State of California — The Resources Agency

Memorandum

Ref ID 91088

To : Donald Fry, Jr. Date: April 13, 1965

From : **Department of Fish and Game** – Region 1
Millard Coots, Fisheries Manager II

Subject: A relationship betwen counts of king salmon grilse and subsequent spawning escapements of large adults, Shasta River Fish Counting Station, Siskiyou County

Dear Don:

Following our recent conversation on the above subject matter, I discovered an almost unbelievable correlation between grilse counts and subsquent spawning escapements of large adult spawners for the Shasta River king salmon counts since 1957. I did not consider previous counts due to intimate knowledge of the conditions of the old racks which, at times, allowed smaller fish to move upstream without being enumerated. The material I used for the analysis were the following counts.

TABLE 1
SHASTA RIVER KING SALMON COUNTS

YEAR	GRILSE	LARGE ADULTS
1957	453	1,781
1958	1,375	4,694
1959	1,256	8,619
1960	1,209	9,489
1961	3,514	5,250
1962	4,991	9,907
1963	9,013	22,825
1964	3,648	30,715

I compared the grilse count with the subsequent counts of large adults. One approach was to determine the relationship between a count of grilse and the escapement of large spawners two years later. This was based on the assumption that the grilse were two-year-old fish and the large adults were, for the most part, four-year-olds. The coefficient of

correlation was a remarkable .96. The line of regression was:

$$\underline{Y} = 2601.83 + 5.56X$$

where $\underline{Y}$ was the theoretical count of the large adults and X was the grilse count. Although only six years of records are available the line fits very well. (Part A of Figure 1). The standard error of estimate was 2,329 fish. The differences between the actual counts and the line of regression values for the large adults are comparatively small for counts over 9,000. (Table 2)

TABLE 2

X	Y	$\underline{Y}$	d
453	8,619	5,121	- 3,498
1,375	9,489	10,247	- 758
1,256	5,250	9,585	- 4,335
1,209	9,907	9,324	583
3,514	22,140	22,140	685
4,991	30,352	30,352	363

Where X is the grilse count.
Y is the count of large spawners two years later.
$\underline{Y}$ is the theoretical regression value of Y.
d is the difference between Y and $\underline{Y}$.

The other approach was to determine the relationship between a grilse count and the average of the next two years of large adult counts. My purpose, although perhaps a dubious nature, was an attempt to consider three as well as four-year-old fish. The coefficient of correlation was calculated to be .98. The line of regression was:

$$\underline{Y} = 2294.76 + 4.69X$$

Where X was the grilse count and $\underline{Y}$ was the theoretical regression value of the average of the subsequent two years of large adults enumerated. Likewise, for such limited data, the regression line fits very well (Part B of Figure 1). The standard error of estimate was 1,475 large adults, almost two-thirds of the standard error in the previous method.

TABLE 3

X	Y	$\underline{Y}$	d
453	6,657	4,419	2,328
1,375	9,054	8,744	310
1,256	7,370	8,185	- 815
1,209	7,578	7,965	- 387
3,514	16,366	18,775	- 2,409
4,991	26,770	25,613	1,157

Where X is the grilse count.
Y is the average of the next two years of large adult counts.
$\underline{Y}$ is the theoretical regression value of Y.
d is the difference between Y and $\underline{Y}$.

Now, I know what is on your mind. What are my predictions for the magnitude of the coming 1965 spawning escapement into the Shasta River? The large grilse count in 1963 of 9,013 fish should indicate a large escapement of large adult spawners in 1965. The line of regression for the first method indicates 53,066 large spawners plus an unknown number of grilse. Three standard errors — 99.7% chances out of 100 — provides a leeway of about 7,000 fish.

The line of regression for the second method in which I averaged the counts of the following two years of large adult spawners indicates 44,566 large adults entering the Shasta River in 1965 with a leeway, three standard errors, of 4,425 fish.

Spawning escapements of this magnitude, as calculated or predicted by these methods, have not entered the Shasta River since or before 1940.

The first method comes out with 22,885 large spawners entering the river in 1966 plus or minus the standard errors. The second method calculates the run of large spawners to be 19,404 fish along with the leeway of standard errors.

