newly designed vertical barrier screens, but little is known about the effects of these devices

on OPE. As a final phase in testing before installation of the new extended-length guidance

systems at McNary Dam, NMFS personnel conducted tests to evaluate OPE with the new

systems. Both orifice trap and mark/recapture methods were used to provide better estimates

and to offer a basis for comparing results from the two techniques. Specific research

objectives for McNary Dam in 1995 were as follows:

1) Evaluate the effects of two alternative beam extension designs (with newly designed

vertical barrier screen systems, extended-length bar screen, and inlet flow vane) on

descaling for yearling and subyearling chinook salmon.

2) Evaluate yearling and subyearling chinook salmon orifice passage efficiency (with

newly designed vertical barrier screen, extended-length bar screen, and inlet flow

vane).

 Compare orifice trap and mark/recapture methods of estimating orifice passage efficiency for yearling and subyearling chinook salmon.



### OBJECTIVE 1: EVALUATE THE EFFECTS OF TWO ALTERNATIVE BEAM EXTENSION DESIGNS (WITH NEWLY DESIGNED VERTICAL BARRIER SCREEN SYSTEMS, EXTENDED-LENGTH BAR SCREEN, AND INLET FLOW VANE) ON DESCALING FOR YEARLING AND SUBYEARLING CHINOOK SALMON

Approach

The use of inlet flow vanes requires lowering the ESBS 0.61 m (2 ft) below standard

elevation. However, lowering the guidance screen increases the gap between the downstream

end of the ESBS and the beam which forms the intake ceiling between the bulkhead and

operating gate slots. To reduce this gap, a vertical continuation of the beam, called a beam

extension, was used (Fig. 1). Gatewells 5B and 6B were used to compare fish condition

using two different beam-extension designs. The beam extension in Slot 6B was bolted to

the turbine intake ceiling, while the extension device used in Slot 5B was mounted to the

downstream side of the ESBS frame (Fig. 2). VBSI was installed in Slot 5B, and VBS2 was

placed in Slot 6B.

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Based on 1994 test results (McComas et al. 1995), inlet flow vanes were chosen for installation at McNary Dam, in place of expansion shapes, for minimizing the separation of flows entering the gatewell. The expansion shape previously used with VBS2 was therefore replaced with an inlet flow vane identical to that used with VBS1. Vertically variable perforated plate panels, specific to each VBS type, were used as a downstream surface to disperse flows evenly through the entire VBS surface. Both test gatewells were equipped with ESBSs with a 30% porosity perforated plate

and were lowered 0.61 m below standard elevation to adjust for the inlet flow vanes.

Extended-length guidance screens (either ESBSs or extended-length submersible



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Figure 2. Cross section of test Gatewells 5B and 6B showing components evaluated during descaling and orifice passage efficiency studies at McNary Dam, 1995.



traveling screens) were also placed in Slots A and C of Turbine Units 5 and 6 to provide consistent flows across all three intakes of each unit. The A and C slots did not contain inlet flow vanes and therefore the guidance screens in these slots were not lowered. Slot 7B was used as a control and represented the default guidance screen/VBS configuration for McNary Dam. This consisted of an STS at standard elevation with an MBFVBS, and a fully raised operating gate.

No operating gates were used in downstream gatewells of test slots, and all guidance screen angles were fixed at 55° for both spring and summer outmigration test periods. Flows through test and control units were maintained at 360 m<sup>3</sup>/s (12,000 cfs), representing maximum turbine efficiency for McNary Dam turbines, at turbine-unit loads of about 70 MW. Outlet flow control devices were installed in test slots, but were not tested in 1995. Fish condition was assessed by percent descaling according to Fish Transportation Oversight Team descaling criteria (Ceballos et al. 1992). The descaling percentage was

defined by species as the number of fish identified as descaled divided by the total number of

fish captured during the sample period.

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Daily descaling samples were collected from test and control gatewells using a dip basket similar to the one described by Swan et al. (1979). For Slots 5B and 7B, sample size was limited to approximately 100 chinook salmon; for Slot 6B, however, sample size consisted of the total number of fish present because of concurrent OPE testing in that gatewell. Samples with fewer than 25 fish were considered inadequate for statistical analysis (McComas et al. 1995); on days when fewer than 25 fish were captured, catches from 2 or

#### more successive days were combined.

#### **Results and Discussion**

#### **Spring Outmigration**

Descaling was significantly higher in the control slot than in either of the beam

extension test slots for yearling chinook salmon (F = 10.66, df = 3, 102, P < 0.0001) and

steelhead (F = 9.06, df = 3, 80, P < 0.0001). Sockeye salmon (O. nerka) descaling was

significantly higher in the control slot than in the beam mounted beam extension test slot

(6B), but not statistically different from the screen mounted condition (F = 6.78, df = 3,

95, P = 0.0003). Mean descaling values for the beam mounted and screen mounted

extensions were statistically similar for all three species, and there was no real difference in

mean coho salmon (O. kisutch) descaling values among any of the three treatments

(F = 2.19, df = 3, 25, P = 0.1140). Mean descaling values (and standard error) for each

Percent descaling (SE)

treatment are summarized below.

Beam extension treatment	Yearling chinook	Steelhead	Coho	Sockeye
Screen mounted	8.9 (0.7)	9.3 (1.5)	7.4 (1.4)	13.1 (1.7)
Beam mounted	7.2 (0.7)	9.1 (1.1)	1.7 (1.7)	9.3 (1.3)
Control	11.2 (0.7)	13.9 (1.3)	4.9 (1.8)	15.2 (1.5)

#### **Summer Outmigration**

No significant difference in mean descaling values was found for subyearling chinook

#### salmon among the beam extension and control treatments (F = 1.79, df = 3, 100,

P = 0.1536). Descaling means were 5.8 (SE = 0.9), 6.5 (SE = 0.8), and 5.6 (SE = 0.9)

for beam mounted, screen mounted, and control conditions, respectively.

Gatewell catch descaling data for individual replicates are presented in Appendix

Table 1. Results of statistical comparisons among descaling treatments are summarized in Appendix Table 2.

### OBJECTIVE 2: EVALUATE YEARLING AND SUBYEARLING CHINOOK SALMON ORIFICE PASSAGE EFFICIENCY (WITH NEWLY DESIGNED VERTICAL BARRIER SCREEN, EXTENDED-LENGTH BAR SCREEN, AND INLET FLOW VANE)

#### Approach

Each gatewell at McNary Dam is equipped with two backlit 30.5-cm (12-in) orifices to provide volitional fish passage into the juvenile fish bypass channel. Orifices are located approximately 1.1 m (3.5 ft) from the north and south ends of the gatewell, at 100 m (330 ft) elevation. The range of potential orifice submergence is from 3 m (10 ft) at high turbine operating pool, to 1.5 m (5 ft) at minimum operating pool.

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Gatewell 6B was used for OPE testing. Orifice passage efficiency was estimated and

comparisons were made between north and south orifices using orifice trap and

mark/recapture methods. The test period was set at 22 hours, from 1300 to 1100 the

following day. This allowed concurrent testing, using both methods in the same gatewell,

with 2 hours between replicates for fish handling.

#### **Orifice** Trap

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Two orifice traps were constructed on platforms suspended above the juvenile fish

bypass channel to capture emigrants from either the north or south orifice of Gatewell 6B

(Fig. 3). Each trap unit included dewatering, holding, fish handling, and recovery facilities.

One trap was operated continuously during each test period, alternating between north and



north

south traps on successive replicates. Fish were removed as they accumulated, anesthetized, enumerated by species, and checked for descaling. Following recovery from anesthetic, all fish were released directly into the fish bypass channel. At the end of the 22-hour sample period, the test orifice was closed and fish remaining in the trap and gatewell were removed, enumerated, and checked for descaling. For each species, OPE using the orifice trap (OPE<sub>T</sub>) method was defined as the ratio of the

number of fish captured in the orifice trap to the total number of fish recovered from the

orifice trap and gatewell combined.

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$$OPE_T = \frac{T}{T+G} \times 100\%$$

where T = orifice trap captures during the sample period G = gatewell captures after the end of the sample period

Mark/Recapture Method

Up to 100 chinook salmon obtained during gatewell cleanout each day were marked

releases, clips were alternated between upper and lower lobes on successive replicates. To begin testing, marked fish were released approximately 9 m (30 ft) below the water surface in the center of the test gatewell between 15 and 30 minutes after orifices were opened. In addition to being approximately the midpoint between the intake ceiling and the gatewell water surface, the 9-m depth was selected as the point below orifice depth which would provide realistic upward movement through the gatewell, without risking additional

using partial caudal fin clips. To minimize the risk of counting marks from previous

stress and possible injury associated with increased flows at a lower release point. To ensure

that all fish were released simultaneously and at the same depth, marked fish were carefully

lowered and released into the gatewell using a release capsule designed specifically for the

purpose.

Marked fish and other residuals remaining in the gatewell at the end of the sample

period were captured with a dip basket. Incidence of marks was noted, and orifice passage

efficiency using the mark/recapture method (OPE<sub>M/R</sub>) was defined as the ratio of marked fish

that exited the gatewell by the end of the sample period to the total number of marked fish

released at the beginning of the sample period.

$$OPE_{M/R} = \frac{M - R}{M} \times 100\%$$

where M = number of marks released at time t R = number of marks recaptured at time t+1

Dip-basket efficiency (DBE) testing was conducted as in past FGE studies (Krcma

et al. 1985). Yearling chinook salmon and steelhead were marked with caudal clips and

released into the gatewell of Slot 6B during the interval between OPE replicates. The DBE

group remained in the gatewell for 1 hour, after which they were removed along with the

gatewell catch during cleanout just prior to beginning the next replicate. Dip-basket

efficiency was defined for each species as the number of recaptured caudal-clipped fish

divided by the total number of marked fish released:

$$DBE = \frac{R}{M} \times 100\%$$

where R = caudal-clipped fish recaptured M = caudal-clipped fish released.

