Pacific Fisheries Resource Conservation Council

- reports to Federal and Provincial Governments on the status of BC salmon

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Pacific Fisheries Resource Conservation Council special report on Fraser sockeye resources and climate change in British Columbia, June 2006
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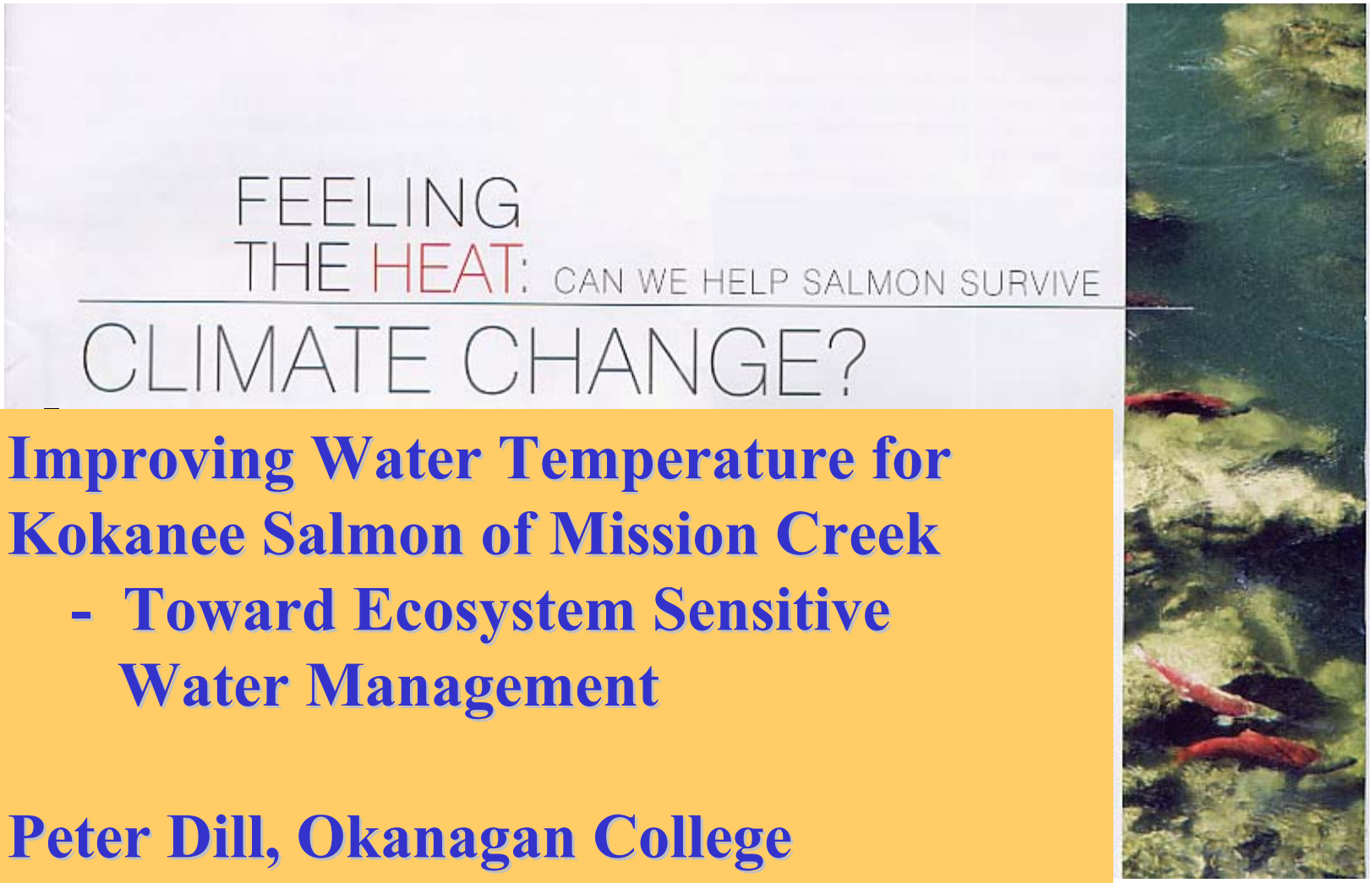
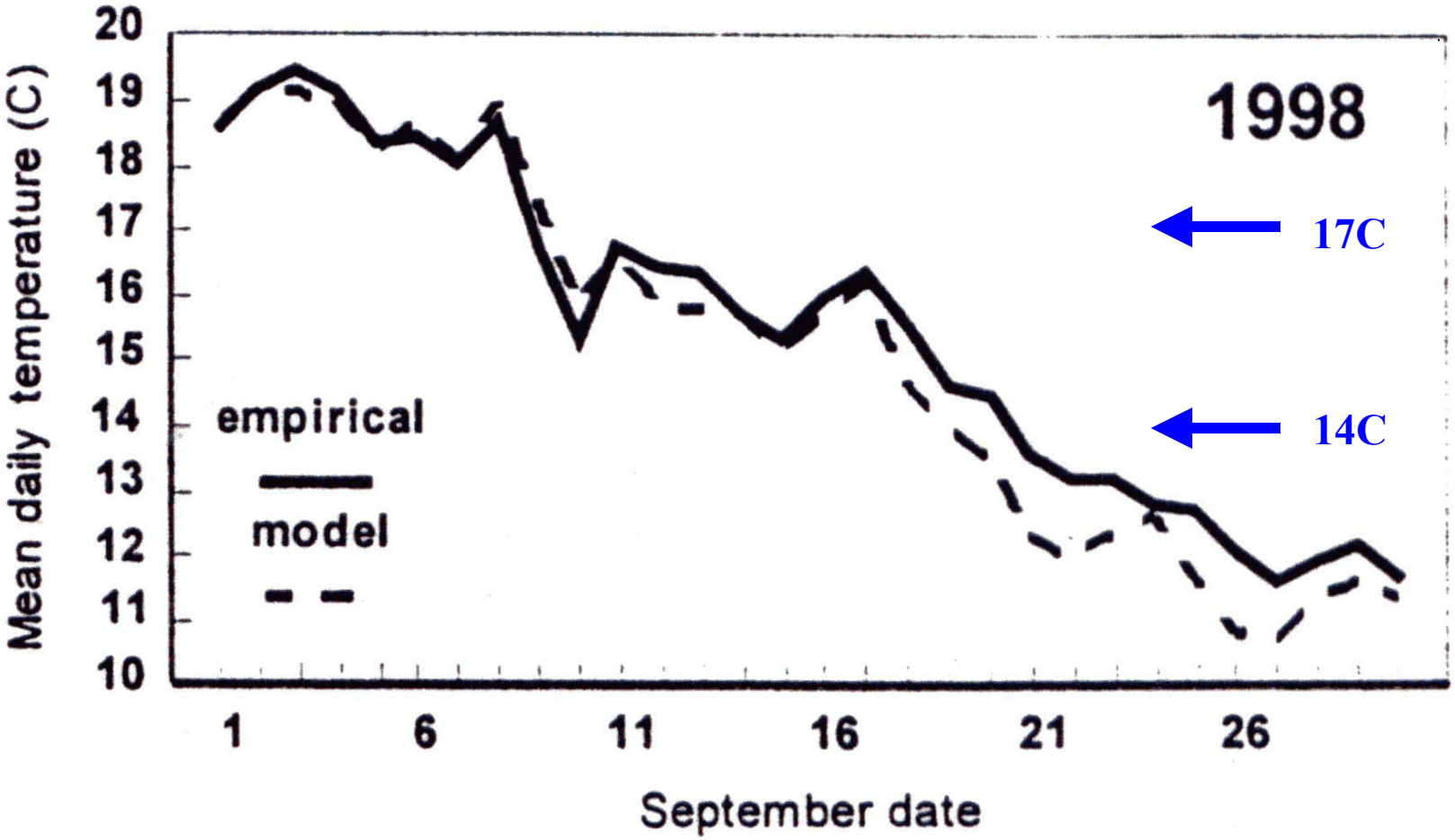
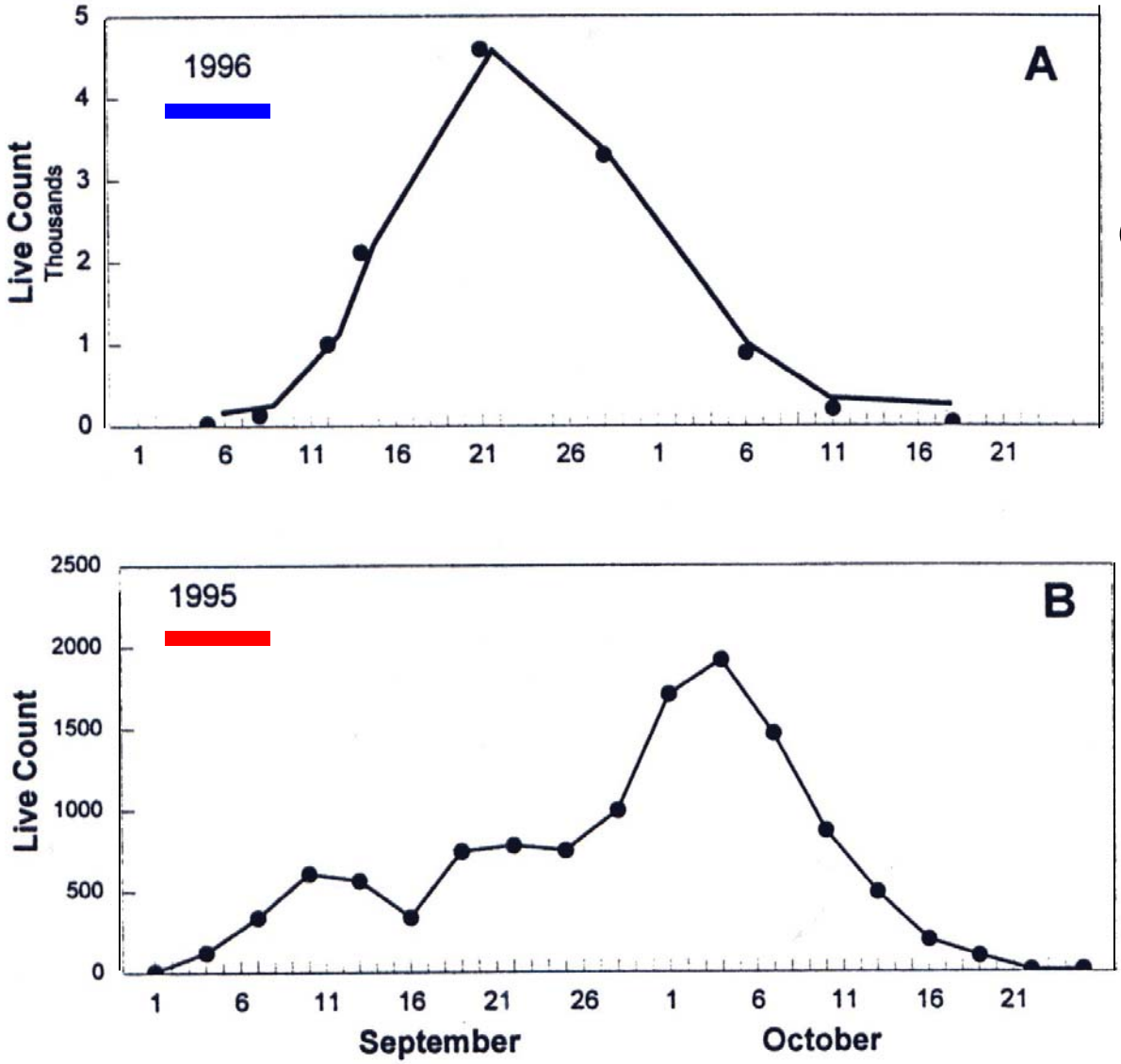


