Acclimation Strategies Improve Post-release Performance of Hatchery Salmon and Steelhead in Northeast Oregon

By

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OREGON Fish & Wildlife

BONNEVILLE POWER ADMINISTRATION

LOWER SNAKE RIVER COMPENSATION PLAN Hatchery Program

Why Acclimate Salmon and Steelhead?

1. Provides operational flexibility for hatchery operations.
2. Provides smolts a recovery period from transportation stress.
    - May increase smolt-to-adult survival rates
3. Increased exposure to release waters
    - May increase adult homing fidelity
    - Exposes smolts to natural temperature cues
4. Volitional release following acclimation might synchronize smolt preparedness for migration with river entry.
    - Possible benefits: increased survival and homing, decreased interactions with wild fish
5. Used as a tool to remove residual steelhead.

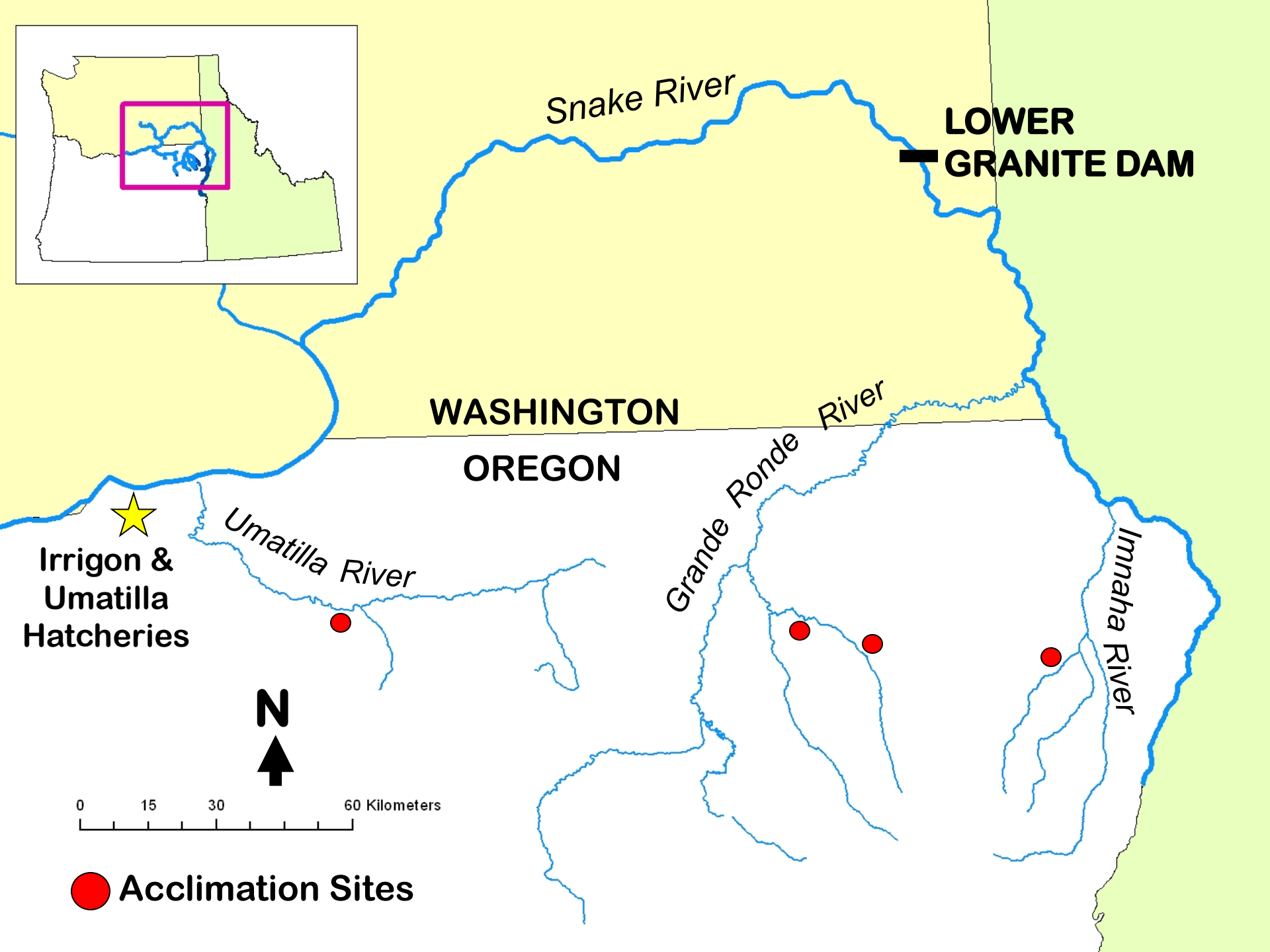
STUDY DESIGNS

1. *Steelhead Acclimation vs. Direct-Release:* One group released after a 16-57 day acclimation, the other group direct-released on same day.

   - 14 paired groups.
     - Spring Creek, (1987-1990)
     - Deer Creek, (1991-1996)
     - Little Sheep Creek, (1993-1996)

2. *Spring Chinook Two and Four Month Acclimation:* One group transferred to acclimation in November, a second group transferred in January. Both groups released in March.

   - 6 paired groups released into the Umatilla River, (2000-2005)


Snake River
LOWER
GRANITE DAM
WASHINGTON
OREGON
Grande Ronde River
Imnaha River
Umatilla River
Irrigon &
Umatilla
Hatcheries
N
0
15
30
60 Kilometers
Acclimation Sites

COMMON METHODS

1. Rearing in hatchery raceways to yearling stage, water temperature range = 10 -14 °C. Fish trucked 1.5 to 4.5 h to acclimation sites.

