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Coastal Zone and Estuarine Studies Division

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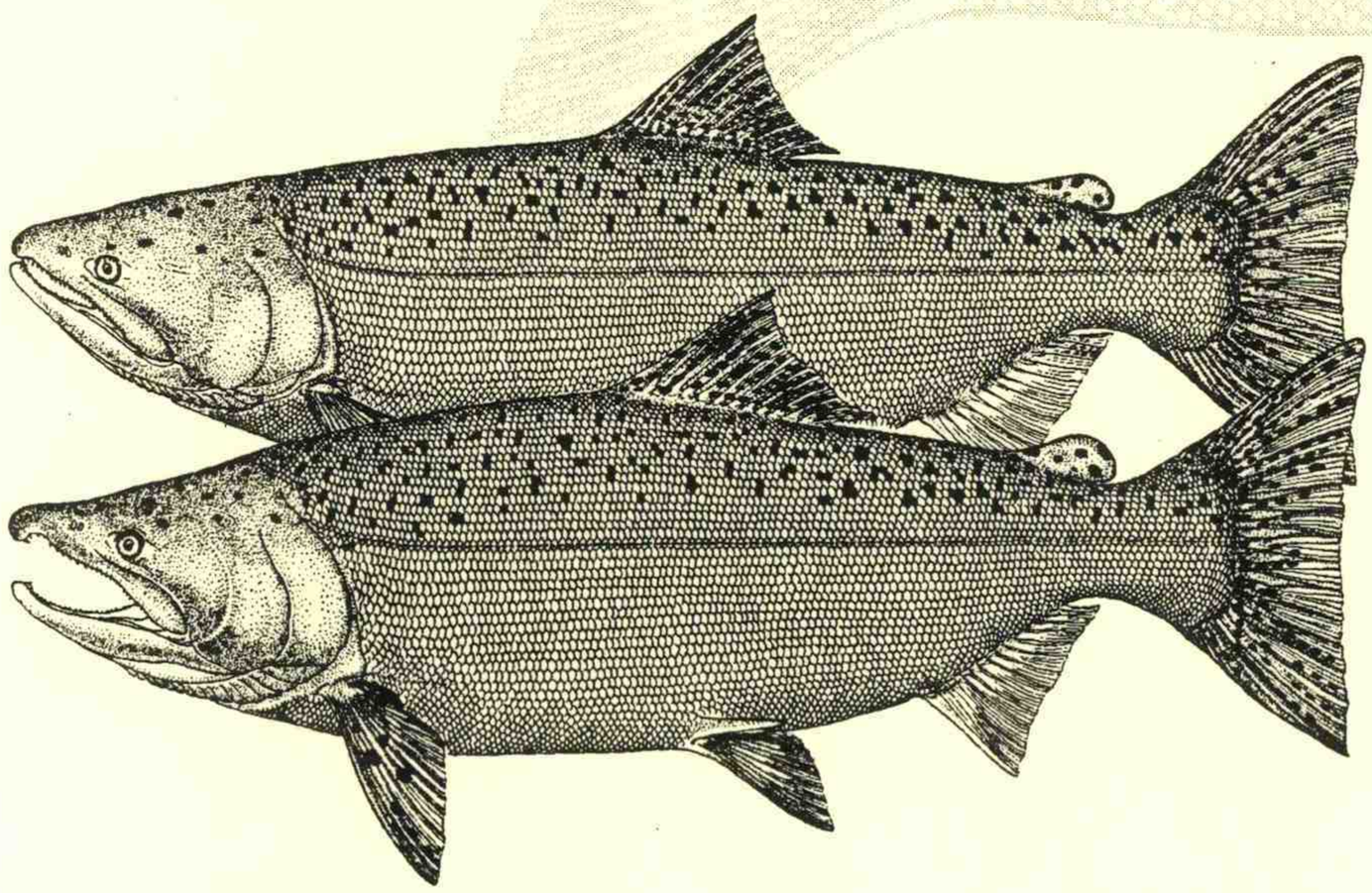

FISHES IN BOTTOM HABITATS IN SIX FLOWLANE DISPOSAL AREAS OF THE LOWER COLUMBIA RIVER, 1996-97

by

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EXECUTIVE SUMMARY

In 1995, the Portland District of the U.S. Army Corps of Engineers (COE) contracted with the National Marine Fisheries Service to study fishes in bottom habitats in six flowlane disposal areas in the Columbia River between River Miles (RM) 24 and 81. All six areas were used for in-water disposal of sediments dredged from the navigational channel. The goal of the study was to describe fish communities in these areas, with particular emphasis on white sturgeon (*Acipenser transmontanus*).

Bottom trawling was conducted in April, July, and October 1996 and January 1997 at the following flowlane disposal areas: RM 24, RM 37, RM 41, RM 59, RM 68, and RM 81. Each area is identified by its approximate RM from the mouth of the river (COE charts of the Columbia River use RM rather than River Kilometer). In each area, bottom trawling was generally conducted at six to eight sampling stations using a 7.9-m semiballoon shrimp trawl and a 3.0-m beam trawl; the beam trawl was used only in July 1996.

Mean catches (number/trawling effort) and estimated mean densities (number/hectare) of fishes in all six flowlane disposal areas were generally low. Mean densities (total) using data collected with the shrimp trawl ranged from 1 to 112 fish/hectare depending upon the area and month. Using data collected with the beam trawl, mean densities ranged from 0 to 65 fish/hectare. Fish taxa captured in the flowlane disposal areas (all areas combined) included Pacific lamprey (*Lampetra tridentata*), white sturgeon, American shad (*Alosa sapidissima*), juvenile chinook salmon (*Oncorhynchus tshawytscha*), eulachon (*Thaleichthys pacificus*), northern squawfish (*Ptychocheilus oregonensis*), peamouth (*Mylocheilus caurinus*), leopard dace (*Rhinichthys falcatus*), largescale sucker (*Catostomus macrocheilus*), unidentified

sucker (Catostomidae), sand roller (*Percopsis transmontana*), threespine stickleback (*Gasterosteus aculeatus*), black crappie (*Pomoxis nigromaculatus*), prickly sculpin (*Cottus asper*), unidentified sculpin (Cottidae), and starry flounder (*Platichthys stellatus*).

White sturgeon were present in all six flowlane disposal areas, with densities varying by area, month, and gear type. Mean densities of white sturgeon ranged from 0 to 7 fish/hectare for data collected with the shrimp trawl and from 0 to 38 fish/hectare for data collected with the beam trawl. Larval (< 25 mm total length) or small young-of-the-year white sturgeon (<100 mm total length), or both, were collected in July 1996 in four of the six flowlane disposal areas: RM 24, RM 37, RM 41, and RM 59, with highest catches occurring at RM 37, RM 41, and RM 59. Virtually all the larval and small young-of-the-year white sturgeon were collected in the beam trawl, which has much smaller mesh than the shrimp trawl.

It is uncertain how white sturgeon were utilizing the deepwater habitat in the six flowlane disposal areas. Many of the juvenile white sturgeon collected may have been rearing and feeding. In addition, the deepwater habitat in the flowlane disposal areas may serve as a refuge for larval and small young-of-the-year white sturgeon.

Larval and small young-of-the-year white sturgeon would probably be most affected by disposal of dredged material in the flowlane disposal areas. Most likely, these small sturgeon would be buried in the sediments and die. Larger juvenile and adult white sturgeon may be able to survive in the flowlane disposal areas, depending upon the amount of material that is dumped on the fish. Laboratory research is needed to determine the mechanical impacts of flowlane disposal on white sturgeon.

CONTENTS

INTRODUCTION

The lower Columbia River is an important shipping channel in the Pacific Northwest, requiring the maintenance of a navigational channel from the mouth of the river to Portland, Oregon. Annually, the U.S. Army Corps of Engineers (COE) is responsible for removing and disposing of almost 6.9 million m^3 (9 million yd^3) of material from the navigational channel. The dredged material is disposed of at three types of sites: in-water, upland, and shoreline (beach) areas.

In 1995, the Portland District of the U.S. Army Corps of Engineers (COE) contracted with the National Marine Fisheries Service (NMFS) to study fishes in bottom habitats at six flowlane disposal areas in the Columbia River between River Miles (RM) 24 and 81. All six areas were used for in-water disposal of sediments dredged from the navigational channel. The goal of the study was to describe fish communities in these areas, with particular emphasis on white sturgeon (*Acipenser transmontanus*).

METHODS

Bottom trawling was conducted in April, July, and October 1996 and January 1997 at the following flowlane disposal areas: RM 24, RM 37, RM 41, RM 59, RM 68, and RM 81 (Fig. 1). Each area is identified by its approximate RM from the mouth of the river (COE charts of the Columbia River use RM rather than River Kilometer). In each area, bottom trawling was generally conducted at six to eight sampling stations (Table 1, Appendix Table 1).

Two types of bottom trawls were used to sample the six flowlane disposal areas. A 7.9-m (headrope length) semiballoon shrimp trawl, which had an estimated fishing width of