Improving Water Temperature for Kokanee Salmon of Mission Creek

- Toward Ecosystem Sensitive Water Management

Peter Dill, Okanagan College


Mean daily temperature (C)
20
19
18
17
16
15
14
13
12
11
10
1998
17C
14C
empirical
model
1
6
11
16
21
26
September date



Cool September (11.5C)

Warm September (14.4C)

Figure 18. Temporal distribution of spawners during cool (1996; A) and warm (1995; B) Septembers. Note the peak shift of 12 days.

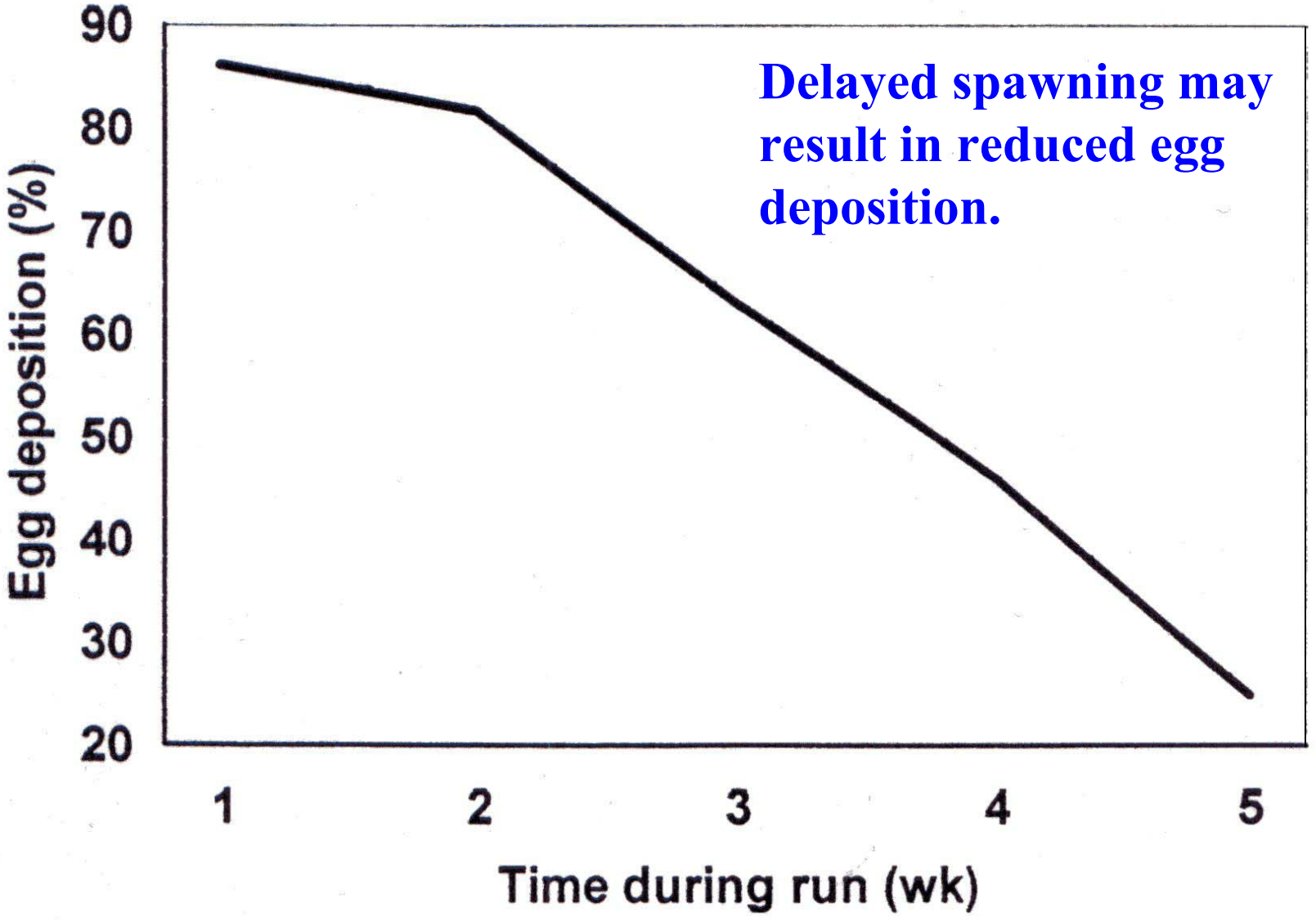
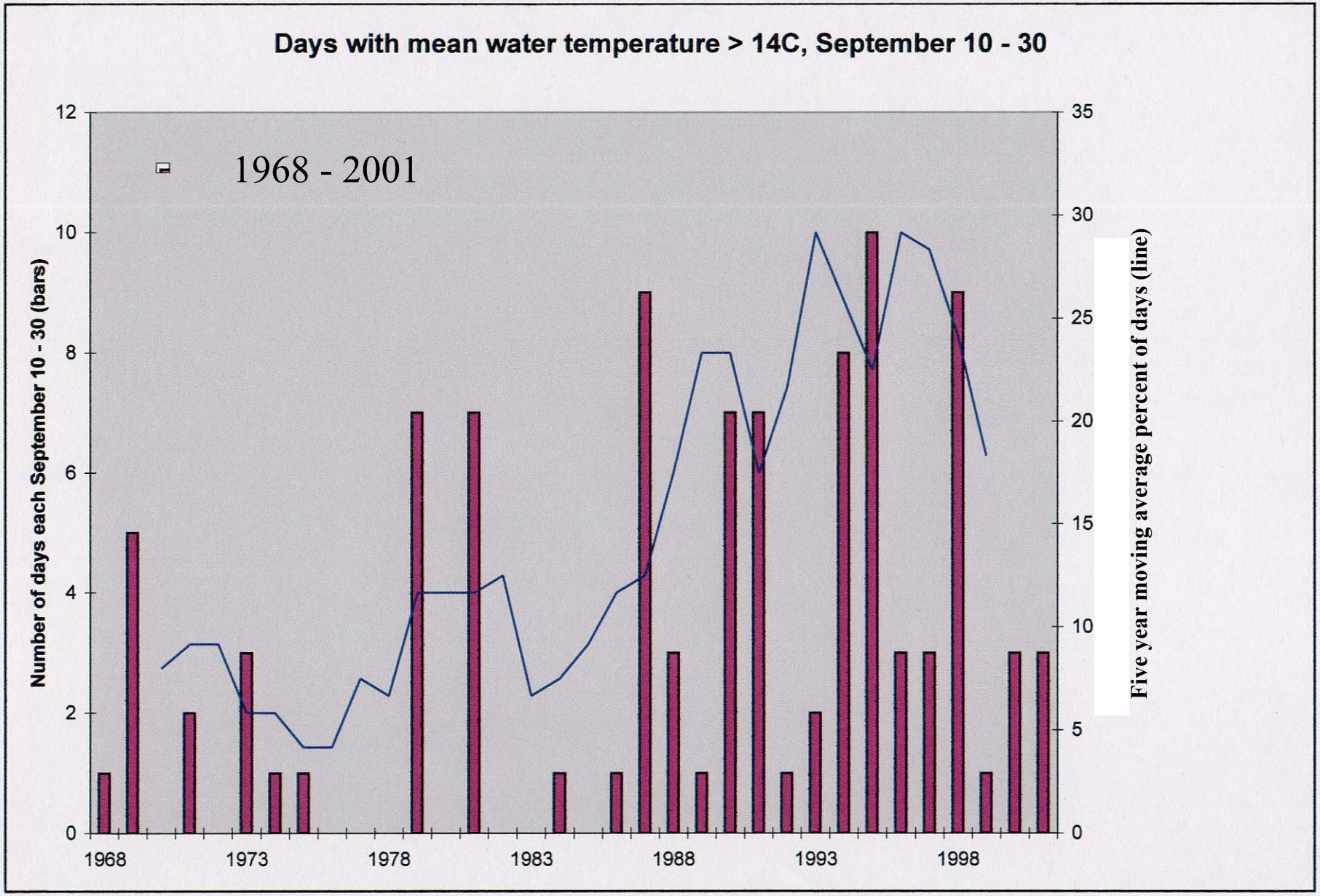


