AGE AND GROWTH OF WHITE STURGEON IN THE LOWER COLUMBIA RIVER, 1980-83

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CONTENTS

TABLES

FIGURES

APPENDIX TABLES

Age and Growth of White Sturgeon in the Lower Columbia River, 1980-83

ABSTRACT

Pectoral fin rays from white sturgeon (Acipenser transmontanus) in the lower Columbia River were collected, sectioned, and aged from June 1980 to December 1983 for the purpose of estimating growth rate in the population. A growth curve was constructed for fish aged 1-21 years. Age estimates revealed considerable variation among sturgeon at each age and length group, generally increasing with age and length. Sturgeon enter the minimum harvestable size length of 91 cm at a mean age of 9 years and leave the maximum harvestable size length of 183 cm at a mean age of 20 years. The 1980-83 growth curve was compared with a 1947-53 growth curve from the same region. Variance between the two groups of data occurred and possible causes are discussed.

INTRODUCTION

The lower Columbia River supports the highest concentration of white sturgeon within their distribution along the west coast of North America. High sustained annual sport and commercial harvests of white sturgeon in the lower Columbia suggests a stable population with adequate recruitment due primarily to the effects of protective minimum and maximum size limits (91-183 cm). Despite the apparent good health of the lower Columbia white sturgeon population very little information related to sturgeon biology is currently available.

The Oregon Fish Commission (since 1975 becoming the Oregon Department of Fish and Wildlife) conducted a sturgeon tagging program during the late 1940's that provided useful data on migration and growth rates (Bajkov 1949, 1951). From 1947-53 fin rays were collected and aged (unpublished data). These data provided the current study with a useful source of growth rate comparison.

OBJECTIVES

From 1980 to 1983 pectoral fin rays were collected from lower Columbia River white sturgeon in order to:

1. Determine current age and growth.

2. Compare growth rates of sturgeon between the 1980-83 and 1947-53 studies.

STUDY AREA

White sturgeon were collected through the entire main stem of the lower Columbia River from the mouth to Bonneville Dam, a total of 145 river miles. The majority of fins were collected near the mouth of the Columbia River and just below Bonneville Dam where the major fisheries occur (Figure 1).

METHODS

Pectoral fin rays from 1,314 white sturgeon were collected between June 1980 and December 1983. The majority of legal-size sturgeon fin rays were taken from commercial landings at buyers and during sampling of anglers' catches. Fins from sublegal sturgeon (<91 cm) were collected in conjunction with test, gill-net fisheries and fins from oversize sturgeon (>183 cm) were taken from illegal fish and natural mortalities. An attempt was made to collect a minimum sample of 40 fins at every designated 5 cm length group but this was not entirely successful. Fins were collected at every opportunity throughout the year.

Fin rays from fish under legal size were removed from live fish that were subsequently tagged and released. The effects of fin ray removal (only the leading ray or a small segment of the leading ray was removed) on survival of released sturgeon was considered to be minimal based upon live-box observations and tag recoveries.

Recorded with each fin collected were: total length, weight (when possible), date, location, presence of tags, and general condition. Sex determination was not conducted during the course of the collecting period.

Fin rays were thoroughly air dried before sectioning. A single-bladed jewelers saw was used to cut thin sections of ray 0.5 to 1.0 mm thick within 1 cm of the fin base. Without polishing, the sections were cleaned and mounted on microscopic slides using clear fingernail polish and examined under a standard dissecting microscope.

The author was the only fin reader involved in the 1980-83 study. For a check on accuracy, at least two readings were made of each section independently until agreement was made. If agreement could not be reached on the readings or if the section was considered too difficult, then it was discarded.

The 1947-53 data were originally recorded in fork length in inches. For the purposes of comparison the data were converted to total length in centimeters. Fork length measurements were increased 10% to approximate total length measurements. Both groups of age data were fitted to a linear regression using the method of least squares.

