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Lower Columbia River White Sturgeon
Current Stock Status and Management Implications

by

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Executive Summary

The white sturgeon population residing in the lower Columbia River downstream from Bonneville Dam (LCR) is the most productive in the species' range. Harvest of white sturgeon in LCR sport and commercial fisheries has averaged over 42,000 annually. Currently, harvest management of white sturgeon is predicated on the precepts outlined in the "Olympia Accord", a management plan jointly developed by the Washington and Oregon Departments of Fish and Wildlife. As part of that plan, allowable harvest is based on estimates of optimal sustainable yield for the legal-sized population. Managers understood that periodic updates of stock status and management goals were needed in the face of uncertainty when setting levels of allowable harvest. Therefore, the initial harvest levels specified in the "Olympia Accord" had a duration of only three years (1997-1999).

New stock status updates are now available for developing new harvest guidelines for the management plan. In-river abundance of legal-sized (42-60") white sturgeon has declined since 1995. Abundance of this size class was estimated to be 227,700 in 1995. The abundance in 1997 is estimated to be 157,100. It appears that the decline is not a result of overharvest, but attributable to a decrease in recruitment to the legal-sized population and a mass emigration from the Columbia River system. These theories are corroborated by a significant increase in out-of-system tag recoveries and harvest, as well as a shift in size composition in sturgeon research fisheries.

In light of this change in stock status, we are recommending that total allowable harvest of white sturgeon in the LCR be decreased in 1999 and in the next management period starting in 2000. Decision-makers and the public should weigh the current management objectives relative to the year-round LCR sport fishery and the current sport and commercial allocation. With a lower total allowable harvest, these two objectives will probably be in conflict.

This document is intended to provide the latest stock assessment data and analyses to stimulate discussion prior to a decision on new management guidelines later this year. Copies of this document will be mailed out to interested parties and provided on the Washington Department of Fish and Wildlife internet web site (www.wa.gov/wdfw). The Washington and Oregon Departments of Fish and Wildlife will be hosting public meetings this summer to solicit management recommendations from the public for the year 2000 and beyond. The decision for the new management plan will be made after November when the respective state commissions will be briefed by staff on stock status and public feedback regarding management options. It is expected that separate meetings will be conducted this spring to discuss management options for the remainder of 1999. Please refer any questions to the authors (addresses on title page): John DeVore ((360) 906-6710; devorjdd@dfw.wa.gov), Brad James ((360) 906-6716; jamesbwj@dfw.wa.gov), or Ray Beamesderfer ((503) 657-2000 ext. 246; ray.beamesderfer@state.or.us).

Introduction

The lower Columbia River downstream from Bonneville Dam (Figure 1; abbreviated LCR in this report) white sturgeon population is the most productive in the species' range (DeVore et al. 1995). This high productivity supports healthy sport and commercial fisheries that have averaged an annual harvest of over 42,000 white sturgeon in the last ten years (Table 1). The sturgeon fishery ranks as the largest sport fishery in the Columbia Basin in terms of effort with a ten year annual average of over 175,000 angler trips. Factors most responsible for the favorable production potential of the population are access to marine areas, abundant food resources, and consistently favorable hydrologic conditions during the spawning timeframe which enhances recruitment (Parsley and Beckman 1994, DeVore et al. 1995, Counihan et al. In Press). This high productivity can only be sustained in the long term with careful, scientifically based management.

The longevity, slow growth, and delayed maturation of sturgeon makes them susceptible to overexploitation (Rieman and Beamesderfer 1990, Rochard et al. 1990, Birstein 1993). Excessive harvest in the 19th century collapsed Columbia River sturgeon stocks. Intensive sturgeon fishing on the Columbia River began in 1889 and peaked in 1892 with about 2,500,000 kg of sturgeon landed. The stock was depleted by 1899 after a ten year period of unregulated exploitation (Craig and Hacker 1940) (Figure 2). Season, gear, and minimum size restrictions failed to bring about an increase in sturgeon production as evidenced by poor yields during the first half of this century.

The sturgeon population rebounded after a maximum size regulation designed to protect sexually mature sturgeon was enacted in 1950. Annual harvests doubled by the 1970's and doubled again by the 1980's. Increased interest in the recreational sturgeon fishery was due to decreased salmon fishing opportunities, increased stock size, and greater appreciation of sturgeon as gourmet fare. In 1987 a recent year record 72,100 white sturgeon were harvested in the LCR. Research indicated that the harvest rate of 30% of the 3-6 foot population, estimated to have occurred during 1985-1987, was twice what the population could sustain in the long term.

A series of management actions ensued between 1988 and 1997 to reduce the annual harvest rate in LCR sturgeon fisheries to a long term, sustainable level (Table 2). The legal size slot for LCR white sturgeon was eventually reduced to 42-60 inches for sport fisheries and 48-60 inches for commercial fisheries. The daily bag limit in the sport fishery was reduced to one fish and the annual possession limit to ten fish. Harvest guidelines were also placed on LCR sport and commercial fisheries.

Management Objectives

The following management objectives have been adopted by Washington and Oregon for LCR white sturgeon:

- Provide adequate recruitment to the broodstock population
- Manage fisheries for optimal sustainable yield (OSY)
- Maintain an OSY harvest rate determined for the legal-sized population in sport and commercial fisheries
- Maintain concurrent Washington and Oregon regulations in the Columbia River
- Provide for year-round sport fishing opportunity
- Maintain sport and commercial shares in the fishery
- Consider emergency regulatory action if harvest is projected to compromise management objectives

These management objectives were designed to build Columbia River sturgeon populations to carrying capacity for the habitats in which they reside. They also reflect a desire to manage for healthy, stable fisheries that provide a long term, sustainable yield. Optimal sustainable yield, as defined for LCR sturgeon management, is a level of harvest that allows enough survival of juvenile fish through the fisheries to insure adequate recruitment into the protected broodstock population (DeVore et al. 1995). With the current 42-60 inch legal size slot and an 80% sport and 20% commercial allocation, the OSY harvest rate is 22.5% of this legal size class.

Stock Assessment Methods

Abundance and exploitation rates of LCR white sturgeon were estimated annually using mark-recapture data. An average of 3,000 white sturgeon have been tagged annually in the LCR from 1976-1998 (Table 3). Sturgeon >90 cm total length (TL) were captured and tagged with sequentially numbered spaghetti tags inserted at the base of the dorsal fin. All fish captured were sampled for marks, fork length (FL), and total length. Additional information collected when possible included sex, stage of maturity, and age.

