STATUS AND DISTRIBUTION OF THE SAND ROLLER (*PERCOPSIS TRANSMONTANA*) IN THE WILLAMETTE BASIN, OREGON

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ABSTRACT—The sand roller, *Percopsis transmontana,* is endemic and considered rare in the lower Columbia River drainage, including the Willamette River and its tributaries. Historical records in the Willamette Basin are scarce. In 2005, we surveyed historical and some recently documented locations to determine the current distribution of sand rollers in the Willamette River basin. Sand rollers were found at 41% of the locations sampled, including most Willamette River subbasins. Sand rollers preferred slow-water habitats in low gradient streams and were most frequently associated with roots, other large wood, and undercut banks over sand or gravel substrates. Sand rollers were more common at locations containing only native fishes; larger numbers were collected at locations where nonnative fish were absent. Infrequent reporting of this species is probably related to its secretive daytime behavior and to inefficient gear, rather than to actual rarity.

Key words: sand roller, *Percopsis transmontana,* distribution, endemic, fish, minnow traps, Willamette River, Oregon

The sand roller, *Percopsis transmontana,* is 1 of 2 species of the teleost fish family Percopsidae. The widespread trout-perch, *P. omiscomaycus,* is found from the upper Mississippi drainage and the Great Lakes to the Yukon (Scott and Crossman 1973). The sand roller is endemic to the Columbia River drainage and has been collected from western Idaho (Pratt and Whitt 1952; Simpson and Wallace 1978), southern Washington (Gray and Dauble 1979; Mongillo and Hallock 1995; Wydoski and Whitney 2003), and northern and western Oregon (Dimick and Merryfield 1945; Reimers 1963; Reimers and Bond 1967). In Oregon, the sand roller has been collected from the Columbia River, the Willamette River, and several Willamette River tributaries. Because of its secretive daytime behavior, the distribution and status of this rarely encountered species in the Willamette River is largely unknown. In 1945, RE Dimick and F Merryfield found sand rollers to be localized in the middle mainstem Willamette River, Santiam River, Rickreall Creek, Mary's River, and the Coast Fork Willamette River. The Oregon State University museum collection contains specimens from the following subbasins: Coast and Middle Forks of the Willamette River, Mary's River, Luckiamute River, Molalla River, Mill Creek (Marion County), Long Tom River, and Santiam River (D Markle, Oregon State University, Corvallis, OR, pers. comm.).

The sand roller is a small perch-like fish, usually measuring <10 cm long, with spiny rays and speckles on the sides and fins. Sand rollers have blue-green coloration, ctenoid scales, and an incomplete lateral line. An unusual feature of this fish is that it has an adipose fin. Males tend to be smaller and more slender than the females (Katula 1992).

These fish are active nocturnally and are most often found in pool margins of low gradient reaches of small to large rivers (Gray and Dauble 1976, 1979). They are found around submerged roots, complex woody debris and brush, and undercut banks and generally over sandy or rocky substrates (Reimers and Bond 1967; Gray and Dauble 1979). They are also found near vegetation over sand. During the day, they have been found in pools up to 4 m deep in small depressions over sandy substrates (Gray and Dauble 1976). In deep rivers, sand rollers may exhibit diel periodicity, moving into deep waters as cover during the day and into shallow waters at night (Wydoski and Whitney 2003).

The purposes of this investigation were to update information regarding the current distribution of sand rollers in the Willamette River basin,

to compare fish communities between locations where sand rollers were collected and were not collected, to describe sand roller habitat preferences, and to estimate trapping efficiency.

Methods

The Oregon Department of Fish and Wildlife's Native Fish Investigations Project conducted surveys at 56 locations in the Willamette River drainage in 2005 (Fig. 1). All locations had prior records of sand roller occurrence. We sampled low gradient stream habitats using baited minnow traps (23 cm × 46 cm with 64-mm mesh), a 1-m × 5-m seine with 64-mm mesh, or a 0.6-m-diameter hoop net (3 m long consisting of 7 hoops with 32-mm mesh). Due to the reported nocturnal habits of sand rollers, most sampling was conducted using 24 minnow traps fished overnight (17 to 18 h). Traps were baited with ⅓ slice of whole-wheat bread and set approximately 10 m apart at stream locations that included the variety of cover types present at each sampling site. We identified and counted all fish captured. We measured fork lengths (FL) and total lengths (TL) of the sand rollers we collected at each site.