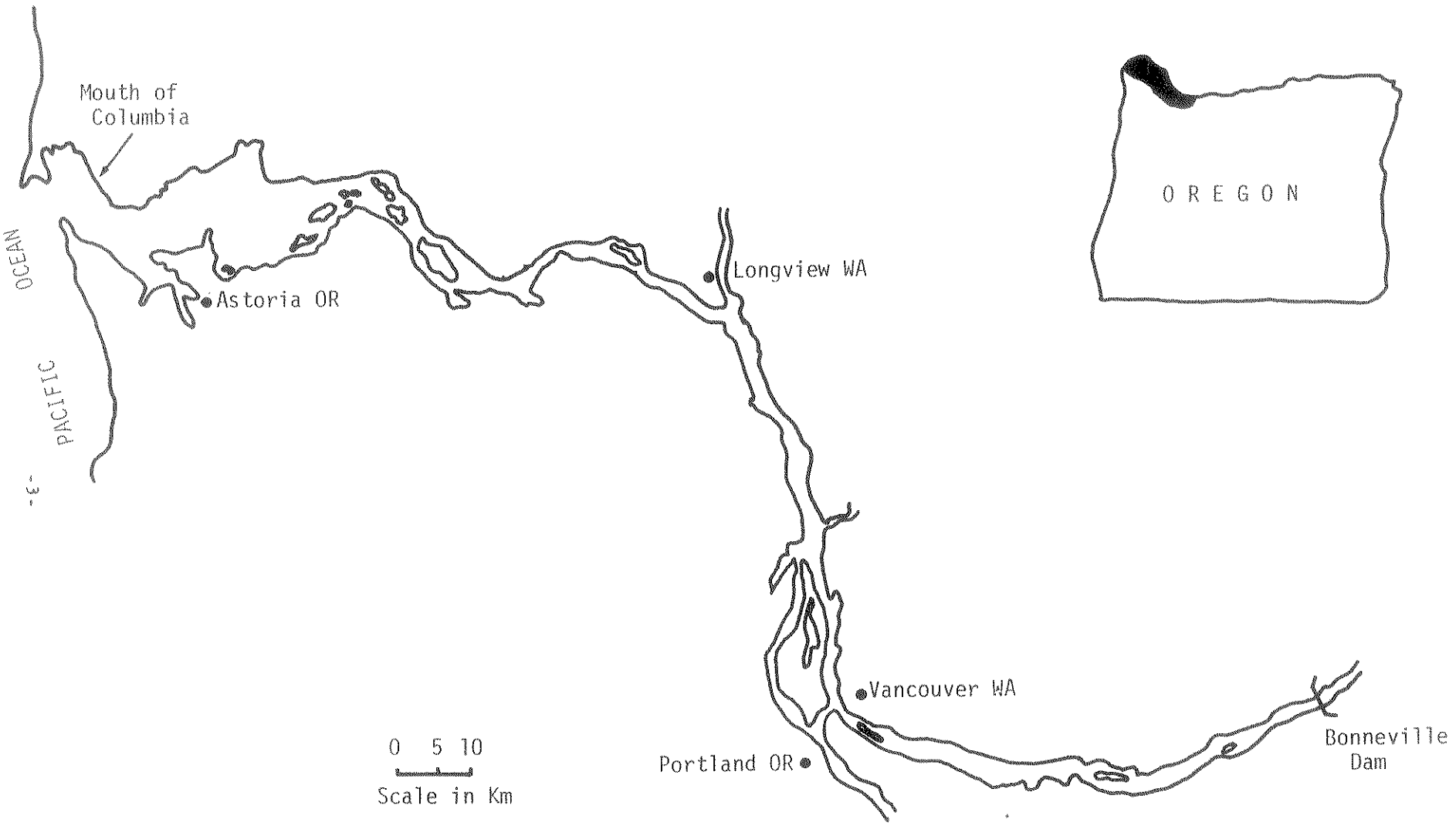

Figure 1. Lower Columbia River Study Area

RESULTS

Lower Columbia River white sturgeon sampled in the 1980-83 study demonstrated considerable variation in length for a given age which tended to increase with age (Table 1, Figure 2). Conversely, variation in age for a given length tended to increase with length (Table 2, Figure 3). Growth variability is probably a normal characteristic of white sturgeon populations as noted in other studies, Cuerrier 1966, Semakula and Larkin 1968, and Kohlhorst, et al., 1980. Appendix Tables 1 and 2 give the frequencies of samples by lengths and ages. Tables 3 and 4 present previously unpublished data from the 1947-53 study in comparison with the 1980-83 study. Difficulty in aging sturgeon fin rays varied considerably, but tended to increase in difficulty with age. Some sturgeon appear to be inherently faster growing individuals while others display a slower growing pattern. Those fish identified as faster growing, based upon wider spacing between annuli, were easier to age. In contrast, slower growing fish or those with closely spaced annuli were more difficult to age due to the uncertainty of distinguishing individual annuli. As a result, there is probably some bias in aging accuracy between slow and fast growing individuals.