Recaptures of tagged fish, a critical parameter in estimates of abundance and exploitation, were obtained from randomly sampling LCR sport and commercial fisheries. Out-of-system recoveries of white sturgeon tagged in the LCR, but recaptured outside the Columbia River system, were voluntarily returned by anglers and commercial fishermen. The Chapman (1951) modification of the Petersen mark-recapture model for closed populations was used to estimate annual abundance of harvestable size white sturgeon each year from 1995-1997. Fish were marked during May-August research fisheries and recaptured by sampling subsequent

consumptive fisheries. Tag groups were stratified based on the month and year that fish were tagged. The recapture period for each tag group began the month following tagging and encompassed all months through November of the following year. Annual point estimates of abundance were determined by averaging the estimates of monthly tag groups within a tag year. Stratifying the abundance estimate by monthly tag groups is a departure from the past methodology. This modification was considered an improvement over 1995 and 1996 analyses because it reduced a known bias associated with incomplete mixing of marked and unmarked fish in the estuary in the summer where most of the tagging and recaptures of tagged fish occurred. Averaging abundance estimates calculated separately for each tag group was considered to be a more accurate estimate of the harvestable sturgeon population within the LCR.

Recruitment to harvestable size was accounted for by including recaptures of marked fish<107 cm TL. We assumed marked and unmarked fish recruited at the same rate and that any differential survival was negligible.

Abundance projections were made using the Age Structured Abundance Projection (ASAP) model developed by WDFW staff. This model simulates the LCR population from a starting age structure derived from research sampling. Recruitment was assumed to be constant. The model matches modeled and empirical abundance and harvest estimates and then projects abundance and population age structure using estimated growth and mortality rates (harvest and natural mortality). The ASAP model has been used to project abundance by age or size for harvest management purposes.

The OSY harvest rate was estimated using MOCPOP 2.0 (Beamesderfer 1991), a population simulator that models the effect of multiple fisheries with different size slots. The model estimates the maximum yield given estimated natural mortality rates and imposed constraints such as legal size slots and targeted broodstock recruitment. Total allowable harvest was determined by applying the OSY harvest rate for the current size slot to the abundance of the legal-sized population.

Recent Management Actions and the Olympia Accord

In October 1996 a management plan dubbed the “Olympia Accord” was formally adopted by Washington and Oregon. The Olympia Accord specified that harvest guidelines for LCR fisheries were to be updated every three years based on the most recent abundance information. Additionally, emergency action could be taken if new information became available in the interim that indicated a significant change in stock status. The first iteration of the Olympia Accord, which was implemented on January 1, 1997, set the harvest constraints for LCR fisheries for the 1997-1999 seasons. It designated a new maximum size limit of 60 inches for white sturgeon in fisheries statewide in Washington and Oregon. It also designated a maximum size limit of 60

inches for sport-caught green sturgeon and 66 inches for commercially-caught green sturgeon. An allocation of the total allowable white sturgeon harvest in LCR fisheries of 80% sport and 20% commercial was also agreed to in the plan. Other regulations and policies outlined in the Olympia Accord included a one fish daily bag limit for all sport sturgeon fisheries and allowance of target commercial sturgeon fisheries in the LCR to access the commercial quota and optimize the market value of commercially-caught sturgeon. All other miscellaneous regulations governing these fisheries that were in effect in 1996 were maintained as part of this management plan.

Abundance of LCR white sturgeon in the 42-60 inch size class was estimated to be 227,700 in 1995 (Figure 3). The ASAP model projected the abundance in this size class would increase to 308,900 by 1999. The 1997-1999 average abundance for the 42-60 inch size class, as projected by the ASAP model, was 298,700. Based on a harvest allocation scenario of 80% sport and 20% commercial, the OSY harvest rate was estimated at 22.5%. Applying the OSY harvest rate of 22.5% predicted an allowable annual harvest of 67,300 white sturgeon. The allocation agreement for 1997-1999 LCR fisheries therefore set annual harvest guidelines of 53,840 white sturgeon in the sport fishery and 13,460 white sturgeon in the commercial fishery. Other OSY harvest scenarios that varied the legal size slot and the allocation were presented to decision-makers as well and presented in the form of a decision matrix. The decision matrix filtered harvest scenarios against risk to maintaining a year round sport fishery (Table 4). The harvest scenario presented above was the one finally adopted by the Washington and Oregon Fish and Wildlife commissions as the allocation and 1997-1999 harvest guideline component of the Olympia Accord.

Current Stock Status

Recent analysis of 1995-1998 mark-recapture data indicates a decreased in-river abundance of LCR white sturgeon in the legal size range of 42-60 inches total length since 1995 (Table 5, Figures 3 and 4). One contributing problem was the recent discovery of five in-sample tag recoveries from the 1995 tag group that were not included in the past analysis. Addition of these tags reduced the point estimate of 1995 abundance by about 13,400 fish. Recalculating the 1995 estimate by stratifying monthly tag groups and computing the average abundance further reduced the 1995 point estimate by 12,400 fish. The recalculated abundance of 42-60 inch sturgeon in 1995 was therefore 202,700, compared to the original estimate of 227,700 (Table 5). However, this correction does not explain the trend of decreased abundance indicated by the 1996 and 1997 data. There are two theories that may explain the trends revealed in this recent analysis.

Decreased recruitment into the sport fishery

The ASAP model used in 1996 assumed a constant annual recruitment of younger white sturgeon into the 42 inch size class. This assumption was made based on the observation of

uninterrupted recruitment into fisheries through 1995 and evidence of constant recruitment of young-of-the-year (YOY) white sturgeon 7-12 years ago (McCabe and Tracy 1994). Recent examination of catch rates in the LCR sport fishery indicate that recruitment into the sport fishery has apparently decreased in the last three years (Figure 5).

The apparent recruitment decline could be partially explained by reduced growth rate. The decline in Columbia River smelt runs since 1993 and the recent reduction in marine productivity from El Niño conditions could have reduced the forage base for LCR white sturgeon. A reduced growth rate would also be expected if the burgeoning juvenile sturgeon population in the LCR has encountered a freshwater carrying capacity limit. Further analysis of tag and fin data is being conducted to ascertain if significant growth rate reduction is occurring in the population, especially in the juvenile age classes. It is also recommended that the ASAP model assume a more conservative recruitment rate into fisheries when projecting future abundance.

There is no direct evidence of a decline in spawning success or juvenile recruitment into the LCR white sturgeon population. There has been an increased amount of effort in the catch and release fishery for oversized white sturgeon downstream from Bonneville Dam. Some concern has been raised that this may cause a disruption in spawning or recruitment if too many mature females are handled in this fishery. However, increased effort in this fishery has been too recent to affect recruitment to the legal size class (42" total length) in 1996-1999. Washington and Oregon staff have been conducting weekly surveys in the summer from Camas upstream to Bonneville Dam every year since 1994 to look for mortalities of oversized sturgeon. An average of 18 dead oversized white sturgeon have been found annually during these surveys. There is no trend with these data and only a few of the mortalities are linked to handling stress in the sport fishery (i.e. hooks in the gut, etc.). We will continue to conduct these surveys and monitor the catch and release fishery to ensure that it does not cause harm to broodstock fish.

