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A FISH SURVEY OF THE WHITE RIVER, NEVADA

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Abstract.—In spring and summer 1991 and 1992, we surveyed fishes of the White River system, Nye and White Pine Counties, Nevada, to determine the status of natives. There are 5 known native fishes to the White River: *Lepidomeda albivallis* (White River spinedace), *Crenichthys baileyi albivallis* (Preston White River springfish), *Crenichthys baileyi thermophilus* (Moorman White River springfish), *Catostomus clarki intermedius* (White River desert sucker), and *Rhinichthys osculus* ssp. (White River speckled dace). All 5 had declined in range. *Lepidomeda albivallis* had experienced the greatest decline, with less than 50 remaining, and these were restricted to a 70-m stream reach. *Rhinichthys osculus* spp. was most widespread, found in 18 spring systems. *Cottus bairdi* (mottled sculpin) was collected for the 1st time from the White River system, where it was probably native. Protective measures should be implemented to conserve all native White River fishes to include *C. bairdi*.

Key words: fish survey, spinedace, sculpin, springfish, desert sucker, speckled dace, White River, Colorado River, largemouth bass.

Native fishes of the White River system, Nye and White Pine Counties, Nevada, are endemic, and all have declined due to habitat alteration and nonnative fish introductions (Deacon 1979, Courtenay et al. 1985, Miller et al. 1989). Endemism is a result of isolation after desiccation of the pluvial White River, which until about 10,000 years ago flowed from interior Nevada to the lower Colorado River. Today's White River is an interior basin vestige of the pluvial White River and, because of the river's prehistoric linkage, White River fishes display close taxonomic affinity with lower Colorado River fishes (Hubbs and Miller 1948).

Five native fishes were known from the White River system: *Lepidomeda albivallis* (White River spinedace), *Rhinichthys osculus* ssp. (White River speckled dace), *Catostomus clarki intermedius* (White River desert sucker), *Crenichthys baileyi albivallis* (Preston White River springfish), and *Crenichthys baileyi thermophilus* (Moorman White River springfish). *Lepidomeda albivallis* was, because of its rarity and extirpation from most of its historic range, federally listed as endangered (U.S. Fish and Wildlife Service 1985). By 1988 it was reported from only a single spring system (D. Withers, U.S. Fish and Wildlife Service, personal communication). The other natives also declined and were considered for listing (U.S. Fish and Wildlife Service 1991).

There has been no comprehensive survey of White River fishes since the 1930s (Miller and Hubbs 1960), leaving the possibility of undiscovered populations. In this paper we report status and distribution of White River native fishes.

Study Area

The White River is the northernmost relic of the prehistoric pluvial White River, which flowed from east central Nevada south to the Virgin River, and then to the Colorado River (Hubbs and Miller 1948). Two other relic waters are Pahranagat Creek (a.k.a. Pahranagat River) and Muddy River (a.k.a. Moapa River) along the mid- and terminal reach, respectively (Fig. 1). The primary water source of the 3 relic reaches is thermal springs (Eakin 1966, Garside and Schilling 1979).

The largest contributing springs to the White River are in the upper and lower White River valley (Fig. 1). Upper valley springs are Preston Big, Arnoldson, Nicholas, Cold, and Indian Springs, collectively referred to as Preston Springs (Maxey and Eakin 1949), and Lund, a large spring several kilometers south of these (Figs. 1, 2). Cumulative discharge for these springs is about 0.6 $m^3 \cdot s^{-1}$ (Maxey and Eakin 1949); water temperature of Preston Springs

