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Final Summary Report:
Green Sturgeon Population Characteristics in Oregon

FINAL PROGRESS REPORT

FISH RESEARCH PROJECT
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JOB TITLE:	Green Sturgeon Population Characteristics In Oregon
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SUMMARY OF FINDINGS

Beginning in 2000, Oregon Department of Fish and Wildlife conducted field research in Oregon coastal streams to examine characteristics of green sturgeon populations in Oregon. This study began with field work in the Rogue River in 2000 and 2001, moved to the Umpqua River in 2002, and in 2003 and 2004 focused on sampling in the Coos, Coquille, Siuslaw, and Yaquina rivers. Samples from other projects were examined throughout the study from areas including the Columbia River estuary and Washington coastal systems.

The green sturgeon has long been known to be a highly migratory, transitory visitor to various Oregon Coast rivers. However, beyond sport and commercial fisheries harvest records, little is known about the characteristics of green sturgeon populations in general, and in Oregon in particular. This study was able to confirm some basic information regarding green sturgeon populations, and provide some new basic information as well.

We report on progress from 1 October 1999 – 30 September 2004 to describe characteristics of green sturgeon populations in Oregon. This report provides a summary of major findings and documents data sources we have assembled during this period.

Major activities conducted during this period include:

1. We sampled to capture or document presence of green sturgeon of all life stages in the Rogue, Umpqua, Coos, Coquille, Yaquina, and Siuslaw rivers.

    - We sampled during the Spring and Summer months from 2000 – 2004.
    - We sampled to capture or observe various life-stages of green sturgeon and white sturgeon using gill nets, setlines, angling, artificial substrates, a plankton net, beach seines, a screwtrap, snorkeling, smallmouth bass *Micropterus dolomieu* stomach contents, and an underwater video camera.
    - We set 720 gill nets for an average 0.9 h and captured 312 green sturgeon (94 – 204 cm FL) and 37 white sturgeon (113 - 187 cm FL).
    - We set 65 setlines for an average 25.3 h and captured no green sturgeon and one white sturgeon (146 cm FL).
    - We angled for sturgeon five times for an average 1.7 h and caught no sturgeon.
    - We set egg mat substrates 12 times for an average 59.9 h and observed no sturgeon eggs.
    - We set mop head egg substrates three times for an average 29.7 h and observed no sturgeon eggs.
    - We deployed a plankton net 74 times for an average 0.3 h and observed no sturgeon eggs.
    - We set 42 seine nets for an average 0.4 h and captured 26 green sturgeon (15 – 194 cm FL) and one white sturgeon (201 cm FL).
    - We deployed the screw trap 16 times for an average 23.3 h and observed no sturgeon.
    - We snorkeled eight times during daylight and observed no sturgeon.

- We angled eight times for an average 2.1 h sampling smallmouth bass and observed no sturgeon in bass stomach contents.
- We deployed the underwater camera 37 times for a total of 15.5 h and observed no sturgeon.
- Most adult and sub-adult unmarked sturgeon were tagged with spaghetti tags and passive integrated transponder (PIT) tags.

2. We assigned ages to pectoral fin spine samples collected from green sturgeon in the Rogue River and Umpqua River, as well as samples collected by other projects along the Pacific coast. (Farr and Rien 2002).

3. We captured green sturgeon in the Rogue and Umpqua rivers.

4. Results from sampling in the Rogue River include (Farr et al. 2001, Rien et al. 2000):

    - We captured 249 individual green sturgeon (15-204 cm FL). Fifty-seven of these were subsequently recaptured at least once. We captured green sturgeon up to river kilometer 105.
    - We found no sturgeon eggs or larvae, however, during radio tag implantation surgeries, we internally examined 76 green sturgeon adults. We found 6 of the 31 sampled females (19%) were ripe or spent, and 9 of the 34 males (26%) were ripe or spent. We were unable to determine the gender of 11 fish.

5. Results from sampling in the Umpqua River include (Farr and Rien 2002):

    - We captured 33 individual green sturgeon (113-192 cm FL). Two of these fish were subsequently recaptured at least once. We captured green sturgeon up to river kilometer 20.9. We found a newspaper article and photograph from 1979 referring to a 178-cm green sturgeon caught by an angler at river kilometer 164. We also have a sample of a juvenile green sturgeon (~10 cm FL) that was regurgitated by a smallmouth bass caught by an angler at river kilometer 134 in 2000.
    - We did not sample for eggs or larvae in the Umpqua River. We did not surgically examine any fish for stage of maturity.

Major findings of this project were:

1. We were able to document presence of juvenile green sturgeon and reproductive adult green sturgeon in the Rogue River. We have assembled some ancillary information suggesting the presence of juveniles in the Umpqua and Coos rivers (this report).

2. Adult green sturgeon were captured in the Columbia (commercial harvest sampling), Rogue, and Umpqua rivers (Farr and Rien 2003, Farr and Kern 2004).

3. Recoveries of tags applied during this study and concurrent studies confirm previous findings that green sturgeon are highly mobile as adults (this report).

4. In samples obtained from Columbia River commercial fisheries harvest for diet analysis, no green sturgeon had food items in their stomachs (Farr et al. 2001). This finding, combined with the fact that very few of these fish were classified as "mature" or "maturing", may raise the question of why adult green sturgeon are found in the Columbia River, if not for feeding or spawning.

5. Catch rate analyses from Columbia River fisheries indicate a slight, but non-significant increasing CPUE trend (Farr and Rien 2002). We have interpreted this to mean that catch rates were either stable, or slightly increasing over the period examined. Caution in interpreting this data is warranted, as most harvest of green sturgeon currently occurs during target fisheries for other species. Trends in harvest may be more dependent on management strategies initiated for other species than on green sturgeon abundance or strategies employed to manage green sturgeon populations.

6. We summarized (Rien et al. 2002) and updated (Appendix C, this report) Columbia River commercial fisheries samples collected from 1985-2001. Harvest of mature green sturgeon in these fisheries are rare, with 91% of harvested fish classified as immature when harvested. Only 2% of harvested fish were mature ("ripe" or within 3 years of spawning), and 7% were classified as "maturing" (developing gonads). Average fork length of mature female green sturgeon in commercial fisheries was about 159 cm. These samples of length-at-maturity likely underestimate mean length of maturity, because all samples come from a size-slot fishery, therefore mature fish over legal harvest size were not represented in these samples.

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. They 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 – NOAA Fisheries) initiated a status review to determine if action was warranted (Federal Register 2001). NOAA Fisheries decided that action was not warranted under the Endangered Species Act in June of 2002 (Adams et al. 2002). The Environmental Protection Information Center and the Center for Biological Diversity sued in April 2003 claiming the decision was "arbitrary and capricious". The District Court for Northern California ordered NOAA Fisheries to reconsider their finding that green sturgeon do not merit Endangered Species Protection in March 2004. The Biological Review Team issued a Green Sturgeon (Acipenser medirostris) Status Review Update in February 2005. In April 2005, after reviewing new and updated information on the status of green, a Proposed Rule to list the Southern DPS of green sturgeon as threatened under the ESA was published in the *Federal Register* (70 FR 17386). NOAA Fisheries reaffirmed its earlier finding that the Northern DPS does not warrant listing under the ESA at this time, but recommended that it remain on NOAA Fisheries Species of Concern List (69 FR 19975) due to remaining uncertainties about its status and threats.

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. Field sampling was initiated in the spring of 2000. 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 Columbia River, Rogue River, Umpqua River, Coos River system, Coquille River, Yaquina River, and Siuslaw River, Oregon during spring and summer 2000 - 2004 as we initiated the objectives and attempted to document presence outside of known and suspected spawning populations.

METHODS

Sampling Gear

Large-Mesh Experimental Gill Nets

Nets were 3.0 m deep and 61.0 m long and were constructed of 23.5-cm stretched-measure multi-strand monofilament (Tables 1-3). Nets were fished as static nets or drifted with tides in suitable areas for an average 0.9h.

Experimental Gill Net

The experimental gill net was 2.4 x 45.7 m and was constructed of six alternating 7.6 m panels of monofilament nylon mesh. Stretched mesh sizes were 3.2 and 5.1 cm (three panels each) (Tables 1-3). Net was constructed with a foam-core floating line at the top and a 3.4-kg/net sinking line at the bottom. We deployed the net close to and diagonal (≤ 45°) to shore. The net was fished for a total of 0.5 h

Setlines

Setlines consisted of 24 baited hooks along a 61-m mainline of 6-mm multi-strand nylon rope (Tables 1-3). Lines were marked with paint at 2.4-m intervals to aid in hook placement. We used 12/0, 14/0, and 16/0 circle hooks attached to hook clips with either #42 or #72 braided ganion line. Hooks were baited with pieces of Pacific lamprey *Lampetra tridentata*, Pacific herring *Clupea harengus*, northern anchovy *Engraulis mordax*, eulachon *Thaleichthys pacificus*, sand shrimp *Callianassa californiensis*, or pickled squid *Loligo spp.* Setlines were weighted with 9-14 kg pyramid-style anchors at each end in addition to several 0.5-2.3 kg weights interspersed along the line. One end was attached to shore with a leader rope to facilitate in recovery and to ensure gear was not lost. Lines were generally fished overnight for an average 25.3 h.

Angling

Limited sturgeon angling effort was made by ODFW staff (Tables 1-3), additional effort was contributed by several volunteers. The volunteer anglers were provided with sampling kits allowing them to measure, spaghetti tag, and collect genetic tissue samples from captured fish. Volunteer anglers recorded lateral scute counts to verify species identification.

Artificial Substrates

Egg mat substrates were constructed of 0.70-m^2 frames of angle iron that encased a sheet of latex-coated animal hair filter material (Tables 1 and 2). We deployed egg substrates for an average 59.9 h at sites immediately downstream of high velocity riffles where green sturgeon were suspected to spawn and in locations occupied by previously radio-tagged sturgeon. Substrates were attached to an anchor that was, in turn, attached to the shore via a weighted rope. Upon retrieval, we closely examined each substrate for the presence of eggs.

We set three mophead substrates (Van Eenennaam et al. 2001) for an average of 29.7 h (Tables 1 and 2) to capture sturgeon eggs. Substrates were constructed from five standard size

string-mop heads attached to snap hooks with hog rings. Substrates were spaced out on 23.6 – 35.4 m of rope depending on the width and length of the area sampled. Weights were spaced along the rope to keep it on the bottom. We deployed mop head substrates at sites immediately downstream of high velocity riffles where green sturgeon were suspected to spawn. Mop heads were collected into a 19-litre bucket and examined individually for eggs.

Plankton Nets

We used a D-shaped plankton net to capture sturgeon eggs and larva (Tables 1-3). The net frame was 0.8 m wide at the base and 0.5 m deep. Netting was 7.9 mesh/cm marquisette. Lead weights were attached to the base of the frame to hold the net on the river bottom. A mechanical flow meter (General Oceanics[1]) was suspended in the mouth of the net to estimate the volume of water sampled. We deployed the net from an anchored boat for an average 0.3 h immediately downstream of high velocity riffles where we believed green sturgeon could spawn or where larvae might be concentrated and transported by the current. The duration of deployment was contingent upon sediment and debris load. Upon retrieval, the contents of the collection cup were emptied into a white plastic tray and were examined for eggs and larvae.

