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Green Sturgeon Population Characteristics in Oregon

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ABSTRACT

During May through August 2003, we used gill nets, seine nets, and an underwater video camera to attempt to capture adult and sub-adult green sturgeon *Acipenser medirostris* and white sturgeon *Acipenser transmontanus* in the Umpqua River, Coos River, Coquille River, Siuslaw River, and Yaquina River, Oregon. We set 66 static gill nets for an average 1.0 h and captured no green sturgeon and 8 individual white sturgeon (114-181 cm FL). We deployed 17 seine nets for an average 0.1 h and captured no sturgeon. We deployed the underwater camera 21 times for 0.1–0.8 h and observed no sturgeon. Unmarked sturgeon were tagged with spaghetti and passive integrated transponder (PIT) tags.

Field staff from Oregon Department of Fish and Wildlife's Gold Beach office sampled green sturgeon in the Rogue River. Fifty unmarked green sturgeon (136-197 cm FL) were captured in gill nets and one unmarked green sturgeon was captured angling (147 cm FL). Forty-eight of the unmarked sturgeon were tagged with spaghetti tags and 47 were tagged with PIT tags. Of these, 5 were recaptured once and 1 was a recapture from the previous year. Thirty-five fish were radio tagged, sonic tagged, or both. One juvenile green sturgeon (17-cm TL) was captured during beach-seine sampling.

We interpreted ages of 27 green sturgeon from pectoral fin-spine sections collected by Oregon Department of Fish and Wildlife, Columbia River Management staff during Oregon coastal estuary sampling and estimated parameters of von Bertalanffy growth functions using these and previously collected data.

INTRODUCTION

Relatively little is known about the biology and life history of green sturgeon *Acipenser medirostris* and there is widespread concern and uncertainty regarding their status. Green sturgeon are classified as a species of special concern by the U.S. Fish and Wildlife Service and California Department of Fish and Game. The are classified as "rare" in Canada, but have no special status in Washington or Oregon. In June 2001, green sturgeon were petitioned for listing under the Endangered Species Act (EPIC 2001), and in December 2001, the National Marine Fisheries Service (now National Oceanic and Atmospheric Administration Fisheries) initiated a status review to determine if action is warranted (Federal Register 2001).

The harvest of green sturgeon in Oregon has been managed without the benefit of a comprehensive statewide investigation of population status. Most green sturgeon harvest occurs in the lower Columbia River, Oregon and Washington, and in Willapa Bay and Gray's Harbor, Washington.

In 1999, the Oregon Department of Fish and Wildlife (ODFW) initiated a multi-year project to increase the understanding of green sturgeon population characteristics, distribution, and status in Oregon. The specific objectives of the project are to:

1. Summarize and analyze existing information on green sturgeon.

2. Describe characteristics of adult populations in the Columbia, Umpqua, and Rogue rivers.

3. Describe spawning and recruitment in the Umpqua and Rogue rivers.

This report documents field activities performed on the Umpqua River, Coos River, Coquille River, Siuslaw River, and Yaquina River during spring and summer 2003 as we attempted to document presence outside of known and suspected spawning populations because of the possibility that this would be the last year of funding. We also report on green sturgeon and white sturgeon catches by Wildlife Conservation Society (WCS) from work to monitor adult sturgeon movement (Erickson et al. 2002) and by ODFW's Gold Beach office, during salmonid monitoring in the Rogue River (Weber 2003).

METHODS

Sampling Areas

We conducted field work on five Oregon rivers, the Umpqua, Coos, Siuslaw, Coquille, and Yaquina. In addition, WCS and ODFW, Gold Beach conducted sampling on the Rogue River.

The Umpqua River Basin is located in Douglas County in southwestern Oregon and flows from the Cascade Mountain crest to the Pacific Ocean at Reedsport, Oregon. The North and South Umpqua rivers and their tributaries combine to form the main stem Umpqua River northwest of Roseburg, Oregon. The drainages of the North and South Umpqua rivers together

make up about two-thirds of the greater basin drainage. The main stem Umpqua River flows in a northwesterly direction to the ocean. Together, the three rivers form one of the longest coastal basins in Oregon. The estuary of the Umpqua River has a large seawater wedge that extends inland 45 rkms (Johnson et al. 1994). Field sampling for green sturgeon and white sturgeon *A. transmontanus* was conducted in July and August 2003, using the underwater camera at rkm 14 (Figure 1a) and the underwater camera and beach seines at rkm 171 and 180 (Figure 1b). We targeted juvenile sturgeon in habitat similar to that in which a juvenile green sturgeon had been noted previously (Farr and Rien 2002).

The Coos River is located in Coos County in southwestern Oregon. The Coos River enters the Pacific Ocean at Coos Bay, Oregon. Major tributaries include the Millicoma River and the Williams River. Gill-net sampling for green sturgeon and white sturgeon was conducted in June and July 2003, between rkm 11 and 15, in Isthmus Slough, and at the mouth of the Millicoma River (Figure 2). We also used the underwater camera at the mouth of the Millicoma River. We gillnetted primarily in Isthmus Slough in areas that green sturgeon had been noted previously (Farr and Rien 2002).

The Siuslaw River Basin is located in Lane County in southwestern Oregon. The Siuslaw enters the Pacific Ocean near Florence, Oregon. The Siuslaw has two major tributary systems, the North Fork Siuslaw and Lake Creek. Field sampling for green sturgeon and white sturgeon was conducted in May and June 2003, with gill nets and seines between rkm 4 and 9 and with the underwater camera between rkm 13 and 19 (Figure 3).

The Coquille River is located in Coos County in southwestern Oregon. It is formed by the confluence of the North Fork Coquille and South Fork Coquille and enters the Pacific Ocean at Bandon, Oregon. Field sampling for green sturgeon and white sturgeon was conducted in June and July 2003, with gill nets and seines between rkm 9 and 15 (Figure 4). We gillnetted in areas that sturgeon had been noted previously by anglers.

The Yaquina River is located in Lincoln County in western Oregon. It enters the Pacific Ocean at Newport, Oregon. Field sampling for green sturgeon and white sturgeon was conducted in May and June 2003, with gill nets, seines, and the underwater camera between rkm 4 and 24 (Figure 5). We gillnetted in areas that sturgeon had been noted previously by anglers.

The Rogue River is located in Curry County in southwest Oregon. It enters the Pacific Ocean at Gold Beach, Oregon. Field sampling for green sturgeon and white sturgeon was conducted in May and June 2003, with gill nets and seines between rkm 8 and 39 (Figure 6).