Sturgeon collected from 1980-83 study grew at an annual mean rate of 6.6 cm with a range of 2.1-14.0 cm between the ages of 1 and 21 years. The current tagging program suggests that lower Columbia River white sturgeon between 70 and 130 cm in length grow an average of about 10 cm per year (unpublished data).

No attempt was made during the study to sex fish for the purpose of comparing growth rates. Kohlhorst, et al., (1980) found no significant difference in growth rate between sexes in the Sacramento River.

White sturgeon enter the sport fishery at a minimum length of 91 cm and at a mean age of 9 years, the commercial fishery at a minimum length of 122 cm and at a mean age of 12 years, and leave both fisheries at a maximum length of 183 cm at a mean age of 20 years. The average sturgeon is susceptible to harvest for approximately 11 years.

A comparison of growth curves between 1947-53 and 1980-83 is given in Figure 4. The 1947-53 growth curve is steeper which would suggest that sturgeon are presently growing at a slower rate. The two studies show equally high correlations, but the 1947-53 study demonstrates less variability than the present study.

There are a number of possible causes for the differences exhibited between the two groups of data. The 1947-53 study involved a sample size nearly three times larger than the 1980-83 study and this would reduce the range of variability in the earlier study. In the process of converting the 1947-53 data from fork length to total length, for the purpose of comparison, some error may have been incorporated into the data. The author found the majority of his readings of the 1947-53 fins to be younger than the original readings which would indicate that some degree of discrepancy in aging methodology exists between the two studies.

Table 1. Mean Total Length and Range of Aged Lower Columbia River White Sturgeon, 1980-83

Age	n	Total Length (cm)	
		Mean	Range
0	1	21.0	--
1	29	35.5	24-46
2	28	40.2	32-50
3	18	46.0	32-58
4	32	57.8	42-76
5	46	63.4	50-82
6	42	71.1	48-89
7	53	79.8	50-111
8	40	85.3	67-106
9	63	96.5	59-130
10	83	105.8	61-144
11	129	112.6	64-161
12	150	126.5	74-169
13	119	128.6	84-168
14	100	136.9	96-175
15	101	144.1	90-185
16	59	152.6	94-185
17	51	159.0	125-182
18	47	161.5	113-185
19	28	168.2	138-185
20	33	167.0	133-185
21	19	171.5	137-186
22	8	166.5	146-179
23	7	169.8	159-183
24	6	181.8	176-188
25	6	177.1	165-188
26	2	191.5	177-206
27	4	181.7	173-196
28	3	181.3	176-185
29	1	232.0	--
30	3	208.3	185-244
31	1	292.0	--
32			
33			
34	1	274.0	--
35			
36			
37			
38			
39			
40	1	269.0	--
Total	1,314		