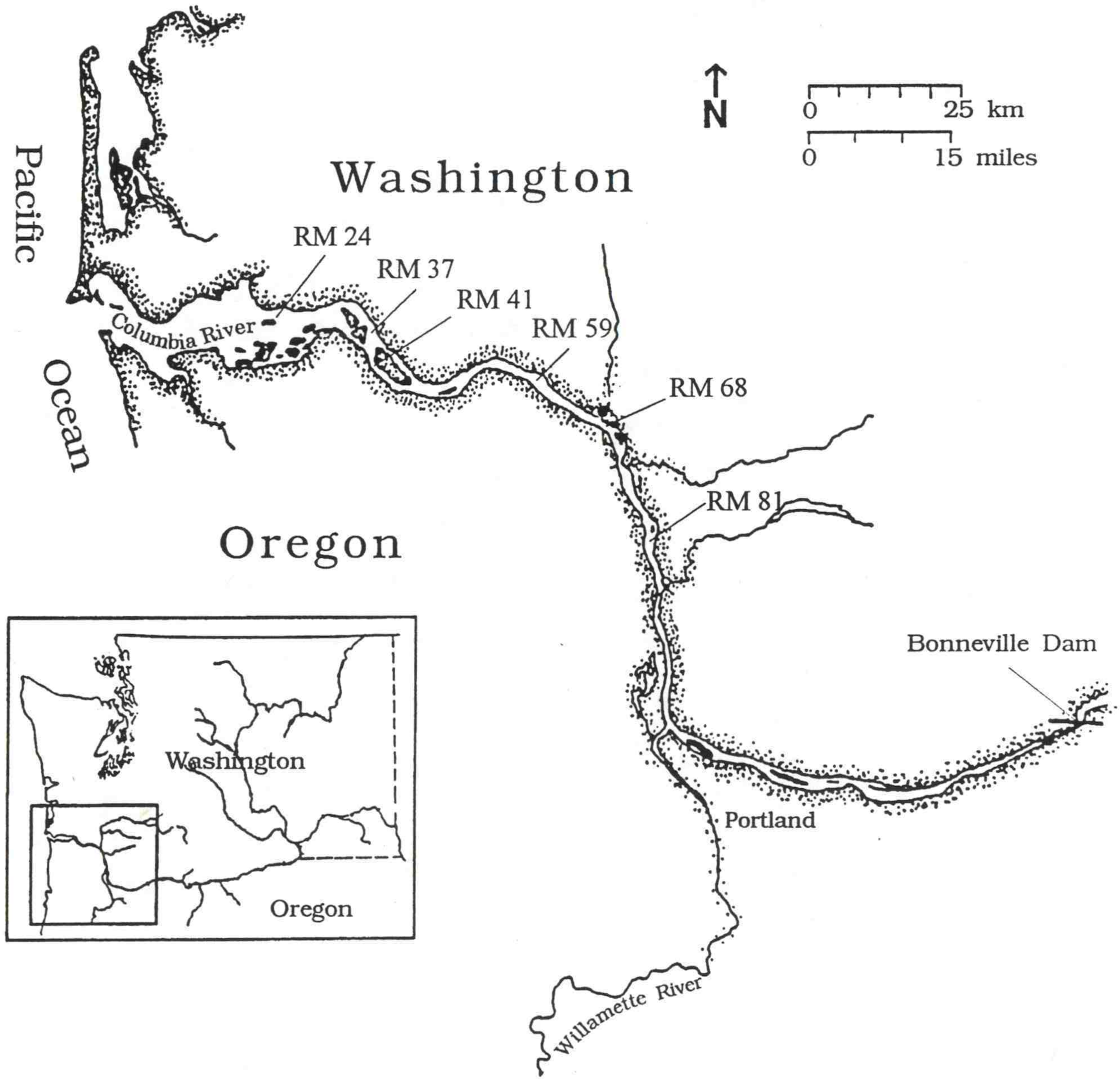


Figure 1. Location of the six flowlane disposal areas in the Columbia River downstream from Bonneville Dam. Bottom trawling was conducted in each area, which is designated by River Mile (RM), in April, July, and October 1996 and January 1997.

Table 1. Numbers of sampling efforts at six flowlane disposal areas in the lower Columbia River. The location of each area is identified by the approximate River Mile (RM) from the mouth of the river. Sampling was conducted using bottom trawls in April, July, and October 1996 and January 1997. The approximate dimensions of the flowlane disposal areas and the dates when they were last used are also shown.

Area	Number of sampling efforts				Length (m)	Width (m)	Date last used[a]
	Apr	Jul	Oct	Jan			
7.9-M SHRIMP TRAWL							
RM 24	8	8	7	6	1,372	122	1994
RM 37	8	8	8	8	1,158	122	1996
RM 41	6	6	6	6	1,006	91	1994
RM 59	8	8	8	8	1,067	183	1994
RM 68	8	8	8	8	1,036	122	1993
RM 81	8	8	8	8	1,097	122	1995
3.0-M BEAM TRAWL							
RM 24	0	8	0	0			
RM 37	0	8	0	0			
RM 41	0	6	0	0			
RM 59	0	6	0	0			
RM 68	0	0	0	0			
RM 81	0	5	0	0			

[a] The date listed is a fiscal year, which is the period from 1 October through 30 September (for example, fiscal year 1994 begins on 1 October 1993 and ends on 30 September 1994). The dates were provided by the Portland District, U.S. Army Corps of Engineers.

5.3 m, was used in each area during all four surveys. Mesh size in the trawl was 38 mm (stretched measure) in the body; a 10-mm mesh liner was inserted in the cod end of the net. In July 1996, a 3.0-m beam trawl was also used to determine if larval (< 25 mm total length) or small young-of-the-year (<100 mm total length) white sturgeon were present in the disposal areas. Larval and small young-of-the-year white sturgeon are generally not as vulnerable to capture in the shrimp trawl as in the beam trawl due to the larger mesh in the shrimp trawl. The estimated fishing width of the beam trawl was 2.7 m and the height was 0.5 m. A 1.59-mm knotless nylon liner was inserted into the body of the net. The beam trawl was not used in April and October 1996 and January 1997 because larval and small postlarval white sturgeon would not have been present in the disposal areas. Trawling efforts were usually 5 to 10 minutes in duration in an upstream direction; the durations of the efforts varied because of river currents, wind, and bottom characteristics. The trawling effort began when the trawl and the proper amount of cable were deployed, and the effort was considered ended when 5 to 10 minutes had elapsed. We estimated the distance the net fished during each sampling effort using a radar range-finder. Trawl speeds over the bottom were usually 3 to 6 km/hour for the shrimp trawl and 2 to 4 km/hour for the beam trawl.

The area fished for each effort was calculated using the distance fished during each trawling effort and the estimated fishing width of the net. Fish densities (by species) for each effort were calculated and expressed as number/hectare (10,000 m^2).

Fishes captured in the trawls were identified and counted. White sturgeon from each sampling effort were measured (total and fork lengths (mm)) and weighed (g); larval and small postlarval white sturgeon were not weighed. Juvenile white sturgeon longer than 199 mm total length were routinely examined for the nematode parasite *Cystoopsis acipenseri*

(Chitwood and McIntosh 1950, McCabe 1993). When present, the parasite is encased in blister-like cysts under the skin.

RESULTS

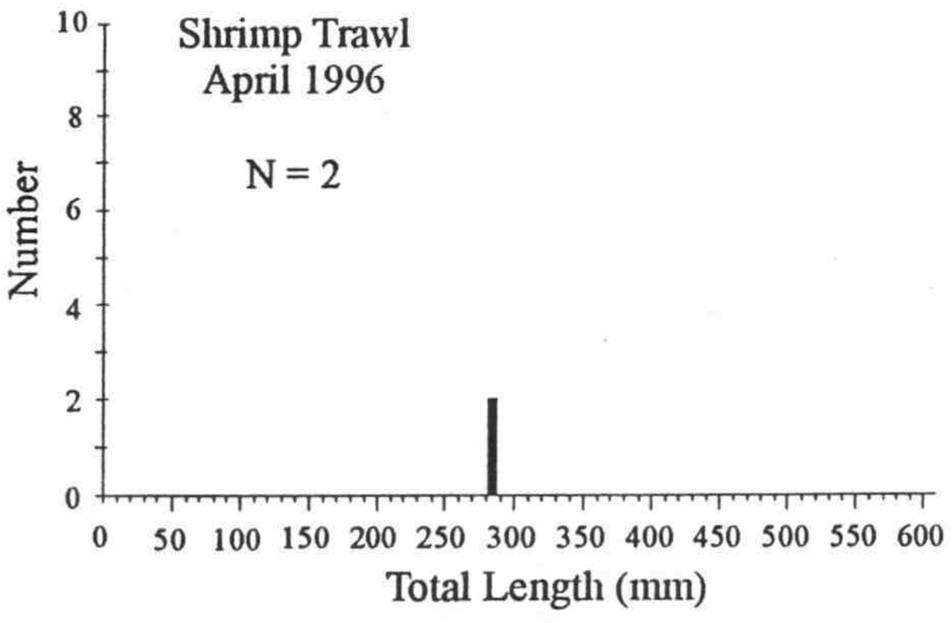
River Mile 24

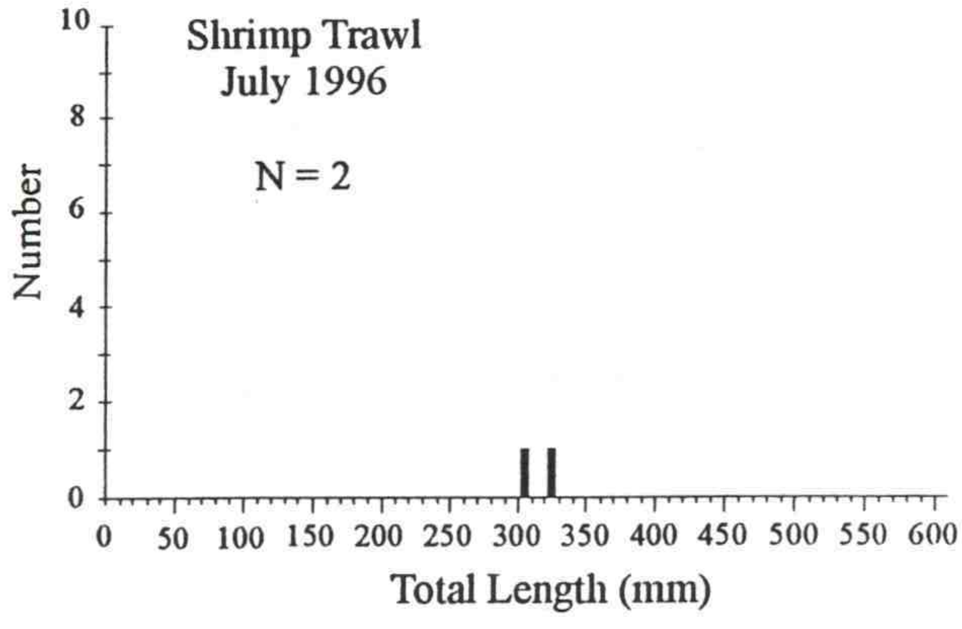
Catches of fishes in the flowlane disposal area near RM 24 were generally low. Mean catches (total) ranged from <1 fish/trawling effort in January 1997 to 24 fish/trawling effort in October 1996 (shrimp trawl); mean densities (number/hectare) ranged from 2 fish/hectare in January 1997 to 112 fish/hectare in October 1996 (Table 2). Summaries of individual trawling efforts for all surveys are available upon request from NMFS, Northwest Fisheries Science Center, Point Adams Biological Field Station, P.O. Box 155, Hammond, Oregon 97121. Fish taxa captured in the flowlane disposal area near RM 24 included white sturgeon, American shad (*Alosa sapidissima*), juvenile chinook salmon (*Oncorhynchus tshawytscha*), eulachon (*Thaleichthys pacificus*), peamouth (*Mylocheilus caurinus*), threespine stickleback (*Gasterosteus aculeatus*), prickly sculpin (*Cottus asper*), unidentified sculpin (Cottidae), and starry flounder (*Platichthys stellatus*).

