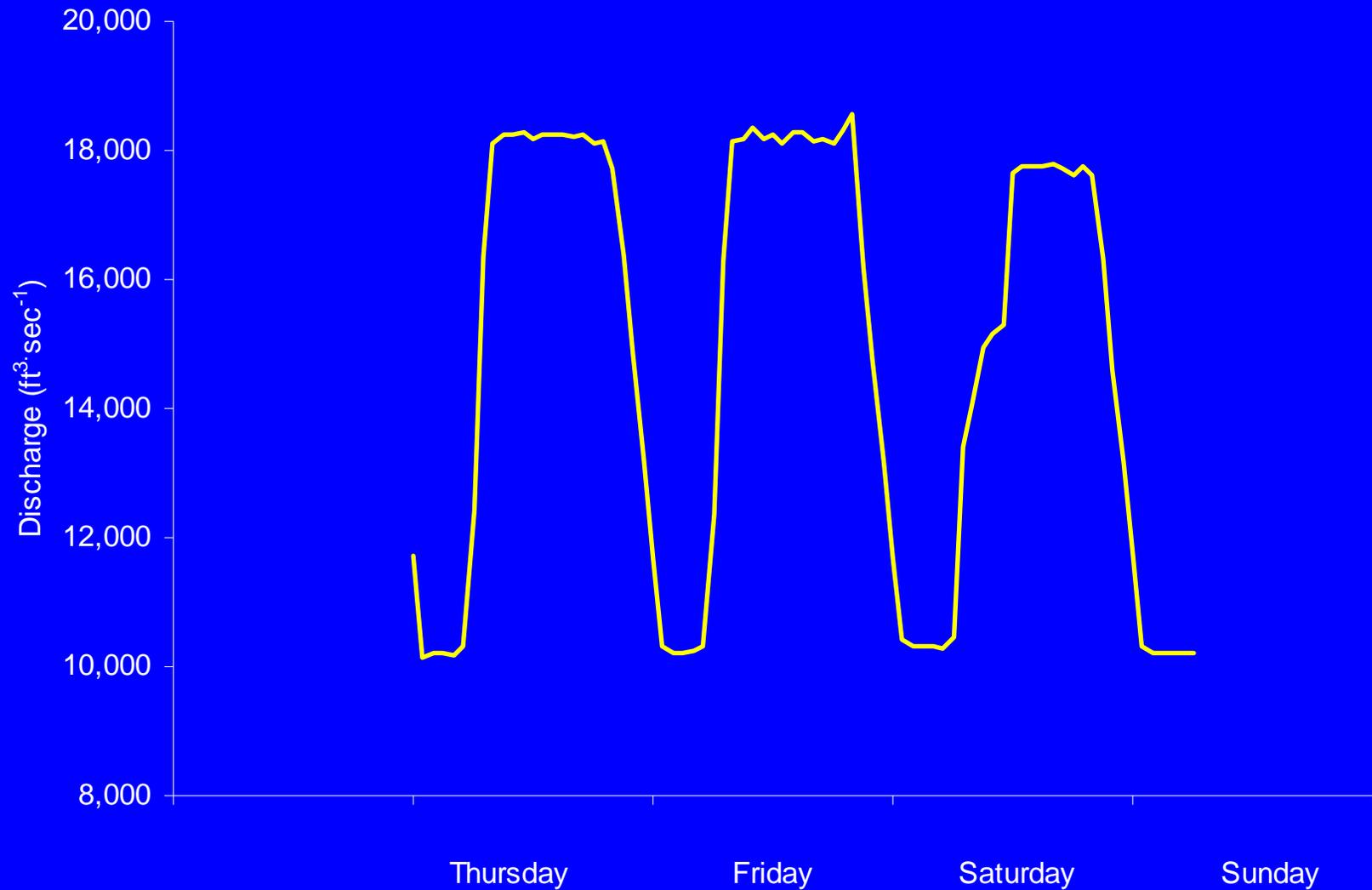


**Hourly and Seasonal Variation in
Nearshore Habitat Use by Age-0 Rainbow
Trout In Lees Ferry:**

**Implications for Nonnative Fish
Suppression Flow Experiments**

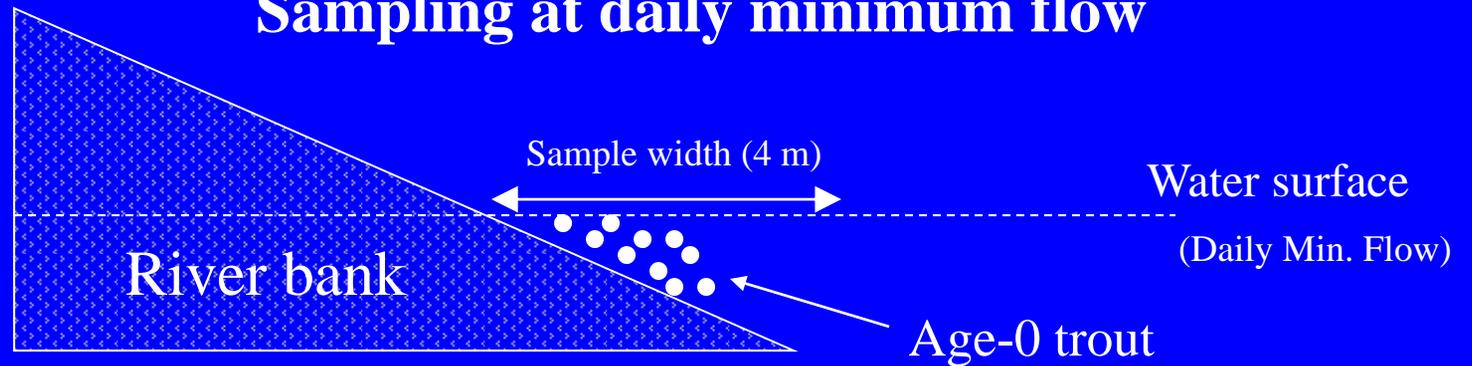
Josh Korman

GCD Weekday Hydrograph, Summer 2004



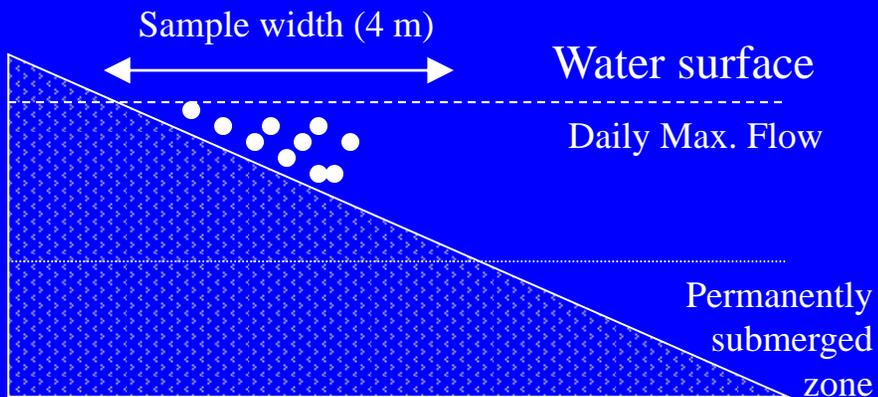
Alternate movement responses to changes in flow

Sampling at daily minimum flow

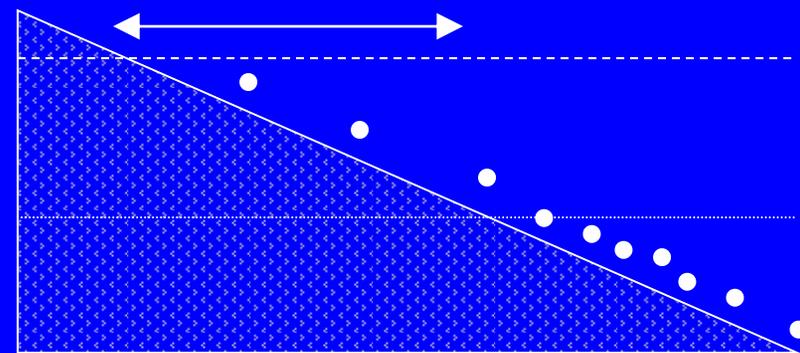


Sampling at daily maximum flow

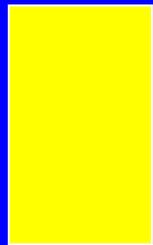
1) Shoreline-tracking



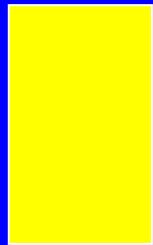
2) Restricted-Movement



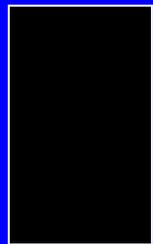
Design of flow-nearshore abundance evaluation