Sampling Gear

Large-Mesh Experimental Gill nets

From May through August 2003, we sampled 3 weeks in 4 rivers. We deployed 66 gill nets in tidally influenced water (Table 1 and 2) to capture sub-adult and adult sturgeon. Nets were fished in suitable areas for up to 1.6 h. From May through October, field staff from ODFW's Gold Beach office sampled 3 weeks in the Rogue River. They deployed 51 gill nets. Nets were fished in suitable areas for up to 1.7 h. All nets were 3.0 m deep and 61.0 m long and were constructed of 23.5-cm stretched-measure multi-strand monofilament.

Beach Seine

From July through August 2003, we sampled 3 weeks in 4 rivers. We deployed 17 seine nets in both fresh and tidal influenced water (Table 1 and 2) to capture juvenile sturgeon. Seines were used at suitable sites where gradient and flow allowed. The seine was 45.7 m long and 2.4 m deep and constructed of 4.8-mm nylon mesh, with a weighted line at the bottom and a floating line at the top.

Underwater Video Camera

From July through August 2003, we sampled 3 weeks in 4 rivers. We deployed an underwater video camera (Table 1) to document juvenile sturgeon and to record habitat associated with juvenile sturgeon. We used an Atlantis AUW-525C Video Camera System attached to a Sony DCR-TRV240 Digital Camcorder[1]. The camera was either suspended from the boat while it was at anchor or was held at a position just off the bottom while the boat drifted with the current or tide.

Fish Processing

We identified fish to family and to species if possible. We measured fork length (FL) and total length (TL) to the nearest 1 cm for sturgeon and TL to the nearest 1 mm for juvenile salmonids. We examined all fish for tags and marks. Sturgeon were tagged with both a passive integrated transponder (PIT) tag and an external spaghetti tag. The second left lateral scute was removed to indicate the fish was implanted with a PIT tag (Rien et al. 1994) and the tenth left lateral scute was removed to indicate that the fish was handled in 2003. Tissue samples were taken from the pectoral fins and stored in ethyl alcohol for subsequent genetic analyses. No pectoral fin-spine sections were collected for age analysis during our regular sampling.

Angling

WCS conducted angling effort to capture sturgeon. We have no information about methods or effort.

Other Activities

Two experienced readers estimated ages for green sturgeon collected from Oregon coastal estuaries during 2003 (Morgan and Melcher 2003). Using techniques developed for white sturgeon (Rien and Beamesderfer 1994; Brennan and Cailliet 1989), we counted annular rings in pectoral-fin spine sections. These data were added to older data sets developed by various agencies and ODFW (Farr and Rien 2002).

We used nonlinear regression (SAS Institute 1988a and 1988b) to derive von Bertalanffy equations ($L_t = L_\infty\ (1-e^{-k\,(t\,-\,t_0)})$) to describe FL at age for green sturgeon. We standardized t_0 (the theoretical age at length 0) to the value estimated for all fish combined (Farr and Rien 2002).

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[1] The use of trade names does not constitute endorsement by the Oregon Department of Fish and Wildlife.

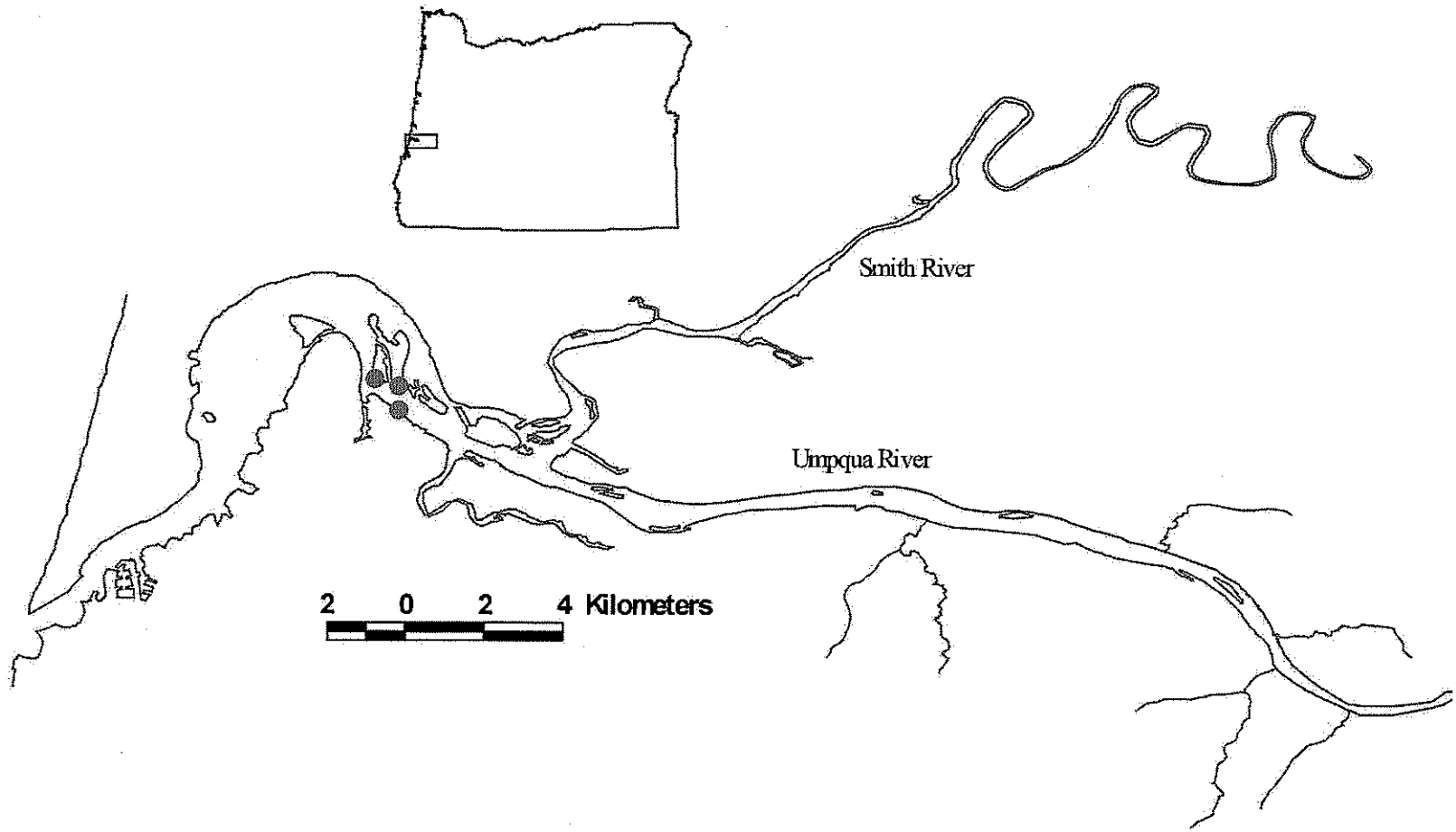

Figure 1a. Umpqua River Basin, Oregon. Circles are locations of underwater camera use.