Beach Seine

We employed 2 sizes of beach seines (Tables 1-3). The large seine was 47.2 m long by 5.7 m deep of 0.01-cm square mesh. The small seine was 45.7 m of 0.5-cm square mesh by 2.4 m deep. Seines were used at sites where gradient and flow allowed, during daylight hours.

Screw Trap

A standard 2.4-m rotary screw trap was anchored at the head of the glide behind an island for an average of 23.3 h a day (Tables 1-3). Site selection was based on avoiding boat traffic, not potential catch.

Snorkeling

We snorkeled in the evening before dark (Table 1). We usually teamed one person snorkeling in shallower water (approximately 5 m or less) with one person following in the boat using the underwater video camera in deeper water parallel to shore. Floats were downstream at or slightly faster than the river current.

Smallmouth Bass Stomach Contents

We angled for smallmouth bass to examine stomach contents for presence of juvenile sturgeon (Tables 1-3). We used spinning gear with lures or earthworms. We angled from late afternoon to shortly after dark. Stomachs were pumped immediately on most fish >19 cm FL and all fish were returned to the water. Stomach contents were identified to order and recorded. No stomach contents were preserved.

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

Underwater Video Camera

We deployed an underwater video camera (Tables 1 and 2) to document sturgeon and habitat associated with juvenile sturgeon. We used an Atlantis AUW-525C Video Camera System[1] attached to a Sony DCR-TRV240 Digital Camcorder[1]. The camera was suspended from the boat and held in position just off the bottom while the boat drifted with the current or tide. During low flows we paddled boat to maintain headway.

Fish Processing

We identified fish to family and to species if possible. We measured fork length (FL) for sturgeon and smallmouth bass. We examined all fish for tags and marks. Most 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 another lateral scute was removed to indicate the year the fish was handled (9^{th} right in 2000, 9^{th} left in 2001, 10^{th} right in 2002, 10^{th} left in 2003, and 11^{th} right in 2004). Pectoral fin-spine sections were collected from some sturgeon for age analyses. Unlike white sturgeon *A. transmontanus*, green sturgeon are prone to prolonged bleeding when fin spines are removed so not every fish was sampled. Tissue samples were taken from most sturgeon pectoral fins and stored in ethyl alcohol for subsequent genetic analyses. After processing, some fish were transfered to Wildlife Conservation Society (WCS) staff for radio tag implantation. When a radio tag was surgically implanted, a determination of sex and maturity (ripe or not ripe) was made. Fish were classified as ripe if there was running milt or engorged, soft testis in male fish and large, loose dark, olive-brown oocytes in female fish. In addition, some fish (including one recaptured radio tagged fish) were fitted with satellite archival pop-off tags by WCS.

Other Activities

Two experienced readers estimated ages for green sturgeon. 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 (Rien et al. 2000, Farr et al. 2001, Farr and Rien 2002, Farr and Rien 2003).

We used nonlinear regression (SAS Institute 1988a and 1988b) to derive von Bertalanffy equations to describe length at age for green sturgeon. We standardized t_0 (the theoretical age at length 0) to –2.4 (Farr and Rien 2002).

Some of the sturgeon captured in gill nets and setlines were outfitted with radio tags. Radio telemetry activities were performed in collaboration with WCS staff. The majority of tags were internally implanted in the abdominal cavity following methods outlined in North et al. (1995). Some tags were applied externally, ventral to the dorsal fin following methods outlined by Kappenman et al. (1999). Wildlife Conservation Society personnel performed the majority of the radio tracking activity (Erickson et al. 2001).

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

We obtained historical catch data of green sturgeon from ODFW field (Rien et al. 2000, Farr and Rien 2002, Appendix B)

We sampled green sturgeon caught near Astoria in the Columbia River commercial gill-net fishery. Fish were sampled for length, weight, sex, maturity, tissue for genetic studies. A sub-sample were sampled for morphometrics and meristics. The digestive tracts from some of the fish were frozen and later visually examined to determine food items. The digestive tract was partially thawed and opened lengthwise with a knife. No microscopic examination was done. One digestive tract of a Rogue River green sturgeon was also examined (Rien et al. 2000, Farr et al. 2001, North et al. 2002).

The 4th International Sturgeon Symposium was held in Oshkosh, Wisconsin, 8-12 July 2001. We presented a poster entitled "Morphometric measurements and meristic count comparisons for North American and Asian forms of green sturgeon *Acipencer medirostris*" and made an oral presentation entitled "Green Sturgeon *Acipenser medirostris* Fisheries in the Eastern Pacific: Are Harvest Rates Sustainable?" which synthesized current knowledge of population characteristics to describe potential production of green sturgeon and relate it to current Columbia River harvest.

Ripe egg samples collected while implanting radio tags were sent to the University of California at Davis by WCS to measure the germinal vesicle position to determine the oocyte polarization index (PI). Two of these samples were collected in 2001 and one sample was collected in 2000 (Farr et al. 2001).

We attempted to use gastric levage on three commercially caught green sturgeon to assess the viability of pumping the stomachs of live fish to determine food habits. We also tested the viability of using a arthroscope to identify the sex of live fish in the field to avoid using surgical procedures (Farr et al. 2001).

Table 1. Gears used in Oregon south coast river systems by year. 2000 – 2004.

	Year				
Gear	2000	2001	2002	2003	2004
Large-mesh experimental gill net	Rogue	Rogue	Rogue Umpqua	Rogue Coos Siuslaw Yaquina Coquille	Rogue Coos
Experimental gill net					Umpqua
Setlines	Rogue	Rogue		Rogue	
Angling	Rogue				
Artificial substrates					
Egg mats	Rogue	Rogue			
Mop heads		Rogue			
Plankton nets	Rogue	Rogue			
Large Beach Seine	Rogue	Rogue	Rogue	Rogue	Rogue
Small Beach Seine				Siuslaw Umpqua Yaquina Coquille	Umpqua
Screw trap		Rogue			
Snorkeling					Umpqua
Smallmouth bass stomach contents					Umpqua
Underwater video camera				Coos Siuslaw Umpqua Yaquina	Coos Umpqua

Table 2. Number of times sampling gears were deployed (effort in hours) in Oregon south coast river systems, 2000 – 2004.

Gear	Rogue	Umpqua	Coos	Coquille	Yaquina	Siuslaw
Large-mesh experimental gill net	447 (378.1)	149 (142.7)	92 (92.1)	15 (15.1)	5 (5.1)	11 (11.02)
Experimental gill net		1 (0.5)				
Setlines	65 (1,643)					
Angling	5 (8.7)					
Artificial substrates						
Egg mats	12 (719.1)					
Mop heads	3 (89.2)					
Plankton nets	74 (22.9)					
Beach seine						
Large	24 (15.0)					
Small		11 (1.9)		1 (0.2)	2 (0.2)	4 (0.5)
Screw trap	16 (372)					
Smallmouth bass stomach contents		8 (16.8)				
Underwater video camera		24 (10.5)	3 (1.3)		4 (0.6)	6 (1.4)

Table 3. Catch composition by gear type (mortalities in parentheses) in Oregon south coast river systems, 2000 –2004.

	Angling	Gillnet	Large Seine	Small Seine	Plankton Net	Set Line	Screw Trap
Lamprey ammocoetes							5 (1)
American shad				4			
Bullhead sp.				2			
Chinook		35 (5)	585	28			67
Cottid sp.			64	20	1	(1)	4
Crayfish sp.			1	4	(1)		2
Dace sp.				46 (1)			
Flounder sp.				10			
Green sturgeon	3	312 (3)[a]	6 (2)	20			
Northern pikeminnow			1,114	152 (9)		2	
Redside shiner			1,275	376 (25)	2		
Shiner perch				82			
Smallmouth bass	33 (2)			19 (1)			
Steelhead				2			
Striped bass		1					
Sucker sp.		8	16	181 (9)			
Threespined stickleback			1,613	105	17		15,000[b]
White sturgeon	1	37	1			1	

[a] One gillnet mortality and two juveniles sacrificed.

[b] Numbers were sometimes estimated when catch was high.

Sampling Areas

Rivers were chosen based on existing data of green sturgeon catches and anecdotal information gathered from fishing guides and sport anglers. The amount of time spent in each system was dictated by the length of our field season and not all potential rivers systems were investigated.

Rogue River

The Rogue River terminates in Curry County in southwest Oregon. It enters the Pacific Ocean at Gold Beach, Oregon. Field sampling was conducted between rkm 0.9 and 78.7 (Figures 1 and 2).

Umpqua River

The Umpqua River Basin terminates 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. The drainages of the North and South Umpqua rivers together make up about two-thirds of the greater basin drainage. Together, the North, South and main stem 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 was conducted from rkm 6.1 to 45.4 and 154 to 207.1 (Figures 3 and 4). We targeted habitat similar to the area in which a juvenile green sturgeon was recovered from a smallmouth bass stomach (Farr and Rien 2002).

Coos River

The Coos River terminates 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. Field sampling was conducted in Coos Bay between rkm 14 and 24, in Isthmus Slough from the mouth to Davis Slough, Millicoma River between rkm 0 and 5, and the South Coos River between rkm 0 and 11 (Figure 5). We gillnetted in Isthmus Slough in areas where green sturgeon catches had been noted in historical sampling data obtained from the ODFW Charleston office (Farr and Rien 2002).

Coquille River

The Coquille River terminates 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 6). We gillnetted in areas where sturgeon had been noted by anglers.

Yaquina River

The Yaquina River terminates in Lincoln County in western Oregon. It enters the Pacific Ocean at Newport, Oregon. Field sampling was conducted between rkm 4 and 24 (Figure 7). We gillnetted in areas where sturgeon had been noted by anglers.

Siuslaw River

The Siuslaw River Basin terminates in Lane County in southwestern Oregon. The Siuslaw enters the Pacific Ocean near Florence, Oregon. The Siuslaw has two major tributaries, the North Fork Siuslaw and Lake Creek. Field sampling was conducted between rkm 4 and 19 (Figure 8).

Figure 1. Rogue River, Oregon adult sampling locations. Triangles are gillneting locations. Diamonds are beach seining locations. Arrows are setlining locations. Green fish are green sturgeon capture locations. Gray fish are white sturgeon capture locations.