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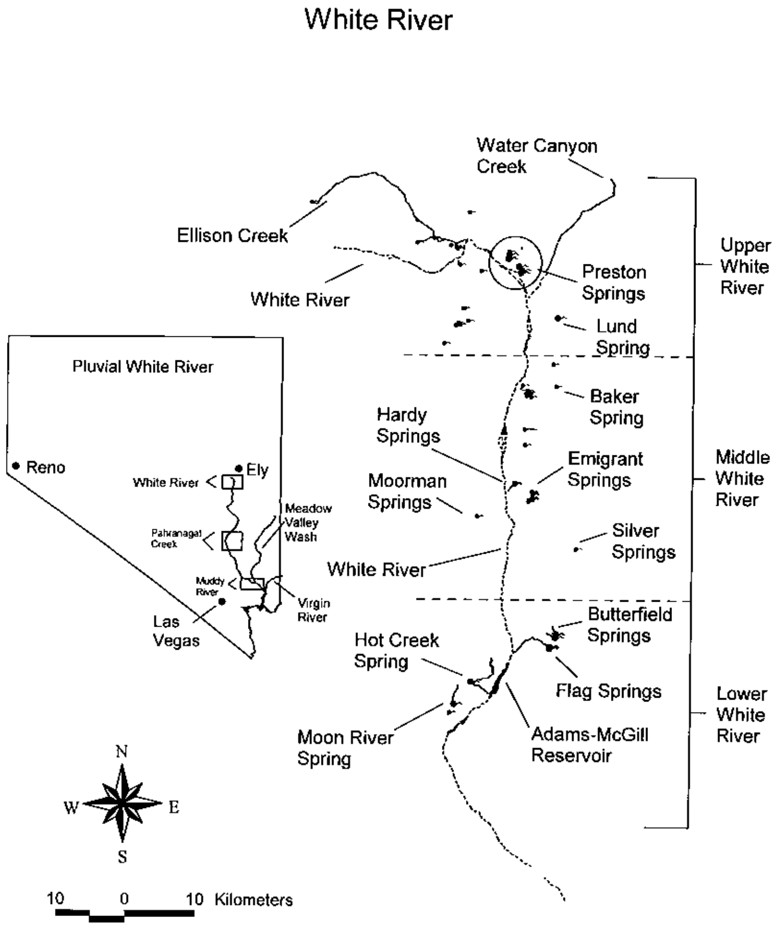

Fig. 1. Map of the White River System showing distribution of major springs. Inset: White River in relation to the State of Nevada and the pluvial White River.

ranges from 20°C to 23°C and Lund Spring is 18.5°C. Upper White River springs were the only localities for *C. b. albivallis* and the only ones with the community of *L. albivallis, R. osculus, C. c. intermedius,* and *C. b. albivallis* (Miller and Hubbs 1960, Williams and Wilde 1981). Large springs in lower White River are Flag, Butterfield, Hot Creek, and Moon River Springs (Figs. 1, 3), and their cumulative discharge is also about 0.6 $m^3 \cdot s^{-1}$ (Maxey and Eakin 1949). Hot Creek, Moon River, and Moorman Springs in the middle reach of White River are the warmest (30°–34°C) and are inhabited by *C. b. thermophilus.* There was no survey record for the Butterfield Springs system. Flag Springs harbored *L. albivallis, C. c.* Springs was the last site in which *L. albivallis* was known to exist (D. Withers, U.S. Fish and Wildlife Service, personal communication).

There are 4 known nonnative fish species established in the White River system. *Poecilia reticulata* (guppy) established in Preston and Lund Springs prior to 1961 (Deacon et al. 1964). *Micropterus salmoides* (largemouth bass) was stocked in Adams-McGill Reservoir (Fig. 3), which was a source of invaders to Hot Creek (Courtenay et al. 1985) and Flag Springs (D. Withers, U.S. Fish and Wildlife Service, personal communication) until fish barriers were installed. White River and Ellison Creek support populations of *Salmo trutta* (brown trout)

