INTERNATIONAL NORTH PACIFIC FISHERIES COMMISSION

Established by Convention between Canada, Japan and the United States for the Conservation of the Fisheries Resources of the North Pacific Ocean

ANNUAL REPORT 1971

OFFICES : 6640 Northwest Marine Drive
Vancouver 8, B.C., Canada

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VIABILITY OF ADULT SOCKEYE SALMON THAT DISENTANGLE FROM GILLNETS

by Richard B. Thompson and
Charles J. Hunter*

Research on the survival of adult, maturing sockeye salmon exposed to and enmeshed in gillnets was continued in 1970 in Puget Sound, Wash. Emphasis was on determination of mortality among those fish that had been enmeshed in gillnets and, by means of their own escape efforts, had become disentangled (dropouts). A significant difference was found between mortalities in 1968 and 1969 in the control groups of fish (Thompson, Hunter, and Patten, 1971 ; Hunter, Patten, and Thompson, 1972)—assumed to have been caused by infection of experimental fish with *Vibrio* in 1969. This led to continuation of the study through 1970.

The sources of adult sockeye salmon, the experimental design, and the procedures were the same as in previous years (Thompson et al., 1971). The major experimental groups of fish, test and control, were treated essentially the same ; the only exception was the exposure of the test fish to gillnets of monofilament and multifilament nylon. Following each test, fish in the control group and the test fish surviving their entanglement in the gillnets were held for observation and determination of survival in a floating enclosure, described by Hunter and Farr (1970).

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Table 26. Numbers of fish in the control groups, types of gillnets fished, numbers of fish in the test groups exposed to the gillnets, and numbers and percentages of fish that became enmeshed in the nets, and that became disentangled from the nets.

Year	Control fish (number)	Type of gillnet: Mesh size (inches)	Type of gillnet: Material (nylon)	Test fish: Number exposed to gillnet	Exposed fish that became enmeshed: Number	Exposed fish that became enmeshed: Percentage	Enmeshed fish that became disentangled: Number	Enmeshed fish that became disentangled: Percentage
1968	68	5–1/4	Multifilament	171	164	85.4	70	47.9
1969	128	5	Multifilament	137	123	89.8	53	43.1
		5	Monofilament	131	125	95.4	62	49.6
1970	171	5	Multifilament	225	144	64.0	61	42.4
		5	Monofilament	215	155	72.1	89	57.4
			Total-Multifilament	533	413	77.5	184	44.6
			Total-Monofilament	346	280	80.9	151	53.9
Total				879	693	78.8	335	48.3

The numbers of fish and type of gillnet in each treatment category are shown in Table 26. Approximately 30% of the fish were controls. Test fish were exposed to a 5–1/4-inch multifilament gillnet in 1968 and to 5-inch multifilament and monofilament gillnets in 1969 and 1970.

Enmeshed Test Fish

The numbers and percentage of test fish that were enmeshed are shown in Table 26. There were no significant differences in percentages of exposed fish that became enmeshed in 1968 and 1969, but the percentages of exposed fish caught in the multifilament nets were smaller in 1970 than in 1968 and 1969. Examination of the length-frequency curves of the fishes indicated that on the average experimental fish were larger in 1970 than in 1968 and 1969, and the larger fish were caught less efficiently than the smaller fish.

The average percentage of test fish that became enmeshed during the 3-year study was similar between multifilament and monofilament gillnets—78% for the multifilament gillnet and 81% for the monofilament.

Enmeshed Fish That Became Disentangled

About half of the enmeshed fish escaped from entanglemen:, that is, dropped out. The percentages that became disentangled from the monofilament gillnet were larger than the percentages that became disentangled from the multifilament gillnets (Table 26). The percentage of salmon that escaped from the monofilament net was about 7% higher than from the multifilament net in 1969 and was 15% higher in 1970. French et al. (1971), in a study of the dropout of sockeye salmon from gillnets on the high seas, found that the percentage of salmon lost from monofilament nets was about twice that from multifilament nets in both 1968 and 1969. Thus, results from their studies are in general agreement with our findings, but the difference in percentages of fish becoming unmeshed from monofilament and multifilament nets was greater in the high seas study.

Mortality Among Experimental Groups of Fish

Mortalities of the different groups of fish are shown in Figures 40, 41, and 42 for 1968, 1969, and 1970, respectively. Included in Figure 40 is a mortality curve for fish from which all scales anterior to the dorsal fin were removed; even these fish, on the average, lived longer than those that escaped from the gillnets.

In all years, the mortality of fish that escaped the nets was greater than the mortality of other groups of fish. In 1969 and 1970, when multi- and monofilament nets were fished, the mortality of fish that escaped from the multifilament nets was slightly greater than the mortality of fish that escaped from the monofilament nets.

Figure 43 shows the mortality of the control groups for the three years; the fish in 1969 had a much higher mortality than in 1968 or 1970. Examination of some carcasses in 1969 disclosed that infection by the marine bacterium *Vibrio anguillarum* probably

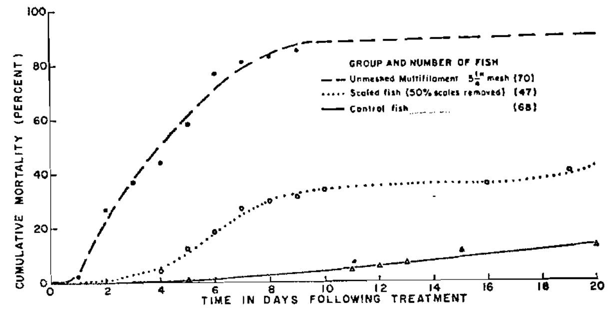

Figure 40. Cumulative mortalities of sockeye salmon that disentangled from multifilament gillnets, of scaled fish, and of control fish, 1968.