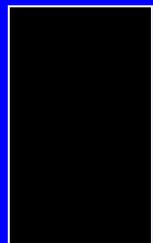
Min Q - day



Max Q - day



Min Q - night



Max Q - night

Δ day

Δ night

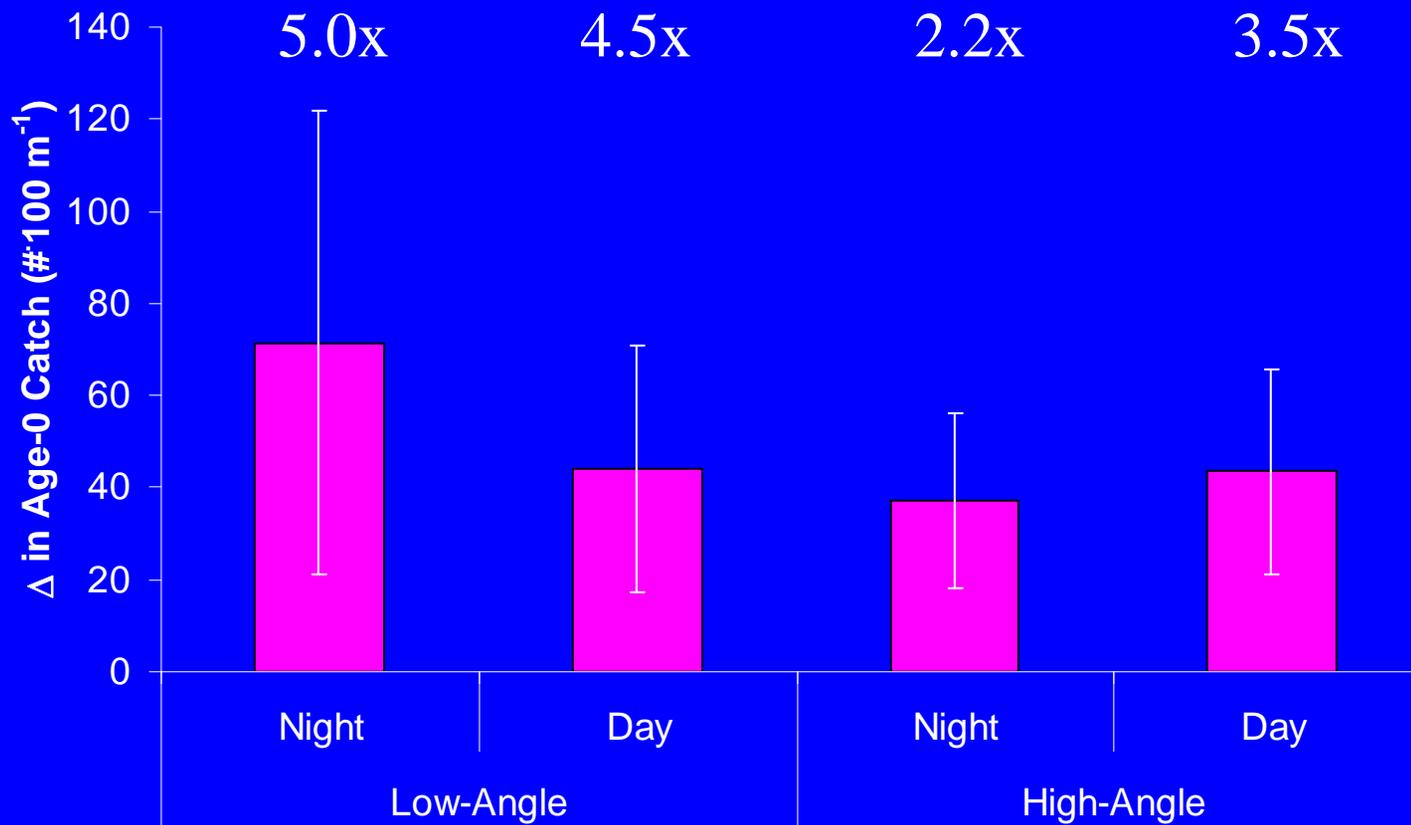
x 12 sites

Low-Angle
(backpack EF)

High-angle
(boat EF)

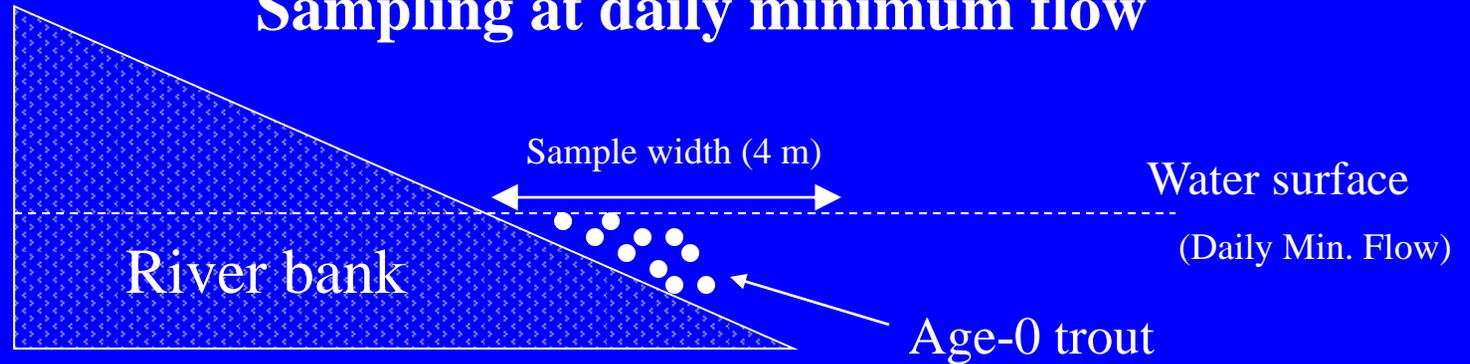
Evidence for restricted-movement

$$\Delta = \text{Catch}_{\min Q} - \text{Catch}_{\max Q}$$



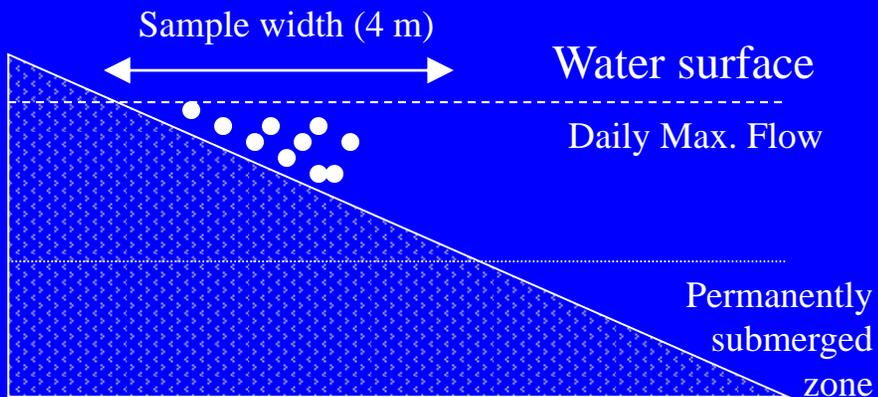
Alternate movement responses to changes in flow