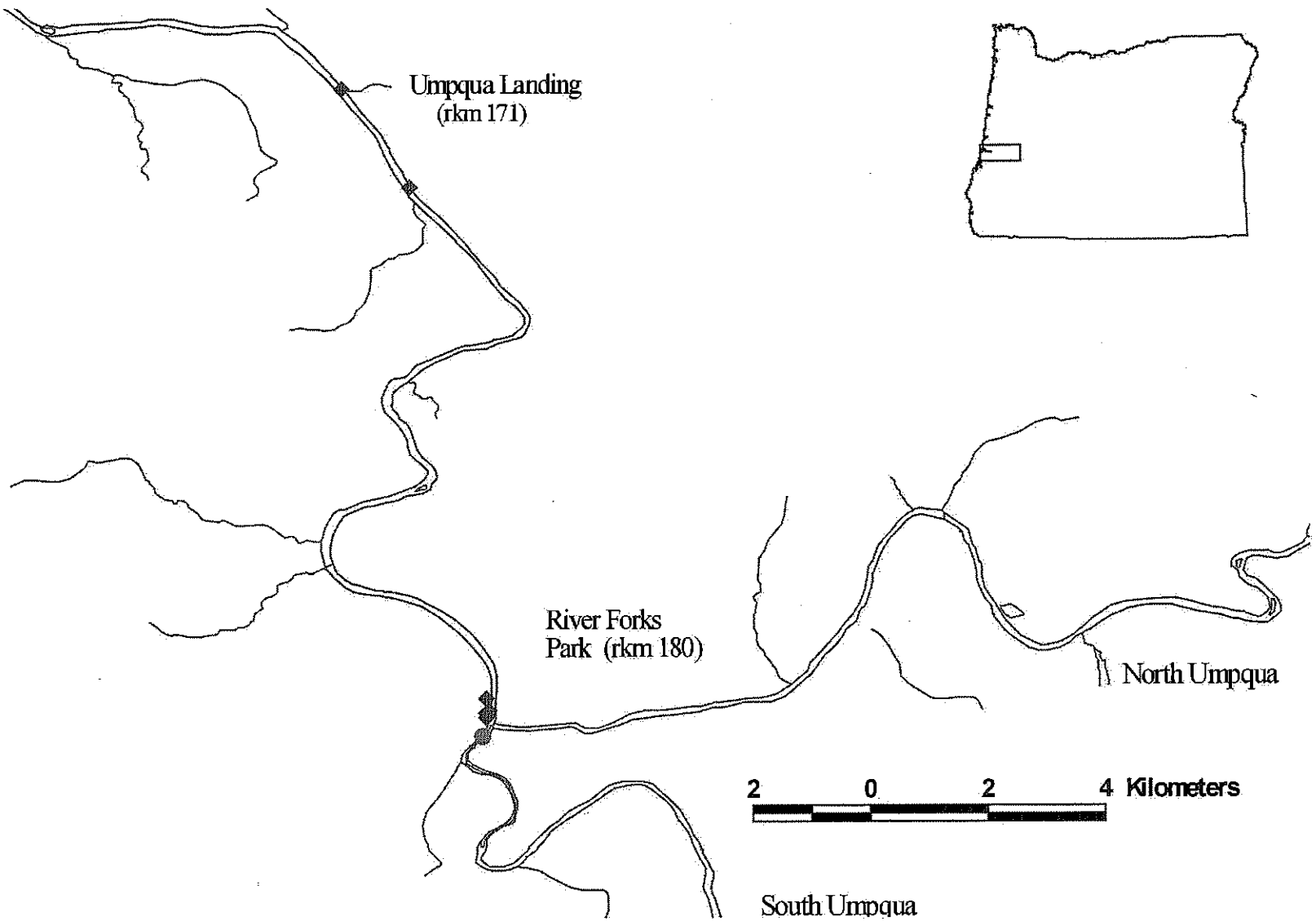

Figure 1b. Umpqua River Basin, Oregon. Diamonds are seine set locations. Circles are underwater camera set locations.

