Comparisons of Hook Types:
A Summary of Past Studies

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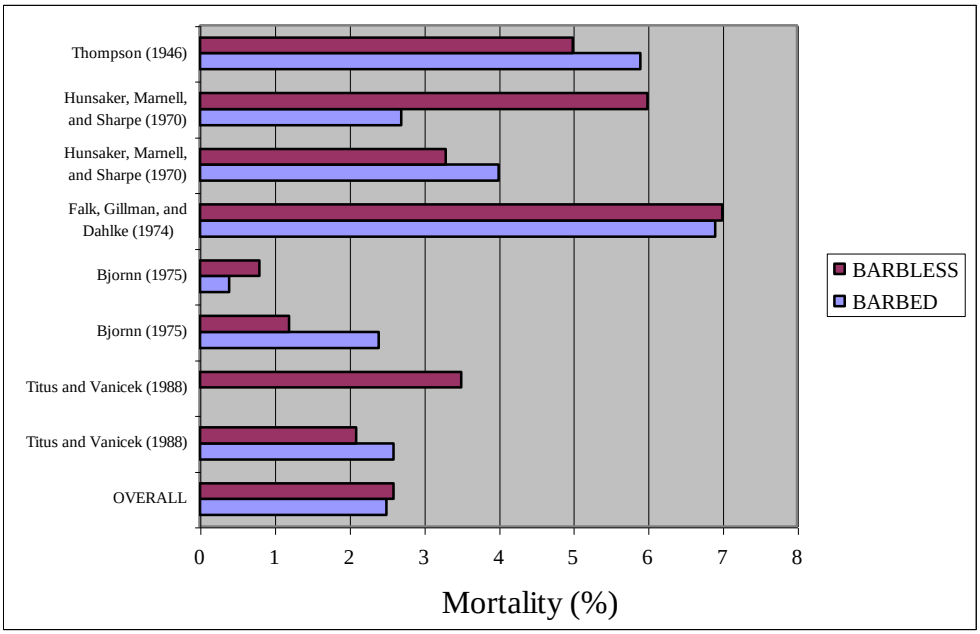
Introduction

Debates over benefits of barbless versus barbed hooks or single versus treble hooks on artificial flies and lures have been going on for decades. Proponents of barbless hooks have argued that they are easier to remove and thus cause less tissue damage to the fish than barbed hooks. Opponents claim barbed hooks cause lower mortality because the barb prevents the hook from penetrating areas like the roof of the mouth too deeply. Anglers in favor of single hooks make the argument that treble hooks become embedded in more than one location and are harder to remove than single hooks. Others favor treble hooks and maintain that the relatively large size of the treble hook prevents fish from swallowing the hook entirely, which prevents internal organ damage. Intuitive reasoning may give anglers different opinions on these debates depending on individual experiences with different fly and lure types or hook sizes. Many scientific studies have been conducted to evaluate the differences between barbed, barbless, single, and treble hooks. This paper is a summary of past studies that could be found in the literature where direct comparisons of salmonid mortality were made between hook types.

Barbed Versus Barbless Hooks

A summary of studies where direct comparisons were made between barbed and barbless hooks is shown in the following graph. Descriptions of the studies shown will follow. Sample sizes, along with numbers of fish that lived and died in each experiment are shown in Table 1. Statistical tests of significance between hook types were evaluated using one-tailed tests for comparing binomial proportions (Ott 1993) with an alpha level of 0.05.



Study #1 is the oldest recorded study of this kind found in the literature. It was conducted by Thompson (1946) on an unknown species of trout in New Mexico. Comparisons were made between mortality of trout caught on barbed and barbless flies. Barbed hook mortality was 5.9%, and barbless hook mortality was 5.0%. No significant difference was found between the two hook types ($P = 0.419$).

The second study was conducted by Hunsaker, Marnell, and Sharpe (1970) at Yellowstone Lake, Wyoming. Cutthroat trout (*Oncorhynchus bouvieri*) were captured on lures with barbed and barbless treble hooks. Mortality was 6.0% for barbless hooks and 2.7% for barbed hooks. The difference was not significant ($P = 0.113$).

Study #3 was also conducted by Hunsaker, Marnell and Sharpe (1970) on cutthroat trout in Yellowstone Lake, Wyoming. Comparisons were made between barbed and barbless flies. As with the other studies, no significant differences ($P = 0.420$) were found between barbed (4.0%) and barbless hooks (3.3%).

The fourth study, conducted by Falk, Gillman, and Dahlke (1974) evaluated mortality of lake trout (*Salvelinus namaycush*) with barbed and barbless treble hooks on the Great Slave Lake in Canada. While barbless hooks caused slightly higher mortality (7.0%) than barbed hooks (6.9%), the results were not significantly different ($P = 0.493$).