Figure 16. Decrease in egg deposition as time of spawning gets later in September, 1992.


Days with mean water temperature > 14C, September 10 - 30
1968 - 2001
Number of days each September 10 - 30 (bars)
Five year moving average percent of days (line)
0
2
4
6
8
10
12
0
5
10
15
20
25
30
35
1968
1973
1978
1983
1988
1993
1998

Can we develop a management strategy that will reduce this impact?

Three approaches studied:

Riparian Vegetation

Cooler Source Water

Greater Discharge

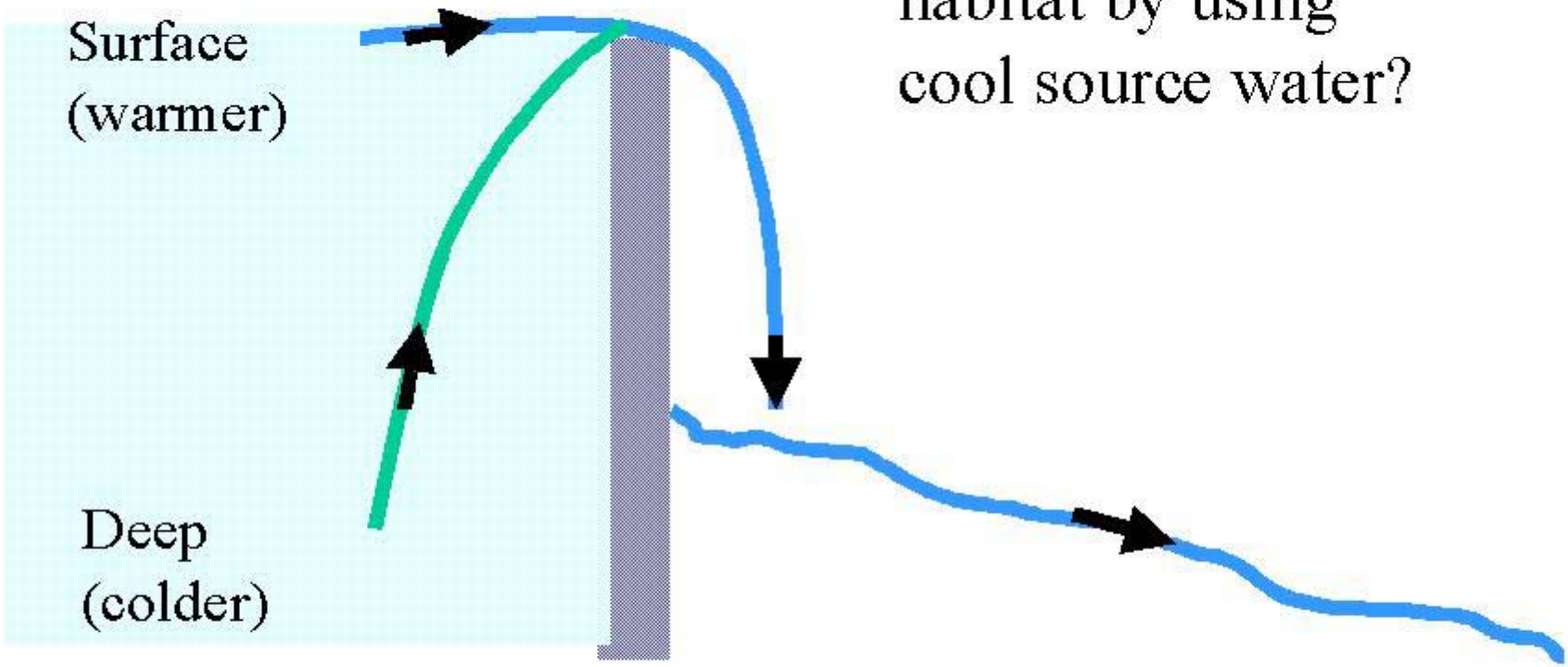
Three approaches studied:

