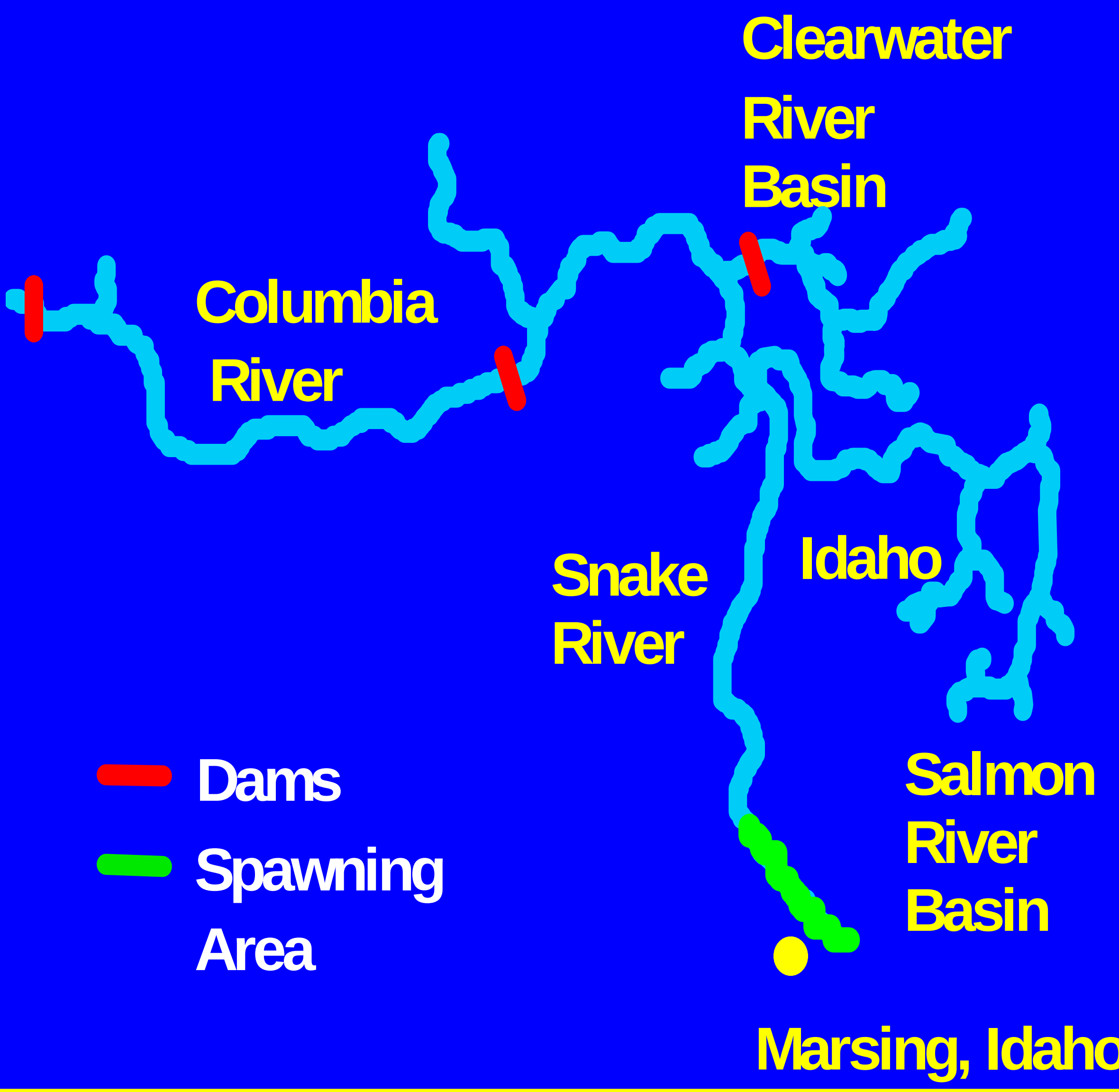
Snake River Fall Chinook Salmon Research Summary 1992-2002

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

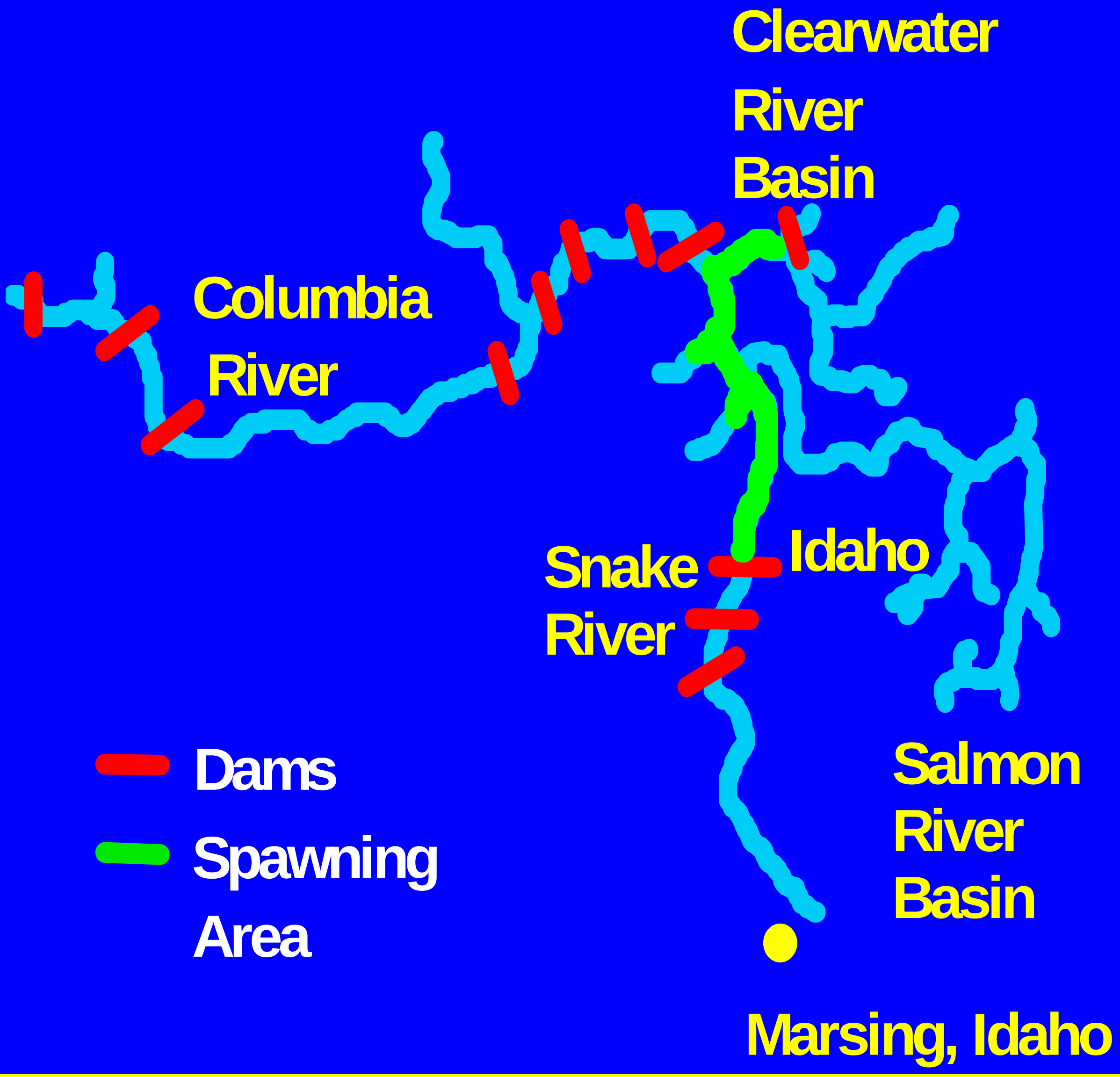
USGS
science for a changing world

Bonneville
Power Administration

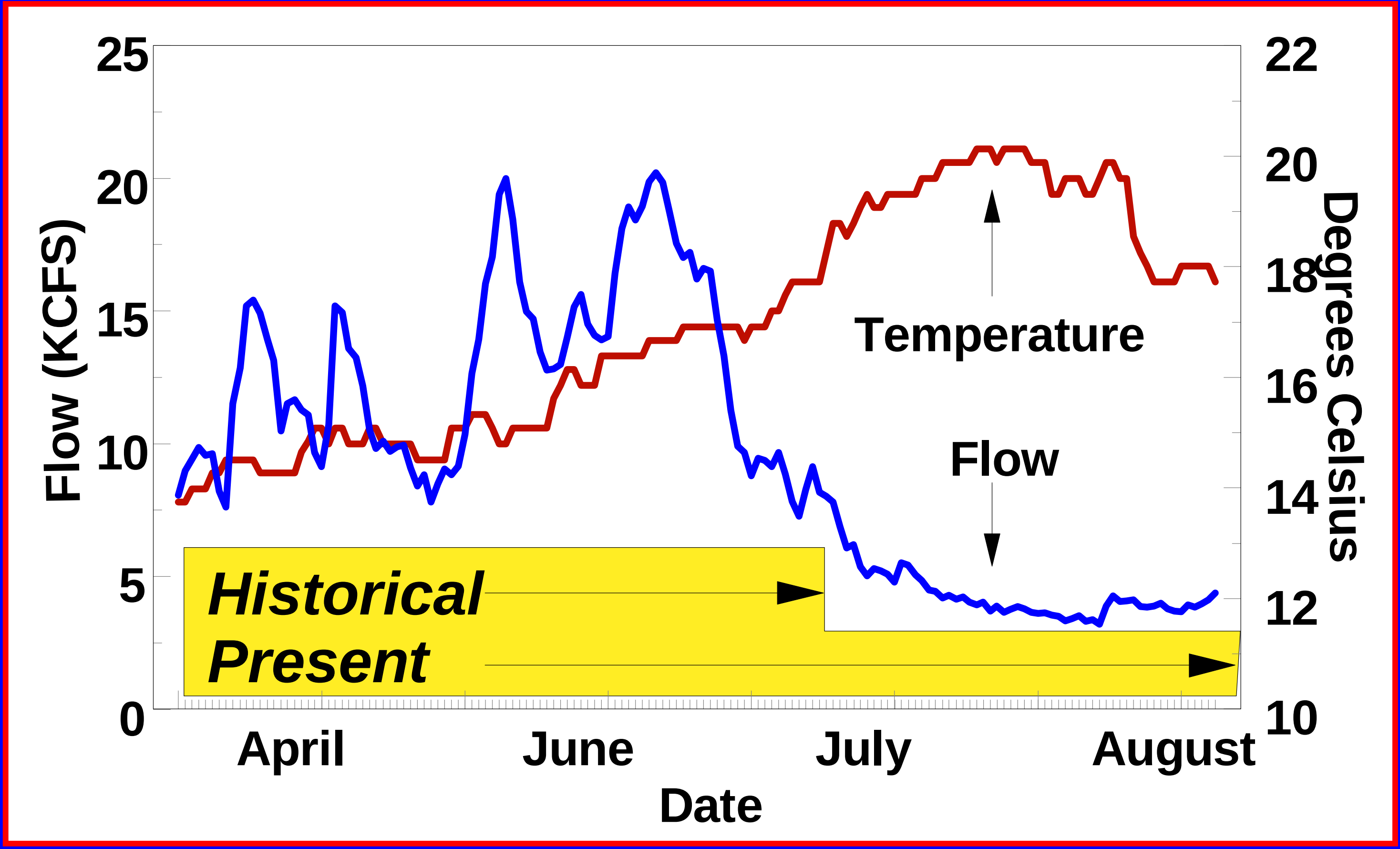
Freshwater Habitat for Snake River Fall Chinook Salmon before 1953