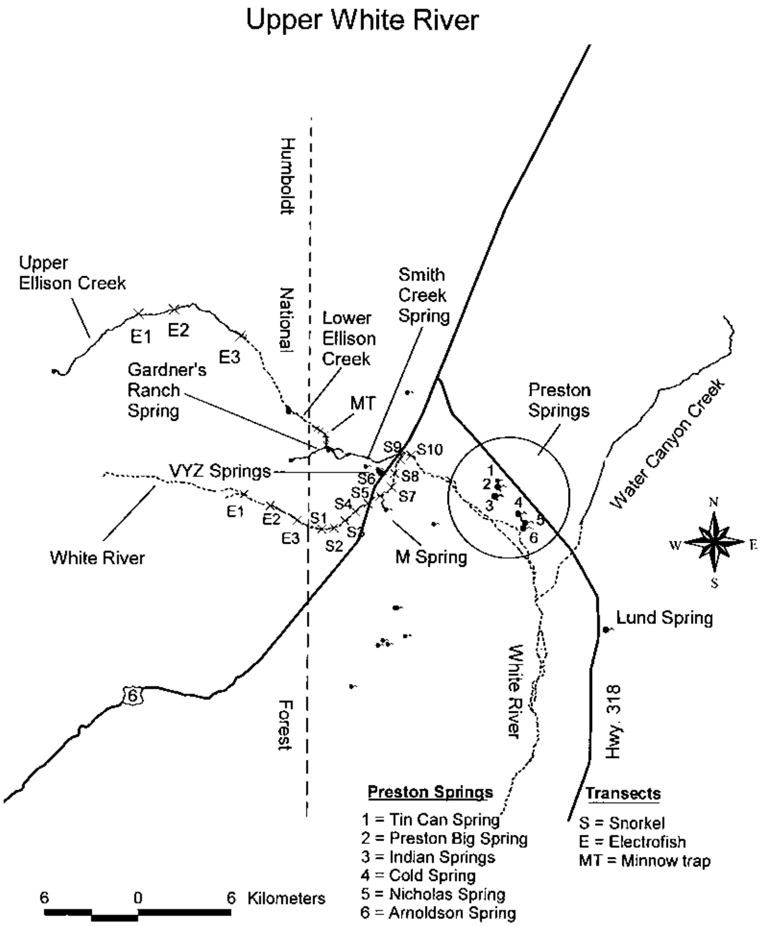

Fig. 2. Map of the upper White River system showing the large springs and sampling locations on the White River and Ellison Creek.

Materials and Methods

White River valley perennial water sources include the upper White River, Ellison Creek, Water Canyon Creek (Fig. 1), and 30 spring systems. Sampling was during drought years 1991 and 1992 when perennial water in the White River was intermittent and limited to the upper 25 km. Methods included snorkeling, electrofishing (Smith Root Type VII), using standard galvanized 6-mm-mesh "Gee" traps baited with dry dog food, and observing from banks. We report the fish species and number encountered at each system.

The upper 25 km of the White River and Ellison Creek were the most extensive systems, and agricultural diversions. Perennial reaches within Humboldt National Forest (herein White River Humboldt National Forest and Upper Ellison Creek, respectively) were managed for trout, reducing the likelihood of native fish presence. Thus, we electrofished only three 50-m segments in these reaches (Fig. 2). Perennial segments downstream from Humboldt National Forest (White River Highway 6 and Lower Ellison Creek) had warmer water without trout and were sampled with greater effort. We snorkeled a 100-m reach every kilometer for 10 km along White River Highway 6 and fished a total of 5 minnow traps spaced 150–200 m apart on Lower Ellison Creek (Fig. 2).

We sampled sufficiently deep (>5 cm)