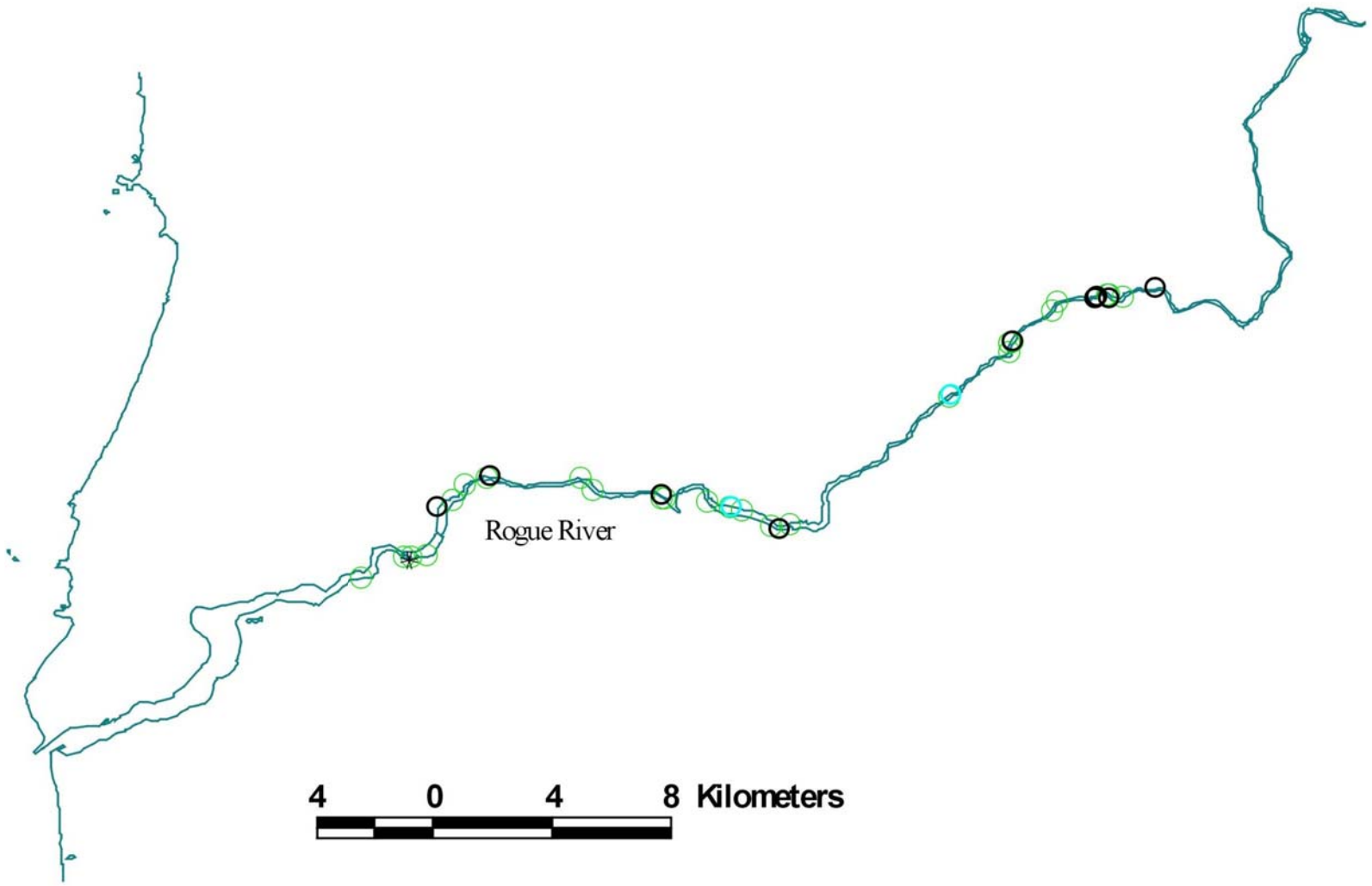

Figure 2. Rogue River, Oregon juvenile and egg sampling locations. Asterisk is the screw trap location. Light blue circles are mop-head substrate locations. Black circles are egg mat locations. Green circles are d-ring plankton net locations.

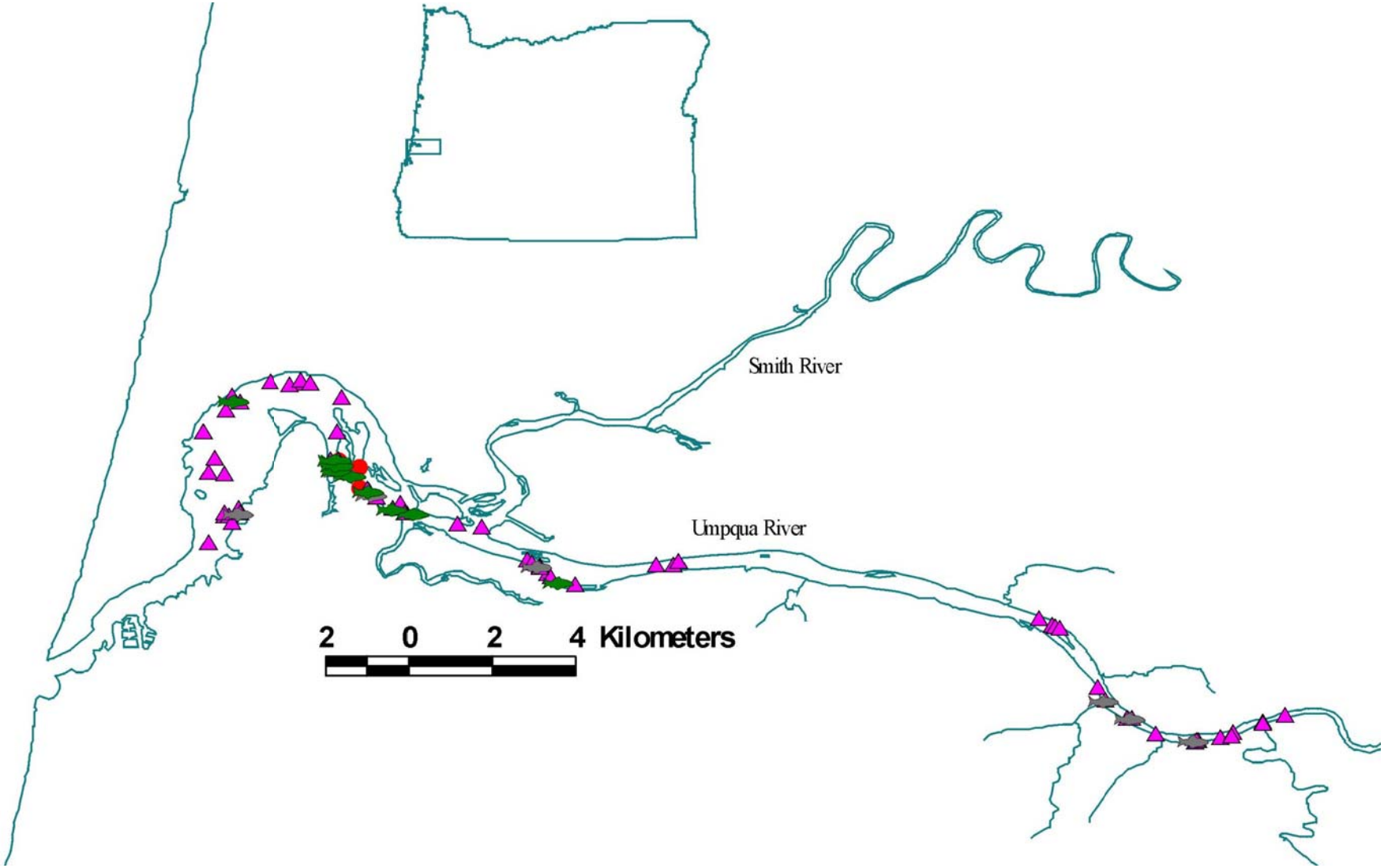

Figure 3. Lower Umpqua River, Oregon sampling locations. Triangles are gillnetting locations. Circles are underwater camera locations. Green fish are green sturgeon capture locations. Gray fish are white sturgeon capture locations.

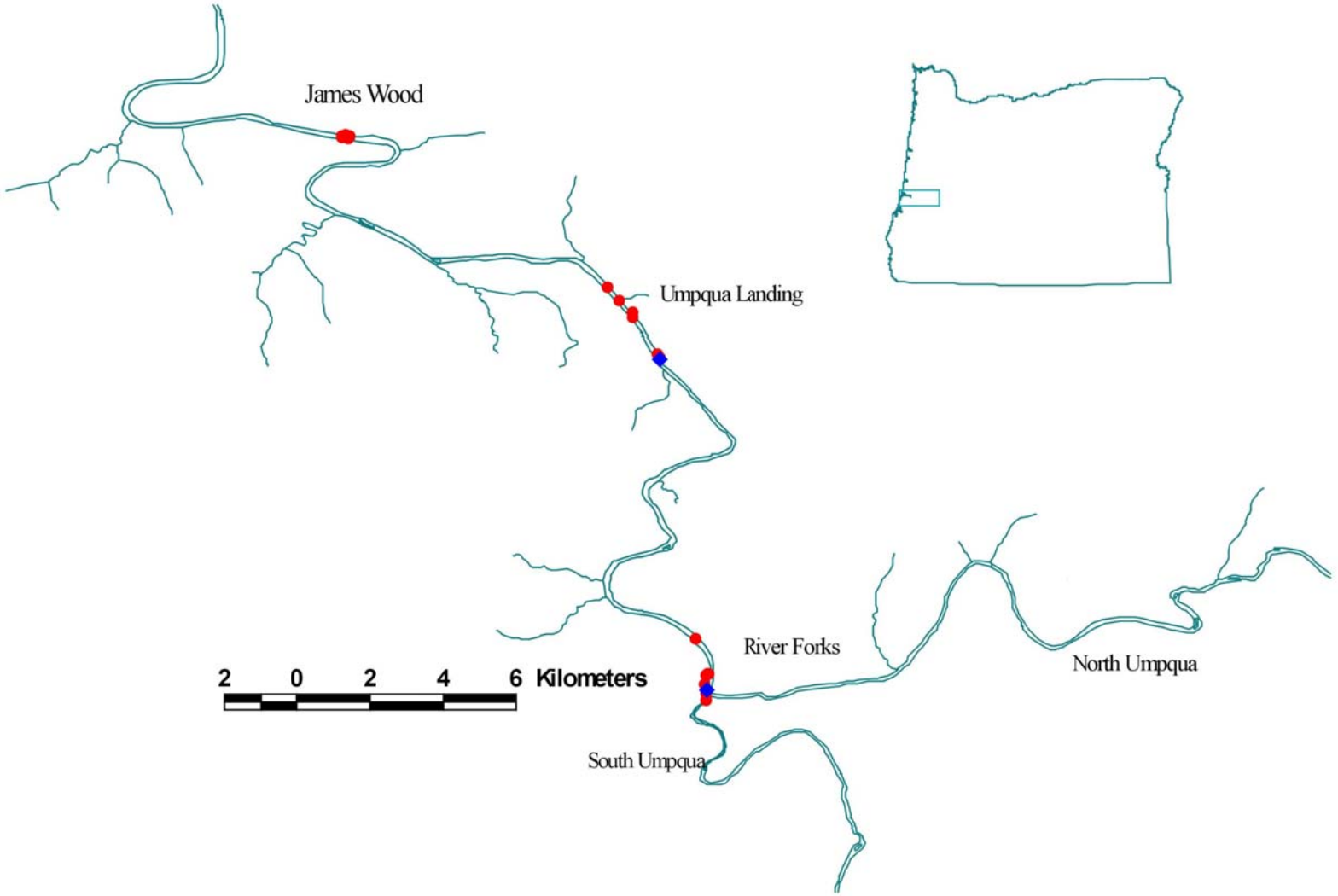

Figure 4. Upper Umpqua River, Oregon sampling locations. Diamonds are seining locations. Circles are underwater camera locations.

