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DIET OF THE LEATHERSIDE CHUB, *SNYDERICHTHYS COPEI,* IN THE FALL

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Diet analysis provides a powerful method for determining a species' role in the community. Potential competitors, potential prey, and the position of a species in the community food web are all determined by what an organism eats (Mittlebach 1994). In addition, a species' diet is often sensitive to specific conditions of the environment (e.g., predators, resource availability; Reinthal 1994). Thus, variation in diets can provide insight about potential competitive interactions and spatial distribution, as well as the effects of invasive species (Breitburg 1994). An understanding of diet may be particularly useful for determining factors affecting declining species.

Leatherside chub, *Snyderichthys copei,* is a small cyprinid native to rivers and streams of the Bonneville Basin and the upper Snake River drainage of Utah, Idaho, and Wyoming. In recent years the distributional range of leatherside chub has declined and become increasingly fragmented (Wilson and Belk 2001). Habitat degradation and introduction of nonnative species have been implicated in the decline (Walser et al. 1997, Wilson and Belk 2001). In particular, the presence of introduced brown trout (*Salmo trutta*) has been suggested to have strong negative effects on leatherside chub. However, little is known about trophic interactions between leatherside chub and other members of the fish assemblage (both introduced and native).

Previously, all populations of leatherside chub were thought to represent a cohesive species with no obvious genetic or ecological differences among populations (Wilson and Belk 2001). However, recent phylogenetic analysis based on mtDNA gene sequences (cyt b) suggests that leatherside chub comprise 2 distinct lineages. Specifically, populations located in northern Utah, southern Idaho, and southern Wyoming represent 1 distinct lineage, and populations located in central and southern Utah represent another (Johnson and Jordan 2000, Dowling et al. 2002).

Despite the importance of understanding the trophic ecology of leatherside chub, their diet has not been adequately described (Sigler and Sigler 1987, 1996). To determine trophic relations of leatherside chub and to aid in a clearer understanding of this poorly known species, we describe and quantify the diet of leatherside chub from both northern and southern lineages based on stomach samples collected in early fall. Further, we compare diet of leatherside chub with previously published diets of other co-occurring species.

We sampled stomach contents of 47 leatherside chub and quantified their diets from analysis of these contents. To represent the southern lineage, 15 leatherside chub were collected from East Fork Sevier River, Piute County, Utah, at a site 5 km above Piute Reservoir with an elevation of about 1850 m (38°12′N, 112°10′W). Fifteen leatherside chub were collected from Spanish Fork River, Utah County, Utah, near its confluence with Thistle Creek at an elevation of 1626 m (40°00′N, 111°30′W). To represent the northern lineage, we collected 17 leatherside chub from Sulphur Creek (a tributary of the Bear River), Uintah County, Wyoming, at a location about 3 km above Sulphur Creek Reservoir at about 2200 m elevation (41°08′N, 110°48′W). All 3 locations are characterized by a narrow strip of riparian vegetation bordered by typical cold desert shrubs and grasses. All collection locations contained similar co-occurring fish species:

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redside shiner (*Richardsonius balteatus*), speckled dace (*Rhinichthys osculus*), mountain sucker (*Catostomus platyrhynchus*), mottled sculpin (*Cottus bairdi*), and a small number of brown trout.

We collected leatherside chub from mid-September to mid-October between 1000 and 1500 hours with a backpack electroshocker. For diet analyses we used only adult fish (>65 mm total length; Johnson et al. 1995). Fish were euthanized with an overdose of MS-222, placed on ice for transportation, and later fixed in 10% formalin solution.

We used the gravimetric method to quantify diet items in the stomachs according to methods in Hyslop (1980). We removed stomach contents from preserved specimens and measured mass of the contents in grams (Denver Instruments, Inc., digital balance). Diet items were identified to order and then grouped into the following more general categories: aquatic insects, terrestrial insects, mollusks, crustaceans, miscellaneous (e.g., vegetation, Porifera, Hirudinea, etc.), and unknown. The proportion of total mass attributable to each diet was estimated. We used proportion of mass rather than counts of individuals because in many cases individuals were difficult to determine due to the effects of mastication of food by cyprinid species (Hyslop 1980). To account for the variation in stomach fullness among individuals, we calculated a weighted proportion (weighted by the ratio of each individual's total stomach content mass to the mean stomach content mass from all individuals sampled at a given location) for each diet category for all individuals. Kruskal-Wallis tests (SAS 1997) were used to compare differences among sampling locations of mean unweighted proportions and mean weighted proportions for 4 diet categories (excluding miscellaneous and unidentified categories).