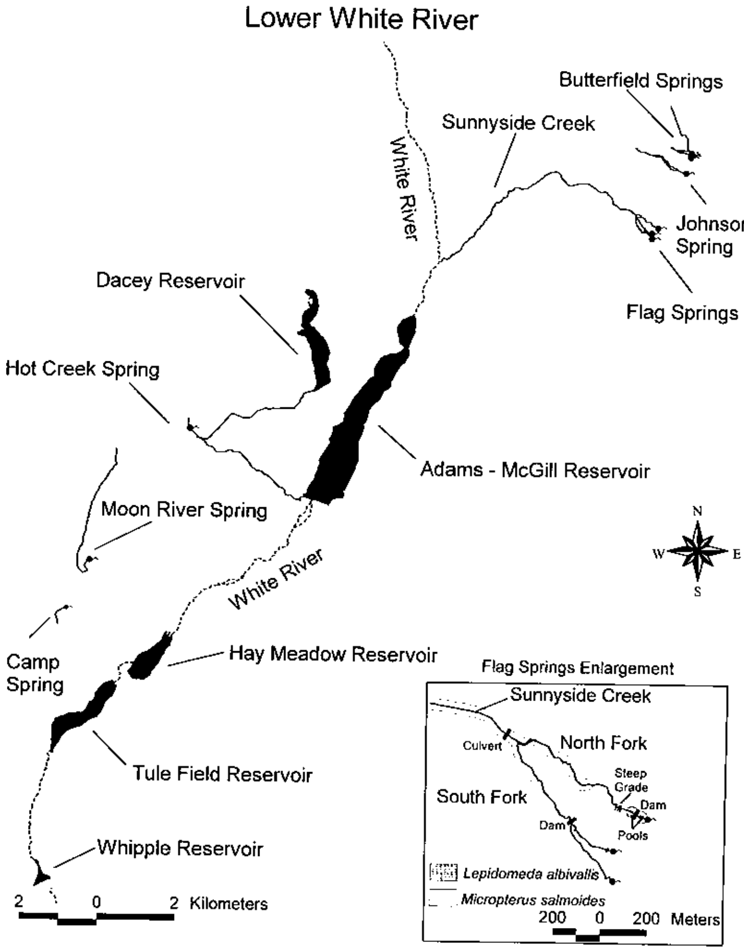

Fig. 3. Map of the lower White River system showing the large springs and their relationship to reservoirs on the Wayne E. Kirch Wildlife Management Area. Inset is map of Flag/Sunnyside Springs system showing the distribution of the last known population of *Lepidomeda albivallis* and distribution of *Micropterus salmoides* in summer 1991 and 1992.

spring systems. Typically, these areas were the spring pool where the stream emerged, an earthen ditch, and in some cases a reservoir along or at the terminus of the channel.

Results

Native Fishes

Lepidomeda albivallis was found in only 1 (Flag Springs/Sunnyside Creek) of 7 waters from which it had been collected previously (Table 1). Only 37 individuals were sighted, all of which appeared adult (>70 mm FL). They occupied 2 pools in the upper 70 m of the Figs. 1, 3). A 2-m-high dam separated the 2 pools, and a steep gradient separated the downstream pool from the rest of the North Fork and the predacious *Micropterus salmoides*.

Rhinichthys osculus ssp. was widely distributed, inhabiting 18 spring systems compared to 4 or fewer for other natives (Table 1). It was extirpated from Cold and Nicholas Springs. Greatest number captured or observed was in Indian (1105) and Preston Big (699).

Catostomus clarki intermedius was extirpated from 4 sites where it once co-occurred with *L. albivallis*, *C. b. albivallis*, and *R. osculus* ssp. It had limited distribution and, where found, ABLE 1. Distribution and relative abundance of fishes within the White River system, Nevada. Springs without fish are not included. E = extirpated, P = present but not counted, = not found. Springs named by the authors are indicated by the pound or number symbol (#), and entire populations are noted with an asterisk (*).

	Native fishes						Nonnative fishes			
er resources	*L. albivallis*	*R. osculus*	*C. c. intermedius*	*C. b. albivallis*	*C. b. thermophilus*	*C. bairdi*	*M. salmoides*	*P. reticulata*	*S. trutta*	*O. mykiss*
ER WHITE RIVER SYSTEM										
rnoldson Spring	E	14	E	234	—	—	—	183	—	—
old Spring	E	E	E	E	—	—	—	28	—	—
pper Ellison Creek	—	—	—	—	—	—	—	—	—	13
ower Ellison Creek	—	46	—	—	—	—	—	—	—	—
ardner's Ranch Spring#	—	10	—	—	—	—	—	—	—	—
ndian Springs	—	1105	—	206	—	—	—	—	—	—
und Spring	E	190*	90*	E	—	—	—	>5000	—	—
I Spring#	—	64	—	—	—	—	—	—	—	—
icholas Spring (a.k.a. Preston Town Spring)	E	E	E	40*	—	—	—	>800	—	—
reston Big Spring	E	699	E	983	—	—	—	—	—	—
mith Creek Spring	—	39	—	—	—	—	—	—	—	—
in Can Spring#	—	P	—	—	—	—	—	—	—	—
YZ Springs#	—	6192	—	—	—	—	—	—	—	
/hite River										
Humboldt National Forest	—	—	—	—	—	—	—	—	16	—
Highway 6	E	225	1	—	—	—	—	—	—	—
DDLE WHITE RIVER SYSTEM										
aker Spring#	—	618	—	—	—	—	—	—	—	—
Reservoirs	—	—	—	—	—	—	1	—	—	14
migrant Springs	—	16	—	—	—	—	—	—	—	—
Reservoir	—	—	—	—	—	—	163	—	—	—
lardy Springs	—	117	—	—	—	—	—	—	—	—
Ioorman Springs	—	—	—	—	205	—	—	—	—	—
ilver Springs Reservoir	—	—	—	—	—	—	201	—	—	—
VER WHITE RIVER SYSTEM										
utterfield Springs	—	20	—	—	—	25	—	—	—	—
amp Spring	—	84	—	—	—	—	—	—	—	—
lag Springs/ Sunnyside Creek	37*	359*	7*	—	—	—	3	—	—	—
Iot Creek Spring	—	—	—	—	<50*	—	95*	—	—	—
ohnson Spring#	—	2	—	—	—	—	—	—	—	—
Ioon River Spring	—	—	—	—	306	—	—	—	—	—

