

JAW INJURY AND CONDITION OF KING SALMON¹

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Examination of 84 fall-run king (chinook) salmon, *Oncorhynchus tshawytscha*, caught in the Mad and Eel rivers of California during 1965 showed a significant negative relationship between healed jaw injuries and condition factor. Among uninjured and slightly injured fish, age, sex, and stream showed no significant relationship with condition but a significant decrease in condition was noted as the season progressed, and as the color of the fish darkened. Serious effects of the ocean troll fishery beyond direct hooking mortality are implied and warrant additional study.

Casual observation of salmon caught in fresh water by sportsmen has suggested that poor condition is related to old jaw injuries. Data were collected during the fishing season of 1965 to evaluate this relationship.

Jaw injuries may occur when fish are hooked and released or when they escape from the ocean troll fishery. The survival of sublegal salmon caught and released by this fishery has concerned biologists for some time (Milne and Ball, 1956; Parker and Black, 1959; and Lasater and Haw, 1961). However, sublethal effects could be as important as direct mortality in regulating salmon populations. If the condition of released fish is affected adversely, their reproductive potential and production are reduced.

Eighty-four fall-run king salmon were examined. These fish were caught from the Mad and Eel rivers of north coastal California by sportsmen between September 30 and November 15, 1965. Each fish was classified into one of the following categories:

Uninjured—no evidence of an old injury to the jaw.

Slightly Injured—evidence of a healed injury in the form of scar tissue but without distortion of the jaw structure (often this category included fish with torn or missing maxillaries).

Moderately Injured—evidence of a healed injury which resulted in some distortion and/or displacement of the jaw structure (Figure 1).

Extensively Injured—evidence of a healed injury which resulted in extensive distortion and/or displacement of the jaw structure (Figure 2).

The fork length (to the nearest one-eighth inch) and the weight (to the nearest one-tenth pound) of each fish were recorded for computation of the condition factor. Scale samples were taken for age determinations. Additional factors, that conceivably could have affected the condition of the salmon and were recorded, included sex, date of catch, external

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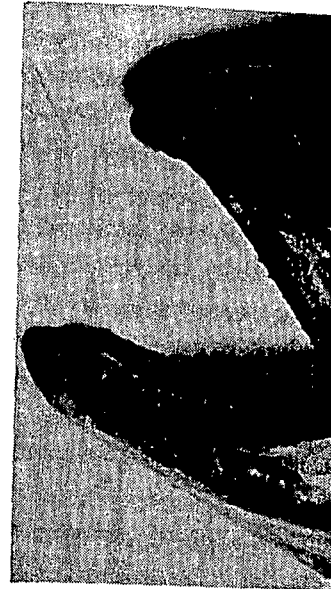


FIGURE 1—Chinook salmon showing moderate jaw injury from Eel River, October 9, 1965. C = 46.



FIGURE 2—Chinook salmon showing extensive jaw injury from Eel River, October 9, 1965. C = 46.

OF KING SALMON¹

J. L. RIDENHOUR

age

salmon, *Oncorhynchus tshawytscha* of California during 1965. Comparison between healed jaw injured and slightly injured fish, and its relationship with condition is noted as the season progressed. Serious effects of the mortality are implied and war-

fresh water by sportsmen has led to old jaw injuries. Data of 1965 to evaluate this rela-

hooked and released or when the survival of sublegal salmon concerned biologists for some Black, 1959; and Lasater and would be as important as direct studies. If the condition of released fish and its survival potential and production

are examined. These fish were from north coastal California by September 15, 1965. Each fish was classified as follows:

injury to the jaw.

slight injury in the form of scarred jaw structure (often this category maxillaries).

moderate healed injury which resulted in a change of the jaw structure (Fig. 1).

extensive healed injury which resulted in a complete cementation of the jaw structure

(1/4 inch) and the weight (to be recorded for computation) were taken for age determinations. It is noted that old jaw injuries would have affected the condition of the fish, sex, date of catch, external

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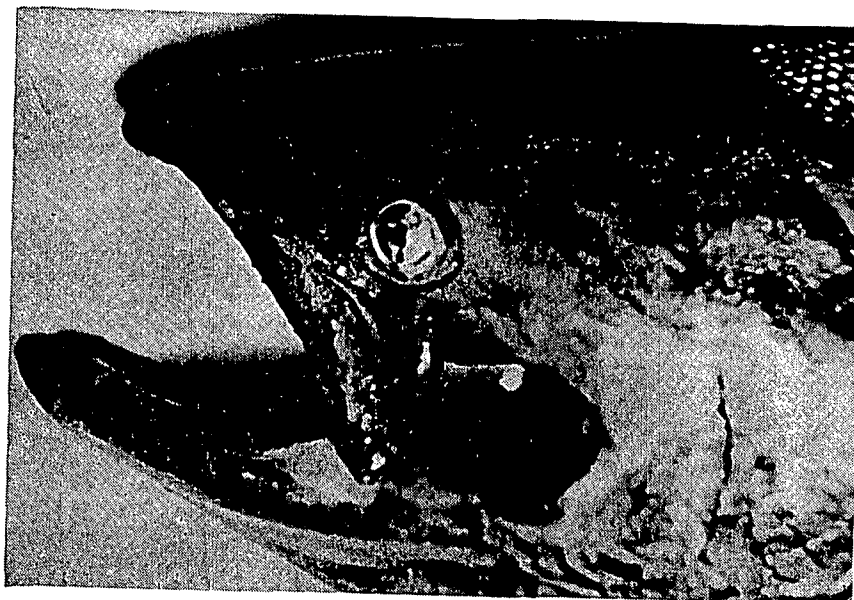