![](_page_19_Picture_19.jpeg)

#### **Results and Discussion**

A list of non-salmonid species incidentally captured in orifice traps during both spring

and summer sampling periods is presented by catch frequency in Appendix Table 3.

Dip-basket efficiency testing conducted 2 June resulted in 99% efficiency for chinook

salmon and 100% for steelhead.

#### **Spring Outmigration**

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Releative to the gatewell water surface, orifice submergence over the spring

outmigration sample period ranged from approximately 1.6 to 2.1 m (5.3 to 7 ft), with a

mean of 1.9 m (6.3 ft) (SE = 0.0620). Mean operating pool elevation during the spring test

period was 101.69 m (338.95 ft). From 20 April through 7 June, a total of 36 replicates

were completed using the orifice trap, and 29 replicates were completed using the

mark/recapture method. Yearling chinook salmon data from four orifice trap replicates

(28 April; 2, 5, and 24 May) were omitted from analysis due to suspected enumeration

Using orifice traps, there was no significant difference in mean OPE values between

north and south orifices for yearling chinook salmon (t = 0.05, df = 30, P = 0.9586),

steelhead (t = 0.62, df = 30, P = 0.5399), coho salmon (t = 0.47, df = 12, P = 0.6483),

or sockeye salmon (t = 0.10, df = 26, P = 0.9241). Estimated mean OPE (with standard

errors) using orifice traps is summarized below for each species.

#### Percent OPE (SE)

#### Yearling

Steelhead

Coho

Sockeye

![](_page_20_Figure_26.jpeg)

Mean mark/recapture OPE estimates for yearling chinook salmon were

79% (SE = 3.1) and 78% (SE = 3.8) for the north and south orifices, respectively. The

difference was not significant (t = 0.06, df = 13, P = 0.9559).

A paired t-test using successive 2-day blocks as pairs revealed no difference in mean

descaling values for yearling chinook salmon (t = 1.11, df = 16, p = 0.2846), steelhead

(t = 0.27, df = 17, p = 0.7872), coho salmon (t = 0.56, df = 5, p = 0.5977), or sockeye

salmon (t = 1.17, df = 15, p = 0.2614) passing through the north and south orifices. For

each species, mean descaling using north and south orifices is summarized below.

	Voorling	Percent of	lescaling (SE)	
Orifice	chinook	Steelhead	Coho	Sockeye
North	6.4 (0.7)	6.0 (0.7)	3.9 (0.8)	7.8 (1.0)
South	7.3 (0.8)	6.2 (0.8)	4.6 (1.5)	6.7 (0.8)

Fisher's Protected Least Significant Difference procedure detected no significant

difference in mean descaling between gatewell and orifice trap catches for any of these four

salmonid species.

Daily orifice trap, mark/recapture, and OPE data for yearling chinook salmon are

presented in Appendix Table 4, and statistical comparisons between OPE treatments are

summarized in Appendix Table 5. Orifice trap catch and OPE data for non-target salmonids

are included in Appendix Table 6.

**Summer Outmigration** 

Orifice submergence below the gatewell water surface ranged from approximately 1.5

to 2.1 m (5 to 7 ft), with a mean of 1.9 m (6.3 ft) (SE = 0.0677). Mean operating pool

elevation during the summer test period was 101.57 m (338.56 ft). Sampling for subyearling chinook salmon comprised 30 orifice trap replicates from 21 June through 1 August, and 18 mark/recapture replicates beginning 28 June. Mark/recapture tests were terminated after 22 July to minimize negative impacts on fish associated with elevated water temperatures and higher levels of descaling in test gatewells.

Respective mean OPE estimates for north and south orifices were 81 (SE = 2.7) and

86% (SE = 2.6) using orifice traps, and 95 (SE = 1.9) and 99.6% (SE = 0.2) using the

mark/recapture method. Estimates using orifice traps were not statistically different

(t = 1.16, df = 28, P = 0.2555); however there was a significant difference between mean

subyearling chinook salmon OPE values for the north and south orifices using the

mark/recapture method (t = 2.13, df = 7, P = 0.0706).

As with yearling chinook salmon during the spring series, there was no difference

between gatewell and orifice trap descaling for subyearling chinook salmon. However, the

difference between mean descaling values for the north orifice (4.8%, SE = 0.4) and the

south orifice (3.2%, SE = 0.4) was significant (t = 3.86, df = 14, P = 0.0017) for

subyearling chinook salmon.

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Daily orifice trap, mark/recapture, and OPE data for subyearling chinook salmon are presented in Appendix Table 7.

![](_page_22_Picture_15.jpeg)

### OBJECTIVE 3: COMPARE ORIFICE TRAP AND MARK/RECAPTURE METHODS OF ESTIMATING ORIFICE PASSAGE EFFICIENCY FOR YEARLING AND SUBYEARLING CHINOOK SALMON

#### Approach

Orifice trap and mark/recapture methods of estimating OPE were compared using

paired t-tests for yearling and subyearling chinook salmon. Comparisons were made only for

those days when both methods were used simultaneously.

### **Results and Discussion**

**Spring Outmigration** 

There was a significant 4% difference between the two methods of measuring OPE

for yearling chinook salmon (t = 2.56, df = 24, P = 0.0174). Combined mean OPE

estimates for both orifices were 78% (SE = 1.4) using the mark/recapture method and 74%

(SE = 1.8) using orifice traps.

#### **Summer Outmigration**

The combined mean OPE estimates for both orifices were 83% (SE = 1.9) using

orifice traps and 97% (SE = 1.2) with the mark/recapture method. The 14% difference was significant (t = 6.14, df = 17, P < 0.0001).

There are two readily apparent factors contributing to the difference in mean OPE

values between estimation techniques. The mark/recapture method relied on a point release

at the beginning of the sample period, allowing nearly the entire 22-hour period for egress,

while the orifice trap technique relied on migrants accumulating over the entire period. It is

#### possible that fish entering the gatewell just prior to the end of the test period did not have

time to acclimate and find the exit point before the test terminated. In addition, orifice

passage was bimodal; distinct peaks were generated during late evening and early morning (Fig. 4). The morning peak extended later into the replicate as the season progressed, with increased numbers of fish exiting closer to the end of the sample period. This undoubtedly resulted in more fish in the gatewell at the end of the test, particularly during the subyearling chinook salmon outmigration, and may have contributed to the greater disparity in mean OPE

values between the two methods in summer.

The result of this comparison indicates fundamental differences for the application of results from the two approaches. The mark/recapture method furnishes a measure of individual residence time in the gatewell. Orifice traps can be used to provide seasonal and diel passage timing data, and can provide the opportunity to assess condition associated with orifice passage. Methods selected for future investigations will depend on the goals of the

study.

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![](_page_24_Picture_5.jpeg)

1) There was no significant difference in mean descaling values for yearling and subyearling

chinook salmon between beam and screen-mounted beam extensions used with extended-

length bar screens and inlet flow vanes.

2) Mean descaling for yearling chinook salmon was significantly higher with the control

MBFVBS and a standard-length traveling screen than for either beam extension treatment

used with extended-length bar screens and inlet flow vanes. Mean descaling differences

among the three treatments for subyearling chinook salmon were not significant.

#### 3) Orifice passage efficiency was >70% for both orifice trap and mark/recapture estimation

#### methods using an extended-length bar screen and VBS2 with an inlet flow vane.

![](_page_25_Picture_0.jpeg)

4) There was no significant difference between orifice passage efficiency values for the north and south orifices using orifice traps for yearling and subyearling chinook salmon or the mark/recapture method for yearling chinook salmon. Subyearling chinook salmon orifice passage efficiency was significantly higher for the south orifice than for the north orifice using the mark/recapture method.

5) Differences in mean descaling values between gatewell and orifice traps for yearling and

subyearling chinook salmon were not significant.

6) Descaling was significantly higher for subyearling chinook salmon using the north orifice

than for those using the south orifice. Mean yearling chinook salmon descaling values

were statistically similar for both orifices.

7) Orifice passage efficiency estimated using the mark/recapture method was significantly

higher than OPE estimated using orifice traps for both yearling and subyearling chinook

salmon.

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![](_page_26_Picture_12.jpeg)

#### REFERENCES

Brege, D. A., S. J. Grabowski, W. D. Muir, S. R. Hirtzel, S. J. Mazur, and B. P. Sandford. 1992. Studies to determine the effectiveness of extended traveling screens and extended bar screens at McNary Dam, 1991. Report to U.S. Army Corps of Engineers, Contract DACW68-84-H-0034, 32 p. plus Appendixes. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

Brege, D. A., D. R. Miller, and R. D. Ledgerwood. 1987. Evaluation of the rehabilitated

juvenile salmonid collection and passage system at John Day Dam - 1986. Report to U.S. Army Corps of Engineers, Contract DACW57-86-F-0245, 37 p. plus Appendix. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

Ceballos, J. R., S. W. Pettit, and J. L. McKern. 1992. Fish Transportation Oversight Team. Annual Report - 1991. Transportation operations on the Columbia and Snake Rivers. NOAA Technical Memo. NMFS F/nwr-29. 77 p. plus Appendix.

Gessel, M. H., L. G. Gilbreath, W. D. Muir, and R. F. Krcma. 1986. Evaluation of the juvenile collection and bypass system at Bonneville Dam, 1985. Report to U.S. Army Corps of Engineers, Contract DACW57-85-H-0001, 63 p. plus Appendix. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

Harmon, J. R., and D. L. Park. 1980. Evaluation of a bypass system for juvenile salmonids at Little Goose Dam. Marine Fisheries Review 42:25-28.