greatest number, 90, was encountered in Lund Spring. This spring had little emergent vegetation and suckers were observed under roots and banks. Co-occurring native fishes were *L. albivallis* in northernmost Flag Springs and *R. osculus* ssp. at all sites. Nonnative cohabitants were *P. reticulata* and *M. salmoides*, each at a single site.

Crenichthys baileyi albivallis was extirpated from Cold and Lund Springs. The greatest number encountered was 983 in Preston Big Spring and the least was 40 in Nicholas Spring. Co-occurring fishes were *R. osculus* ssp. in Preston, Indian, and Arnoldson Springs and *P. reticulata* in Arnoldson and Nicholas Springs.

We observed tens of thousands of *C. b. thermophilus* on 10 June 1991 in the upper 100 m of Hot Creek. The population had declined markedly to a count of only 5656 *C. b. thermophilus* by 25 July 1991 after an invasion of *M. salmoides*. By 12 September 1991 less than 50 *C. b. thermophilus* were observed hiding in emergent vegetation near the spring head. *Crenichthys baileyi thermophilus* was the only fish at Moon River and Moorman Springs.

Previously Unreported Species

On 23 July 1991 we discovered a population of *Cottus* in the upper 120 m of Butterfield Springs. We counted only 25 hiding under watercress (*Rorippa* sp.) and estimate a total population of probably less than 100. Carl Bond, Oregon State University, identified 9 specimens that we had collected as an unprickled form of *Cottus bairdi*. Fish (>50 mm FL) were found over sandy gravel, and smaller fish over sandy silt. *Rhinichthys osculus* ssp. was the only cohabitant.

Nonnative Fishes

Micropterus salmoides, the most widespread nonnative species in the White River system, was in 5 spring systems (Table 1). It was introduced to reservoirs along Baker, Emigrant, and Silver Springs. In Hot Creek and Flag Springs systems, it apparently invaded from reservoirs on the Wayne E. Kirch Wildlife Management Area, and in both systems it had crossed barriers installed to exclude it.

Poecilia reticulata was predominant in Lund, Arnoldson, and Nicholas Springs and the only fish in Cold Spring (Table 1). *Oncorhynchus mykiss* inhabited Upper Ellison Creek and headwaters of the main stem White River within the Humboldt National Forest.

Discussion

Lepidomeda albivallis is the rarest of White River native fishes, with fewer than 50 fish remaining and having been extirpated from 6 of 7 spring systems. *Catostomus clarki intermedius* exhibited the 2nd greatest decline; it has been extirpated from 4 spring systems and is represented by few fish where the species occurs. The rarity of these 2 species suggests they were most sensitive to alteration of White River system aquatic habitats. Extirpation of both from the Preston Springs complex occurred some time after physical isolation of individual springs in 1973, and copper sulfate treatment for aquatic plant control was probably a contributing factor in Preston Big Spring (Courtenay et al. 1985). Similarly, *C. clarki* ssp. (Pahranagat desert sucker) and *Lepidomeda altivelis* (Pahranagat spinedace) were the most environmentally sensitive species of Pahranagat Creek where habitat alteration rendered *L. altivelis* extinct by the 1950s and *C. clarki* ssp. by the late 1960s (Minckley and Deacon 1968). *Rhinichthys osculus* ssp., on the other hand, was the most widespread and abundant species both in Pahranagat Creek (G.G. Scoppettone unpublished data) and the White River system, attesting to its adaptability (Moyle 2002).

