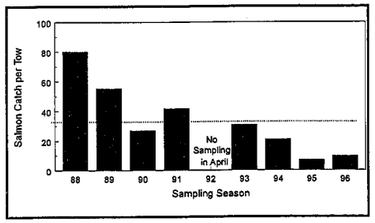

Figure 1
MEAN CATCH OF SALMON SMOLTS PER 20-MINUTE TOW, SACRAMENTO MIDWATER TRAWL, APRIL-JUNE 1988-1996
There was no sampling in April 1992. In 1990, trawling was at Courtland, about 20 miles downstream of the Sacramento site. Dotted line is the 1988-1996 mean, not including 1992.

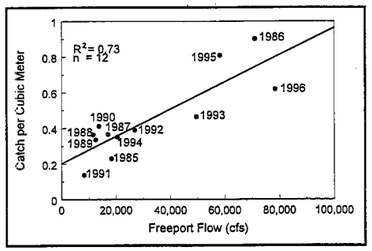

Figure 2
MEAN CATCH PER CUBIC METER SEINED IN THE NORTHERN DELTA IN JANUARY-MARCH VERSUS MEAN FEBRUARY FLOW IN THE SACRAMENTO RIVER AT FREEPORT, 1985-1997

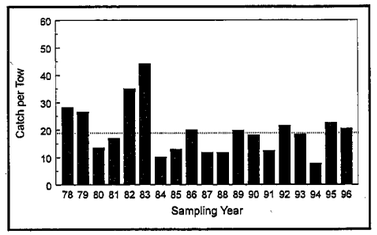

Figure 3
MEAN CATCH OF SALMON SMOLTS PER 20-MINUTE TOW, CHIPPS ISLAND MIDWATER TRAWL, APRIL-JUNE 1978-1996
Dotted line is the 1978-1996 mean.

Survival through the delta in 1996 was estimated for juvenile salmon using coded-wire-tagged smolts released at Miller Park on the Sacramento River (Table 1) and Mossdale on the San Joaquin River (Table 2) and recovering them in a midwater trawl at Chipps Island.

Releases at Miller Park on April 25 and May 6 yielded a mean survival index to Chipps Island of 0.84 (range 0.58-1.09). The mean 1996 index is relatively high compared to those estimated historically. Historical indices have ranged from 0.00 in 1978 and 1994 to 1.87 in 1982. The lowest survival indices generally have corresponded to releases made when water temperature was above 70°F. However, the 1990 release was made at 70°F and survived well (0.86), indicating temperature alone is not driving the low survival indices. When release temperatures have been more favorable, the indices have generally been between 0.30 and 1.00.

Survival was indexed for the San Joaquin River in 1996, from Mossdale to Chipps Island, in mid-April and early May. Overall survival was very low for both releases (0.02 and 0.01). Survival since 1992 has rarely exceeded 0.20 in the southern delta. Survival was highest in 1995, with high San Joaquin River flows, moderate exports, and no barrier at the head of Old River. Southern delta survival is extremely low compared to that in the Sacramento River delta.

Table 1
SURVIVAL INDICES FOR CODED-WIRE-TAGGED SALMON RELEASED AT SACRAMENTO

Release Date	Release Temperature (°F)	Survival Index	Season Average
04/25/96	57	1.09	
05/06/96	65	0.58	0.84
05/01/95	58.5	0.63	0.63
05/03/94	67	0.07	
05/24/94	71	0.00	0.04
04/23/93	61	0.63	
05/03/93	62	0.43	
05/21/93	65	0.35	
05/28/93	64	0.75	0.54
04/25/91	62	0.77	
04/29/91	62	0.50	0.64
05/07/90	70	0.86	0.86
06/01/89	67	0.16	
06/14/89	70	0.20	0.18
05/05/88	62	0.65	
06/23/88	74	0.08	0.37
05/11/82	60	1.87	
06/04/82	68	0.55	1.21
06/04/81	76	0.01	0.01
06/03/80	62	0.32	
06/05/80	62	0.38	0.35
06/06/79	68	0.43	0.43
06/06/78	73	0.00	0.00