Increased emigration

There is evidence of increased emigration of white sturgeon from the LCR in recent years. An analysis of the timing and distribution of 1976-1998 out-of-system tag recoveries of white sturgeon that were tagged in the LCR indicate a recent increase in emigration rates (Figure 6 and Table 6). The percent of tags from annual tag groups of white sturgeon tagged in the LCR in the most recent three years but recovered in fisheries outside the LCR was calculated as an annual index of emigration. The percent of out-of-system recoveries in 1996 was significantly higher than for any other recovery year in the analysis. This may be an event-driven result, a consequence of the February 1996 flood. Other years when emigration was high were 1981 and 1988, possibly associated with the 1980 Mt. St. Helens eruption and drought conditions in the late 1980's.

Coincident to the increase in out-of-system recoveries in 1996 was a significant increase in out-of-system harvest. In 1996 the white sturgeon harvest in Grays Harbor increased 440%

relative to the 1980-1996 average annual harvest, the result of a dramatic increase in the Quinault Indian commercial harvest in the lower Chehalis River that year. Although the significant increase in tag recoveries in our analysis was due to increased outside harvest, especially in the Quinault fishery, the increased abundance of LCR white sturgeon in Washington and Oregon coastal bays and estuaries in 1996 was responsible for increased outside harvest. Anecdotal evidence of increased abundance of white sturgeon in Oregon coastal estuaries (harvest estimates for 1996-1998 are not yet available) and in Puget Sound (harvest is not accounted for with the current WDFW sturgeon catch record card) corroborate the increased emigration theory. We have theorized for some time that we would observe increased emigration from the LCR and evidence of increased abundance of white sturgeon along the Washington and Oregon coasts when the LCR sturgeon population grew to an LCR carrying capacity limit.

White sturgeon have been captured annually in Oregon coastal bays and estuaries as part of an ODFW mark-recapture effort. Tag recovery data attest that these fish primarily originate in the LCR (Table 6). Catches made by angling and gill net gears since 1990 indicate that over 50% were less than the current legal minimum size of 42 inches total length (Figure 7). We believe that the emigration phenomenon and the reduced recruitment into LCR fisheries may be related. That is, some of the reduced recruitment into LCR fisheries may be due to increased emigration of sublegal fish from the Columbia River. It is unknown at this time how much of the reduced recruitment can be explained by increased emigration and how much is due to reduced productivity of the LCR population.

Management Implications

The implications to management of LCR sturgeon fisheries will be largely based on the amount of risk we are collectively willing to take given the uncertainty in predicting future in-river abundance of white sturgeon. If the group of fish that apparently emigrated from the LCR in the last few years were to return in significant numbers in the near future, then LCR abundance may get back on the track predicted by the ASAP model in 1996. Management for the 1997-1999 harvest levels could well be sustained without a risk to future population productivity if we could expect this return of emigrated fish. Otherwise, it may be prudent to adopt more conservative harvest strategies that calibrate harvest levels based on the lesser abundance estimated by recent analyses as called for in the Olympia Accord. These considerations need to be assessed relative to the risk of maintaining the current sport and commercial allocation of allowable harvest and an expectation for allowing year-round sturgeon retention in the LCR sport fishery.

Management in 1999

Management of 1999 LCR sturgeon fisheries is currently directed by the Olympia Accord. However, given the updated stock assessment, a reduction in sport and commercial harvest

guidelines in the LCR should be considered for this year. We do not believe that severe disruption of fisheries are warranted. Annual harvests above OSY only present a management problem if the magnitude and duration of overharvest is large or extended. While it is not expected that the 1999 harvest will be a huge problem, it is predicted to be greater than OSY with the current guidelines prescribed by the Olympia Accord. A reduction of harvest guidelines this year would be consistent with the management objectives for this population as prescribed in the Olympia Accord and would be a conservative reaction to the new stock assessments.

A reduction of the sport guideline in 1999 will probably not constrain year-round fishing opportunity. Catches for the January through March period this year are tracking about 22% less than for the same time period last year (Table 7). A high runoff this summer will probably reduce catch rates in the summer estuarial fishery as it did in the last two years. Anglers will also have increased salmon fishing opportunity in Ocean Area 1 and Buoy 10 for hatchery coho. This will tend to reduce sturgeon fishing effort in late July and August, especially for the charter fleet. It is also expected that there will be increased salmon fishing opportunity for the commercial fleet in 1999, thereby reducing dependence on sturgeon for economic viability. Therefore, we recommend that harvest reductions be imposed on the commercial fishery since environmental conditions and increased salmon fishing opportunity will probably limit the sport fishery this year.

Management in 2000 and beyond

The same logic governing the decisions that need to be made this year for LCR sturgeon fisheries apply for next year and beyond. A conservative reaction to the new stock assessments is recommended. A new decision matrix will provide harvest scenarios that are based on these new data. The management objectives of maintaining the current sport and commercial harvest allocation for the near future while providing a reasonable expectation of a year-round sport fishery may be in conflict with a lesser total allowable harvest. The new decision matrix, which will be available by the time Washington and Oregon staffs host public meetings later this year to discuss new sturgeon harvest guidelines for 2000 and beyond, will clearly evaluate these two objectives with each modeled harvest scenario.

Given an expectation that overall harvest will be reduced in the next few years to stay within OSY limits, managers and fishers still have some flexibility in choosing management strategies. One possible strategy is to evaluate abundance annually and base total allowable harvest on the previous years' abundance estimates. This strategy is very conservative in that annual harvest levels will not reflect the increased recruitment into, and growth of, the LCR sturgeon population that the ASAP model predicts when setting harvest levels. However, white sturgeon grow so slowly that foregone harvest benefits could be recouped in subsequent years as we become more certain of increased abundance. It also conflicts with a staff recommendation to change stock assessment methods to do a more thorough mark and recapture assessment throughout the LCR on a periodic basis. We believe that accuracy and precision of current stock

assessment methods can be vastly improved. These recommended changes in assessment methods and management strategies depend on greater resources than we currently have available.

A less conservative but justifiable management strategy would be to use the ASAP model to predict abundance for the years 2000 and beyond and set harvest levels accordingly. Analogous to the current management plan, as described in the Olympia Accord, the model would be calibrated to the abundance estimated in 1996 and 1997. It is not recommended that the ASAP model be depended on for more than three years in the future since it cannot predict events such as the 1996 flood, which may dramatically affect harvestable abundance of LCR white sturgeon. However, this strategy, as long as abundance and harvest are recalibrated every three years or less, is cost effective and reasonably conservative.

The least conservative strategy would be to readopt the harvest guidelines in place for 1997-1999 fisheries with the expectation that the white sturgeon that recently emigrated from the LCR will soon return. This strategy could conceivably lead to higher harvest rates than set for 1997-1999 LCR fisheries. The LCR sturgeon population would not be impacted if immigration into the LCR made up the difference and kept harvest at OSY. However, if the decrease in abundance indicated from 1996 and 1997 abundance estimates resulted from higher mortality rates and not from a potentially reversible increased emigration, then this strategy would exacerbate a real stock decline. Given the higher level of risk, we do not recommend this management strategy.