Study #5 was conducted by Bjornn (1975), who compared mortality of barbed and barbless flies on cutthroat trout in the St. Joe River in Idaho. Mortality was 0.8% for barbless hooks and 0.4% for barbed hooks. The results were not significantly different ($P = 0.291$).

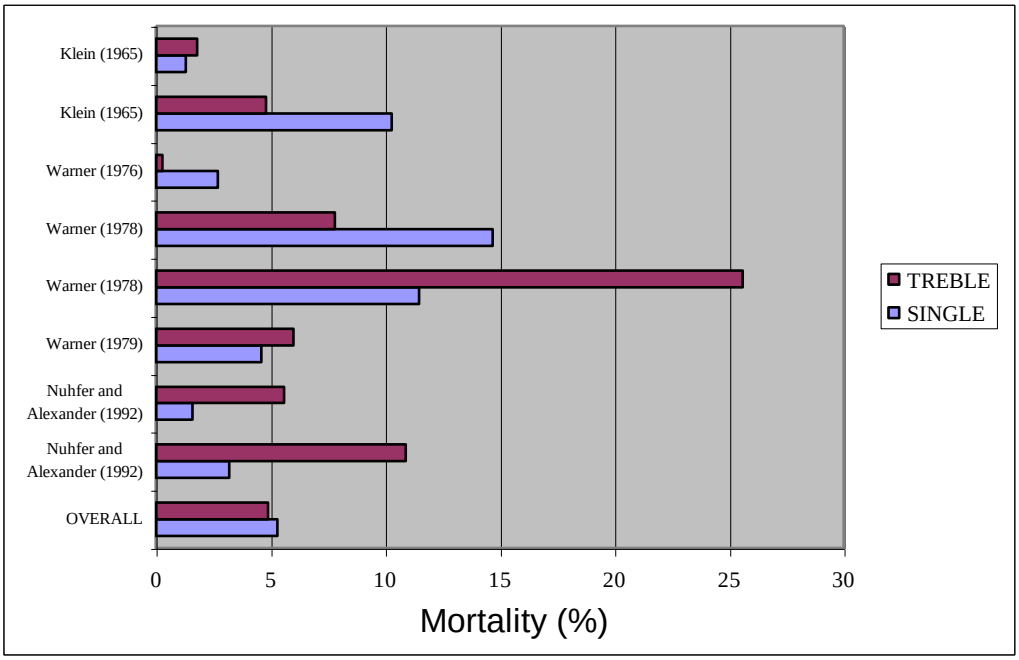
Study #6 was also conducted by Bjornn (1975) on the St. Joe River with cutthroat trout. Mortality caused by lures with barbed and barbless treble hooks was evaluated. Mortality for barbless hooks was 1.2%, and mortality for barbed hooks was 2.4%. These differences were not significant ($P = 0.200$).

Studies #7 and #8 were conducted by Titus and Vanicek (1988) who evaluated mortality of lure-caught cutthroat trout (*Oncorhynchus clarki henshawi*) in Heenan Lake, California with barbed and barbless treble hooks on lures. Barbed hooks resulted in mortality of 0% and 2.6%, while barbless hooks resulted in mortality of 3.5% and 2.1%. One other replicate was conducted at Heenan Lake by Titus and Vanicek in mid-summer at high water temperatures (21° C). Barbed hooks caused mortality of 48.1% and barbless hooks caused mortality of 35.3%. Cutthroat trout reach their upper lethal temperature at 21° to 24° C, so the results of that replicate experiment were heavily influenced by the high water temperatures. Because of the confounding effect of high water temperature, we left that replicate out of the data set shown in Figure 1. Differences between hook types were not significant in study #7 ($P = 0.165$), or in study # 8 ($P = 0.400$).

The overall results include the combined total mortality from barbed and barbless hooks in all of the studies shown in Figure 1. These mortality values average 2.5% for barbed hooks and 2.6% for barbless hooks. These values are not significantly different ($P = 0.424$). Mortality for both barbed and barbless hooks on artificial flies and lures are generally very low. The results of all studies thus far indicate that there is no benefit to using barbed or barbless hooks.

Treble versus Single Hooks

Mortality caused by treble and single hooks has been evaluated as extensively as barbed versus barbless hooks. A summary of past studies on treble versus single hooks is shown in the following graph. Descriptions of those studies will follow. Sample sizes and mortality values are shown in Table 2.



Studies #1 and #2 (Klein 1965) compared mortality of rainbow trout (*Oncorhynchus mykiss*) caught and released on lures with single and treble hooks in a rearing pond. Mortality were 1.3% for trout caught on single hooks, and 1.8% for those caught on treble hooks in the first replicate experiment. Mortality in the second replicate experiment was 10.3% for fish caught on single hooks, and 4.8% for fish caught on treble hooks. No significant differences were found in study #1 ($P = 0.333$), although single hooks caused significantly higher mortality than treble hooks ($P = 0.008$) in study #2.