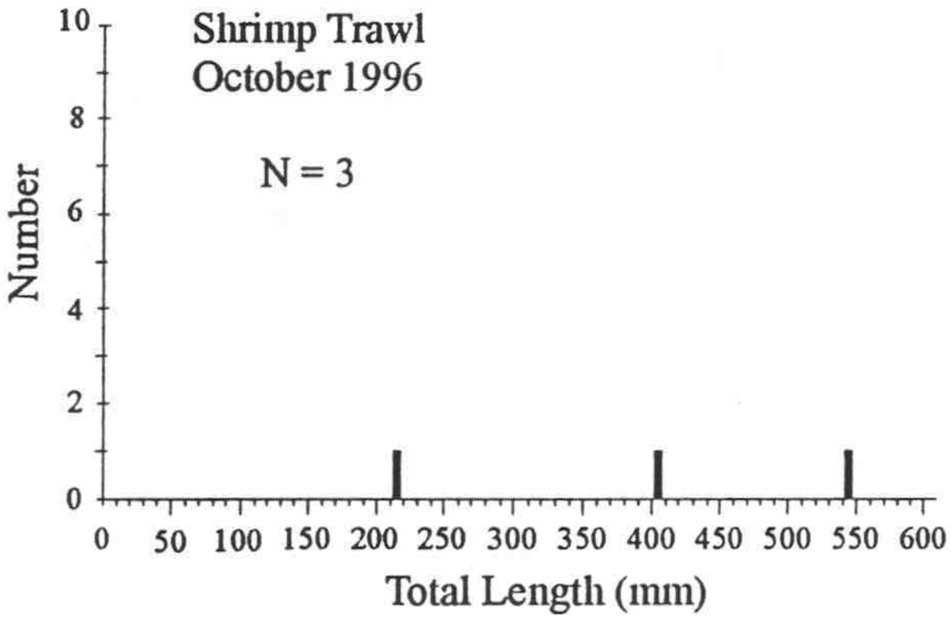
White sturgeon were captured in the flowlane disposal near area RM 24 during all surveys, except the January 1997 survey. During all surveys, densities of white sturgeon averaged $\leq$6 fish/hectare (Table 2). All of the 11 white sturgeon captured were juveniles or larva (Fig. 2); one white sturgeon larva was captured in the beam trawl in July 1996. Only 1 (10%) of the 10 juvenile white sturgeon examined for *Cystoopsis acipenseri* was infested with the nematode parasite.

Table 2. Catch summaries for four bottom trawling surveys conducted in a flowlane disposal area near River Mile 24 in the Columbia River; all number (no.) and number/hectare (no./ha) values are means calculated from multiple trawling efforts. The 3.0-m beam trawl was used only in July 1996.

Taxon	April 1996		July 1996		October 1996		January 1997	
	No.	No./ha	No.	No./ha	No.	No./ha	No.	No./ha
7.9-M SHRIMP TRAWL								
White sturgeon	<1	1	<1	1	<1	2	0	0
American shad	0	0	0	0	1	3	0	0
Chinook salmon (juv.)	0	0	1	5	0	0	0	0
Eulachon	<1	1	0	0	0	0	<1	2
Peamouth	0	0	<1	1	16	75	0	0
Threespine stickleback	0	0	<1	1	5	24	0	0
Prickly sculpin	3	14	<1	<1	1	4	0	0
Unidentified sculpin	0	0	1	3	1	2	0	0
Starry flounder	<1	1	0	0	<1	2	0	0
Total	4	17	3	11	24	112	<1	2
3.0-M BEAM TRAWL								
White sturgeon	--	--	<1	6	--	--	--	--
Peamouth	--	--	<1	2	--	--	--	--
Threespine stickleback	--	--	<1	2	--	--	--	--
Prickly sculpin	--	--	1	8	--	--	--	--
Unidentified sculpin	--	--	4	39	--	--	--	--
Total			6	57				







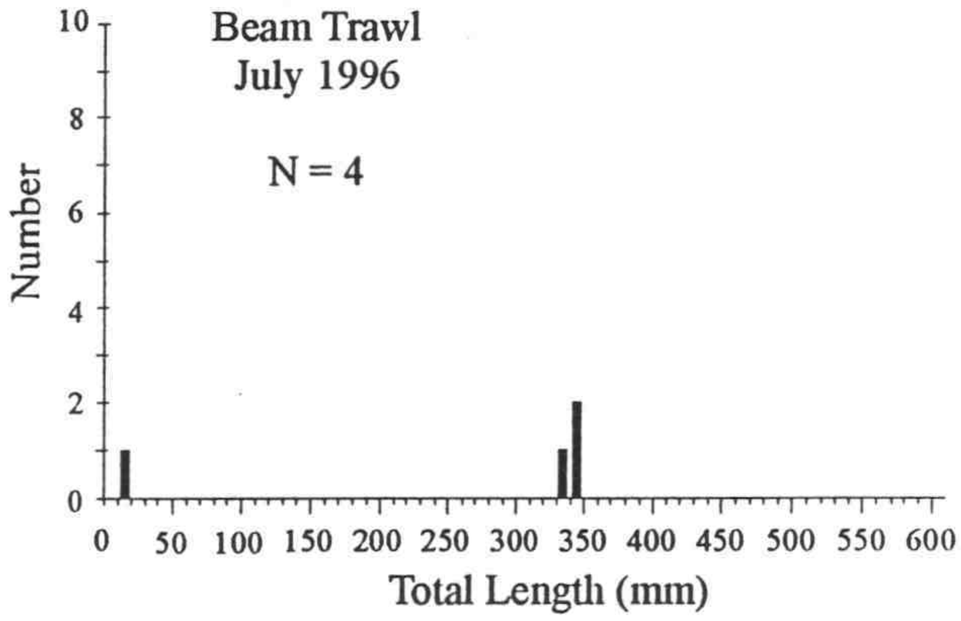


Figure 2. Length-frequency histograms for white sturgeon collected in a flowlane disposal area near River Mile 24 in the Columbia River.

River Mile 37

Catches of fishes in the flowlane disposal area near RM 37 were low. Mean catches (total) ranged from 2 fish/trawling effort in April and July 1996 (shrimp trawl) and January 1997 to 6 fish/trawling effort in July 1996 (beam trawl); mean densities ranged from 8 fish/hectare in July 1996 (shrimp trawl) to 65 fish/hectare in July 1996 (beam trawl) (Table 3). Fish taxa captured in the flowlane disposal area near RM 37 included Pacific lamprey (*Lampetra tridentata*), white sturgeon, American shad, juvenile chinook salmon, eulachon, peamouth, unidentified sucker (Catostomidae), threespine stickleback, prickly sculpin, unidentified sculpin, and starry flounder.

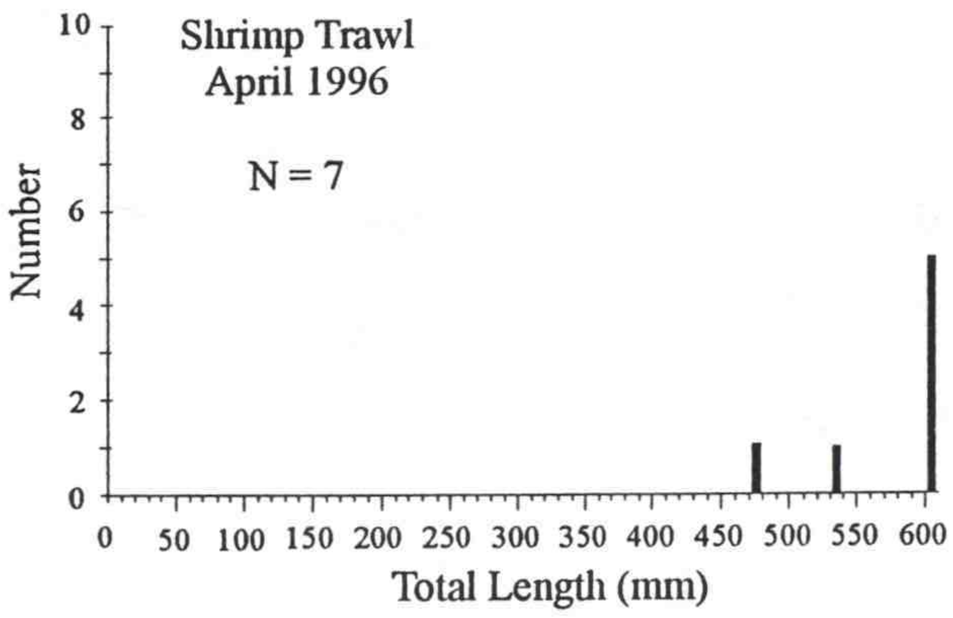
White sturgeon were captured in the flowlane disposal area near RM 37 during all surveys. Densities of white sturgeon averaged ≤4 fish/hectare, except in July 1996 (beam trawl) when the average density was 36 fish/hectare (Table 3). We collected 44 white sturgeon during the 4 surveys, and of these, 17 were larval or small postlarval sturgeon (<100 mm total length) (Fig. 3). All but one of the larval and small young-of-the-year sturgeon were collected in the beam trawl in July 1996. Two (8%) of the 26 juvenile white sturgeon examined for *Cystoopsis acipenseri* were infested with the nematode parasite.