Sampling at daily minimum flow

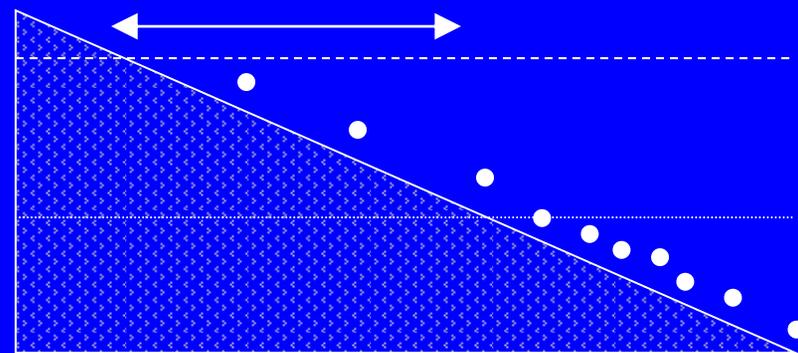


Sampling at daily maximum flow

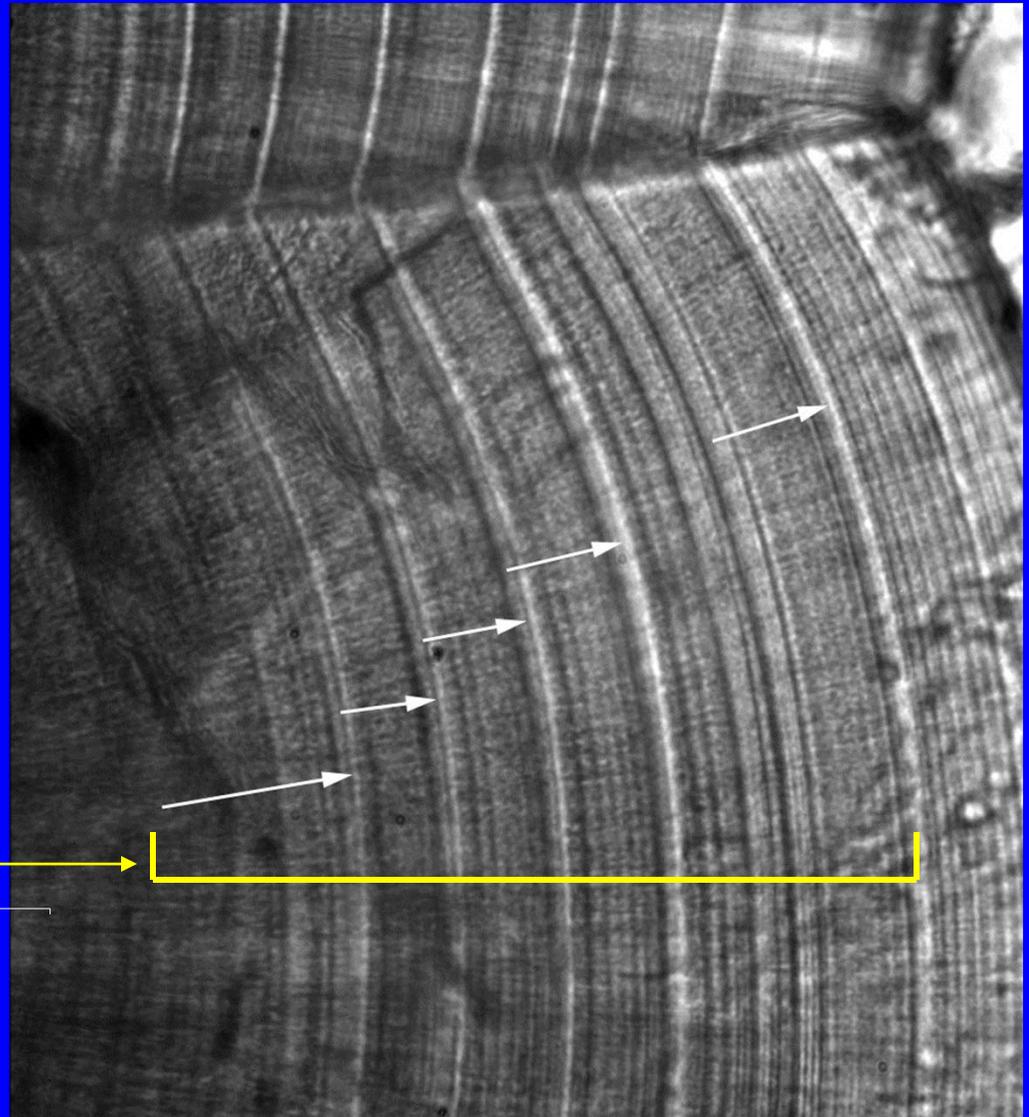
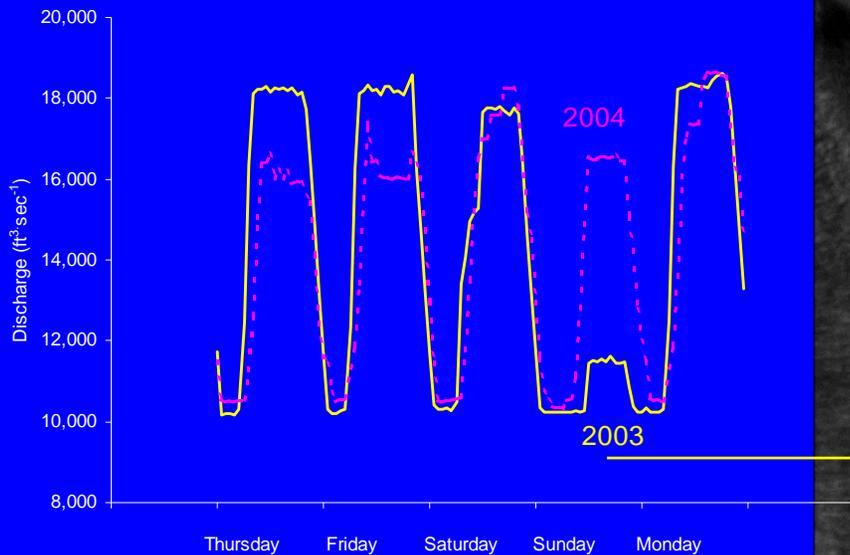
1) Shoreline-tracking



