

COMPARISON OF EFFICIENCY AND SELECTIVITY OF THREE GEARS USED TO SAMPLE WHITE STURGEON IN A COLUMBIA RIVER RESERVOIR ¹

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We compared the efficiency and size selectivity of setlines, gillnets, and angling to select a cost-effective means of capturing a large number of adult and subadult white sturgeon, *Acipenser transmontanus*, unharmed while minimizing size selectivity and catch of non-target game fish. Setlines provided the greatest catch rate per sampling week (61.4), followed by gillnets (49.4) and angling (34.4). Setlines also captured a wider size-range of sturgeon than gillnets or angling. No other game fish were caught with setlines or angling while gillnets caught other game fish including salmon and steelhead, *Oncorhynchus spp.*

INTRODUCTION

White sturgeon, *Acipenser transmontanus*, is a valuable resource along the Pacific Coast of North America (Pycha 1956, Semakula and Larkin 1968, Kohlhorst 1980, Cochnauer 1983, Oregon Department of Fish and Wildlife 1988). In the Columbia River, white sturgeon support recreational, commercial, and tribal fisheries (Galbreath 1985). With the decline of anadromous salmonid fisheries (Raymond 1988), the white sturgeon fishery has rapidly increased in importance. Total effort and landings have increased several-fold since 1970 (Oregon Department of Fish Wildlife 1988), and effort by recreational white sturgeon anglers now exceeds effort by recreational salmon anglers downstream from Bonneville Dam (Hess and King 1988).

The status of white sturgeon varies within the Columbia River basin. Although the population below Bonneville Dam has supported a harvest of over 50,000 fish annually in recent years, populations in the Snake and Kootenai rivers (Columbia River tributaries) have diminished to the point where no harvest is allowed. Populations have declined in tributaries, possibly for several reasons: (i) migration of white sturgeon into the upper basin has been blocked by the construction and operation of hydroelectric dams (Bajkov 1951, Lukens 1981); (ii) habitat, including food availability, flow, and temperature has been altered by the creation of reservoirs formed by these dams (Bajkov 1951, Coon et al. 1977, Haynes et al. 1978, Lukens 1981); (iii) other biological and physical factors such as predation and the level of pesticides also may have changed (Bosley and Gately 1981).

We needed a gear that would collect a large sample of white sturgeon unharmed to evaluate effects of dam construction and operation on white sturgeon and to design management strategies to optimize yield (Rieman et al. 1987). Other considerations included sampling efficiently to minimize the cost

¹ Accepted for publication June 1990.

of sampling hundreds of kilometers of river, gear size selection which might bias representation of the population (Beamesderfer and Rieman 1988), and incidental catch of other game fish. Hence, the objective of this report is to describe the most effective gear for capturing subadult and adult white sturgeon unharmed while minimizing size selectivity and catch of other game fish.

STUDY AREA

We selected The Dalles Reservoir, a mainstem impoundment of the Columbia River (Figure 1), for our gear analysis because this reservoir is relatively small compared with other impoundments in the Columbia River and access to all parts of the reservoir is good. The Dalles Reservoir is located between The Dalles and John Day dams (river kilometer 308 to 347). It was formed in 1957 with the closure of The Dalles Dam, a U.S. Army Corps of Engineers hydroelectric, navigation, and flood control project. At mean operating level, the reservoir has a surface area of 3,800 hectares, water elevation of 48.2 m above mean sea level, and depth as great as 61 m. The upper reservoir is riverine, and measurable current exists throughout the reservoir. Average daily inflow and outflow ranges from 3,000 to over 12,000 m³/s.