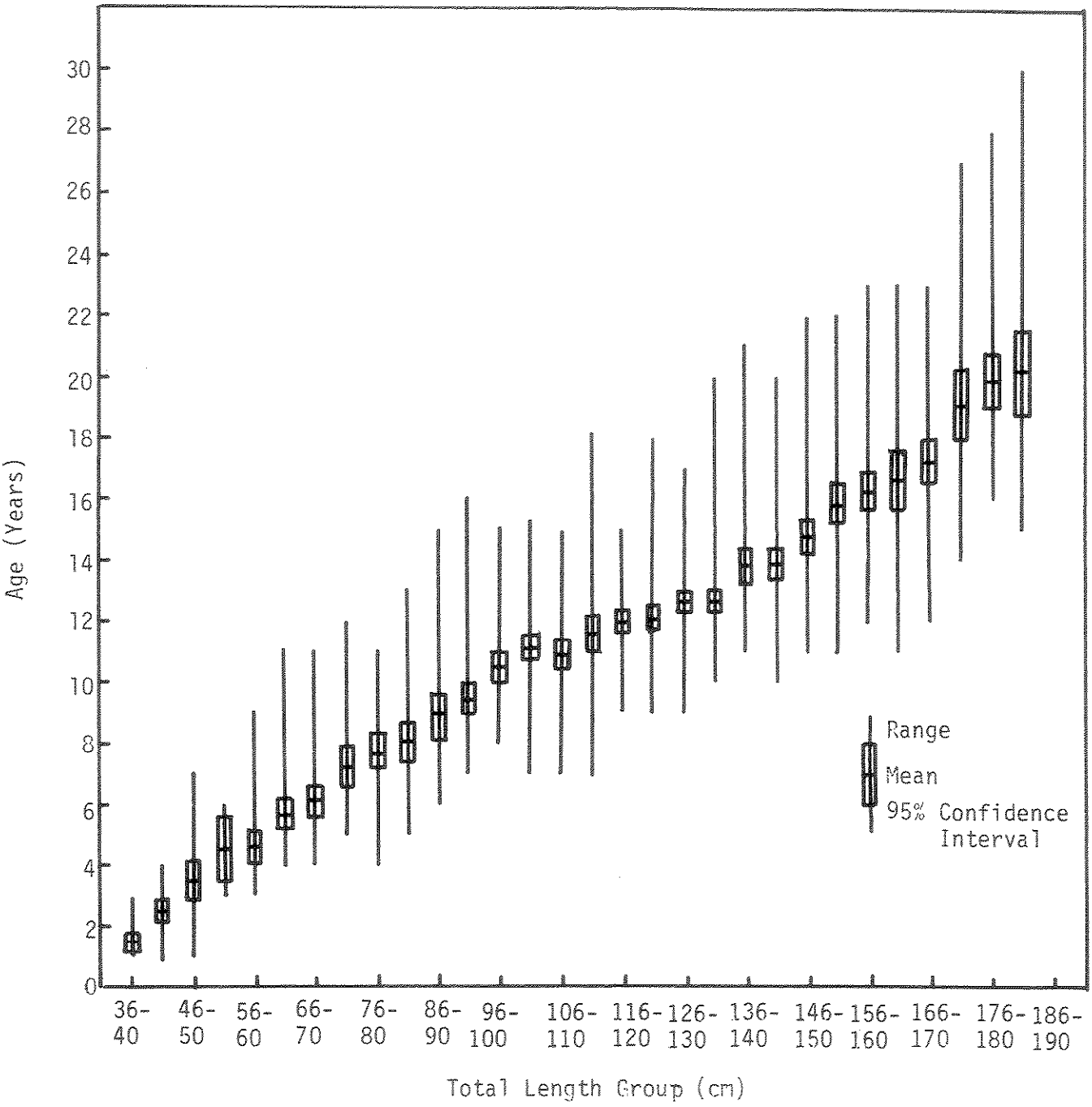

Figure 2. Length-Age Growth Curve for Lower Columbia River White Sturgeon, 1980-83

Table 2. Mean Age and Range of Measured Lower Columbia River White Sturgeon, 1980-83

Total Length (cm)	n	Age (Years) Mean	Range
21-25	2	0.5	0-1
26-30	3	1.0	--
31-35	15	1.5	1-3
36-40	25	1.6	1-3
41-45	18	2.5	1-4
46-50	23	3.5	1-7
51-55	7	4.6	3-6
56-60	24	4.6	3-9
61-65	33	5.7	4-11
66-70	39	6.1	4-11
71-75	29	7.2	5-12
76-80	36	7.8	4-11
81-85	31	8.1	5-13
86-90	32	8.9	6-15
91-95	48	9.5	7-16
96-100	45	10.5	8-15
101-105	49	11.2	7-15
106-110	44	11.0	7-15
111-115	43	11.7	7-18
116-120	53	12.0	9-15
121-125	84	12.2	9-18
126-130	82	12.7	9-17
131-135	72	12.7	10-20
136-140	57	13.9	11-21
141-145	56	13.9	10-20
146-150	53	14.8	11-22
151-155	51	15.9	11-22
156-160	60	16.3	12-23
161-165	40	16.7	11-23
166-170	43	17.3	12-23
171-175	34	19.1	14-27
176-180	40	19.9	16-28
181-185	32	20.3	15-30
186-190	3	23.3	21-25
196-200	2	28.5	27-30
206-210	1	26.0	--
231-235	1	29.0	--
236-240			
241-245	1	30.0	--
266-270	1	40.0	--
271-275	1	34.0	--
291-295	1	31.0	--
Total	1,314		