Freshwater Habitat for Snake River Fall Chinook Salmon after 1975



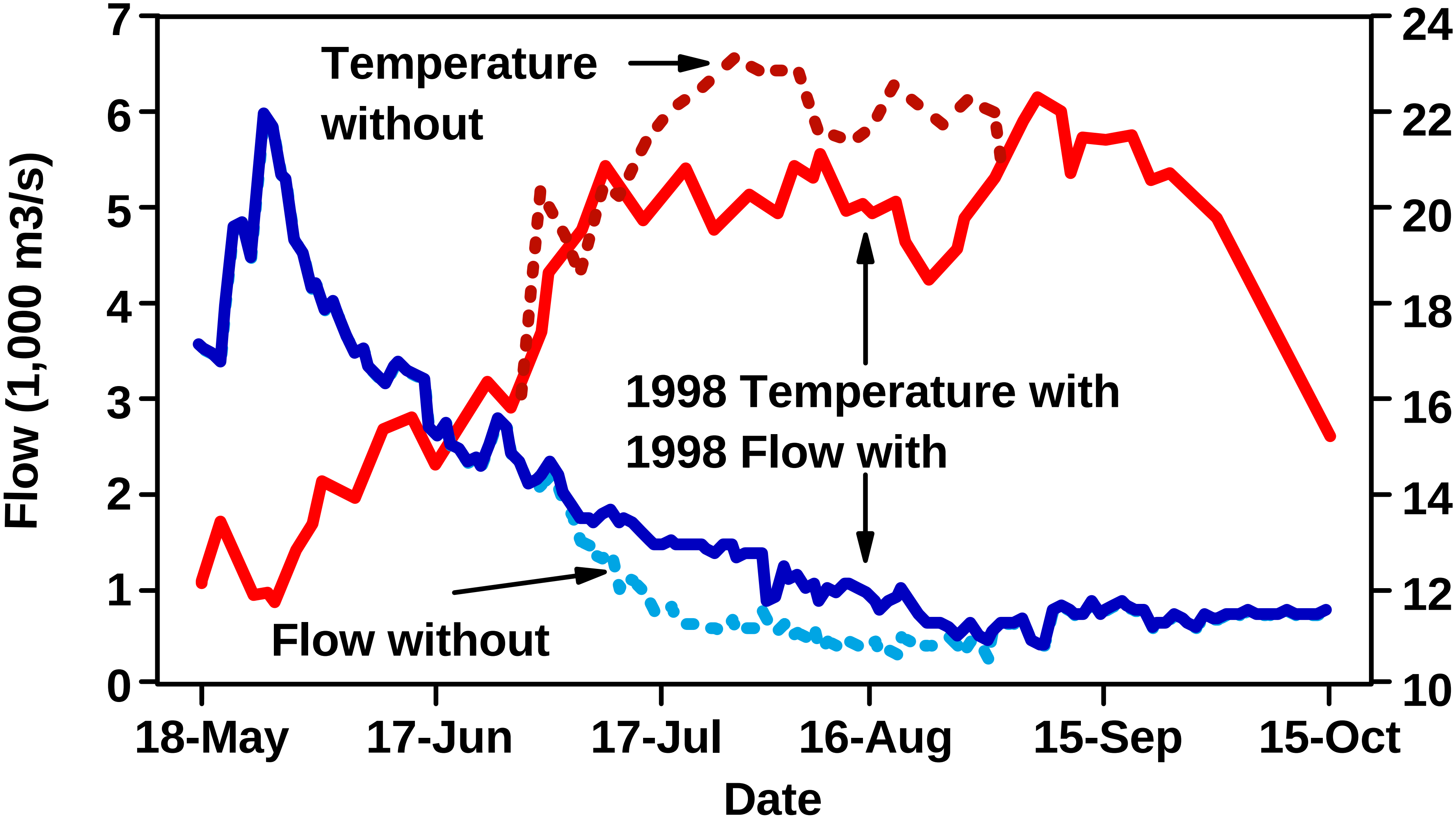
Dam construction changed juvenile fall chinook salmon life history in the Snake River basin by shifting production to areas with relatively cool water temperatures (Connor et al. 2002).



Summer flow augmentation is the release of stored reservoir water between 21 June and 31 August to maintain an average flow of approximately 1,500 m^3/s in Lower Granite Reservoir.

NMFS (1995)

Lower Granite Reservoir flow and temperature with and without summer flow augmentation (Connor et al. in press<u>b</u>)



Underlying beliefs:

Summer flow augmentation increases rate of seaward movement and survival of young fall chinook salmon by increasing flow and decreasing temperature

The disconnect between policy and science (Anderson 2002)

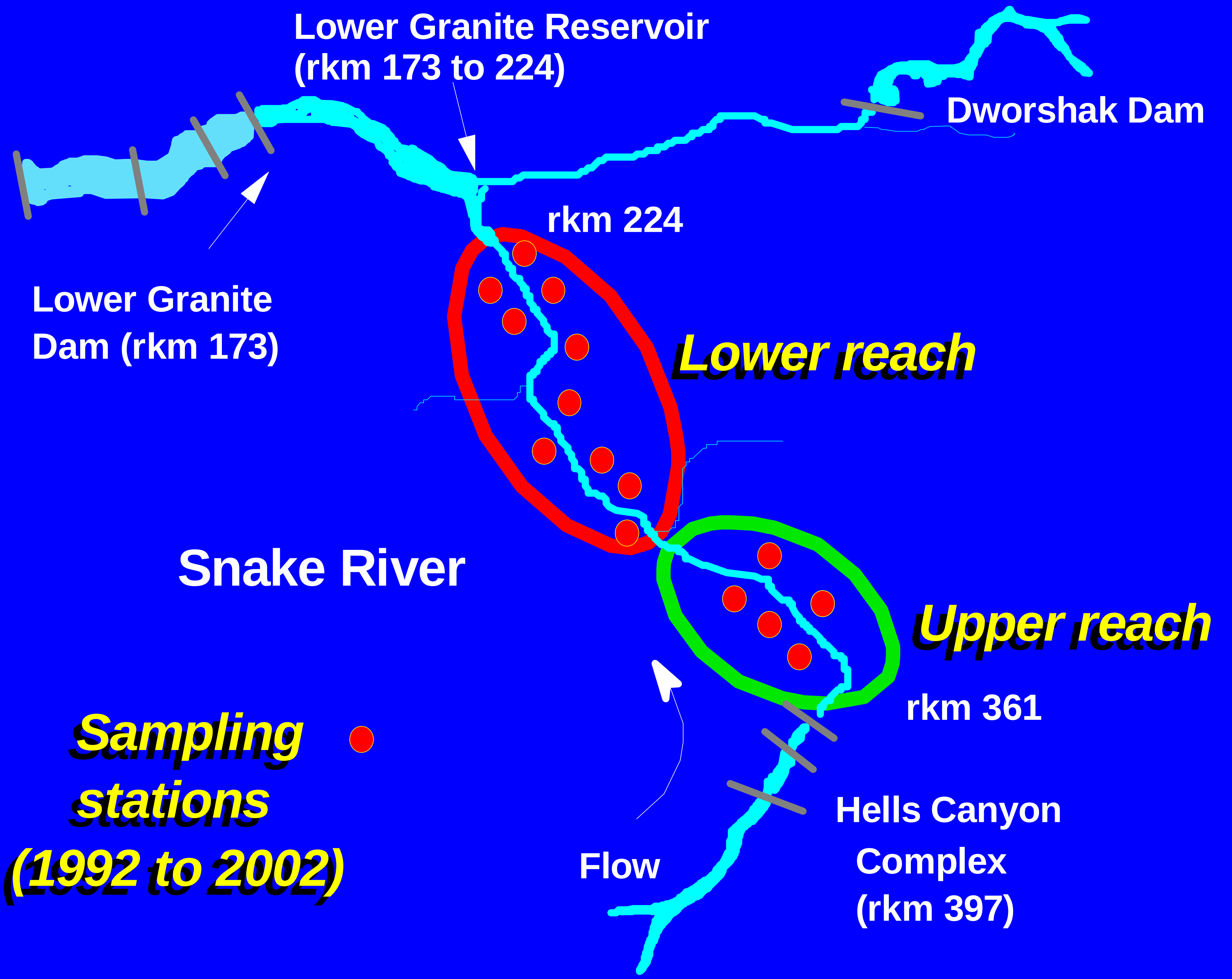
"While the cumulative body of scientific information all points to flow not affecting survival in any meaningful context, the policy of reducing water withdrawals and augmenting river flow has continued to expand. Furthermore, fish and water managers have consistently acted to discredit or ignore the information against their policies."

Why ignore all the data on wild Snake River fall chinook salmon?