2. Release groups of 25,000 to 80,000 coded-wire-tagged fish; tag recoveries used to estimate smolt-to-adult survival and straying. A sample of fish were freeze-branded or PIT-tagged to measure outmigration travel time and survival to dam. Rearing densities were between 12-28 kg/m^3.

Response Metrics

1. Outmigration Travel Time
2. Outmigration Survival
3. Smolt-to-Adult-Survival
4. Stray Rate Index

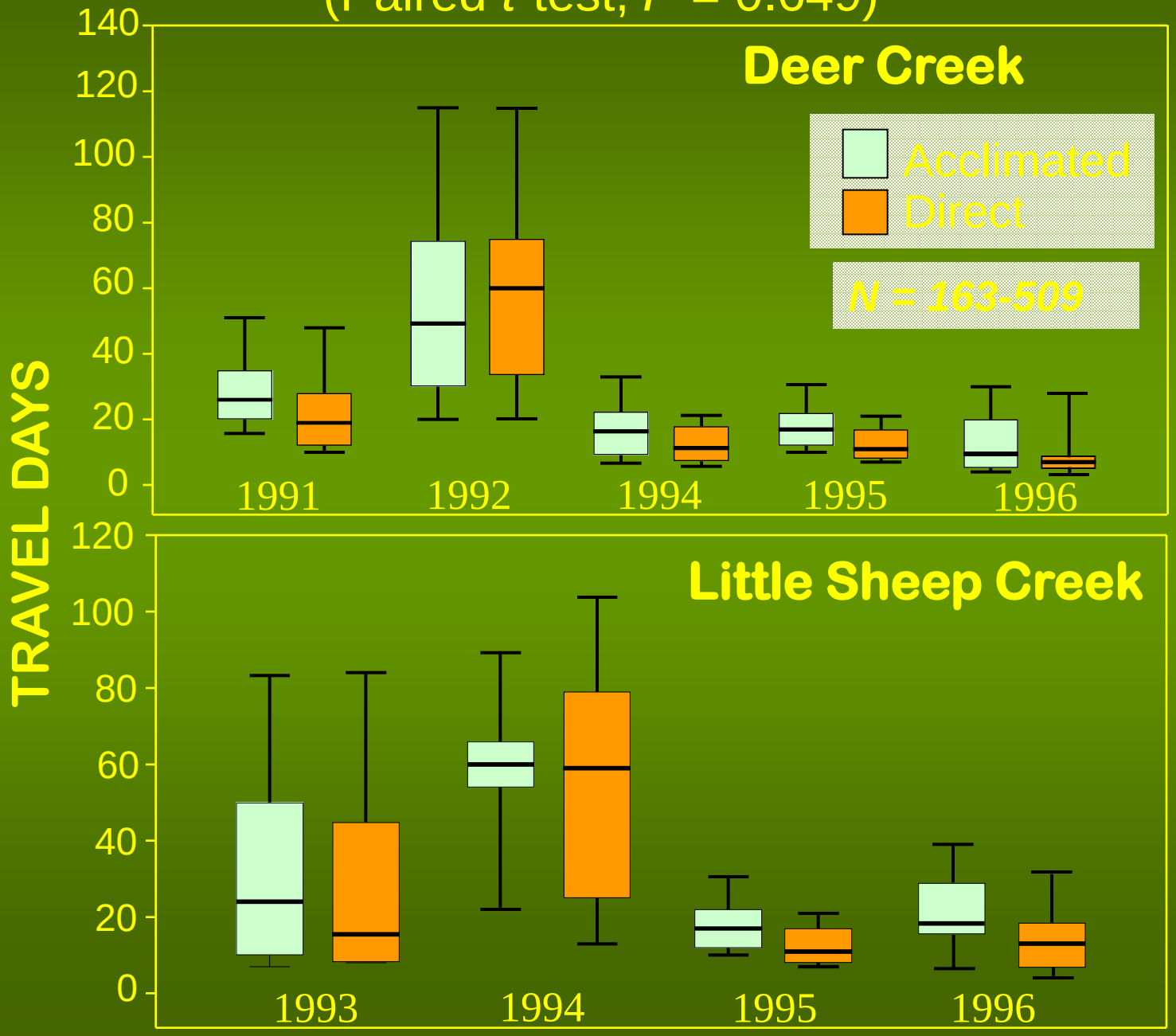
Acclimation Ponds

- Concrete ponds, not semi-natural
- Acclimation densities similar to hatchery densities