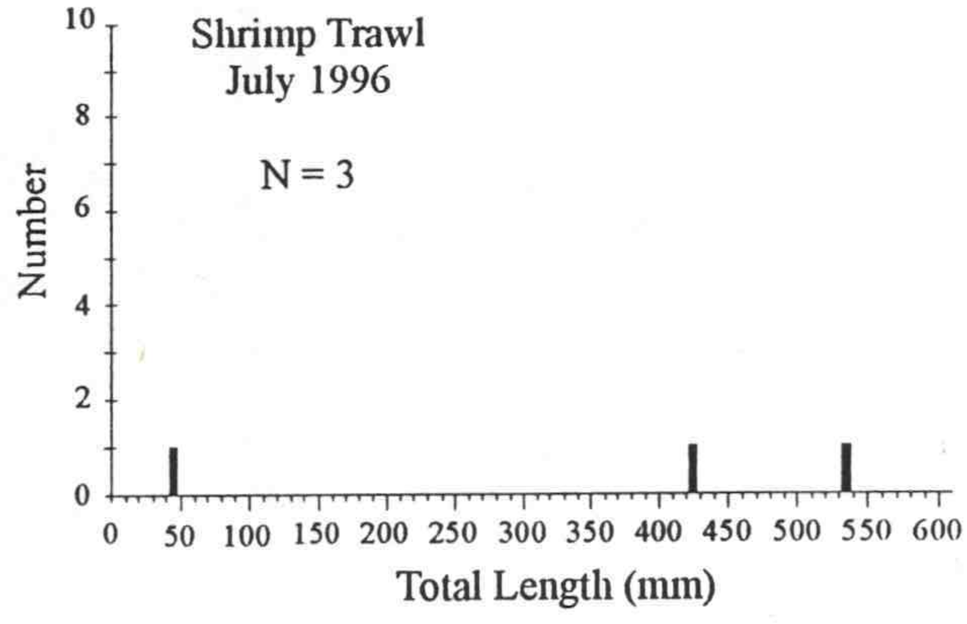
River Mile 41

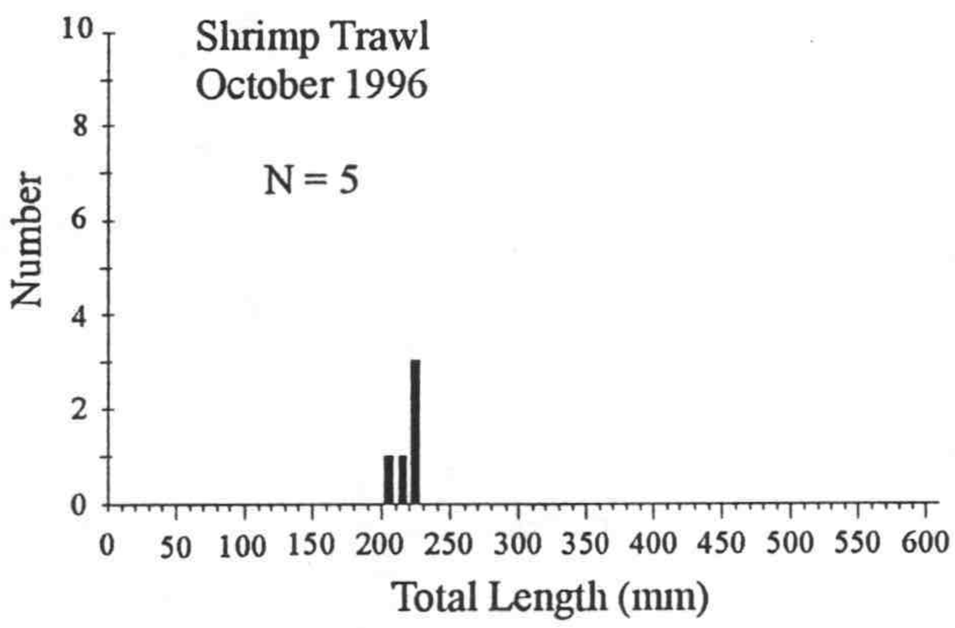
Catches of fishes in the flowlane disposal area near RM 41 were low. Mean catches (total) ranged from <1 fish/trawling effort in July 1996 (shrimp trawl) to 6 fish/trawling effort in July 1996 (beam trawl); mean densities ranged from 2 fish/hectare in July 1996 (shrimp trawl) to 65 fish/hectare in July 1996 (beam trawl) (Table 4). Fish taxa captured in the flowlane disposal area near RM 37 included white sturgeon, American shad, juvenile chinook

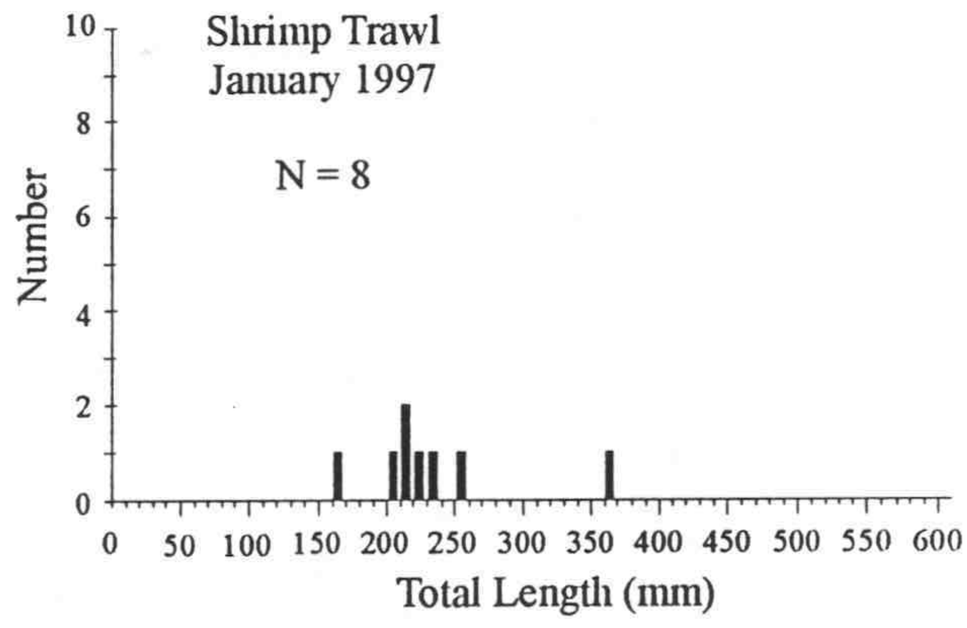
Table 3. Catch summaries for four bottom trawling surveys conducted in a flowlane disposal area near River Mile 37 in the Columbia River; all number (no.) and number/hectare (no./ha) values are means calculated from multiple trawling efforts. The 3.0-m beam trawl was used only in July 1996.

Taxon	April 1996		July 1996		October 1996		January 1997	
	No.	No./ha	No.	No./ha	No.	No./ha	No.	No./ha
7.9-M SHRIMP TRAWL								
Pacific lamprey	0	0	0	0	0	0	<1	<1
White sturgeon	1	4	<1	2	1	3	1	4
American shad	0	0	0	0	1	4	0	0
Chinook salmon (juv.)	<1	1	<1	2	0	0	0	0
Eulachon	0	0	0	0	0	0	<1	<1
Peamouth	<1	1	<1	1	<1	2	0	0
Threespine stickleback	<1	2	<1	1	<1	2	0	0
Prickly sculpin	<1	1	<1	<1	0	0	1	3
Unidentified sculpin	<1	1	<1	2	<1	1	0	0
Starry flounder	0	0	0	0	<1	1	<1	<1
	--	--	--	--	--	--	--	--
Total	2	10	2	8	3	13	2	9
3.0-M BEAM TRAWL								
White sturgeon	--	--	3	36	--	--	--	--
Unidentified sucker	--	--	<1	1	--	--	--	--
Threespine stickleback	--	--	<1	4	--	--	--	--
Unidentified sculpin	--	--	2	23	--	--	--	--
Starry flounder	--	--	<1	1				
			--	--				
Total			6	65				









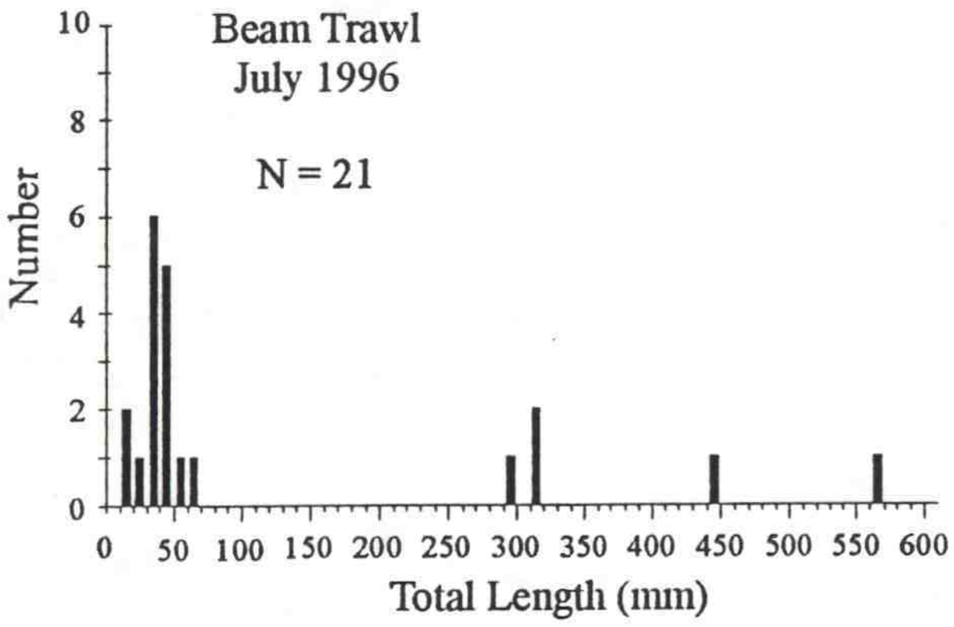


Figure 3. Length-frequency histograms for white sturgeon collected in a flowlane disposal area near River Mile 37 in the Columbia River. White sturgeon longer than 600 mm are included in the 600-mm interval.

Table 4. Catch summaries for four bottom trawling surveys conducted in a flowlane disposal area near River Mile 41 in the Columbia River; all number (no.) and number/hectare (no./ha) values are means calculated from multiple trawling efforts. The 3.0-m beam trawl was used only in July 1996.

Taxon	April 1996		July 1996		October 1996		January 1997	
	No.	No./ha	No.	No./ha	No.	No./ha	No.	No./ha
7.9-M SHRIMP TRAWL								
White sturgeon	<1	2	0	0	<1	3	<1	2
American shad	0	0	0	0	<1	2	0	0
Chinook salmon (juv.)	<1	2	<1	1	0	0	0	0
Eulachon	0	0	0	0	0	0	<1	2
Peamouth	<1	1	0	0	1	3	0	0
Largescale sucker	<1	1	0	0	0	0	0	0
Prickly sculpin	0	0	0	0	1	3	0	0
Unidentified sculpin	1	3	<1	1	<1	3	0	0
Starry flounder	0	0	0	0	1	3	0	0
Total	2	9	<1	2	4	17	1	4
3.0-M BEAM TRAWL								
White sturgeon	--	--	2	27	--	--	--	--
Threespine stickleback	--	--	1	13	--	--	--	--
Prickly sculpin	--	--	<1	2	--	--	--	--
Unidentified sculpin	--	--	2	23	--	--	--	--
Total			6	65				

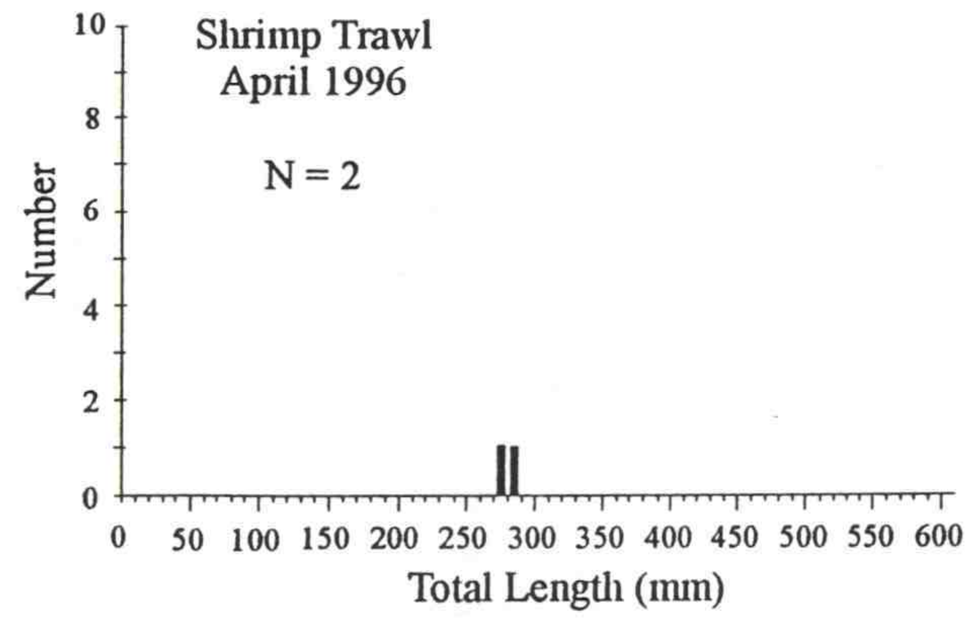
salmon, eulachon, peamouth, largescale sucker (*Catostomus macrocheilus*), threespine stickleback, prickly sculpin, unidentified sculpin, and starry flounder.