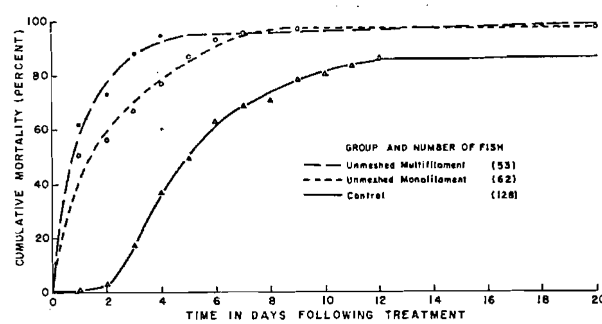

Figure 41. Cumulative mortalities of sockeye salmon that disentangled from multifilament and monofilament gillnets and of control fish, 1969.

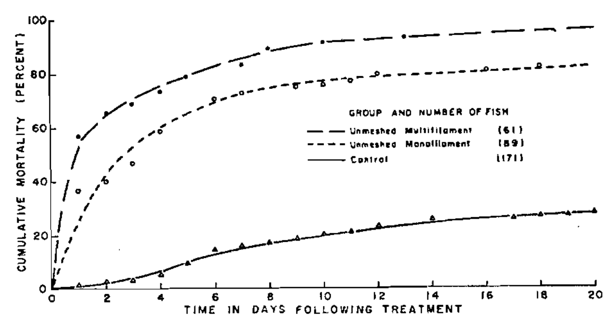

Figure 42. Cumulative mortalities of test groups of sockeye salmon that disentangled from multifilament and monofilament gillnets and of control fish, 1970.

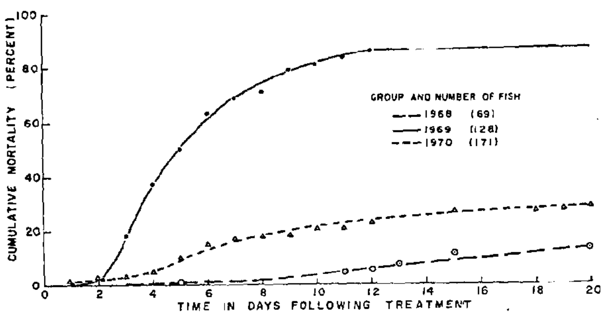

FIGURE 43. Cumulative mortalities of control groups of sockeye salmon, 1968–70.

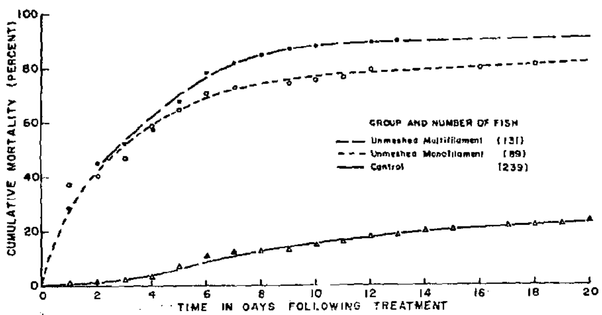

FIGURE 44. Cumulative mortalities of groups of sockeye salmon that became disentangled from multifilament gillnets (average of 1968 and 1970), from monofilament gillnets (1970), and of control groups (average of 1968 and 1970).

caused this unusual mortality (not one of the more than 100 sockeye examined in 1970 was infected with *Vibrio*). The 1969 data on mortality were deleted from the overall averaging of data among years because of the low survival rate of the *Vibrio*-infected experimental fish.

Average cumulative mortalities of the 1968 and 1970 test and control fish are shown in Figure 44. The mortality curve for fish taken by monofilament net is from the 1970 data only because the data from 1969—the only other year that the monofilament naterial was used—were deleted. The mortality lepicted in Figure 44 shows that under our experinental conditions (collecting the fish near the floating nclosure, exposing them to gillnets during an overiight fishing period, and holding the test and control sh in the enclosure until death) the unmeshed group f fish had approximately a four-times greater morılity than the control group—fish that were colcted and treated identically except that they were ɔt exposed to the gillnets.

It should be noted that the mortality curves for the rviving test fish rise rapidly to about the sixth day d then slope very gradually upward; this continues rough and beyond the 20-day period shown in Figures 40 through 44. This gradual mortality following the initial rapid rise held steady to the end of the observation period, when most of the surviving fish were probably dying from the effects of sexual maturation and retention in salt water. This suggests that the majority of the fish in the unmeshed group that died from the effects of the gillnets died within the first six days of the study. In some high seas and inshore fisheries, however, predation by large fishes or marine mammals could increase the mortality of fish that escape from gillnets—as well as upon fish in the nets. The fish in our study were contained in the net enclosure and were thus protected from any possible predation.

The results of the descaling study in 1968 suggest that the physical injuries that were visible were not the only damage sustained by the fish in the nets. Physiological stress caused by their efforts to escape was a likely contributor to mortality. This type of stress was not identified nor measured in this study but should be a subject for future research. It seems likely that there could be a " panic " factor involved. Since emergence from the gravel some three or four years previously, these fish had been surrounded by a supporting medium, had little contact with anything but this medium, and had not in any way been forcefully held or constrained. It may well be that the neurophysiological shock resulting from such constraint was the primary element causing the high mortality of test fish in our studies in Puget Sound.

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SCALE STUDIES TO DETERMINE AREA OF ORIGIN OF IMMATURE SOCKEYE SALMON

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Since 1969 the primary objective of studies with scales of sockeye salmon has been to provide informa-

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