ACCLIMATION VERSUS DIRECT-RELEASE RESULTS

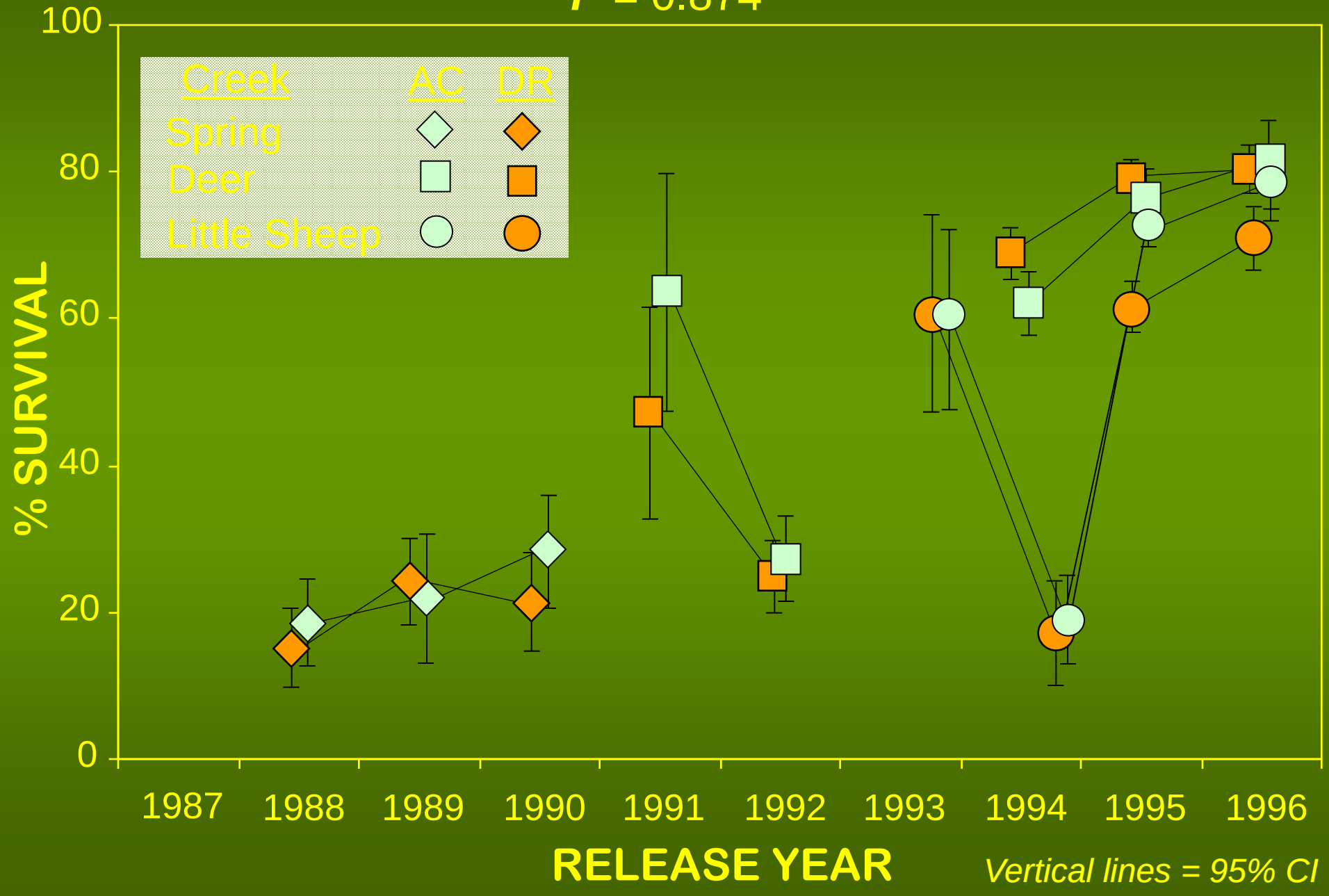
SIMILAR TRAVEL TIME TO LOWER GRANITE DAM

(Paired *t*-test, *P* = 0.649)