2) Restricted-Movement

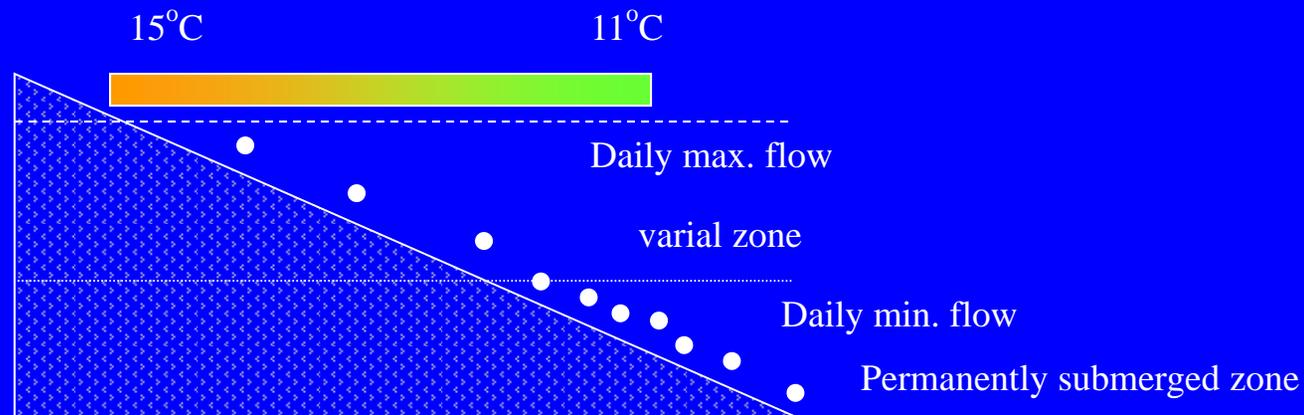


25% Increase in otolith growth on Sundays in 2003 when flow was low and steady

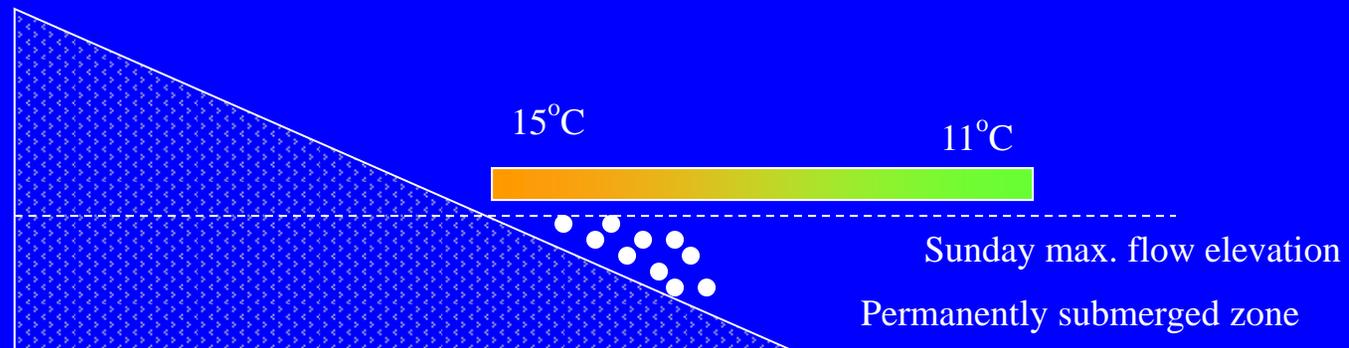


Growth and Nearshore Habitat Use are Linked

Daytime – Monday through Saturday



Daytime – Sunday (2003 only)