We recorded the dominant (most common) and subdominant (2nd most common) substrate types and the types of physical cover present at each site. Physical cover included large wood, submerged roots, off-channel pools, submerged aquatic vegetation, overhanging terrestrial vegetation, undercut banks, pools deeper than 1.5 m, boulders >0.5 m in diameter, and channels cut into the bedrock. Large wood was defined as wood that was at least 0.15 m in diameter and 3 m in length. The root ends of large wood were recorded separately from the trunks and were excluded from the large wood category. Substrate types included silt and organics, sand, gravel (2 to 64 mm), cobble (65 to 256 mm), boulders (>256 mm), and bedrock. We also recorded the dominant and subdominant substrate types and types of physical cover in the microhabitats where sand rollers were collected.

We used baited minnow traps to obtain mark-recapture population estimates of sand rollers at 2 locations. We fished the traps overnight, marked all sand rollers captured with a partial caudal-fin clip, and returned them to the water. Approximately 1 wk later, we again fished the traps overnight and recorded the total number of marked and unmarked sand rollers captured. We estimated population abundance using single-sample mark-recapture procedures (Ricker 1975). We calculated 95% confidence intervals using a Poisson approximation (Ricker 1975). We used population estimates to estimate trapping efficiency by dividing numbers of fish captured overnight in 24 minnow traps by estimated total sand roller abundance. No block nets were used because of large stream sizes and currents, which likely violated the assumption of no fish immigration or emigration between marking and recapture events.

Results

Sand rollers were collected from 23 of 56 locations (41%), including sites in the following subbasins: Yamhill River, Molalla River, Santiam River, Luckiamute River, Calapooia River, Big Muddy Creek, Mary's River, McKenzie River, Coast Fork Willamette River, and Middle Fork Willamette River (Table 1; Fig. 1).

The native fish species collected at locations containing sand rollers included (percent occurrence in parentheses) sculpins (*Cottus* spp., 91%), redside shiners (*Richardsonius balteatus,* 83%), speckled dace (*Rhinichthys osculus,* 57%), northern pikeminnows (*Ptychocheilus oregonensis,* 48%), threespine sticklebacks (*Gasterosteus aculeatus,* 30%), largescale suckers (*Catostomus macrocheilus,* 22%), longnose dace (*R. cataractae,* 17%), Oregon chub (*Oregonichthys crameri,* 17%), cutthroat trout (*Oncorhynchus clarki,* 9%), chiselmouth (*Acrocheilus alutaceus,* 4%), and rainbow trout (*O. mykiss,* 4%). The crayfish *Pacifastacus* sp. and *Procambarus clarkii* were also common (67%) at locations where sand rollers were present.

Nonnative fish species collected at locations containing sand rollers included (percent occurrence in parentheses) bluegills (*Lepomis macrochirus,* 22%), black crappies (*Pomoxis nigromaculatus,* 9%), brown bullheads (*Ameiurus nebulosus,* 9%), pumpkinseeds (*L. gibbosus,* 9%), largemouth bass (*Micropterus salmoides,* 4%), and western mosquitofish (*Gambusia affinis,* 4%).

Nonnative fish were present at 5 of the 23 locations where sand rollers were collected (22%), as compared to 19 of the 33 locations where sand rollers were not collected (58%). At locations where sand roller were found associated only with native fish, we captured significantly larger numbers of sand rollers ($\bar{x} = 9.8$; $s = 3.4$) than at

TABLE 1. Numbers of sand rollers (*Percopsis transmontana*) collected and presence of nonnative fish at locations surveyed in the Willamette River drainage in 2005. Sampling gear types are MTN = minnow traps fished overnight, MTD = minnow traps fished during day, SD = seining during day, and HNN = hoop net fished overnight.