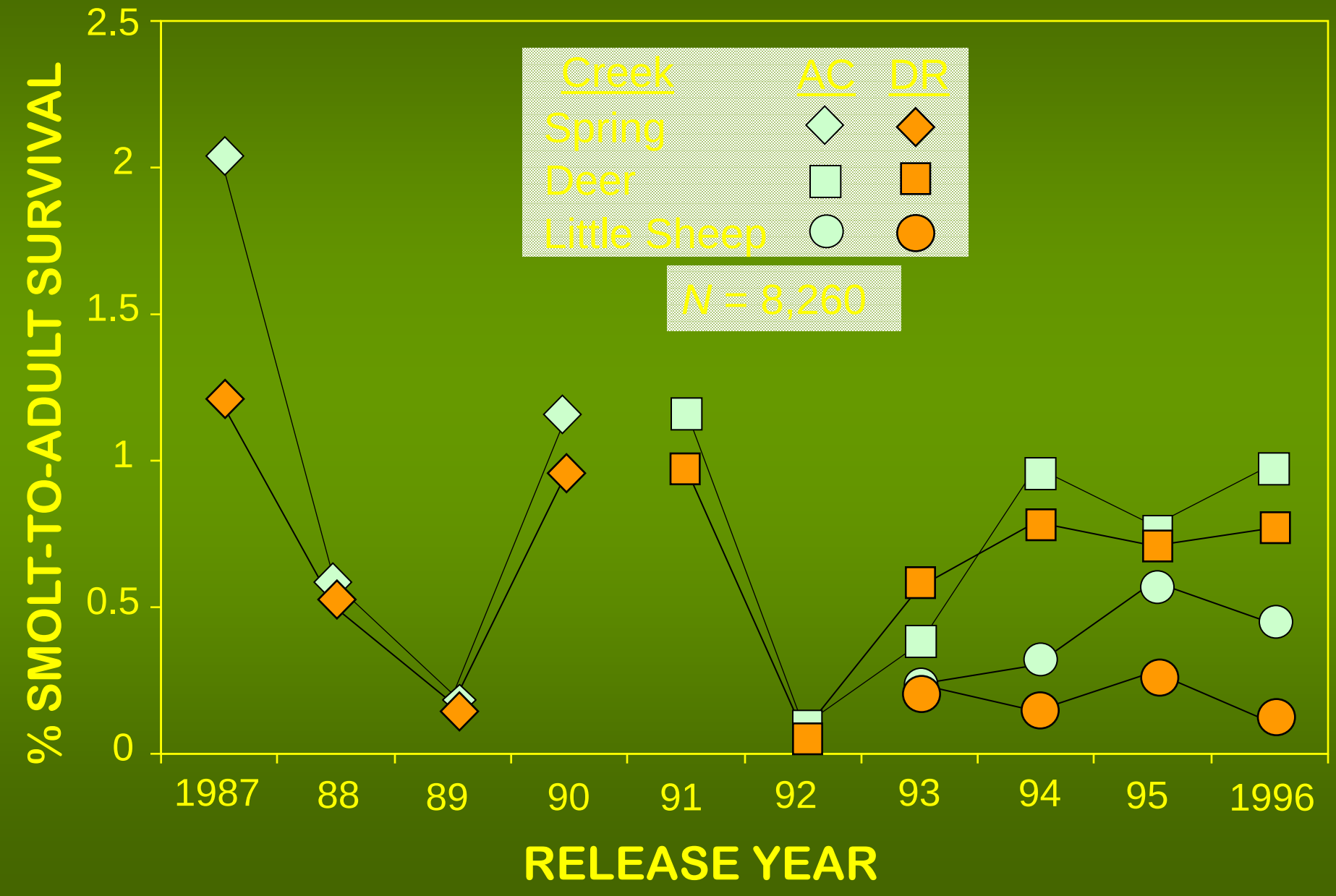


SIMILAR OUTMIGRATION SURVIVAL TO DAM

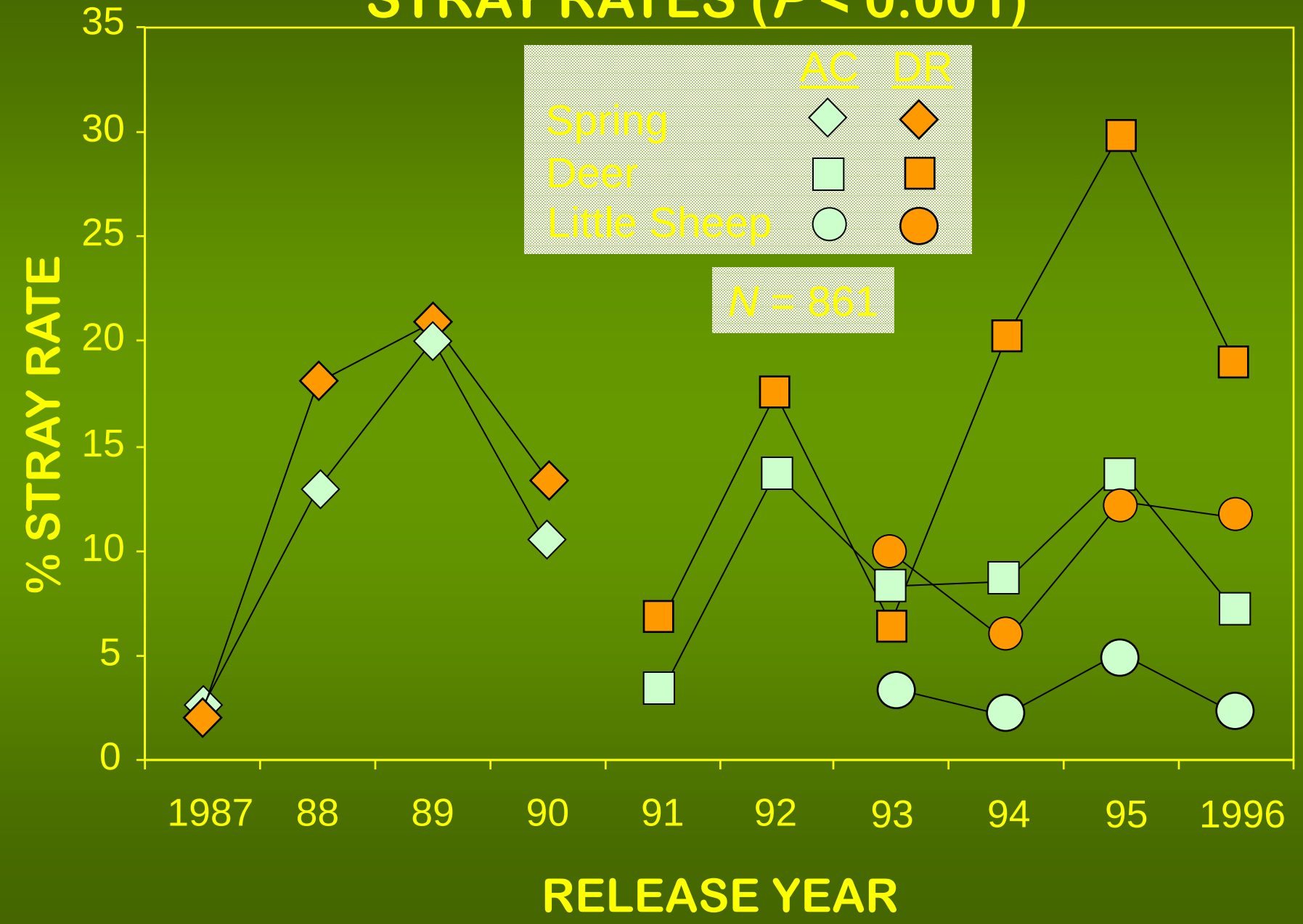
P = 0.874