Table 2
SURVIVAL INDICES FOR CODED-WIRE-TAGGED SALMON RELEASED AT MOSSDALE

Release Date	Release Temperature (°F)	Survival Index	Season Average
04/15/96	59.5	0.02	
04/30/96	64	0.01	0.02
04/17/95	57	0.22	
05/05/95	62	0.12	
05/17/95	63	0.07	0.14
04/11/94	63	0.00	
04/26/94	60	0.04	
05/02/94	66	0.00	
05/09/94	68	0.02	0.02
04/06/93	64	0.04	
04/28/93	64	0.07	
05/04/93	61	0.07	
05/12/93	65	0.07	0.06
04/07/92	64	0.18	
04/13/92	63	0.12	
04/24/92	69	0.08	
05/04/92	71	0.01	
05/12/92	72	0.02	0.08

Releases at Mossdale have been made using smolts originating from the Feather River Hatchery, since smolts from the Merced River Fish Facility were unavailable. To evaluate the possibility that using Feather River Hatchery smolts for south delta survival experiments has biased these estimates low, comparisons of survival through the southern delta were made with smolts from both the Merced and Feather River hatcheries in 1996. Releases from both hatcheries were made simultaneously at Dos Reis on May 1 and at Jersey Point on May 3 (Table 3). Survival was somewhat improved for the Merced River release groups, although the indices were still very low, with both Dos Reis indices below 0.20.

Table 3
SURVIVAL INDICES FOR MERCED AND FEATHER RIVER HATCHERY CODED-WIRE-TAGGED RELEASES IN 1996

Hatchery	Release Site	Release Date	River Temperature (°F)	Survival Index
Feather	Dos Reis	May 1	63	0.02
Merced	Dos Reis	May 1	63	0.10
Feather	Jersey Point	May 3	64	0.35
Merced	Jersey Point	May 3	65.5	0.72

Chinook Salmon Catch and Escapement

Randall Brown and Sheila Greene, DWR

Much of the following information was taken from the February 1997 report, "Review of the 1996 Ocean Salmon Fisheries" by the Pacific Fishery Management Council. Copies of the report can be obtained by calling 503/326-6352. Additional information was provided by Alan Baracco and Nick Villa of DFG.

The 1996 ocean commercial and recreational fisheries, and escapement of adult salmon not harvested in the ocean and inland fisheries, were affected by management actions to protect the listed winter chinook and the weak Klamath River stocks. In March 1996, NMFS issued a biological opinion that required ocean take to be reduced enough so that winter chinook spawning escapement would be increased by 35%. The reduction was achieved by regulations implemented south of Horse Mountain, California, to shorten the season, increase the minimum size of legal salmon, and restrict the type of gear that may be used. The 1997 management measures recently released by PFMC will be even more restrictive, with some measures included off California to protect Snake River runs.

Figure 1 — Ocean commercial and recreational catch.

- The total 1996 ocean catch landed in California was about half of that landed in 1995 and was the seventh lowest catch since 1971. The sports fishing fleet, including the charter boats and private boats, was particularly hard hit, landing only about 40% of the 1995 landings.
- The 1996 Central Valley chinook salmon ocean harvest index (ocean catch/catch + escapement) was 0.63, the lowest index in the past 10 years. (In recent years the index has varied between 0.70 and 0.79.)
- The lower ocean harvest index indicates that the relatively low ocean harvest was likely a function of regulatory changes as well as fish availability.
- In 1997, recreational catch may increase due to new regulations, after July 1, that require recreational anglers to keep the first two fish they catch, regardless of size. Last year the minimum size during this period was 24 inches, and many of the hooked fish had to be returned because they were less than the minimum size.

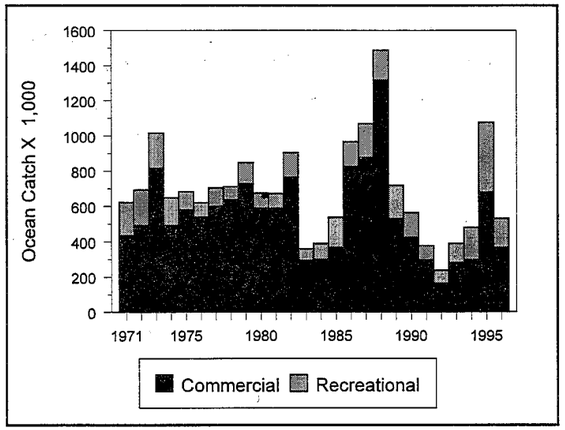

Figure 1
ANNUAL CALIFORNIA COMMERCIAL AND RECREATIONAL CHINOOK OCEAN CATCH
Preliminary DFG Data

Figure 2 — Annual spring run escapement to Butte Creek.