Subbasin	Location	Number of sand rollers	Nonnative fish	Gear
Lower Willamette River	Cedar Island Alcove	0	no	MTN
	Champoeg Creek	0	no	MTN
	Goat Island	0	no	MTN
	Meldrum Bar	0	yes	MTN
	Mission Slough	0	yes	MTN
	Rocky Beach	0	yes	MTN
	Ross Island Channel	0	yes	MTN
Yamhill River	Yamhill River	0	yes	MTN
	South Yamhill River	52	no	MTN
Molalla River	Molalla River	0	no	MTN
	Pudding River 1	0	no	MTN
	Pudding River 2	0	no	MTN
Lower Willamette River	Sidney Ditch	1	no	MTN
Rickreall Creek	Rickreall Creek	0	yes	MTN
Mill Creek	Mill Creek	0	no	SD
	Mirth Lake	0	yes	SD
Santiam River	Santiam River 1	5	yes	MTN
	Santiam River 2	0	yes	SD
	Santiam River 3	0	yes	SD
	Santiam River 4	0	no	SD
	Santiam River 5	0	yes	SD
	Santiam River 6	0	yes	SD
South Santiam River	South Santiam River 1	0	yes	MTN
	South Santiam River 2	1	yes	SD
	Beaver Creek	0	yes	MTN
	Hamilton Creek	21	no	MTN
	Thomas Creek	0	yes	MTN
Luckiamute River	Luckiamute River	21	no	MTN
	Rittner Creek	0	no	MTN
Calapooia River	Calapooia River 1	0	yes	MTN
	Calapooia River 2	3	yes	MTN
Big Muddy Creek	Big Muddy Creek	1	no	MTN
	Dry Muddy Creek 1	12	no	MTN
	Dry Muddy Creek 2	0	no	MTN
Marys River	Marys River 1	80	no	MTN
	Marys River 1	1093[a]	no	MTN
	Marys River 2	9	no	MTN
	Marys River 3	0	no	MTN
	Beaver Creek	2	no	MTN
	Bull Run Creek	2	no	MTN
	Muddy Creek	0	yes	MTN
Long Tom River	Long Tom River 1	0	no	MTD
	Long Tom River 2	0	yes	MTD
McKenzie River	Cedar Creek 1	40	no	MTN
	Cedar Creek 1	451[a]	no	MTN
	Mohawk River 1	0	no	MTD
	Mohawk River 1	9	no	MTN
	Mohawk River 2	1	no	MTD
	Mohawk River 2	2	no	MTN
	Mohawk River 3	0	no	MTD
	Mohawk River 3	5	no	MTN
	Mohawk River 4	1	no	MTN
	Green Island	0	yes	MTN
Coast Fork Willamette River	Coast Fork Willamette River	1	yes	MTN
	Camas Swale	4	yes	MTN
	Silk Creek	0	no	MTN
	Lynx Hollow	6	yes	MTD
	Lynx Hollow	16	no	MTN
Middle Fork Willamette River	Dexter Reservoir	0	yes	HNN
	Lookout Point Reservoir	0	no	HNN
	Lost Creek	3	no	MTN

[a] Mark-recapture population estimate.

sites where nonnative fish were also present ($\bar{x}$ = 0.8; s = 0.4) (t = −2.80, df = 28, P = 0.009). To minimize bias related to differential gear efficiencies, we only included sites where minnow traps were fished overnight.

When we compared the number of sand rollers captured using minnow traps fished during the day and overnight, larger numbers of sand rollers were captured overnight ($\bar{x}$ = 8.0; s = 6.1) than during the day ($\bar{x}$ = 1.8; s = 2.9), although these differences were not significant (t = −1.87, df = 4, P = 0.135). However, at 2 of these locations, no sand rollers were captured during the day sets. Seining was conducted at 4 locations where sand rollers were collected in minnow traps; no sand rollers were captured in the seines at these locations.

Population estimates obtained in segments of Cedar Creek and the Mary's River indicate that our trapping methods (24 minnow traps fished overnight) captured approximately 9% of the sampled populations. We estimated 451 sand rollers (95% CI = 183 to 902 fish) in Cedar Creek, and captured 40 fish (8.9% of estimate) and 43 fish (9.5% of the estimate) during marking and recapture events, respectively. We estimated 1093 sand rollers (95% CI = 542 to 2049 fish) in the Mary's River, and captured 80 fish (7.3% of estimate) and 101 fish (9.2% of the estimate) during marking and recapture events, respectively. These results suggest that our trapping protocols were relatively effective at capturing sand rollers and that these fish may be locally abundant at several of the sampling locations.