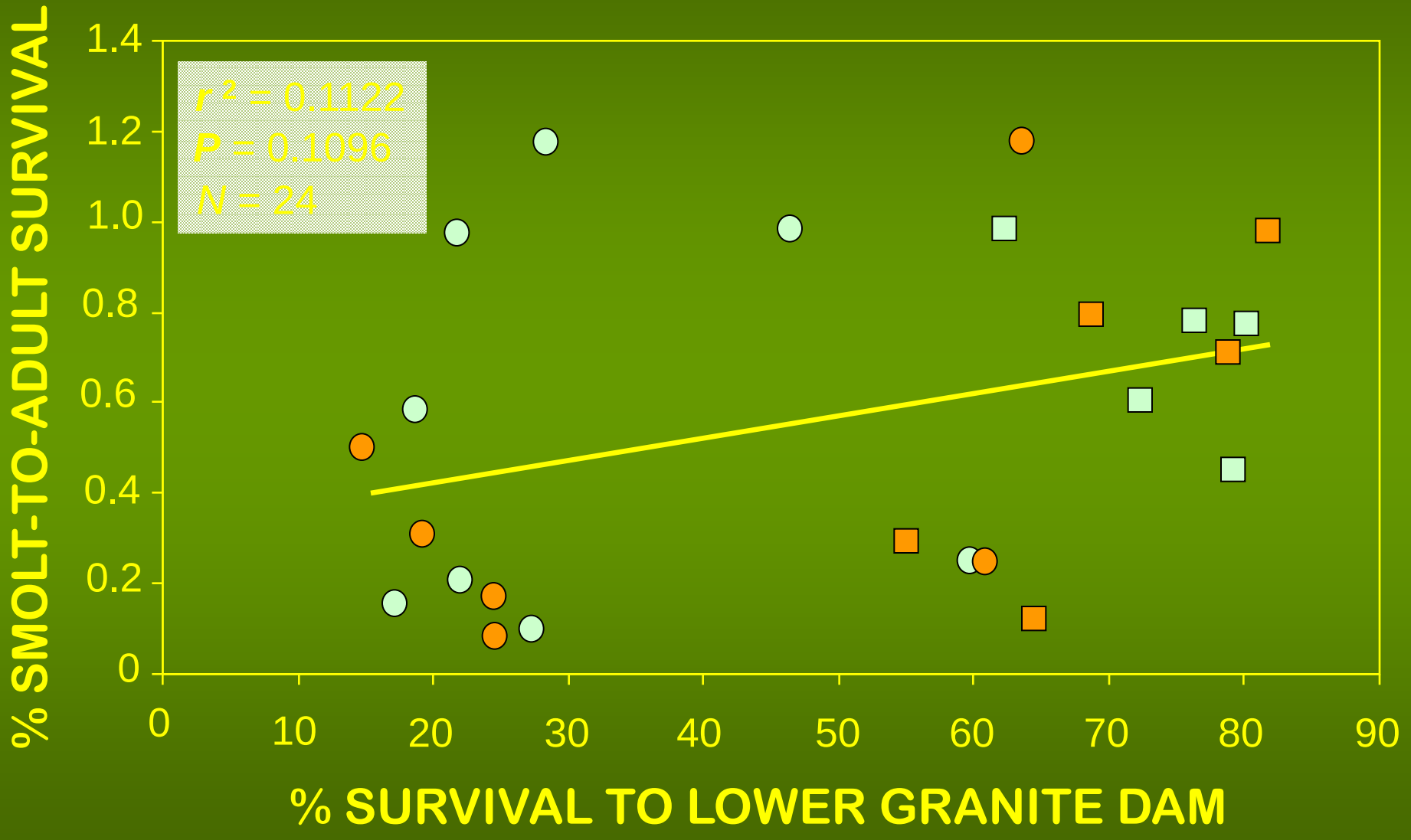
ACCLIMATED GROUPS HAD 32% HIGHER SURVIVAL TO ADULTHOOD ($P = 0.013$)



ACCLIMATED GROUPS HAD 41% LOWER STRAY RATES ($P < 0.001$)