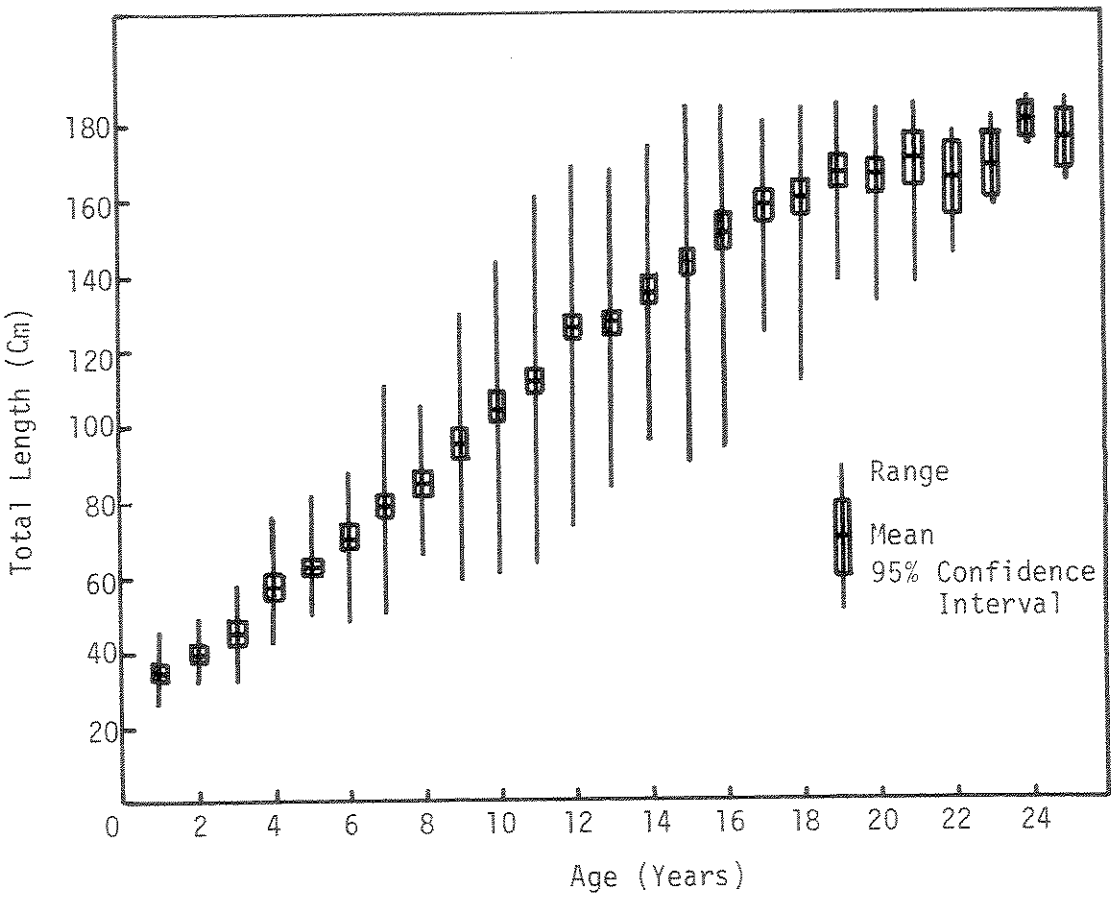

Figure 3. Age-Length Growth Curve for Lower Columbia River White Sturgeon, 1980-83

Table 3. Mean Total Length and Range of Aged Lower Columbia River White Sturgeon, 1947-53 and 1980-83

