STATUS, DISTRIBUTION, AND BIOLOGY OF SCULPINS (COTTIDAE) IN MONTANA: A REVIEW

A Report to:

USDA Forest Service

Kootenai National Forest
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Submitted by

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ABSTRACT

Five species of sculpins (Cottidae) have been reported from the freshwater systems of Montana. Two species, the Torrent Sculpin (*Cottus rhotheus*) and Slimy Sculpin (*C. cognatus*), are restricted to river systems of the Columbia River Basin, west of the Continental Divide. The Spoonhead Sculpin (*C. ricei*) is restricted to the Saskatchewan River System (draining into Hudson Bay) around Glacier National Park, on the U.S.-Canada border. The Shorthead Sculpin (*C. confusus*) is found mostly west of the Continental Divide in the Flathead River system, but there are records of this species from the Clark Fork River west of the Divide and the Upper Missouri River system (Milk River) east of the Divide. The Mottled Sculpin (*C. bairdi*) has the widest distribution of the five sculpins, occurring in the western half of Montana in all three major drainages (Columbia, Missouri, Saskatchewan). Three species (*C. rhotheus, C. ricei, C. confusus*) are listed by the Montana Natural Heritage Program as Animal Species of Special Concern; two species (*C. rhotheus* and *C. confusus*) are listed as Sensitive by Region 1 of the U.S. Forest Service.

Some sculpin species show substantial variation in morphometric traits, which has led to difficulties in species determinations. Contributing to the confusion, hybrids between Slimy and Shorthead sculpins have been found in restricted sites, and individuals with traits intermediate between Shorthead and Mottled sculpins are found in the Flathead and Milk river drainages. Recent and as yet unpublished evidence suggests that these intermediates may represent an undescribed species which is genetically distinct from "typical" Shorthead and Mottled sculpins, and that true Shorthead Sculpins may not occur in Montana. This is of significant management interest because of the legal status accorded the Shorthead Sculpin.

Two additional sculpin species are considered "Hypothetical" for Montana. The Deepwater Sculpin (*Myoxocephalus thompsoni*) has been collected in Alberta in Upper Waterton Lake. Because the lake crosses the international border into Glacier National Park, it is likely that the Deepwater Sculpin is present in Montana. To date, however, no surveys for this species have be conducted on the Montana portions of the lake. The Piute Sculpin (*Cottus beldingi*) is present in the Clearwater River system (Columbia River Basin) of Idaho; this species has been found in the Selway-Bitterroot Wilderness Area within a few miles of the Montana border. Significant mountain barriers are present, however, effectively preventing the dispersion of this species into adjacent parts of Montana. There are unpublished reports of sculpins in the St. Regis River that appear unlike any of the other species known in western Montana; the Piute Sculpin should looked for in this area, although it has not yet been reported from the Coeur d'Alene and St. Joe river systems nearby in Idaho.

All species of *Cottus* known in Montana occupy rubble and gravel riffles of fast moving streams and rivers, often in cold water. With one exception (the Shorthead Sculpin), all Montana sculpin species also occur in lakes. In lakes, the Spoonhead Sculpin is sometimes found at considerable depths (> 100 m), while the other species tend to stay in relatively shallow, near-shore water. Multiple sculpin species coexist in several western Montana streams; segregation patterns within streams are not clearly defined. Few studies of sculpin life history have been conducted in Montana, although polygamy has been documented in populations of the Mottled Sculpin. Most species are probably relatively sedentary, like the Mottled Sculpin, with small adult

home ranges, at least in stream systems. Because sculpins are bottom-dwellers, foods include benthic invertebrates, fish eggs and small fry.

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ACKNOWLEDGMENTS

Several persons helped directly or indirectly with the production of this review. Foremost was William R. Gould, who shared with me his knowledge and frustrations regarding sculpins, and provided data on sculpins in the fish collections at Montana State University, Bozeman. A significant amount of the material covered in this review was summarized previously in an unpublished report by him. Alex E. Peden (Royal British Columbia Museum) discussed and made available his unpublished electrophoretic analysis of sculpins (especially *Cottus confusus*) along the Canadian-U.S. border in the Pacific Northwest. His work puts the current dilemma of sculpin determination in Montana on more solid ground. Dave Dyer allowed me ready access to the fish collection at The University of Montana, Missoula. Dave Catania (California Academy of Sciences), Douglas W. Nelson (University of Michigan), Scott A. Schaefer (Academy of Natural Sciences, Philadelphia), and Jeffrey T. Williams (National Museum of Natural History) provided data on Montana sculpins in their respective collections. Paul Muehlhausen (Lolo National Forest) and Chris Clancy (Bitterroot National Forest) kindly shared sculpin survey data for their respective Forests; Paul also made available correspondence of Ron Gregg pertaining to the sculpins of the St. Regis River. Robb Leary (University of Montana) provided a copy of an unpublished study by Ron Gregg, Fred Allendorf and himself on the genetics of sculpins in northwestern Montana. Andy Sheldon (University of Montana) let me rummage through his reprint file on sculpins and drew my attention to Gregg's work on the sculpins of the St. Regis River. Gavin More reminded me that the Deepwater Sculpin is present in Upper Waterton Lake, Alberta and probably occurs in Montana. Cedron Jones produced the distribution maps after locations were entered into the Montana Natural Heritage Program database by Debbie Dover. Finally, special thanks are due Doug Perkinson (Kootenai National Forest) for funding this work and patiently awaiting the final product.

INTRODUCTION

The Corps of Discovery, under the command of Meriwether Lewis and William Clark, provided to western science the first records of several species of freshwater fishes in the northwestern United States (Burroughs 1961, Cutright 1969) but apparently overlooked the inconspicuous bottom-dwelling fishes of the family Cottidae known variously in the literature (e.g., Evermann 1893, Weisel 1952, Brown 1971, Luecke et al. 1990) as "blobs", "bloaters", "bullheads", "muddlers" and, more frequently, "sculpins." At least some Native American tribes in western North America, however, appear to have been well-acquainted with sculpins (see Weisel 1952, Nelson 1983) prior to the period of western settlement; the Flathead called them "s'tit'ma."

The first official determinations that sculpins occurred in what is now called Montana date to government surveys of the 19th century. The Mottled Sculpin (*Cottus bairdi*) was reported from the Gallatin River of the Missouri River drainage in 1870-1871 (Cope 1872), and the Slimy Sculpin (*C. cognatus*) was collected in 1891 from several streams and rivers of the Columbia River drainage west of the Continental Divide (Evermann 1893), although the species was referred to as *C. bairdi* at the time. The Montana sculpin fauna was not expanded for another 40 years. The Shorthead Sculpin (*C. confusus*) was collected from the Middle Fork of the Flathead River in 1932 and 1934 (although not formally recognized as a distinct species until 1963; see Bailey and Bond 1964), and the Spoonhead Sculpin (*C. ricei*) was collected from the St. Mary and Waterton river drainages in Glacier National Park in 1934 (see Brown 1971). A fifth and final species known from Montana, the Torrent Sculpin (*C. rhotheus*), was first collected from the Fisher River of the Kootenai River system in 1952 (see Brown 1971). Results of numerous collections led to the tidy conclusion that a single species (Mottled Sculpin) occupied the Missouri River system of Montana east of the Continental Divide, three species (Slimy, Shorthead, and Torrent sculpins) were found in various portions of the Columbia River system west of the Continental Divide, and one species (Spoonhead Sculpin) occupied waters of the Saskatchewan River system.

The last 40 years have seen additional collections of sculpins in Montana and published summaries of their known distributions (e.g., Weisel 1957, Gould and Brown 1970, Brown 1971), and a few studies have contributed to our knowledge of sculpin life history in Montana (e.g., Bailey 1952, McCleave 1964, Brown and Downhower 1982a, 1982b). Increasingly sophisticated statistical techniques, however, have helped highlight the considerable morphometric variation that occurs within and between populations of some sculpin species (Godkin et al. 1982, Peden et al. 1989), and sculpins with traits intermediate between two species have been identified. Recent use of molecular techniques has led to uncertainty regarding taxonomic determination of certain sculpin species within Montana; especially confusing is the Shorthead Sculpin and its relationship with the Mottled Sculpin.