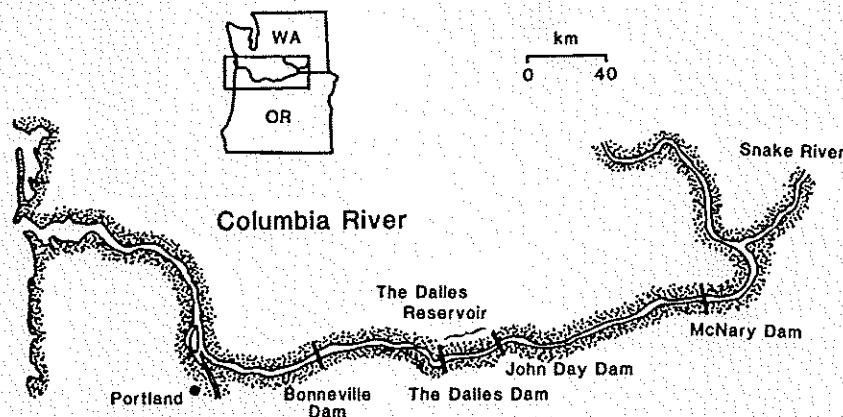


FIGURE 1. Location of The Dalles Reservoir.

METHODS

We chose setlines, gillnets, and angling as potential ways to collect white sturgeon based on review of the literature and discussions with commercial fishermen. We sampled from March through September, 1987. Effort of each gear was evenly distributed throughout the reservoir and the period of sampling.

Setlines consisted of a 182-m long mainline of 6.4 mm diameter nylon rope, along which 40 hook lines (gangions) were equally spaced. Each gangion consisted of a removable, spring-loaded snap attached to a 0.5-m length of parachute cord by a swivel, with a hook attached to the other end of the cord. Each setline included 10 each of size 10/0, 12/0, 14/0 and 16/0 circle hooks. Circle hooks have the point bent at a 90° angle to the shaft to better retain hooked fish for long periods of time. Each end of a setline was held in place by

a 15–20 kg anchor. Each anchor was also attached to a buoy with rope identical to the mainline. Lines were set for 4–48 h in depths from 3 to 50 m. Hooks were baited with 2.5- to 5-cm long cross-section slices of adult pacific lamprey, *Entosphenus tridentatus*, or 2.5- to 10-cm² pieces of adult coho salmon, *Oncorhynchus kisutch*, with skin attached. Only one bait type was used on each line. Setlines were deployed and retrieved from a 7 m fiberglass skiff equipped with a hydraulic pot hauler.

Gillnets were sinking type and set stationary and perpendicular to the current. Each net was 45.6 m long and consisted of six, equal length, alternating panels of 5.1 cm, 8.3 cm and 11.4 cm bar mesh. Net panels were constructed from multifilament and cable nylon. Each panel was hung with 4.6 m deep mesh on a framework with a 3-m long vertical slacker lines attached to the float and leadline at 3.8 m intervals along the length of the net. Gillnets were held in place by 4.5-20 kg anchors depending on current. A buoy marked each anchor. Gillnets were fished for 1–4 h in depths from 3 to 35 m. Nets were deployed and retrieved by hand from the boat.

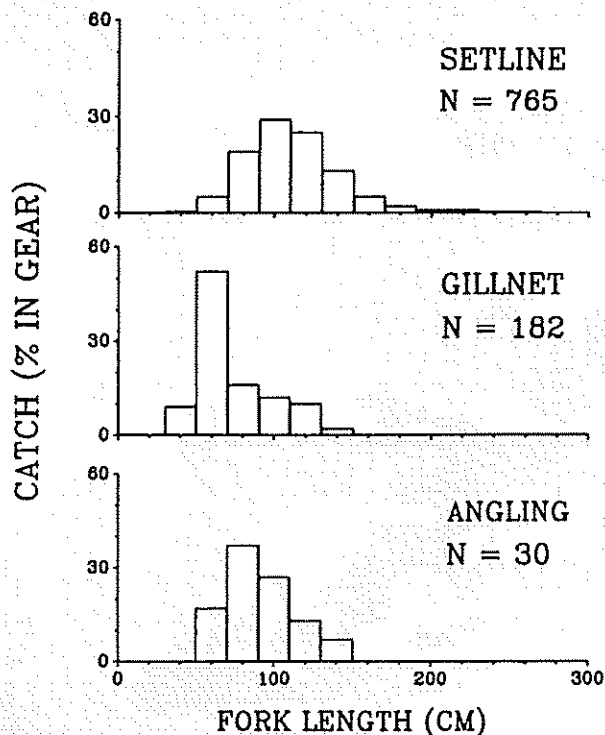


FIGURE 2. Length-frequency distributions of white sturgeon collected with various gear in The Dalles Reservoir of the Columbia River, 1987.