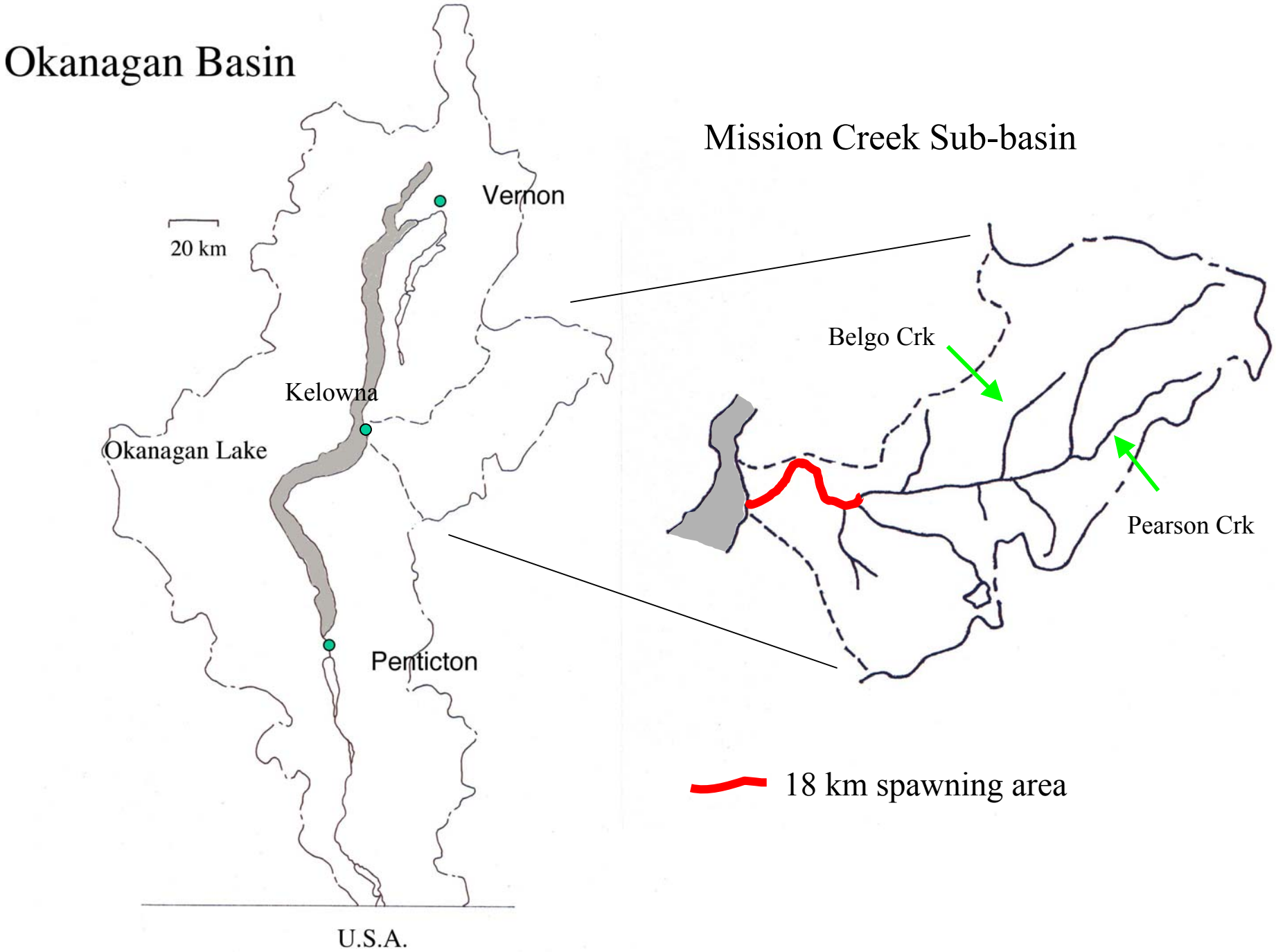
Riparian Vegetation X

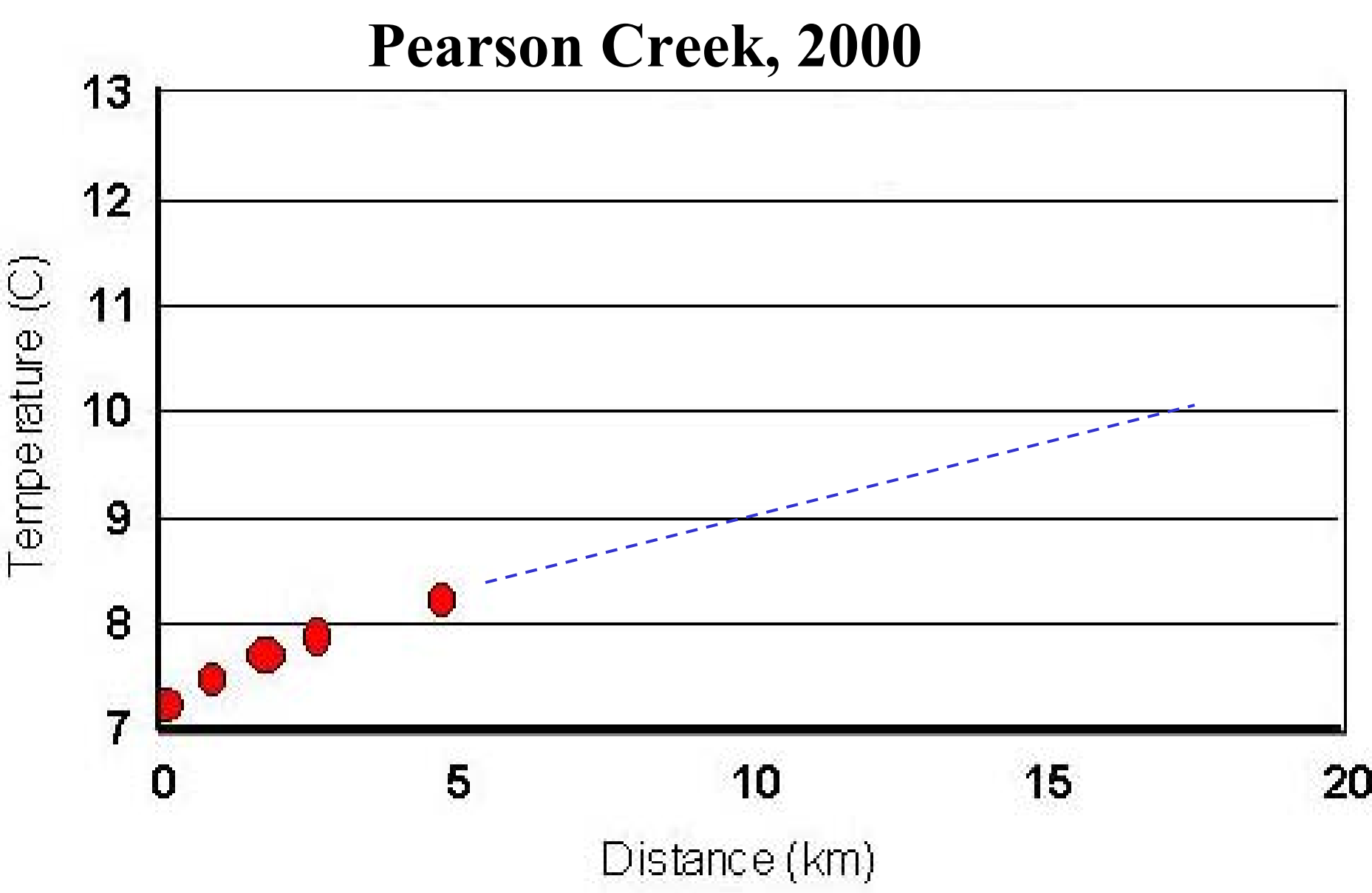
Cooler Source Water

Greater Discharge

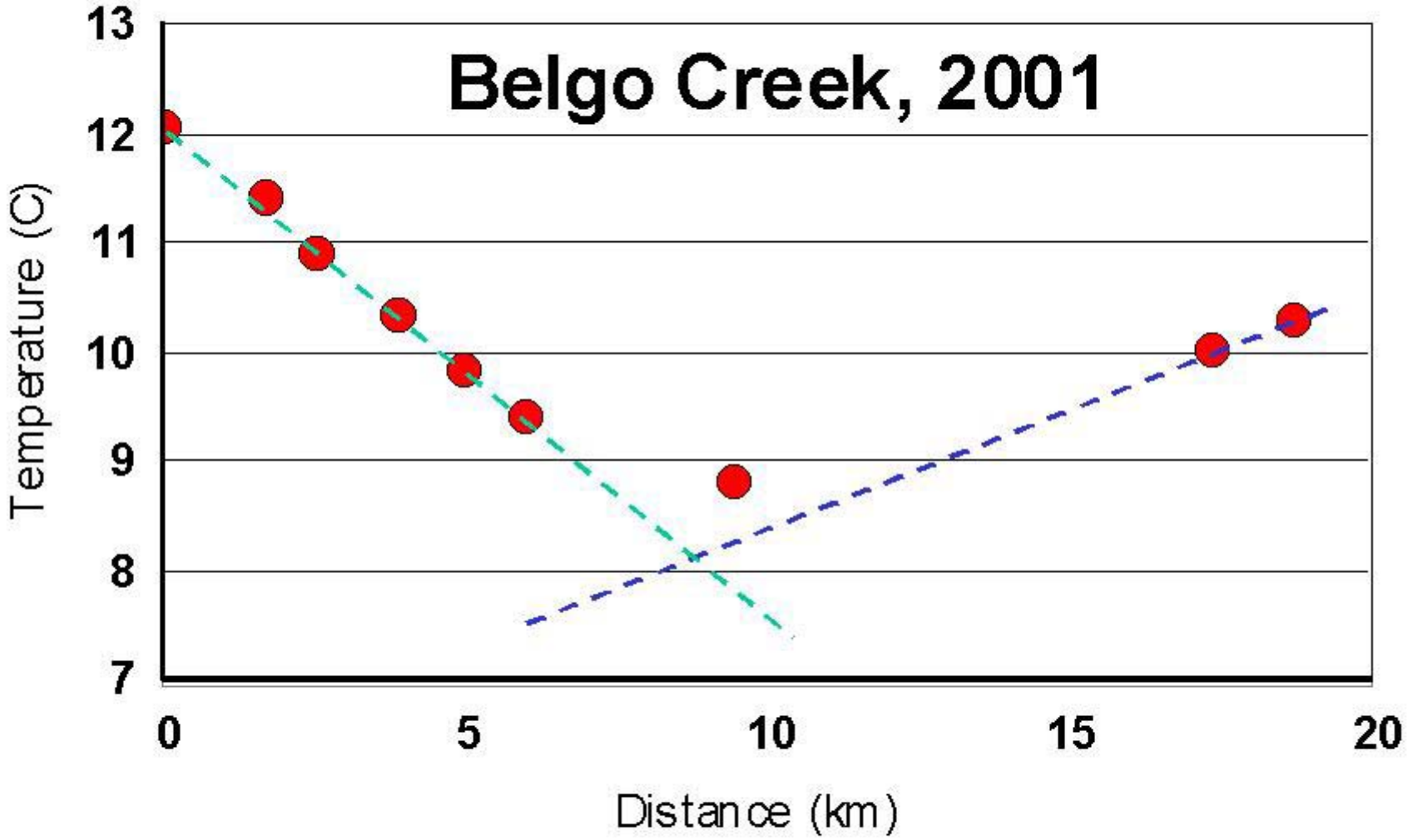
Can't we cool stream habitat by using cool source water?

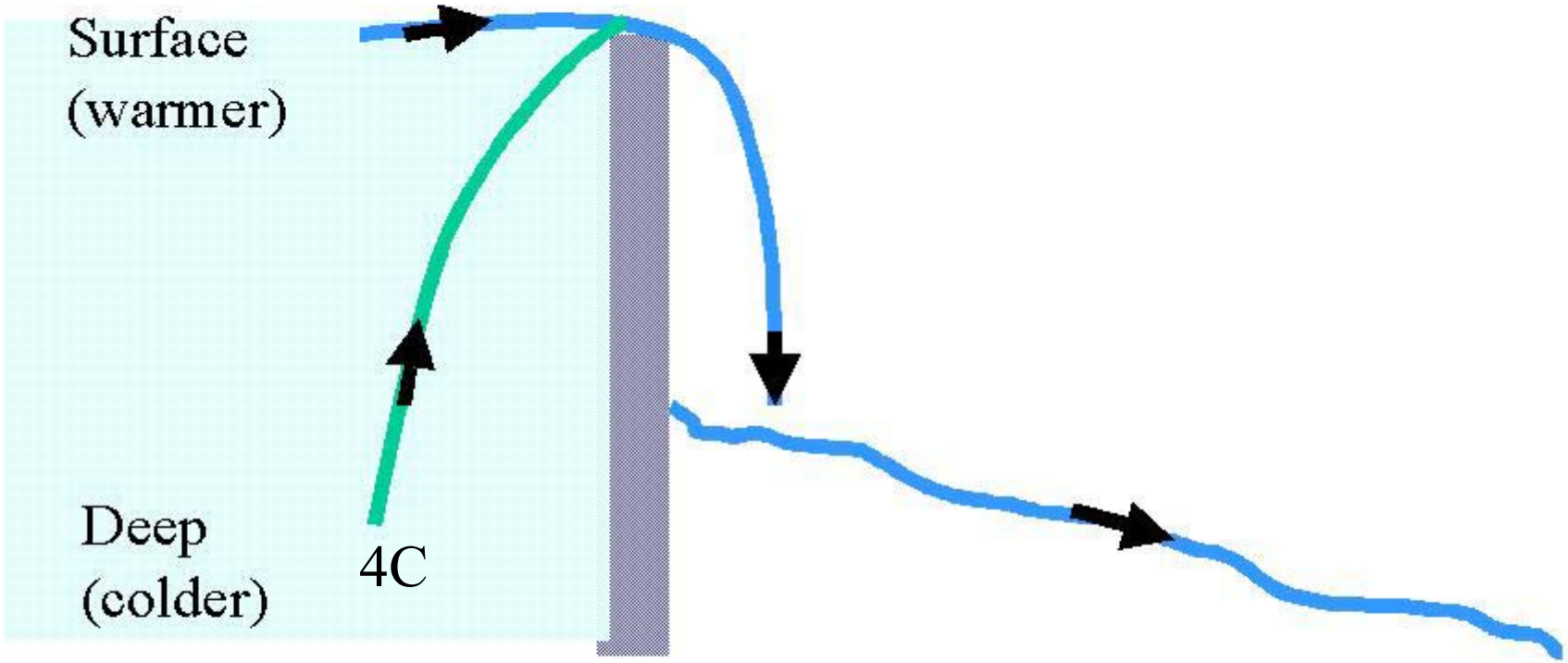



Okanagan Basin
Vernon
20 km
Kelowna
Okanagan Lake
Penticton
U.S.A.
Mission Creek Sub-basin
Belgo Crk
Pearson Crk
18 km spawning area



Natural equilibrium


Belgo Creek, 2001
Temperature (C)
13
12
11
10
9
8
7
0
5
10
15
20
Distance (km)



With natural equilibrium at approximately 7C in September at this altitude and the coolest possible water from deep behind the dam at 4C, the maximum 3C cooling effect would be lost by only 5km downstream.