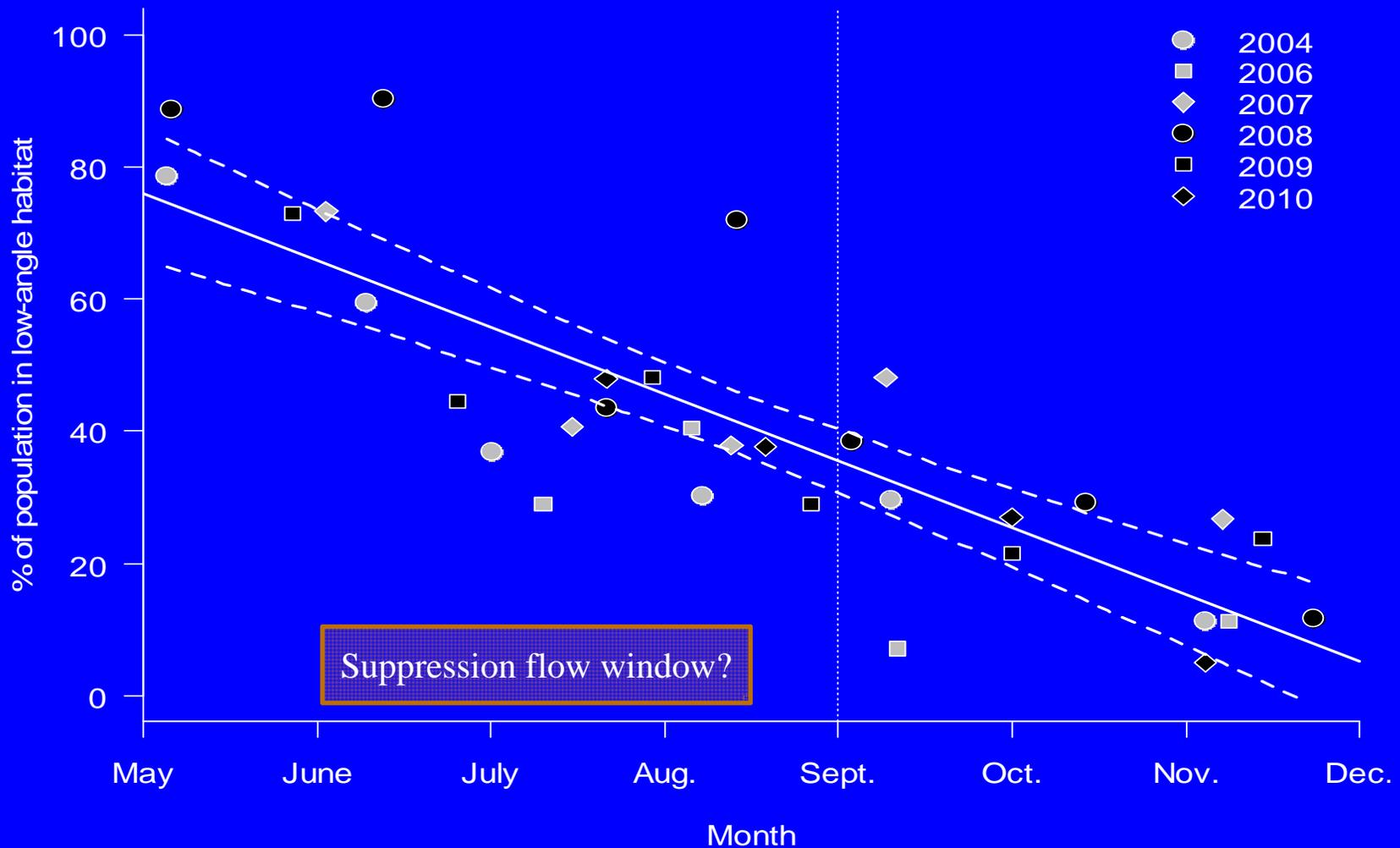


Timing of Low-Angle Habitat Use (when are Age-0 Trout Vulnerable to suppression flows?)

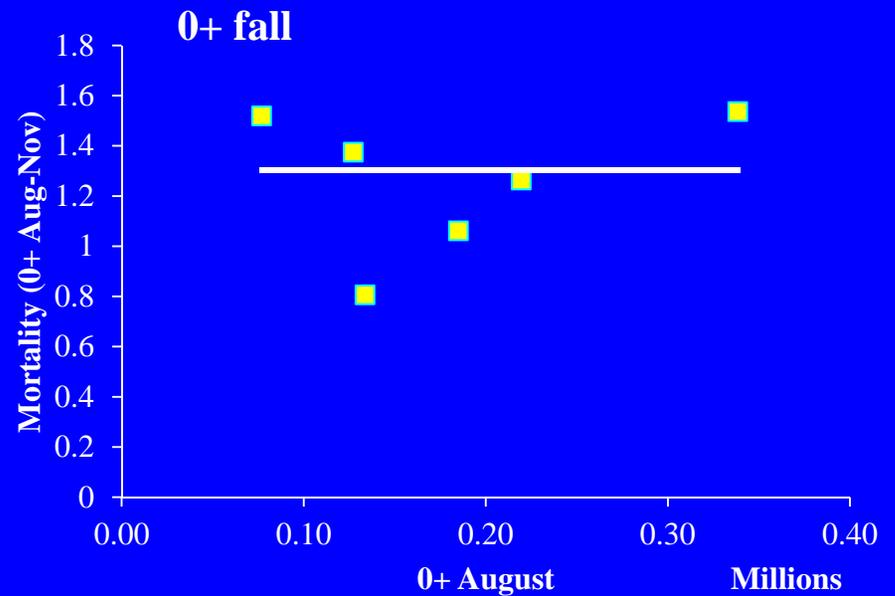