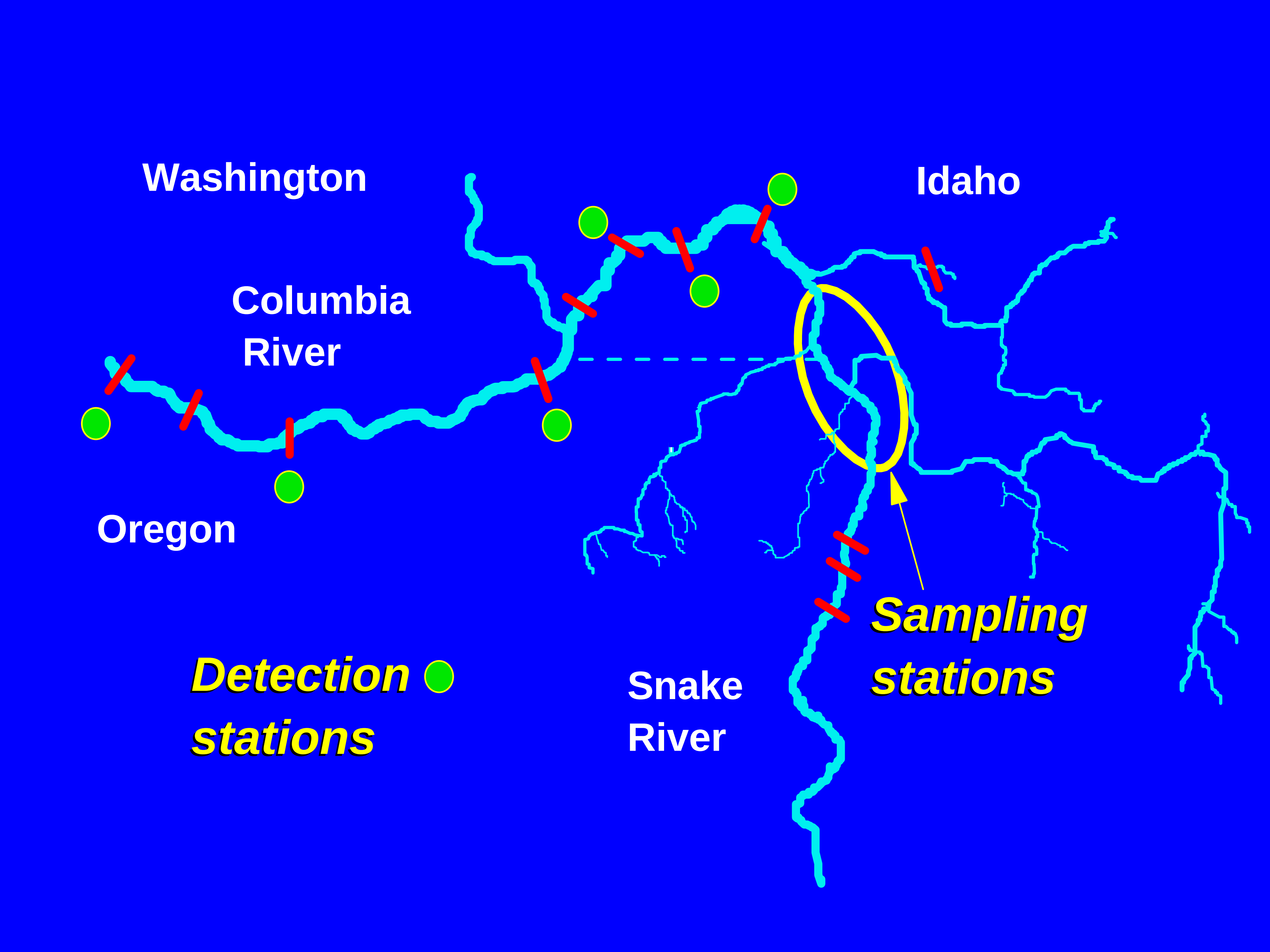
Discussion topics:

1) Seaward movement and the factors that affect it

2) Survival and the factors that affect it


Lower Granite Reservoir
(rkm 173 to 224)
Dworshak Dam
rkm 224
Lower Granite
Dam (rkm 173)
Lower reach
Snake River
Upper reach
rkm 361
Sampling
stations
(1992 to 2002)
Hells Canyon
Complex
(rkm 397)
Flow

Collecting and Tagging Juveniles


Washington
Idaho
Columbia
River
Oregon
Sampling
stations
Detection
stations
Snake
River

Period 1: Passage from the river to the tailrace of Lower Granite Dam

Migrational phases (Connor et al. in press<u>a</u>)

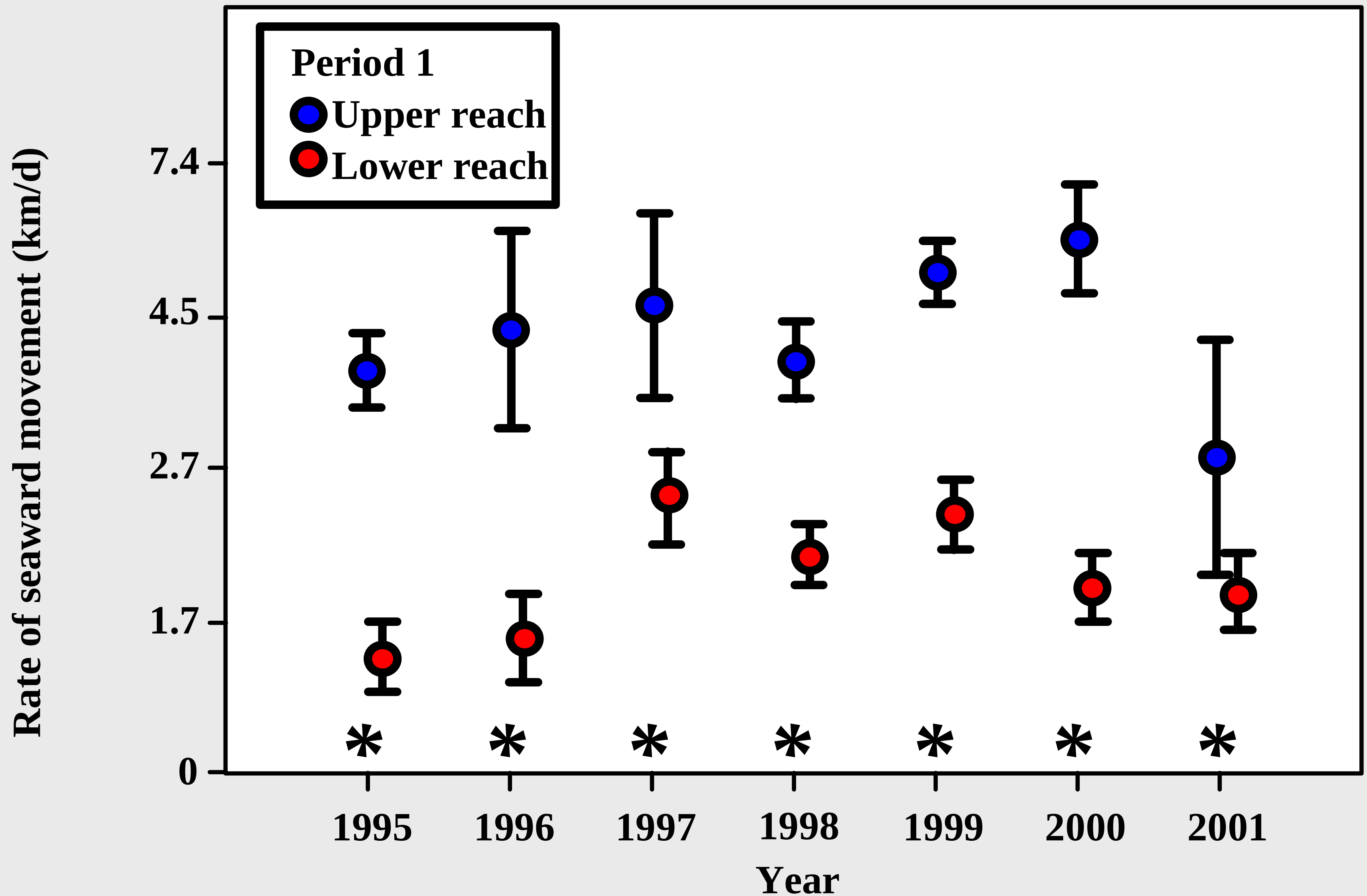
1) Discontinuous downstream dispersal along the shorelines of the free-flowing river.
2) Abrupt and mostly continuous downstream dispersal offshore in the free-flowing river.
3) Passive-discontinuous downstream dispersal offshore in Lower Granite Reservoir (***e.g., 32/40 d***).
4) Active and mostly continuous seaward migration in Lower Granite Reservoir as fish become smolts.

Period 1 rate of seaward movement (km/d)