Age	n		Mean Total Length (cm)		Range (cm)	
	1980-83	1947-53	1980-83	1947-53	1980-83	1947-53
0	1		21.0		--	
1	29		35.5		24-46	
2	28	63	40.2	46.0	32-50	36-54
3	18	353	46.0	52.2	32-58	39-68
4	32	591	57.8	60.4	42-76	44-75
5	46	426	63.4	70.3	50-82	55-89
6	42	463	71.1	81.7	48-89	68-97
7	53	344	79.8	91.3	50-111	71-107
8	40	340	85.3	105.3	67-106	79-131
9	63	192	96.5	117.4	59-130	93-149
10	83	205	105.8	123.6	61-144	101-156
11	129	217	112.6	129.1	64-161	103-165
12	150	135	126.5	137.9	74-169	113-176
13	119	66	128.6	148.3	84-168	125-185
14	100	48	136.9	155.4	96-175	121-181
15	101	46	144.1	165.6	90-185	138-189
16	59	28	152.6	173.4	94-185	150-195
17	51	13	159.0	182.2	125-182	170-194
18	47	14	161.5	184.7	113-185	171-201
19	28	8	168.2	186.6	138-185	167-206
20	33	4	167.0	207.4	133-185	198-217
21	19	3	171.5	207.6	137-186	195-215
22	8	2	166.5	192.7	146-179	191-194
23	7	2	169.8	228.4	159-183	223-233
24	6	1	181.8	237.0	176-188	--
25	6	3	177.1	215.1	165-188	189-240
26	2		191.5		177-206	
27	4		181.7		173-196	
28	3		181.3		176-185	
29	1		232.0		--	
30	3		208.3		185-244	
31	1		292.0		--	
32						
33						
34	1		274.0		--	
35						
36						
37						
38						
39						
40	1		269.0		--	
Total	1,314	3,567				

Table 4. Mean Age and Range of Lower Columbia River White Sturgeon, 1947-53 and 1980-83

Total Length (cm)	n		Mean Age (Yrs)		Range (Yrs)	
	1980-83	1947-53	1980-83	1947-53	1980-83	1947-53
21-25	2		0.5		0-1	
26-30	3		1.0			
31-35	15		1.5		1-3	
36-40	25	5	1.6	2.2	1-3	2-3
41-45	18	45	2.5	2.4	1-4	2-4
46-50	23	147	3.5	2.8	1-7	2-4
51-55	7	288	4.6	3.3	3-6	2-5
56-60	24	221	4.6	3.8	3-9	3-5
61-65	33	321	5.7	4.1	4-11	3-5
66-70	39	204	6.1	4.8	4-11	3-6
71-75	29	248	7.2	5.2	5-12	4-7
76-80	36	156	7.8	5.9	4-11	5-8
81-85	31	212	8.1	6.1	5-13	5-8
86-90	32	204	8.9	6.5	6-15	5-8
91-95	48	145	9.5	7.1	7-16	6-9
96-100	45	146	10.5	7.6	8-15	6-9
101-105	49	97	11.2	7.9	7-15	7-11
106-110	44	117	11.0	8.2	7-15	7-11
111-115	43	106	11.7	8.9	7-18	8-12
116-120	53	156	12.0	9.5	9-15	8-12
121-125	84	193	12.2	10.2	9-18	8-14
126-130	82	97	12.7	10.7	9-17	8-13
131-135	72	102	12.7	11.0	10-20	8-13
136-140	57	52	13.9	11.5	11-21	9-15
141-145	56	62	13.9	11.9	10-20	9-15
146-150	53	57	14.8	12.6	11-22	9-16
151-155	51	20	15.9	13.6	11-22	12-16
156-160	60	41	16.3	13.4	12-23	10-15
161-165	40	13	16.7	14.5	11-23	11-16
166-170	43	27	17.3	16.8	12-23	14-19
171-175	34	18	19.1	15.4	14-27	12-18
176-180	40	19	19.9	16.4	16-28	12-19
181-185	32	16	20.3	16.0	15-30	13-18
186-190	3	9	23.3	18.0	21-25	15-25
191-195		8		19.1		16-22
196-200	2	3	28.5	19.0	27-30	18-20
201-205		2		19.0		18-20
206-210	1	1	26.0	19.0	--	--
211-215		4		21.7		20-25
216-220		1		20.0		--
221-225		1		23.0		--
226-230						
231-235	1	1	29.0	23.0	--	--
236-240		2		24.5		24-25
241-245	1		30.0		--	
266-270	1		40.0		--	
271-275	1		34.0		--	
291-295	1		31.0		--	
Total	1,314	3,567				