Crenichthys baileyi is thermophilic and, consequently, localized in distribution (Williams and Wilde 1981). However, its distribution was further reduced by spring isolation associated with water development, and the opportunity for genetic mixing among populations has been eliminated (J.E. Deacon, retired, University of Nevada, Las Vegas, personal communication). In this study we found *C. b. albivallis* in 4 isolated spring systems compared with 6 connected springs in the 1960s (Williams and Wilde 1981). Last reported in Lund Spring in 1984 when it was noted as rare (Courtenay et al. 1985), *C. b. albivallis* is now extirpated from both Lund and Cold Springs. Because Preston and Lund Springs are no longer connected, there is no opportunity for *C. b. albivallis* recolonization. Similarly, loss of connectivity between Hot Creek and Moon River springs eliminated gene flow between 2 populations of *C. b. thermophilus*, and close proxreservoirs has lead to intermittent invasions of *M. salmoides* (Williams and Wilde 1981), resulting in population crashes, the most recent occurring in summer 1991. Nevada Division of Wildlife eliminated *M. salmoides* from the upper reaches of Hot Creek by summer 1993, and *C. b. thermophilus* now number in the thousands (J. Heinrich, Nevada Division of Wildlife, personal communication).

The fish community (*L. albivallis, R. osculus, C. c. intermedius,* and *C. b. albivallis*) described by Miller and Hubbs (1960) for the Preston Springs/Lund Spring systems no longer exists. The last report of co-occurrence of the 4 fishes was in 1984 in Lund Spring (Courtenay et al. 1985), and *L. albivallis* and *C. b. albivallis* were reported as rare even then. Since 1992 there has been no further *C. b. albivallis* or *R. osculus* population loss from Preston Springs (Scoppettone and Rissler 2002). In May 2002, Lund Spring continued to harbor *R. osculus* and *C. c. intermedius,* but only about 20 large *C. c. intermedius* remain, suggesting an aging population with little to no reproduction (M.B. Nielsen, U.S. Fish and Wildlife Service, personal communication). The only notable change in fish population since 1992 was removal of *M. salmoides* from Hot Creek and Flag Springs followed by a dramatic increase in native fish number (J. Heinrich, Nevada Division of Wildlife, personal communication).

This survey presents another species, *Cottus bairdi,* perhaps to be added to the White River valley native fish assemblage. In Nevada, *C. bairdi* had previously been documented from the Bonneville Basin and Snake River system (La Rivers 1962, Bond 1963, Deacon and Williams 1984). *Cottus bairdi* also is known from the Colorado River system (Lee et al. 1980). In western North America, *C. bairdi* has been divided into 2 subspecies (Bond 1963): *C. b. semiscaber* of the Columbia River and Bonneville Basin, and *C. b. punctulata* of the upper Colorado Basin (Bond 1963, Minckley et al. 1986). The White River *C. bairdi* is without prickles, characteristic of *C. b. punctulata,* and serves as supporting evidence that it is of the Colorado River drainage and native to the White River valley. Furthermore, 9 White River *C. bairdi* examined by Carl Bond (unpublished data) indicate a tendency for reduced fin ray counts (mean count: dorsal ray and pelvic rays left 3.3 and right 3.4) and a thick caudal peduncle (0.091 of SL) when compared to Bonneville Basin and Colorado River forms, thus suggesting they may be native. *Cottus bairdi* has no other representation in the lower Colorado River system (Lee et al. 1980). However, the species' propensity for inhabiting cool-water streams (Bond 1963) may account for its localized distribution in the pluvial White River and White River valley. Of the 3 relic segments of the pluvial White River, Muddy River and Pahranagat Creek originate from warm-water springs (26.0°–33.0°C; Garside and Schilling 1979), thus precluding the presence of *C. bairdi.* Only the contemporary White River system has sufficiently cool water (15.0°–16.5°C at Butterfield, North Fork Flag Springs, and the headwater White River system) to support *C. bairdi.* We believe this is the reason they are only along this relic segment of the pluvial White River. It is unlikely these fish were transported hundreds of miles from the Colorado River system and across state boundaries to be stocked or used as bait in a small eastern Nevada spring. To determine if the population is native, further research is needed to establish its taxonomic relationship with other populations of *C. bairdi* along the Colorado River system. If White River *C. bairdi* are native, we would expect the *C. bairdi* population in closest physical proximity (San Juan River system) to have the closest taxonomic affiliation, but there would be sufficient difference to suggest thousands of years of isolation (B. May, University of California, Davis, personal communication).

This survey indicates that White River fishes have experienced substantial decline and are in need of conservation measures to prevent further loss. The species most urgently needing attention is *L. albivallis,* which is close to extinction. However, measures to improve the status of *L. albivallis* also will benefit its 3 historic co-occurring species. *Cottus bairdi,* discovered in this survey, needs to be protected, but managed, in Butterfield Springs until its taxonomic status can be determined.

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