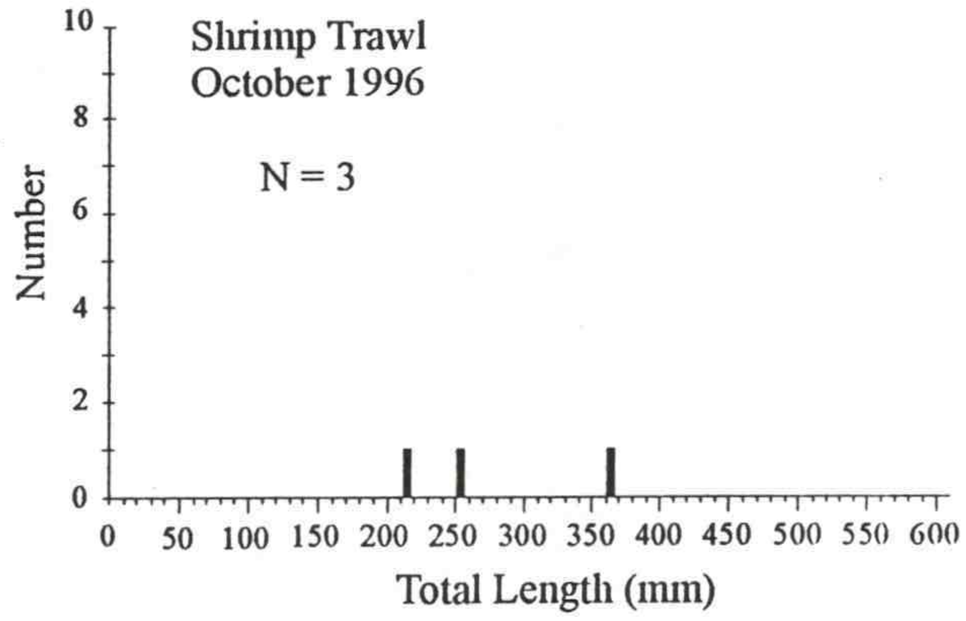
White sturgeon were captured in the flowlane disposal area near RM 41 during all surveys. Densities of white sturgeon averaged ≤3 fish/hectare, except in July 1996 (beam trawl) when the average density was 27 fish/hectare (Table 4). We collected 22 white sturgeon during the 4 surveys, and of these, 10 were larval or small young-of-the-year sturgeon (Fig. 4). All of the larval and small young-of-the-year sturgeon were collected in the beam trawl in July 1996. Two (17%) of 12 juvenile white sturgeon examined for *Cystoopsis acipenseri* were infested with the nematode parasite.

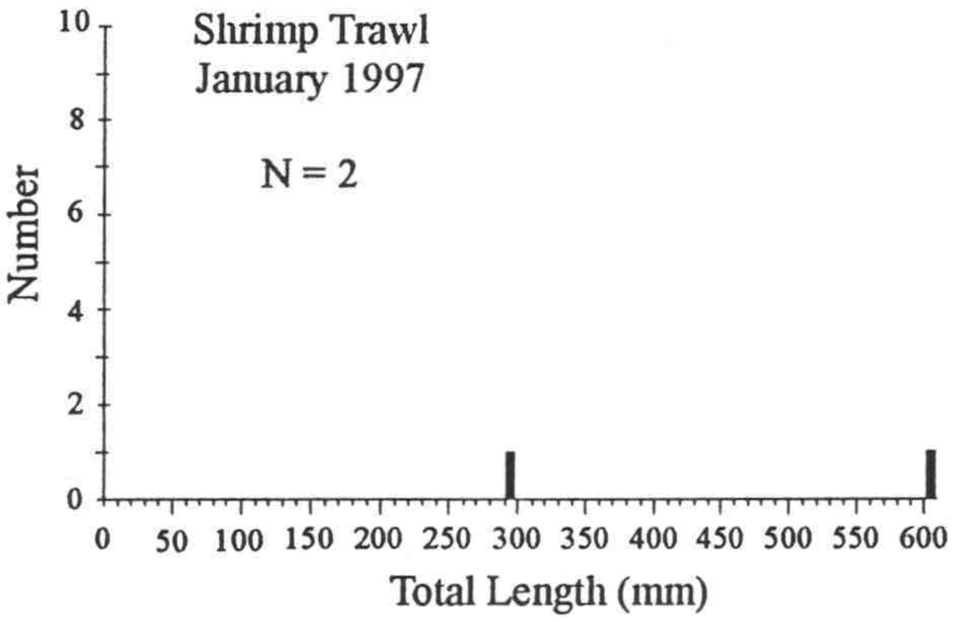
River Mile 59

Catches of fishes in the flowlane disposal area near RM 59 were low. Mean catches (total) ranged from 1 fish/trawling effort in July 1996 (shrimp trawl) to 4 fish/trawling effort in July 1996 (beam trawl); mean densities ranged from 3 fish/hectare in July 1996 (shrimp trawl) to 43 fish/hectare in July 1996 (beam trawl) (Table 5). Fish taxa captured in the flowlane disposal area near RM 59 included Pacific lamprey, white sturgeon, American shad, juvenile chinook salmon, eulachon, northern squawfish (*Ptychocheilus oregonensis*), peamouth, largescale sucker, sand roller (*Percopsis transmontana*), threespine stickleback, unidentified sculpin, and starry flounder.

White sturgeon were captured in the flowlane disposal area near RM 59 during all surveys, except the October survey. Densities of white sturgeon averaged ≤7 fish/hectare, except in July 1996 (beam trawl) when the average density was 38 fish/hectare (Table 5). We collected 39 white sturgeon during the 4 surveys, and of these, 23 were larval or small







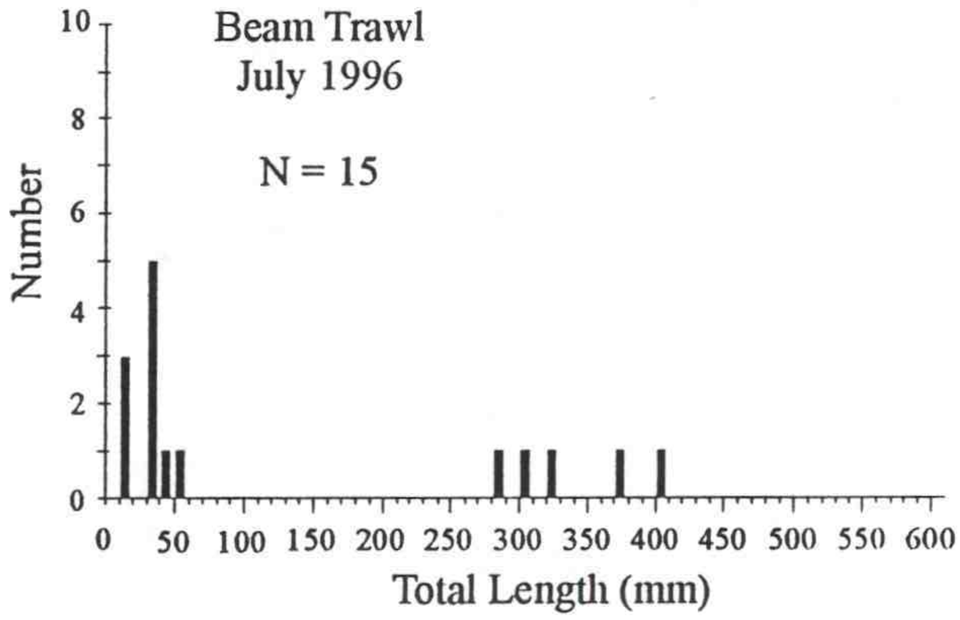


Figure 4. Length-frequency histograms for white sturgeon collected in a flowlane disposal area near River Mile 41 in the Columbia River. White sturgeon longer than 600 mm are included in the 600-mm interval.

Table 5. Catch summaries for four bottom trawling surveys conducted in a flowlane disposal area near River Mile 59 in the Columbia River; all number (no.) and number/hectare (no./ha) values are means calculated from multiple trawling efforts. The 3.0-m beam trawl was used only in July 1996.

Taxon	April 1996		July 1996		October 1996		January 1997	
	No.	No./ha	No.	No./ha	No.	No./ha	No.	No./ha
7.9-M SHRIMP TRAWL								
Pacific lamprey	0	0	0	0	0	0	<1	1
White sturgeon	<1	2	0	0	0	0	2	7
American shad	0	0	0	0	1	3	0	0
Chinook salmon (juv.)	0	0	<1	1	0	0	0	0
Eulachon	<1	<1	0	0	0	0	<1	<1
Northern squawfish	<1	1	0	0	0	0	0	0
Peamouth	2	10	<1	1	1	4	0	0
Largescale sucker	<1	1	0	0	<1	1	<1	1
Sand roller	0	0	0	0	<1	1	0	0
Threespine stickleback	0	0	<1	1	0	0	0	0
Unidentified sculpin	0	0	0	0	<1	1	0	0
Starry flounder	0	0	0	0	<1	1	0	0
	--	--	--	--	--	--	--	--
Total	3	14	1	3	3	11	2	9
3.0-M BEAM TRAWL								
White sturgeon	--	--	4	38	--	--	--	--
Threespine stickleback	--	--	<1	2	--	--	--	--
Unidentified sculpin	--	--	<1	3	--	--	--	--
			--	--				
Total			4	43				

young-of-the-year sturgeon (Fig. 5). All of the larval and small young-of-the-year sturgeon were collected in the beam trawl in July 1996. One (8%) of 12 juvenile white sturgeon examined for *Cystoopsis acipenseri* was infested with the nematode parasite.