The uncertainty regarding species identification has ramifications that transcend the realm of biology and extend into biopolitics. Currently (1997), three of the five sculpin species are on the Montana Natural Heritage Program's "Animal Species of Special Concern" list, and two of these (Torrent and Shorthead sculpins) are listed as Sensitive by Region I, U.S. Forest Service, providing them with special legal status. It is, therefore, of interest to conservation biologists and

managers to be able to determine which species are which.

This review is composed of five parts. First, morphometric characters used to segregate species, and problems with their use, are presented. Recent research using electrophoretic techniques in conjunction with metric data is contrasted with studies based on traditional methods; implications of the genetic studies and needs for future research are discussed. Second, distribution maps are presented that incorporate all records currently in the Montana Natural Heritage Program database; these update previous maps in Gould and Brown (1970) and Brown (1971). The maps are based primarily on museum records from several major collections (see Acknowledgments). Survey data solicited from Forests of the U.S. Forest Service are not included unless species-level determinations were made, even though these may add to known distributions in river systems where only a single species has been previously documented. Status and distribution of each species known in Montana is briefly discussed, and species considered "Hypothetical" for the state are mentioned. Heritage Program Ranks (G = Global, S = State) range from 1 (critically imperiled because of extreme rarity) to 5 (demonstrably secure, though perhaps rare in parts of range, especially at the periphery). Third, various aspects of the life history of each species are discussed. Primary emphasis is given to life history studies conducted in Montana. Because of the paucity of such research, however, life history information has been consolidated from a number of studies conducted in a variety of states and provinces. An unpublished manuscript by Dr. W. R. Gould (in the files of the Montana Natural Heritage Program) formed the nucleus of each species account in this section. Fourth, recommendations for furture work on sculpins in Montana are presented. Mostly, these address gaps in our knowledge regarding life history and distribution in Montana, but the confusion over the status of certain taxa needs to be resolved. Fifth, a bibliography of relevant literature is provided. For species where distributions are disjunct (with eastern and western subspecies) or widespread across the boreal regions of North America, emphasis is on western taxa. Thus, the bibliography is comprehensive for each species, but not complete.

I. SPECIES DETERMINATION

Morphometric Characters.--Traditional methods for determining species identification include use of taxonomic keys based on morphological characteristics. For Montana sculpins in the genus *Cottus*, the characters used include number of chin pores, extent of lateral line, number of pelvic fin rays, presence of palatine teeth, presence and location of body prickles, number and size of preopercular spines, shape and size of head, and shape of caudal peduncle (Brown 1971, Pratt 1980, Holton 1990, Page and Burr 1991, Gould 1995, Holton and Johnson 1996). Combinations of these traits usually allow the Torrent (*C. rhotheus*), Spoonhead (*C. ricei*) and Slimy (*C. cognatus*) sculpins to be distinguished from other Montana species (Table 1).

Problems in species identification arise because some sculpin species are quite variable in phenotype within and among populations. In eastern North America, Mottled (*C. bairdi*) and Slimy sculpins are often difficult to tell apart, partly due to within-species variability and overlap in traits, and partly due to hybridization and possible back-crossing between the two species (McAllister 1964, Godkin et al. 1982, Strauss 1986, 1989). Studies of Mottled and Slimy sculpins in western Montana and adjacent areas (Gregg et al. no date, Gregg unpub. data, Peden pers. comm.), however, indicate little hybridization between these two species, unlike in eastern North America. Hybrids between Slimy and Shorthead (*C. confusus*) sculpins have been reported in Montana (Zimmerman and Wooten 1981), but occurrences are very localized and apparently rare.

Most confusion with species determination in Montana occurs when trying to distinguish the Mottled Sculpin from the Shorthead Sculpin. The two forms were considered conspecific until the early 1960's, when Bailey and Bond (1963) described the Shorthead Sculpin as a distinct species in the *bairdi* group. The two species are often difficult to segregate because each species is variable in morphology, and morphological traits of the two species are quite similar (Maughan 1978, Peden et al. 1989, W. R. Gould pers. comm.).

Further difficulty can arise when using available guides for identification. Page and Burr (1991) indicate that the dorsal fins can be used to segregate the two species, with fins joined near the base for Mottled Sculpin and separate to the base for Shorthead Sculpin. Representatives of each species illustrated in Brown (1971) and Holton (1990), however, show the Mottled Sculpin with a wide separation between the dorsal fins and the dorsal fins joined (or nearly joined) at the base for Shorthead Sculpins. The condition depicted in Brown (1971), Holton (1990) and Holton and Johnson (1996) for Shorthead Sculpins is consistent with Bailey and Bond (1963) and Peden and Hughes (1984), but the dorsal fin morphology of the Mottled Sculpin is unlike other illustrations for that species (e.g., McAllister 1964, Lee et al. 1980).

Specimens of Mottled Sculpin from Montana and Idaho in the University of Montana collection show variation in dorsal fin morphology ranging from the condition as shown in Brown (1971), with a distinct gap between the two fins, to a condition where the fins are connected, but never to the degree depicted in McAllister (1964), Lee et al. (1980) and Page and Burr (1991); the same degree of variation in dorsal fin morphology was present in a collection of Mottled Sculpins from Michigan, which is in the eastern segment of the range. Most specimens of Shorthead Sculpin in the collection from Montana and Idaho are similar to the illustration of the holotype (Bailey and Bond 1963), and as depicted in Brown (1971) and Holton (1990), but a few

Table 1. Some morphological traits used to identify species of sculpins (*Cottus*) found in Montana.

	Chin Pores	Palatine Teeth	Pelvic Rays	Pectoral Rays	Lateral Line	Body Prickles	Preopercular Spines
C. ricei	1	--	4 soft	14-16	complete	most of body	3, top curved
C. rhotheus	2	+	4 soft	15-17	complete	back and sides	3-4, top large
C. cognatus	2	--	3-4 soft	12-15	incomplete	usually absent	2-3, top large
C. bairdi	2	+	4 soft	14-16	incomplete	upper back	3 (2-4)
C. confusus	2	+	4 soft	11-15	incomplete	pectoral area	2 (1-3)

specimens show a distinct gap between the dorsal fins, as shown in Page and Burr (1991).

Neither Maughan (1978) nor Peden et al. (1989) used the degree of dorsal fin segregation to distinguish between Mottled and Shorthead sculpins in the region, but instead relied on a combination of traits, including those listed in Table 1. Until additional analysis occurs, it seems wise not to use dorsal fin morphology (see Page and Burr 1991) to distinguish between these two sculpin species in Montana.

Electrophoretic Analyses.--There has been an increased interest in electrophoretic analyses of the sculpin genus *Cottus* in recent years (e.g., Zimmerman and Wooten 1981, Strauss 1986, 1989). Part of the reason for the new emphasis on genetic techniques has been the difficulty discussed in the previous section in species determination using traditional analyses. Several researchers have used electrophoretic methods in conjunction with standard morphometric analyses to identify underlying genetic structure of populations of purported species, especially in areas of sympatry. Molecular techniques also allow more refined reconstruction of historical scenarios that may explain current distributions through isolation events (cf. Howard and Morgan 1993). As will be seen below, much research remains to be done, especially in Montana and adjacent regions.