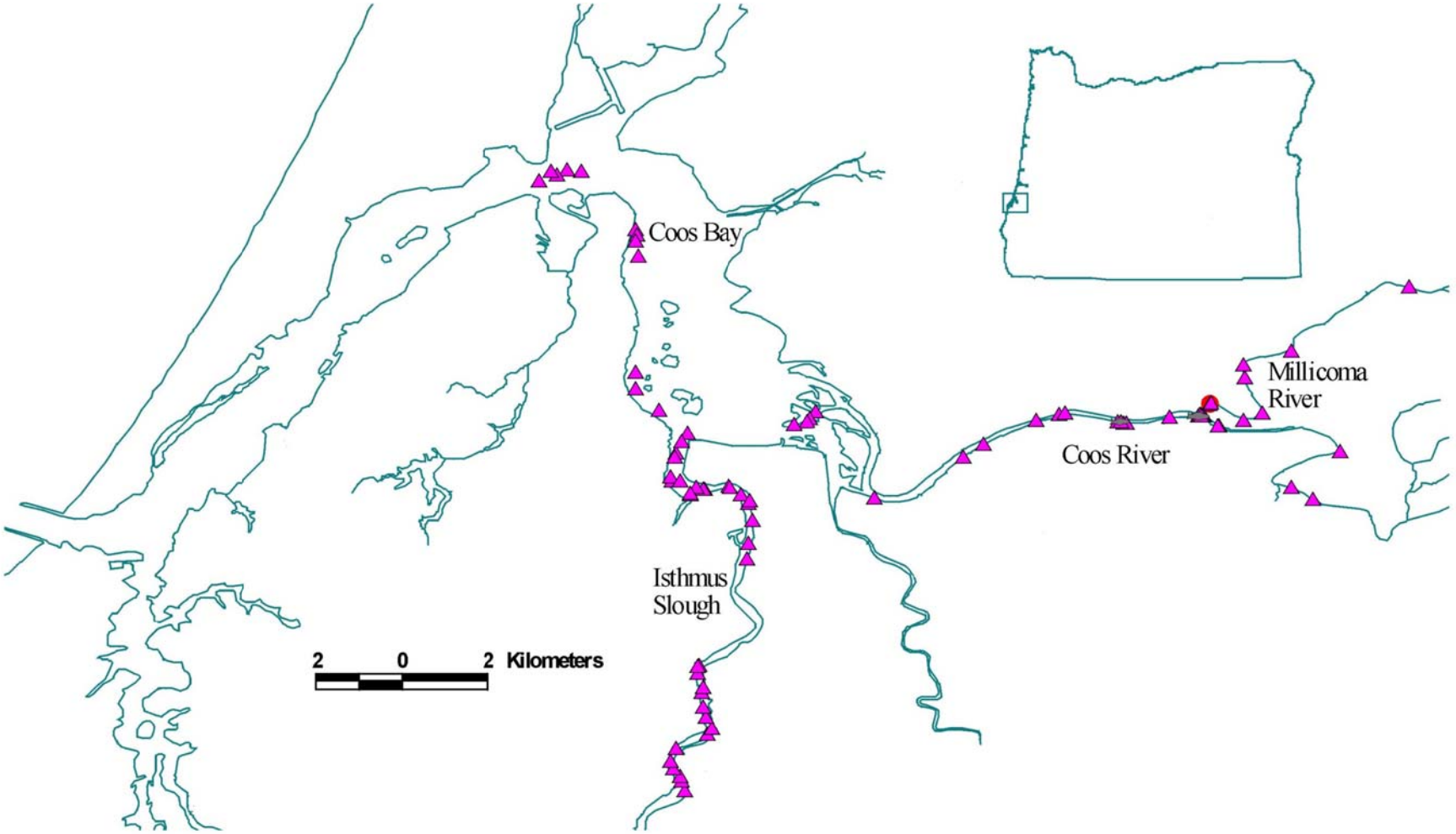

Figure 5. Coos River, Oregon sampling locations. Triangles are gillnetting locations. Circles are underwater camera locations. Gray fish are white sturgeon capture locations.

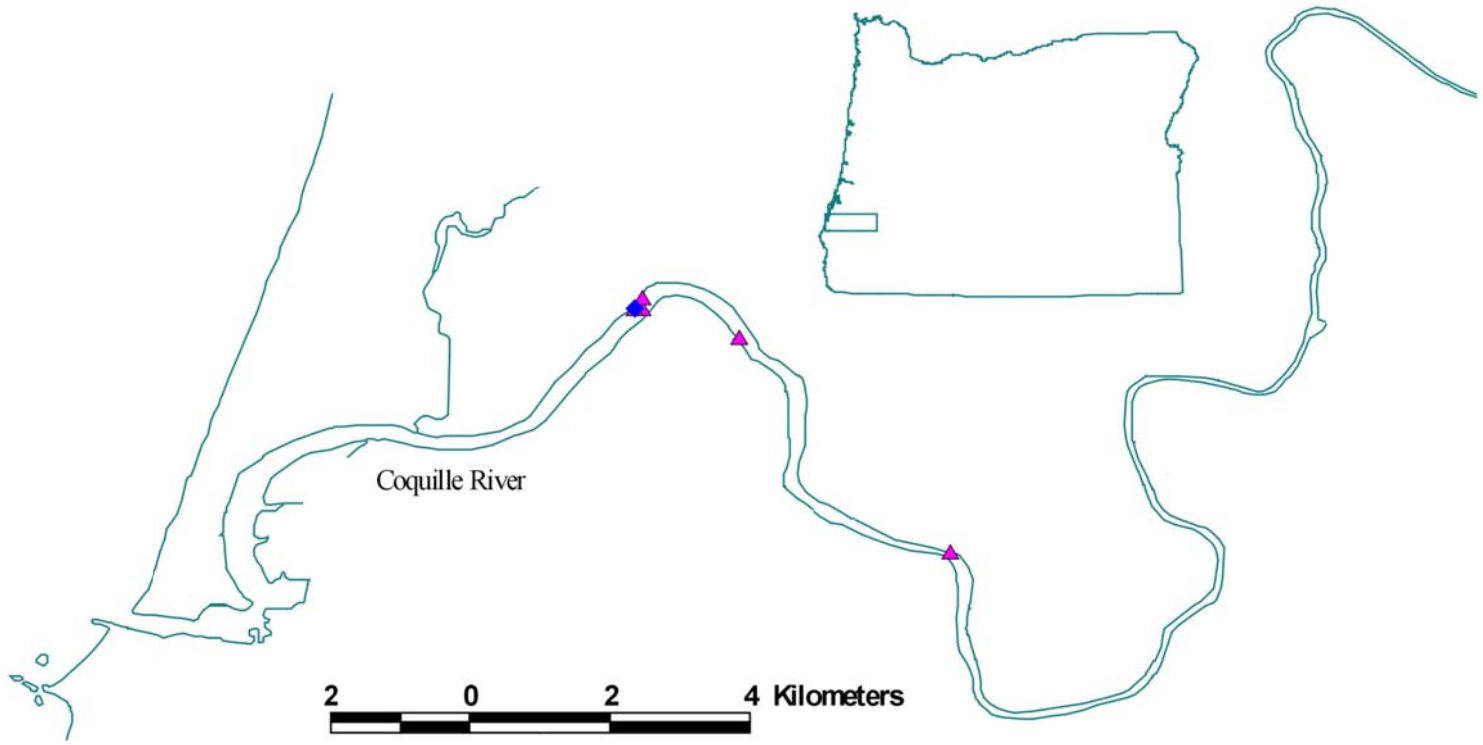

Figure 6. Coquille River, Oregon sampling locations. Triangles are gillnetting locations. Diamonds are seining locations.

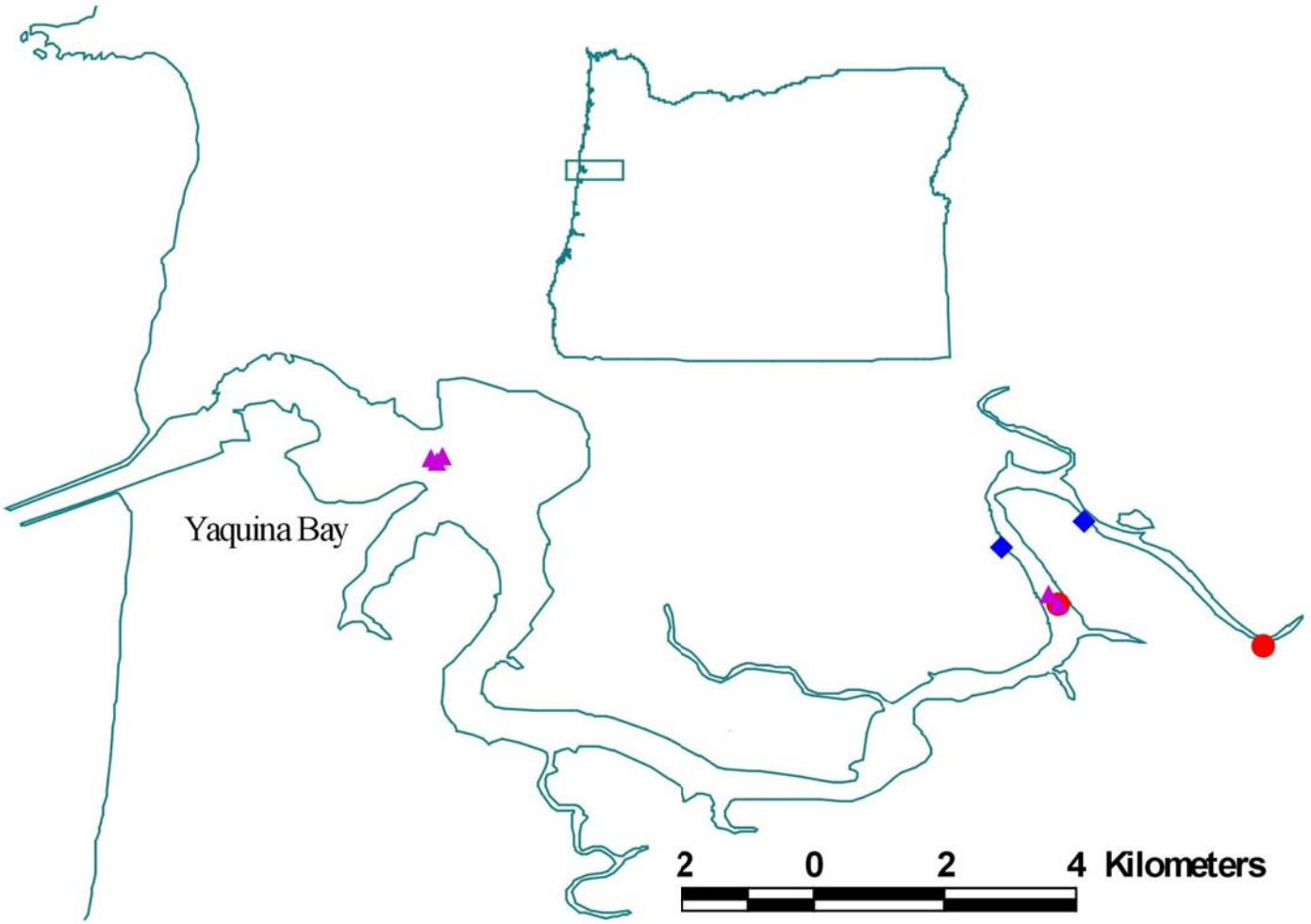

Figure 7. Yaquina River, Oregon sampling locations. Triangles are gillnetting locations. Diamonds are seining locations. Circles are underwater camera locations.