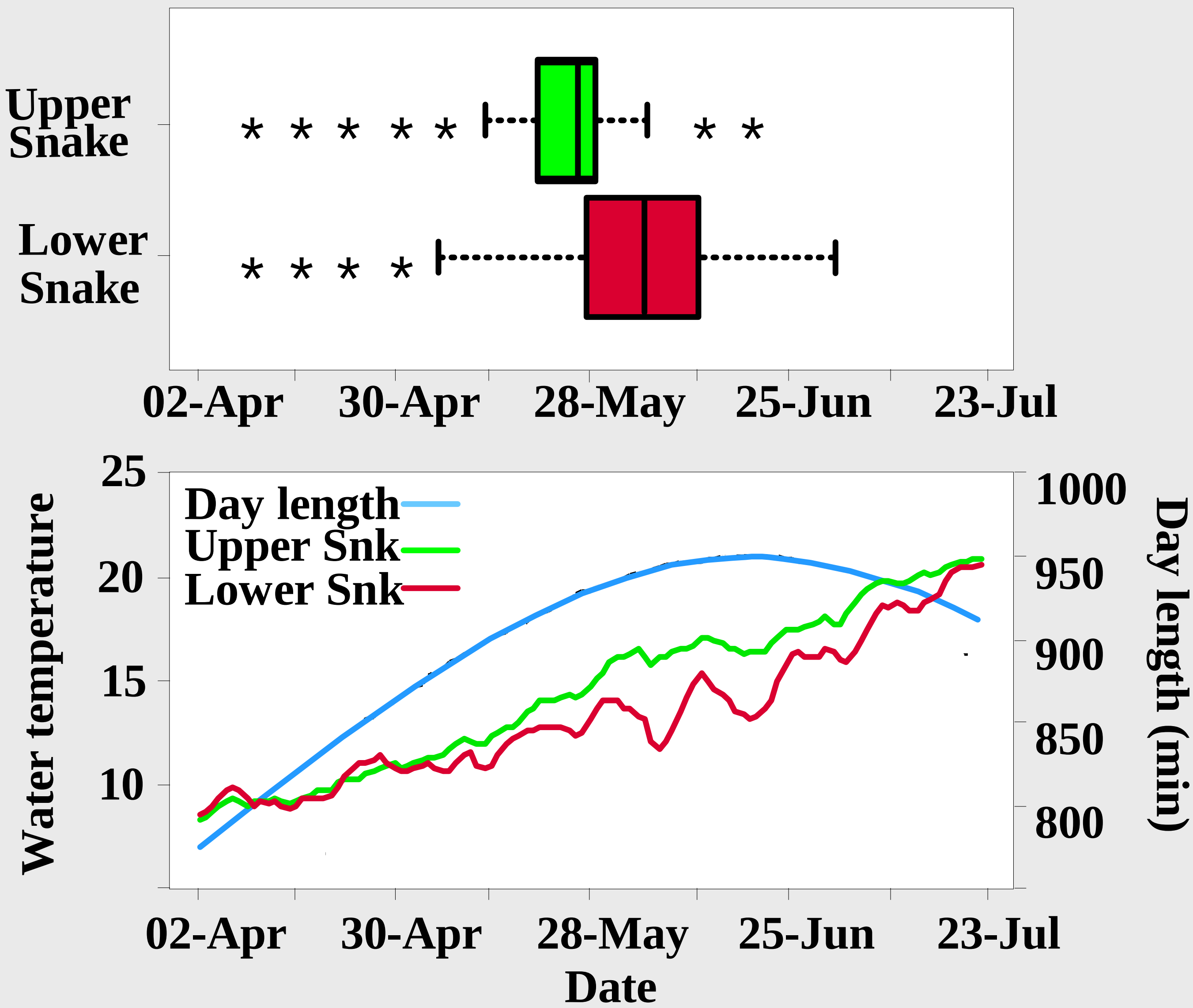
— Calculated on a fish-by-fish basis (1992-2001) as travel time divided by distance traveled

— Averaged by within each reach by year

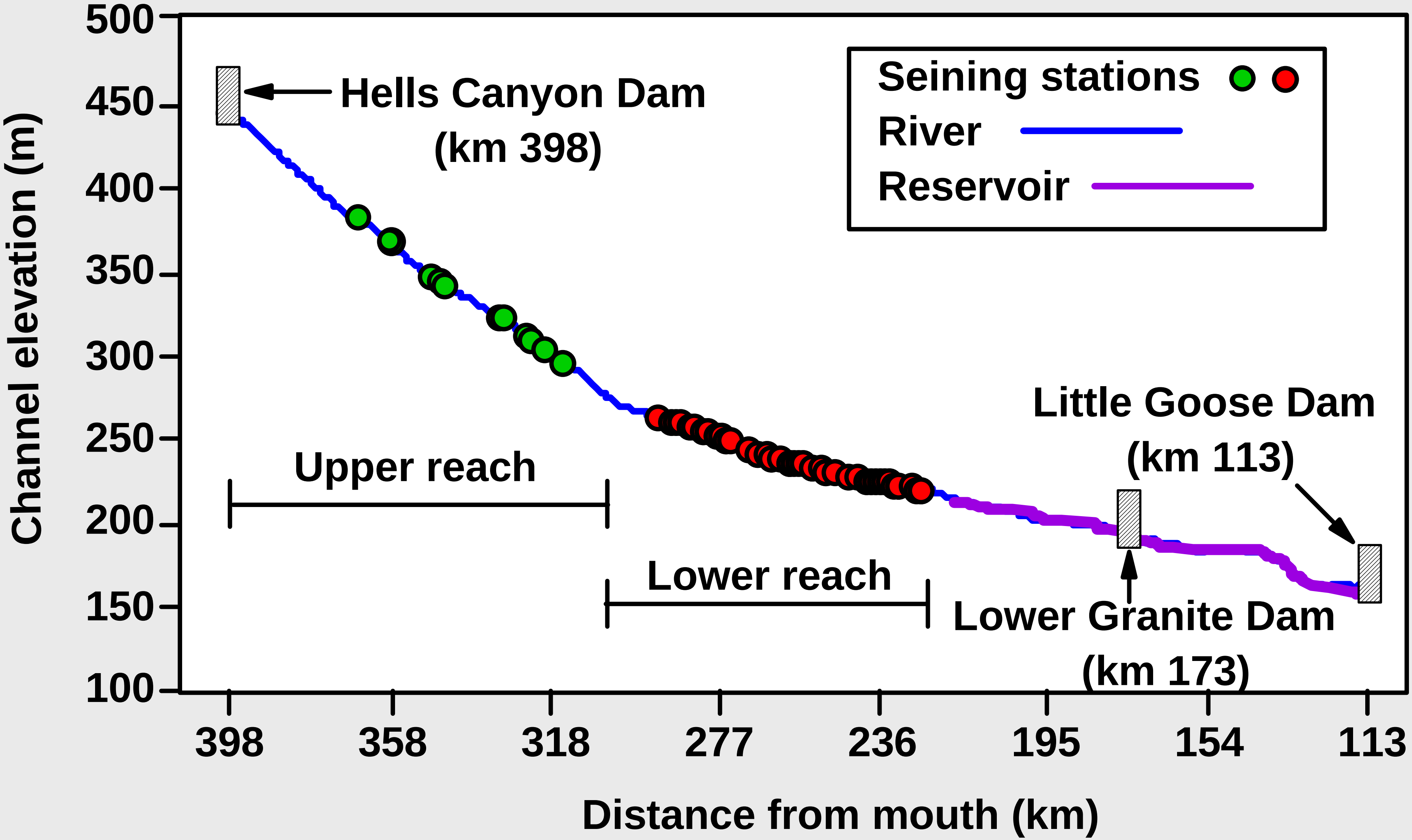
Period 1 rates by reach and year (1995-2001)



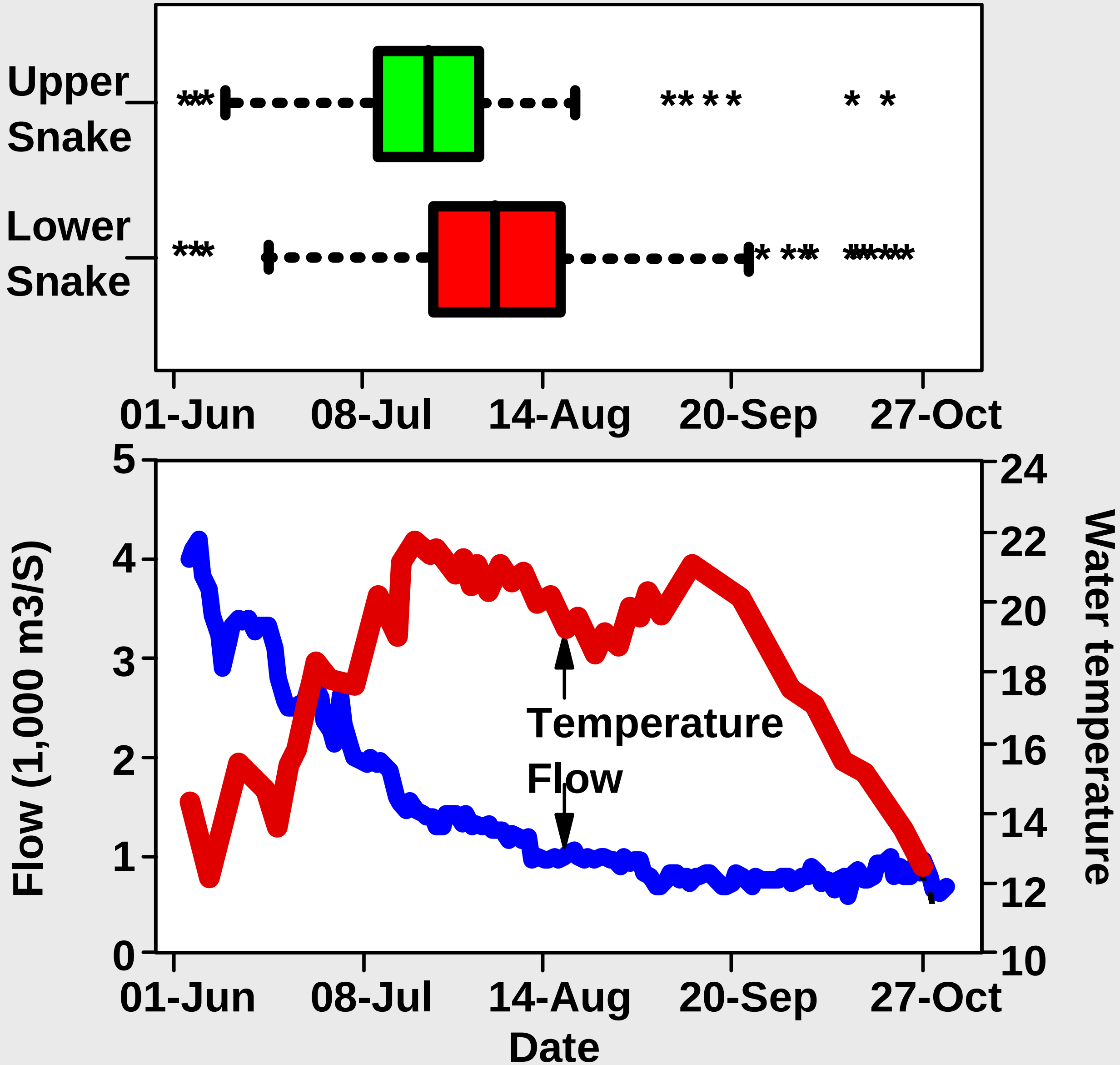
Difference in time dependent success of smoltification represented by release date