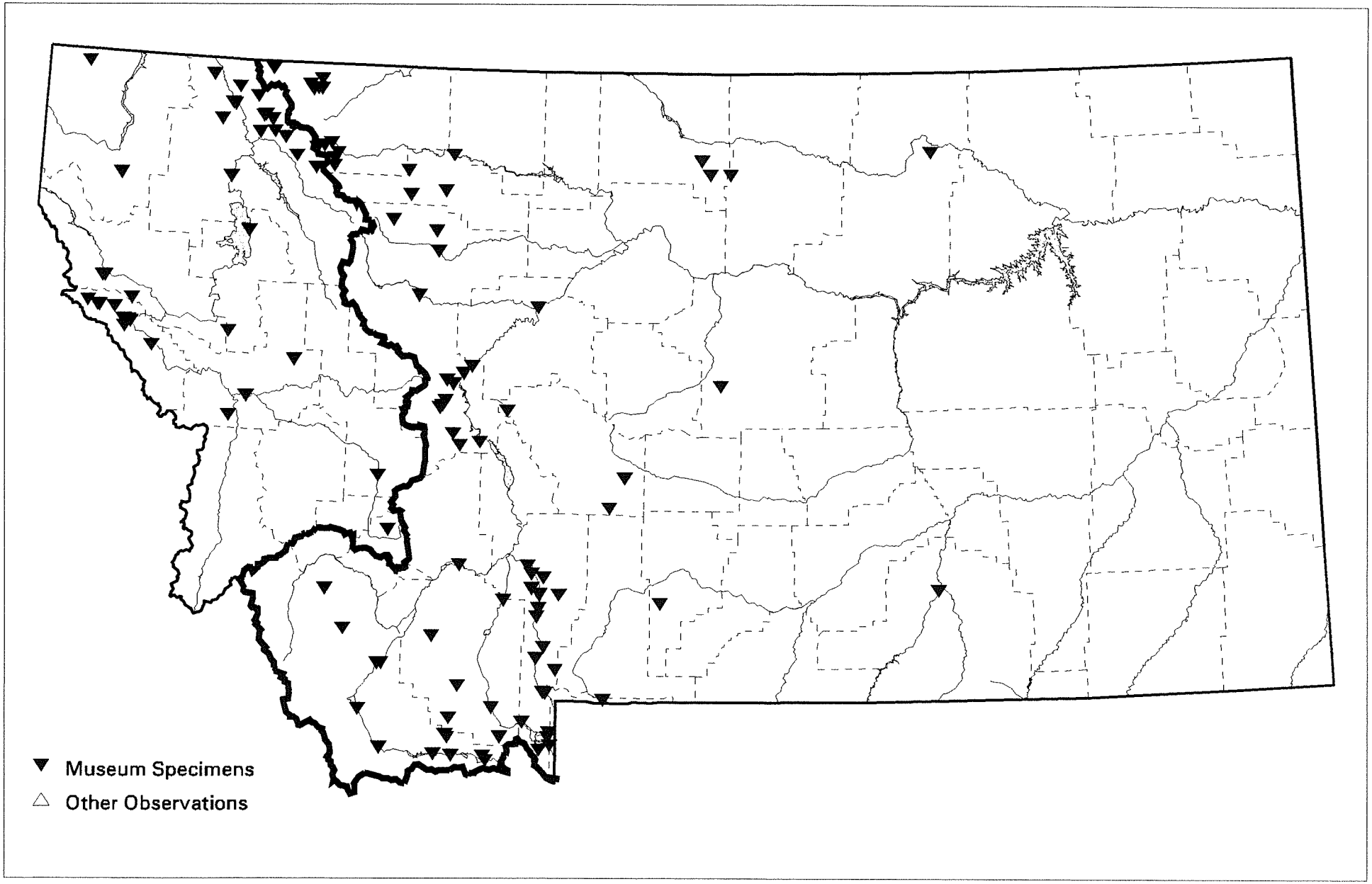
Strauss (1989) reported a strong correlation between genetic heterozygosity (using 20 enzyme loci) and morphological variability in 32 populations of sculpins in the eastern United States, including Mottled and Slimy sculpins; heterozygosity was relatively low (0-7%), suggesting limited gene flow between populations. However, genetic and morphological structure seemed relatively independent of environmental variation. Strauss (1989) stressed that correlations in one set of populations should not be indiscriminantly extrapolated to other populations, even closely related ones. It seems prudent to heed this advice when considering Montana sculpins.

Zimmerman and Wooten (1981) found that Slimy Sculpins and Shorthead Sculpins in the Flathead River Basin, Montana could be completely separated on the basis of alternate alleles at six loci (out of 33 examined). Gregg et al. (No date) found Shorthead and Slimy sculpins differed at seven diagnostic loci (out of 32 examined); samples of Slimy Sculpins came from a larger geographical area in northwestern Montana than in the Zimmerman and Wooten (1981) study, but the concurrence of results is encouraging. Torrent and Slimy sculpins were distinguishable at 11 loci, and Torrent and Shorthead sculpins differed at 13 loci. No evidence of hybridization was present in any species pair, and species seemed distinguishable using morphology alone. At only one site, however, were two species sympatric. Mean heterozygosity in Slimy Sculpins was 0-2.0% (n = 8 samples), in Torrent Sculpins 0-0.2% (n = 4 samples), and only 0.5% in the single Shorthead Sculpin sample. Again, this suggests little variation in genetic structure in populations of the same species, which is consistent with evidence that sculpins are relatively sedentary (see Life History section). Unfortunately, none of these studies examined sympatric nor allopatric Montana populations of the two most confusing species, the Mottled and Shorthead sculpins (Gregg, pers. comm. to Lolo National Forest, did examine both species during a study of sculpins from the St. Regis River, but Mottled Sculpins were not from Montana).

Peden et al. (1989) studied Mottled and Shorthead sculpins from a number of localities near the western border of Canada and the United States. The published work, based on body morphology, identified sympatric populations of the two species from the Kettle, Slocan and

Columbia rivers. Shorthead Sculpins from the Flathead River differed from Columbia River populations of the same species, and sculpins from the St. Mary and Milk rivers were similar to the Shorthead Sculpins of the Flathead River. More recently, Peden (pers. comm.) was able to examine the genetics of sculpin populations from many of these drainages. Results of the electrophoretic analyses corroborate the morphometric analyses in Peden et al. (1989). Nominal Shorthead Sculpins from the Columbia and Kettle rivers segregate from sympatric Mottled Sculpins and Flathead/St. Mary rivers Shorthead Sculpins at a genetic distance of 0.52; Shorthead Sculpins from the Flathead and St. Mary rivers segregate from allopatric Mottled Sculpins at a genetic distance of 0.17, but are more similar to Mottled Sculpins than nominal Shorthead Sculpins (Flathead Shorthead Sculpins segregated from sympatric Slimy Sculpins at a genetic distance of 0.39, again in agreement with previous studies in this drainage). Genetic distances of these magnitudes are indicative of great (0.15-0.25) to very great (> 0.25) differentiation (Hartl 1981). Peden's results (Peden et. 1989, pers. comm.) suggest that there may be an undescribed sculpin taxon in the Flathead, St. Mary and perhaps Milk rivers in Montana and Alberta, at either the species or subspecies level, currently termed "Shorthead Sculpin", but with closest affinities to the Mottled Sculpin.

Distribution of Cottus bairdi in Montana



Montana Natural Heritage Program, March 17, 1997

II. SPECIES DISTRIBUTIONS

Mottled Sculpin (*Cottus bairdi*)

The Mottled Sculpin is found in two widely disjunct areas in North America (Page and Burr 1991) and has the widest distribution of any sculpin species in Montana. As with the other sculpin species, however, it is most abundant in the western third of the state. It has been collected from the Upper Missouri River and tributaries, Yellowstone River, and Milk River, all east of the Continental Divide (the thick solid line in the distribution maps). The distribution, as shown in Gould and Brown (1970), Brown (1971), Holton (1990) and Holton and Johnson (1996), is restricted to this region.