The length-frequency distributions of sand rollers in the Willamette Basin varied among locations (Fig. 2). Fish ranged from 42 to 95 mm TL (39 to 87 mm FL). Although most locations had only 1 definitive peak for measured lengths, these peaks frequently occurred around 45 to 50 mm FL and 60 to 65 mm FL. These peaks are similar to the mean sizes of age 1 (45 mm FL) and age 2 (67 mm FL) sand rollers in the lower Columbia River (Gray and Dauble 1979). Probable overlap in the range of lengths for the different age classes complicates interpretation and reduces the utility of the length histograms.

Sand rollers were captured primarily near large wood, undercut banks, and roots (Table 2). These cover types were common at the locations sampled. Sand rollers were occasionally captured in off-channel pools, deep pools, and submerged vegetation. In many cases, a combination of cover types was present (for example, roots and undercut banks) at locations where sand rollers were captured. Sand rollers were primarily associated with sand (dominant substrate at 48% of sites and subdominant substrate at 26% of sites) and gravel substrates (dominant substrate at 26% of sites and subdominant substrate at 30% of sites), which were typical of the low gradient stream segments sampled.

Discussion

Sand rollers were collected from locations throughout the Willamette River Basin. Our sampling targeted areas where sand rollers had been collected in the past, including locations for sand rollers catalogued in the OSU museum collection, as well as locations reported (mostly unpublished) by other fisheries biologists working in the drainage.

Minnow traps fished overnight appeared to be an effective method for determining the presence of sand rollers in small to medium-sized low gradient tributaries to the Willamette River. This is consistent with reports that sand rollers are active nocturnally and infrequently encountered during daylight hours (Gray and Dauble 1976, 1979). Minnow traps fished during the day and seining were much less effective at capturing sand rollers. These methods did not capture sand rollers at several sites where their presence was confirmed using minnow traps fished overnight. We did not capture any sand rollers from locations sampled in the mainstem Willamette River. Other fisheries biologists have reported collecting them in recent years from these habitats using backpack electrofishing (R Wildman, Oregon State University, Corvallis, OR, pers. comm.), boat electrofishing (Friesen and others 2003), or large beach seines (Schroeder and Kenaston 2004). Minnow traps may be less effective in these large mainstem habitats. However, electrofishing can be more harmful to the fish and is often restricted where listed fish are present. A trade-off exists between capture efficiency and potential fish injury or mortality.

Sand rollers were frequently associated with complex cover (large wood, roots, or undercut banks) over sand or gravel substrates. Sites where complex cover was absent frequently