Angling gear consisted of a medium heavy action rod with a sensitive tip, a bait casting reel with 18 kg breaking strength monofilament line and 7/0 or 9/0 J-type hooks. Rods were closely attended. Hooks were baited with Pacific lamprey pieces, coho salmon pieces, whole eulachon, *Thaleichthys pacificus*,

whole juvenile coho salmon or pickled herring, *Clupea* sp. We fished from an anchored boat for durations of 1/2 to 3 h in depths from 15 to 45 m.

We measured fork length of captured white sturgeon to the nearest centimeter. Hook size and bait type were recorded for all sturgeon caught by setlines and angling. We also identified and counted the catch of other fish species.

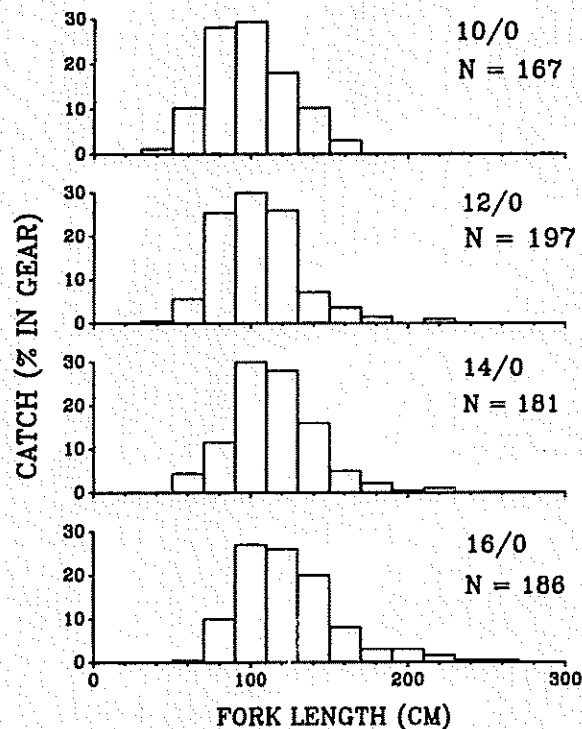


FIGURE 3. Length-frequency distributions of white sturgeon collected with various hook sizes on setlines in The Dalles Reservoir of the Columbia River, 1987.

We evaluated gear based on harm caused to white sturgeon, sampling efficiency, size selectivity, and catch of other game fish. Harm was evaluated by the number of dead white sturgeon in the catch by gear. Sampling efficiency was evaluated by comparing catch-per-unit-effort (CPUE) among gears. We standardize CPUE of gear by calculating mean catch per crew week (40 hours of sampling by a crew using the gear) based on 13.4 crew weeks of setlining, 3.7 crew weeks of gillnetting and 0.9 crew weeks of angling. We evaluated size selectivity by comparing length-frequency distributions of catch among gears. We assumed size selectivity was least where the range of lengths sampled was greatest. Statistical differences in length frequencies of fish captured among gears were identified with chi-square tests. We also used chi-square analysis to test for the selectivity associated with hook size and bait type used while setlining.

TABLE 1. Summary of white sturgeon effort and catch in The Dalles Reservoir, 1987.

Gear	Number of Observations	Crew hours	Catch	Catch per 40 crew hours
Setline	233	538	826	61.4
Gillnet	87	149	184	49.4
Hook and line	25	36	31	34.4

RESULTS

All three gear sampled white sturgeon essentially unharmed. Direct mortality was only one fish for each gear.

Setlines were the most productive gear (Table 1). Catch per crew week with setlines was 1.24 times catch with gillnets and 1.78 times catch by angling.