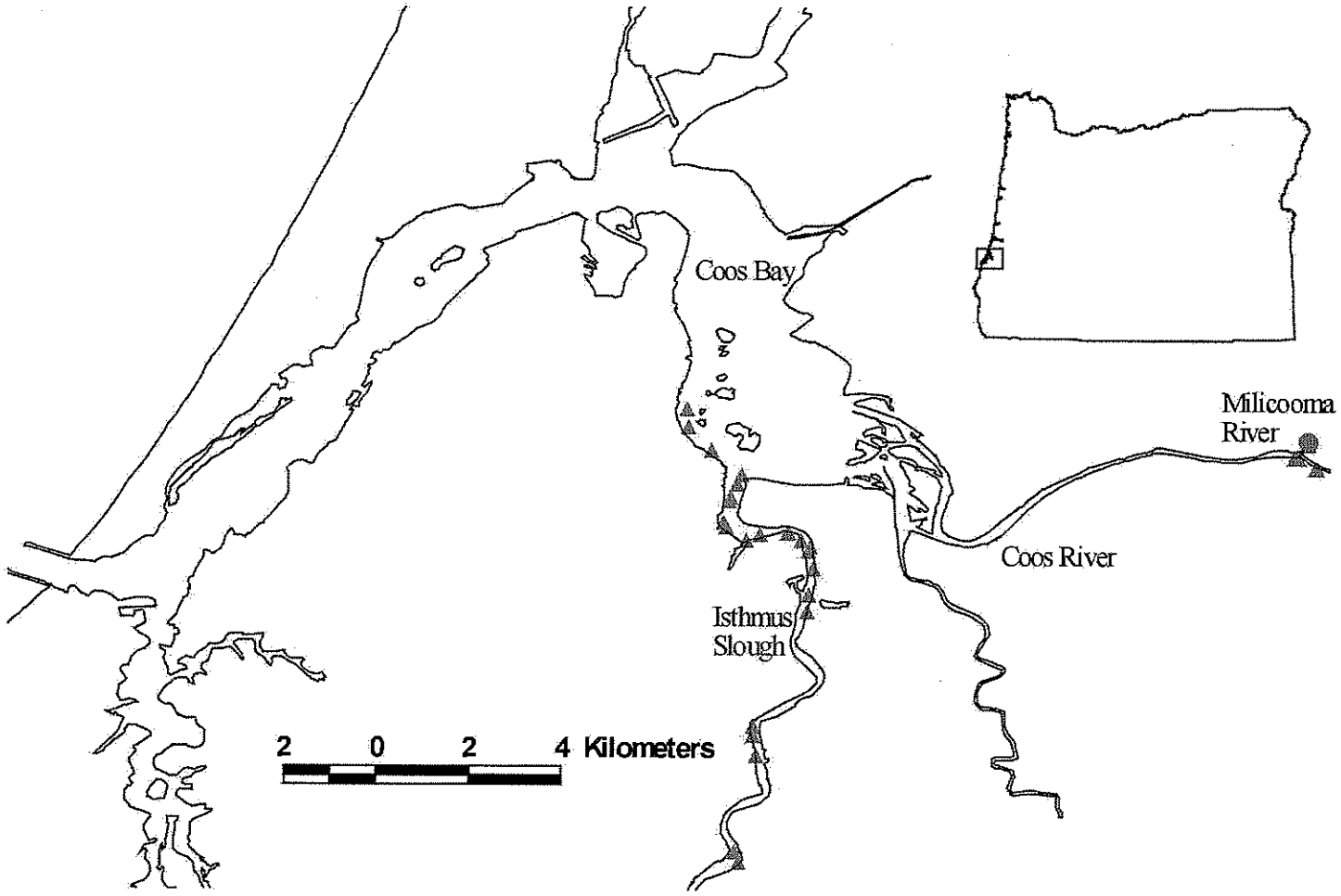

Figure 2. Coos River, Oregon. Triangles are gill-net set locations. Circle is underwater camera set location.

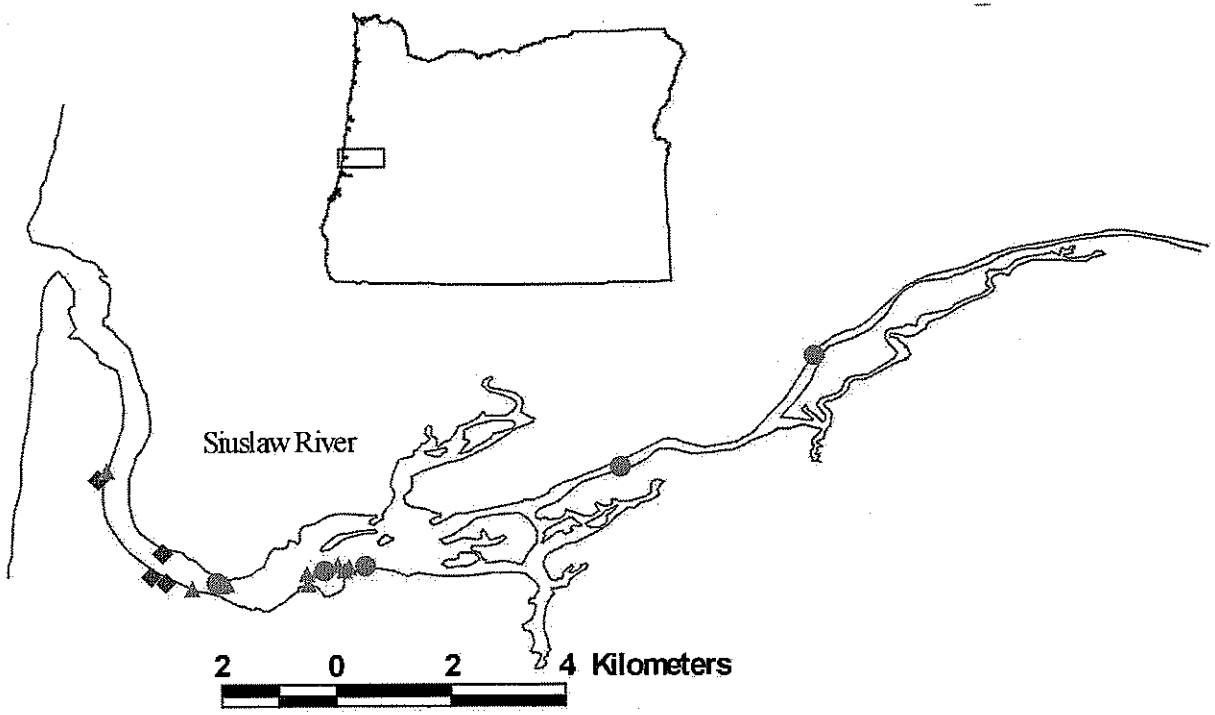

Figure 3. Siuslaw River, Oregon. Triangles are gill-net set locations. Diamonds are seine set locations. Circles are underwater camera set locations.