- Krcma, R. F., D. A. Brege, and R. D. Ledgerwood. 1986. Evaluation of the rehabilitated juvenile salmonid collection and passage system at John Day Dam - 1985. Report to U.S. Army Corps of Engineers, Contract DACW57-85-H-0001, 25 p. plus Appendix. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)
- Krcma, R. F., C. W. Long, and C. S. Thompson. 1978. Research on the development of a fingerling protection system for low-head dams--1977. Report to U.S. Army Corps of Engineers, Contract DACW57-77-F-0307, 32 p. plus Appendix. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

Krcma, R. F., M. H. Gessel, and F. J. Ossiander. 1983. Research at McNary Dam to develop and implement a fingerling protection system for John Day Dam, 1982.
Report to U.S. Army Corps of Engineers, Contract DACW57-82-F-0373, 24 p. plus Appendix. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

Krcma, R. F., G. A. Swan, and F. J. Ossiander. 1985. Fish guiding and orifice passage efficiency tests with subyearling chinook salmon, McNary Dam, 1984. Report to U.S. Army Corps of Engineers, Contract DACW68-84-F-0034, 19 p. plus Appendixes. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

Long, C. W., R. F. Krcma, and T. E. Ruehle. 1977. Development of a system for protecting juvenile salmonids at the Second Powerhouse at Bonneville Dam--Progress 1976. Report to U.S. Army Corps of Engineers, Contract DACW57-76-F-0512, 15 p. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

McComas, R. L., D. A. Brege, W. D. Muir, B. P. Sandford, and D. B. Dey. 1993. Studies to determine the effectiveness of extended-length submersible bar screens at McNary Dam, 1992. Report to U.S. Army Corps of Engineers, Contract DACW68-84-H-0034, 34 p. plus Appendixes. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

McComas, R. L., B. P. Sandford, and D. B. Dey. 1994. Studies to evaluate the effectiveness of extended-length screens at McNary Dam, 1993. Report to U.S. Army Corps of Engineers, Contract DACW68-84-H-0034, 25 p. plus Appendixes. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

14

McComas, R. L., B. P. Sandford, and D. B. Dey. 1995. Vertical barrier screen studies at McNary Dam, 1994. Report to U.S. Army Corps of Engineers, Contract DACW68-84-H-0034, 25 p. plus Appendixes. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

Swan, G. A., R. F. Krcma, and W. E. Farr. 1979. Dip basket for collecting juvenile salmon and trout in gatewells at hydroelectric dams. Progressive Fish Culturist 41:48-49.

Swan, G. A., R. F. Krcma, and F. J. Ossiander. 1984. Research to develop an improved fingerling protection system for Lower Granite Dam. Report to U.S. Army Corps of Engineers, Contract DACW68-78-C-0051, 20 p. plus Appendixes. (Available from Northwest Fisheries Science Center, 2725 Montlake Blvd. E., Seattle, WA 98112-2097.)