The third study, conducted by Warner (1976), evaluated mortality of Atlantic salmon (*Salmo sal*ar) caught in a hatchery environment on lures with barbed treble and barbed single hooks. Mortality was 0.3% for treble and 2.7% for single hooks. Mortality from single hooks was significantly higher than mortality for treble hooks in this study ($P = 0.006$).

The fourth study was conducted by Warner (1978), and evaluated mortality of Atlantic salmon caught on lures with treble and single hooks in a lake situation. No significant differences were found between the treble (7.8%) and single (14.7%) hooks ($P = 0.053$).

Study #5 was conducted by Warner (1978) on Atlantic salmon in a lake environment, and compared treble versus single hook flies. Treble hook flies resulted in 25.6% mortality, while single hook flies resulted in 11.5%

mortality. Treble hook flies caused significantly higher mortality ($P = 0.040$). The author reported that the difference may have been due to the very small size treble hooks used (No. 10), which may have been easily ingested.

Study #6 was also conducted by Warner (1979) on Atlantic Salmon in a hatchery situation. Mortality from lures with treble hooks was 6.0%, and mortality from lures with single hooks was 4.6%. These results were not significantly different ($P = 0.228$).

Studies #7 and #8 were conducted simultaneously by Nuhfer and Alexander (1992) on brook trout (*Salvelinus fontinalis*). Treble and single hook mortality was evaluated for two different lure types. These were Cleo spoons (Study #7) and Mepps spinners (Study #8). Treble hooks caused mortality of 5.6% in study #7 and 10.9% in study #8. Single hooks caused mortality of 1.6% in study #7, and 3.2% in study #8. Significantly higher mortality with treble hooks was found in both study #7 ($P = 0.046$) and study #8 ($P = 0.008$).

All studies combined result in overall mortality of 5.3% for single hooks, and 4.9% for treble hooks. No significant difference between treble and single hooks was found with the combined totals ($P = 0.347$). These data suggest that there is no benefit to using either treble or single hooks.

Summary

Very little evidence has been found to support any particular hook type to reduce catch and release mortality. No consistent patterns can be found in past studies that favor one hook type over another. Individual preference should dictate what hook type an angler uses. We recommend that if anglers want to fine tune their ability to release fish alive, they should try different types of hooks, and depending on the size of the fish being captured, voracity of the fish, fishing location, and other factors, decide for themselves what hook type works the best to minimize mortality. When artificial flies and lures are used, angler skill and capture conditions have greater effects than hook type on post-release mortality in most situations.

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Table 1. Mortality studies of barbed versus barbless hooks.

Author	Species	Hook Type	Caught	Killed	Mortality (%)
Thompson (1946)	UNKNOWN	BARBED	51	3	5.9
		BARBLESS	60	3	5
Hunsaker, Marnell, and Sharpe (1970)	CUTTHROAT	BARBED	113	3	2.7
		BARBLESS	100	6	6
Hunsaker, Marnell, and Sharpe (1970)	CUTTHROAT	BARBED	75	3	4
		BARBLESS	60	2	3.3
Falk, Gillman, and Dahlke (1974)	LAKE TROUT	BARBED	72	5	6.9
		BARBLESS	57	4	7
Bjornn (1975)	CUTTHROAT	BARBED	256	1	0.4
		BARBLESS	264	2	0.8
Bjornn (1975)	CUTTHROAT	BARBED	209	5	2.4
		BARBLESS	166	2	1.2
Titus and Vanicek (1988)	CUTTHROAT	BARBED	27	0	0
		BARBLESS	29	1	3.5
Titus and Vanicek (1988)	CUTTHROAT	BARBED	77	2	2.6
		BARBLESS	95	2	2.1
OVERALL	MIXED	BARBED	880	22	2.5
		BARBLESS	831	22	2.6

Table 2. Mortality studies of single versus treble hooks.

Author	Species	Hook Type	Caught	Killed	Mortality (%)
Klein (1965)	RAINBOW TROUT	SINGLE	233	3	1.3
		TREBLE	224	4	1.8
Klein (1965)	RAINBOW TROUT	SINGLE	272	28	10.3
		TREBLE	271	13	4.8
Warner (1976)	A. SALMON	SINGLE	296	8	2.7
		TREBLE	333	1	0.3
Warner (1978)	A. SALMON	SINGLE	95	14	14.7
		TREBLE	116	9	7.8
Warner (1978)	A. SALMON	SINGLE	52	6	11.5
		TREBLE	39	10	25.6
Warner (1979)	A. SALMON	SINGLE	302	14	4.6
		TREBLE	300	18	6
Nuhfer and Alexander (1992)	BROOK TROUT	SINGLE	124	2	1.6
		TREBLE	125	7	5.6
Nuhfer and Alexander (1992)	BROOK TROUT	SINGLE	127	4	3.2
		TREBLE	128	14	10.9
OVERALL	MIXED	SINGLE	1501	79	5.3
		TREBLE	1536	76	4.9