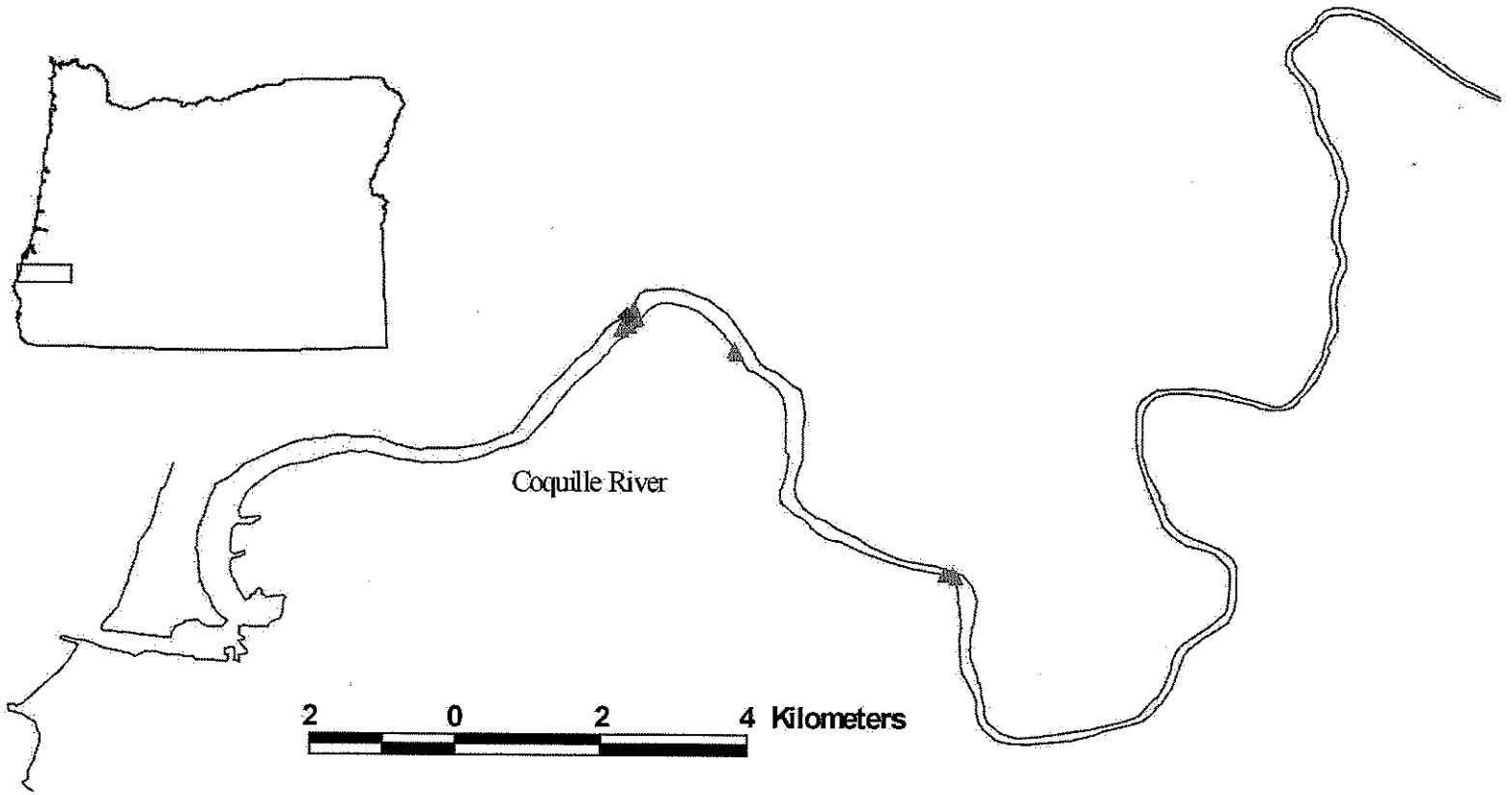

Figure 4. Coquille River, Oregon. Triangles are gill-net set locations. Diamonds are seine set locations.

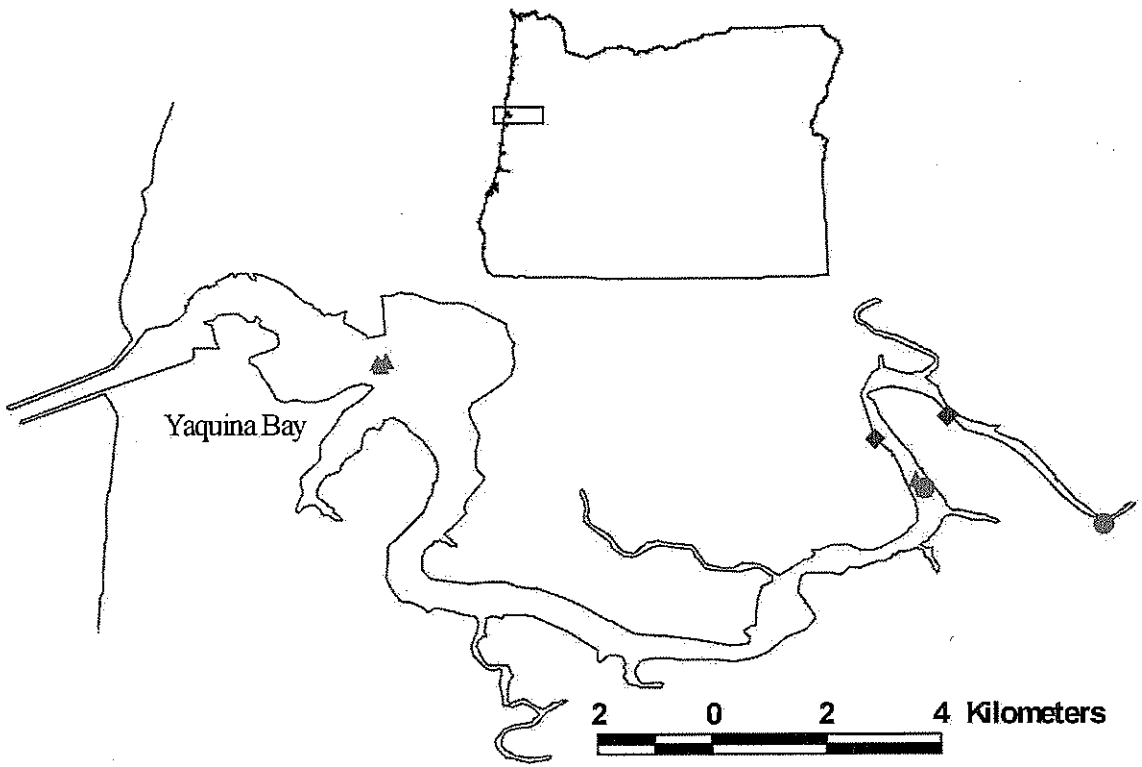

Figure 5. Yaquina River, Oregon. Triangles are gill-net set locations. Diamonds are seine set locations. Circles are underwater camera set locations.