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5 June       251       27       10.8       153       26       17         7 June       183       17       9.3       6       14       21.         22 June       101       14       13.9       7       5.0       7       1       14       21.         23 June       112       14       13.9       7       5.0       7       1       14.       21.         23 June       112       5       4.5       12.6       12       9       0.       0.         28 June       112       5       4.5       12       9       0.       0.         29 June       112       6       2.5       4.5       12       0.       0.         30 June       129       4       3.1       10       5.6       19       0.       0.         7 July       115       10       5.6       11       16       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       0.       10.       11       10.       0.       0.       10.       11. <t< td=""><td>5 June       251       <math>27</math> <math>10.8</math> <math>153</math> <math>26</math> <math>17</math>         7 June       517       35       <math>6.8</math> <math>6.4</math> <math>14</math> <math>21</math>         22 June       101       14       <math>13.9</math> <math>6</math> <math>0</math>         23 June       101       14       <math>13.9</math> <math>6</math> <math>0</math>         24 June       112       <math>14</math> <math>13.9</math> <math>6</math> <math>0</math>         28 June       112       <math>6</math> <math>2.5</math> <math>9</math> <math>0</math>         29 June       112       <math>5</math> <math>4.5</math> <math>12</math> <math>0</math> <math>20</math> June       112       <math>6</math> <math>2.6</math> <math>9</math> <math>0</math> <math>20</math> June       112       <math>6</math> <math>2.6</math> <math>9</math> <math>0</math> <math>20</math> June       112       <math>6</math> <math>2.6</math> <math>11</math> <math>10</math> <math>0</math> <math>1</math> July       115       <math>8</math> <math>5.2</math> <math>119</math> <math>0</math> <math>0</math> <math>6</math> <math>7</math> <math>11</math> <math>116</math> <math>10</math> <math>116</math> <math>116</math> <math>0</math> <math>1</math> July       <math>116</math> <math>116</math> <math>116</math> <math>126</math> <math>11</math> <math>11</math> <math>127</math> <math>11</math> July</td><td>4 June</td><td>278</td><td>8</td><td>2.9</td><td>59</td><td>12</td><td>20.</td></t<>	5 June       251 $27$ $10.8$ $153$ $26$ $17$ 7 June       517       35 $6.8$ $6.4$ $14$ $21$ 22 June       101       14 $13.9$ $6$ $0$ 23 June       101       14 $13.9$ $6$ $0$ 24 June       112 $14$ $13.9$ $6$ $0$ 28 June       112 $6$ $2.5$ $9$ $0$ 29 June       112 $5$ $4.5$ $12$ $0$ $20$ June       112 $6$ $2.6$ $9$ $0$ $20$ June       112 $6$ $2.6$ $9$ $0$ $20$ June       112 $6$ $2.6$ $11$ $10$ $0$ $1$ July       115 $8$ $5.2$ $119$ $0$ $0$ $6$ $7$ $11$ $116$ $10$ $116$ $116$ $0$ $1$ July $116$ $116$ $116$ $126$ $11$ $11$ $127$ $11$ July	4 June	278	8	2.9	59	12	20.
6 June       517       35 $6.8$ $6.4$ $14$ $21.$ 7 June       183       17       9.3 $6$ 1 $21.$ 22 June       183       17       9.3 $6$ 1 $21.$ 23 June       182       3       1 $4$ $13.9$ $6$ $0.$ 23 June       112 $5$ $4.5$ $12.6$ $12$ $0.$ 29 June       112 $5$ $4.5$ $12.6$ $0.$ $0.$ $7$ July       115 $6$ $21.6$ $4$ $3.11$ $12$ $0.$ $7$ July       115 $8$ $56$ $11.6$ $11.6$ $0.$ $0.$ $7$ July $115$ $8$ $56$ $11.6$ $0.$ $0.$ $8$ July $116$ $0.0$ $11.6$ $0.0$ $11.6$ $0.$ $0.$ $10$ July $106$ $2$ $10.6$ $11.6$ $0.$ $0.$ $11$ July $100$ $2$ $10.6$ $11.6$ $0.$ $0.$ <td>6 June       517       35       6.8       64       14       21.         7 June       183       17       9.3       6       14       21.         22 June       101       14       13.9       7       5.0       7       1       14.         23       June       139       7       5.0       7       1       14.         28 June       139       7       5.0       7       1       14.         29 June       112       5       4.5       12       9       0.         30 June       129       4       3.1       16       9       0.         7 July       117       10       5.6       19       9       0.         7 July       115       8       5.2       19       0.       0.         8 July       115       10       5.6       11       19       9         11 July       104       2       1.6       1       1       1         10 July       1014       2       1.6       1       1       1         11 July       100       5       5.0       1       1       1         13 July</td> <td>5 June</td> <td>251</td> <td>27</td> <td>10.8</td> <td>153</td> <td>26</td> <td>17.</td>	6 June       517       35       6.8       64       14       21.         7 June       183       17       9.3       6       14       21.         22 June       101       14       13.9       7       5.0       7       1       14.         23       June       139       7       5.0       7       1       14.         28 June       139       7       5.0       7       1       14.         29 June       112       5       4.5       12       9       0.         30 June       129       4       3.1       16       9       0.         7 July       117       10       5.6       19       9       0.         7 July       115       8       5.2       19       0.       0.         8 July       115       10       5.6       11       19       9         11 July       104       2       1.6       1       1       1         10 July       1014       2       1.6       1       1       1         11 July       100       5       5.0       1       1       1         13 July	5 June	251	27	10.8	153	26	17.
7 June       183       17       9.3       6       0         22 June       101       14       13.9       6       0         23 June       139       7       5.0       7       1       14         23 June       139       7       5.0       7       1       14         28 June       139       7       5.0       7       1       14         28 June       117       10       5.6       9       0       0         29 June       117       10       5.6       12       14       14         7 July       115       8       5.2       12       19       0         6 July       115       8       5.2       19       0       0         8 July       118       9       7.6       4       1       25       10         10 July       104       2       1.6       6       1       16       0       0         11 July       104       2       1.9       0       11       10       1       2       1       1       1       1       1       1       1       1       1       1       1       1 <td>7 June       183       17       9.3       6       0         22 June       101       14       13.9       7       1       14         23 June       139       7       5.0       7       1       14         28 June       139       7       5.0       7       1       14         28 June       139       7       5.6       12       9       0         29 June       112       5       4.5       12       9       0         30 June       112       5       4       3.1       15       9       0         30 June       112       6       17       10       5.6       19       0       0         7 July       115       8       5.2       119       15       9       0       0         8 July       118       9       7.6       4       1.6       0       0       0         10 July       101       2       10       3       2.1       1       1       1       1       1       1         11 July       100       5       5.0       1       1       1       1       1       1       1<td>6 June</td><td>517</td><td>35</td><td>6.8</td><td>64</td><td>14</td><td>21.</td></td>	7 June       183       17       9.3       6       0         22 June       101       14       13.9       7       1       14         23 June       139       7       5.0       7       1       14         28 June       139       7       5.0       7       1       14         28 June       139       7       5.6       12       9       0         29 June       112       5       4.5       12       9       0         30 June       112       5       4       3.1       15       9       0         30 June       112       6       17       10       5.6       19       0       0         7 July       115       8       5.2       119       15       9       0       0         8 July       118       9       7.6       4       1.6       0       0       0         10 July       101       2       10       3       2.1       1       1       1       1       1       1         11 July       100       5       5.0       1       1       1       1       1       1       1 <td>6 June</td> <td>517</td> <td>35</td> <td>6.8</td> <td>64</td> <td>14</td> <td>21.</td>	6 June	517	35	6.8	64	14	21.
24 June       123       1.6       1       1.6       1       1.6       1       1.6       1       1.4         28 June       139       7       5.0       7       1       14       1         28 June       139       7       5.0       7       1       14       1         29 June       112       5       4.5       12       9       0       0         30 June       112       5       4       5.6       19       2       10         7 July       115       8       5.2       19       2       10       0         8       July       115       9       7.6       4       1       2       10         9       July       100       5       5.0       11       1       2       1       1       2         10       July       100       5       5.0       1       1       2       1       1       2       1       <	24 June       182       3       1.6       1       1.6       1       14.         28 June       139       7       5.0       7       1       14.         28 June       139       7       5.0       7       1       14.         29 June       112       5       4.5       12       0.         30 June       129       4       3.1       15       0         7 July       117       10       5.6       19       2       10         7 July       115       8       5.2       19       0       0         7 July       115       8       5.2       19       0       0         7 July       115       8       7.6       4       1       2       10         9 July       118       9       7.6       4       1       2       16       1         11 <july< td="">       100       5       5.0       1       1       2       1       16         12<july< td="">       113<july< td="">       100       5       5       1       1       2       1       1         13 July       120       10       3       3       3</july<></july<></july<>	June 72 Tuno	101	17	9.3	9		.0
27. June       139       7       5.0       7       1       14         28 June       112       5       4.5       12       9       0       0         29 June       112       5       4.5       12       9       0       0         30 June       112       5       4       3.1       15       9       0       0         7 July       115       10       5.6       19       2       10       0	27 June       139       7       5.0       7       1       14.         28 June       112       5       4.5       12       9       0.         29 June       112       5       4.5       12       9       0.         30 June       112       5       4.5       12       9       0.         1 July       117       10       5.6       19       2       10.         7 July       115       8       5.2       19       0       0         8 July       118       9       7.6       4       1       2       10         9 July       104       2       1.9       4       1       2       1       9         10 July       100       5       5.0       1       1       2       1       16         11 July       100       5       5.0       1       1       2       1       16         13 July       124       3       2.3       3       2       1       2       1       1       6       1       16       1       1       1       2       1       1       2       1       1       2       1	atino 22	182		1.6	1		.0
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29 June       112       5       4.5       12       0         30 June       129       4       3.1       15       0         1 July       117       10       5.6       19       2       10         6 July       115       8       5.2       19       2       10         7 July       115       8       5.2       19       2       0         8 July       118       9       7.6       4       1       1       9         9 July       100       5       5       0.0       11       1       9       0         10 July       100       5       5       1.0       11       1       9       0         11 July       100       5       6       1       1       9       0       0         11 July       100       5       5       0       1       1       6       1       16         12 July       124       3       2       1       3       32       2       6       1         13 July       120       1       1       1       1       1       4       36       1         1	29 June       112       5       4.5       12       0         30 June       12yy       117       10       5.6       19       2       10         6 July       115       10       5.6       19       2       10         7 July       115       8       5.2       19       2       10         8 July       115       8       5.2       19       2       0         9 July       118       9       7.6       4       1       1       9         10 July       104       2       1.9       7       4       1       1       9         11 July       100       5       5.0       1       1       9       0         11 July       100       5       1.0       1       1       1       1       1         13 July       100       5       5.0       1       1       6       1       1       1       1         13 July       120       9       7.1       1       3       2       1       1       1       1       1       1       1       1       1       1       1       1       1       1	28 June	236	9	2.5	6		0.
30 June       129       4       3.1       15       0         1 July       117       10       5.6       19       2       10         6 July       115       8       5.2       19       2       10         7 July       115       8       5.2       19       2       0         8       July       118       9       7.6       4       0       0         9 July       104       2       1.9       4       1       25       1       9         10 July       100       5       5.0       1       1       2       1       1       2         11 July       100       5       5.0       1       1.6       4       1       2       1       16         13 July       100       5       5.0       1       2       1       2       1       16       1       16       1       1       1       2       1       1       2       1 <td< td=""><td>30 June12943.11501 July117105.6192106 July11585.21907 July11585.21908 July11897.64199 July10421.97.6412511 July25041.6611612 July10055.019013 July2304103.32.421913 July12097.51143613 July12097.51143613 July12097.51143613 July12097.51143613 July12097.51143613 July12097.51143618 July12097.5112919 July10632.871143619 July10632.871143619 July1001111.0623320 July10632.8711422 July1524127.0400</td><td>29 June</td><td>112</td><td>S</td><td>4.5</td><td>12</td><td></td><td>0.</td></td<>	30 June12943.11501 July117105.6192106 July11585.21907 July11585.21908 July11897.64199 July10421.97.6412511 July25041.6611612 July10055.019013 July2304103.32.421913 July12097.51143613 July12097.51143613 July12097.51143613 July12097.51143613 July12097.51143613 July12097.51143618 July12097.5112919 July10632.871143619 July10632.871143619 July1001111.0623320 July10632.8711422 July1524127.0400	29 June	112	S	4.5	12		0.
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$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		1 July	117	10	5.6	19	2	10.
7 July       115 $0.0$ 11       1       9         8 July       118       9       7.6       4       1       25         9 July       104       2       1.9       4       1       25         10 July       100       5       5.0       1       1       25         11 July       250       4       1.6       6       1       16         12 July       124       3       2.4       2       1       16         12 July       124       3       2.4       2       1       16         13 July       124       3       2.3       32       2       6       1       16         14 July       120       9       7.5       11       4       36       14       16         18 July       120       6       5       11       8       7       1       14       36         19 July       120       1       100       11       11       1       2       14       1       4       36         19 July       127       11       8       7       1       1       4       3       3       14<	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	6 July	115	8	5.2	19	8	0.
B July $118$ $9$ $7.6$ $4$ $1$ $25$ $9 July$ $104$ $2$ $1.9$ $4$ $1$ $25$ $11 July$ $250$ $4$ $1.6$ $6$ $1$ $16$ $12 July$ $100$ $5$ $5.0$ $1$ $16$ $6$ $1$ $16$ $12 July$ $124$ $3$ $2.4$ $2$ $1$ $16$ $13 July$ $124$ $3$ $2.4$ $2$ $1$ $16$ $13 July$ $124$ $3$ $2.3$ $32.3$ $22$ $14$ $16$ $14 July$ $120$ $9$ $7.5$ $11$ $4$ $36$ $18 July$ $120$ $9$ $7.5$ $11$ $4$ $36$ $19 July$ $120$ $11$ $8.7$ $21$ $21$ $2$ $9$ $20 July$ $106$ $3$ $2.8$ $7$ $1$ $14$ $2$ $21 July$ $100$ $11$ $110$ $11$ $11.0$	8 July       118       9       7.6       4       1       25.0       1       9       0.0         10 July       104       2       1.9       4       1       25.0       1       16       0       0         11 July       250       4       1.6       6       1       16       0         12 July       120       5       5       0       1       6       1       16         13 July       124       3       2.4       2       1       16         13 July       133       3       2.3       32       2       6       1       16         13 July       120       9       7.5       11       8       7       14       36         18 July       120       9       7.5       11       8       7       14       36         19 July       127       11       8       7       21       2       9       31       14         20 July       100       11       11.0       6       2       33       14       0       0         21 July       106       3       2.8       7       1       14       2	7 July	115	(	0.0	11	T	С
9 July $104$ 2 $1.5$ $2.4$ $2$ $1.5$ $6$ $1$ $16.$ $11$ July $250$ $4$ $1.6$ $6$ $1$ $16.$ $0.$ $12$ July $124$ $3$ $2.4$ $2$ $1$ $50.$ $13$ July $124$ $3$ $2.4$ $2$ $1$ $50.$ $14$ July $123$ $3$ $2.3$ $32$ $2$ $6$ $14.$ $14$ July $120$ $9$ $7.3$ $32.3$ $22.4$ $2$ $14.$ $14$ July $120$ $9$ $7.5$ $11.$ $8$ $36.$ $18$ July $120$ $9$ $7.5$ $11.$ $4$ $36.$ $19$ July $127$ $11$ $8.7$ $21$ $21$ $2$ $9.$ $20$ July $100$ $11$ $11.0$ $11.10$ $6$ $2$ $33.$ $21$ July $100$ $11.1$ $11.0$ $6$ $2$ $33.$ $21$ July $100$	9 July       104       2       1.2       2       1.2       2       1.2       1	8 July	118	6	9.1	<b>7</b>	-	. 0 25
11       July       250       4       1.6       6       1       16         12       July       124       3       2.4       2       1       50         13       July       124       3       2.3       32       2       6         13       July       124       3       2.3       32       2       6         14       July       133       3       2.3       32       2       6         15       July       120       9       7.5       11       4       36         18       July       120       6       5       11       4       36         19       July       120       6       5       11       2       18         20       July       127       11       8       7       1       1       1         20       July       100       11       11.0       6       2       3       14         20       July       127       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1       1	11 July25041.6611612 July25041.6611613 July1243232.332214 July13332.33.321315 July130103.32.13315 July12097.51143619 July12097.51143619 July127118.7212920 July127118.7212921 July1001111.0623322 July1524127.0400		100	V U	0 5	*	4	. 0
12 July1243 $24$ 21 $50.$ 13 July1333 $23$ $32.3$ $32$ $2$ $6.$ 14 July $304$ $10$ $33$ $2.1$ $3$ $14.$ 15 July $120$ $9$ $75$ $111$ $4$ $36.$ 16 July $120$ $9$ $75$ $111$ $4$ $36.$ 19 July $120$ $6$ $5.0$ $111$ $2$ $18.$ 20 July $100$ $11$ $87$ $211$ $2$ $9.$ 21 July $106$ $3$ $28$ $7$ $1$ $14.$ 22 July $100$ $11$ $11.0$ $6$ $2$ $33.$ 22 July $152$ $41$ $27.0$ $4$ $0.$	12 July       124       324       24       24       24       26         13 July       133       323       323       32       26       66         14 July       304       10       3.3       21       32       26         15 July       304       10       3.3       21       314         15 July       120       9       7.5       11       4       36         19 July       120       6       5.0       11       21       2       18         19 July       120       6       5.0       11       21       2       18         20 July       127       11       8.7       21       2       9       14         20 July       106       3       2.8       7       1       14       2       33       33         21 July       106       3       2.8       7       1       14       2       33       33       33       33       34       36       33       33       34       36       34       36       33       34       35       33       34       36       33       33       34       35       33       31 <td>VINE UI</td> <td>250</td> <td>u 4</td> <td>1.6</td> <td>9</td> <td>٦</td> <td>16.</td>	VINE UI	250	u 4	1.6	9	٦	16.
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14July $304$ 10 $3.3$ $21$ $3$ $14$ 15July $120$ $9$ $7.5$ $11$ $4$ $36.$ 18July $120$ $6$ $5.0$ $11$ $2$ $18.$ 19July $127$ $11$ $8.7$ $21$ $2$ $9$ 20July $106$ $3$ $2.8$ $7$ $1$ $14.$ 21July $100$ $11$ $11.0$ $6$ $2$ $33.$ 22July $152$ $41$ $27.0$ $4$ $0.$	14July $304$ 10 $3.3$ $21$ $3$ $14$ 15July12097.511436.18July12065.01121819July12711 $8.7$ 2129.20July10632.87114.20July10632.87114.21July1001111.06233.21July1524127.040.	13 July	133	3	2.3	32	2	.9
15 July12097.511436.18 July12065.011218.19 July12711 $8.7$ 2129.20 July1063 $2.8$ 7114.21 July1001111.06233.22 July15241 $27.0$ 40.	15 July       120       9       7.5       11       4       36.         18 July       120       6       5.0       11       2       18.         19 July       127       11       8.7       21       2       9.         20 July       106       3       2.8       7       1       14.         20 July       106       3       2.8       7       1       14.         21 July       100       11       11.0       6       2       33.         21 July       152       41       27.0       4       0.       0.	14 July	304	10	3.3	21	e	14.
18 July       120       6 $5.0$ 11       2       18.7         19 July       127       11 $8.7$ 21       2       9.         20 July       126       3 $2.8$ 7       1       14.         20 July       106       3 $2.8$ 7       1       14.         21 July       100       11       11.0       6       2       33.         22 July       152       41 $27.0$ 4       0.	18 July       120       6       5.0       11       2       18         19 July       127       11       8.7       21       2       9         20 July       106       3       2.8       7       1       14         21 July       100       11       11.0       6       2       33         21 July       152       41       27.0       4       0       0         22 July       152       41       27.0       4       0       0	15 July	120	6	7.5	11	4	36.
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$\begin{array}{cccccccccccccccccccccccccccccccccccc$	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	19 July	127	11	8.7	21	2	9.
21 July 100 11 11.0 6 2 33. 22 July 152 41 27.0 4 0.	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	20 July	106	e	2.8	7	1	14.
22 July 152 41 27.0 4 0.	22 July 152 41 27.0 4 0.	21 July	100	11	11.0	9	2	33.
		22 July	152	41	27.0	4		0.