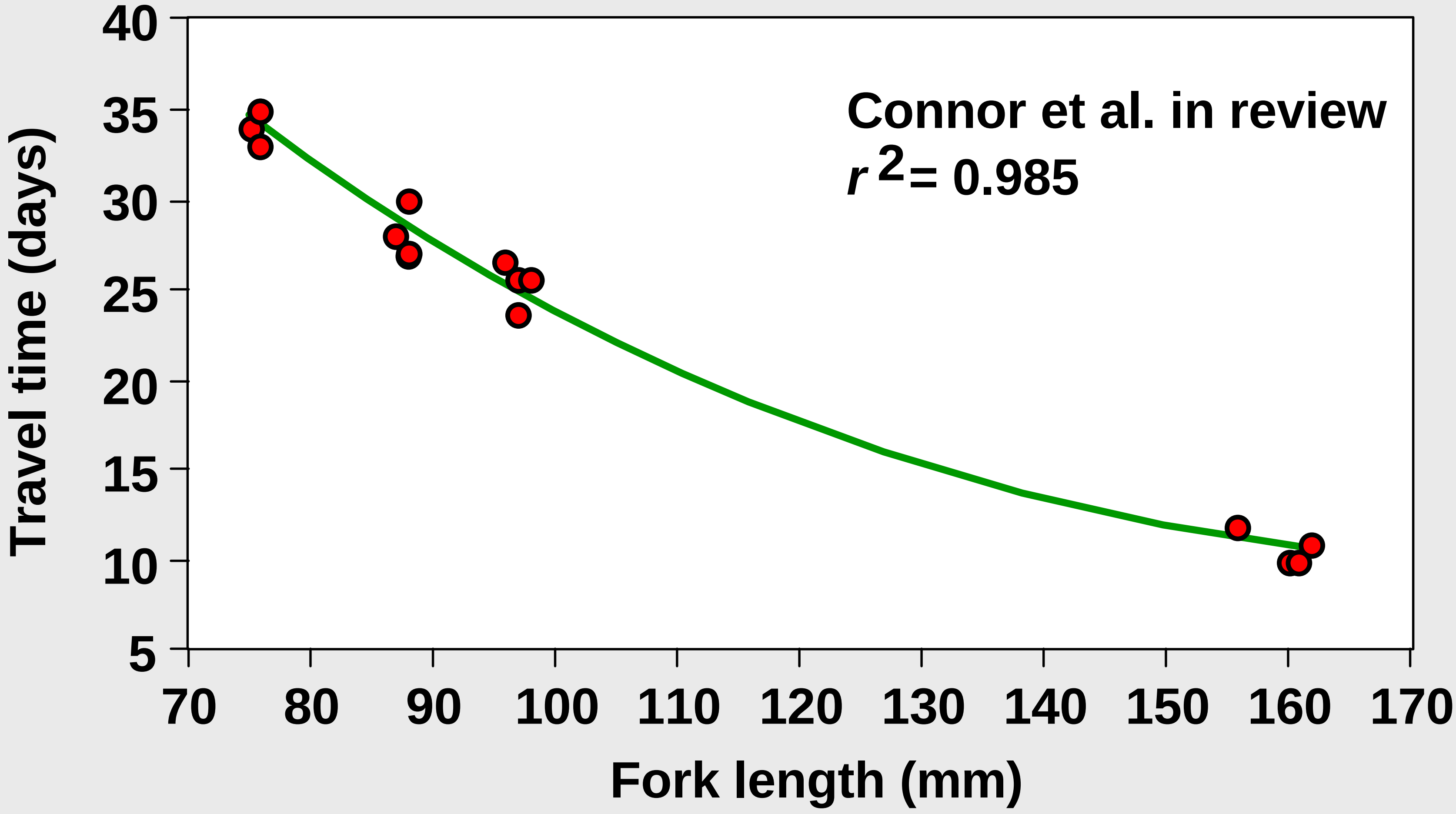
Differences in distance traveled in the free-flowing river



Differences in flows and temperatures experienced during period 1



Fork length does not differ markedly between fish of the two reaches but is an important determinant of migrational behavior (Berggren and Filardo 1993; Giorgi et al. 1997; Connor et al. 2000).



Top two regression models

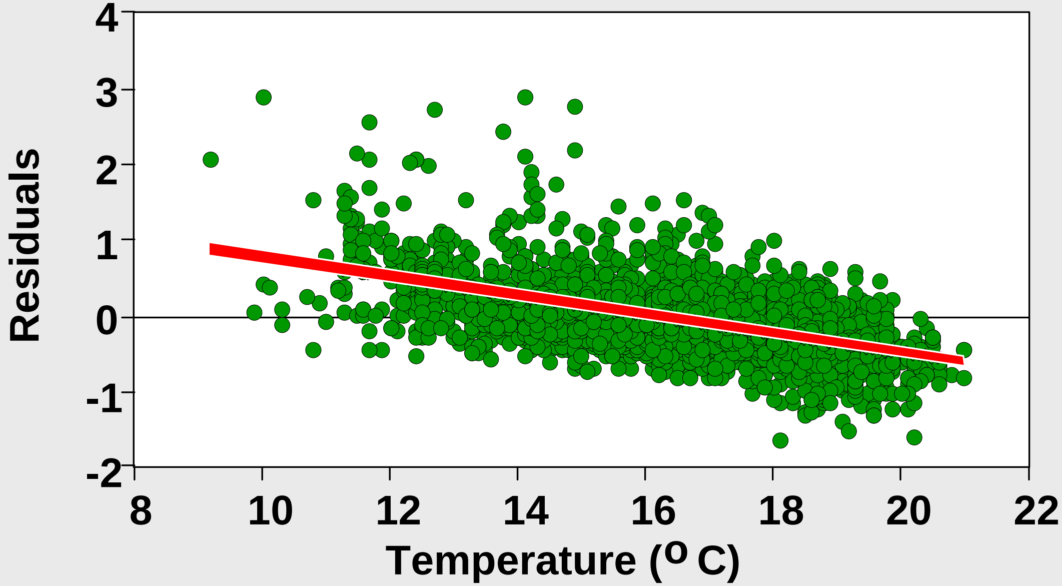
Log_e Rate = 0.816 - 0.151*Temperature
+ 0.028*Fl + 0.008*Km

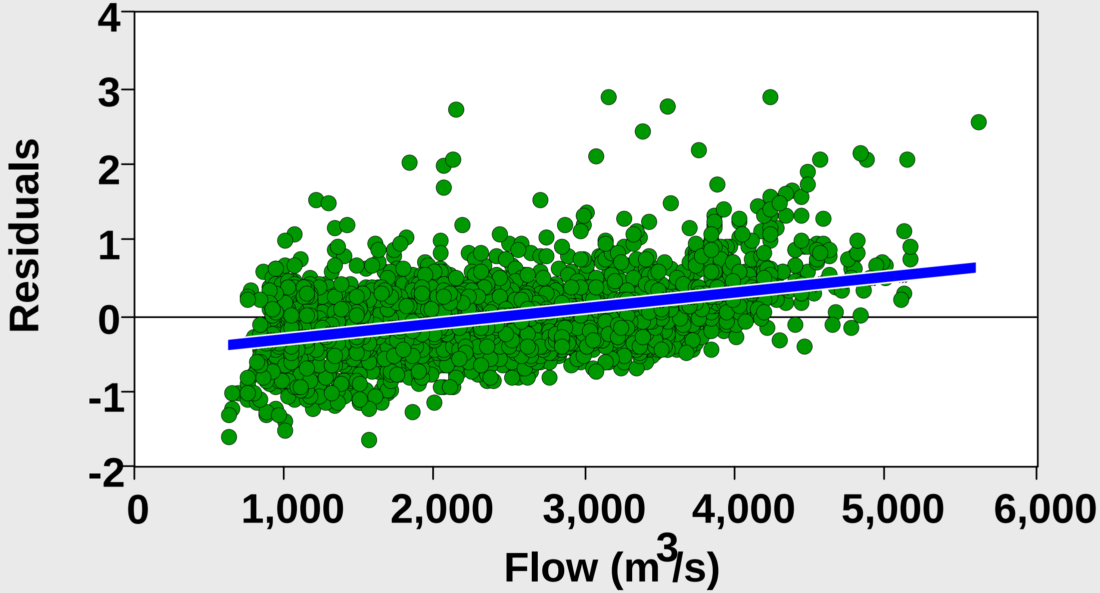
$R^2 = 0.726$ $P \leq 0.0001$

Log^e Rate = - 2.072 + 0.0002*Flow
+ 0.025*Fl + 0.009*Km

$R^2 = 0.659$ $P \leq 0.0001$

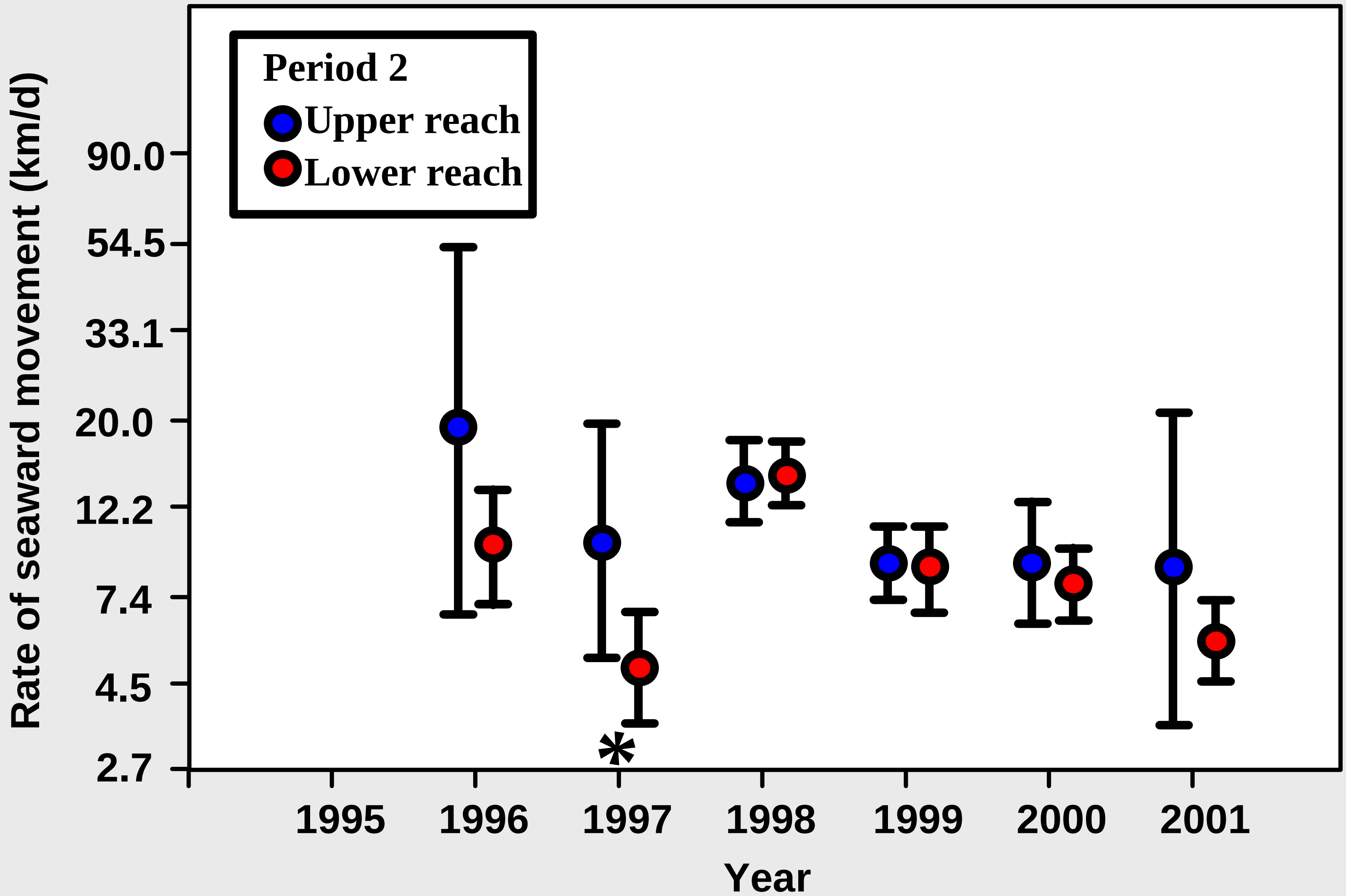
The relation between temperature and rate and between flow and rate during period 1