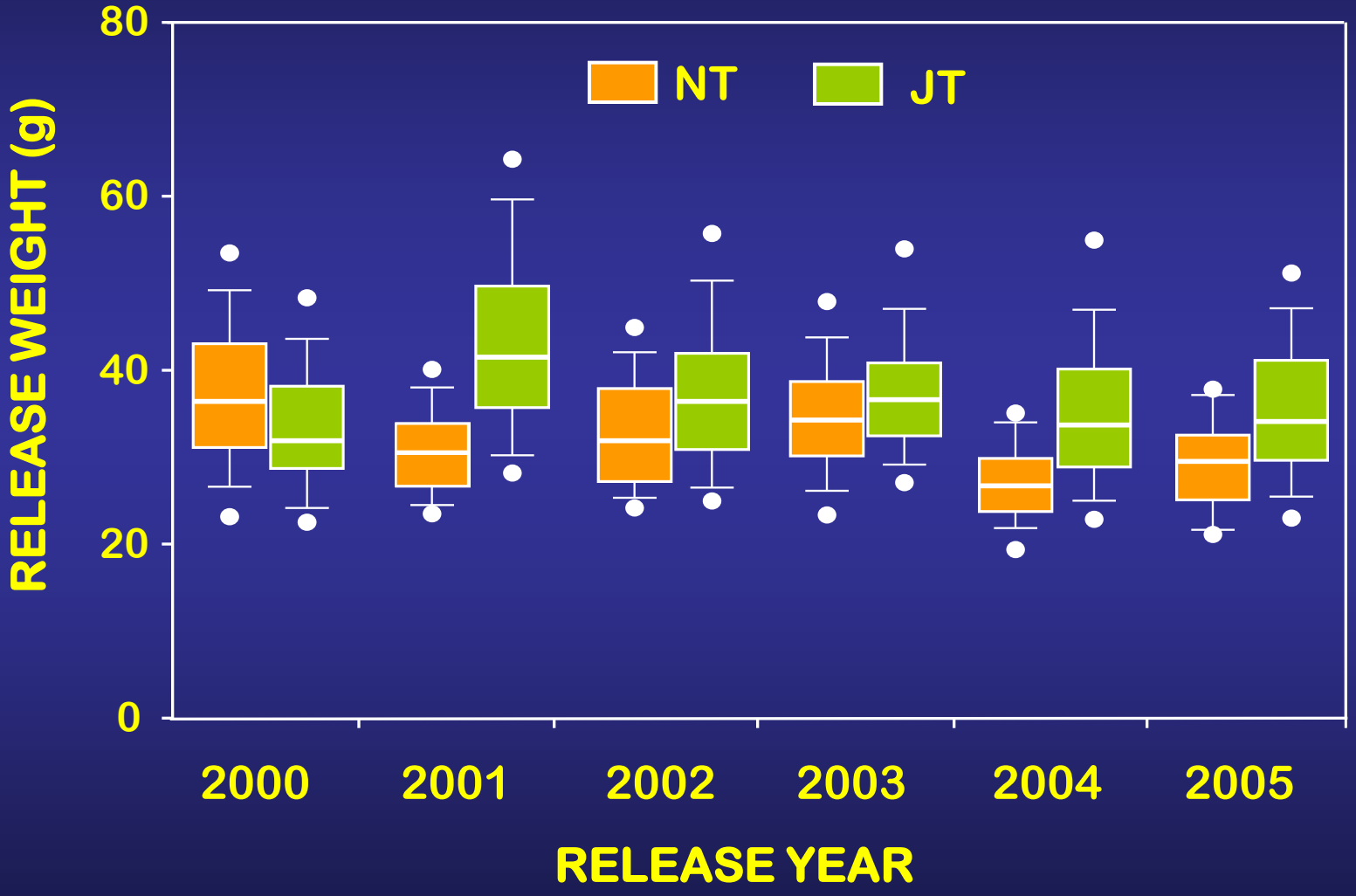
DOES OUTMIGRATION SURVIVAL MATTER?