- Estimated spawning escapement was 1,400 fish, down from the near-record 7,500 adult spring run in 1995.
- Even though 1996 escapement was significantly lower than 1995, it was one of the better runs in the past 30 years and, assuming the fish were mostly 3-year-olds, was about double the 1993 parent stock.
- As with all the spawning escapements, the reduced ocean harvest makes it difficult to determine if restoration measures, natural conditions (1994 was a dry year), or change in harvest caused the relatively strong run to Butte Creek.

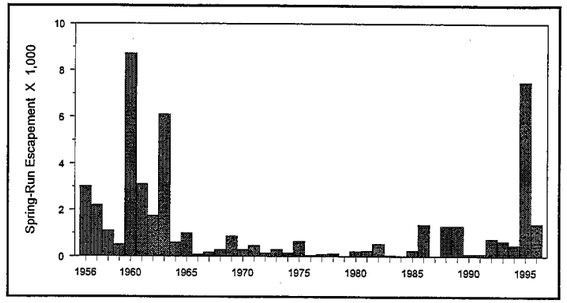

Figure 2
ANNUAL SPRING-RUN ESCAPEMENT TO BUTTE CREEK
Preliminary DFG Data

Figure 3 — Estimated spring chinook escapement to the upper Sacramento River.

- The data shown include runs to Mill, Deer, and Butte creeks and the Sacramento River above the Red Bluff Diversion Dam.
- The decrease in 1996 runs, as compared to 1995, was across all segments of the runs and showed the continued low, but relatively stable, abundance observed since 1990.

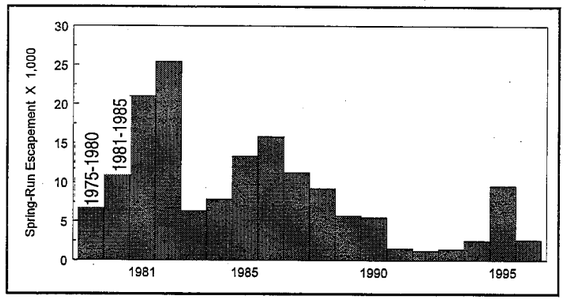

Figure 3
ANNUAL SPRING-RUN ESCAPEMENT TO THE UPPER SACRAMENTO RIVER
Preliminary DFG Data

Figure 4 — Annual winter chinook escapement to the upper Sacramento River.

- This race is listed as endangered by both the State and Federal governments.
- The estimated run of 940 wild fish more than replaced the 340 fish in the 1993 parent stock. Both estimates include 2- and 3-year-old fish, so they are only roughly comparable.
- In addition to the 940 wild winter chinook, an estimated 356 winter chinook adults resulted from the artificial propagation program at Coleman National Fish Hatchery. This return is particularly dramatic since only 20-30 adult were used in the program and 19,000 smolts were released in the upper river. However, these fish returned to Battle Creek and did not supplement the natural production. Battle Creek summer water temperatures are not adequate for natural reproduction of the winter run.
- In 1996, three run-estimating techniques were used to help confirm the estimates obtained by counting fish passing Red Bluff Diversion Dam when the gates are down. Two of these estimates were quite similar to estimates obtained from extrapolating the ladder counts, indicating that, at least for 1996, ladder counts are providing reliable estimates.

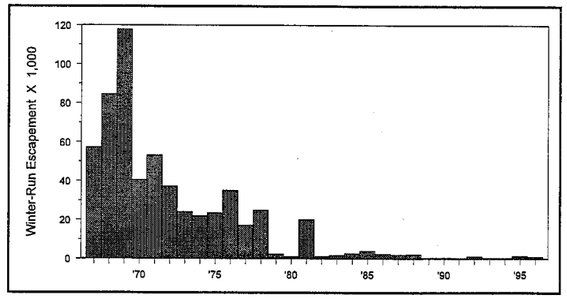

Figure 4
ANNUAL WINTER-RUN ESCAPEMENT TO UPPER SACRAMENTO RIVER
Preliminary DFG Data

Figure 5 — Annual fall run escapement to the Yuba River.