	dР	0.0		0.0	0.0	0.0	0.0	0.0	2.4	3.0	1.3	3.2	4.1	16.7	16.8	9.9	6.0	8.3	14.9	20.1	10.8	29.6	2.6	17.9	23.1	0.0	23.3	5.6	10.0	4.0	7.7	500	11.1		
ckeye	Desc.							90 	1 0	4 80	e	9	- 12	• •	19	13	m	4	10	35	23	c 12		L	7 0	)	7	ŝ	5 C	1	1	1	1		
So	Catch	-		2	2	~ æ	10	33	42	268	228	190	49 68	36	113	131	50	48	67	174	212	17	39	39	36 13	2	30	54	20	25	13	2	6		
	90									0.0	0.0	0.0	0.0	16.7	11.1	0.0	6.25	0.0	0.0	9.1	0.0	0.0	)	0.0											
Coho	Desc.													1	1	ł	1			1															
	Catch									8	4	2.5	21	9	6	28	16	2	7	11	4		•	1											
	96	0.0	0.0	0.0	5.3	0.0	0.0	0.0	5.9	6.1	5.7	3.7	6.4	10.8	5.9	2.3	7.2	5.6	9.8	7.6	16.7	25.0	20.0	7.1	50.0	)	50.0	26.7	40.0	33.3	0.0				
eelhead	Desc.				1			3	1 6	n (7	2	1	2 3	n co	e	1	9 01	<i>L</i>	11	6	13	n r	n m	-	2 0		2	8	2	-					
Ste	Catch	2	9 6	5	19	35 11	14	12	17	33	3.5	27	90 87.	74	51	43	210	126	112	119	78	12	15	14	15		4	30	2	- m	2				

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Jnit 6, Sl	ot B					
rest	Sub	yearling	5	Ye	arling	
late	U	hinook		ch	inook	
	Catch	Desc.	dР	Catch	Desc.	đP
17 April				30	2	6.7
18 April	1		0.0	52	2	3.8
19 April	1		0.0	16	2	2.6
21 April				381	10	2.6
22 April	2		0.0	592	15	2.5
25 April				655	10	1.5
27 April	c			787	0	0.0
28 April	2		0.0	541	15	2.8
29 April	6		0.0	419	11	2.6
2 May				294	20	6.8
З Мау	4		0.0	234	8	3.4
4 May	5		0.0	407	19	4.7
5 May	e		0.0	387	19	4.9
6 May	9		0.0	597	16	2.7
9 May	7		0.0	610	40	9.9
11 may	-		0.0	780	20 7	0.11
12 Mav	9		0.0	623	66	10.6
13 May	6		0.0	690	38	5.5
16 May	17		0.0	840	67	8.0
17 may	25		0.0	671	39	5.8
18 May	79		0.0	699	41	6.1
19 May	196	2	1.0	807	58	7.2
20 May	11	,	0.0	667	34	4. r
3 May	102	1	1.0 6 6	283	01	C. L a ol
SE May	BD	0 -	0.0	76	5	8 . L
16 Mav	59	4	0.0	123	• •	4.1
27 May	16		0.0	235	20	8.5
29 May	64	1	1.6	48	5	10.4
31 May	15		0.0	2	1	20.0
1 June	244	25	10.2	47	S	10.6
2 June	332	5	1.5	141	14	9.9
3 June	39		0.0	8	1	12.5
4 June	182	8	4.4	42	8	19.0
5 June	129	4	3.1	53	10	18.9
6 June	280	13	4.6	30	5	16.7
7 June	246	33	13.4	16	e	18.8
22 June	42.4	AC		VV		-
		C F	10.0	7	4	7.1

![](_page_33_Figure_0.jpeg)

Coho	Catch Desc.				Coho	Catch Desc.	
	æ	0.0				æ	0.0
teelhead	Desc.				teelhead	Desc.	
S	Catch	F			S	Catch	7

					and have	
est	ns	byear111	60	PI .	6011110	
ate		hinook		CD	NOOULI	
	Catch	Desc.	œ	Catch	Desc.	90
4 June	645	23	3.6	13		0.0
7 June	1392	57	4.1	25	1	4.0
8 June	2419	93 52	3.8	121		0.0
	1515	2.8	1.8	144	7	4.9
1 July	783	29	3.7	67	9	6.2
6 July	1537	67	4.4	80	2	6.3
7 July	610	11	1.8	27	1	3.7
8 July	3157	157	5.0	175	16	9.1
9 July	193	15	7.8	1.2		B. /
0 July	731	53	5.7 A D	31	5ª -	12.Y
Arne T	101	97	0. e	n r	+ <b>v</b>	P. 78
s Julv	565	10	17.9	2	<b>)</b>	0.0
4 July	17		0.0	9	1	16.7
5 July	120	12	10.0	17	1	5.9
8 July	172	8	4.7	19		0.0
9 July	31	4	12.9	15	2	33.3
0 July	288	25	8.7	38	5,	13.2
1 July	409	60	14.7	48	9 T	5.55
2 July	618	17	11.1	56	~ v	11.5
Vlub 6	102	5	2.0	20	2	25.0
7 July	61	1	1.6	10	Э	30.0
8 July	56	1	1.8	14		0.0
9 July	55		0.0	25	2	8.0
0 July	38	3	7.9			
1 August	26	e	11.5			
nit 7, S]	Lot B					
est	Sub	yearlin	5	X	(earling	-
ate		hinook		0	:hinook	
	Catch	Desc.	<del>,</del> 0	Catch	Desc.	<b>%</b>
7 April	2		0.0	100	L	7.0
8 April	2		0.0	100	11	11.0
9 April				103	4	3.9
1 April				103	e	2.9
2 April				107	L	6.5