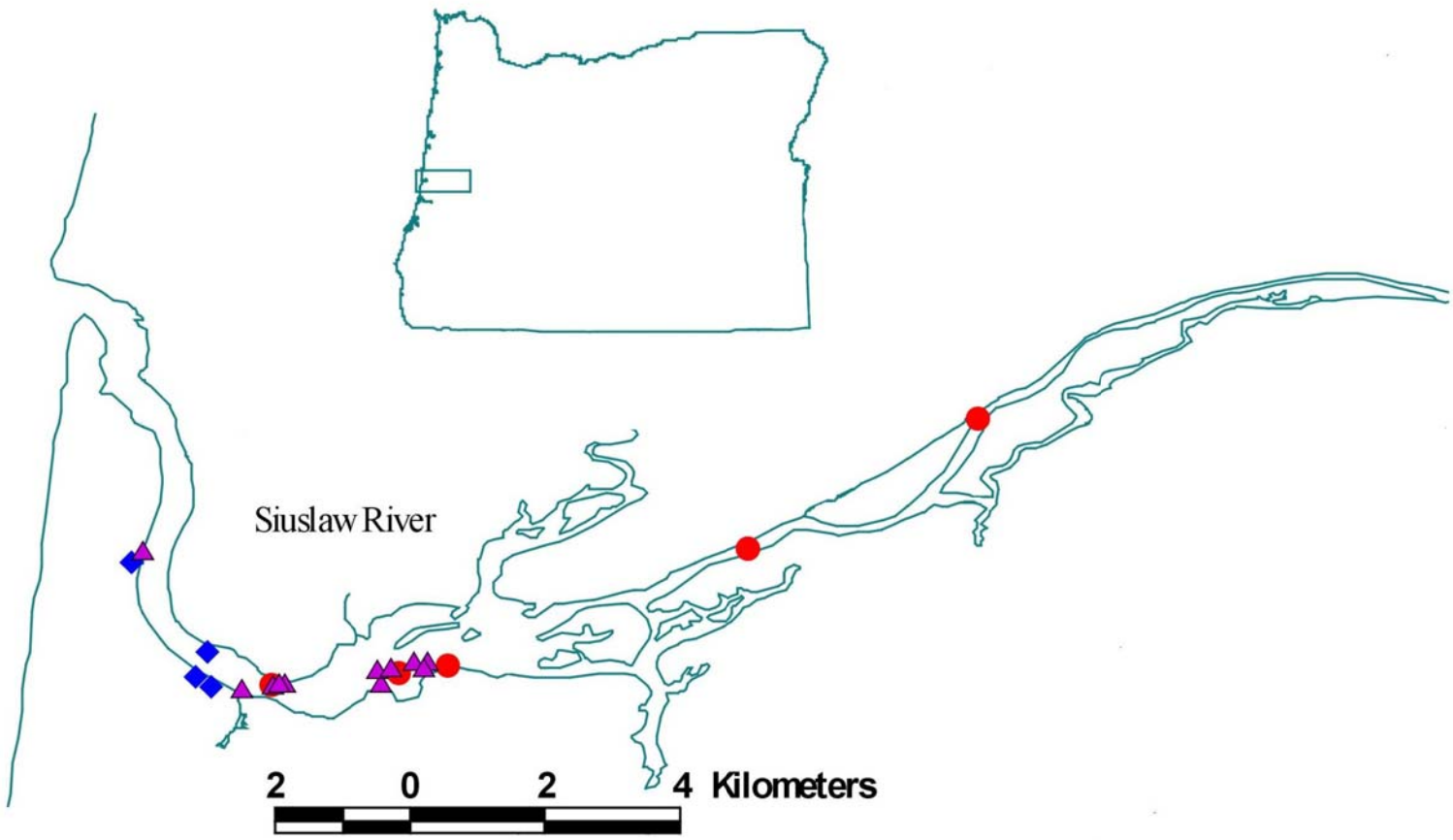

Figure 8. Siuslaw River, Oregon sampling locations. Triangles are gillnetting locations. Diamonds are seining locations. Circles are underwater camera locations.

RESULTS AND DISCUSSION

Catches

In 107 gill-net sets, 24 small seine sets and 3 large seine sets we captured 249 individual green sturgeon (15–204 cm FL) and recaptured 57 fish (142–210 cm FL) in the Rogue River . In 27 gill-net sets we captured 33 individual green sturgeon (113–192 cm FL) and recaptured 2 fish (94 and 164 cm FL) in the Umpqua River (Table 3).

Of the 282 green sturgeon captured, 271 were spaghetti-tagged, 241 were PIT-tagged, 87 were radio-tagged, and two were archival-pop-off-tagged (Rien et al. 2000, Farr et al. 2001, Farr and Rien 2002, Farr and Rien 2003, Farr and Kern 2004).

In a total of 12 egg mat sets, 74 D-ring plankton net sets, 16 screw trap days, and 3 string-mop head sets we found no sturgeon eggs or larvae (Rien et al. 2000, Farr et al. 2001).

Age and Growth

Two experienced readers assigned final ages to 195 green sturgeon from 1990 – 2004. These were added to previous datasets (Tables 4–6). Ages ranged from 0 – 52 years old. We had a 21% exact agreement rate and a 90% agreement rate within 3 years.

Work is needed to validate and verify the fin-spine method of age determination in green sturgeon. Similar to work done on white sturgeon (Brennan and Cailliet 1989), multiple age structures could be obtained and examined to ensure annuli are formed consistently among various structures. Regardless of the utility of alternate age structures, fin-spines are likely the only structure that can be taken from living fish. Oxytetracycline injection and comparison of ages after extended periods of time at large have been used to verify ages in long-lived fishes (Beamish and Chilton 1982, Rien and Beamesderfer 1994). The rarity of recaptures and relative brevity of research studies will make age verification in wild green sturgeon particularly difficult. Coordination and cooperation among research and management groups working with green sturgeon will be needed to obtain age structures from recaptured fish.

Von Bertalanffy growth curves were generated for males, females and all fish combined (Figure 9).

Sex Ratio and Maturity

Among 76 green sturgeon for which we determined gender through surgical examination, 19% of the females and 26% of the males were ripe or spent (Table 7). The ripe egg samples sent to University of California, Davis were determined to have mean egg diameters from 4.44 mm – 4.45mm and mean PI's of 0.034 – 0.039. As a morphologic criterion of oocyte ripeness (Dettlaff et al. 1993), a PI of less than 0.10 is used as a guideline for spawning induction in hatchery practices. Based on this criteria, the females from the Rogue River were in spawning condition and likely were in a spawning region of the river or close to one (personal communication, Joel Van Eenennaam, UC Davis). For more detailed information on maturity and analysis see Erickson and Webb (in Review).

Presence/Absence

We documented green sturgeon in the Rogue River up to river kilometer (rkm) 105. We documented green sturgeon in the Umpqua River up to rkm 20.9. We found a newspaper clipping from the News Review, Roseburg, Oregon dated 3 May, 1979 that has a story and picture of a 178-cm green sturgeon that was caught at River Forks Park (km 164), Umpqua River. We obtained a sample of a juvenile green sturgeon (approximately 10 cm) regurgitated from a smallmouth bass, *Micropterus dolomieu,* caught by a sport angler 30 July, 2000 at km 134, Umpqua River.

Movement

Movement of spaghetti and PIT tagged fish within and among river systems were documented for 49 green sturgeon a total of 54 times (Figure 10). Most fish (89%) stayed within 2 km of the initial tagging location. One fish moved from the Umpqua River to the Rogue River. Data from tag recovery databases maintained by Washington Dept. of Fish and Wildlife found exchanges of tagged fish between the Columbia River and Willapa Bay, WA (3 fish), the Columbia River and Campbell River area, British Columbia (1 fish), the Columbia and Umpqua rivers (1 fish), the Umpqua and Klamath rivers (2 fish), Willapa Bay, WA and San Pablo Bay, CA (1 fish), and the Rogue and Klamath rivers (1 fish) between 1998 and 2004. Detailed information about movement and habitat use can be found in Erickson et al. 2002.

A better understanding of movement and freshwater/saltwater residence time is a priority. This information is critical for State, Federal, and Tribal entities to make informed management decisions.

DNA Collection

Green sturgeon DNA samples pooled with other samples collected from the West Coast of the United States were analyzed by the Genomic Variation Laboratory, University of California, Davis. Results to date were published in Israel et al. 2004.

Morphometrics and Meristics

Six meristic and 12 morphometric measurements were collected from 50 green sturgeon (125 – 170 cm TL) from the Columbia River commercial fishery. From published data we were able to document sample size for meristics in only 8 cases and the sample sizes used ranged from 1 – 10 specimens. Our meristic data expand published ranges of variability for several characters of this species including lateral scutes (22; minimum), ventral scutes (12; maximum), and gill rakers (26; maximum). Because we sampled significantly more fish than previous studies, our data also confirm absolute published ranges of several meristic characters of North American green sturgeon including dorsal scutes (7 minimum; 12 maximum), lateral scutes (22 minimum; 33 maximum), and gill rakers (15 minimum; 26 maximum). We updated the descriptions for green sturgeon and white sturgeon in the Oregon Dept. of Fish and Wildlife Sport Fishing Synopsis in an effort to diminish the error in angler identification of sturgeon species when returning their harvest cards as this is a major source of non-commercial harvest estimates.

Stomach Contents

Digestive tract contents from 46 commercially caught Columbia River green sturgeon were found to contain only algae (species unknown) and three pebbles. Approximately 50% of the digestive tracts were populated with cysts that appeared to contain nematodes. The cysts appeared along the mid to lower intestines. One Rogue River green sturgeon digestive tract sample contained an exoskeleton of one crayfish (*Pacifasticus spp.*) and algae.