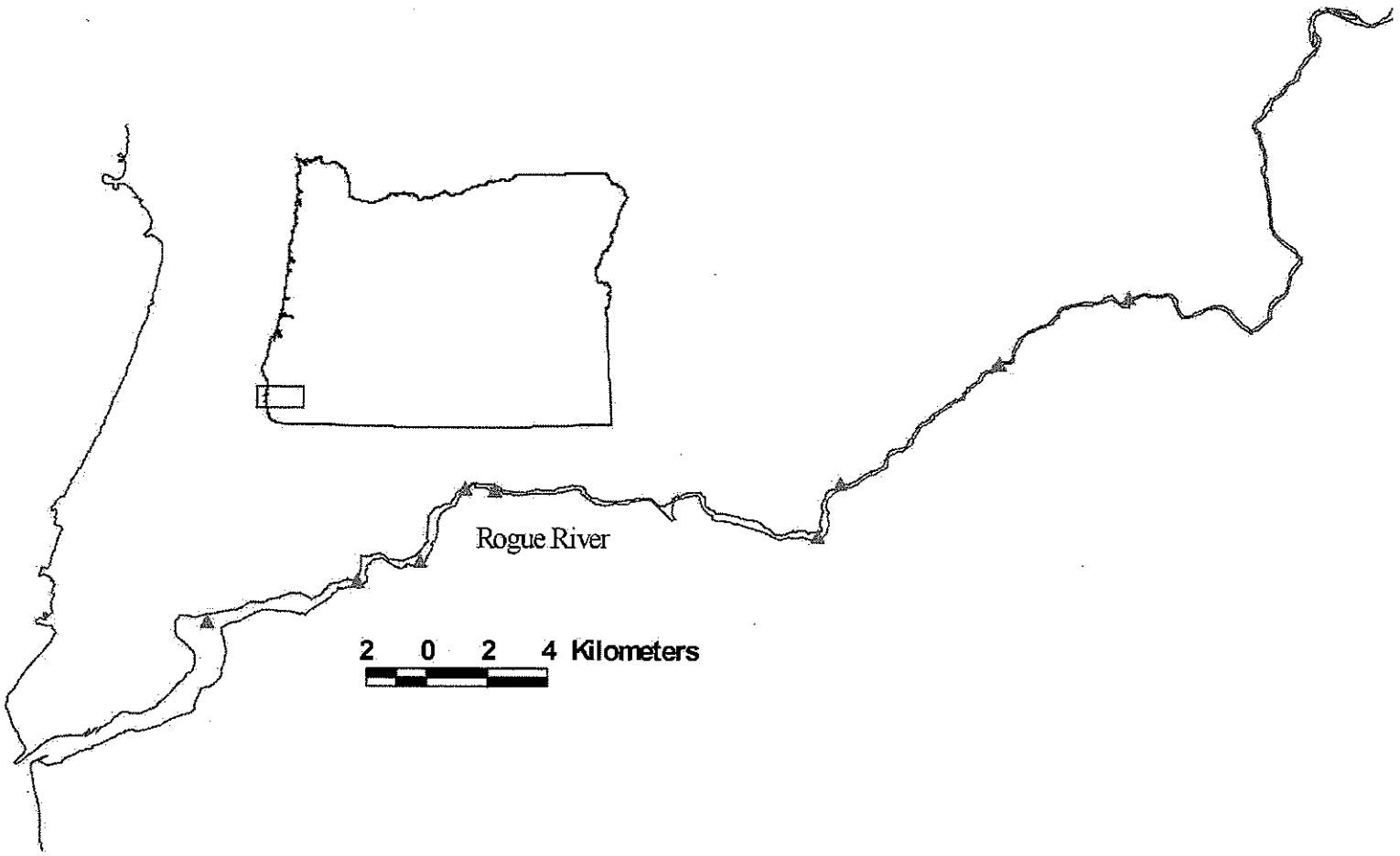

Figure 6. Rogue River, Oregon. Triangles are gill-net set locations.

Table 1. Schedule of effort for gears by water body and week, 2003. A dash (--) indicates no fishing effort.

	Gear		
	Gillnet Week (sets)	Seine Week (sets)	Camera Week (h:mm:ss)
Umpqua River	--	7/7 (10)	7/7 (1:50:59) 8/4 (0:53:17)
Coos River	6/23 (18) 7/21 (17)	--	7/21 (0:46:08)
Siuslaw River	5/26 (11)	8/4 (4)	8/4 (1:24:57)
Coquille River	6/23 (7) 7/21 (8)	7/21 (1)	--
Yaquina River	5/26 (5)	8/4 (2)	7/21 (0:11:30) 8/4 (0:26:51)
Rogue River	5/5 (13) 6/9 (3) 10/6 (35)	--	--

Table 2. Effort (hours) by gear and water body, 2003.

Gear / Water Body	Effort					
	Sets	Hours	Mean	Minimum	Maximum	STD
Gill net						
Coos River	34	34.22	1.01	0.63	1.55	0.12
Millicoma *	1	1.00	1.00	1.00	1.00	--
Siuslaw River	11	11.02	1.00	1.00	1.02	0.01
Coquille River	15	15.05	1.00	1.00	1.02	0.01
Yaquina River	5	5.05	1.01	1.00	1.03	0.01
Rogue River	51	41.97	0.82	0.25	1.73	0.29
Seine						
Umpqua River	10	1.52	0.15	0.07	0.25	0.06
Siuslaw River	4	0.48	0.12	0.10	0.13	0.05
Coquille River	1	0.15	0.15	0.15	0.15	--
Yaquina River	2	0.20	0.10	0.07	0.13	0.05

* The Millicoma is a tributary to the Coos River.

RESULTS

Field Sampling

We captured no sturgeon in the Umpqua, Siuslaw, Coquille, and Yaquina rivers (Table 3). We captured no green sturgeon and 7 individual adult white sturgeon using gill nets at the confluence of Coos and Millicoma rivers. We recaptured one white sturgeon the following day.

In the Rogue River, Gold Beach field staff (ODFW) captured 51 individual adult green sturgeon and 1 individual adult white sturgeon using gill nets (Table 3). They recaptured 3 green sturgeon within a day at the same location. They recaptured 2 green sturgeon 4 months later in the same location. These recaptures were not measured. They recaptured 1 green sturgeon that had been tagged outside the system in a previous year. It was originally tagged in the Umpqua River at rkm 16 in July 2002. They recaptured it in the Rogue River at rkm 14 in June 2003. It had not grown. One adult green sturgeon was captured by WCS while angling. One juvenile green sturgeon was captured by ODFW in a seine net during salmonid monitoring.

Other Activities

We assigned ages to 27 green sturgeon (42-cm to 88-cm FL; Tables 4-6). Growth curves were generated for male, female, and all fish aged. In addition, a growth curve was generated for

fish aged by ODFW since 2000 (Figure 7). All green sturgeon DNA samples collected are shared with genetics programs at University of California, Davis, and at the U. S. Fish and Wildlife Service laboratory in Ashland, Oregon (Table 7).

Table 3. Catch by gear and water body, 2003. A dash (--) indicates no fishing effort. Numbers in parentheses are mortalities.