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		æ	7.0	11.0	3.9	2.9
Битттра	hinook	Desc.	7	11	4	e
I	C	Catch	100	100	103	103
		<b>,</b> 9	0.0	0.0		
yearing	hinook	Desc.				
ans	0	Catch	2	2		

Steelhead         atch       Desc.       %         1       Desc.       %         2       0.0       0.0         1       1       20.0         8       1       12.5         17       2       11.8         11       2       0.0         9       0.0       0.0	Cato 5 4	coho ch Desc.				
atch       Desc.       *         2       0.0       0.0         1       1       100.0         5       1       20.0         8       1       12.5         17       2       11.8         11       2       11.8         11       2       11.8         9       0.0       0.0	2 Cato	h Desc.			sockeye	
2 0.0 1 1 100.0 5 1 20.0 8 1 12.5 17 2 11.8 11 0.0	4 Ω Φ		*	Catch	Desc.	*
1       1       100.0         5       1       20.0         8       1       20.0         17       2       11.8         11       2       11.8         9       0.0       0.0	4 0 0			•		1
5 1 20.0 8 1 12.5 17 2 11.8 0.0 0.0	4 0 0			n m		33.3
5 1 20.0 8 1 12.5 17 2 11.8 11 0.0 9 0.0	4.00			16		0.0
8 1 12.5 17 2 11.8 11 0.0 9 0.0	4 2 0			26	m	5.
11 0.0 0.0	* 50 m	-	0 30	33	~ 0	2.1
0·0	n n	-		800	ر د د	
			0.0	41	4	. 6
9 11.1	11	1	9.1	15		. 0
0.0	e		0.0	25	6	36.
58 7 14.3	L	1	14.3	11	2	18.
0.0	13		0.0	21		0.0
6 1 16.7	e	1	33.3	16	4	25.0
2 0.0	24	1	4.2	62	4	9
55 29 8.2	2		0.0	L .	ŝ	71.
98 16 16.3 05 15 15 0	T		0.0	162	18	
8.CL CL CY			0	191	17	
50 11 22.0			2	165	21	12.
28 1 3.6				20	4	20.0
28 4 14.3	1		0.0	13	10	76.9
24 2.3				39	4	10.
65 8 12.3				84	13	15.3
4 1 25.0				18	9	33.
17 2 11.8				20	L	35.(
14 3 21.4				09	11	18.
						0.1
1.11 22 62				5 C C	0 0	
					n d	
				22	n -	
				5 1	• •	36
				**	7	
				6		20

Test	Su	ıbyearli	bu	X	tearlin
date		chinook			chinook
	Catch	Desc.	æ	Catch	Desc.
25 April				222	11
26 April				132	13
27 April				100	4
28 April				106	6
29 April 2 Mav				102	16
3 May				105	14
4 May	2		0.0	102	L
5 May	2		0.0	118	11
6 Мау				100	11
9 Мау	1	1	100.0	100	27
10 May				104	11
12 May				501	0 T
12 May				115	<b>n</b> . r
16 May	n -		0.0	911	° (1
17 May	15		0.0	104	10
18 May	8		0.0	16	10
19 May	32	1	3.1	127	12
20 May	19	1	5.3	103	5
24 Mav	۲ 1	ſ	45.5	120	5 16
25 May	35		0.0	100	2
26 May	50	3	6.0	113	6
27 May	21	1	4.8	102	24
29 May	26	۳,	11.5	100	11
JI May		10	13.0	001	13
2 June	180	13	7.2	80	12
3 June	236	40	16.9	104	19
4 June	253	24	9.5	85	31
5 June	262	28	10.7	71	11
e June	279	28	10.0	51	10
J June	154	23	14.9	6	2
22 June	112	12	10.7		
23 June	120	n n	7 - F		
27 June	124	n 0	1.6	7	
28 June	155	- m	1.9	10	1
29 June	142	2	1.4	17	1
30 June	106	L	6.6	12	1

![](_page_35_Picture_0.jpeg)

		Desc.	
		Catch	
		Desc.	
		ltch	
		Ŭ	
11 20.0 20.0 20.0 20.0 20.0 20.0 20.0 20	20.0 0.0 33.3 33.3	11.1 20.0 33.3 33.3 5.4 5.0 0.0 0.0 5.4 1.1 1.1 8 20.0 8 1.1 8 1.1 8 1.1 8 1.1 8 1.1 8 1.1 8 1.1 8 1.1 8 1.1 8 1.1 1.1	
- 2 5 - 1 - 7 5 -	м <b>ч</b>	Desc. 1 2 2 1 1 4 1 1 2 2 1 2 1 2 2 1 2 2 1 2 2 2 2	e 
9 15 15 23 23 23 23 23 23 23 23 23 23 23 23 23	15 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	atch 9 9 15 15 2 2 2 3 7 2 2 3 7 3 7 3 7 3 7 3 7 3 7 3	
		ĨÕ	
01018981012	5 - 0 2 m Q	° 1 0 1 8 9 8 1 0 1 5	
98974444097749	0 0 0 7 7 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	989504444060746	
10 10 10 10 10 10 10 10 10 10 10 10 10 1	1 4 7 6 7 7 9 7 4	Desc. 10 13 13 26 13 26 13 26 23 23 26 13	
145 215 215 114 117 121 121 121 121 121 121 121 121 121	215 137 114 114 121 121	atch 45 45 08 08 17 17 17 11 12 12 12 12 12 12 12 12 12 12 12 12	

Ĕ	lot																			
endi	7, S			ly	lγ	$1_{Y}$	lγ	lγ	lγ	lγ	lγ									
be	it	st	Le Le	Ju	Ju	Ju	Ju	Ju	Ju											
AF	Un	Tes	dal	٦	9	L	8	6	10	11	12	13	14	15	18	19	20	21	22	

11	P	<0.0001	<0.0001	0.1140	0.0003	<0.0001	<0.0001	0.1140	0:0003	0.2846	0.7872	0.5977	0.2614	<0.1536	<0.1536	2	0.0017
orifice indicate	đf	3,102	3,80	3,25	3,95	3,102	3,80	3,25	3,95	16	17	2	15	3,100	3,100		14
ed during Asterisks	Calculated test statistic	F = 10.66	F = 9.06	F = 2.19	F = 6.78	F = 10.66*	F = 9.06*	F = 2.19	F = 6.78*	t = 1.11	t = 0.27	t = 0.56	t = 1.17	F = 1.79	F = 1.79		t = 3.86*

29

<i>E</i> .	ů l	Ū.							
	n descaling estimates obtai udies at McNary Dam, 1995. Lifferences between means.	Analysis source	Orifice trap vs. gatewell	Screen mounted beam extension vs. beam mounted beam extension vs. control	North orifice vs. south orifice	Orifice trap vs. gatewell	Screen mounted beam extension vs. beam mounted beam extension vs. control	North orifice vs. south orifice	
	mean () st	ß	* A	A	test test test			test	

RBANOVA ANOVA<sup>b</sup> Analysis type <u>т</u> Statistical analyses of passage efficiency (OPE) statistically significar ANOVA RBANOV ANOVA ANOVA ANOVA ANOVA ANOVA ANOVA paired paired paired paired Subyearling chinook chinook chinook chinook chinook chinook Species Subyearling Subyearling Yearling c Steelhead Steelhead Steelhead Yearling Yearling Sockeye Sockeye Sockeye Coho Coho Coho 2. August August August April April April April July July June June July June June June Мау Мау Мау able Test dates 29 31 6 29 31 6 31 31 30 31 29 31 6 1 -

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		1	21 1	1	22	21	22	
	ß							
	est rie	la	la	1b	2a	2a	2b	
	T Se							0

sampl fact Single Paired Random υ p

Appendix Table 3. Nonsalmonid species incidentally captured in orifice traps at McNary Dam, 1995. Species are listed in order of total catch.

Total Scientific name catch Common name Entosphenus tridentata 1,136 lamprey Alosa sapidissima shad 214 Prosopium williamsoni whitefish 170 Catostomus spp. 96 sucker Acrocheilus alutaceus 83 chiselmouth Perca flavescens 77 yellow perch Mylocheilus caurinus peamouth 68 Micropterus spp. bass 34 Richardsonius balteatus 32 redside shiner Ptychocheilus oregonensis squawfish Gasterosteus aculeatus stickleback 6 black crappie Pomoxis nigromaculatus Cyprinus carpio carp Ictalurus punctatus channel catfish Columbia transmontanus sand roller Lepomis macrochirus bluegill Stizostedion vitreum walleye

![](_page_37_Picture_3.jpeg)

![](_page_37_Picture_6.jpeg)

Appendix Table 4. Daily yearling chinook orifice passage efficiency (OPE) estimates obtained using orifice traps (Trap OPE) and mark/recapture (M/R OPE) estimation methods, McNary Dam, 1995.