Leatherside chub foraged on a wide variety of prey (Table 1). Prey items were typical of organisms attached to various substrates or on the benthos (e.g., odonates, some stages of Plecoptera, mollusks) and some taxa found in the drift (e.g., Trichoptera, terrestrial insects). The most important prey categories were aquatic and terrestrial insects and crustaceans, which combined accounted for over 75% of the diet at all locations. Aquatic insects were the dominant prey category at the East Fork Sevier River location (southern lineage). Aquatic insects and crustaceans were the dominant prey categories at the Spanish Fork River location (southern lineage). Aquatic and terrestrial insects were the dominant prey categories at the Sulphur Creek location (northern lineage). Proportions in the diet of 3 of 4 prey categories (excepting mollusks) differed significantly among locations for either the weighted or unweighted analysis (Table 1). Crustaceans (Amphipoda and Isopoda) were observed only in the diet at the Spanish Fork River location, and mollusks were observed only in the diet at the Sulphur Creek location.

Differences in diet among locations may indicate differences in environment or adaptive history; however, they must be interpreted with caution. For species with relatively broad diets, such as leatherside chub, differences in diet could result from differential availability of prey in different streams and seasons. Variation of the mean proportion of prey categories in diets would be expected to fluctuate throughout the year. This would suggest that diet differences between locations and lineages noted here are likely an overestimate of differences averaged over an entire year. Further study of leatherside chub diet is needed to determine differences by season and location.

Diet of leatherside chub appeared similar to diets of several co-occurring fish species: mottled sculpin, redside shiner, cutthroat trout, and brown trout. Diet of mottled sculpin comprises, almost completely, bottom-dwelling aquatic insects (Bailey 1952, Zarbock 1952). Adult redside shiner feed mainly on aquatic and terrestrial insects, crustaceans, and snails (Wydoski and Whitney 1979). Diet of cutthroat trout and brown trout consists mainly of aquatic and terrestrial insects and crustaceans (Behnke 2002). Because of the similarity in diet, competitive interactions between leatherside chub and these other species may occur in natural systems.

Although they were not found at the sampling sites, fathead minnows have been introduced in some streams within the range of leatherside chub. Because the fathead minnow is similar in size and habitat, there has been some concern that this species may actively compete with leatherside chub (personal observation). However, the diet of fathead minnows appears to be somewhat different from what was found for leatherside chub. Diet of fathead minnow includes primarily

TABLE 1. Comparison of unweighted and weighted mean proportion (s) of prey categories found in stomach samples from 3 populations of leatherside chub. Contents not listed below were miscellaneous and unidentified debris categories.

	East Fork Sevier River* ($N = 15$)		Spanish Fork River* ($N = 15$)		Sulphur Creek** ($N = 17$)		Kruskal-Wallis test (d.f.= 2)	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
Aquatic insects[a]	0.8 (0.107)	0.943 (0.283)	0.353 (0.124)	0.282 (0.131)	0.335 (0.102)	0.459 (0.21)	$\chi^2 = 7.9067$ $P = 0.019$	$\chi^2 = 5.13$ $P = 0.077$
Terrestrial insects[b]	0.197 (0.105)	0.056 (0.03)	0.04 (0.0335)	0.019 (0.013)	0.503 (0.107)	0.389 (0.145)	$\chi^2 = 11.63$ $P = 0.0030$	$\chi^2 = 9.12$ $P = 0.012$
Mollusks[c]	0 (0)	0 (0)	0 (0)	0 (0)	0.0824 (0.0620)	0.093 (0.067)	$\chi^2 = 3.61$ $P = 0.16$	$\chi^2 = 0.133$ $P = 0.94$
Crustaceans[d]	0 (0)	0 (0)	0.367 (0.124)	0.57 (0.29)	0 (0)	0 (0)	$\chi^2 = 11.61$ $P = 0.0030$	$\chi^2 = 3.47$ $P = 0.18$

*southern lineage; **northern lineage
[a]Trichoptera, Plecoptera, Odonata
[b]Coleoptera, Hymenoptera, Lepidoptera
[c]Gastropoda
[d]Amphipoda, Isopoda

algae, zooplankton, organic detritus, and some larval aquatic insects (Hambright and Hall 1992, Sigler and Sigler 1996). Competition for food between leatherside chub and fathead minnow appears unlikely.