	Water Body					
Gear Species	Coos River	Coquille River	Rogue River	Siuslaw River	Yaquina River	Umpqua River
Gill net						
Green sturgeon	0	0	56	0	0	--
White sturgeon	8	0	1	0	0	--
Seine						
American shad	--	0	--	0	4	0
Bullhead sp.	--	0	--	0	0	2
Chinook (juvenile)	--	3	--	20	0	5
Cottid sp.	--	0	--	4	15	1
Dace sp	--	0	--	0	0	46 (1)
Flounder sp.	--	2	--	8	0	0
Northern pikeminnow	--	0	--	0	0	97 (6)
Redside shiner	--	0	--	0	0	277 (19)
Shiner perch	--	52	--	26 (1)	4	0
Smallmouth bass	--	0	--	0	0	14
Steelhead smolt	--	0	--	0	0	2
Sucker sp	--	0	--	0	0	180 (9)
Three-spined stickleback	--	0	--	1	0	104

Table 4. Age frequency distribution for green sturgeon collected from Puget Sound, Columbia River, Yaquina Bay, Winchester Bay, Coos Bay, and Rogue River, 1949–2003. To clarify trends, this table is not zero-filled.

	Fork length interval (cm)													
Age	0-19	20-39	40-59	60-79	80-99	100-119	120-139	140-159	160-179	180-199	200-219	Mean length	STD	N
0	2	2										24.6	10.0	4
1														0
2		1										36.0		1
3			1	5	1							68.6	13.7	7
4				10	4							76.7	6.3	14
5				3	10							79.9	8.1	13
6				1	11							84.3	4.7	12
7				3	10	6						93.2	14.0	19
8				1	6	8	1					103.2	15.6	16
9						9	3					116.5	6.4	12
10					2	8	6					113.6	11.2	16
11					1	9	10					118.7	9.0	20
12						8	7					119.7	8.4	15
13						7	5	4				127.1	13.1	16
14					1	3	6	3				127.0	14.3	13
15						3	6	2				129.8	15.1	11
16						8	5	2	2			128.8	18.0	17
17						1	3	5	1			140.6	15.7	10
18						3	3	4	1			131.6	16.2	11
19							2	11	1			146.9	8.2	14
20							1	5	2			150.5	11.7	8
21							2	6	2	1		151.7	17.3	11
22								6	3	1		154.0	13.6	10
23							1	1	1			150.3	11.2	3
24								4	3			155.7	7.4	7
25							1	7	6			155.6	12.8	14
26									4	1		168.0	9.0	5
27								3	1			150.8	7.5	4
28								3	2	1		164.7	12.6	6
29							1	3	1			148.8	11.2	5
30								1				141.0		1
>30								4	9	5	1	171.3	16.3	19
All ages	2	3	1	23	46	73	63	74	39	9	1	124.1	32.3	334

Table 5. Age frequency distribution for male green sturgeon collected from Puget Sound, Columbia River, Yaquina Bay, Winchester Bay, Coos Bay, and Rogue River, 1949–2003. To clarify trends, this table is not zero-filled.

	Fork length interval (cm)													
Age	0-19	20-39	40-59	60-79	80-99	100-119	120-139	140-159	160-179	180-199	200-219	Mean length	STD	N
0														0
1														0
2														0
3														0
4														0
5														0
6														0
7														0
8					1	3	1					111.4	12.9	5
9							1					131.0		1
10						4	4					117.5	10.6	8
11					1	4	4					117.2	10.5	9
12						1	2					122.0	5.6	3
13						1	1	3				139.4	13.2	5
14							2	2				136.8	12.6	4
15							2	1				144.3	11.0	3
16							2	1				137.7	4.5	3
17						1	1	2	1			141.4	20.1	5
18							2	3				134.8	11.1	5
19								6	1			149.4	7.0	7
20								2	2			158.0	11.2	4
21								1				150.0		1
22									1			162.0		1
23														0
24								1	1			151.0	12.7	2
25							1	1	1			152.0	16.5	3
26														0
27								1	1			151.0	12.7	2
28								1				155.0		1
29														0
30								1				141.0		1
>30									1			165.0		1
All ages	0	0	0	0	2	14	23	26	9	0	0	135.6	18.3	74

Table 6. Age frequency distribution for female green sturgeon collected from Puget Sound, Columbia River, Yaquina Bay, Winchester Bay, Coos Bay, and Rogue River, 1949–2003. To clarify trends, this table is not zero-filled.

	Fork length interval (cm)													
Age	0-19	20-39	40-59	60-79	80-99	100-119	120-139	140-159	160-179	180-199	200-219	Mean length	STD	N
0														0
1														0
2														0
3														0
4														0
5														0
6														0
7						3						110.7	4.6	3
8						5						114.2	2.9	5
9						8	2					115.8	4.4	10
10					1	1	1					110.3	16.0	3
11							6					126.0	3.8	6
12							1					133.0		1
13							2	1				132.7	8.0	3
14							1					139.0		1
15							2	1				135.0	14.4	3
16						1			2			149.7	33.9	3
17								2				149.0	7.1	2
18									1			164.0		1
19								1				147.0		1
20														0
21								1	2			163.3	8.7	3
22									2			165.0	0.0	2
23														0
24								1				159.0		1
25									3			169.0	8.0	3
26									2			164.5	0.7	2
27								1				149.0		1
28									1			166.0		1
29									1			166.0		1
30														0
>30									2		1	178.0	20.9	3
All ages	0	0	0	0	1	18	15	8	16	0	1	137.5	24.3	59