Managing the LCR white sturgeon population on a regional basis is another strategy that makes sense given the widespread migrations and harvest of these fish occurring in Washington and Oregon coastal areas. Managers have addressed this issue in the past by making any regulation changes that affect size slots or bag limits effective statewide in Washington and Oregon. This strategy works well when harvest trends on this stock in areas outside the LCR do not dramatically change from year to year. However, as noted in the significantly increased sturgeon harvest in Grays Harbor and the Chehalis River in 1996, target fisheries will develop when the local abundance of white sturgeon increases dramatically. The first step toward successful regional management of LCR white sturgeon is to fully account for all harvest outside the Columbia River. The Washington Department of Fish and Wildlife will be pursuing a regulation change requiring a sturgeon catch record card in greater Puget Sound, the Straits of Juan de Fuca, and all inclusive tributaries beginning in 2000. It will then be possible to account for the majority of harvest of LCR white sturgeon through their entire range. Developing OSY management strategies for all coastal areas where white sturgeon are harvested in Washington and Oregon is more problematic. It is difficult to determine relative or actual abundance in these coastal areas without mark and recapture data. The Oregon Department of Fish and Wildlife has been conducting tagging studies in the most important Oregon coastal estuaries where white sturgeon are harvested. The data generated by this effort could be used to develop sustainable harvest strategies for those areas. A like effort in Washington coastal areas such as Willapa Bay, Grays Harbor, and some of the Puget Sound tributaries (where target fisheries on LCR white

sturgeon are occurring) would be needed to develop OSY harvest strategies region-wide. Otherwise, an alternative strategy would be to adjust annual harvest guidelines in outside coastal areas proportionally to LCR guidelines. It is reasonable to assume that if harvest in coastal areas is limited to an average historical proportion relative to LCR harvest, then these guidelines would be sustainable.

Conclusions and Recommendations

We conclude that the in-river abundance of legal-sized white sturgeon has decreased in the LCR in the last three years. There is evidence of a reduced recruitment into LCR fisheries and an increased emigration from the LCR. Both results may be event driven, resulting from the 1996 flood and a lesser forage base within the LCR. It appears that the greatest decrease was in size classes less than 4 feet in length. Increased abundance of older aged fish through fisheries is still a positive indicator that OSY management is succeeding in allowing greater survival through fisheries and greater recruitment of broodstock. However, lesser legal-sized abundance than predicted is still a concern.

Given a decreased abundance, we recommend a more conservative management strategy be considered for this year and the next sturgeon management period beginning next year. Although we don't believe that the reduced in-river abundance is a result of increased mortality, it would be prudent to scale down total allowable harvest given the uncertainty.

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Literature Cited

Beamesderfer, R.C. 1991. MOCPOP 2.0: A flexible system for simulation of age-structured populations and stock-related functions. Oregon Department of Fish and Wildlife, Information Report 91-4, Portland, OR.

Birstein, V.J. 1993. Sturgeons and paddlefishes: threatened fishes in need of conservation. Conservation Biology 7:773-787.

Chapman, D.G. 1951. Some properties of the hypergeometric distribution with applications to zoological censuses. University of California Publications in Statistics 1:131-160.

Counihan, T.D., J.D. DeVore, and M.J. Parsley. In Press. The effect of river discharge and water temperature on the year-class strength of Columbia River white sturgeon. Submitted to the Canadian Journal of Fisheries and Aquatic Sciences.

Craig, J.A., and R.L. Hacker. 1940. Sturgeon fishery of Columbia River basin. Bulletin of the Bureau of Fisheries 49:204-208.

DeVore, J.D., B.W. James, C.A. Tracy, and D.H. Hale. 1995. Dynamics and potential production of white sturgeon in the unimpounded lower Columbia River. Transactions of the American Fisheries Society 124:845-856.

McCabe, G.T., Jr., and C.A. Tracy. 1994. Spawning and early life history of white sturgeon, *Acipenser transmontanus*, in the lower Columbia River. Fishery Bulletin 92:760-772.

Parsley, M.J., and L.G. Beckman. 1994. White sturgeon spawning and rearing habitat in the lower Columbia River. North American Journal of Fisheries Management 14:812-827.

Rieman, B.E., and R.C. Beamesderfer. 1990. White sturgeon in the lower Columbia River: Is the stock overexploited? North American Journal of Fisheries Management 10(4):388-396.

Rochard, E., G. Castelnaud, and M. Lepage. 1990. Sturgeons (Pisces: Acipenseridae); threats and prospects. Journal of Fish Biology 37A:123-132.

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Tables

Table 1. Lower Columbia River Catch (In Thousands of Fish) of White Sturgeon, 1969-1998.

Year	Zones 1-5 Commercial Gill Net 1/	Setline 2/	L. Col. Sport	Z.1-5 Comm.Tot.	Pct. Comm.	Pct. Sport	L. Col. Total
1969	7.5	0.0	6.9	7.5	52%	48%	14.4
1970	6.3	0.0	8.9	6.3	41%	59%	15.2
1971	7.2	0.0	3.7	7.2	66%	34%	10.9
1972	7.6	0.0	6.6	7.6	54%	46%	14.2
1973	10.7	0.0	12.9	10.7	45%	55%	23.6
1974	10.7	0.0	12.3	10.7	47%	53%	23.0
1975	13.0	1.0	18.1	14.0	44%	56%	32.1
1976	18.1	4.7	19.3	22.8	54%	46%	42.1
1977	8.9	0.8	25.8	9.7	27%	73%	35.5
1978	8.8	1.0	30.4	9.8	24%	76%	40.2
1979	18.5	2.0	31.4	20.5	39%	61%	51.9
1980	6.8	2.6	27.0	9.4	26%	74%	36.4
1981	10.8	4.1	27.2	14.9	35%	65%	42.1
1982	7.0	4.6	25.1	11.6	32%	68%	36.7
1983	9.5	2.9	36.0	12.4	26%	74%	48.4
1984	15.7	1.8	42.0	17.5	29%	71%	59.5
1985	7.6	0.8	43.8	8.4	16%	84%	52.2
1986	11.6	--	49.8	11.6	19%	81%	61.4
1987	9.7	--	62.4	9.7	13%	87%	72.1
1988	6.9	--	43.1	6.9	14%	86%	50.0
1989	5.0	--	25.4	5.0	16%	84%	30.4
1990	5.2	--	17.3	5.2	23%	77%	22.5
1991	3.8	--	22.7	3.8	14%	86%	26.5
1992	6.2	--	40.1	6.2	13%	87%	46.3
1993	8.1	--	37.9	8.1	18%	82%	46.0
1994	6.4	--	33.5	6.4	16%	84%	39.9
1995	6.2	--	45.1	6.2	12%	88%	51.3
1996	8.4	--	42.8	8.4	16%	84%	51.2
1997	12.8	--	38.2	12.8	25%	75%	51.0
1998 3/	13.9	--	41.6	13.9	25%	75%	55.5
1969-98 avg.	9.3	0.9	29.2	10.2	26%	74%	39.4
Recent 10 yr. avg.	7.6	0.0	34.5	7.6	18%	82%	42.1

1/ Target sturgeon gill net seasons eliminated since 1989.