	Test	Orifice	Orifice tr	ap estima	tion method	Mark/recap	ture estimatio	on method
3	date	trap	Gatewell catch <sup>a</sup>	Trap catch <sup>b</sup>	Trap OPE estimate	Marked released <sup>c</sup>	Marked recaptured <sup>d</sup>	M/R OPE estimate
~ 1	2	<u></u>	2.0.1	700	C.F. 4			

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	ubrrr	5	201	120	05.4			
22 7	April	Nf	592	636	51.8			
25 /	April	S	655	1067	62.0			
26 2	April	N	749	1296	63.4			
27 4	April	S	287	788	73.3			
28 2	April	N				100	57	43.0
29 A	April	S	419	741	63.9	100	38	62.0
1 1	May	N				100	26	74.0
2 N	May	S	234	1003	81.1	73	18	75.3
4 N	May	N	407	1657	80.3	82	13	84.1
5 N	May	S				100	31	69.0
6 N	May	N	597	1966	76.7	100	16	84.0
9 N	May	S	610	1983	76.5	100	29	71.0
10 M	May	N	808	1450	64.2	100	36	64.0
11 N	May	S	780	3000	79.4	100	20	80.0
12 N	May	N	623	1402	69.2	100	32	68.0
13 N	May	S	690	1951	73.9	100	13	87.0
16 N	May	N	840	1814	68.3	95	26	72.6
17 N	May	S	671	2056	75.4	100	3	97.0
18 N	May	N	669	4462	87.0	100	14	86.0
19 N	May	S	807	1595	66.4	100	24	76.0
20 M	May	N	755	1193	61.2	100	15	85.0
23 N	May	S	283	718	71.1	100	40	60.0
24 M	May	N				100	36	64.0
25 N	May	S	76	418	84.6	100	14	86.0
26 N	May	N	123	269	68.6			
27 N	May	S	235	561	70.5	100	12	88.0
29 N	May	N	48	426	89.9	100	8	92.0
31 N	May	S	5	272	98.2	97	3	96.9
1 3	June	N	47	130	73.4	99	13	86.9
2 3	June	S	141	269	65.6	98	35	64.3
3 3	June	N	8	125	94.0			
4	June	S	42	112	72.7	103	24	76.7
5	June	N	53	328	83.8	100	17	83.0
6	June	S	30	153	83.6	100	12	88.0
7	June	N	16	66	80.5	95	1	98.9

- <sup>a</sup> Fraction captured from gatewell using dip baskets at the end of the test.
  <sup>b</sup> Fraction enumerated from orifice trap during the test.
- <sup>c</sup> Number of marked fish released at the beginning of the test, time t. <sup>d</sup> Number of marked fish recaptured at the end of the test, time t+1.
- <sup>e</sup> South orifice trap.
- a North orifice trap.

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ts at es at	٩	0.9586 0.5399 0.6483 0.9241	0.9559	0.0174	0.25555	0.0706	<0.001	
or tes ferenc	đf	30 36 26	13	24	28	2	11	
mates f ant dif	alculated test tatistic	0.05 0.47 0.10	0.06	2.56*	1.16	2.13*	6.14*	
orifice passage efficiency esti indicate statistically signific	Analysis source	North orifice trap <sup>b</sup> vs. south orifice trap	North orifice $M/R^d$ vs. south orifice $M/R$	Orifice trap method vs. M/R method	North orifice trap vs. south orifice trap	North orifice M/R vs. south orifice M/R	Orifice trap method vs. M/R method	
nalyses of mean 995. Asterisks ment means.	Analysis type	2 t-test 2 t-test 2 t-test 2 t-test	paired t-test <sup>c</sup>	paired t-test	2 t-test	paired t-test	paired t-test	timation method. block pairing. estimation method.
Statistical a McNary Dam, 1 between treatr	Species	Yearling chinook Steelhead Coho Sockeye	Yearling chinook	Yearling chinook	Subyearling chinook	Subyearling chinook	Subyearling chinook	t-test. passage efficiency est 's t-test using 2 day e passage efficiency e
dix Table 5.	Test dates	21 - 30 April 1 - 31 May 1 - 6 June	28 - 29 April 1 - 31 May 1 - 6 June	28 - 29 April 1 - 31 May 1 - 6 June	22 - 30 June 1 - 31 July 1 August	28 - 30 June 1 - 22 July	28 - 30 June 1 - 22 July	sample Student's Ice trap orifice ed sample Student /recapture orific
Appen	Test series	la	Jb	lc	2a	2b	20	a Two Two C Pair d Mark,