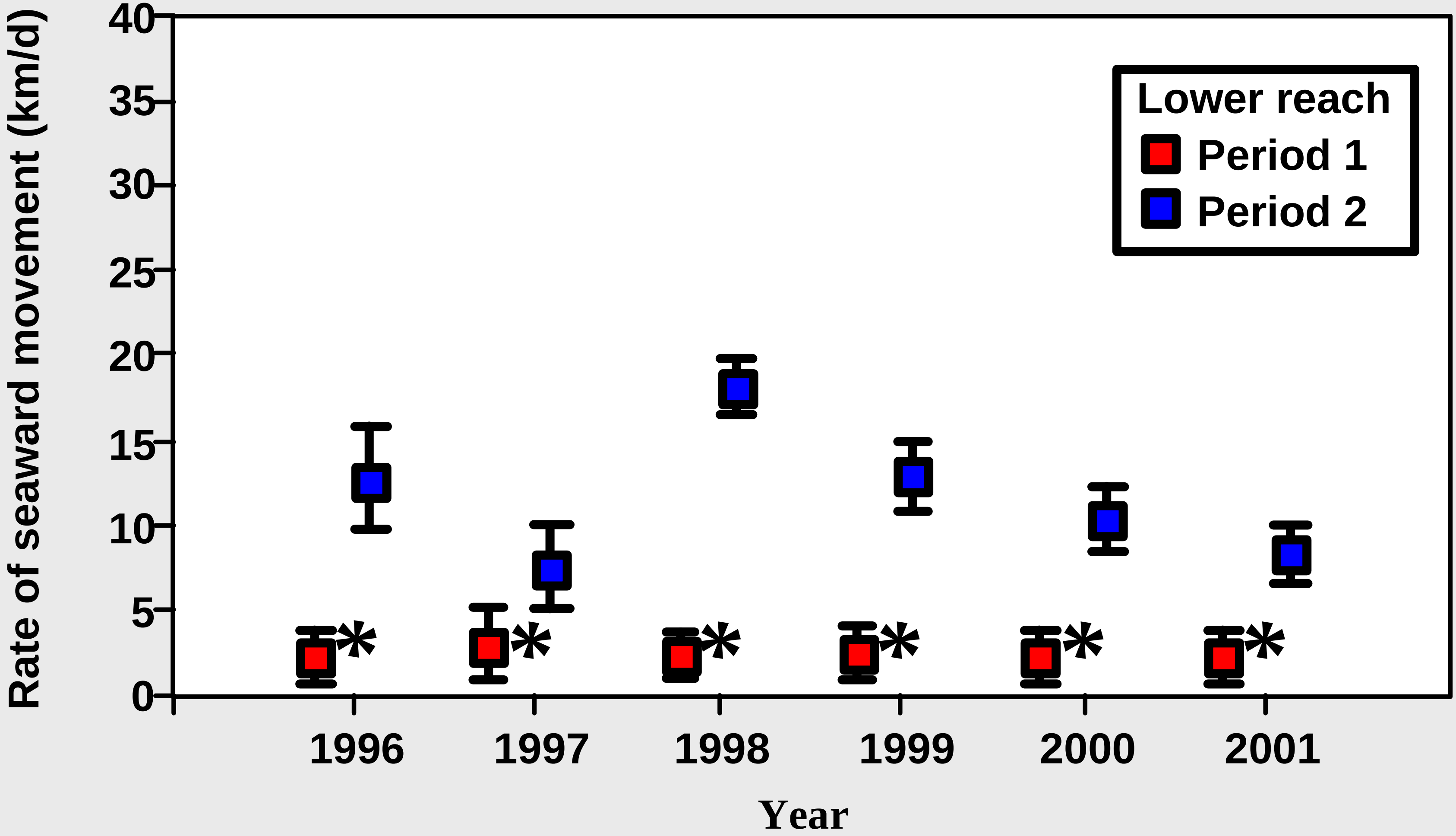


Period 2: Passage from Lower Granite to Little Goose Dam

Period 2 rates by reach and year (1996-2001)



Period 1 versus period 2 rates for the lower reach (1996-2001)



Top regression model for period 2:

$\log_e \text{Rate} = B_o + B_1*\text{Flow} + B_2*\text{Temp}….$

$R^2 = 0.19 \quad P \leq 0.0001$

Conclusions on seaward movement (Connor et al. in press<u>a</u>)

— Rate of seaward movement from release to the tail race of Lower Granite Dam is a multivariate process influenced simultaneously by several factors including flow.

— Summer flow augmentation decreases the time young fall chinook salmon spend in Lower Granite Reservoir by 1 to 5 days.

Conclusions on seaward movement (Continued)

— Flow and temperature effects on rate of seaward movement of PIT-tagged fall chinook salmon in Little Goose Reservoir were not apparent in our study.

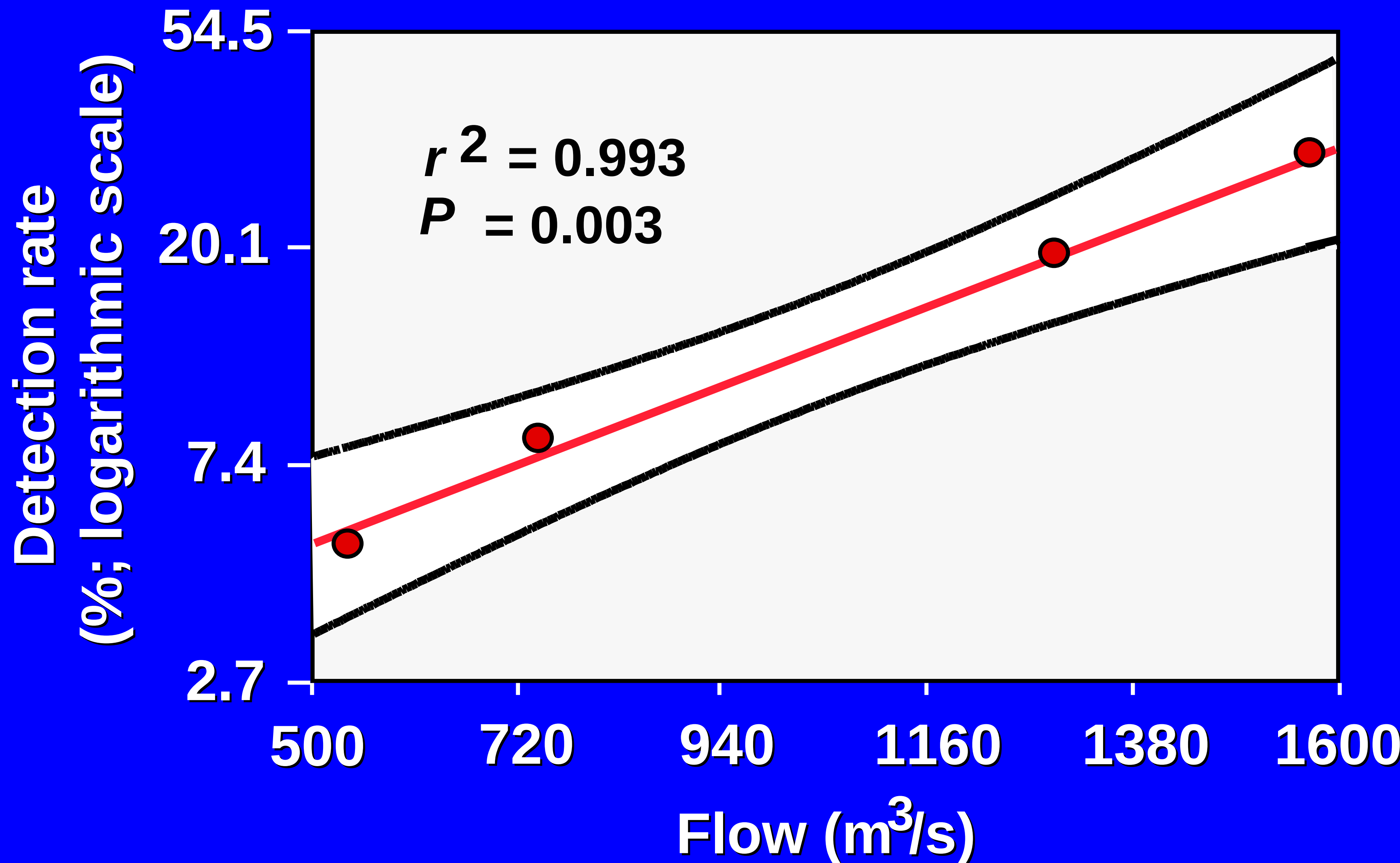
— However, even if rate of seaward movement is not linearly dependent on flow and temperature, warm temperatures in the absence of summer flow augmentation might disrupt growth and normal patterns of smoltification.