2/ Prior to 1975, minor setline landings are included in gill net totals. Setline fishing prohibited in Zones 1-5 since 1986.

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Table 2. Summary of recent sturgeon management regulations in the Lower Columbia River downstream from Bonneville Dam, 1980-1997.

Year	Sport	Commercial
1980	Night closure (WA)	
	(Same in OR many years prior)	
1983	Eggs must remain with carcass in the field (OR)	Setline season decreased from 9 to 6 months
		Target gill net seasons established
1984		Setline season decreased from 6 to 3 months
1985		Setline season decreased from 3 to 1 month(s)
		No mutilation so size cannot be determined
1986	2 daily bag (WA & OR)	Setline season eliminated
	No gaffing (WA)	
	Single point hooks (WA)	
	30 annual limit (OR)	
	Sturgeon catch record card (OR)	
	N.Bradford Is. deadline lowered (OR)	
1987	Eggs must remain with carcass in the field (WA)	
1988	Sturgeon catch record card (WA)	
1989	40 in. min. length (WA & OR)	Target gill net seasons eliminated
	15 annual limit (WA)	
1990	Barbless single point hooks (WA & OR)	Oct. mesh restrictions
	No gaffing (OR)	
	15 annual limit (OR)	
1991	1/1 daily bag (WA & OR)	2 lb./fathom lead line limit
		(Same in OR many years prior)
		Oct. mesh restrictions
1992	60 in. max. length (WA only) 1/	60 in. max. length (WA only) 1/
	4 mile Bonn. Dam sanctuary (WA only)	No gaffing
		Oct. mesh restrictions
1993		66 in. max length (WA & OR)
		Closed to retention after Oct. 7
1994	42-66 in. size slot (WA & OR)	6,000 annual limit
	10 annual limit (WA & OR)	Closed to retention after Oct. 10
1995	Closed to retention Sept. 1- Dec. 31	Annual catch ceiling of 8,000 during salmon
		seasons, of which not more than 6,800 (85%)
		may be taken in fall fisheries
1996	1 daily bag Apr. 1- Dec. 31	Same as 1995
1997	60 in. max length for whites & greens (WA & OR)	60 in. max for whites & 66 in. max for greens (WA & OR)
	53,840 white sturgeon quota	13,460 white sturgeon quota
	1 daily bag	Allowance of target seasons

1/ Rescinded in Jan. 1993.

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Table 3. Lower Columbia white sturgeon tag groups, 1976-1998. 1/

Tag Group	Number Tagged	Tag Group	Number Tagged	Tag Group	Number Tagged
1976	1,238	1984	1,235	1992	4,133
1977	457	1985	1,992	1993	4,954
1978	1,000	1986	4,642	1994	926
1979	1,030	1987	3,789	1995	4,962
1980	1,344	1988	2,706	1996	4,755
1981	1,414	1989	5,378	1997	6,523
1982	1,466	1990	3,502	1998	5,216
1983	1,989	1991	4,958		
Totals	69,609				
Average	3,026				

1/ Number white sturgeon tagged in the lower Columbia (including tributaries).

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Table 4. Decision making matrix for 1997 to 1999 potential sturgeon rule changes.

Commercial		Sport			1997 to 1999 Average			
Share	Size limit	Size limit	Bag limit	Achieve three years of 12 month sport harvest	Projected sport harvest at 200,000 angler trips	Allowable sport harvest	Allowable commercial harvest	Total allowable harvest
1995-96 Agreement	**48"- 60"**	**42"- 60"**	**1**	**yes**	**52,900**	**61,900**	**8,000**	**69,900**
			2	**likely**	**59,700**			
	48"- 66"	42"- 66"	1	no	53,900	49,100	8,000	57,100
			2	no	61,200			
15%	**48"- 60"**	**42"- 60"**	**1**	**yes**	**52,800**	**58,100**	**10,300**	**68,400**
			2	**possible**	**59,400**			
	48"- 66"	42"- 66"	1	no	53,800	47,900	8,400	56,300
			2	no	60,900			
20%	**48"- 60"**	**42"- 60"**	**1**	**likely**	**52,300**	**53,800**	**13,500**	**67,300**
			2	no	58,800			
	48"- 66"	42"- 66"	1	no	53,400	44,200	11,000	55,200
			2	no	60,400			
25%	48"- 60"	42"- 60"	1	no	51,900	48,500	16,200	64,600
			2	no	58,200			
	48"- 66"	42"- 66"	1	no	52,900	40,100	13,400	53,400
			2	no	59,800			

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Table 5. Estimated abundance of white sturgeon in the lower Columbia River downstream from Bonneville Dam, 1987-1997.

	Total length interval (inches)						
Year	36-42"	42-48"	48-60"	**42-60"**		60-72"	36-72" 1/
1987	146,300	77,100	28,100	**105,200**		10,300	261,800
1988	118,400	34,800	33,700	**68,500**		19,800	206,700
1989	117,700	32,500	16,800	**49,300**		7,900	174,900
1990	158,000	26,100	12,000	**38,100**		7,300	203,400
1991	193,800	32,900	11,700	**44,600**		4,700	243,100
1992	308,200	59,900	8,700	**68,600**		2,200	379,000
1993	343,800	85,000	14,200	**99,200**		2,000	445,000
1994	NA	NA	NA	**NA**		NA	NA
1995	185,400	143,200	59,000	**202,200**	2/	NA	387,600
1996	202,800	131,700	33,500	**165,200**		NA	368,000
1997	202,100	123,700	33,400	**157,100**		NA	359,200

1/ Total does not include abundance of 60-72" fish in 1995-1997.

2/ Original estimate in 1996 was 228,000.

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Table 6. Columbia River white sturgeon out-of-system tag recoveries by recovery area, 1976-1997 tag groups.

Recovery Area	Tag Group																						
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	Totals
Sacramento	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Oregon coast	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	1	0	4
Coos Bay	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	0	0	5
Umpqua	0	0	0	0	0	0	0	0	0	0	1	0	0	2	0	0	0	5	0	8	0	1	17
Siuslaw	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	2
Yaquina	1	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	1	2	0	2	0	0	9
Siletz	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Tillamook	0	0	0	0	0	0	0	0	0	1	3	3	1	5	2	0	0	9	1	6	1	12	44
Nehalem	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	1	0	0	0	0	4
Washington coast	0	1	0	1	0	0	1	1	0	3	0	0	0	1	0	0	0	1	0	0	0	0	9
Willapa Bay	2	1	0	3	3	4	4	3	0	4	8	14	8	7	4	10	4	14	1	15	12	6	127
Grays Harbor	1	1	1	1	4	9	4	3	3	4	14	24	11	18	8	17	0	24	5	30	6	3	191
Quinault	0	0	0	0	0	0	0	0	1	2	3	0	3	3	1	0	0	0	0	2	0	0	15
Hoh	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	0	3
Neah Bay	0	0	0	0	0	0	0	0	1	1	11	4	2	0	0	2	0	0	0	0	0	1	22
SJDF	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	2	0	1	0	0	6
Hood Canal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	3
Puget Sound	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Nisqually	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Duwamish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Snohomish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	2
Stillaguamish	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	2
Fraser	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Totals	4	3	2	5	8	14	9	7	5	15	41	45	26	41	17	31	8	64	7	73	22	24	471

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Table 7. Catch and effort in the lower Columbia white sturgeon sport fishery, January -March, 1996-1999.