TABLE 2. Incidental catch of fish other than sturgeon in The Dalles Reservoir, 1987.

Species	Setline	Gillnet	Hook and Line
Carp, <i>Cyprinus carpio</i>	0	4	0
Channel catfish, <i>Ictalurus punctatus</i>	0	1	0
Chinook salmon, <i>Oncorhynchus tshawytscha</i>	0	1	0
Largescale sucker, <i>Catostomus macrocheilus</i>	0	6	0
Northern squawfish, <i>Ptychocheilus oregonensis</i>	19	14	0
Sockeye salmon, <i>Oncorhynchus nerka</i>	0	3	0
Steelhead, <i>Oncorhynchus mykiss</i>	0	10	0
Walleye, <i>Stizostedion vitreum</i>	0	2	0

Different gear caught different sizes of fish (Figure 2) and differences were significant between setlines and gillnets ($X^2 = 340.7$; $df = 7$; $p < 0.01$). Setlines captured white sturgeon over a much wider range of lengths and fish of a greater length than gillnets. Sample sizes from angling were inadequate to statistically compare length distribution differences with other gears.

Differences in length-frequency distributions were significant for white sturgeon captured by various hook sizes ($X^2 = 88.3$; $df = 18$; $p < 0.01$) (Figure 3). Larger hooks took larger fish and fish over a wider range of fork lengths. White sturgeon greater than 90 cm fork length appeared fully recruited to all setline hook sizes.

No significant difference in length-frequency distributions was detected between bait types ($X^2 = 5.2$; $df = 5$; $p = 0.389$).

Gillnets frequently caught fish other than sturgeon including several game species (Table 2). Setlines caught only the nongame northern squawfish. No other fish were caught while angling for sturgeon.

DISCUSSION

We concluded that setlines were the best available gear for our study. Setlines caught more white sturgeon per crew hour than the other gears and did not catch any other game fish. Setlines also appeared to take the most representative sample of white sturgeon over 90 cm based on length-frequency distributions of catches. We were primarily concerned with white sturgeon 90 cm and larger, corresponding to lengths harvested in the fisheries, and the reproductive stock (fish longer than 183 cm, the maximum legal length limit).

The gillnets had many drawbacks and few advantages over setlines. Whereas white sturgeon mortality was low in gillnets, the nets captured fish other than sturgeon, particularly adult salmon and steelhead, often with a substantial mortality rate. This restricted use of gillnets to areas and times where salmon and steelhead were absent. Gillnets also captured white sturgeon from a narrower range of lengths than did setlines, and much of the catch consisted of fish under 90 cm fork length.

Angling was also inferior to setlines. Although mortality was low, the effort per fish was high. The length range of white sturgeon captured with hook and line fell within that captured by setlines, although a similar distribution might be expected with a greater sample size.

We will only sample with setlines for the remainder of the study. However, we have made a few modifications to address the efficiency and selectivity of our setlines. We are discontinuing using 10/0 hooks for the following reasons: (i) they required more crew hours to use because they were harder to sharpen and bait and required more frequent replacement; (ii) the white sturgeon they captured were within the range of those captured with 12/0 hooks; and (iii) these hooks were often straightened out or snapped off, apparently unable to hold larger fish. We will only use 136-kg test gangions because of the number of broken 68-kg test gangions observed.

Finally, we will only use Pacific lamprey for bait. Pacific lamprey slices appear to be an attractive bait for white sturgeon for more than one day. Coho salmon pieces often fell apart within 24 hours. Further, Pacific lamprey is relatively easy to obtain and minimizes preparation and gear deployment time.

ACKNOWLEDGMENTS

We thank Doug Engle and Ray Hartlerode for assistance with field sampling. Bruce Rieman guided this project through its early stages. Wayne Burck, Mary Buckman, and Tony Nigro provided constructive editorial comments on early drafts of this manuscript. The Bonneville Power Administration provided funding for this work under Contract DE-AI79-86BP63584.

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