FIGURE 1—Chinook salmon showing healed jaw injury classified as "moderate". Fish caught from Eel River, October 9, 1965: Age = 1+, FL = 23 inches, W = 5.6 pounds, C = 46.0. Photograph by Leland Rossi.

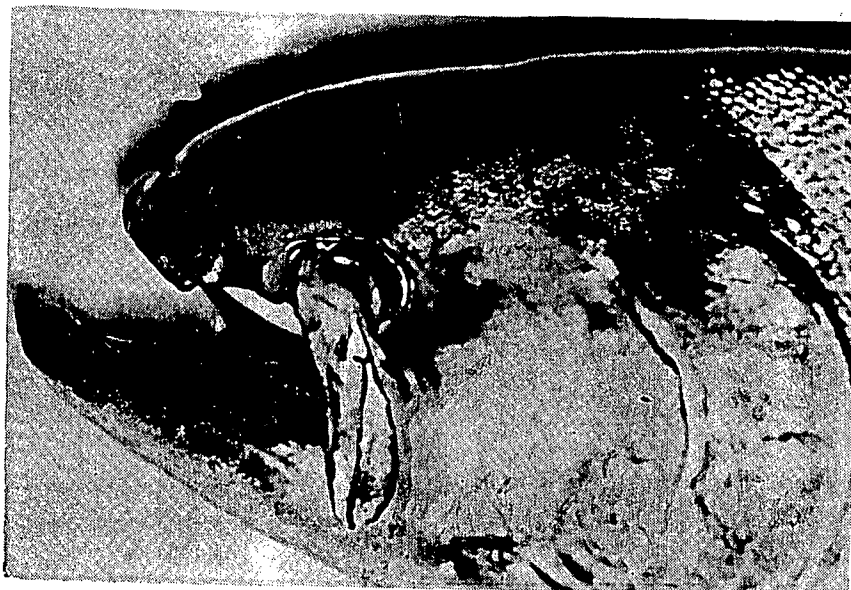


FIGURE 2—Chinook salmon showing healed jaw injury classified as "extensive". Fish caught from Eel River, October 9, 1965: Age = 1+, FL = 21.25 inches, W = 4.1 pounds, C = 39.9. Photograph by Leland Rossi.

coloration (as an indication of time spent in fresh water and classified as silver bright, slightly copper, copper, or dark), and stream of catch.

The condition factor was computed for each fish ($C = 100,000 W/L^3$). Average condition of all fish was 45.4, with a range from 24.1 to 55.1.

Summaries were made to evaluate the effects of various factors other than injury (Table 1). Data used in these evaluations were restricted to reduce potential interactions. There was no indication that age, sex, or stream was related to the condition of the fish. There was a significant decrease in condition as the season progressed and a barely significant difference between silver bright and copper colored fish. The condition factor of uninjured and slightly injured 1+ fish decreased from 51.1 to 43.1 during a 4-week period.

The average condition factor was reduced significantly as the degree of jaw injury increased (Table 2). The analysis was restricted to the 1+ fish since few older fish were caught, although the limited data from older fish tends to support the conclusions based on the 1+ fish. The condition factor for slightly injured fish averaged 47.5, which was only slightly less than the 48.2 average for uninjured fish. However, the condition factor for moderately injured fish averaged only 40.6 and for extensively injured fish only 36.5. Although there was no significant difference between the conditions of uninjured and slightly injured fish and between the conditions of moderately injured and extensively injured fish, all other differences were highly significant. The decreased condition as the season progressed had no appreciable influence on the

TABLE 1
Factors and Their Influence on the Condition Factor of Upstream
Migrating King Salmon Caught in 1965
Only Uninjured and Slightly Injured Fish Are Included