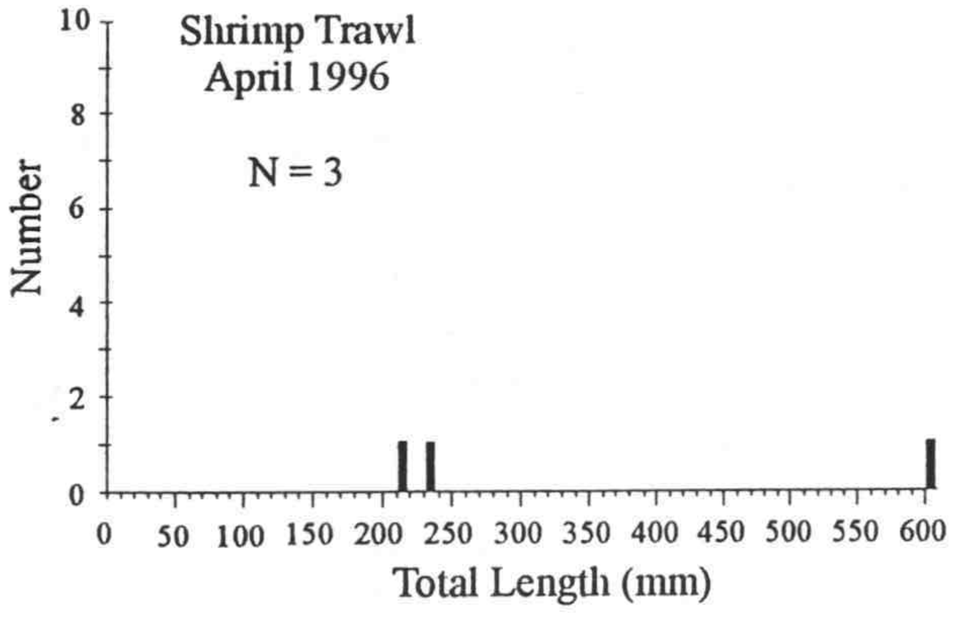
River Mile 68

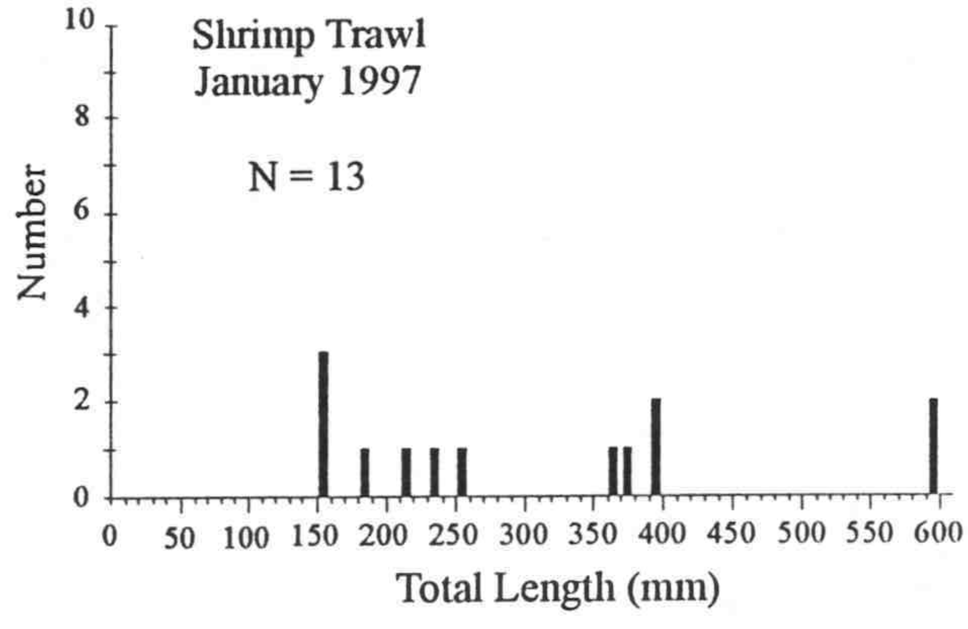
Catches of fishes in the flowlane disposal area near RM 68 were low. Mean catches (total) ranged from <1 fish/trawling effort in July 1996 and January 1997 to 4 fish/trawling effort in October 1996; mean densities ranged from 1 fish/hectare in January 1997 to 15 fish/hectare in October 1996 (Table 6). Fish taxa captured in the flowlane disposal area near RM 68 included white sturgeon, American shad, juvenile chinook salmon, eulachon, northern squawfish, peamouth, largescale sucker, sand roller, threespine stickleback, black crappie (*Pomoxis nigromaculatus*), prickly sculpin, unidentified sculpin, and starry flounder. We were not successful in using the beam trawl in the flowlane disposal area near RM 68 because the trawl would begin to fill with bottom sediments rapidly.

White sturgeon were captured in the flowlane disposal area near RM 68 during two of the four surveys. Densities of white sturgeon averaged ≤4 fish/hectare (Table 6). We collected 12 white sturgeon during the 4 surveys; none of these were larval or small young-of-the-year sturgeon (Fig. 6). None of 10 juvenile white sturgeon examined for *Cystoopsis acipenseri* was infested with the nematode parasite.

River Mile 81

Catches of fishes in the flowlane disposal area near RM 81 were low. Mean catches (total) with the shrimp trawl ranged from 1 fish/trawling effort in April and July 1996 and January 1997 to 4 fish/trawling effort in October 1996; mean densities ranged from 4





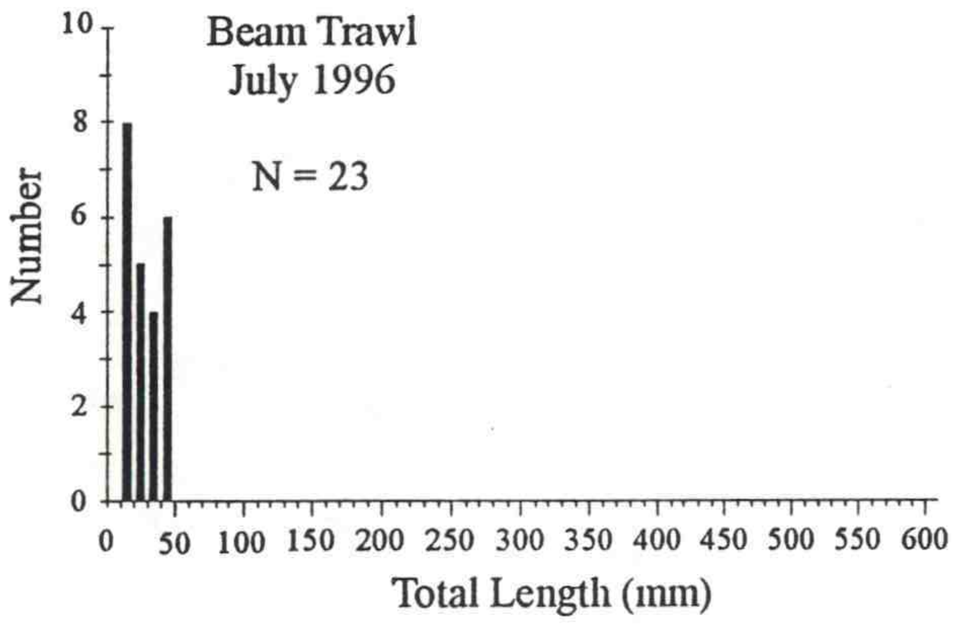


Figure 5. Length-frequency histograms for white sturgeon collected in a flowlane disposal area near River Mile 59 in the Columbia River. White sturgeon longer than 600 mm are included in the 600-mm interval.

Table 6. Catch summaries for four bottom trawling surveys conducted in a flowlane disposal area near River Mile 68 in the Columbia River; all number (no.) and number/hectare (no./ha) values are means from multiple trawling efforts. All sampling was conducted using a 7.9-m shrimp trawl.

Taxon	April 1996		July 1996		October 1996		January 1997	
	No.	No./ha	No.	No./ha	No.	No./ha	No.	No./ha
7.9-M SHRIMP TRAWL								
White sturgeon	1	4	0	0	1	3	0	0
American shad	0	0	0	0	<1	1	0	0
Chinook salmon (juv.)	<1	1	0	0	0	0	0	0
Eulachon	<1	1	0	0	0	0	0	0
Northern squawfish	0	0	0	0	<1	2	0	0
Peamouth	<1	2	0	0	2	6	0	0
Largescale sucker	<1	<1	0	0	<1	1	<1	1
Sand roller	0	0	<1	<1	0	0	0	0
Threespine stickleback	<1	1	<1	1	0	0	0	0
Black crappie	0	0	0	0	<1	<1	0	0
Prickly sculpin	0	0	<1	1	0	0	0	0
Unidentified sculpin	0	0	0	0	<1	2	0	0
Starry flounder	0	0	0	0	<1	<1	0	0
	--	--	--	--	--	--	--	--
Total	2	10	<1	2	4	15	<1	1

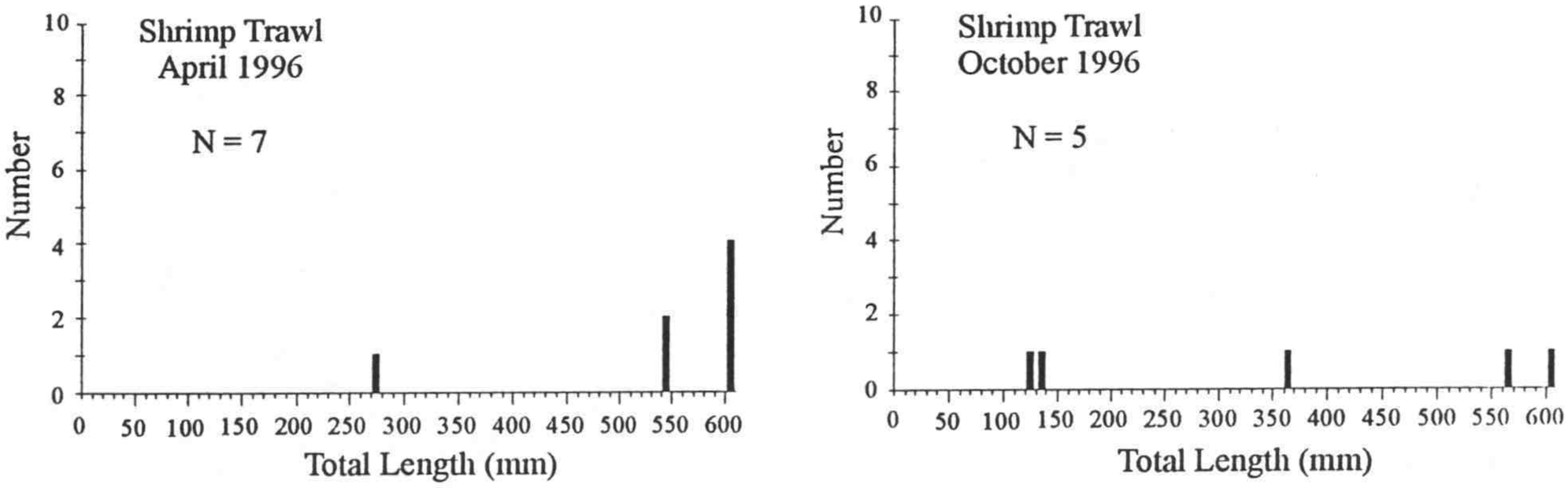


Figure 6. Length-frequency histograms for white sturgeon collected in a flowlane disposal area near River Mile 68 in the Columbia River. White sturgeon longer than 600 mm are included in the 600-mm interval.

fish/hectare in April 1996 and January 1997 to 20 fish/hectare in October 1996 (Table 7). Fish taxa captured in the flowlane disposal area near RM 81 included white sturgeon, American shad, northern squawfish, peamouth, leopard dace (*Rhinichthys falcatus*), largescale sucker, threespine stickleback, prickly sculpin, unidentified sculpin, and starry flounder.