- Although the Yuba River is tributary to the Feather River, the run appears to be relatively independent of hatchery practices on the Feather.
- The 1996 run was the third best in the past 27 years.

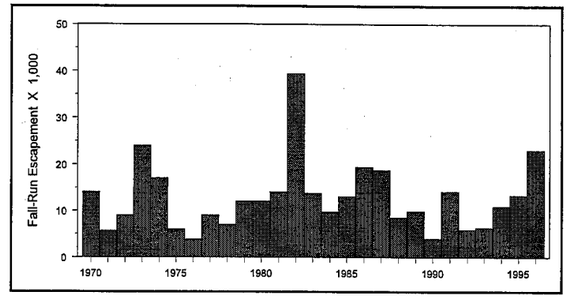

Figure 5
ANNUAL WINTER-RUN ESCAPEMENT TO YUBA RIVER
Preliminary DFG Data

Figure 6 — Annual fall chinook escapement to the American River.

- Only fall chinook spawn in the American River, and this race is supported by a mitigation hatchery operated by DFG. Smolt production is trucked to San Pablo Bay for release in late spring.
- The American River fall run in 1996 was also the third best since 1970. Although the plot indicates that most of the fish were nonhatchery, the hatchery numbers only reflect the number of salmon actually taken into the hatchery. Without an intensive tagging and recovery program, it is not possible to determine how many of the natural in-river spawners originated from hatchery releases. DFG has shown that there is substantial emigration of naturally spawned fry and smolts from the river each winter and spring.

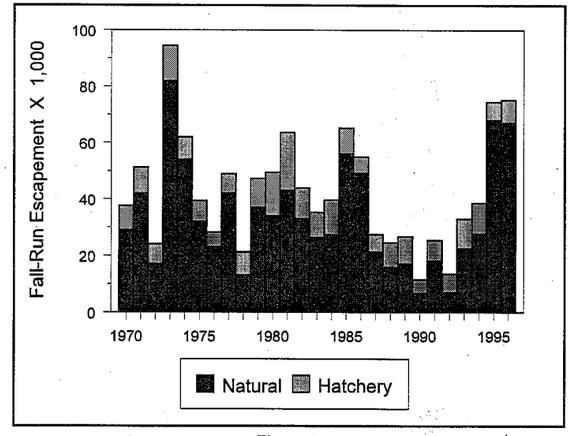

Figure 6
ANNUAL FALL-RUN ESCAPEMENT TO AMERICAN RIVER, NATURAL AND HATCHERY CONTRIBUTION
Preliminary DFG Data

Figure 7 — Annual fall chinook escapement to the Feather River.

- As with the American River, DFG operates a mitigation hatchery on the Feather River and trucks smolt production to San Pablo Bay. Although not shown, the hatchery also produces spring chinook. Genetic studies are underway to determine if spring chinook produced at the hatchery genotypically resemble spring run in Mill, Deer, and Butte creeks.
- Escapement in 1996 was among the highest recorded since 1970. The hatchery/natural breakdown is based on the number of spawners entering the hatchery and estimated on the spawning grounds. We are hoping tag returns in 1997 from an extensive marking program will enable a more useful breakdown between the two run components.

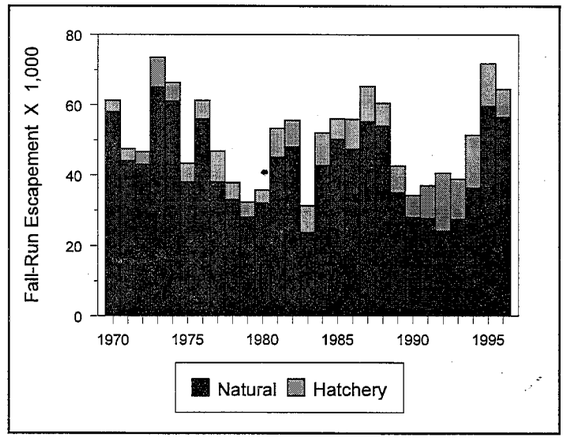

Figure 7
ANNUAL FALL-RUN ESCAPEMENT TO FEATHER RIVER, NATURAL AND HATCHERY CONTRIBUTION
Preliminary DFG Data

Figure 8 — Annual fall-run escapement to Sacramento River and major tributaries.