Month	1996	1997	1998	1999	Average
			Catch		
January	1,681	230	859	893	916
February	879	1,447	1,041	826	1,048
March	4,071	3,796	2,112	1,430	2,852
Totals	6,631	5,473	4,012	3,149	4,816
			Effort (angler trips)		
January	9,235	2,780	6,276	6,976	6,317
February	4,957	17,688	10,430	8,419	10,374
March	22,002	24,997	19,581	14,847	20,357
Totals	36,194	45,465	36,287	30,242	37,047
January-March CPUE	0.183	0.120	0.111	0.104	0.130

Figures

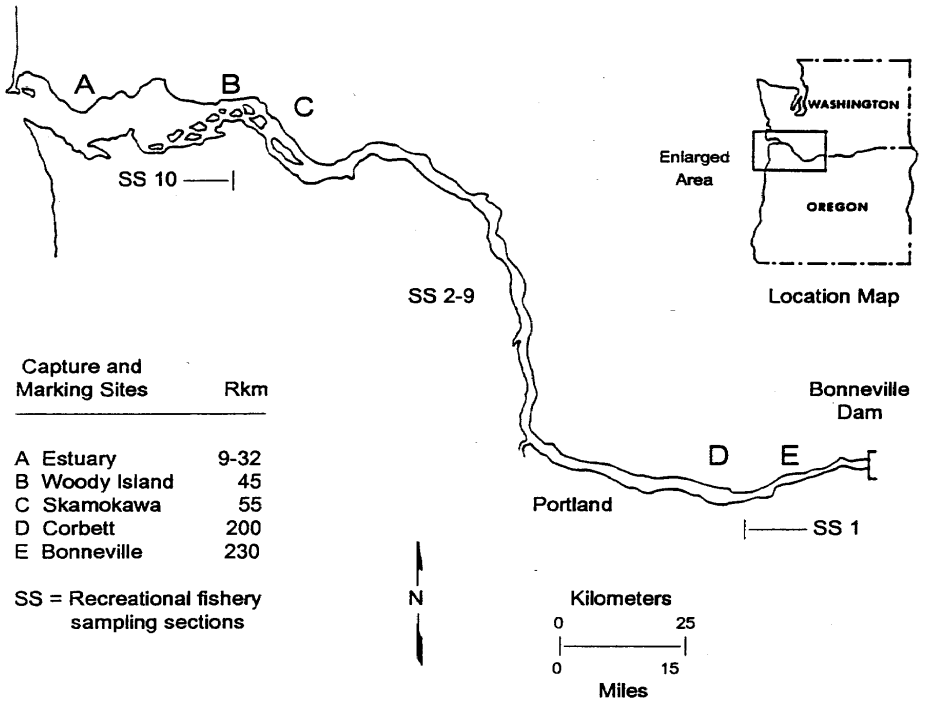

Figure 1. The lower Columbia River downstream from Bonneville Dam (LCR).

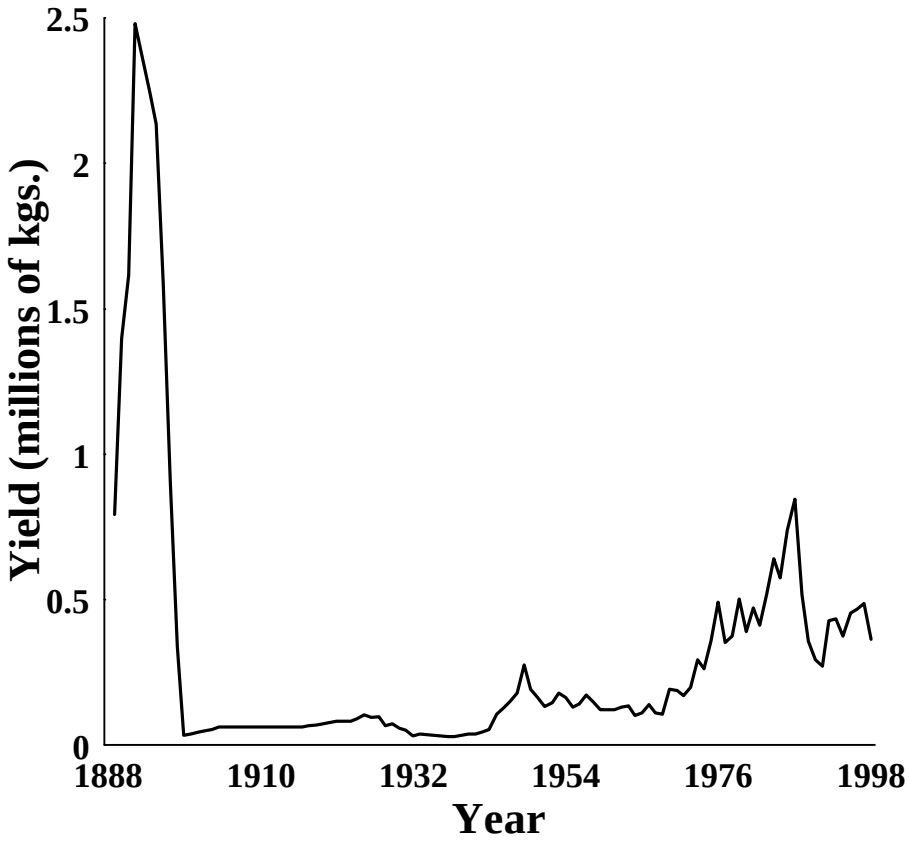

Figure 2. Historical yield of Columbia River white sturgeon.