Spring Chinook Two and
Four Month Acclimation

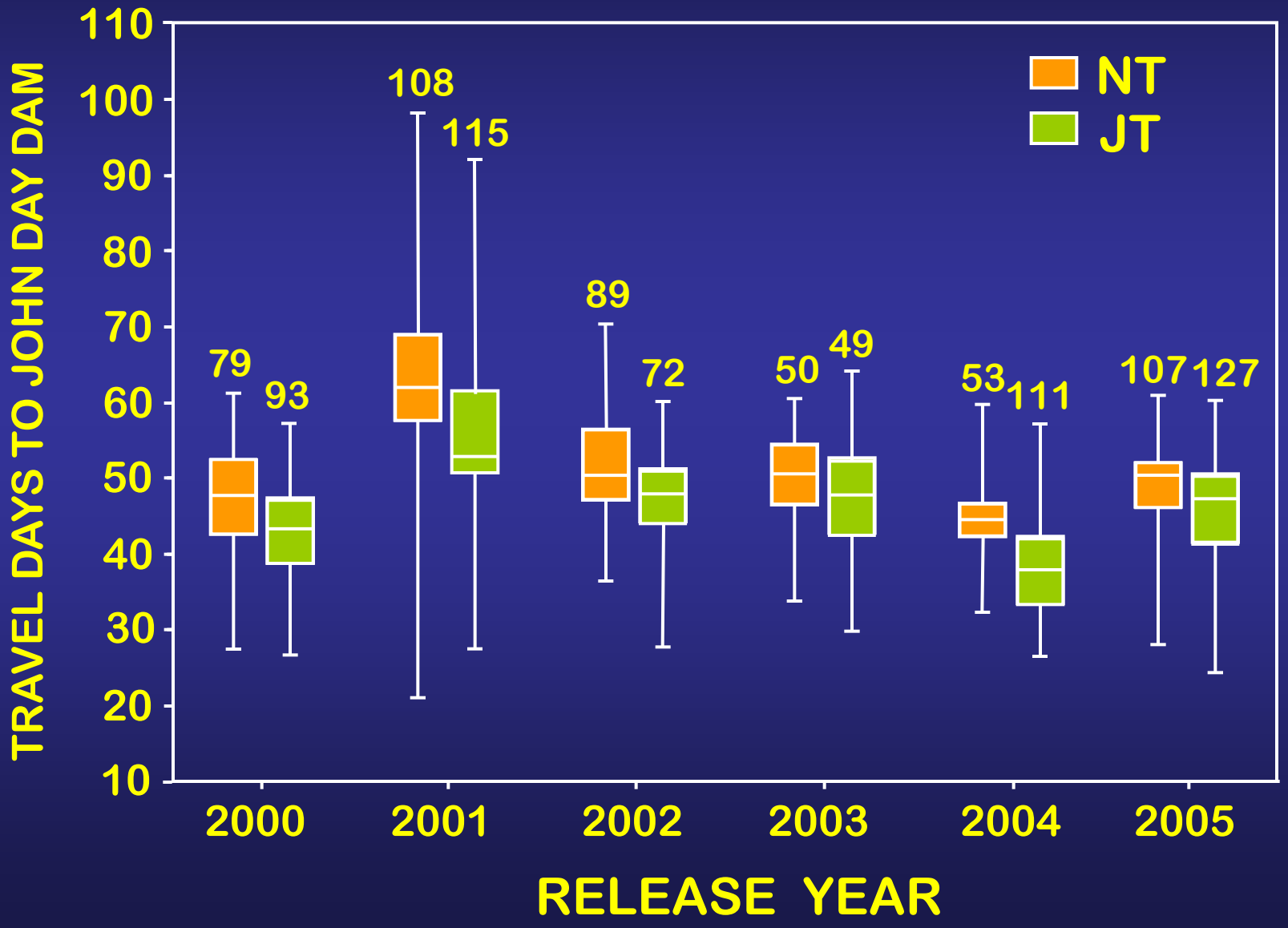
Average Weight at Release

JT groups averaged 18% larger at release



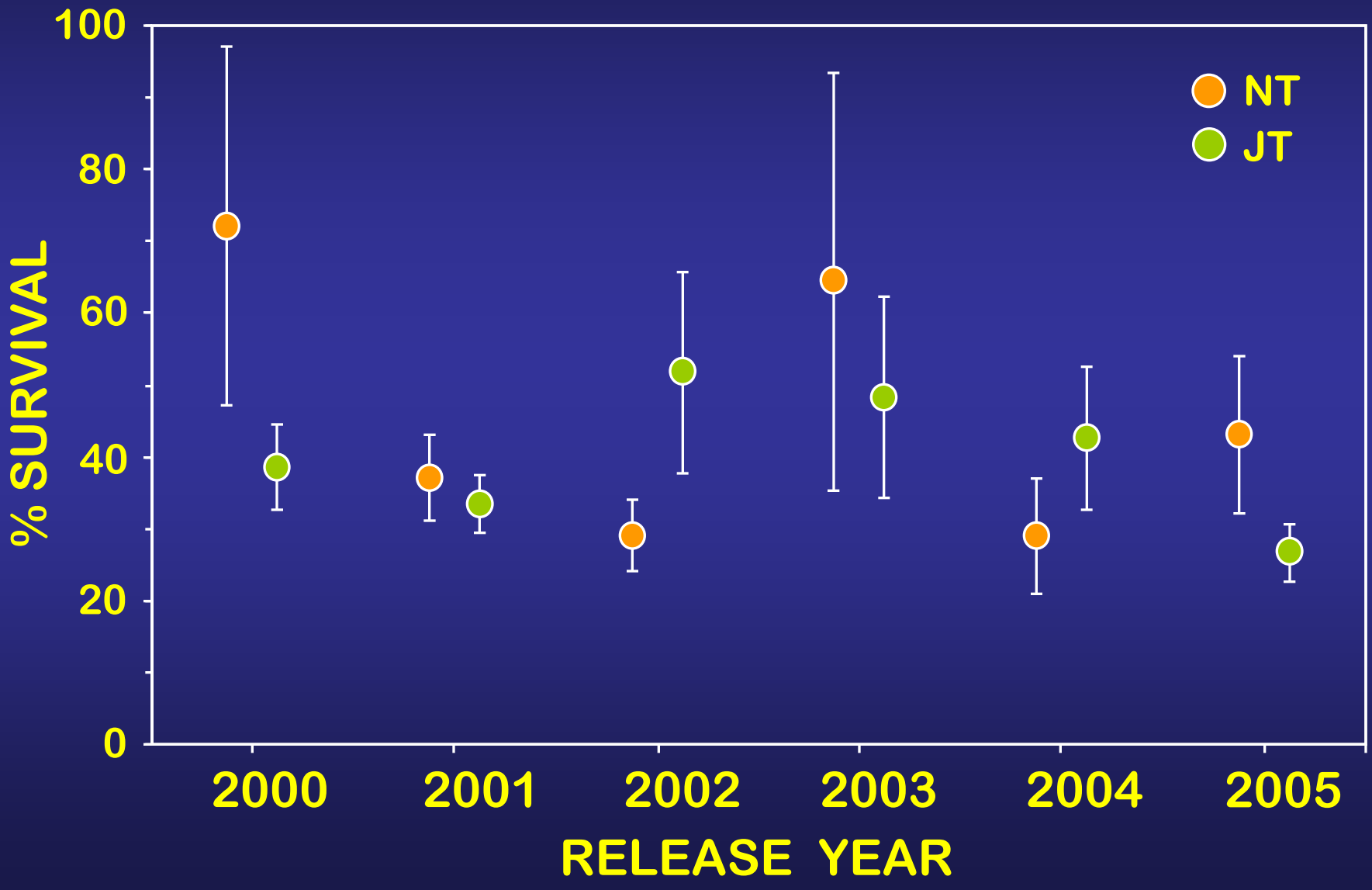
Juvenile Travel Time to John Day Dam

NT groups slower, significant difference (*t*-test; $P < 0.001$)