- The estimate includes spawning in the mainstem Sacramento as well as the American, Feather, and Yuba rivers and Battle Creek.
- Total estimated escapement was the third highest since 1970 and more than met the PFMC goal of 122,000-180,000 spawners in the Central Valley.

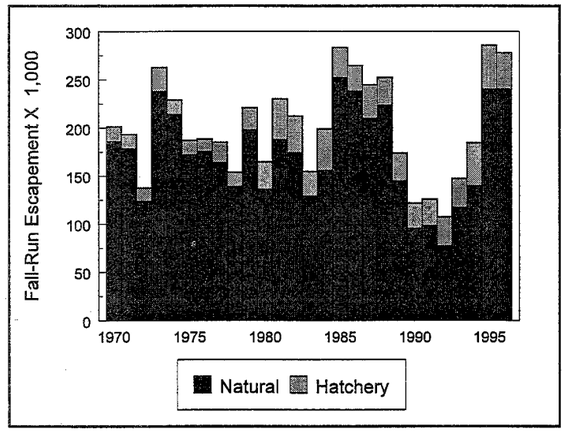

Figure 8
ANNUAL FALL-RUN ESCAPEMENT TO THE SACRAMENTO RIVER AND MAJOR TRIBUTARIES, NATURAL AND HATCHERY CONTRIBUTIONS
Preliminary DFG Data

Figure 9 — Annual fall chinook escapement to the San Joaquin River system.

- These data include the Mokelumne, Stanislaus, Tuolumne, and Merced rivers. There are hatcheries on the Mokelumne and Merced rivers.
- There are presently only fall chinook in the San Joaquin system.
- Although San Joaquin system escapement was by far the best since 1990, it did not approach some of the high runs seen in the mid-1980s.

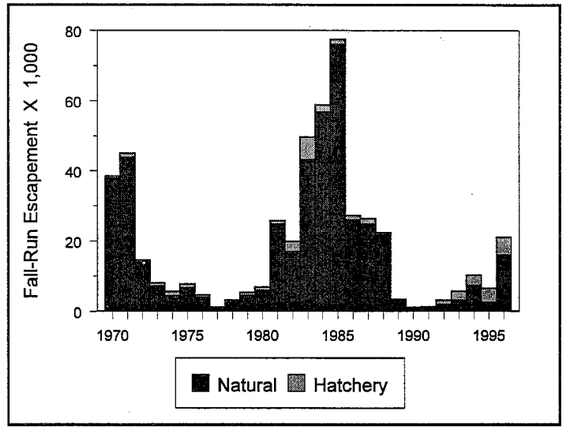

Figure 9
ANNUAL FALL-RUN ESCAPEMENT TO THE SAN JOAQUIN RIVER SYSTEM, NATURAL AND HATCHERY CONTRIBUTION
Preliminary DFG Data

American Shad

Jane D. Arnold and Lee W. Miller, DFG

The abundance of young striped bass and other species has declined in the fall midwater trawl in recent years, but abundance of American shad has been increasing. The American shad mean abundance index was 1,653 for 1967-1976 and 2,750 for 1977-1996, a 40% increase (Figure 1). A record high index of 6,859 was recorded for American shad in 1995; in 1996, the index was 4,312, the fifth highest of record. The five highest indices for American shad have all been since 1982 — the same period in which the lowest striped bass indices were measured.

In the 1996 survey, American shad were found from San Pablo Bay and throughout the delta during September-December. However, by December fewer fish were caught in the delta as most of the fish moved out of the estuary (Figure 2).

To find out more about the fall midwater trawl survey and American shad results, look on the Internet at www.delta.dfg.ca.gov/mwt96/.