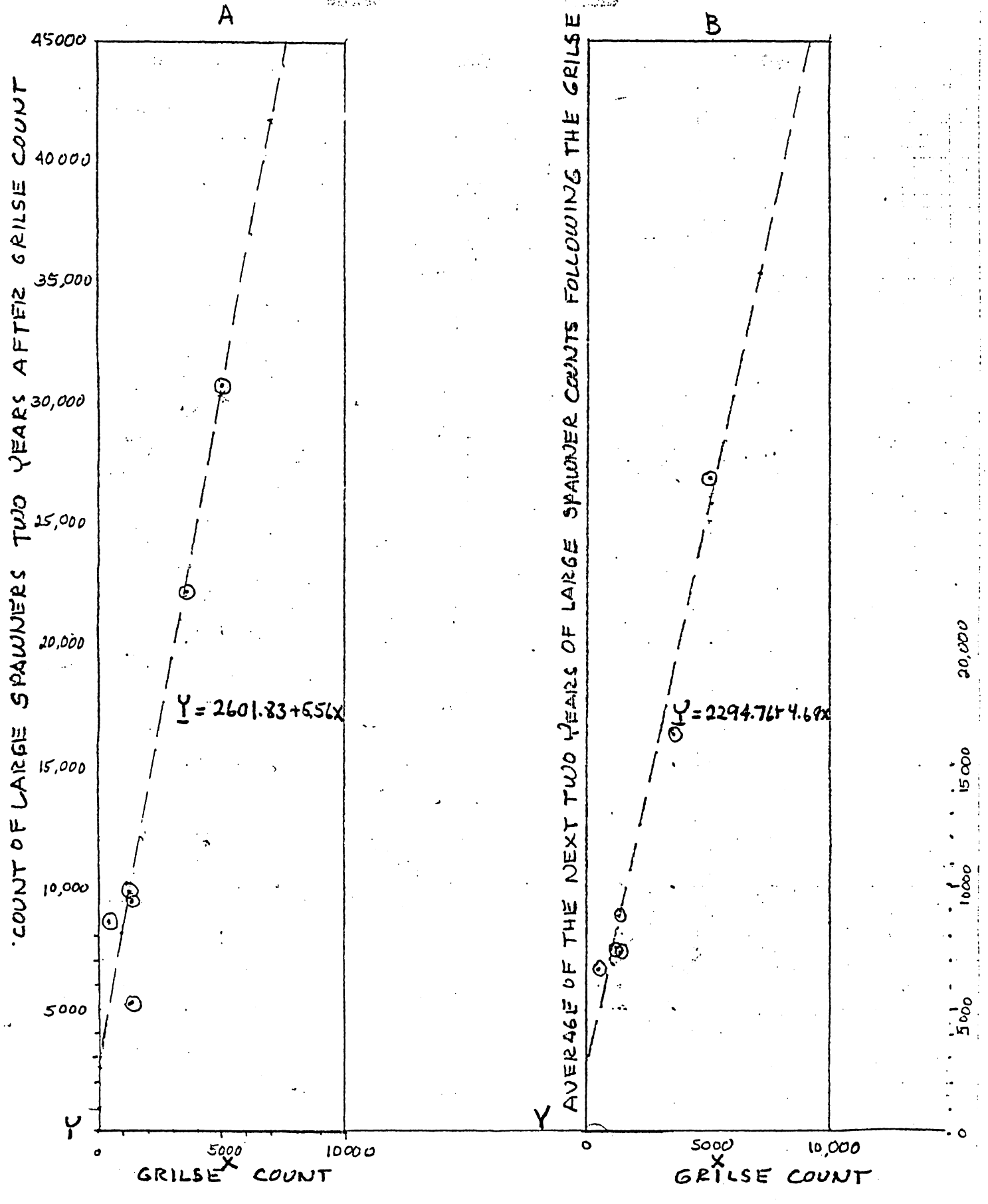
In addition to the accuracy of my predications, I am curious if correlations between grilse and subsequent escapements of large adults have ever been attempted or assessed. I do know, however, that fish counting weirs have to be efficient if they are utilized for such determinations.

Millard Coots
Fisheries Manager II

MC:lz

cc: Leo Shapavalov
Richard Hallock
Jim Riley, Jr.

FIGURE 1


A
B
COUNT OF LARGE SPAWNERS TWO YEARS AFTER GRILSE COUNT
AVERAGE OF THE NEXT TWO YEARS OF LARGE SPAWNER COUNTS FOLLOWING THE GRILSE COUNT
Y = 2601.83 + 6.56X
Y = 2294.76 + 4.69X
GRILSE COUNT
GRILSE COUNT
45000
40000
35,000
30,000
25,000
20,000
15,000
10,000
5000
0
5000
10000
10,000
20,000
15000
10000
5000
0
X
X
Y
Y