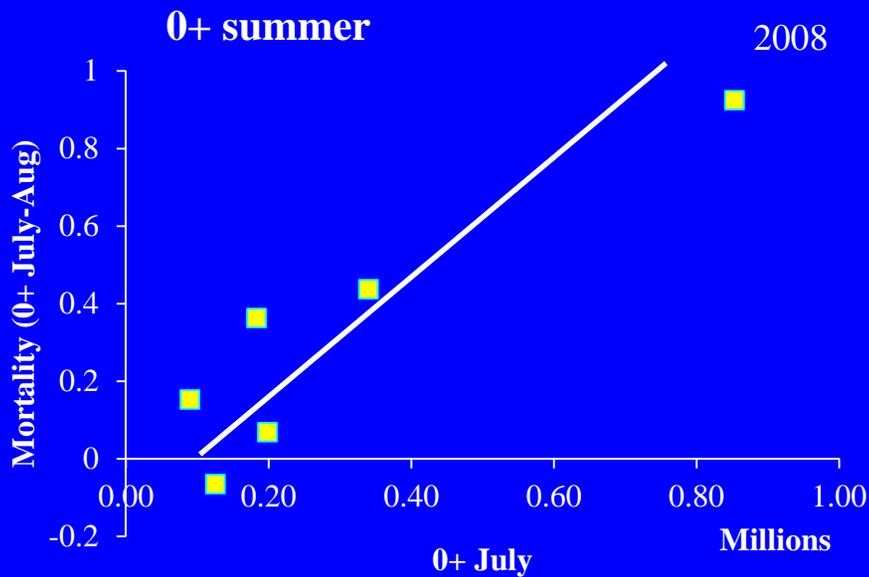
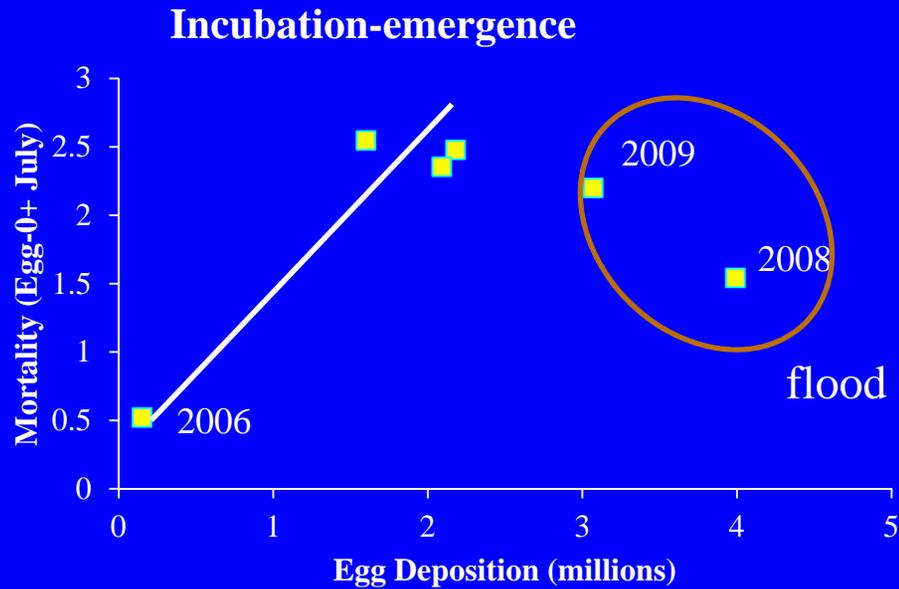
Most fish in vulnerable habitat
but more scope for compensation