Gastric Levage/Arthroscope

We used gastric levage on three commercially captured green sturgeon to test the success of using the technique on live fish to obtain stomach content samples. We were unable to pass the levage past the first bend in the alimentary canal and were unable to fill the stomach with water as it was diverted into the air bladder. We chose not to use the technique on live fish.

We used a arthroscope to test if we could use the device to determine the sex and stage of maturity of live fish. With practice this could be a viable tool for identifying vitellogenic females in the field.

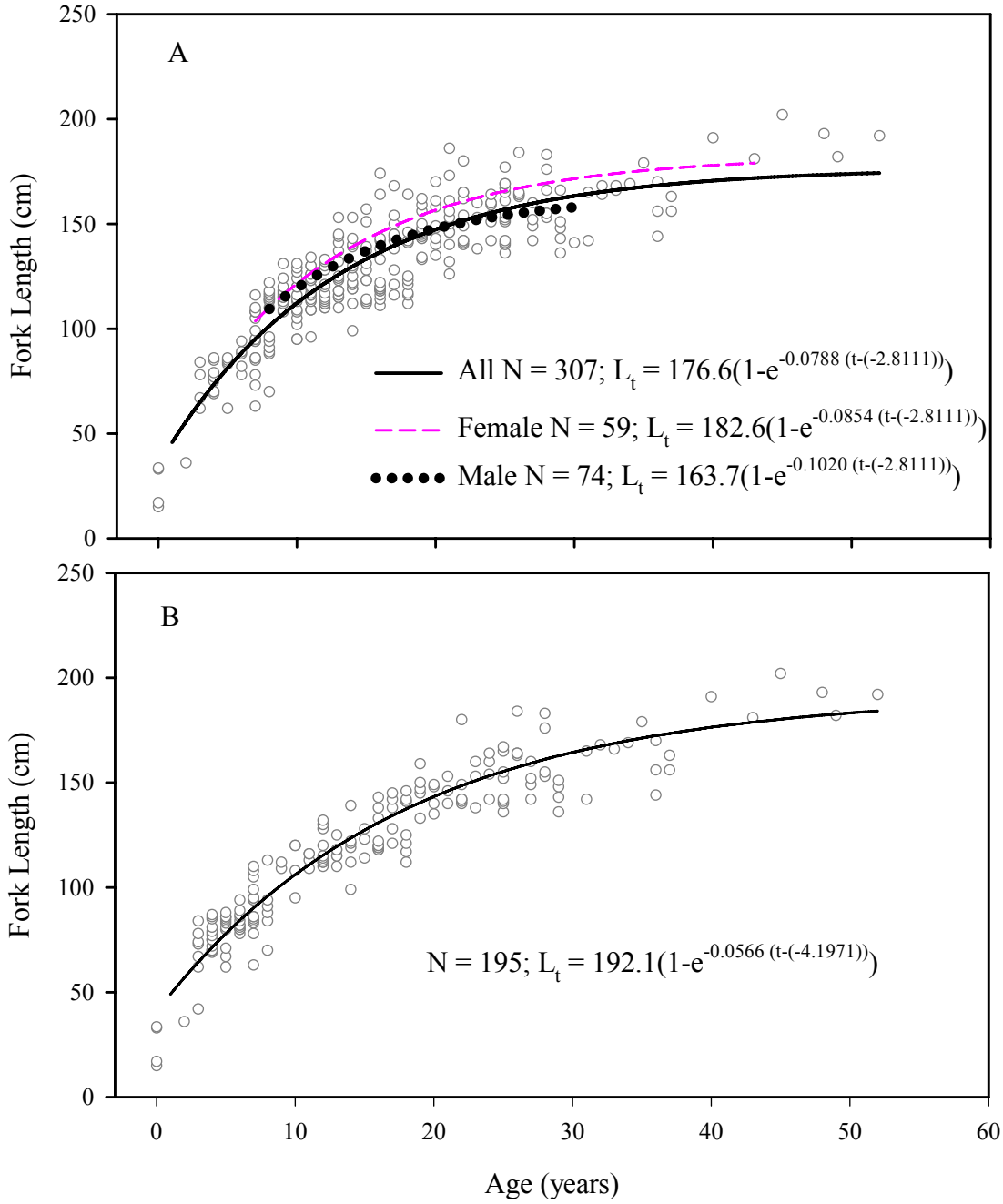

Figure 9. Von Bertalanffy growth curves for green sturgeon. (A) all aged green sturgeon. (B) green sturgeon aged by ODFW. t = age (years); where L_t = FL (cm) at age t.

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

Table 4. Continued.

	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
31								1	1			153.5	16.3	2
32									2			166.0	2.8	2
33									2			167.0	1.4	2
34									1			169.0		1
35									1			179.0		1
36								2	1			156.7	13.0	3
37								1	1			159.5	4.9	2
38														0
39														0
40										1		191.0		1
41														0
42														0
43										1		181.0		1
44														0
45											1	202.0		1
46														0
47														0
48										1		193.0		1
49										1		182.0		1
50														0
51														0
52										1		192.0		1
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

Table 5. Continued.

	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
31									1			165.0		1
32														0
33														0
34														0
35														0
36														0
37														0
38														0
39														0
40														0
41														0
42														0
43														0
44														0
45														0
46														0
47														0
48														0
49														0
50														0
51														0
52														0
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

Table 6. Continued.

	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
31														0
32									1			164.0		1
33									1			168.0		1
34														0
35														0
36														0
37														0
38														0
39														0
40														0
41														0
42														0
43														0
44														0
45											1	202.0		1
46														0
47														0
48														0
49														0
50														0
51														0
52														0
All ages	0	0	0	0	1	18	15	8	16	0	1	137.5	24.3	59

Table 7. Field determination of gender and stage of maturity for green sturgeon sampled, Rogue River, Oregon, 2000 – 2004.

Field Determined Sex	Number	Fork Length Range	Date Range
Females	31	148 - 202	4/11 - 10/15
Ripe	3	154 - 202	4/11 - 6/27
Spent	3	165 - 193	4/30 - 10/10
Males	34	136 - 184	4/11 - 10/10
Ripe	7	146 - 176	4/11 - 6/28
Spent	2	160 - 183	5/6 - 10/6
Unknown	11	142 - 201	4/10 - 9/10

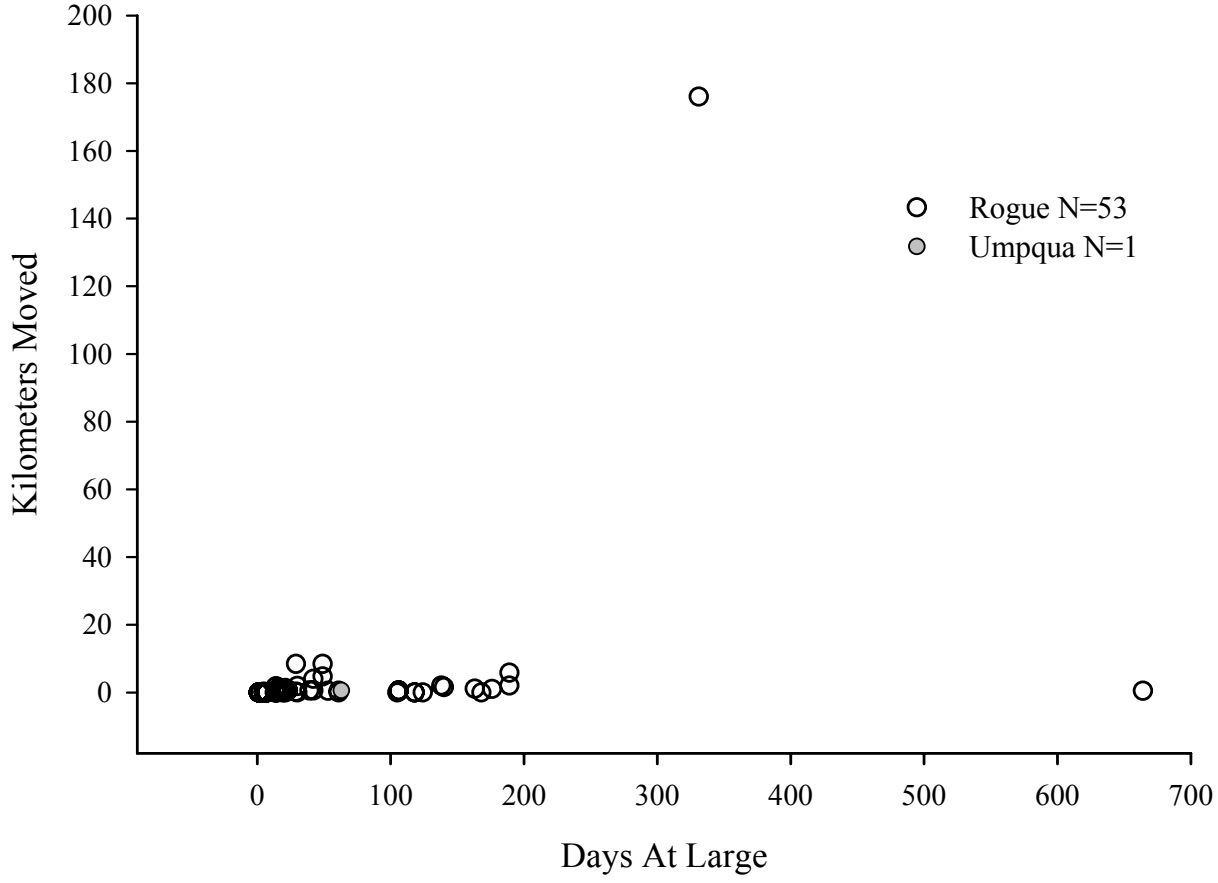

Figure 10. Movement of tagged green sturgeon over time, 2000 – 2004.

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Appendix B. Ancillary Green Sturgeon Data and Information

Umpqua River

Sturgeon tagging in the Umpqua River, 1986-1990. Thirty-seven sturgeon tagged of which 6 were identified as green sturgeon. Data from files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

6/13/86 green sturgeon 130 cm FL
7/2/97 green sturgeon 71 cm FL
6/19/87 green sturgeon 93 cm FL
5/19/89 green sturgeon 86 cm FL
5/19/98 green sturgeon 76 cm FL
2/23/90 green sturgeon 61 cm TL

Coos River and system

Table 23. Pounds of green and white sturgeon landed in the commercial fishery in Coos Bay, 1923-49.