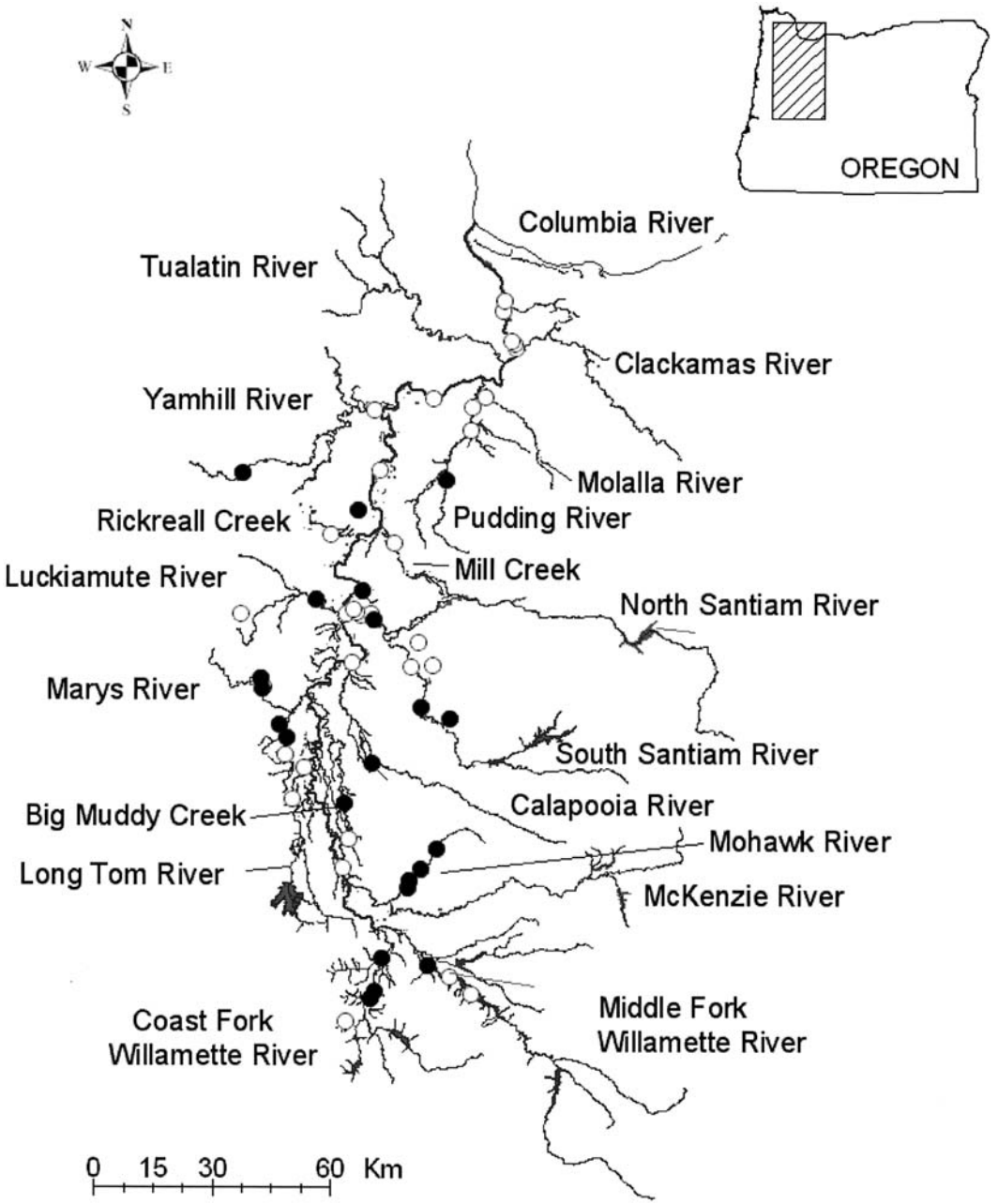

FIGURE 1. Survey locations for sand rollers (*Percopsis transmontana*) in the Willamette River drainage in 2005. Closed circles indicate sample locations where sand rollers were collected. Open circles indicate sample locations where no sand rollers were collected.

yielded no sand rollers. Many sites in the mainstem Willamette River had little or no complex cover. Although others have reported sand rollers either to occur as solitary individuals or to be territorial (Gray and Dauble 1976; Wydoski and Whitney 2003), at the 5 locations where we captured larger numbers of sand rollers (>20 fish), we found 10 or more fish in single traps.