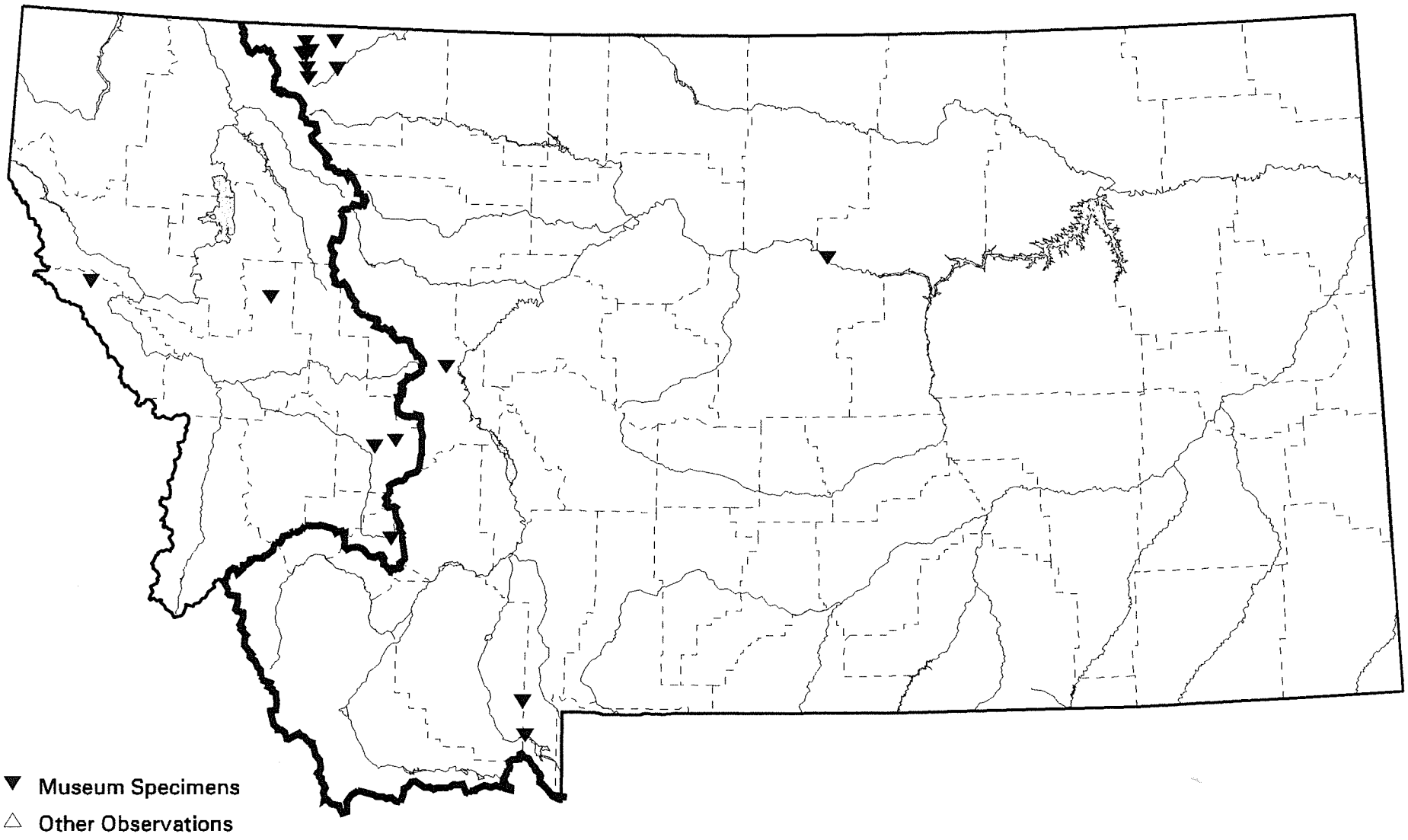
With additional collecting (and compounded confusion, perhaps) the Mottled Sculpin is now reported from west of the Continental Divide (also shown in Page and Burr 1991), predominantly in the Clark Fork and Flathead river drainages. The discrepancy between the map in this report and other portrayed distributions is related (in part) to the current difficulty in distinguishing the Mottled Sculpin from the Shorthead Sculpin. Several samples of Shorthead Sculpin from west of the Divide in the collections at Montana State University have been tentatively reclassified as Mottled Sculpin (Gould pers. comm.). Mottled Sculpins are present in the Upper Columbia River Basin in northeastern Washington, northern Idaho and southeastern British Columbia (Maughan and Saul 1979, Wydoski and Whitney 1979, Peden et al. 1989), so their occurrence in the Clark Fork and Flathead rivers is not beyond reason. Gaps in the distribution of this species in Montana, and some of the differences in former and current distribution maps, could represent sampling artifacts. In some cases intervening waters may not have been surveyed, or if so then sculpins were not identified to species. However, sculpins formerly were used as bait fish, and disjunct occurrences may represent "bait-bucket" introductions (D. Perkinson pers. comm.).

Mottled Sculpins are found in greatest abundance in riffle areas of fast-flowing streams with clear water and rocky (gravel or rubble) substrate (Bailey 1952, Brown 1971, Wydoski and Whitney 1979), less often along rocky shorelines of lakes (Holton and Johnson (1996). Water depth is usually < 1 m, summer water temperatures are usually 13-19^{0}C: maximum = 21^{0}C (Bailey 1952, McCleave 1964, Pierce 1966, Wydoski and Whitney 1979).

The Mottled and Shorthead sculpins need a thorough reanalysis; their current distributions in Montana, especially west of the Continental Divide, are unclear. The Mottled Sculpin currently has no special designation by any federal or state agency.

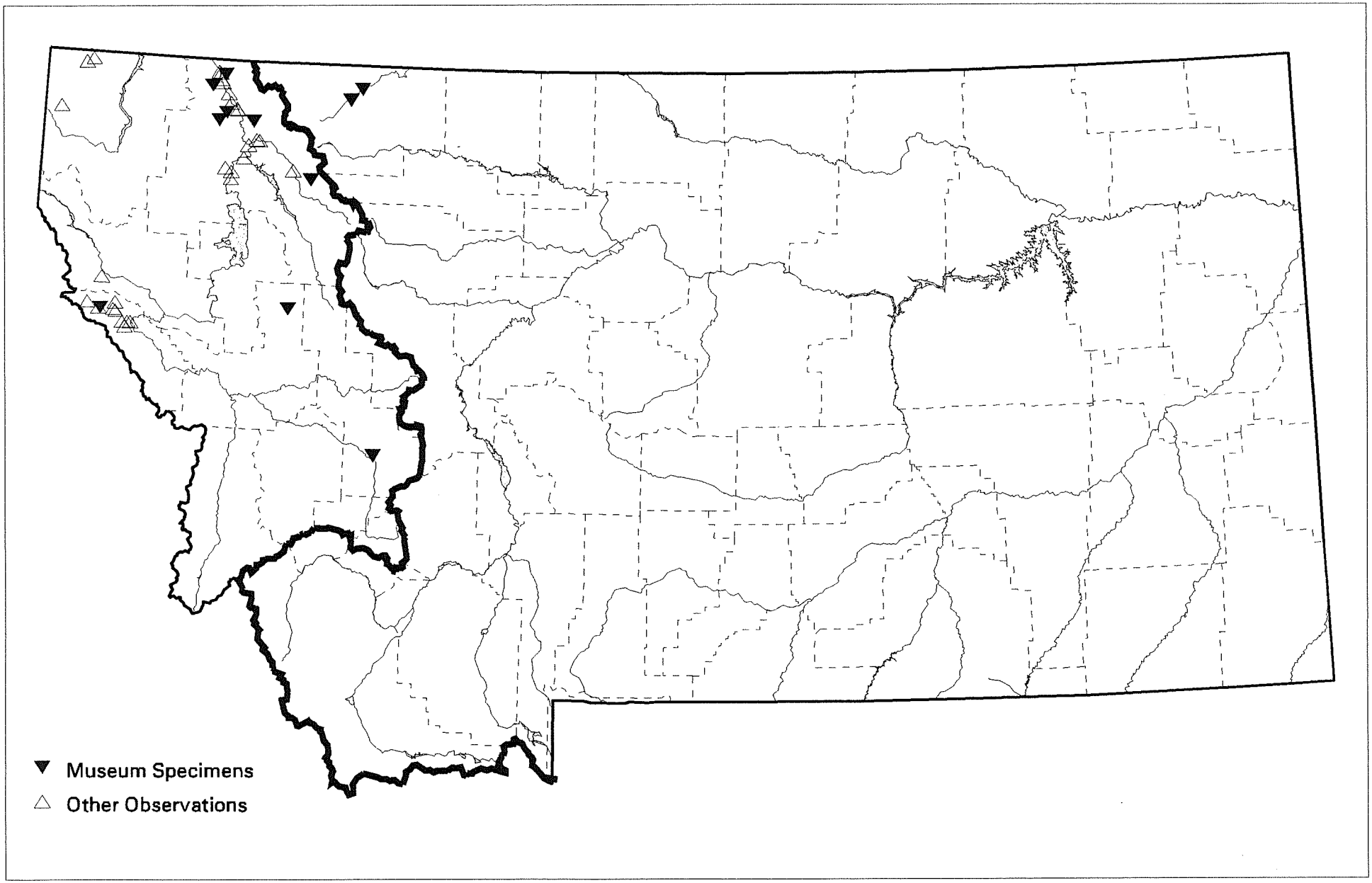
Montana Heritage Program Rank: G5, S5.