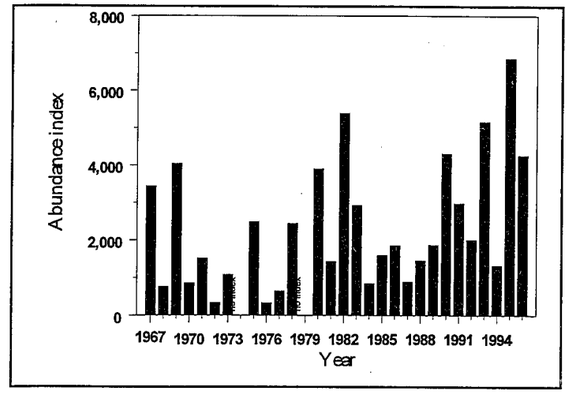

Figure 1
ABUNDANCE INDICES FOR AMERICAN SHAD BASED ON SEPTEMBER-DECEMBER FALL MIDWATER TRAWL SURVEYS
No survey in 1974 and 1979.

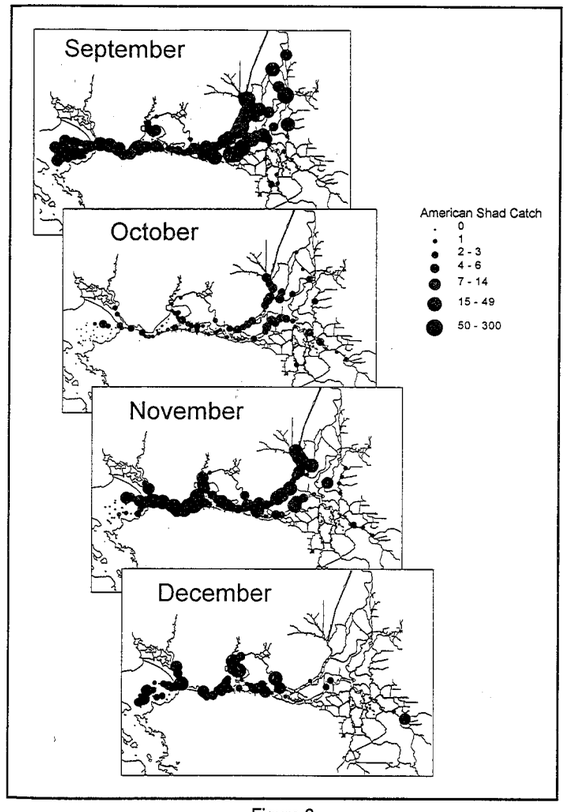

Figure 2
DISTRIBUTION OF AMERICAN SHAD IN THE 1996 FALL MIDWATER TRAWL SURVEY

Young Striped Bass

Jane D. Arnold, Stephen F. Foss, and Lee W. Miller

The summer tow-net survey measures an index of striped bass abundance when the population mean size is 38mm. In 1996, the index was 2.1, the lowest since 1959, when the survey began (Figure 1). The 1996 index was lower than expected, based on the high mean April-July delta outflow. Possible causes of the lower index were discussed in "Low Striped Bass Index for 1996" in the Autumn 1996 *Newsletter*. Results from 1996 were similar to those of 1995, when we reported a similar unusually low young bass index for the water year type (discussed in the Summer 1996 *Newsletter*).

The fall midwater trawl survey measures abundance of young striped bass and other species of interest. The survey has been conducted annually since 1967 except in 1974 and 1979, with a total of 28 years surveyed. The fall midwater trawl abundance index is the sum of monthly indices for September-December.

The 1996 fall midwater trawl abundance index for young striped bass was 388, the lowest index of record; the 1995 index of 479 was the third lowest of record (Figure 2), continuing the trend since 1977. For 1977-1996, the index has averaged 2,571 — 65% lower than the average of 7,350 for 1967-1976.

High mean April-July outflow usually produces larger striped bass year classes than low flow, but despite high flows in 1995 and 1996, the fall midwater trawl abundance indices for those years were very low. However, these low fall abundance indices corroborate the low striped bass abundance as measured by the summer tow-net survey. Fall striped bass abundance usually reflects the summer abundance, because the two sets of indices are strongly correlated ($r=0.85$, $p=0.0001$).

Young striped bass were found in Suisun Bay and the delta from September through November. In December, striped bass distribution expanded into San Pablo Bay (Figure 3). Abundance also increased markedly in December following winter storms that increased outflow and turbidity. Such events apparently affect the vulnerability or availability of striped bass to the trawl. Striped bass abundance indices have often been much higher after storms than we would have expected based on the surveys preceding such events.

More information about the fall midwater trawl and striped bass results can be viewed on the Internet at www.delta.dfg.ca.gov/mwt96/.