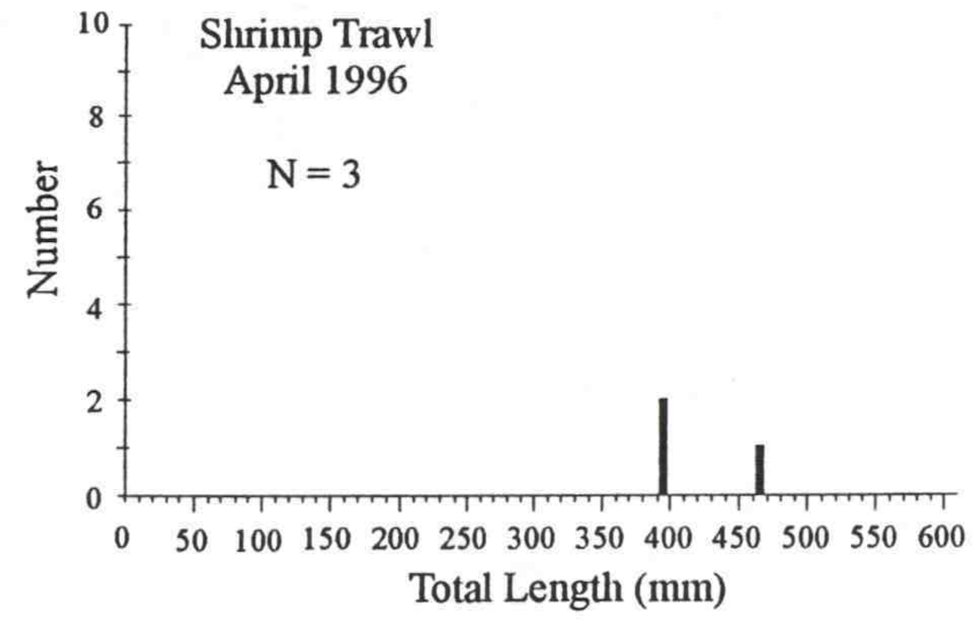
White sturgeon were captured in the flowlane disposal area near RM 81 during all four surveys. Densities of white sturgeon averaged ≤6 fish/hectare (Table 7). We collected 22 white sturgeon during the 4 surveys; none of these were larval or small young-of-the-year sturgeon (Fig. 7). Three (17%) of 18 juvenile white sturgeon examined for *Cystoopsis acipenseri* were infested with the nematode parasite.

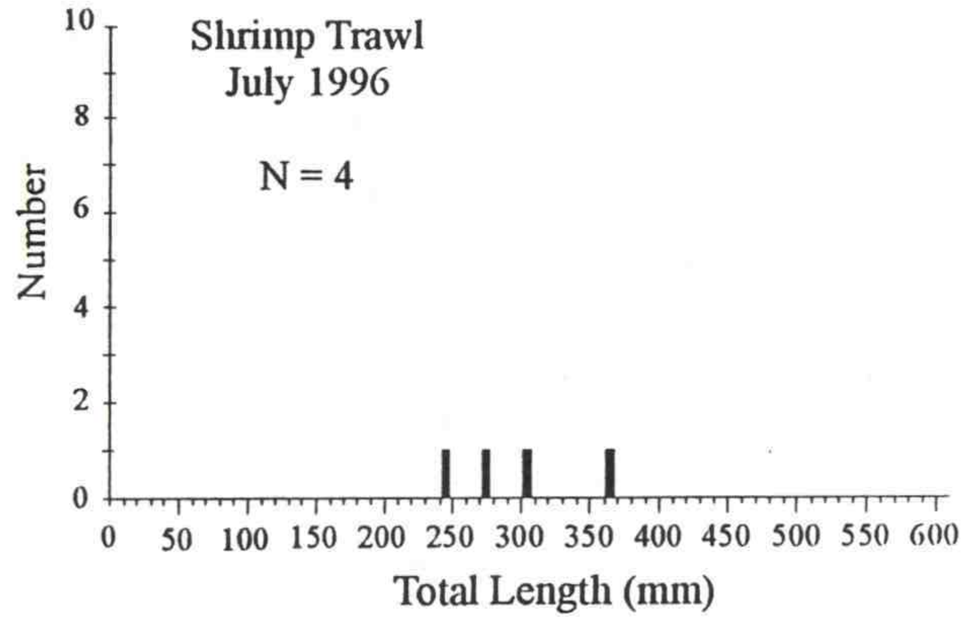
DISCUSSION

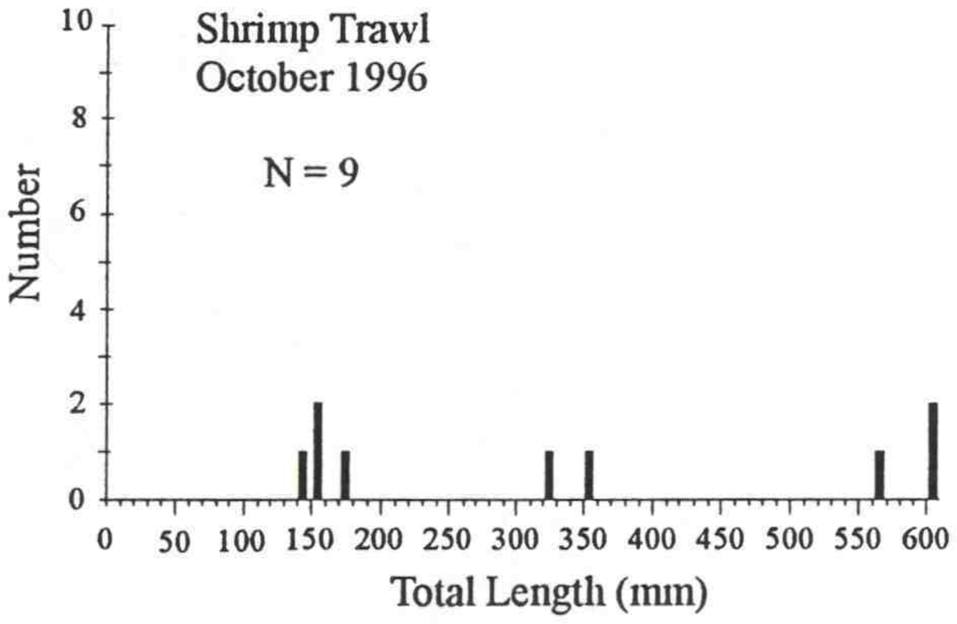
White sturgeon are distributed throughout the Columbia River downstream from Bonneville Dam (RM 145), with certain habitats being more important to different life history stages. White sturgeon spawning occurs primarily in the fast-flowing reach just downstream from Bonneville Dam from late April or early May through late June or early July (McCabe and Tracy 1994). After hatching from eggs into yolk sac larvae, the larvae are dispersed widely downstream by river currents. In laboratory experiments, Brannon et al. (1985) observed that white sturgeon larvae moved into the water column immediately after hatching. After completion of the water column phase, the white sturgeon larvae entered a hiding phase in the substrate cover, and finally an active feeding stage before metamorphosing into postlarval (young-of-the-year) sturgeon. The larval white sturgeon we collected in the flowlane disposal areas were probably either in the hiding or active feeding stage.

Table 7. Catch summaries for four bottom trawling surveys conducted in a flowlane disposal area near River Mile 81 in the Columbia River; all number (no.) and number/hectare (no./ha) values are means from multiple trawling efforts. The 3.0-m beam trawl was used only in July 1996.

Taxon	April 1996		July 1996		October 1996		January 1997	
	No.	No./ha	No.	No./ha	No.	No./ha	No.	No./ha
7.9-M SHRIMP TRAWL								
White sturgeon	<1	2	<1	3	1	6	1	4
American shad	0	0	0	0	1	4	0	0
Northern squawfish	0	0	<1	<1	0	0	0	0
Peamouth	<1	2	0	0	1	3	0	0
Leopard dace	0	0	0	0	<1	<1	0	0
Largescale sucker	0	0	<1	1	0	0	0	0
Threespine stickleback	0	0	0	0	<1	<1	0	0
Prickly sculpin	0	0	0	0	1	5	0	0
Unidentified sculpin	<1	<1	<1	1	<1	1	0	0
Starry flounder	0	0	0	0	<1	1	0	0
	--	--	--	--	--	--	--	--
Total	1	4	1	5	4	20	1	4
3.0-M BEAM TRAWL								
No fishes were collected with the beam trawl.								







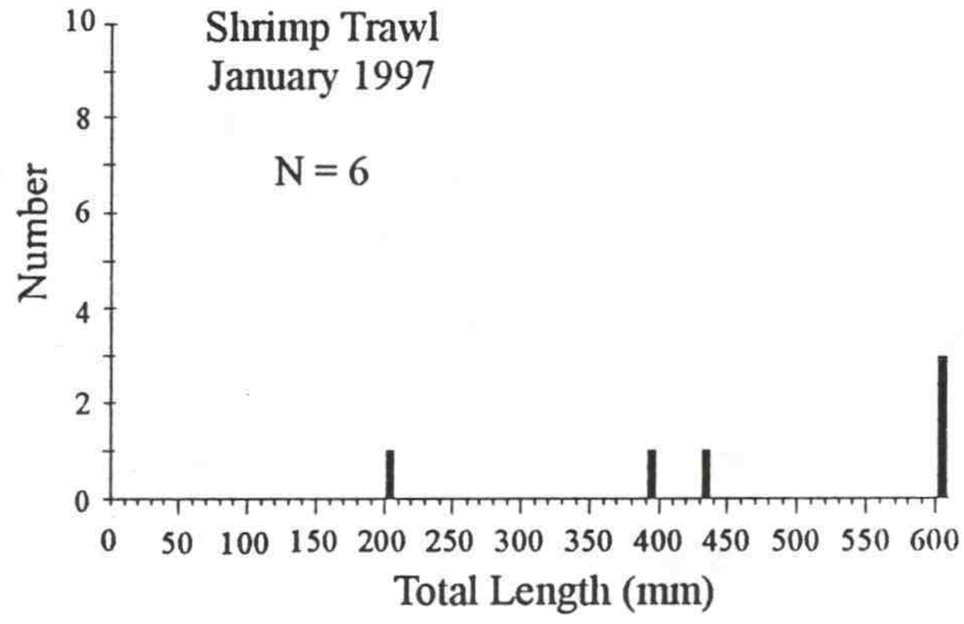


Figure 7. Length-frequency histograms for white sturgeon collected in a flowlane disposal area near River Mile 81 in the Columbia River. White sturgeon longer than 600 mm are included in the 600-mm interval.