Distribution of Cottus bairdi/confusus in Montana



Montana Natural Heritage Program, March 17, 1997

Distribution of Cottus confusus in Montana



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Shorthead Sculpin (*Cottus confusus*)

The Shorthead Sculpin is found in several seemingly disjunction areas in the Pacific Northwest (Wydoski and Whitney 1979, Page and Burr 1991). Distribution of Shorthead Sculpin in Montana is uncertain, because of the difficulty in distinguishing this species from the Mottled Sculpin. Gould and Brown (1970) showed the Montana distribution as restricted to the Flathead River drainage; Brown (1971) added the Little Blackfoot River of the Clark Fork drainage. In the last 20 years there are records from the Yaak River and tributaries of the Kootenai River, St. Regis River, upper Clark Fork River, St. Mary River and upper Milk River. All records, except those in the St. Mary and Milk rivers, are west of the Continental Divide. As can be seen in the map for Mottled/Shorthead sculpins (*Cottus bairdi/confusus*), which are classified as indeterminant, there are confusing specimens from other localities east of the Continental Divide. Specimens from the upper Madison River and Missouri River near Fort Peck Reservoir are probably not Shorthead Sculpins. The St. Mary and Milk rivers Shorthead Sculpins, also found in Alberta (Roberts 1988), may be an undescribed species or subspecies, as they and the Flathead River Shorthead Sculpins segregate morphologically and genetically from nominant Shorthead and Mottled sculpins (Peden et al. 1989, Peden pers. comm.) in British Columbia, Washington and Idaho; similarities are greatest with Mottled Sculpins (genetic distance of 0.17) for both Flathead and St. Mary river populations.

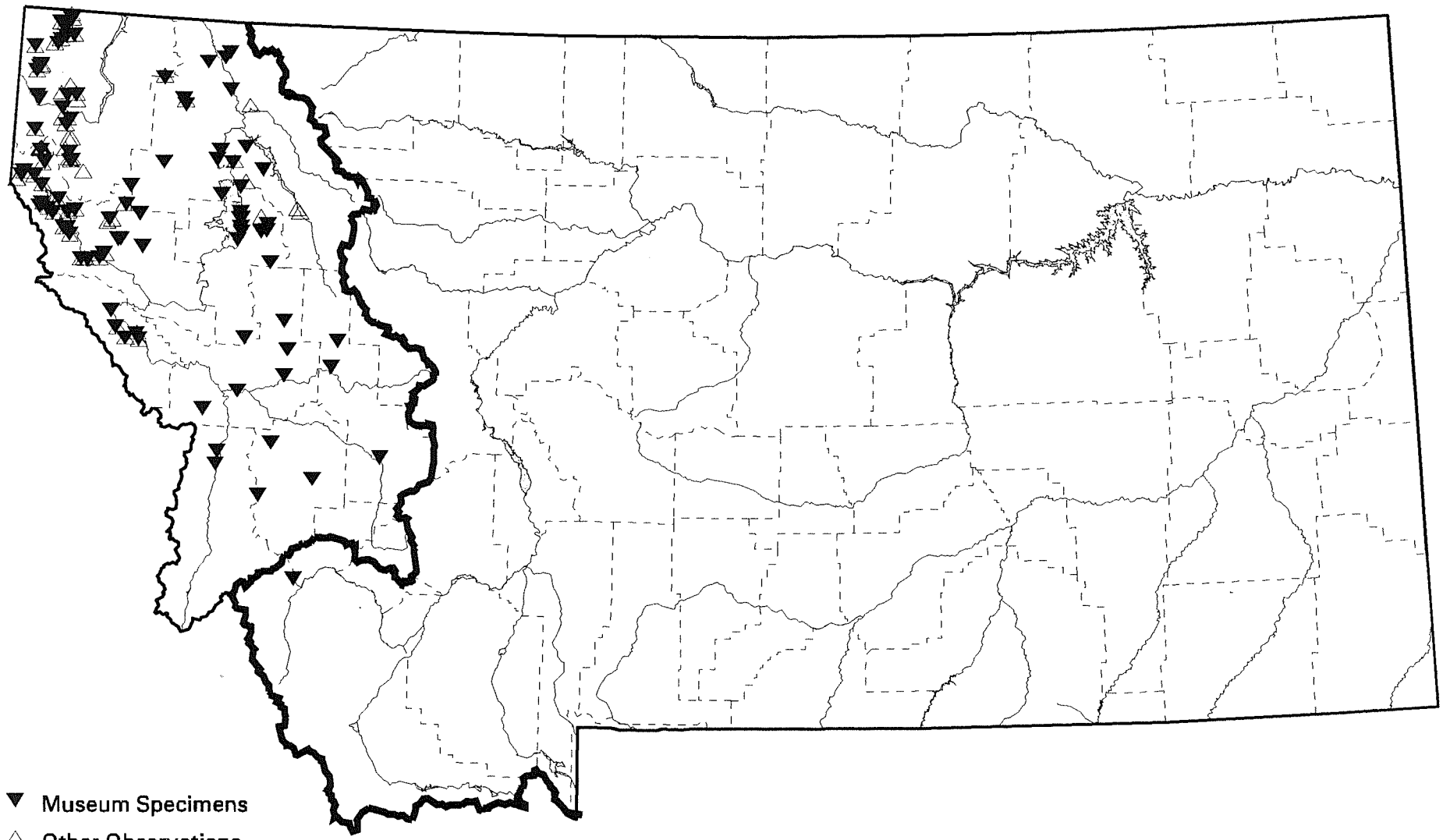
Gaps in the distribution of this species in Montana, and some of the differences in former and current distribution maps, could represent sampling artifacts. In some cases intervening waters may not have been surveyed, or if so then sculpins were not identified to species. However, sculpins formerly were used as bait fish, and disjunct occurrences may represent "bait-bucket" introductions (D. Perkinson pers. comm.). These possibilities, in conjunction with confusion regarding the taxonomy, make suspect the accuracy of any current distribution map.

Shorthead Sculpins inhabit cold, fast riffles in streams with gravel and rubble (Brown 1971, Wydoski and Whitney 1979), but sometimes in slower water (Peden and Hughes 1984). In some localities this species is more abundant in headwaters of drainages than other sculpin species (Maughan and Saul 1979, Wydoski and Whitney 1979), elsewhere the pattern is the opposite (Hughes and Peden 1984). Water temperatures in summer are somewhat cooler than for other sculpin species (7.5-16^{0}C) (Wydoski and Whitney 1979, Roberts 1988); mean summer temperature for occupied streams in northwestern Montana was 7^{0}C (Gangemi 1992)..

The Shorthead and Mottled sculpins need thorough reanalysis in Montana. In addition to further collecting, museum specimens should be reexamined and classified morphologically and genetically. There is strong preliminary evidence that the sculpin in Montana and Alberta currently classified as *Cottus confusus* is a taxon distinct at the species level from nominant Shorthead and Mottled sculpins. This taxonomic conundrum is of legal and management (as well as biological) interest because of the special status this fish has in the United States and Canada. The Shorthead Sculpin is listed as Threatened in Canada (see McAllister et al. 1985), is a U.S. Forest Service (Region 1) Sensitive species, and a state fish species of special concern (MT Dept. Fish, Wildlife & Parks).

Montana Heritage Program Rank: G5, S3 (Animal Species of Special Concern).

Distribution of Cottus cognatus in Montana



Montana Natural Heritage Program, March 17, 1997

Slimy Sculpin (*Cottus cognatus*)

