

Lower Colorado River Multi-Species Conservation Program



Balancing Resource Use and Conservation

Effects of Elevated pH on Survival of Early Life Stage Razorback Sucker and Bonytail

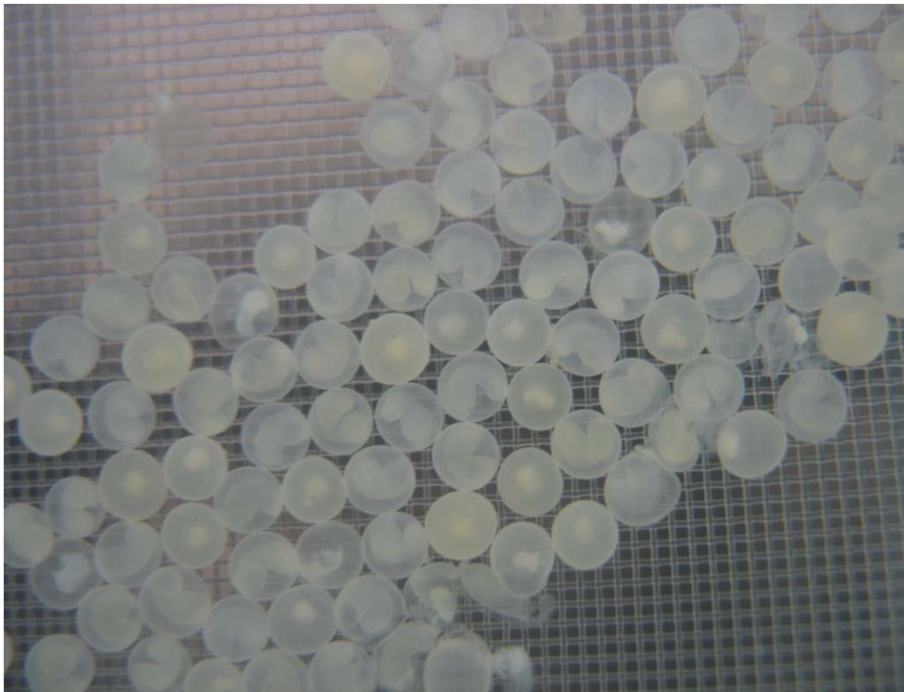
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pH Tolerance



OBJECTIVES

- Identify the lethal pH limit for razorback sucker eggs, larvae, and fingerling/juvenile life stages
- Identify the lethal pH limit for the bonytail fingerling/juvenile life stage
- Evaluate survival through both acute (72 hour) and chronic (15 – 20 days) exposures to elevated pH



Methods



- Experimental setup
- Target temperatures
- Target pH 7 – 11
- WQ recorded three times daily
- Periodic water exchange for all tanks during 15-20 d trials



Results



Razorback Egg Hatch

- 5 to 7 days required for complete hatch

Table 1: Percent survival to swim-up stage. Table values represent combined totals of three replicate pH treatments.

| Target pH | Median pH (range in parentheses) | Number of Eggs * | Larvae from Eggs | % Survival |
|-----------|----------------------------------|------------------|------------------|------------|
| 7.00 | 7.09 (6.96 – 7.14) | 3750 | 2335 | 62.6 |
| 8.00 | 7.99 (7.88 – 8.18) | 4800 | 2241 | 46.7 |
| 9.00 | 8.96 (8.91 – 9.04) | 3750 | 2029 | 54.1 |
| 10.00 | 9.95 (9.89 – 10.09) | 4800 | 117 | 2.4 |
| 11.00 | 11.1 (10.92 – 11.07) | 3750 | 0 | 0 |

* - number of eggs estimated based on 50 eggs/mL measurement.

Results



Razorback Larval Trials (72 hour exposure)

Table 2: Larval Mortality. Table values represent combined totals of replicate pH treatments.

| Target pH | Median pH (range) | Percent Mortality |
|-----------|-----------------------|-------------------|
| 7.00 | 7.04 (6.98 – 7.14) | 1.7 |
| 8.00 | 8.00 (7.94 – 8.13) | 0.6 |
| 9.00 | 8.98 (8.89 – 9.11) | 0.0 |
| 10.00 | 9.97 (9.92 – 10.08) | 0.0 |
| 10.25 | 10.23 (10.20 – 10.31) | 21.0 |
| 10.50 | 10.50 (10.42 – 10.59) | 57.0 |

Results



Razorback Larval Trials (15 day exposure)

Table 3: Larval Mortality. Table values represent combined totals of replicate pH treatments.

| Target pH | Median pH (range) | Percent Mortality |
|-----------|-----------------------|-------------------|
| 7.00 | 7.04 (6.94 – 7.24) | 3.6 |
| 8.00 | 8.04 (7.92 – 8.19) | 2.3 |
| 9.00 | 9.02 (8.89 – 9.16) | 0.6 |
| 10.00 | 9.96 (9.90 – 10.08) | 1.3 |
| 10.25 | 10.30 (10.23 – 10.38) | 48.0 |
| 10.50 | 10.51 (10.42 – 10.56) | 98.6 |

Results



Razorback Fingerling Trial results at 20°C

- Fingerling average TL 83.7 mm (58 - 110 mm)

Table 4: Razorback Fingerling Mortality. Table values represent combined totals of replicate pH treatments evaluated at 20°C.