Three approaches studied:

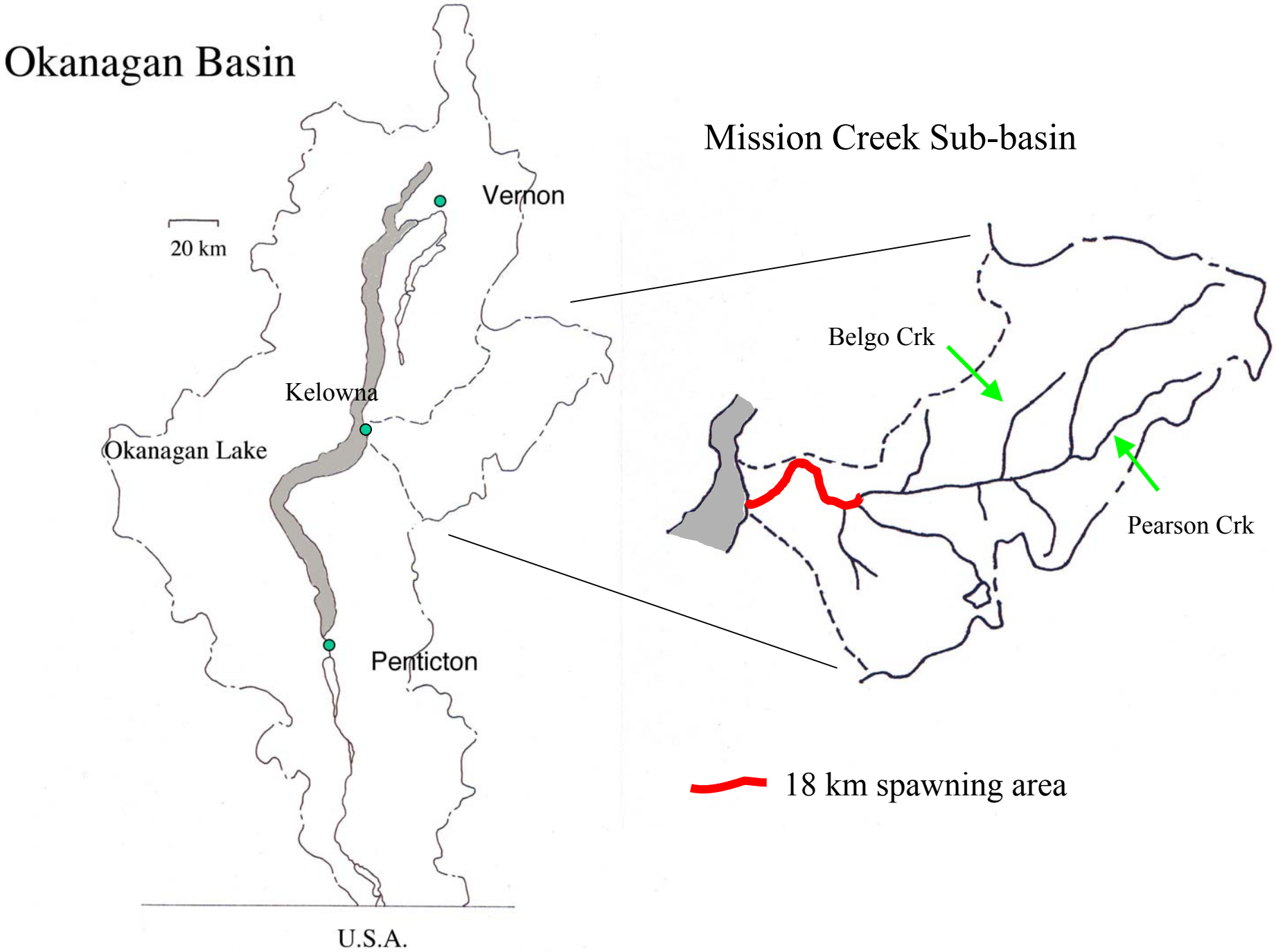
Riparian Vegetation X

Cooler Source Water X

Greater Discharge

Discharge hypothesis:

By increasing discharge, solar energy will be dispersed into a greater amount of water, resulting in less increase in water temperature.


Okanagan Basin
Vernon
20 km
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Okanagan Lake
Penticton
U.S.A.
Mission Creek Sub-basin
Belgo Crk
Pearson Crk
18 km spawning area

Collect hourly water temperatures in September for four years.

Explore literature to find variables that can influence water temperature.

Use readily available correlates of these variables to develop a multiple linear regression model.

The MODEL:

$$W = a + b \cdot S + c \cdot D + d \cdot P + e \cdot L + f \cdot U$$

where:

W = Mean daily **W**ater temperature

S = **S**eptember date

D = Natural log of daily **D**ischarge

P = Mean air temperature of **P**revious three days

L = Daily **minimum air** temperature

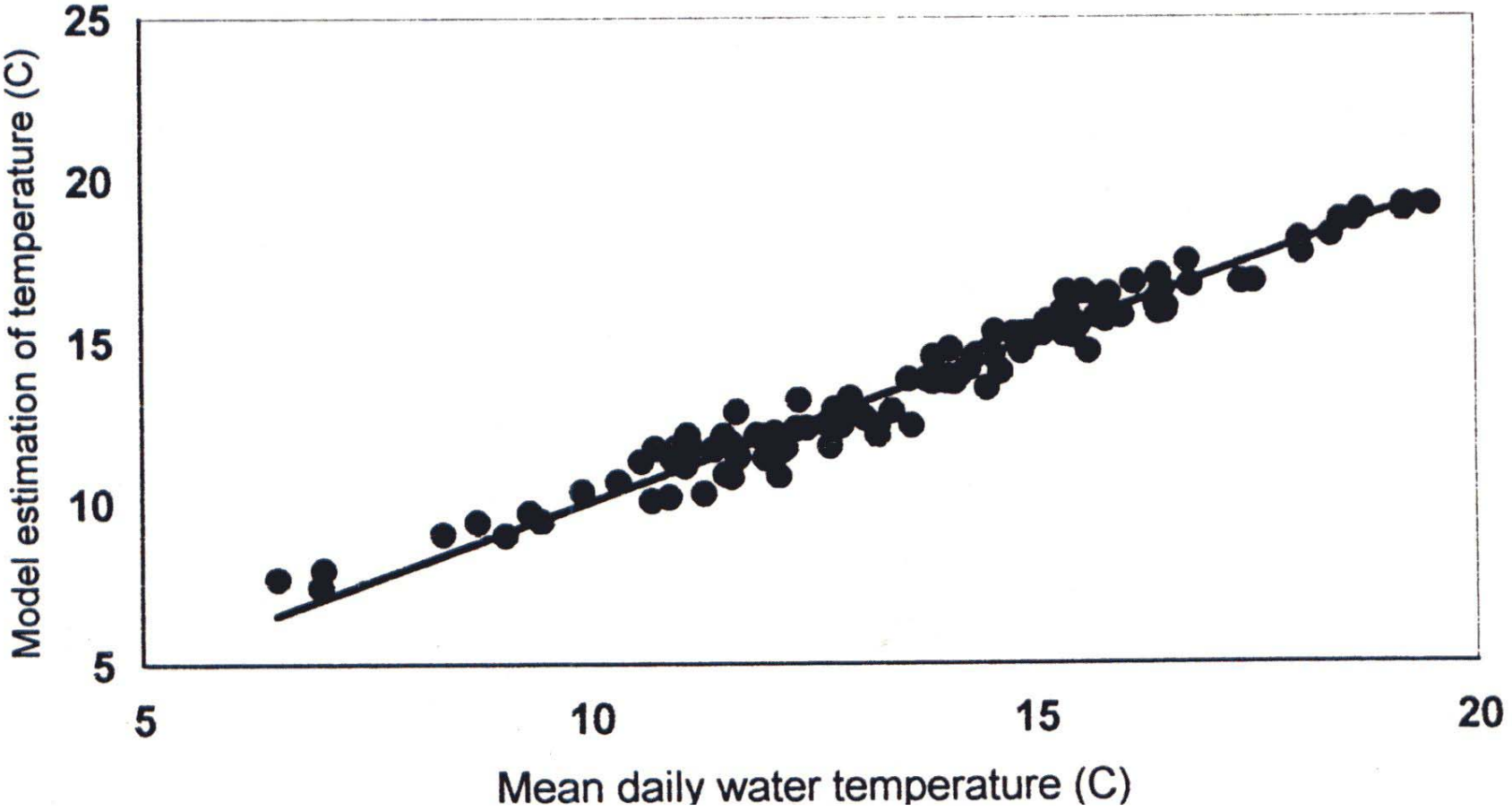
U = Daily **maximum air** temperature

with:

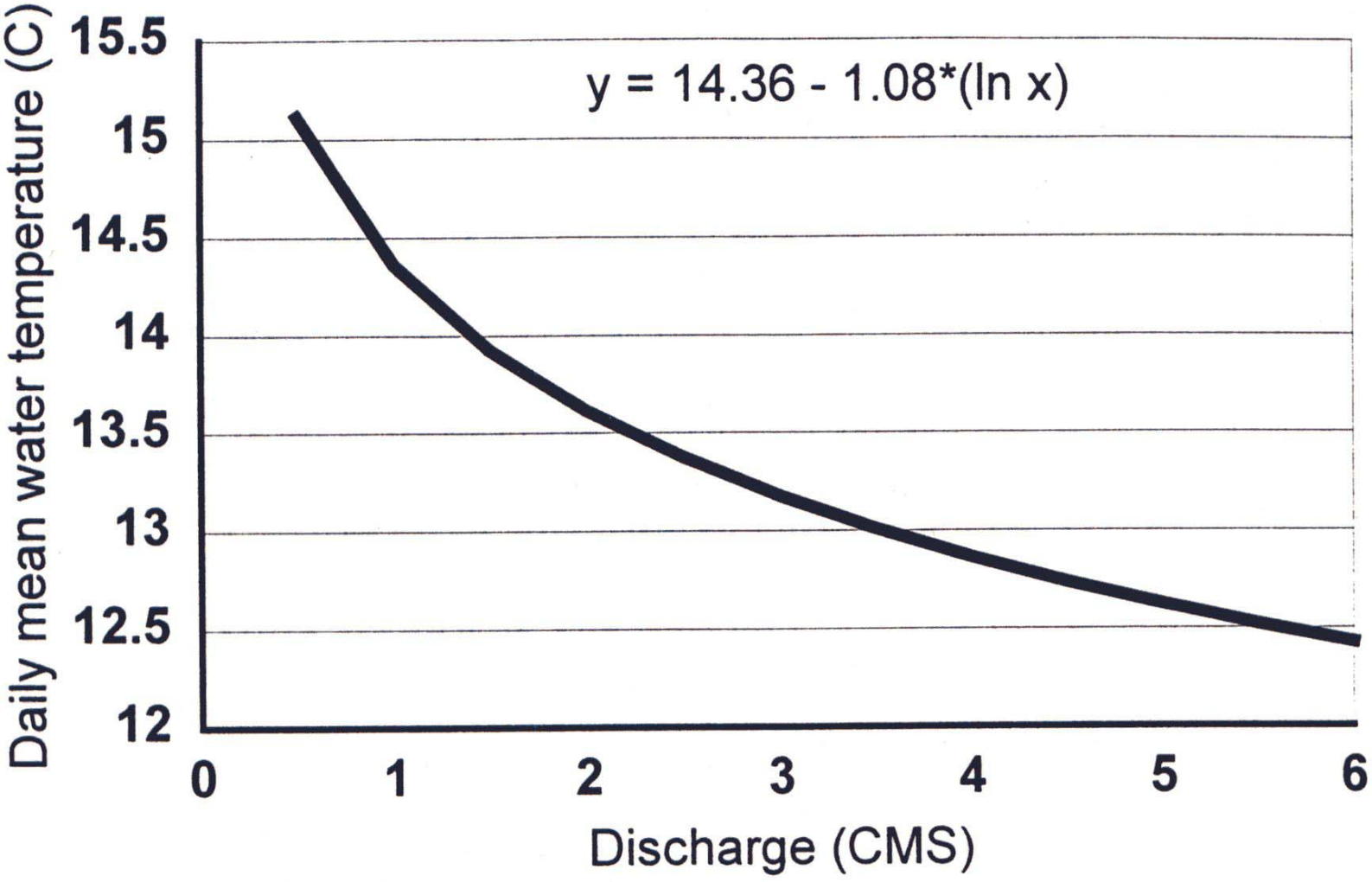
a = 5.886	b = - 0.068	c = - 1.081
d = 0.301	e = 0.222	f = 0.142

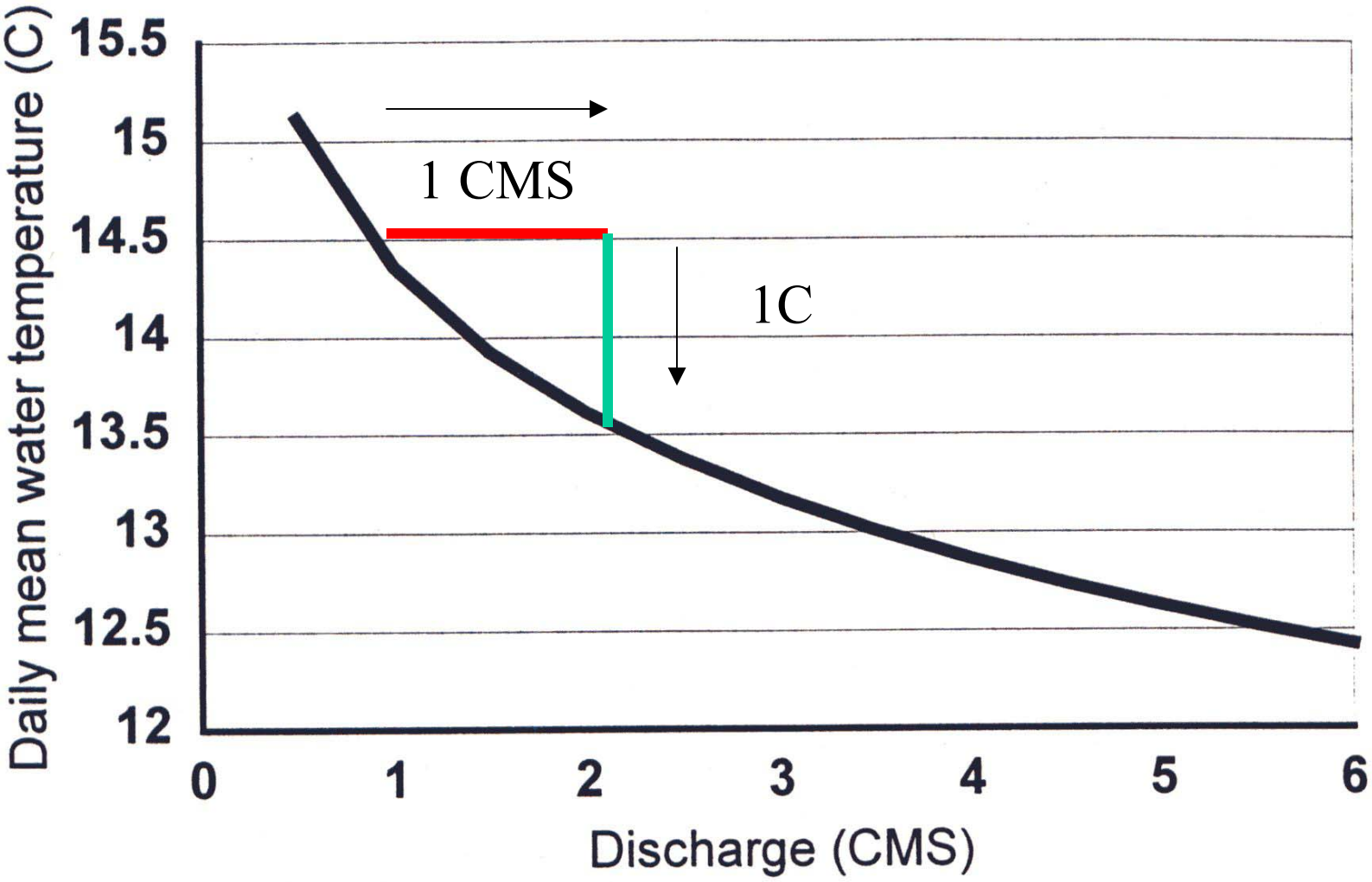
Model explains 96% of stream temperature variation.

It predicts daily mean temperature to +/- 0.5C.



We now use the model to isolate the effect of discharge on creek temperature.




Daily mean water temperature (C)
15.5
15
14.5
14
13.5
13
12.5
12
0
1
2
3
4
5
6
Discharge (CMS)
1 CMS
1C

But water is in short supply, therefore, I propose to increase discharge to cool water only on hot September days.

Example criteria:

Increase discharge only on days when mean air temperature for the previous 6 days was over 13C.

In addition, we focused only on September 8 to 30
-the 23 day period when most of the migration and spawning occurs.