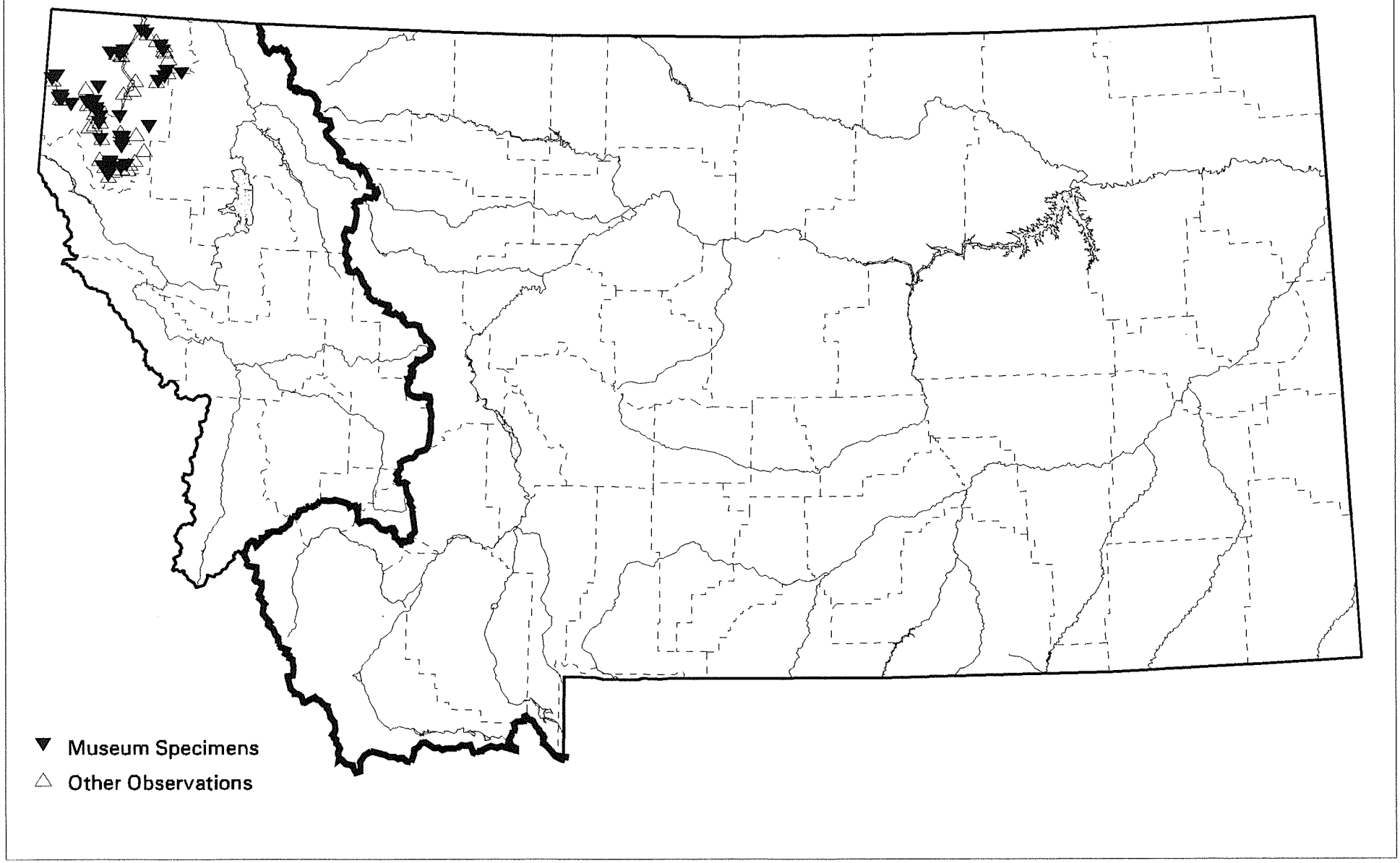
The Slimy Sculpin is widely distributed across Canada and the northeastern United States, also south along the Northern Rocky Mountains in the west to northeastern Washington, central Idaho and western Montana (Wydoski and Whitney 1979, Page and Brooks 1991). In Montana, the Slimy Sculpin is found exclusively west of the Continental Divide, except for one record in Beaverhead County (Pintler Creek in the Big Hole River drainage). Slimy Sculpins have been found east of the Continental Divide in the Peace and Athabasca river drainages of Alberta (Paetz and Nelson 1970, Roberts 1988), but these localities are far north of Beaverhead County; the Beaverhead County record needs verification. The mapped distribution in Montana remains essentially unchanged since Gould and Brown (1970) and Brown (1971). There are many additional records of sculpins from the headwaters and tributaries of the Bitterroot River (C. Clancy pers. comm.), all probably Slimy Sculpins, which were not determined to species level; these records are not shown on the distribution map. Seemingly anomalous records, such as that from Beaverhead County, may have been the result of "bait-bucket" introductions during the time when sculpins were legal live bait fish.

Slimy Sculpins inhabit cold, clear streams with gravel and rubble substrate, but also are found along gravel beaches and inlets of lakes (Brown 1971, Wydoski and Whitney 1979, Holton and Johnson 1996). Usually found in shallow water, but can be found in deeper water, from 3-70 m (Johnson 1975, Wydoski and Whitney 1979). Prefers water temperatures usually $< 15^0$C (Symons et al. 1976, Otto and Rice 1977); mean summer water temperature of occupied streams in northwestern Montana was 9^0C (Gangemi 1992).

Slimy Sculpins hybridize with both Mottled and Shorthead sculpins (e.g., Zimmerman and Wooten 1981, Godkin et al. 1982); hybrids should be looked for in areas of sympatry, especially in the Flathead River drainage. The Slimy Sculpin currently has no special designation by any federal or state agency.

Montana Heritage Program Rank: G5, S5.

Distribution of Cottus rhotheus in Montana



Montana Natural Heritage Program, March 17, 1997

Torrent Sculpin (*Cottus rhotheus*)

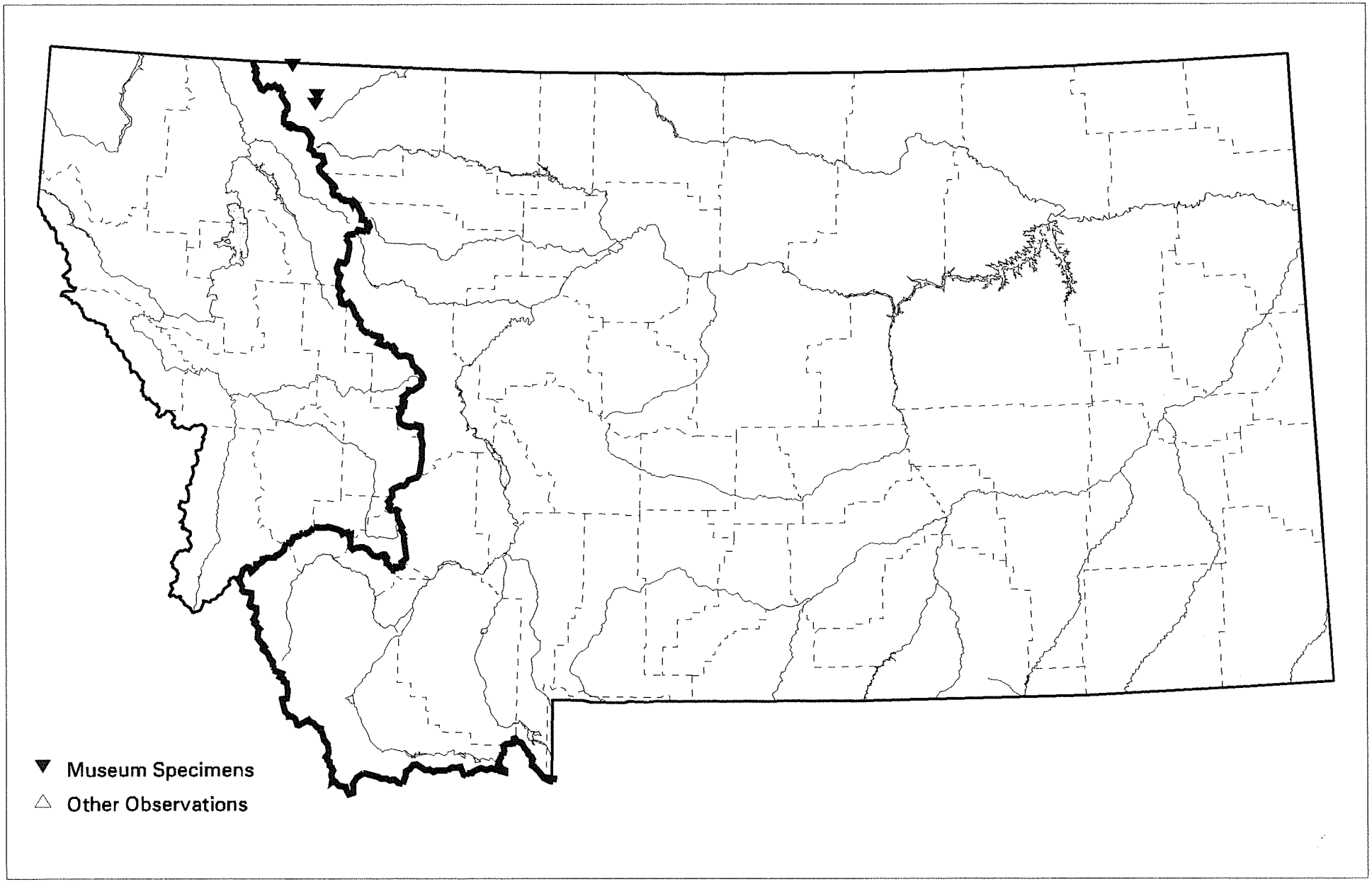
The Torrent Sculpin is a fish of the Pacific Northwest (Wydoski and Whitney 1979, Maughan and Saul 1979, Page and Burr 1991), principally in the Columbia River Basin of Oregon, Washington, Idaho, and British Columbia. The distribution in Montana is limited to the Kootenai River system in northwestern Montana west of the Continental Divide. Collections made in the last 20 years have filled out the distribution depicted in Gould and Brown (1970) and Brown (1971), which now includes the Tobacco River, Fortine Creek, Libby Creek and the Yaak River, but the range remains essentially that shown in the earlier publications. There is no indication that this species was introduced into previously unoccupied streams in Montana during the period when sculpins were legal live bait fish.