Year	Green sturgeon	White sturgeon	Total
1923	478	3,178	3,656
1924	1,609	306	1,915
1925	1,553	289	1,842
1926	1,638	183	1,821
1927	75	202	277
1928	302	23	325
1929	638	252	890
1930	1,270	105	1,375
1931	1,159	--	1,159
1932	539	243	782
1933	164	945	1,109
1934	271	--	271
1935	277	--	277
1936	1,117	34	1,151
1937	587	29	616
1938	1,466	17	1,482
1939	195	76	271
1940	104	155	259
1941	67	--	67
1942	177	--	177
1943	464	--	464
1944	95	44	139
1945	178	66	244
1946	1,957	38	1,995
1947	379	--	379
1948	70	34	104
1949	395	26	421

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Scanned table, source unknown. Data from files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

Striped Bass Tagging Study 1950. Seven sturgeon recorded as incidental catch. Four as just sturgeon and 3 as green sturgeon. Data from files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

4/26/50 sturgeon spp. 39 cm FL/TL ?
4/26/50 sturgeon spp. 41 cm FL/TL ?
4/29/50 sturgeon spp. No length
4/29/50 sturgeon spp. 48 cm FL/TL ?
7/17/50 green sturgeon 44 cm FL/TL ?
7/17/50 green sturgeon 48 cm FL/TL ?
7/17/50 green sturgeon 46 cm FL/TL ?

Striped Bass Tagging Study 1951. Three green sturgeon recorded as incidental catch.. Data from files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

3/26/51 green sturgeon 53 cm FL, 58 cm TL – Hayes Slough
3/29/51 green sturgeon 53 cm FL, 58 cm TL – Cooston Point
4/4/51 green sturgeon 46 cm FL, 51 cm TL – Cooston Point

Ocean trawl commercial landings of green sturgeon delivered to Coos Bay dealers, 1956 and 1957. No indication of pounds or counts. Probably poundage. Data from files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

April 1956 - 100
October 1956 - 48
November 1956 - 34
December 1956 - 153
January 1957 - 73
February 1957 - 167
March 1957 – 96

Observed catches in 69 and 139 denier nets Coos River Setnet fishery May, 1976. Data from Table 1, An evaluation of 69 denier setnets and driftnets in the 1976 commercial shad fisheries on the Coos and Umpqua rivers. Oregon Dept. of Fish and Wildlife. 1977. From files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

5/5/76 sturgeon spp. No length.

Spring Gill-net Sampling, Isthmus Slough, Coos Bay 1980 – 1984. Data from files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

5/5/80 green sturgeon 46 cm FL/TL ? - Across from Davis Slough
7/22/80 green sturgeon 47 cm TL – At West Coast Trucking
8/1/80 green sturgeon 64 cm TL – Confluence of Millicooma and Coos rivers
8/1/80 green sturgeon 58.5 cm TL – Confluence of Millicooma and Coos rivers
8/1/80 green sturgeon 53.5 cm TL – Confluence of Millicooma and Coos rivers
8/20/80 green sturgeon, no size, - Just south of Davis Slough

8/20/80 green sturgeon, no size, - Just south of Davis Slough
8/20/80 green sturgeon, no size, - Just south of Davis Slough
8/20/80 green sturgeon, no size, - Just south of Davis Slough
8/20/80 green sturgeon, no size, - At House of Confusion
8/20/80 green sturgeon, no size, - At House of Confusion
5/21/81 green sturgeon 58 cm TL – At mile post 10
5/21/81 green sturgeon 65 cm TL – One mile north of Davis Slough
8/12/81 green sturgeon 56 cm TL – At mouth of Davis Slough
8/12/81 green sturgeon 65 cm TL – At mouth of Davis Slough
8/12/81 green sturgeon 58 cm TL – One mile north of Davis Slough
8/12/81 green sturgeon 61 cm TL – One mile north of Davis Slough
8/12/81 green sturgeon 58 cm TL – One mile north of Davis Slough
5/28/82 green sturgeon, juvenile – 5.5 miles north of Davis Slough
5/28/82 green sturgeon, juvenile – 5.5 miles north of Davis Slough
5/28/82 green sturgeon, juvenile – 5.5 miles north of Davis Slough
5/28/82 green sturgeon, juvenile – 5.5 miles north of Davis Slough
5/28/82 green sturgeon, juvenile – Across from mouth of Davis Slough
5/28/82 green sturgeon, juvenile – Across from mouth of Davis Slough
5/28/82 green sturgeon, juvenile – Across from mouth of Davis Slough
6/2/83 green sturgeon, between 38-61 cm FL – Across from mouth of Davis Slough
6/2/83 green sturgeon, between 38-61 cm FL – Across from mouth of Davis Slough
6/2/83 green sturgeon, between 38-61 cm FL – Across from mouth of Davis Slough
6/2/83 green sturgeon 48 cm FL/TL ? – 0.8 miles north of Davis Slough
6/2/83 green sturgeon, between 38-61 cm FL - At House of Confusion
6/2/83 green sturgeon, between 38-61 cm FL - At House of Confusion
6/2/83 green sturgeon, between 38-61 cm FL - At House of Confusion
6/2/83 green sturgeon, between 38-61 cm FL - At House of Confusion
6/2/83 green sturgeon, between 38-61 cm FL - At House of Confusion
6/2/83 green sturgeon, between 38-61 cm FL - At House of Confusion
6/2/83 green sturgeon, between 38-61 cm FL - At House of Confusion
6/2/83 green sturgeon, between 38-61 cm FL - At House of Confusion
8/2/83 green sturgeon, ~38 cm FL/TL ? – 5.5 miles north of Davis Slough
4/30/85 green sturgeon 66 cm TL – Powrie log dump
4/30/85 green sturgeon 46 cm TL – Mile post 10
4/30/85 green sturgeon 85 cm TL – Mile post 6
5/5/87 green sturgeon 46 cm TL – Powrie log dump
4/26/89 green sturgeon 53.5 cm TL – 0.8 miles north of Davis Slough
6/8/89 green sturgeon 56 cm TL – 0.8 miles north of Davis Slough
6/15/90 green sturgeon, between 49 cm FL – Across from mouth of Davis Slough
6/15/90 green sturgeon, between 61.5 cm FL – Across from mouth of Davis Slough

Spring Gill-net Sampling 1992. Sturgeon recorded as incidental catch. Data from files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

5/26/92 green sturgeon 84 cm TL – One mile north of Davis Slough

Spring Gill-net Sampling 1993. Sturgeon recorded as incidental catch. Data from files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

5/14/93 green sturgeon 62.5 cm FL – Powrie log dump
5/14/93 green sturgeon 98 cm TL – Across from mouth of Davis Slough

Striped bass gill-net sets 1993. Sturgeon recorded as incidental catch. Data from files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

5/24/93 sturgeon spp., no length – near forks on South Coos River
5/25/93 sturgeon spp., no length – near forks on South Coos River

Coos Bay Tagging, volunteer angler, 1994. Data from files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

2/5/94 green sturgeon 99 cm FL/TL ?
2/14/94 green sturgeon 97 cm FL/TL ?

Gill-net Set at Tenmile Lake 1994. Sturgeon recorded as incidental catch. Data from files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

10/3/94 green sturgeon 152 cm TL

Spring Gill-net Sampling 1996. Sturgeon recorded as incidental catch. Data from files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

5/10/96 green sturgeon 100 cm TL – Powrie log dump
5/10/96 green sturgeon 35 cm TL – One mile north of Davis Slough

Spring Gill-net Sampling 1997. Sturgeon recorded as incidental catch. Data from files of Oregon Dept. of Fish and Wildlife, Charleston, Oregon.

5/16/97 green sturgeon 44.5 cm TL – Powrie log dump
5/16/97 green sturgeon 70 cm TL – Across from mouth of Davis Slough

Yaquina River

Internal memo dated 2/3/03 about a landowner on the Yaquina River approximately two miles upstream of Elk City, near the head of tidewater that for the past several years had been catching many small sturgeon (8 – 13 cm TL) from late spring to mid-summer. He did not know if they were white sturgeon or green sturgeon.

Appendix C. Update of Columbia River commercial green sturgeon harvest data

In Rien et al. 2000, length, sex, and maturity of green sturgeon samples collected from Columbia River commercial fisheries from 1985-1999 were summarized. This appendix updates that information to include samples from 2000 and 2001 commercial fisheries sampling.

Current regulations allow retention of green sturgeon between 48"-66" total length (approximately 110–154 cm fork length) in commercial fisheries, although at the time this report was published, the regulation was under review, and may since have been changed to 48"-60" total length. This slot limit is designed to protect green sturgeon as they grow to maturity. Prior to 1993, fish 48"-72" total length were legal for retention in commercial fisheries (Figure 1). Overall, legal harvest of mature green sturgeon in these fisheries was rare, with 91% of sampled fish being immature at the time of harvest. Only 2% of sampled fish (Figures 2 and 3) were classified as "mature" (either ripe or within 3 years of spawning), and 7% were classified as "maturing" (developing gonads, more than 2 years from spawning). About 50% of sampled green sturgeon were female.

Average fork length of mature female green sturgeon sampled from commercial fisheries was about 159 cm (Table 1). Average fork length of mature male green sturgeon was about 143 cm fork length). Approximately 89% of sampled fish (2,135 of 2,378) were within the legal size slot (110–154 cm FL), therefore these samples likely underestimate mean length of maturity. Since only 6% (133 of 2,378) of sampled fish were >154 cm FL (66" total length), mature fish that were larger than the legal harvest size are very likely under-represented in these samples.

Table 1. Summary statistics, by sex and stage of maturity, for green sturgeon sampled from commercial fisheries harvest, 1985-2001. (No "ripe" males have been sampled).

	Immature ♂	Maturing ♂	Mature ♂	Spent ♂	All ♂	Immature ♀	Maturing ♀	Mature ♀	Ripe ♀	All ♀	All
N	1,083	111	27	1	1,222	1,041	66	22	1	1,130	2,352
Percent	46.0%	4.7%	1.1%	0.0%	52.0%	44.3%	2.8%	0.9%	0.0%	48.0%	100%
Min	100	109	127	104	100	101	104	132	165	101	100
Max	171	173	166	104	173	173	179	177	165	179	179
Average	126.2	140.5	142.6	104.0	127.8	126.3	143.3	158.9	165.0	128.0	127.9
STD	13.2	13.4	9.7		14.0	13.7	17.9	12.3		15.2	14.6