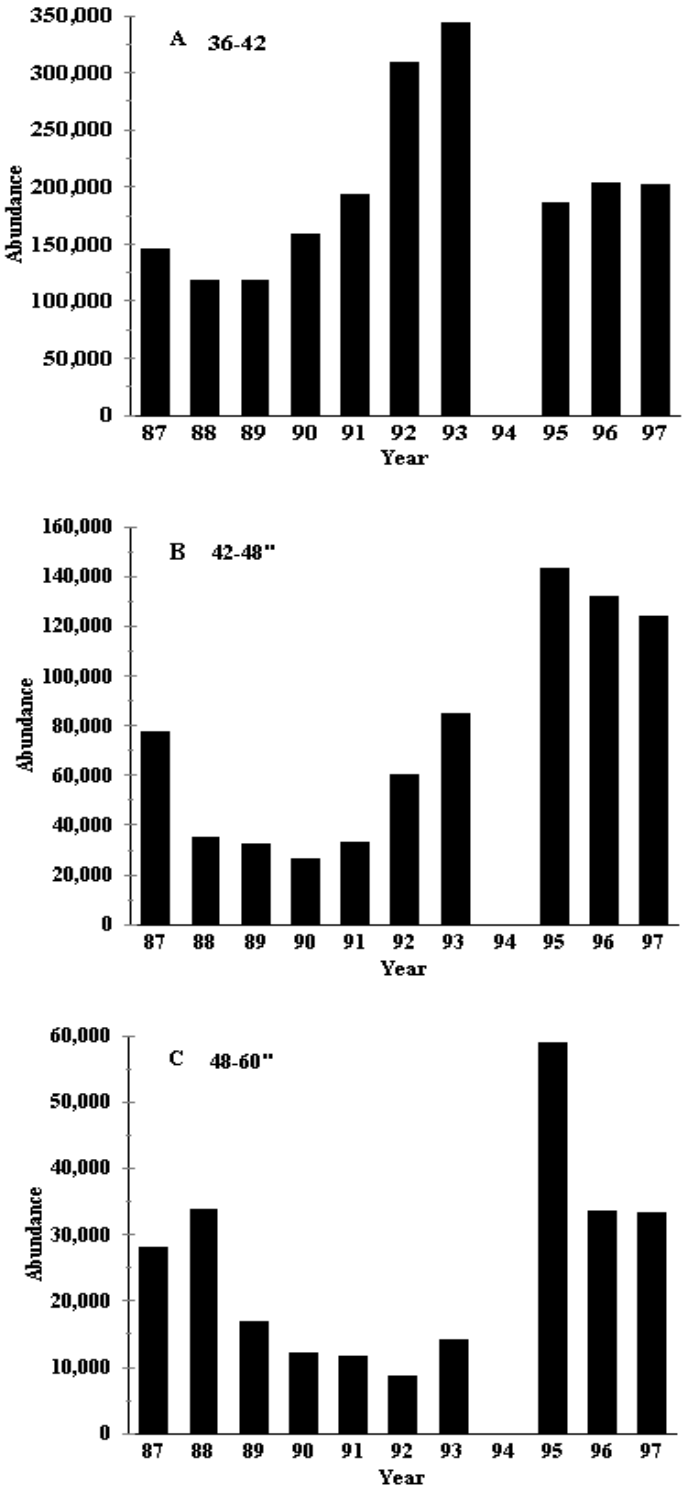

Figure 3. Abundance by size class of lower Columbia white sturgeon, 1987-1997.

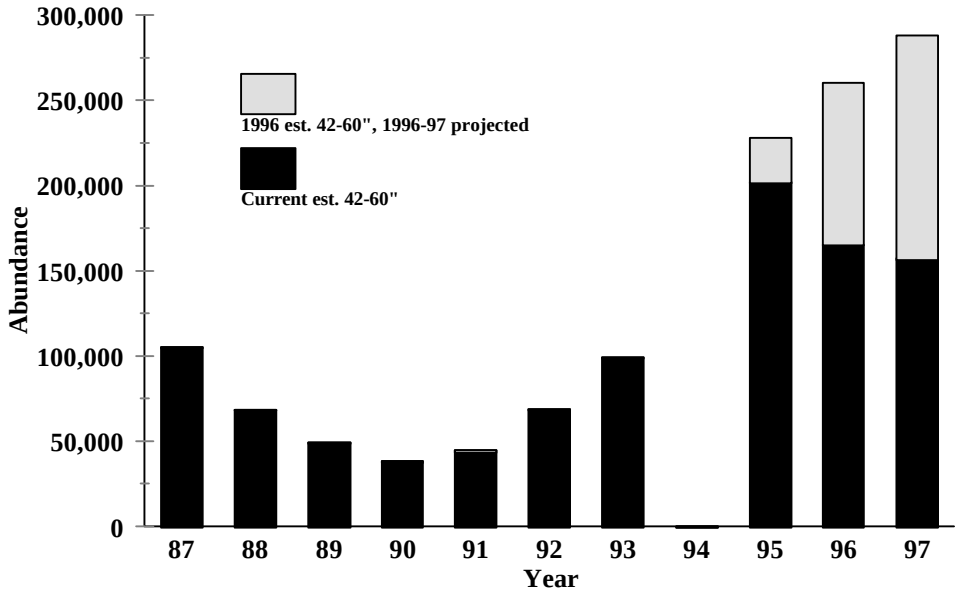

Figure 4. Comparison of current estimates of abundance of 42-60 inch LCR white sturgeon and the estimate and projections made in 1996.