Torrent Sculpins inhabit fast, clear streams with a stable bottom of gravel and rubble, and also is found in rocky shoals and beaches of lakes (Brown 1971, Wydoski and Whitney 1979, Finger 1982, Holton and Johnson 1996). Mean summer water temperature in occupied streams in northwestern Montana was 11.4^{0}C (Gangemi 1992).

The Torrent Sculpin is not known to hybridize with other sculpin species. Additional collecting is unlikely to significantly expand the current range. Because of limited distribution in Montana and adjacent areas, the Torrent Sculpin is listed as Sensitive by the U.S. Forest Service (Region 1).

Montana Heritage Program Rank: G5, S2 (Animal Species of Special Concern).

Distribution of Cottus ricei in Montana



Montana Natural Heritage Program, March 17, 1997

Spoonhead Sculpin (*Cottus ricei*)

The Spoonhead Sculpin has a broad distribution, primarily across boreal Canada (Page and Burr 1991), but occurrences in the United States are limited mostly to the Great Lakes (see Hubbs and Lagler 1958) and northern Ohio in the east. Gould and Brown (1970) and Brown (1971) showed the range as limited to the Waterton (Upper Waterton Lake) and St. Mary (St. Mary Lake) drainages of Glacier National Park in the Saskatchewan River system east of the Continental Divide. At the time of their publications the species was known in Montana only from specimens collected in 1934. Current distribution remains essentially that shown in the earlier publications. Additional specimens have been collected in and near Lower St. Mary Lake in 1986 and 1993, and the Belly River (also in Glacier National Park) in 1986. Thus, current distribution in Montana is limited to the Waterton, St. Mary and Belly river drainages, all in the Saskatchewan River system. There is no evidence that this species was introduced into previously unoccupied streams in Montana during the period when sculpins were legal live bait fish.

Spoonhead Sculpins inhabit a variety of habitats, including cool, clear streams with swift water, turbid rivers and deep lakes (Brown 1971, Roberts 1988, Holton and Johnson 1996). This species is found in shallow water in streams and lakes (Roberts 1988) to great depths (50-90 m) in lakes (Hubbs and Lagler 1958, Selgeby 1988). Preferred summer water temperatures appear to be $< 15^{0}$C (Roberts 1988).

The Spoonhead Sculpin is not known to hybridize with other sculpin species. Because the Spoonhead Sculpin is known in Montana only from Glacier National Park or very nearby on the Blackfoot Reservation, it has no official U.S. Forest Service (Region 1) status.

Montana Heritage Program Rank: G5, S1 (Animal Species of Special Concern).

Hypothetical Species

Two additional species of sculpin may occur in Montana. The Deepwater Sculpin (*Myoxocephalus thompsoni*) was collected in Upper Waterton Lake, Waterton National Park, Alberta in 1966 (McAllister and Ward 1972). Upper Waterton Lake crosses into Montana in Glacier National Park; it is therefore likely that the Deepwater Sculpin is present in Montana as well. Apparently the species has not been looked for in Upper Warterton Lake since the 1966 collections in Alberta. All of the deep lakes in the Saskatchewan River drainage of Glacier National Park are possible sites for this species and should be surveyed. The species is considered a glacial relict, inhabiting some of the same large, deep lakes (such as Upper Waterton Lake) where the Spoonhead Sculpin is also found (see Page and Burr 1991); the Deepwater Sculpin inhabits waters with summer temperatures < 14^0C (Johnson 1975) in Great Bear Lake.

The Piute Sculpin (*Cottus beldingi*) is found in the Clearwater River drainage of the Columbia River Basin in northern Idaho (Maughan and Saul 1979), usually in slower, warmer (15-24^0C) water (Wydoski and Whitney 1979); specimens have been collected in the Selway River drainage (Paradise Ranger Station) of Idaho Co., about 16 km from the Montana border. However, the Bitterroot Mountains form an effective barrier for dispersal into Montana from this area. The only reasonable avenue of access into Montana is up the Clark Fork River, although Piute Sculpins are not found in Idaho in this drainage (Page and Burr 1991). There are sculpins in the St. Regis River of unusual morphology and genetics (Gregg unpub. data) which, though unlikely, could be this species. Because of the possibility of a "stream capture" event (e.g., Howard and Morgan 1993), Piute Sculpins should be looked for in extreme western Montana, and the St. Regis River drainage should be sampled more thoroughly.

III. LIFE HISTORIES

Mottled Sculpin (*Cottus bairdi*)

The Mottled Sculpin is the only sculpin species for which there exist life history and behavior studies from Montana. In Montana, this species is relatively sedentary with adult home ranges of < 150 m (Bailey 1952, McCleave 1964, Brown and Downhower 1982b), but often much less (usually < 50 m); similar results are reported from other regions (e.g., Hill and Grossman 1987). Movements may occur both upstream and downstream with equal frequency (Brown and Downhower 1982b), but McCleave (1964) found a greater tendency for upstream movement. Although adult populations appear to have low dispersal distances, gene flow between populations probably occurs through the few dispersing adults and drift (see Sheldon 1968) of juveniles. These aspects of population dynamics need further study.

Sexual maturity is reached at two or three years of age, by which time individuals of both sexes are about 6.4-7.9 cm standard length (Bailey 1952); adults four years old may be 8.4-12.0 cm standard length. Older fish are rare in Montana collections (Brown 1971). Males tend to be larger than females, and many males are polygamous (Brown and Downhower 1982a); mean number of spawnings/male was 1.5-4.0, depending on the population, with a maximum of 12 for an individual male.

Spawning begins in April and continues through June (Bailey 1952, Downhower and Brown 1979) in Montana; spawning may occur earlier in other regions (Wydoski and Whitney 1979). Eggs are laid in burrows, on the undersides of rocks of 13-38 cm diameter (Bailey 1952); clutch size is related to female length, and averaged 744 eggs (range = 54-1587, n = 12). Males tend the nests after eggs are laid (Bailey 1952); eggs hatch in 20-30 days at 10-16^{0}C (Brown 1971).

Mottled Sculpins eat a variety of foods, including immature aquatic insects of at least six orders, crustaceans, small sculpins, fish eggs, annelids and plants (Bailey 1952, Brown 1971, Wydoski and Whitney 1979). In turn, Mottled Sculpins are prey for a number of salmonid species (Brown 1971, Wydoski and Whitney 1979), and are used as bait fish. At least 25 species of parasites have been reported from Mottled Sculpins (Hoffman 1967, Kritsky et al. 1977, Muzzall et al. 1986, Heckmann et al. 1987).

Shorthead Sculpin (*Cottus confusus*)

Although no life history information was available for the Shorthead Sculpin 25 years ago (Brown 1971), several studies in the intervening years (though none yet from Montana) have provided some data for several locations. There remain several aspects of the life history, however, for which information is lacking. Home range size, dispersal and mating system are undocumented, although Gasser et al. (1981) provide some evidence that adults in Idaho are relatively sedentary.

Sexual maturity is reached at 2-3 years of age (Lee et al. 1980, Gasser et al. 1981, Roberts 1988), by which time both sexes are about 5.2-6.0 cm standard length. Some variation exists between populations, as Hughes and Peden (1984) found a two-year old female of 7.1 cm standard length. Hughes and Peden (1984) also noted that males may grow more rapidly than females. Adults live at least four or more years (Wydoski and Whitney 1979, Gasser et al. 1981).

Spawning occurs in April in Idaho (Gasser et al. 1981) and in late spring in Alberta (Roberts 1988) and Washington (Wydoski and Whitney (1979). Eggs are laid in burrows on the undersides of rocks (Lee et al. 1980, Roberts 1988). Fecundity is related to female body size (Wydoski and Whitney 1979, Gasser et al. 1981, Peden and Hughes 1984); 184 eggs were in a 5.3 cm long female, 511 eggs in a female 7.1 cm long in Idaho. Most females in Alberta contained 100-200 eggs, with a maximum of 354 in a female 8.1 cm long. Eggs per female in British Columbia ranged from 128 (female = 5.5 cm long) to 690 (female = 9.9 cm long). Data on sizes of clutches (individual egg masses) is lacking. Males guard nests once eggs are laid, and hatching probably occurs in two or three weeks (Roberts 1988).