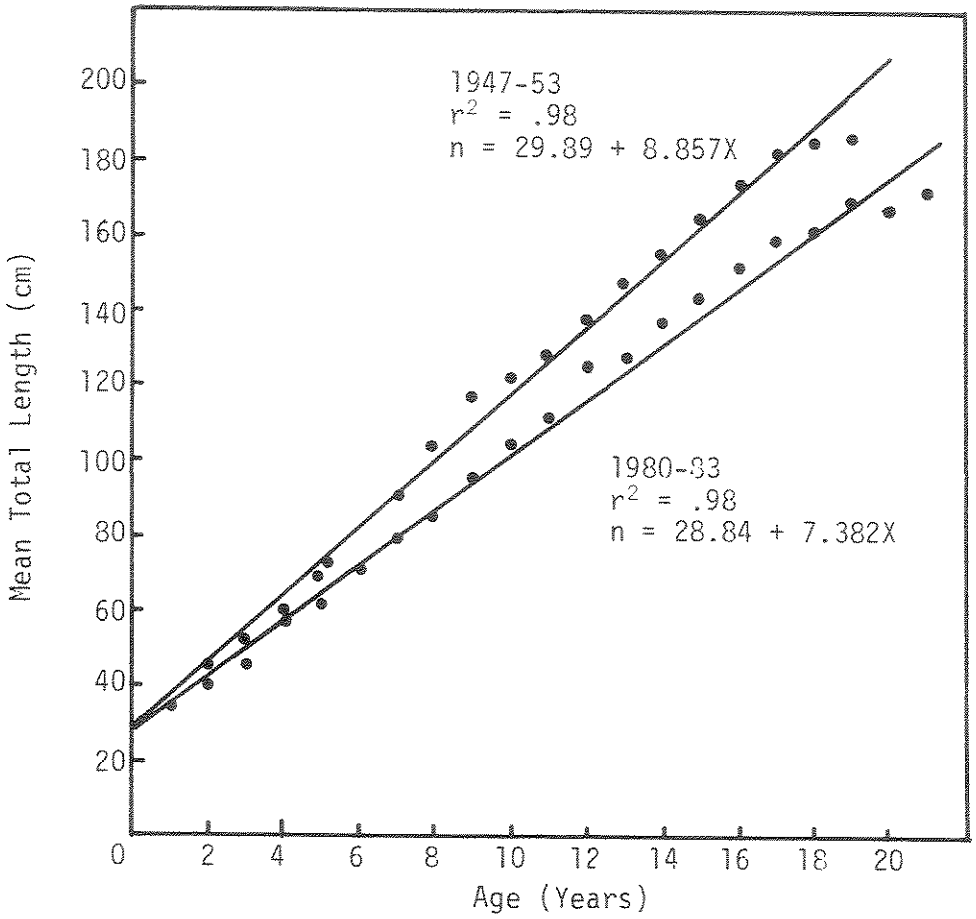

Figure 4. Linear Regression Relationships Between Age and Mean Total Length of Lower Columbia River White Sturgeon, 1947-53 and 1980-83

Lower Columbia River recreational and commercial catches of white sturgeon in recent years continue to increase, suggesting a healthy population. The sturgeon population may be reaching maximum sustained yield relative to habitat (ODFW/WDF 1983). Consequently, intraspecific competition for food may be limiting growth.

ACKNOWLEDGMENTS

I would like to thank personnel from Washington Department of Fisheries, National Marine Fisheries Service in Hammond OR, and Oregon Department of Fish and Wildlife for their important part in collecting the necessary samples. Steve King and Paul Hirose from Oregon Department of Fish and Wildlife provided considerable technical, reviewing, and editorial assistance. Joanne Hirose is responsible for word processing and Shirley McKinney for graphics.

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APPENDIX

Appendix Table 1. Age Frequency by Length of Lower Columbia River White Sturgeon, 1980-83