In summary, the leatherside chub feeds primarily on aquatic and terrestrial insects and crustaceans. These data provide insight concerning the potential trophic overlap of leatherside chub with other co-occurring species such as mottled sculpin, redside shiner, cutthroat trout, and brown trout.

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LITERATURE CITED

BAILEY, J.E. 1952. Life history and ecology of sculpin, *Cottus bairdi punctulatus*, in southwestern Montana. Copei 1952:243–255.

BEHNKE, R.J. 2002. Trout and salmon of North America. Free Press, New York.

BREITBURG, D.L., AND T. LOHER. 1994. Effects of physical disturbance on fish trophic interactions: the importance of consumer mobility. Pages 241–253 *in* D.J. Stouder, K.L. Fresh, and R.J. Feller, editors, Theory and application in fish feeding ecology. University of South Carolina Press, Columbia.

DOWLING, T., C.A. TIBBETS, W.L. MINCKLEY, AND G.R. SMITH. 2002. Evolutionary relationships of the plagopterins (*Teleostei: Cyprinidae*) from cytochrome b sequences. Copeia 2002:665–678.

HAMBRIGHT, D.K., AND R.O. HALL. 1992. Differential zooplankton feeding behaviors, selectivities, and community impacts of two planktivorous fishes. Environmental Biology of Fishes 35:401–411.

HYSLOP, E.J. 1980. Stomach contents analysis: a review of methods and their application. Journal of Fish Biology 17:411–429.

JOHNSON, J.B., AND S. JORDAN. 2000. Phylogenetic divergence in leatherside chub (*Gila copei*) inferred from mitochondrial cytochrome b sequences. Molecular Ecology 9:1029–1035.

MITTLEBACH, G.G., AND C.W. OSENBERG. 1994. Using foraging theory to study trophic interactions. Pages 45–59 *in* D.J. Stouder, K.L. Fresh, and R.J. Feller, editors, Theory and application in fish feeding ecology. University of South Carolina Press, Columbia.

REINTHAL, P.N., AND G.W. KLING. 1994. Exotic species, trophic interactions, and ecosystem dynamics: a case study of Lake Victoria. Pages 295–313 *in* D.J. Stouder, K.L. Fresh, and R.J. Feller, editors, Theory and application in fish feeding ecology. University of South Carolina Press, Columbia.

SAS, Inc. 1997. SAS/STAT software: changes and enhancements through release 6.12. SAS Institute, Cary, NC.

SCOTT, W.B., AND E.J. CROSSMAN. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Bulletin 184:966.

SIGLER, W.F., AND J.W. SIGLER. 1996. Fishes of Utah: a natural history. University of Utah Press, Salt Lake City.

______. 1987. Fishes of the Great Basin: a natural history. University of Nevada Press, Reno.

WALSER, C.A., M.C. BELK, AND D.K. SHIOZAWA. 1999. Habitat use of leatherside chub (*Gila copei*) in the presence of predatory brown trout (*Salmo trutta*). Great Basin Naturalist 59:272–277.

WILSON, K.W., AND M.C. BELK. 2001. Habitat characteristics of leatherside chub (*Gila copei*) at two spatial scales. Western North American Naturalist 61:36–42.

WYDOSKI, R.S., AND R.R. WHITNEY. 1979. Inland fishes of Washington. University of Washington Press, Seattle.

ZARBOCK, W.M. 1951. Life history of the Utah sculpin, *Cottus bairdi semiscaber* (Cope) in Logan River, Utah. Transactions of the American Fisheries Society 81:249–259.

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