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date         truth         Gatewell         Trap         OPE         Gatewell         Trap         OPE         Gatewell         Trap         Trap         OPE         Gatewell         Trap         Trap         Trap         OPE         Gatewell         Trap         OPE         Gatewell         Trap         Trap         OPE         Gatewell         Trap         OPE         Gatewell         Trap         Trap         OPE         Gatewell         Trap OPE         Gatewell         Trap OPE         Gatewell         Trap OPE         Gatewell         Trap OPE         Gatewell         Trap OPE         Gatewell         Trap OPE         Gatewell         Trap OPE         Gatewell         Trap OPE         Gatewell         Trap OPE         Gatewell         Trap OPE         Gatewell         Trap OPE         Gatewell         Trap OPE         G
21       April       S°       2       167       98.8       90.3         22       April       N       35       373       91.4       89.6       90.3         23       April       N       11       1159       92.5       91.4       89.0       90.3         26       April       N       12       144       1189       92.9       91.4       89.0       90.3         27       April       N       12       177       93.7       91.4       89.0       90.3         28       April       N       12       1177       92.4       91.4       89.0       91.4       91.4         28       April       N       28       347       92.9       91.4
22         April         Nd         19         220         92.1         2         17         89.9         2           25         April         N         11         159         93.5         9
25 April         5         373         91.4         3         28         90.3           26 April         N         11         159         93.5         8         90.3           28 April         N         12         177         93.7         93.5         8         90.3           28 April         N         12         177         93.7         93.5         90.0           29 April         S         14         183         92.5         93.6         90.0           29 April         S         17         300         93.5         93.6         93.5           2 May         S         33         446         92.7         8         40         85         90.0           2 May         S         71         93.5         94.6         91.7         93.5         94.5           6 May         N         71         100.0         268         1200         81.7           6 May         S         71         81         40         83.3         228         93.4           9 May         S         71         81         71         100.0         268         94.6           9 May         S         11 </td
26 April       N       11       159       93.5       80       90.9         27 April       S       17       18       92.9       93.5       10       10       71       87.1         28 April       S       17       183       92.9       94.6       42       557       99.0       90.6         28 April       S       17       300       94.6       92.5       14       100.0       268       1200       81.7       90.6       90.6       90.6       90.6       90.6       90.6       90.6       90.6       90.6       90.6       90.6       91.7
27 April       5       14       183       92.9       10       71       87,7         29 April       8       17       300       94.6       33.7       33.2       299.0       90.0         1       May       8       17       300       94.6       81.7       42       557       93.0         29 April       8       17       300       94.6       92.7       81.7       92.6       93.7         29 April       8       17       300       94.5       8       40       81.7       93.5         2       May       8       35       599       94.5       8       40       81.3       33.3       93.5         5       May       8       74       92.7       4       82       95.3       190       1320       87.4         6       May       8       74       91.7       21       81       79.4       91.4       91.4       91.5       91.4
28       Mpril       N       12       177       93.7       93.7         28       April       N       17       300       94.5       42       559       99.6         2       May       N       28       347       92.5       94.6       42       559       94.6         2       May       N       28       347       92.5       92.7       43       93.3       91.6         2       May       N       28       347       92.5       94.6       93.3       93.5         6       May       N       36       95.2       4       82       93.6       90.6         6       May       N       74       742       93.7       6       81.3       79.4       68.9       54.7       88.9       94.6         9       May       N       74       742       93.7       6       36.9       94.9       91.3       91.4       91.7       91.4       91.7       91.4       91.7       91.4       91.7       91.4       91.7       91.4       91.4       91.7       91.4       91.4       91.7       91.4       91.7       91.4       91.7       91.4       91.7
April         D <thd< th=""> <thd< th=""> <thd< th=""> <thd< th=""></thd<></thd<></thd<></thd<>
Z         May         S         33         416         92.7         14         100.0         2.68         12.00         91.7           6         May         N         35         599         94.5         8         40         83.3         303         93.5           6         May         N         35         599         94.5         8         40         83.3         228         3303         93.5           6         May         N         30         866         91.7         2         31         93.9         94.5           6         May         N         74         742         90.5         10         312         95.9         94.5           10         May         S         11         74         742         90.5         10         317         91.9         91.4           11         May         S         126         1374         91.6         36         93.4         91.7           11         May         S         126         93.4         91.4         91.7         91.4         91.7         91.4         91.7         91.7         91.4         91.7         91.7         91.7         91.4
4         May         N         35         599         94.5         8         40         83.3         228         3303         93.5         5         5         5         7.4         9.1         7.1         8.8         9.4         6.8         5.4         7.4         9.4         6.4         6.8         5.4         5.4         5.4         5.4         5.4         5.4         5.4         5.4
5         May         S         27         540         95.2         4         82         95.3         190         1320         87.4           6         May         N         30         805         96.4         2         31         93.9         49         835         94.5           9         May         N         74         742         99.7         21         81         79.4         68         91.7           10         May         N         74         754         93.7         21         81         79.4         68         91.7           11         May         N         75         92.4         91.7         21         81         79.4         68         91.7           12         May         N         43         52.4         91.6         66         369         96.9         91.7         91.7           12         May         N         210         2384         91.6         4         113         1102         124         91.7           17         May         N         2126         1374         91.6         4         1313         1102         1244         91.7           10
6 May         N         30         805         96.4         2         31         93.9         49         835         94.5           9 May         S         78         866         91.7         21         81         79.4         68         547         88.9           10 May         N         74         742         90.5         10         312         96.9         36         547         88.9           11 May         S         51         754         93.7         6         365         96.9         36.7         93.4           12 May         N         43         524         92.4         9         17         1102         89.4           13 May         S         126         1374         91.6         6         86.6         91.7         6         86.6         94.5           17 May         S         126         1374         91.6         4         1361         98.9         94.4           17 May         S         126         93.4         5         1167         96.0         97.4         96.4           18 May         N         112         1576         91.6         97.1         48         1279
9         May         S         78         866         91.7         21         81         79.4         68         547         88.9           10         May         N         74         742         90.5         10         312         96.9         36         513         93.4           11         May         N         74         742         90.5         10         312         96.9         36         513         93.4           11         May         S         125         1364         91.6         6         369         99.0         131         1102         91.7           13         May         N         210         2384         91.6         4         134         97.0         131         1102         94.4           17         May         N         210         2384         91.6         4         134         97.1         48         1279         94.4           17         May         N         216         93.4         5         115         94.4         97.1         97.4         96.9         94.4           17         May         N         112         91.4         5         115
10       May       N       74       742       90.5       10       312       96.9       36       513       93.4         11       May       S       51       754       93.7       6       369       98.4       113       11244       91.7         12       May       S       51       754       93.7       6       369       98.4       113       1244       91.7         12       May       S       125       1364       91.6       28       656       95.9       94.4       91.7         13       May       S       126       1374       91.9       16       1361       98.8       97.1       40       679       94.4         17       May       S       126       1374       91.9       16       1361       98.9       94.4         17       May       N       112       1374       91.6       4       1279       96.4         18       May       N       112       1374       91.6       5       167       96.4       91.7         18       May       N       112       1974       167       96.0       14.4       1279       96.2<
11       May       S       51       754       93.7       6       369       98.4       113       1244       91.7         12       May       S       125       1364       91.6       524       93.7       6       369       98.4       1102       89.4       91.7         12       May       S       125       1364       91.6       28       656       95.9       94.5       94.4       94.4         13       May       S       125       1364       91.6       16       1361       98.8       94.5       94.4       94.4       94.4       94.4       94.4       94.4       94.4       94.4       94.4       94.4       94.4       94.4       94.4       94.4       94.4       94.4       94.4       94.4       96.4       94.4       94.4       94.4       96.4       94.4       96.4       94.4       96.4       94.4       96.4       94.4       96.4       94.4       96.4       96.4       96.4       96.4       96.4       94.4       1655       96.4       94.4       96.4       96.4       96.4       96.4       96.4       96.4       96.4       96.4       96.4       96.4       96.4       96.
12       May       N       43       524       92.4       94.5         13       May       S       125       1364       91.6       28       656       95.9       50       858       94.5         16       May       S       125       1364       91.6       28       656       95.9       50       89.4         17       May       S       126       1374       91.6       4       134       97.1       48       1279       96.4         17       May       S       112       1576       93.4       5       115       95.8       677       98.2       90.5         18       May       N       112       1576       93.4       5       115       95.8       677       98.2         19       979       89.2       7       167       96.0       174       1655       90.5         20       May       N       78       50       91.7       212       1454       85.4         20       May       S       44       212       82.8       4       212       1454       85.4         21       May       S       44       212
13       May       5       125       1364       91.6       1361       95.9       50       858       94.5         16       May       N       210       2384       91.9       16       1361       98.8       40       679       94.4         17       May       S       126       1374       91.6       4       1374       91.7       98.8       94.0       679       94.4         17       May       S       126       1374       91.6       4       1279       96.4       96.4       96.3       96.4       96.4       96.5       90.5       96.6       91.7       212       1454       85.4       90.5         19       May       N       78       502       86.6       11       121       91.7       212       1454       85.9       95.4         20       May       N       78       502       86.6       11       121       91.7       212       1454       85.4         20       May       S       44       212       82.8       91.7       212       1454       85.4         23       May       S       44       22       81.7       21.2
10       1301       90.0       40       6/9       94.4         17       17       126       1374       91.6       4       134       97.1       48       1279       96.4         18       May       N       112       1576       93.4       5       115       95.8       67       3667       98.2         19       May       N       112       1576       93.4       5       115       95.8       67       3667       98.2         19       May       S       119       97.2       7       167       96.0       174       1655       90.5         20       May       S       119       97.2       1       121       91.7       212       1454       85.4         20       May       S       44       212       86.6       11       121       91.7       212       1454       85.4         23       May       S       44       212       82.8       4       32       88.9       71       188       72.6         24       May       S       15       137       90.1       1       1       1       188       72.6 <td< td=""></td<>
19       May       N       112       1576       93.4       5       115       95.8       67       3667       98.2         19       May       N       112       1576       93.4       5       115       96.0       174       1655       90.5         20       May       N       7       167       96.0       174       1655       90.5         20       May       S       119       97.9       89.2       7       167       96.0       174       1655       90.5         20       May       N       78       502       86.6       11       121       91.7       212       1454       85.4         20       May       S       44       212       82.8       4       32       89.9       71       188       72.6         24       May       N       12       146       92.4       1       1       1       1       188       72.6         25       May       S       15       137       90.1       1       1       1       50.0       39       238       85.9
19       May       S       119       979       89.2       7       167       96.0       174       1655       90.5         20       May       N       78       502       86.6       11       121       91.7       212       1454       85.4         20       May       N       78       502       86.6       11       121       91.7       212       1454       85.4         23       May       S       44       212       82.8       4       32       88.9       42       373       89.9         24       May       N       12       146       92.4       1       8       88.9       71       188       72.6         25       May       S       15       137       90.1       1       1       50.0       39       238       85.9
20 May       N       78       502       86.6       11       121       91.7       212       1454       85.4         23 May       S       44       212       82.8       4       32       88.9       42       373       89.9         23 May       S       44       212       82.8       4       32       88.9       42       373       89.9         24 May       N       12       146       92.4       1       8       88.9       71       188       72.6         25 May       S       15       137       90.1       1       1       50.0       39       238       85.9
23 May     S     44     212     82.8     4     32     88.9     42     373     89.9       24 May     N     12     146     92.4     1     8     88.9     71     188     72.6       25 May     S     15     137     90.1     1     1     1     238     85.9
24 May N 12 146 92.4 1 8 88.9 71 188 72.6 25 May S 15 137 90.1 1 1 50.0 39 238 85.9
25 May S 15 137 90.1 1 1 50.0 39 238 85.9
Z6 May N 39 L4 N 39 A 120 58 Nay N 39 L4 D 120 58 A 26 May N 39 A 120 A
27 May S 15 88 85.4 1 5 80.0 36 164 82.0

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	p OPE	TIIId LC	89.0	97.6	58.3	57.1	95.5	81.1	74.2	78.7	88.2	
	ye Tra	ממ								-056		
	Trap	Carci	105	80	42	72	63	86	72	48	15	
	Gatewell	Carcin	13	7	30	54	m	20	25	13	2	
	Trap OPE	Cartillare	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	2
	Trap	Carcin	16	e	4	2	Ч	1	2	S	٦	
	Gatewell	Carcin										
	Trap OPE	escrimate	96.9	100.0	95.6	90.1	100.0	94.6	94.2	96.8	100.0	а ————————————————————————————————————
tinued.	Steelhead Trap	carcn	123	46	86	273	89	88	49	60	58	
6. Con	Gatewell	catcn	4		4	30		2	e	2		
x Table	Orifice trap		N	S	N	S	N	S	N	S	N	
Appendi	Test date		29 May	31 May	1 June	2 June	3 June	4 June	5 June	6 June	7 June	

5W)

Appendix Table 7. Daily subyearling chinook orifice passage efficiency (OPE) estimates obtained using orifice traps (Trap OPE) and mark/recapture (M/R OPE) estimation methods, McNary Dam, 1995.

	Test late	Orifice trap	Orifice tr Gatewell catch <sup>a</sup>	rap estima Trap catch <sup>b</sup>	Trap OPE estimate	Mark/recapt Marked released <sup>c</sup>	Marked recaptured <sup>d</sup>	on method M/R OPE estimate
22	June	Ne	424	5504	92.8			
23	June	Sf	379	701	64.9			
24	June	N	645	1393	68.4			
27	June	S	1392	3434	71.2			
28	June	N	2419	5242	68.4	100		100.0
29	june	S	1656	3973	70.9	100	1	99.0
30	June	N	1515	5275	77.7	100	2	98.0
1	July	S	783	7161	90.1	100		100.0
6	July	N	1537	16151	91.3	100	13	<sup>6</sup> 87.0
7	July	S	610	5482	90.0	100		100.0
8	July	N	3157	5440	63.3	100	17	83.0
9	July	S	193	2355	92.4	100		100.0
10	July	N	731	2020	73.4	100		100.0
11	July	S	707	9710	93.2	100		100.0
12	July	N	556	2731	83.1	100	4	96.0
13	July	S	56	803	93.5	100	1	99.0
14	july	N	17	477	96.6	100		100.0
15	July	S	120	1679	93.3	100		100.0
18	July	N	172	984	85.1	100	2	98.0
19	July	S	31	1027	97.1			
20	July	N	288	970	77.1	100	7	93.0
21	July	S	409	1459	78.1	100	1	99.0
22	July	N	819	1971	70.6	100		100.0
25	July	S	104	742	87.7			
26	July	N	102	812	88.8			
27	July	S	61	288	82.5			
28	July	N	56	6672	92.3			
29	July	S	55	296	84.3			
30	July	N	38	297	88.7			
1	August	c S	26	436	94.4			

- <sup>a</sup> Fraction captured from gatewell using dip baskets at the end of the test.
- <sup>b</sup> Fraction enumerated from orifice trap during the test.
- <sup>C</sup> Number of marked fish released at the beginning of the test, time t.
- d Number of marked fish recaptured at the end of the test, time t+1.
- e North orifice trap.

f South orifice trap.

![](_page_42_Picture_9.jpeg)