Category	Sample size	Condition factor		
		Mean	Standard deviation	Range
Age				
1+.....	51	48.0	4.27	38.6-55.1
2+.....	1	43.2	---	---
3+.....	9	47.0	4.70	39.8-53.2
Sex ¹				
Male.....	5	47.5	5.75	43.2-53.2
Female.....	5	45.9	3.58	42.4-50.6
Date of Catch ²				
9/27-10/3.....	8	51.1	3.27	47.1-55.1
10/4-10/10.....	21	49.2	3.58	43.7-55.1
10/11-10/17.....	15	46.5	4.03	38.6-53.3
10/18-10/24.....	5	43.1	3.22	41.1-48.8
10/25-10/31.....	1	40.8	---	---
11/1-11/7.....	1	49.4	---	---
Color ²				
Silver bright.....	35	48.2	4.26	38.6-55.1
Slightly copper.....	13	48.5	4.15	40.8-55.0
Copper.....	3	42.8	0.83	42.2-43.7
Stream ²				
Mad River.....	26	46.9	4.32	38.6-55.1
Eel River.....	25	49.1	4.00	42.2-55.1

¹ Includes only age 2+ and 3+ fish.

² Includes age 1+ fish.

Jaw Injury as Related to Migrating King

Degree of injury	Sample size
Age 1+ fish	
Uninjured.....	32
Slightly injured.....	19
Moderately injured.....	15
Extensively injured.....	6
Age 2+ fish	
Uninjured.....	1
Slightly injured.....	0
Moderately injured.....	0
Extensively injured.....	1
Age 3+ fish	
Uninjured.....	5
Slightly injured.....	4
Moderately injured.....	1
Extensively injured.....	0

relationship between condition and time period progressed. Actually, the significant change in the period progressed. Actually, the relationship with time was to increase variance of observed differences.

If it is assumed that most fish being hooked by the ocean fishery on the salmon resource considering only the 1+ fish, an old jaw injury. Other estimates of fish caught and released by 1956; Parker and Black, 1959) every hooks approximately two-thirds sublegal in size. Further, over moderately or extensively injured fish affected. The potential effects are obvious. Any factor which will reduce production. An objective is most difficult.

The implications of these data and analysis should be conducted should be obtained, since an evaluation of males has limited value.

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Lasater, J. E., and Frank Haw. 1961. Treble and single hooks on silver salmon. *California Fish and Game*, 47(1): 1-10.

Milne, D. J., and E. A. R. Ball. 1956. The effect of jaw injury on the condition of chinook salmon caught by trolling and tagged or released. *California Fish and Game*, 42(1): 10-13.

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TABLE 2
Jaw Injury as Related to the Condition Factor of Upstream
Migrating King Salmon Caught in 1965

Degree of injury	Sample size	Condition factor		
		Mean	Standard deviation	Range
Age 1+ fish				
Uninjured.....	32	48.2	4.16	38.6-55.1
Slightly injured.....	19	47.5	4.52	41.1-55.1
Moderately injured.....	15	40.6	5.27	24.1-46.0
Extensively injured.....	6	38.5	4.36	29.2-40.0
Age 2+ fish				
Uninjured.....	1	43.2	---	-----
Slightly injured.....	0	---	---	-----
Moderately injured.....	0	---	---	-----
Extensively injured.....	1	34.4	---	-----
Age 3+ fish				
Uninjured.....	5	46.1	5.34	39.8-53.2
Slightly injured.....	4	48.2	4.18	42.4-51.8
Moderately injured.....	1	34.7	---	-----
Extensively injured.....	0	---	---	-----

relationship between condition and degree of injury, since there was no significant change in the proportion of injured fish as the sampling period progressed. Actually, the main effect of changes in condition with time was to increase variation and, therefore, reduce the significance of observed differences.

If it is assumed that most or all of the injuries resulted from the fish being hooked by the ocean troll fishery, the overall effect of that fishery on the salmon resource can be evaluated in broad terms. Again considering only the 1+ fish, over 50% (40/70) showed evidence of an old jaw injury. Other estimates have suggested that at least 50% of fish caught and released by the troll fishery die (Milne and Ball, 1956; Parker and Black, 1959). This would indicate that the troll fishery hooks approximately two-thirds of the salmon while they are still sublegal in size. Further, over 50% (21/40) of the injured fish were moderately or extensively injured, so that their condition was adversely affected. The potential effects of a decreased condition on spawning fish are obvious. Any factor which limits the ability of the fish to reproduce will reduce production. An objective evaluation of these effects would be most difficult.

The implications of these data are serious and a comprehensive study and analysis should be conducted. Particularly, data from older fish should be obtained, since an evaluation based primarily on precocious males has limited value.

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 Parker, Robert R., and Edgar C. Black. 1959. Muscular fatigue and mortality in troll-caught chinook salmon (*Oncorhynchus tshawytscha*). Jour. Fish. Res. Bd. Canada, 16 (1) : 95-106.

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Condition factor	
Standard deviation	Range
4.27	38.6-55.1
4.70	39.8-53.2
5.75	43.2-53.2
3.58	42.4-50.6
3.27	47.1-55.1
3.58	43.7-55.1
4.03	38.6-53.3
3.22	41.1-48.8
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4.26	38.6-55.1
4.15	40.8-55.0
0.83	42.2-43.7
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