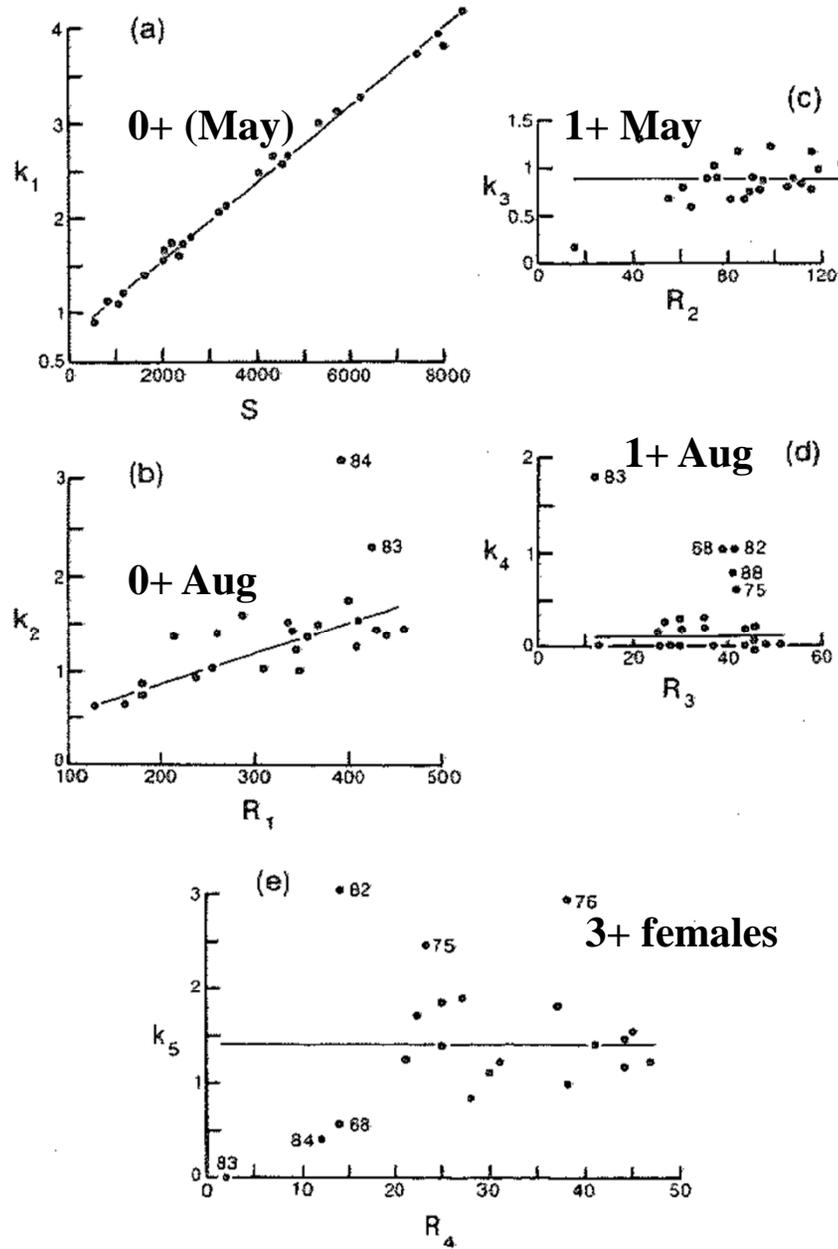
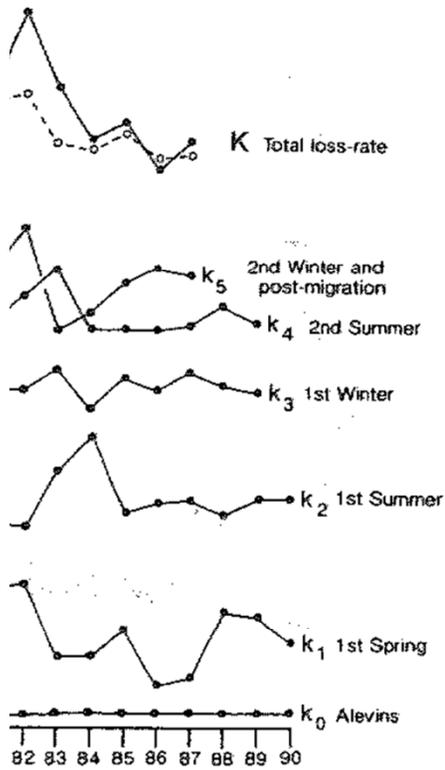