Age (Yrs)	Total Length (cm) 21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	76-80	81-85	86-90	91-95	96-100	101-105	106-110	111-115	116-120	121-125	126-130	131-135	136-140	141-145	146-150	151-155	156-160	161-165	166-170	171-175	176-180	181-185	186-190	191-195	196-200	201-295 1/	Total
0	1																																					1
1	1	3	9	13	2	1																																29
2			5	10	7	6																																28
3			1	2	7	4	1	3																														18
4					2	7	3	8	4	7		1																										32
5						3	1	11	15	8	6	1	1																									46
6						1	2	1	10	8	5	6	5	4																								42
7						1			1	10	9	9	8	6	6		1	1	1																			53
8										4	3	8	7	5	7	3	2	1																				40
9								1	1	1	2	6	3	6	12	10	3	6	2	4	4	2																63
10									1		1	1	3	5	9	12	10	13	8	3	8	5	3		1													83
11									1	1	2	4	2	3	11	9	15	6	13	13	19	11	7	3	3	3	2		1									129
12											1		1		1	7	7	7	8	13	22	23	22	14	9	5	2	5	2	1								150
13													1	2	1	1	5	7	5	10	16	17	14	12	12	7	3	2	3	1								119
14																1	4	3	2	7	9	13	10	8	10	10	7	5	6	2	3							100
15														1		2	2		2	3	3	7	11	7	14	11	10	12	4	7	2		3					101
16															1				1			3	3	8	2	5	9	10	3	6	2	3	3					59
17																					1	1	1	2	1	6	8	9	4	5	6	5	2					51
18																			1		2			1	3	4	3	7	5	7	3	5	6					47
19																								1			1	3	4	7	4	7	1					28
20																							1		1		4	3	6	3	4	7	4					33
21																								1		1	1	2		1	2	6	4	1				19
22																										1	1			2	3	1						8
23																												2	1	1	1		2					7
24																																2	3	1				6
25																													1		2	2		1				6
26																																1					1(206)	2
27																															2		1			1		4
28																																1	2					3
29																																				1	1(232)	1
30																																	1				1(244)	3
31																																					1(292)	1
32																																						
33																																						
34																																						
35																																					1(274)	1
36																																						
37																																						
38																																						
39																																					1(269)	1
Total	2	3	15	25	18	23	7	24	33	39	29	36	31	32	48	45	49	44	43	53	84	82	72	57	56	53	51	60	40	43	34	40	32	3		2	6	1,314

1/ In this category total lengths (cm) are listed in parentheses.

Appendix Table 2. Length Frequency by Age of Lower Columbia River White Sturgeon, 1980-83

Total Length (cm)	Age in Years																																	Total
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	40	
21-25	1	1																																			2
26-30		3																																			3
31-35		9	5	1																																	15
36-40		13	10	2																																	25
41-45		2	7	7	2																																18
46-50		1	6	4	7	3	1	1																													23
51-55				1	3	1	2																														7
56-60				3	8	11	1			1		1																									24
61-65					4	15	10	1		1	1	1																									33
66-70					7	8	8	10	4	1	1	1	1																								39
71-75						6	5	9	3	2	1	2	1																								29
76-80					1	1	6	9	8	6	1	4																									36
81-85						1	5	8	7	3	3	2	1	1																							31
86-90							4	6	5	6	5	3		2		1																					32
91-95								6	7	12	9	11	1	1			1																				48
96-100									3	10	12	9	7	1	1	2																					45
101-105								1	2	5	10	15	7	5	4	2																					49
106-110								1	1	6	13	6	7	7	3																						44
111-115								1		2	8	13	8	5	2	2	1		1																	43
116-120										4	3	13	13	10	7	3																					53
121-125										4	8	19	22	16	9	3		1	2																	84
126-130										2	5	11	23	17	13	7	3	1																		82
131-135											3	7	22	14	10	11	3	1			1															72
136-140												3	14	12	8	7	8	2	1	1		1														57
141-145											1	3	9	12	10	14	2	1	3		1															56
146-150												3	5	7	10	11	5	6	4			1	1													53
151-155												2	2	3	7	10	9	8	3	1	4	1	1													51
156-160													5	2	5	12	10	9	7	3	3	2		2												60
161-165												1	2	3	6	4	3	4	5	4	6			1												40
166-170													1	1	2	7	6	5	7	7	3	1	2	1												43
171-175															3	2	2	6	3	4	4	2	3	1		2		2								34
176-180																	3	5	5	7	7	6	1		2	2	1		1							40
181-185																3	3	2	6	1	4	4		2	3			1	2		1					32
186-190																						1			1	1										3
191-195																																					0
196-200																												1			1						2
201-205																																					0
206-210																											1										1
211-215																																					0
216-220																																					0
221-225																																					0
226-230																																					0
231-235																														1							1
236-240																																					0
241-245																															1						1
																																					0
266-270																																				1	1
271-275																																			1		1
																																					0
291-295																																1					1
Total	1	29	28	18	32	46	42	53	40	63	83	129	150	119	100	101	59	51	47	28	33	19	8	7	6	6	2	4	3	1	3	1			1	1	1,314