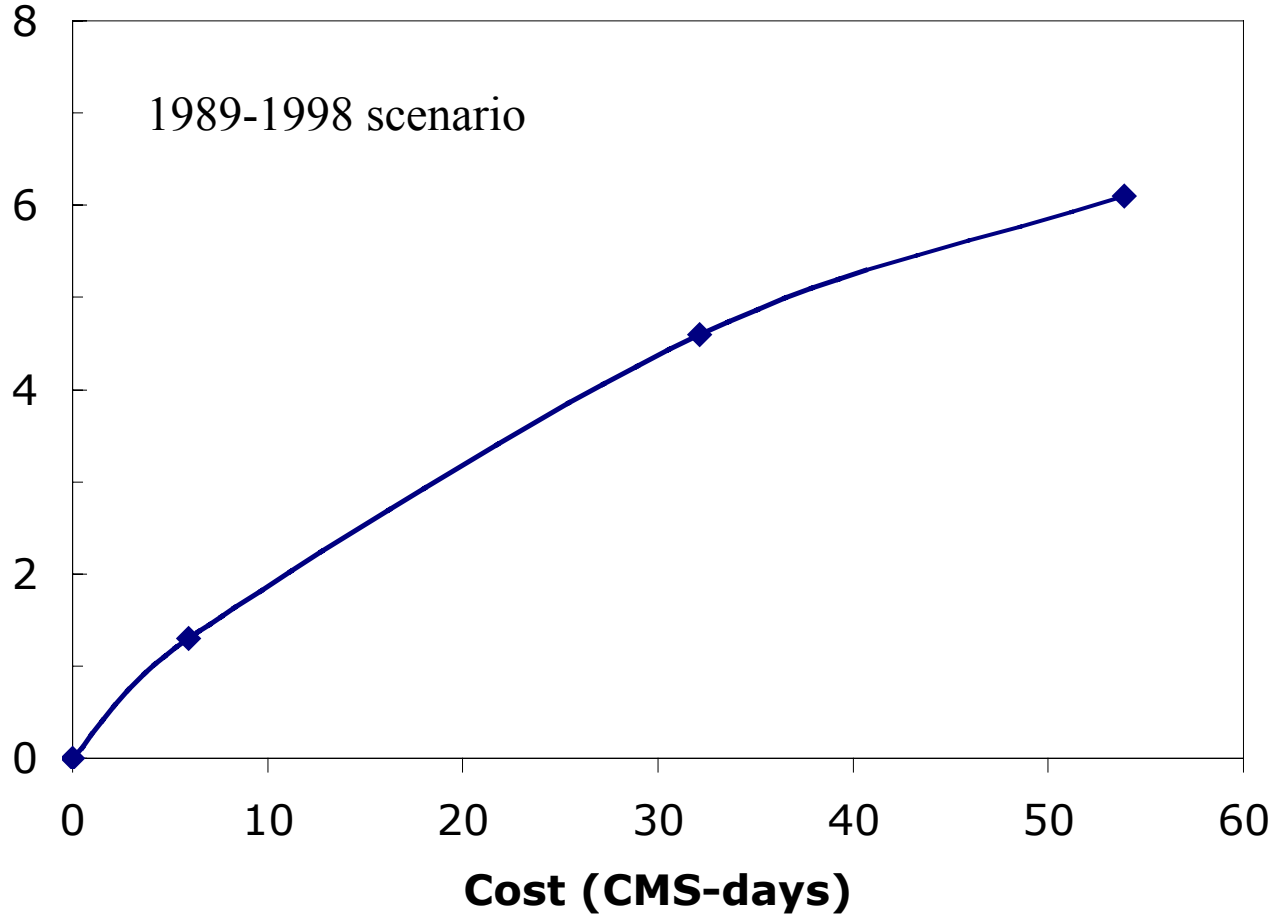
The MODEL simulated reduction in days >14C during Septembers from 1989 - 1998.

6-day average air trigger temperature of 13C.

Four years were cool enough to require no discharge increase. Of the remaining six years:

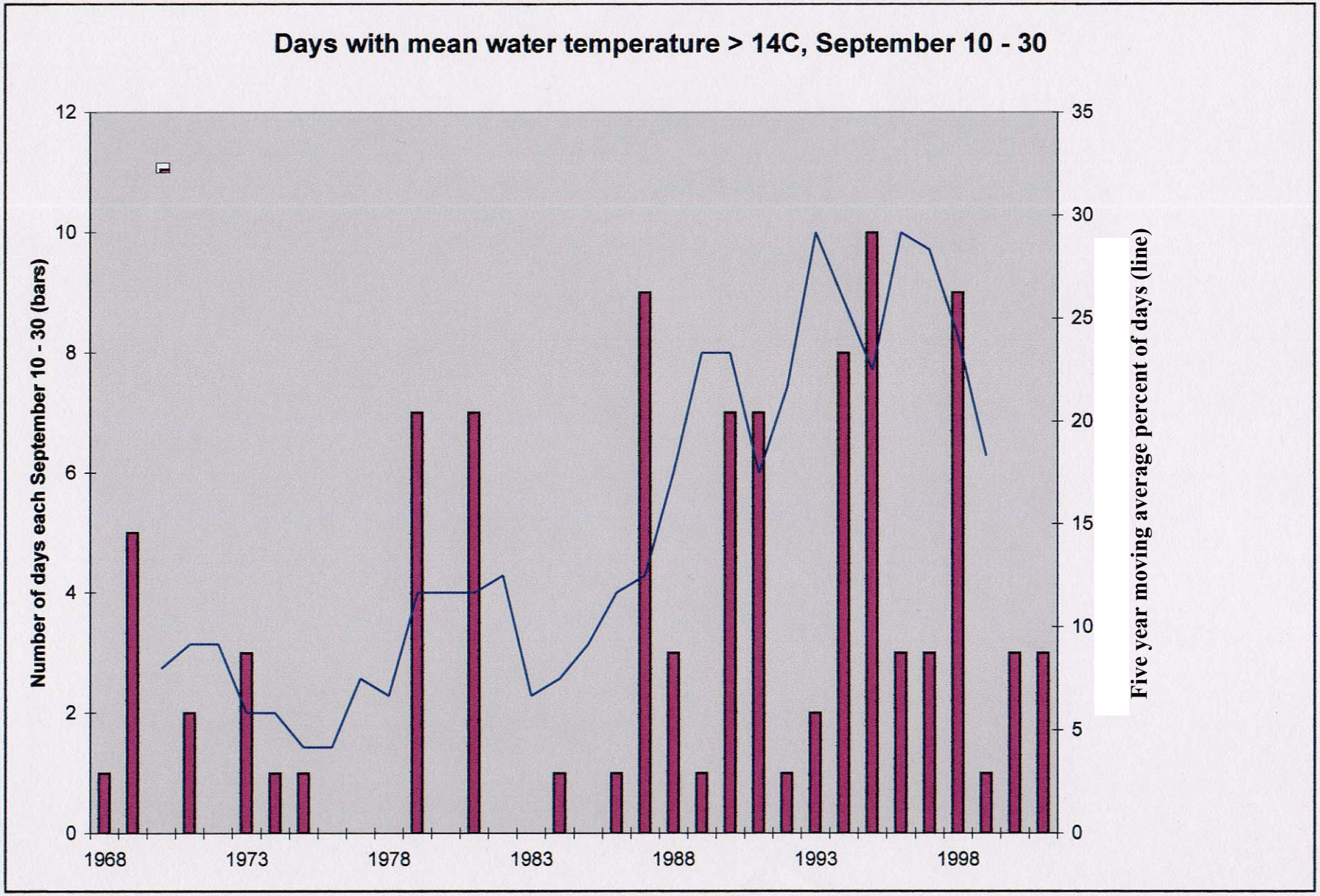
Discharge	Average days >14C	Days that discharge was increased
empirical	11.8 / 23	0
min 1.13CMS	10.5 / 23	11.2
min 2.13CMS	7.2 / 23	21.0
min 3.13CMS	5.7 / 23	21.3

Discharge Reduction of Creek Temperature



So we could increase the discharge in Mission Creek on hot days in September, and bring the temperature experience of the kokanee back to that which occurred in the 1960s & 70s.

Fewer kokanee would have their migration stalled by warm creek water, and egg deposition would increase.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PROJECT REPORT

TITLE:

LOWER MISSION CREEK KOKANEE HABITAT ENHANCEMENT

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