Shorthead Sculpins eat the same variety of prey as most other sculpins species. Aquatic insects of at least five orders are consumed in British Columbia (Hughes and Peden 1984), and Gasser et al. (1981) found six orders in the diet in Idaho; fish remains and eggs were found in the diet at each location (< 1% of total items), but only in the largest size class (7.5-9.7 cm length) in the Idaho sample. Shorthead Sculpins are probably eaten by salmonids, birds and mammals (Wydoski and Whitney 1979, Roberts 1988). There are no reports of parasites in this species (Hoffman 1967).

Slimy Sculpin (*Cottus cognatus*)

Life history information remains scant for the Slimy Sculpin. There are no data on home range and dispersal distances, at least for western North America, although it is expected that this species is relatively sedentary as is the case with other sculpin species.

Age at sexual maturity is not known for all regions (Brown 1971, Wydoski and Whitney 1979) but is attained at 2 years in Minnesota (Petrosky and Waters 1975). Minimum size at maturity is about 5.5-6.0 cm (Petrosky and Waters 1975, Wydoski and Whitney 1979); adults live at least six years, by which time they are 10 cm standard length (Wydoski and Whitney 1979). Size distributions of sympatric Slimy and Shorthead sculpins in British Columbia were similar (Hughes and Peden 1984). Mating system varies between monogamy and polygyny within and between populations in Ontario (Mousseau and Collins 1987, Mousseau et al. 1988).

Spawning occurs in April or May (Petrosky and Waters 1975, Lee et al. 1980). Males select spawning sites on the underside of rocks, which are guarded until hatching (Brown 1971, Scott and Crossman 1973, Wydoski and Whitney 1979, Lee et al. 1980); abundance of nests per male was greater in a monogamous population (Mousseau and Collins 1987). Fecundity ranged from 59 eggs in age 1 females to 645 eggs in age 5 females in Minnesota (Petrosky and Waters 1975). Eggs hatch in about 28 days (Scott and Crossman 1973).

Slimy Sculpins eat a wide variety of foods, including aquatic insects, mollusks, crustaceans, small fishes and vegetation (Wydoski and Whitney 1979, Lee et al. 1980, Selgeby 1988). Four orders of insects were in the diet in British Columbia (Hughes and Peden 1984). Sometimes fish eggs and small fish form a large part of the diet (Wydoski and Whitney 1979), even for sculpin only 4.6 cm long. Slimy Sculpins are eaten by many fish species (Brown 1971, Johnson 1975, Wydoski and Whitney 1979, Brandt and Madon 1986), including lake trout, rainbow smelt, northern pike and burbot. At least three species of parasites have been found in Slimy Sculpins (Lawler 1952, Hoffman 1967).

Torrent Sculpin (*Cottus rhotheus*)

Life history information on Torrent Sculpins is limited, a common situation for most sculpin species. Little information exists on home range size and dispersal. Pre-spawning upstream movements (January-March), and post-spawning downstream movements (April-June) have been reported in Washington (Thomas 1973); distances of these movements were not determined, and may be relatively small.

Sexual maturity is reached at two years of age (Northcote 1954, Brown 1971, Wydoski and Whitney 1979), at about 5.5 cm standard length. Adults can live at least six years and reach 15.2 cm (Wydoski and Whitney 1979). Torrent Sculpins (n = 119) collected from Libby Creek, Montana in October fell into two size groupings of five total age classes (Gangemi 1992): group 1 = 3.5-5.1 cm, group 2 = 7.1-10.8 cm. The larger individuals were probably five years old (see Wydoski and Whitney 1979).

Spawning occurs in April and May, according to Northcote (1954) and Wydoski and Whitney (1979), but Thomas (1973) noted egg-laying only in April during 4 years; eggs are laid on the undersides of rocks. Fecundity is positively related to female size and varies among localities (Wydoski and Whitney 1979). In the Yakima River, Washington a 6.8 cm-long female produced 100 eggs and a female 11 cm long produced 412 eggs; age 2 females averaged 156 eggs, age 4 females averaged 221 eggs. In Newaukum Creek, Washington age 2 females averaged 165 eggs and age 4 females averaged 320 eggs. First fry are found in August (Northcote 1954, Brown 1971).

Torrent Sculpins eat a large variety of prey; larger organisms can be consumed because Torrent Sculpins have large mouths (Scott and Crossman 1973, Wydoski and Whitney 1979, Lee et al. 1980). Five insect orders, fingernail clams, crustaceans, and two species of fish were in the diet in British Columbia (Northcote 1954). Several species of salmonids and other game fishes feed on this sculpin species (Brown 1971, Wydoski and Whitney 1979). At least three species of parasite have been reported in Torrent Sculpins (Hoffman 1967).

Spoonhead Sculpin (*Cottus ricei*)

If life history information is limited for most sculpin species, it is even more so for the Spoonhead Sculpin. Roberts (1988) provides most of the following information, obtained in Alberta. No information is available on home range and dispersal.

Some individuals are mature by two years of age, when about 7.0-8.0 cm standard length. Young are 4.0-4.7 cm long by the end of the first summer and 6.3-7.4 cm by end of the second summer. Individuals larger than 11 cm are not uncommon, and the largest specimen (a male) in Alberta was 13.5 cm.

Spawning in Alberta occurs in April and May along rocky lakeshores, creek bottoms and river margins, after water warms to 6^0 C. Males select nest sites, usually under rocks, and drive other males from nest areas. Eggs are attached to the undersurface of the rocks, following which males drive females from nests. Some males are polygynous; frequency distribution of egg masses guarded by males was one mass-12, two masses-3, three masses-5. Number of egg masses guarded was correlated to male size. Fecundity of females ranged from 280-1200 eggs, and correlated to female size. Clutch size was undescribed. Eggs hatch in 21 days (at 8^0C).

Diet of Spoonhead Sculpins is not well-described. Aquatic insects, including stoneflies,

are most prevalent (Scott and Crossman 1973, Lee et al. 1980, Roberts 1988). Spoonhead Sculpins are prey to larger fish (Brown 1971, Roberts 1988), including lake trout, burbot, northern pike, and other game fish. Smaller individuals in shallow water may be eaten by birds and mammals (Roberts 1988). There are no reports of parasites (Hoffman 1967) for Spoonhead Sculpins.

IV. RECOMMENDATIONS FOR FUTURE WORK

1) Of primary interest is the "true" identity of the Shorthead Sculpin (*Cottus confusus*) in Montana; is this species found in Montana, and is there an as yet undescribed taxon of sculpin in the Flathead, Milk, and St. Mary rivers? A thorough genetic/morphometric analysis needs to be done on populations of putative Shorthead and Mottled (*C. bairdi*) sculpins throughout the state. Interest in this problem is high with some biologists in Alberta and British Columbia; possibly a cooperative project to resolve the confusion can be developed with Canadian biologists.

2) Additional sampling for sculpins is needed to define distributions in Montana with greater precision. Large gaps exist in some distributions in part because sculpins often are not identified to species level during stream surveys. In other cases, such as the St. Regis River, distributions are uncertain because some individuals show intermediate traits, and identity is impossible given the available resources (current taxonomic keys, limited laboratory equipment). Recommendations (1) and (2) could be coordinated to reduce the field effort needed to gather samples for species determinations, by relying on state and federal biologists to provide specimens for analysis (when conducting routine stream surveys) to some central laboratory or person.

3) With the exception of the Mottled Sculpin, no life history studies have been done on sculpins in Montana. Little information is available on local distributions, dispersal, ecological requirements, sensitivity to various kinds of disturbance, habitat segregation in areas of sympatry, demography, and food habits of Montana populations. Effective management for species of concern will need to be built upon these kinds of data.

4) Special Concern (or Sensitive) status appears to be merited by all sculpin species in Montana that are currently so designated, because of limited distributions in the state. Of special concern for federal and state managers is the identity of the species currently referred to as the Shorthead Sculpin, as this species has special legal status with the U.S. Forest Service. There may be two species under this common name in Montana that merit special management consideration, or only one that is as yet undescribed. Again, recommendation (1) is of high priority for this reason.

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