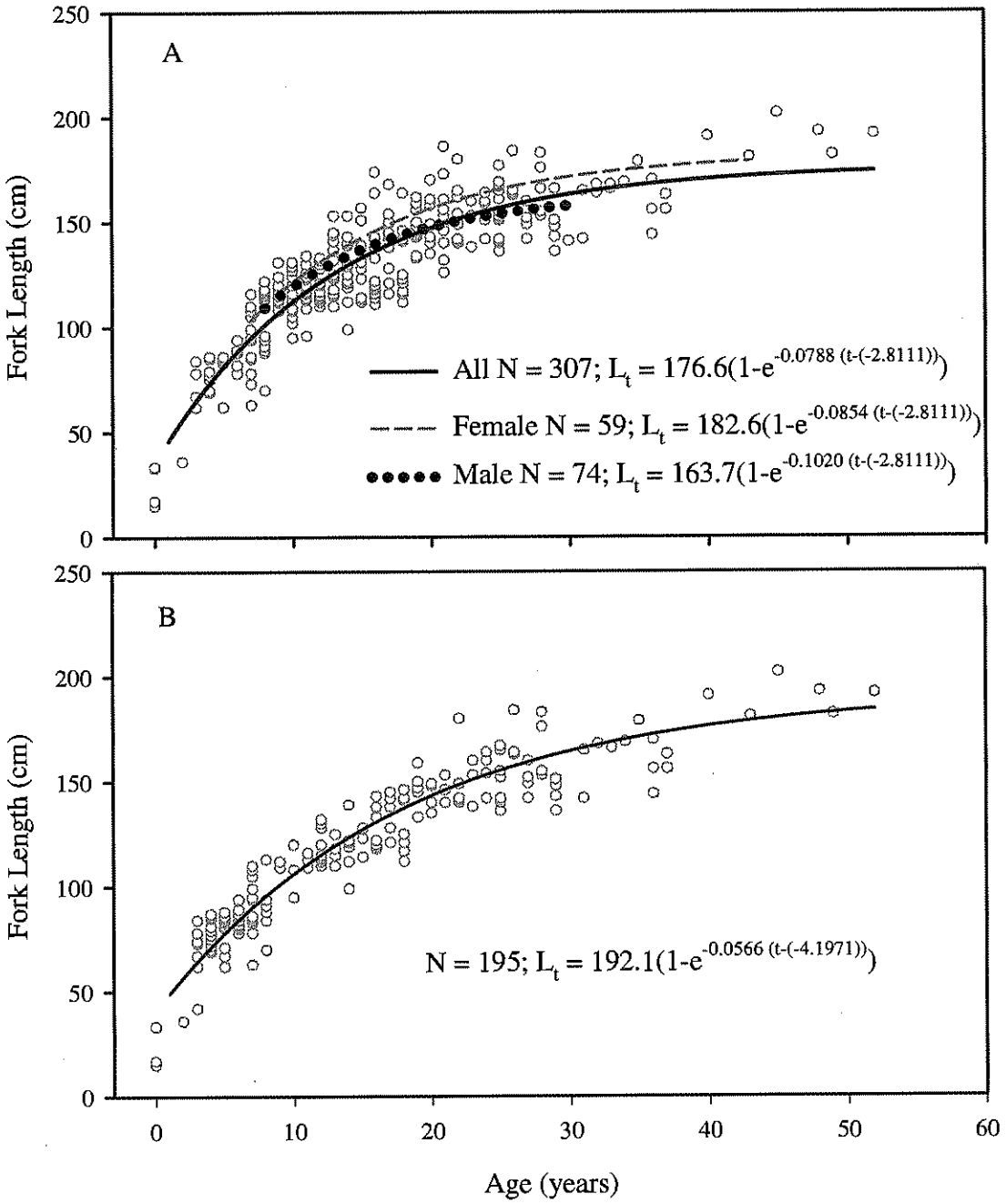

Figure 7. Von Bertalanffy growth curves for green sturgeon. (A) all aged fish (B) fish aged by ODFW. t = age (years); where L_t = FL (cm) at age t.

Table 7. Sumary of green sturgeon tissue samples collected by ODFW staff for genetic assay, 2000 - 2003.

Year	Green Sturgeon		Intermediate[a]
Location	Adult and Sub-adult	Juvenile	Adult
2000			
Coos Bay, OR	1		
Pacific Ocean off Newport, OR	4		
Rogue River, OR	66	10	
Tillamook Bay, OR	6		
Umpqua River, OR	106		
Yaquina Bay, OR	11		
2001			
Coos Bay, OR	8		
Lower Columbia River, OR	160		
Rogue River, OR	49	5	
Umpqua River, OR	20		
Yaquina Bay, OR	5		1
2002			
Coos Bay, OR	2		
Rogue River, OR	96		
Umpqua River, OR	57		
Yaquina Bay, OR	8		
2003			
Coos Bay, OR	1		
Rogue River, OR	36	1	
Tillamook Bay, OR	3		
Umpqua River, OR	31		
Sum	670	16	1
Minimum Total Length (mm)	380	135	1,060
Maximum Total Length (mm)	2,250	335	1,060

[a] This fish (most likely a green sturgeon) had morphological and meristic intermediate between white and green sturgeon.

DISCUSSION

This year's field sampling was directed at identifying coastal rivers that contain adult and sub-adult green sturgeon. We scheduled field work to coincide with expected juvenile movement calculated from juvenile green sturgeon catches in salmonid monitoring on the Rogue River. We didn't capture any adult, sub-adult, or juvenile green sturgeon outside of the Rogue River system. One possible explanation for the lack of green sturgeon catches may be that we dispersed effort too widely in multiple river systems.

The underwater camera shows promise as a tool to locate and observe juvenile sturgeon. We used it in a variety of water conditions and at various tide stages. We were able to identify many fish and invertebrate species that ranged widely in size. In clear water we were able to identify juvenile smallmouth bass *Micropterus dolomieu* as small as a 2-3 cm TL along with bluegill *Lepomis macrochirus*, American shad *Alosa sapidissima*, crayfish Astacideae, suckers *Catostomus spp.*, and sculpin *Cottus spp.* In running and slack tides, we identified adult salmonids *Oncorhynchus spp.*, herring *Clupea sp.*, bay pipefish *Syngnathus leptorhynchus*, Dungeness crab *Cancer magister*, sculpin, shiner perch *Cymatogaster aggregata*, and flounder *Platichthys spp.* We found the top of tide to be the best and the bottom of tide to be the most difficult for viewing in tidally influenced waters due to turbidity .

We were able to interpret ages of 27 green sturgeon from pectoral fin-spine sections. We urge caution in applying these results because of uncertainty with ageing techniques (Farr et al. 2001). Because of rapid growth in juveniles and a very small sample size for age-0 fish, the t_0 value appears unreasonably small. We believe more age-0 samples may change this value. The L_∞ also appears unreasonable as we have observed green sturgeon longer than 192-cm FL. Additional samples of large fish might allow a more realistic estimate of L_∞.

Plans for Next Year

Field sampling plans for 2004 will again emphasize effort to collect juvenile green sturgeon above tidal influence in the Umpqua River. We will use the underwater camera, beach seine, and a d-ring plankton sampler. We will also use gill nets to attempt to capture adult green sturgeon in the Coos River. We will work with local guides to collect stomach samples from harvested green sturgeon along the coast to collect information on diet. The ODFW Gold Beach office will conduct limited gillnetting to attempt to capture adult green sturgeon for sonic tag implantation by the Wildlife Conservation Society (WCS). The WCS will be working under a separate contract to monitor adult movements in the Rogue River.

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