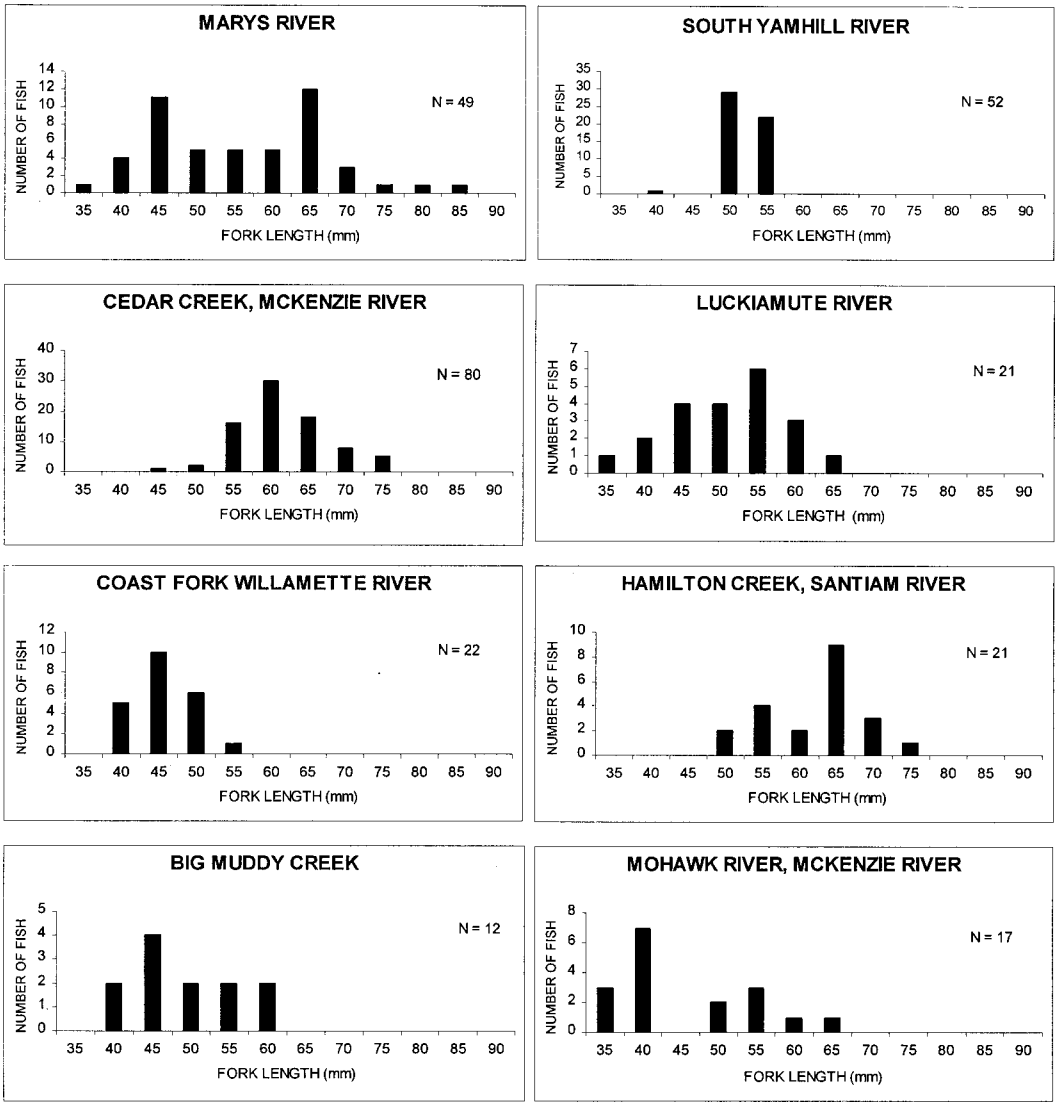

FIGURE 2. Length-frequency histograms for sand rollers (*Percopsis transmontana*) collected using minnow traps from 8 locations in the Willamette River drainage.

It is difficult to discern whether this indicates schooling behavior, reflects substantial nocturnal movements, or was simply a result of fish being attracted to the bait.

This species is highly vulnerable to predation because of its small size, especially if adequate cover is lacking. Zimmerman (1999) and Poe and others (1991) reported predation on sand rollers by walleye (*Sander vitreus*), smallmouth bass (*M. dolomieu*), northern pikeminnows, and channel catfish (*Ictalurus punctatus*). We captured larger numbers of sand rollers in habitats where nonnative fish were not collected and captured substantially lower numbers in habitats where nonnative fish were present.

In summary, sand rollers were found throughout the Willamette Basin in medium to large, low gradient streams over sand and gravel stream substrates. Infrequent reporting of this species is probably related to secretive daytime behavior and inefficient gear rather than to actual rarity. Further, based on our as-

TABLE 2. Types of instream cover available and utilized at locations (n = 23) containing sand rollers (*Percopsis transmontana*). Note that most locations had more than 1 type of cover available.

Types of physical cover	Available	Utilized	Percent of available cover type utilized
Large wood	15	12	80
Undercut banks	13	8	62
Roots	9	8	89
Submerged vegetation	6	1	17
Bedrock channels	4	0	0
Overhanging vegetation	3	0	0
Boulders	2	0	0
Off-channel pools	1	1	100
Deep pools	3	1	33

sessment of gear efficiency, it appears that some populations are relatively abundant. We identified large woody debris, roots, and undercut banks as important physical habitat types. Management practices to protect sand roller habitats should minimize land use activities that would reduce the presence these habitat features. Restricting the introduction and movements of nonnative fish in sand roller habitats is also advised. Future research and monitoring should include periodic surveys to reassess the distribution of sand rollers and further testing of alternative gear to improve sampling efficiency in larger stream channels.

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