| | Target pH | Median pH (range) | Percent Mortality |
|------|-----------|---------------------|-------------------|
| 72 h | 7.00 | 7.10 (6.99 – 7.12) | 5.0 |
| | 8.00 | 8.26 (8.15 – 8.31) | 0.0 |
| | 9.00 | 8.99 (8.92 – 9.09) | 0.0 |
| | 9.50 | 9.53 (9.50 – 9.56) | 0.0 |
| | 10.00 | 9.94 (9.89 – 10.06) | 0.0 |
| 15 d | 7.00 | 7.16 (6.99 – 7.20) | 12.0 |
| | 8.00 | 8.34 (8.15 – 8.40) | 0.0 |
| | 9.00 | 9.06 (8.92 – 9.13) | 3.3 |
| | 9.50 | 9.51 (9.45 – 9.61) | 18.0 |
| | 10.00 | 9.99 (9.89 – 10.06) | 86.6 |

Results



Razorback Fingerling Trial results at 30°C

- Fingerling average TL 81.8 mm (61 - 110 mm)

Table 5: Razorback Fingerling Mortality. Table values represent combined totals of replicate pH treatments evaluated at 30°C.

| | Target pH | Median pH (range) | Percent Mortality |
|------|-----------|----------------------|-------------------|
| 72 h | 7.00 | 7.15 (7.04 – 7.26) | 3.3 |
| | 8.00 | 8.27 (8.24 – 8.29) | 0.0 |
| | 9.00 | 8.98 (8.92 – 9.05) | 0.0 |
| | 9.50 | 9.46 (9.45 – 9.55) | 33.3 |
| | 10.00 | 10.01 (9.92 – 10.09) | 38.3 |
| 15 d | 7.00 | 7.18 (7.04 – 7.44) | 8.3 |
| | 8.00 | 8.25 (8.08 – 8.37) | 11.6 |
| | 9.00 | 8.99 (8.92 – 9.15) | 8.3 |
| | 9.50 | 9.51 (9.45 – 9.61) | 41.6 |
| | 10.00 | 10.08 (9.92 – 10.13) | 96.6 |

Results



Bonytail Fingerling Trial results at 20°C

- Fingerling average TL 94.4 mm (62 - 133 mm)

Table 6: Bonytail Fingerling Mortality. Table values represent combined totals of replicate pH treatments evaluated at 20°C.

| | Target pH | Median pH (range) | Percent Mortality |
|------|-----------|-----------------------|-------------------|
| 72 h | 7.00 | 7.13 (7.00 – 7.19) | 0.0 |
| | 8.00 | 8.27 (8.24 – 8.29) | 36.0 |
| | 9.00 | 9.00 (8.93 – 9.10) | 0.0 |
| | 10.00 | 9.99 (9.88 – 10.05) | 0.0 |
| | 11.00 | 10.93 (10.89 – 10.95) | 100.0 |
| 20 d | 7.00 | 7.14 (7.00 – 7.20) | 4.0 |
| | 8.00 | 8.26 (8.24 – 8.29) | 2.6 |
| | 9.00 | 9.06 (8.94 – 9.09) | 0.0 |
| | 9.50 | 9.49 (9.40 – 9.58) | 21.3 |
| | 10.00 | 10.03 (9.94 – 10.05) | 93.3 |

Results



Bonytail Fingerling Trial results at 30°C

- Fingerling average TL 95 mm (71 - 122 mm)

Table 7: Bonytail Fingerling Mortality. Table values represent combined totals of replicate pH treatments evaluated at 30°C.

| | Target pH | Median pH (range) | Percent Mortality |
|------|-----------|----------------------|-------------------|
| 72 h | 7.00 | 7.20 (7.16 – 7.24) | 1.6 |
| | 8.00 | 8.30 (8.22 – 8.39) | 0.0 |
| | 9.00 | 8.95 (8.89 – 9.02) | 0.0 |
| | 9.50 | 9.58 (9.46 – 9.61) | 3.0 |
| | 10.00 | 10.00 (9.91 – 10.06) | 10.0 |
| 20 d | 7.00 | 7.14 (7.00 – 7.20) | 5.3 |
| | 8.00 | 8.26 (8.24 – 8.29) | 10.0 |
| | 9.00 | 9.06 (8.94 – 9.09) | 8.0 |
| | 9.50 | 9.49 (9.40 – 9.58) | 37.3 |
| | 10.00 | 10.03 (9.94 – 10.05) | 82.6 |

Summary



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- Razorback sucker eggs successfully hatched (54.1%) at pH 9. Success was greatly reduced at pH 10 with only 2.4% hatch.
 - Larval razorback survived for 15 days at pH 10 with minimal mortality. Mortality increased significantly at pH 10.25 and 10.5.
 - Razorback fingerlings had relatively low mortality (18 %) when exposed to pH 9.5 at 20°C for 15 days. Mortality for this treatment doubled when temperature was increased to 30°C.
 - Near total mortality observed for razorback fingerlings exposed to pH 10 at both 20 and 30°C.
 - Bonytail fingerlings had moderate mortality at pH 9.5 for both trial temperatures. Sharp increase in mortality at pH 10.

Questions



Acknowledgements

- NDOW: Mike Burrell
- NPS: Ross Haley, Bryan Moore, Mitch Urban
- USBR: MSCP Fisheries Group, Mike Horn
- USFWS: Mark Olson, Mark Yost