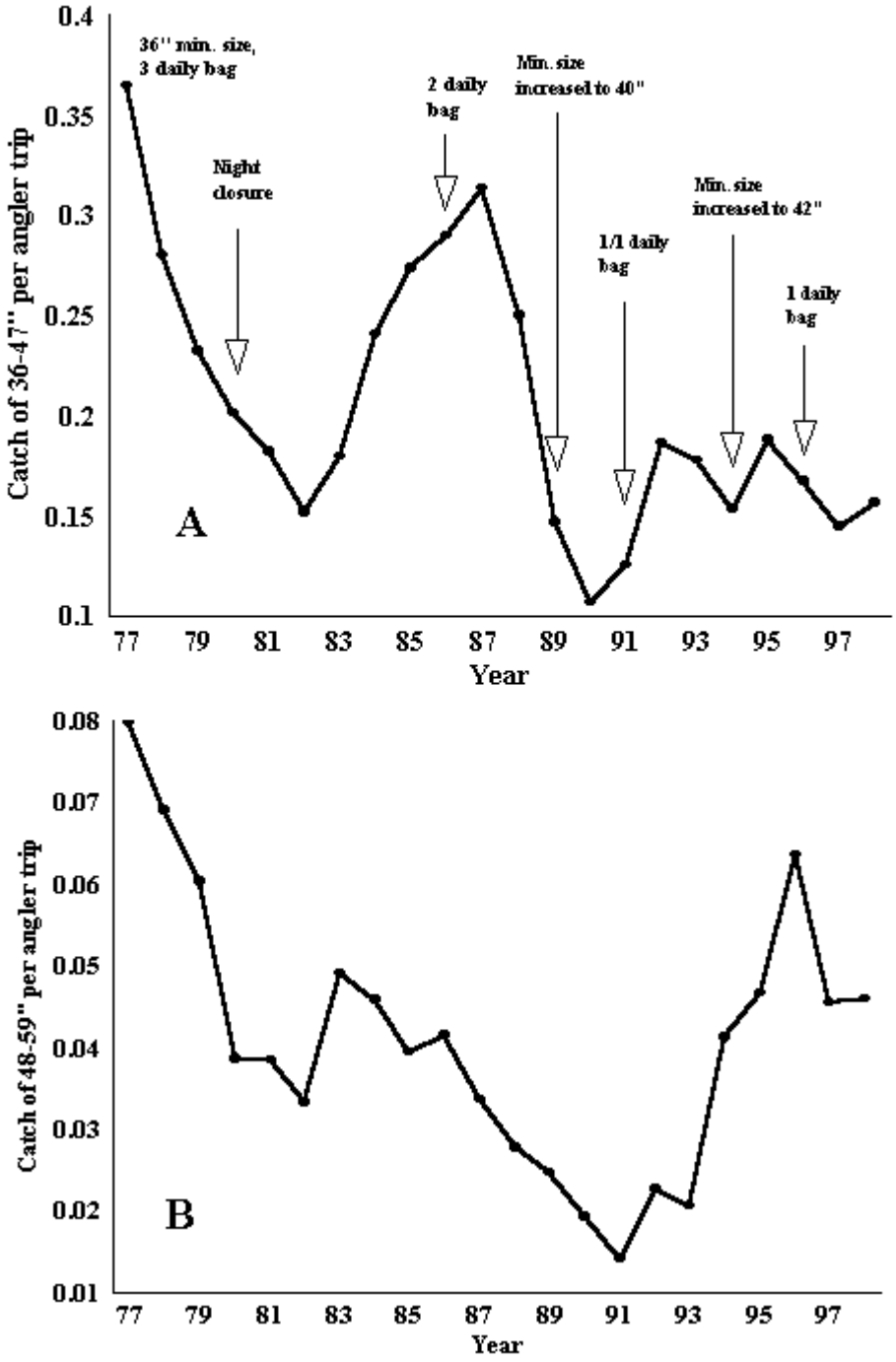

Figure 5. Catch rates for 36-47” (A) and 48-59” (B) white sturgeon in the lower Columbia sport fishery, 1977-1998.

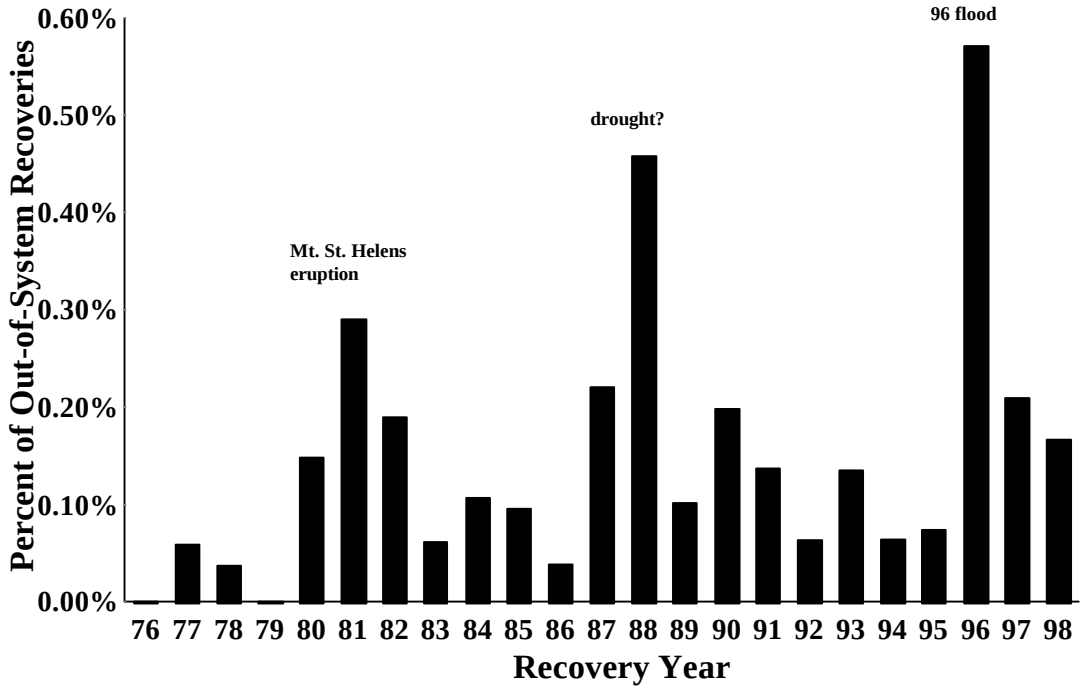

Figure 6. Percent of annual LCR tag groups recovered outside the Columbia River, 1976-1997. Percentages are stratified by recovery year with total LCR tags recovered out-of-system divided by the number of LCR tags put out in the most recent three years to the recovery year.

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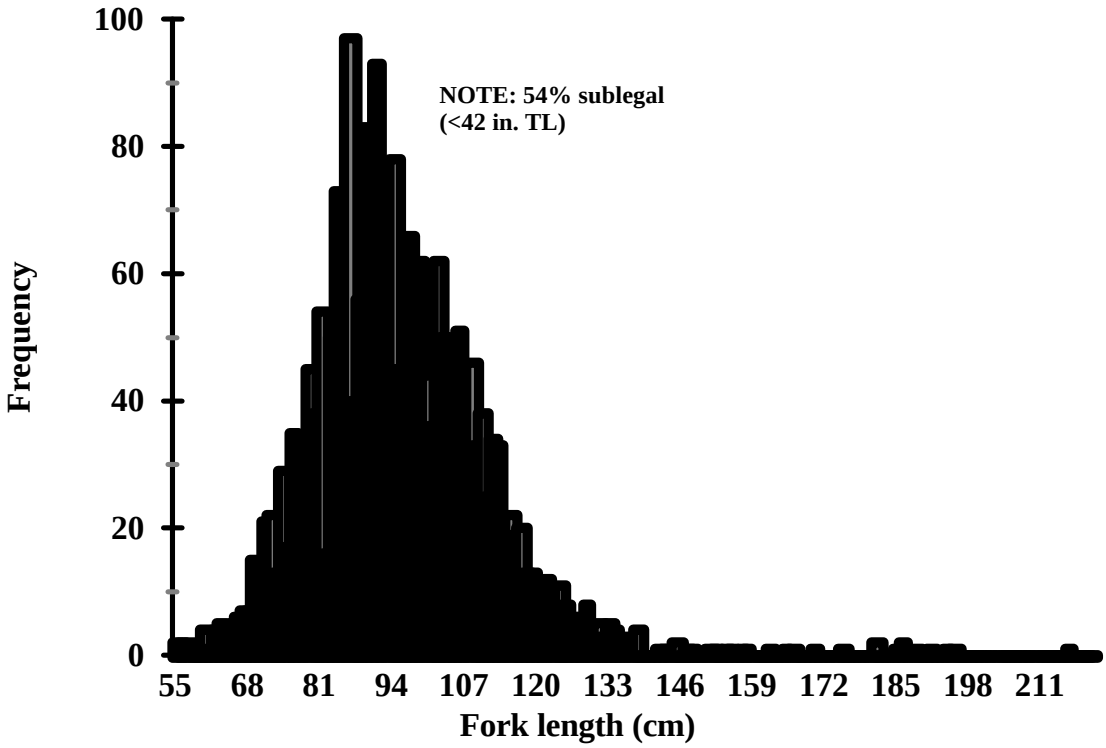

Figure 7. Length frequency of white sturgeon captured in Oregon coastal research fisheries, 1990-1998.