Few fish in vulnerable habitat
but less scope for compensation



Density-Dependence in Mortality for Early Life Stages of Trout





k_0 to the total loss-rate (K) for the 3+ female spawners in the different numbers between egg and alevin stages and 0+ parr stage in May/June [August/September] [$k_2 = \ln(R_1/R_2)$], 1+ parr stage in May/June [$k_3 = \ln(R_2/R_3)$], 2+ parr stage in August/September [$k_4 = \ln(R_3/R_4)$], 3+ parr stage in August/December [$k_5 = \ln(0.5 R_4/R_5)$]; for k_0 to k_5 are provided with values (○) estimated from Elliott 1993a.)

is problem, Varley and Gradwell solutions, one for the initial density or density and one for survivor regression lines plotted on a single

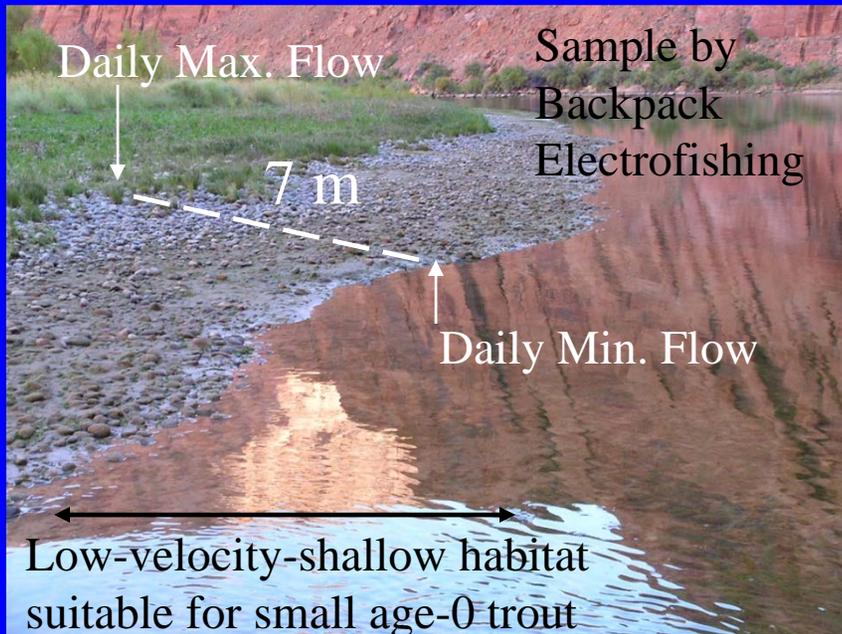
Fig. 3.11 (a)–(e). Relationship between each loss-rate (k_1 – k_5) and initial density (S and R_1 – R_4) for the period over which the loss-rate was estimated; linear regressions for k_1 and S , k_2 and R_1 , and mean values (horizontal lines) for k_3 , k_4 and k_5 are provided

Suppression Flows in 2012

- Flows must be timed when age-0 fish are still in vulnerable habitat, but as late as possible to minimize compensatory response.
- In 2012, flows will be high and steady in late spring and summer. Most age-0 trout will be in flow sensitive habitat at this time.
- If flows are reduced suddenly to 8 kcfs in 2012, it is likely that many age-0 fish will be stranded, especially because flood plain is inundated.
- No need to increase flows for 2-3 days to attract fish to edge in 2012 because flows will be high and steady.
- As flows are high in 2012, no need to drop < 8 kcfs. Requires change in downramp rate and daily flow change rules only.

Extra Slides

Hypotheses of habitat use and flow sensitivity in large rivers



Low-angle habitat

Preferred by smaller age-0 trout

Lower predation risk

More sensitive to variation in flow

High-angle habitat

Preferred by larger age-0 trout

Higher predation risk

Less sensitive to variation in flow