Discussion topics:

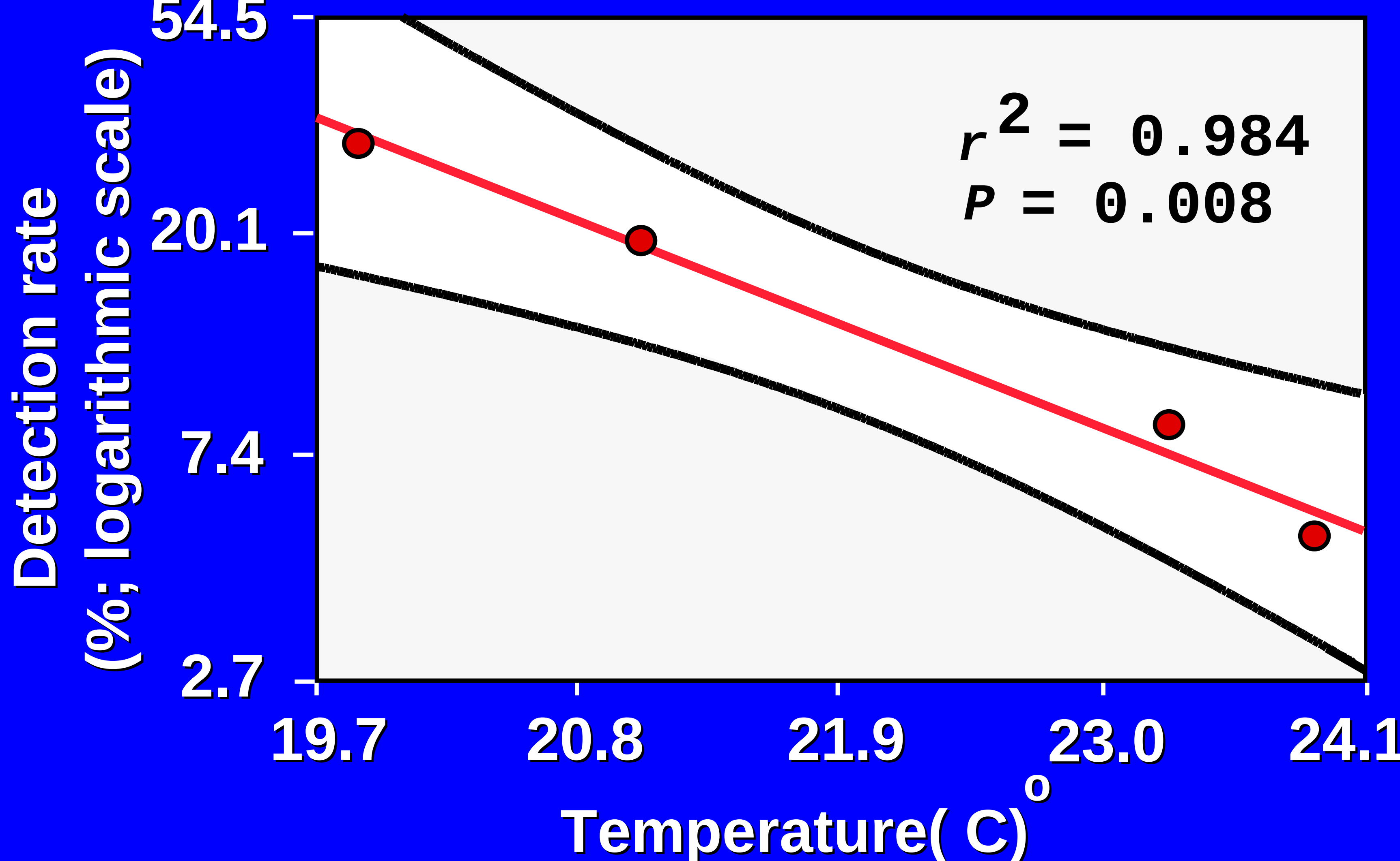
1) ~~Seaward movement and the factors that affect it~~

2) Survival and the factors that affect it

Flow vs. Detection Rate (Connor et al. 1998)



Temperature vs. Detection Rate (Connor et al. 1998)



Objective # 2 analyses with 1998 to 2000 data

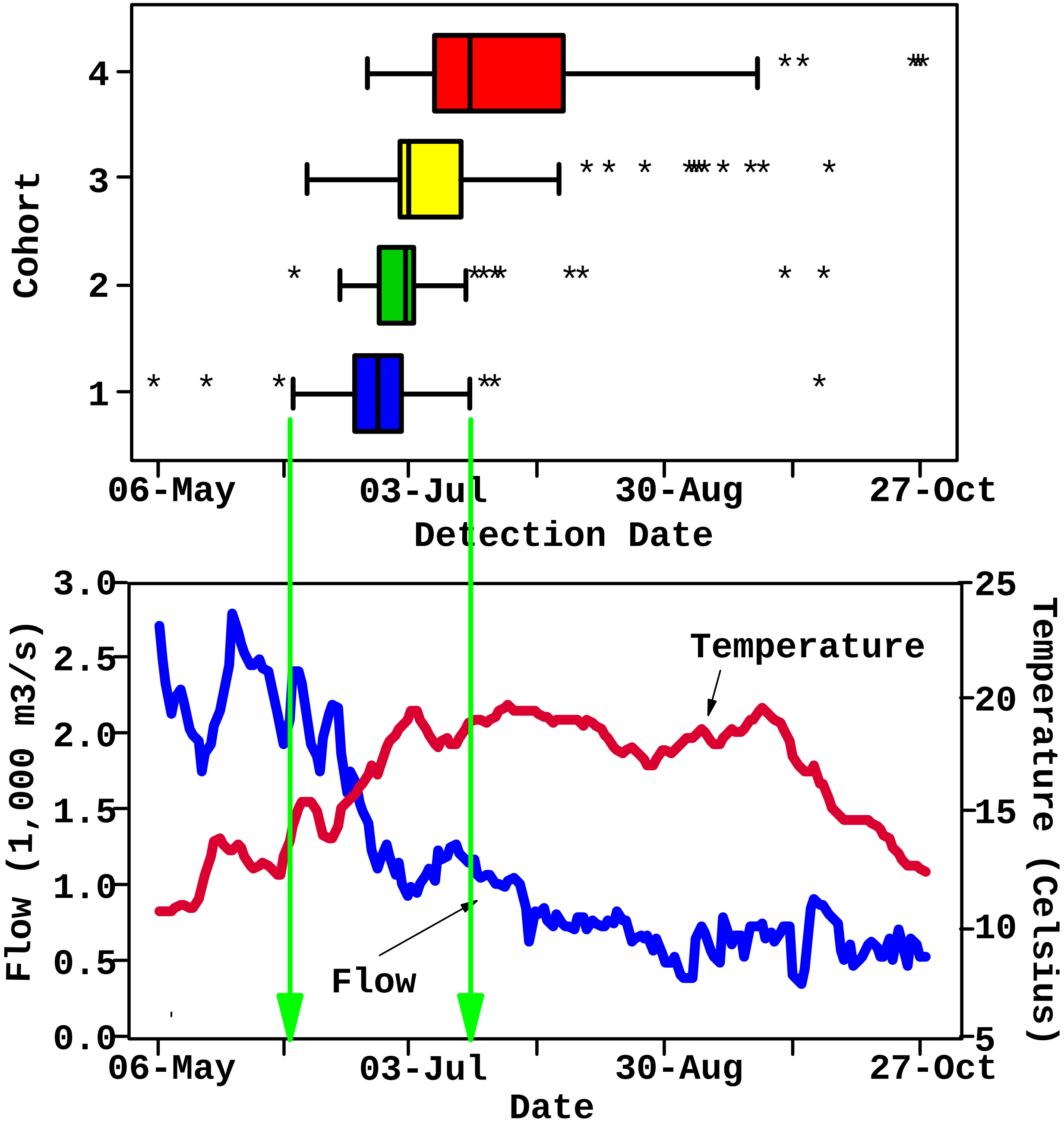
— Estimated survival to the tailrace of Lower Granite Dam on a “cohort” basis

— Cohort survival ranged from 36 to 88%

Factors on a cohort basis

— Median date of release
— Mean fork length at release
— Flow exposure indice
— Temperature exposure indice