Larval or small young-of-the-year white sturgeon, or both, were collected in July 1996 in four of the six flowlane disposal areas: RM 24, RM 37, RM 41, and RM 59, with highest catches occurring at RM 37, RM 41, and RM 59. Catches at RM 24 may have been lower than catches at RM 37, RM 41, and RM 59 because of its proximity to salt water in the Columbia River estuary. During low river flows and neap tides, the maximum salinity along the channel bottom at RM 24 is between 15 and 25 parts per thousand (ppt) (Fox et al. 1984). Although maximum bottom salinities would have been lower than 15 ppt when we sampled in July 1996, maximum salinities would have increased as river flows decreased later in the summer and fall. Brannon et al. (1985) observed that larvae and small young-of-the-year white sturgeon were unable to tolerate salinities >11 ppt in a laboratory experiment.

The distribution of juvenile white sturgeon in the Columbia River downstream from Bonneville Dam is patchy (McCabe and Hinton 1991, McCabe 1996). Densities of juvenile white sturgeon collected with the 7.9-m shrimp trawl in main channel habitats similar to the six flowlane disposal areas we sampled can vary widely, ranging from 0 to >800 fish/hectare (NMFS unpubl. data). Estimated mean densities of juvenile white sturgeon at two proposed dredged-material rehandling sites in the lower Columbia River ranged from 0.3 to 13.6 fish/hectare depending upon the area and month in a study by Johnson and Fishman (1996). These investigators used a 7.9-m semiballoon otter trawl, similar to the one we used, to sample for juvenile white sturgeon. In the six flowlane disposal areas we sampled, mean densities of juvenile white sturgeon (calculated using shrimp trawl data), ranged from 0 to 7 fish/hectare depending upon the area and month. In four of the five flowlane disposal areas where we could use the beam trawl, estimated densities of white sturgeon were higher using data collected with the beam trawl than for data collected with the shrimp trawl (Tables 2-7).

The beam trawl had much smaller mesh than the shrimp trawl and was able to collect larval and small young-of-the-year white sturgeon more effectively.

Based on past research in the Columbia River downstream from Bonneville Dam, it appears that juvenile white sturgeon prefer deepwater habitats, at least during daylight. McCabe and Hinton (1991) noted a significant difference ($P < 0.01$) among juvenile white sturgeon densities when grouped by three depth ranges (maximum depth). At depths $\geq$18.3 m, the mean density was 45 $\pm$ 126 fish/hectare, and at depths $\leq$9.0 m, the mean density was 1 $\pm$ 3 fish/hectare. The mean density at depths from 9.1 to 18.2 m was 6 $\pm$ 13 fish/hectare. McCabe and Tracy (1994) observed that young-of-the-year white sturgeon were more abundant in deeper water in the lower Columbia River; mean minimum depths where young-of-the-year white sturgeon were captured were $\geq$12.5 m. Minimum depths in the six flowlane disposal areas we sampled frequently exceeded 12.5 m (Appendix Table 1).

It is uncertain how the white sturgeon collected in the six flowlane disposal areas were utilizing the deepwater habitat. Many of the juvenile white sturgeon collected may have been rearing and feeding in the flowlane disposal areas. In the Columbia River downstream from Bonneville Dam, juvenile white sturgeon <800 mm total length typically feed on benthic invertebrates, particularly the amphipod *Corophium salmonis* (Muir et al. 1988, McCabe et al. 1993). In addition, the deepwater habitat in the flowlane disposal areas may serve as a refuge for larval and small young-of-the-year white sturgeon. Survival for larval and small white sturgeon may be lower in shallow-water habitats where there are potentially more predators.

The two bottom trawls that we used to collect white sturgeon are relatively ineffective at capturing larger juvenile (>915 mm total length) and adult white sturgeon. Therefore, it is

possible that larger juveniles and adults were using the flowlane disposal areas, but the trawls were unable to capture many of them.

Catches of juvenile white sturgeon in the six flowlane disposal areas in January 1997 could have been affected by unusually high river flows, caused by large amounts of precipitation. Possibly the higher than normal river flows caused some juvenile sturgeon to move to lower velocity habitats outside of the flowlane disposal areas.

In conclusion, white sturgeon were present in all six flowlane disposal areas, with densities varying by area and month. Densities of larval or small young-of-the-year white sturgeon, or both, were highest in the disposal areas near RM 37, RM 41, and RM 59. Larval and small young-of-the-year white sturgeon would probably be most affected by disposal of dredged material in the flowlane disposal areas. Due to their small size, limited swimming ability, and tendency to orient with bottom habitats, these small sturgeon could be easily buried by the deposition of dredged material and die. Larger juvenile and adult white sturgeon may be able to survive in the flowlane disposal areas, depending upon the amount of material that is deposited on the fish. Laboratory research is needed to determine the mechanical impacts of flowlane disposal on white sturgeon.

This report does not constitute formal comments of the NMFS under the Fish and Wildlife Coordination Act or the National Environmental Policy Act.

ACKNOWLEDGMENTS

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REFERENCES

Brannon, E., S. Brewer, A. Setter, M. Miller, F. Utter, and W. Hershberger. 1985. Columbia River white sturgeon (*Acipenser transmontanus*) early life history and genetics study. Final Rep. to Bonneville Power Admin. by Univ. Wash. and Natl. Mar. Fish. Serv., Contract DE-AI-84BP18952. (Available from Bonneville Power Admin., Division of Fish and Wildlife-PJ, P.O. Box 3621, Portland, OR 97208.)

Chitwood, M. B., and A. McIntosh. 1950. An American host record for the Russian sturgeon nematode, *Cystoopsis acipenseri* Wagner, 1868. J. Parasitol. 36(6-2):29.

Fox, D. S., S. Bell, W. Nehlsen, and J. Damron. 1984. The Columbia River estuary: atlas of physical and biological characteristics. Columbia River Estuary Data Development Program, Astoria, OR, 87 p.

Johnson, S., and P. Fishman. 1996. Studies of dredged material rehandling sites; channel deepening feasibility study--fish sampling report. Rep. to Port of Portland and U.S. Army Corps of Engineers by Fishman Environmental Services, Portland, OR, 24 p.

McCabe, G. T., Jr. 1993. Prevalence of the parasite *Cystoopsis acipenseri* (Nematoda) in juvenile white sturgeons in the lower Columbia River. J. Aquat. Anim. Health 5:313-316.

McCabe, G. T., Jr. 1996. Report D. *In* K. T. Beiningen (editor), Effects of mitigative measures on productivity of white sturgeon populations in the Columbia River downstream from McNary Dam, and determine status and habitat requirements of white sturgeon populations in the Columbia and Snake Rivers upstream from McNary Dam, p. 110-132. Rep. to Bonneville Power Admin., Contract DE-AI79-86BP63584. (Available from Bonneville Power Admin., Division of Fish and Wildlife-PJ, P.O. Box 3621, Portland, OR 97208.)

McCabe, G. T., Jr., R. L. Emmett, and S. A. Hinton. 1993. Feeding ecology of juvenile white sturgeon (*Acipenser transmontanus*) in the lower Columbia River. Northwest Sci. 67(3):170-180.

McCabe, G. T., Jr., and S. A. Hinton. 1991. Report D. *In* A. A. Nigro (editor), Status and habitat requirements of the white sturgeon populations in the Columbia River downstream from McNary Dam, p. 145-180. Report to Bonneville Power Admin., Contract DE-AI79-86BP63584. (Available from Bonneville Power Admin., Division of Fish and Wildlife-PJ, P.O. Box 3621, Portland, OR 97208.)

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

Muir, W. D., R. L. Emmett, and R. J. McConnell. 1988. Diet of juvenile and subadult white sturgeon in the lower Columbia River and its estuary. Calif. Fish and Game 74(1):49-54.

APPENDIX

Appendix Table 1. Approximate locations of bottom trawling stations at six flowlane disposal areas in the Columbia River, April 1996 through January 1997. Each area is identified by the approximate River Mile (RM) from the mouth of the river. Station locations were determined from river charts provided by the Portland District of the U.S. Army Corps of Engineers. Depths represent a range from all surveys combined.

Area	Station	Depths (m)	Latitude	Longitude
RM 24	11	13-19	46°15.400'N	123°39.628'W
	12	14-19	46°15.419'N	123°39.628'W
	13	16-25	46°15.437'N	123°39.641'W
	14	15-25	46°15.464'N	123°39.654'W
	15	16-20	46°15.528'N	123°39.128'W
	16	15-20	46°15.546'N	123°39.128'W
	17	14-19	46°15.564'N	123°39.141'W
	18	14-20	46°15.592'N	123°39.154'W
RM 37	21	16-21	46°13.873'N	123°25.550'W
	22	16-21	46°13.873'N	123°25.525'W
	23	16-23	46°13.882'N	123°25.499'W
	24	12-23	46°13.882'N	123°25.474'W
	25	16-23	46°13.573'N	123°25.461'W
	26	18-25	46°13.573'N	123°25.435'W
	27	15-24	46°13.582'N	123°25.410'W
	28	14-22	46°13.582'N	123°25.371'W
RM 41	31	15-22	46°10.600'N	123°25.269'W
	32	12-27	46°10.609'N	123°25.243'W
	33	12-34	46°10.627'N	123°25.218'W
	34	13-18	46°10.410'N	123°25.013'W
	35	14-19	46°10.428'N	123°24.987'W
	36	14-18	46°10.446'N	123°24.962'W
RM 59	41	11-16	46°09.936'N	123°05.218'W
	42	11-16	46°09.954'N	123°05.205'W
	43	12-18	46°09.973'N	123°05.179'W
	44	14-18	46°10.000'N	123°05.154'W
	45	10-20	46°09.755'N	123°04.884'W
	46	14-20	46°09.773'N	123°04.858'W
	47	15-17	46°09.791'N	123°04.833'W
	48	16-19	46°09.819'N	123°04.807'W
RM 68	51	14-21	46°05.527'N	122°55.371'W
	52	15-21	46°05.546'N	122°55.358'W
	53	15-22	46°05.564'N	122°55.346'W
	54	16-21	46°05.591'N	122°55.320'W
	55	14-21	46°05.409'N	122°55.000'W
	56	16-23	46°05.427'N	122°54.987'W
	57	16-23	46°05.445'N	122°54.974'W
	58	17-23	46°05.464'N	122°54.962'W
RM 81	61	12-19	45°56.009'N	122°48.205'W
	62	13-19	45°56.009'N	122°48.179'W
	63	14-21	45°56.009'N	122°48.154'W
	64	13-25	45°56.009'N	122°48.128'W
	65	13-19	45°55.728'N	122°48.243'W
	66	12-20	45°55.718'N	122°48.218'W
	67	12-22	45°55.718'N	122°48.192'W
	68	12-20	45°55.718'N	122°48.166'W