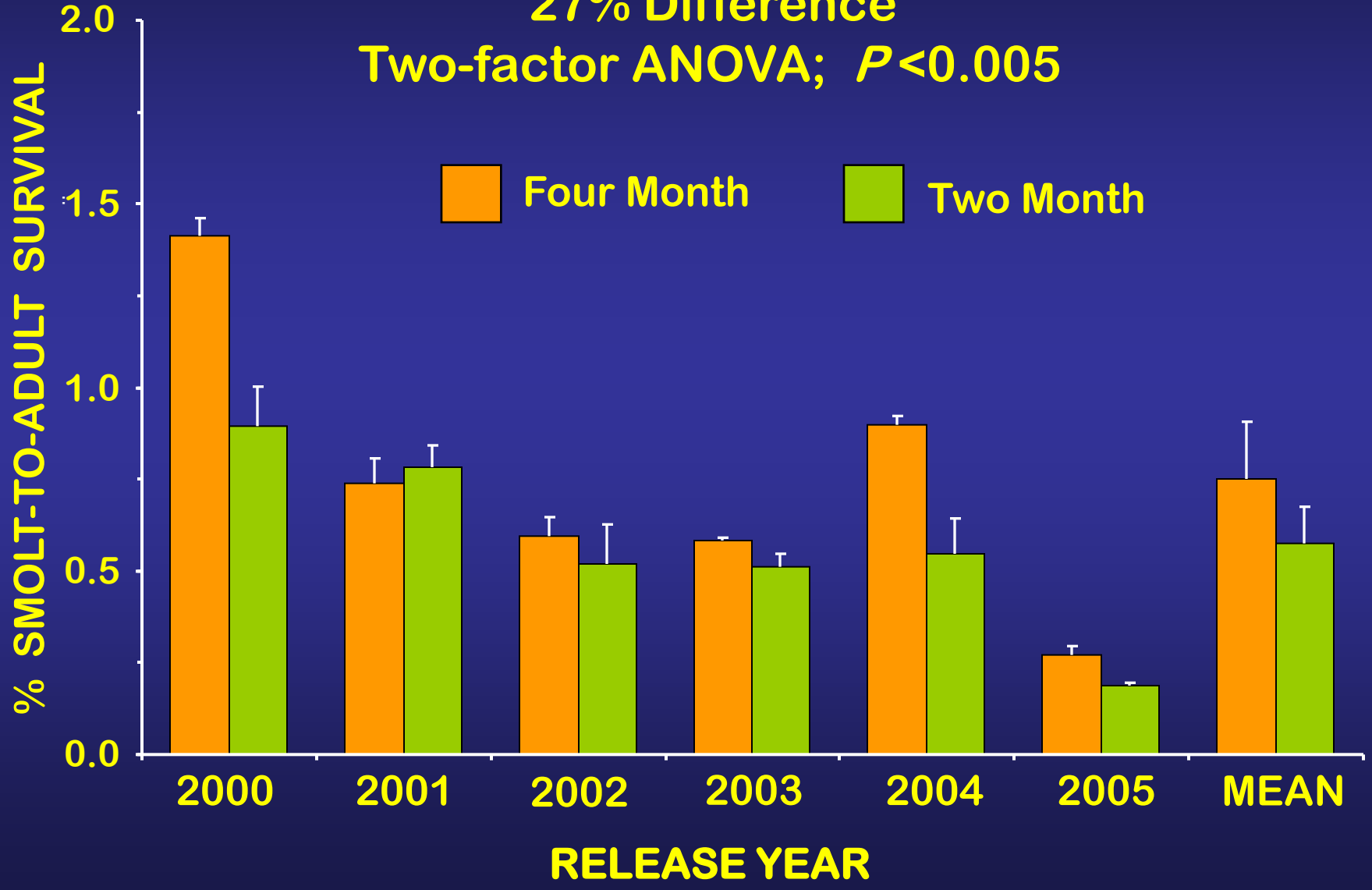


Outmigration Survival to John Day Dam

t-test; *P* = 0.524



Survival to Adulthood, Four Month vs. Two Month Acclimation



CONCLUSIONS

1. Acclimation increased steelhead survival to adulthood and decreased straying.
   - Acclimation appears to ameliorate affects of stress.
   - Survival results not consistent with other steelhead acclimation studies.

2. Four month acclimation increased Chinook survival.
   - Parr-smolt transformation may have been improved by seasonal cues, but measurements not made.
   - Growth profile of NT groups a closer match to natural spring Chinook.

3. Juvenile outmigration survival did not correlate well with survival to adulthood.
   - Judge the success of release groups based on adult returns.

Adjust Acclimation Protocols to the Hatchery Program

1. Acclimation locations, length, timing, fish densities, etc., can affect success of release groups. Hatchery specific investigations are needed.
2. For supplementation programs, small temporary acclimation ponds spread throughout the watershed may promote a better distribution of returning adult spawners.
3. Acclimation is an ideal time to develop behavioral traits (i.e. prey or predator recognition training) that may improve survival.
4. We use volitional release following acclimation as a tool to remove residual steelhead; however, difficult to judge the success of that strategy.

For More Information

Clarke, L.R., M.W. Flesher, T.A. Whitesel, G.R. Vonderohe, and R.W. Carmichael. 2010. Post-release performance of acclimated and direct-released hatchery summer steelhead into Oregon tributaries of the Snake River. North American Journal of Fisheries Management 30:1098-1109.

Clarke, L.R., M.W. Flesher, S.M. Warren, and R.W. Carmichael. 2011. Survival and straying of hatchery steelhead following forced or volitional release. North American Journal of Fisheries Management 31:116-123.

Clarke, L.R., W.A. Cameron, and R.W. Carmichael. 2012 Performance of spring Chinook salmon reared in acclimation ponds for two and four months before release. North American Journal of Aquaculture 74: 65-72