Calculating Flow and Temperature Exposure Indices



The final model

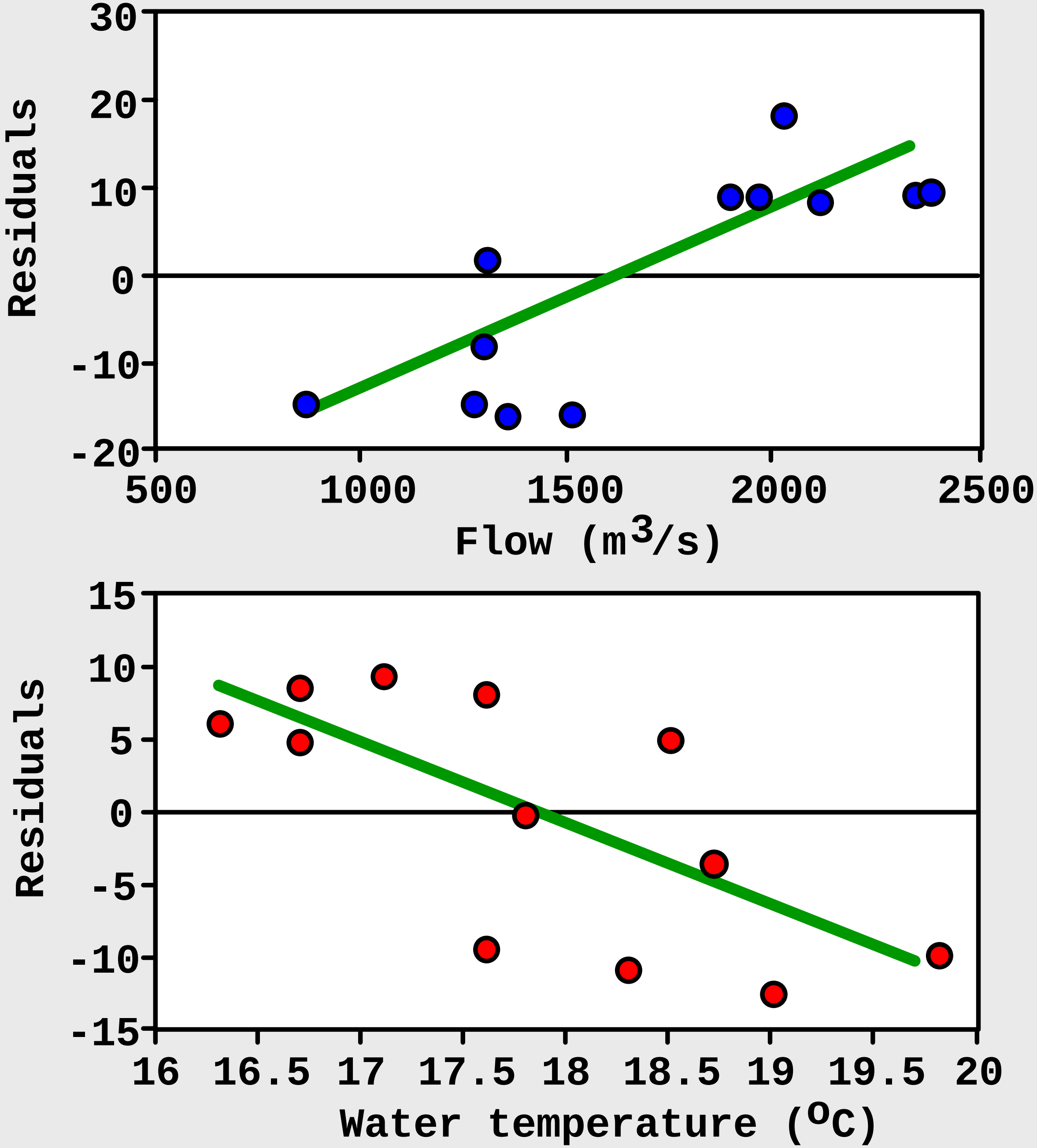
Survival = constant + 0.026 X Flow
- 7.14 X Temperature

N = 12

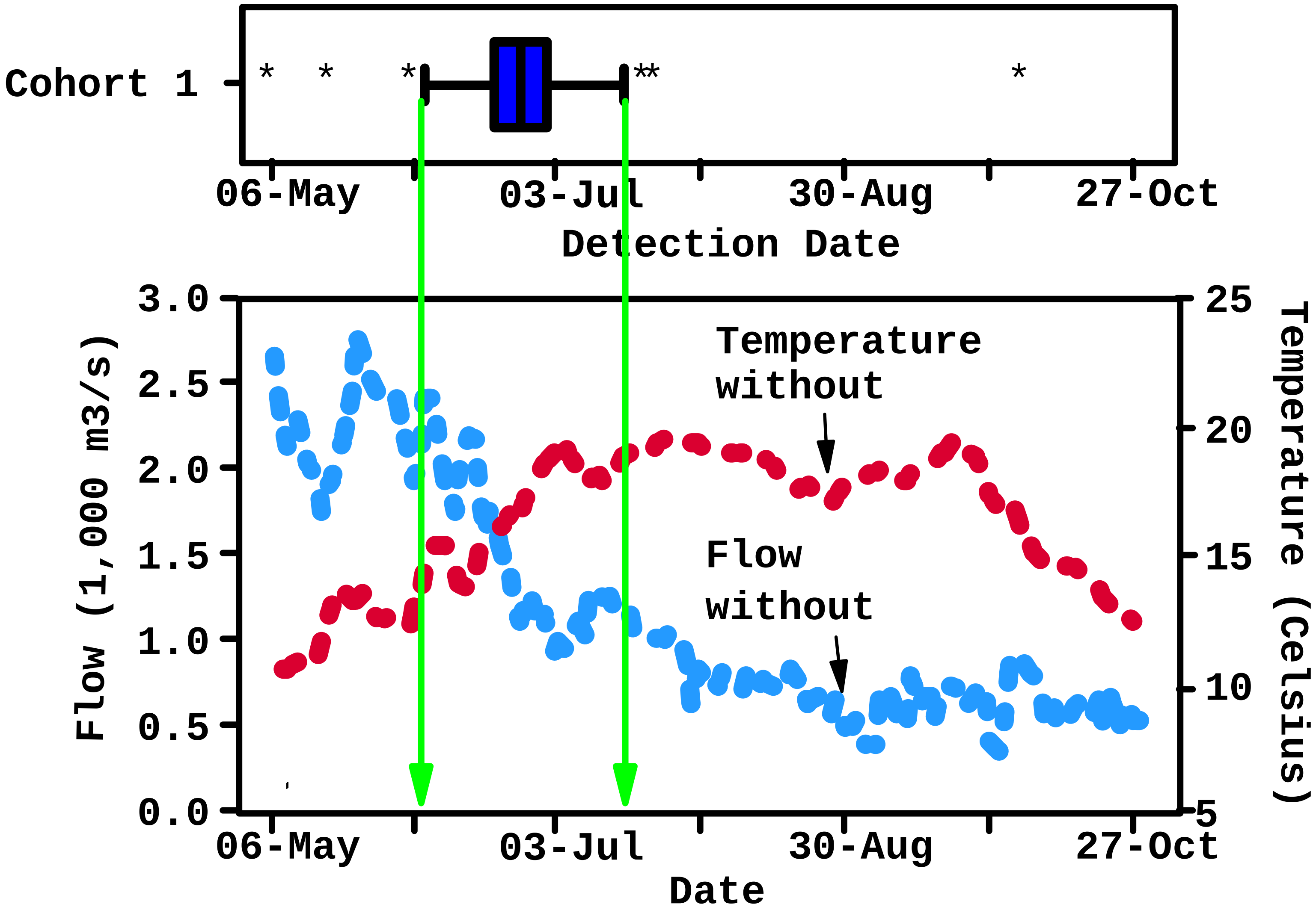
$P \leq 0.0001$

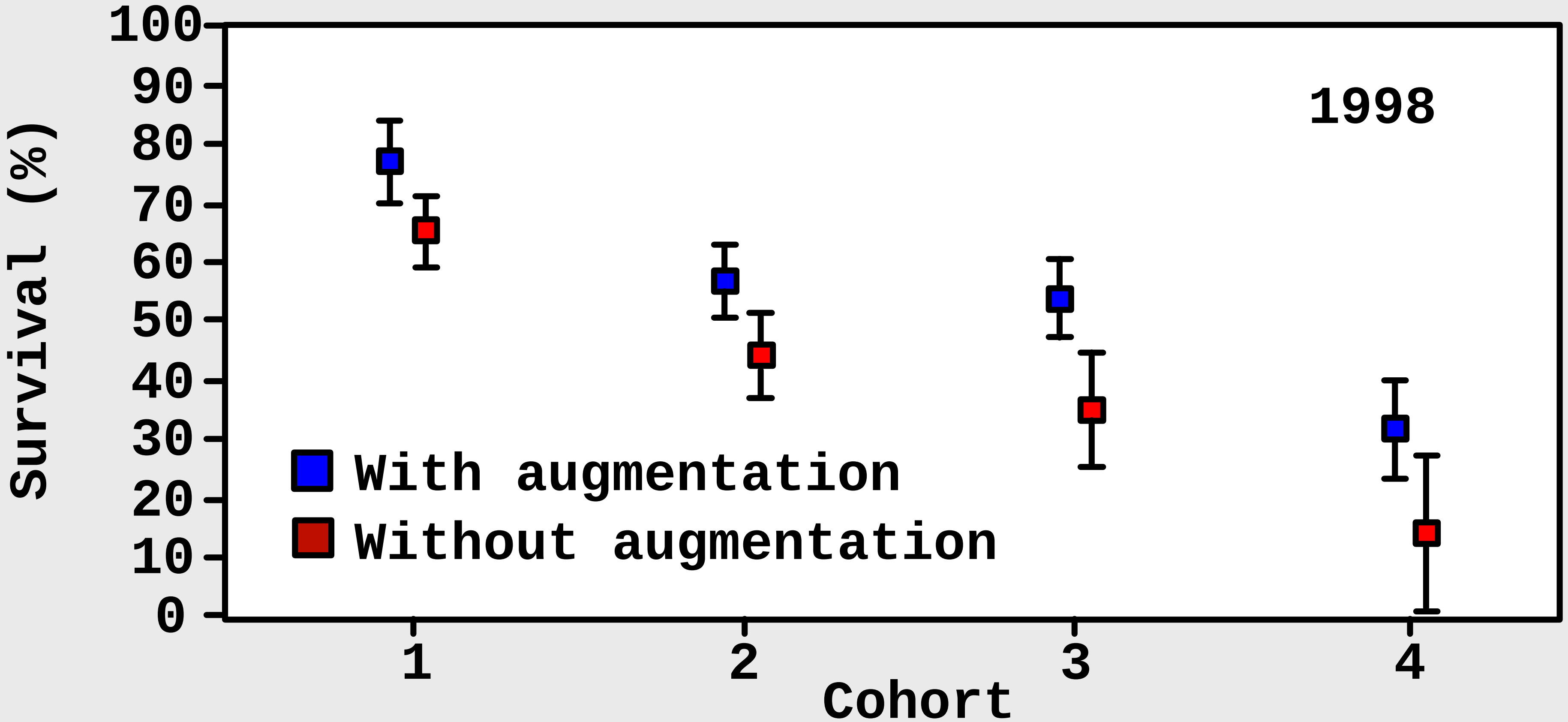
$R^2 = 0.92$

Survival versus flow and temperature



Recalculating flow and temperature exposure indices for survival analyses





Estimated total decreases without augmentation

Cohort 1 down 12.4%

Cohort 2 down 13.0%

Cohort 3 down 19.2%

Cohort 4 down 19.0%

Conclusions (Connor et al. in pressb)

- —Survival is influenced simultaneously by flow and temperature
- — Summer flow augmentation increases flow and decreases temperature
- —Summer flow augmentation increases survival

Underlying beliefs:

Summer flow augmentation increases rate of seaward movement and survival of young fall chinook salmon by increasing flow and decreasing temperature

My Home Town Reservoir