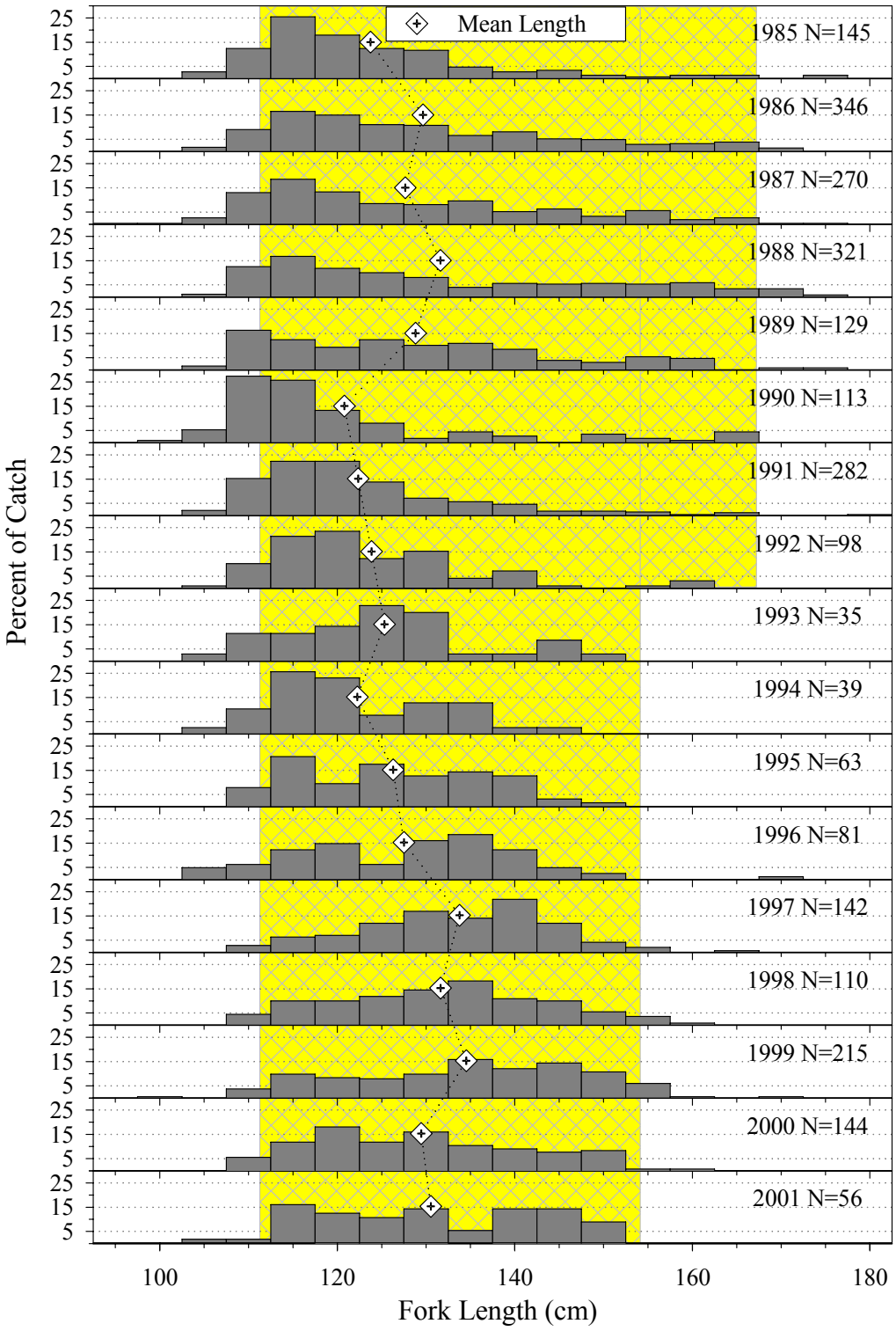

Figure 1. Percent length-frequency distribution of green sturgeon sampled from commercial fisheries harvest, 1985-2001. Mean fork length of sampled fish is indicated by the diamond symbol. Yellow-shaded area indicates legal harvest size slot (48”-72” total length 1985-1993, 48”-66” total length from 1993 on).

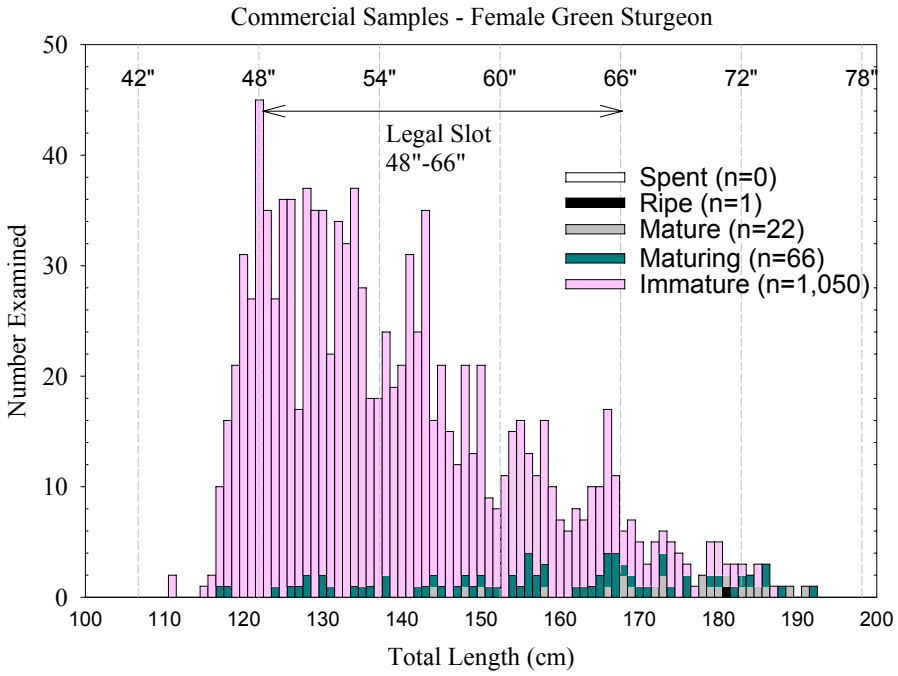

Figure 2. Length-frequency distribution and stage of maturity for female green sturgeon sampled from Columbia River commercial fisheries harvest.

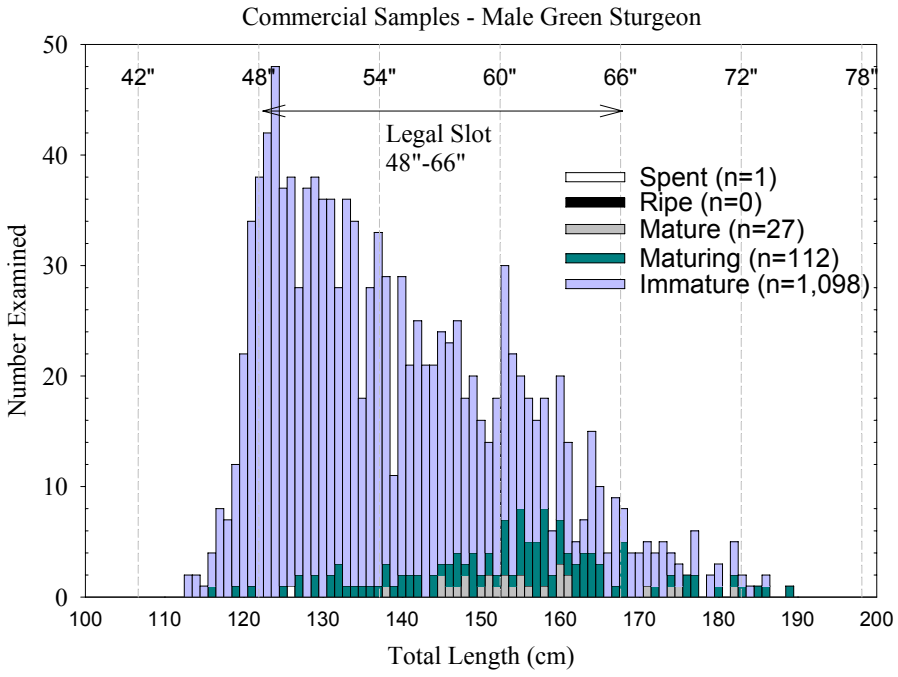

Figure 2. Length-frequency distribution and stage of maturity for female green sturgeon sampled from Columbia River commercial fisheries harvest.

Appendix D. Updated West Coast Green Sturgeon Harvest

Table 1. Harvest of green sturgeon in California, Oregon, and Washington commercial and sport fisheries. Harvest estimates were provided by State and Tribal fisheries managers at a green sturgeon workshop in Weitchpec, California, 22-23 March 2000. Harvest numbers have been updated based on current estimates (November 8, 2005).

	Oregon Coastal		Columbia River OR and WA		Willapa Bay		Grays Harbor/Chehalis River			Washington Ocean	Klamath River			San Fran. Bay Sac./S. Joaquin R.	
Year	Sport	Trawl	Sport	Comm.	Sport	Comm.	Sport	Comm.	Tribal	Trawl	Yurok	Hoopa	Sport	Sport	Total
1985	N/A	726	533	1,600	NA	1,289	NA	227	5	348	351	10	Few	Few	5,089 +
1986	153	190	407	6,000	NA	921	NA	626	3	142	421	30	Few	Few	8,893 +
1987	170	124	228	4,900	NA	877	NA	770	5	52	171	20	Few	Few	7,317 +
1988	258	120	141	3,300	1	1,599	4	609	1	34	212	20	Few	Few	6,299 +
1989	202	210	84	1,700	4	465	12	870	2	133	268	30	Few	Few	3,980 +
1990	157	143	86	2,200	2	954	4	734	9	66	242	20	Few	Few	4,617 +
1991	366	242	22	3,190	0	922	0	1,527	3	99	312	11	Few	Few	6,694 +
1992	197	94	73	2,160	0	1,002	0	737	3	66	212	3	Closed	Few	4,547 +
1993	293	250	15	2,220	32	320	112	542	3	37	417	36	Closed	Few	4,277 +
1994	160	154	132	240	13	300	25	17	22	5	293	6	Closed	Few	1,367 +
1995	78	29	21	390	12	302	96	374	185	3	131	6	Closed	Few	1,627 +
1996	210	182	63	610	24	129	70	137	153	1	119	8	Closed	Few	1,706 +
1997	158	400	41	1,614	4	16	105	316	198	6	306	16	Closed	Few	3,180 +
1998	103	77	73	894	12	67	28	25	55	0	335	10	Closed	Few	1,679 +
1999	73	21	93	861	5	9	29	14	58	4	204	28	Closed	Few	1,399 +
2000	15	12	32	1,224[1]	9	224	27	791	50	3	162	31	Closed	Few	2,580 +
2001	NA	17	50	342	14	106	0	142	33	1	268	10	Closed	Few	983 +
2002	NA	14	51	163	48	0	0	7	131	4	273	5	Closed	Few	696 +
2003	NA	17	52	46	NA	43	NA	2	46	5	287	16	Closed	Few	514 +
2004	NA	NA	29	58	NA	NA	NA	NA	NA	NA	NA	12	Closed	Few	99 +
2005	NA	NA	NA	91	NA	NA	NA	NA	NA	NA	NA	NA	Closed	Few	91 +
Averages															
1985-1989	196	274	279	3,500	3	1,030	8	620	3	142	285	22	Few	Few	6,316 +
1990-1994	235	176	66	2,002	9	700	28	711	8	55	295	15	Few	Few	4,300 +
1995-1999	124	142	58	874	11	105	66	173	130	3	219	14	Closed	Few	1,918 +
2000-2004	15	15	43	367	24	93	9	236	65	3	248	15	Closed	Few	974 +
1985-2004	173	159	111	1,686	12	502	34	446	51	53	262	16	Closed	Few	3,377 +

[1] 2000 Columbia River commercial harvest was previously reported as 861. The final estimate is 1,224 (from Oregon and Washington landing data).

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