

Report on the Diving Beetle *Hygrotus diversipes* Leech (Coleoptera: Dytiscidae)

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INTRODUCTION

Hygrotus diversipes Leech is a rarely-collected beetle of the family Dytiscidae. It is a member of a speciose Holarctic genus with species that are often very abundant and commonly collected in a variety of habitats. The North American species were revised by Anderson (1971; 1976; 1983) with subsequent changes in nomenclature with a better understanding of relationships with Palaearctic species (for updated nomenclature see Larson et al.2000). Historically two genus names, *Hygrotus* Stephens and *Coelambus* Thomson, have been recognized at either genus or subgenus ranks. North American and northern European workers have traditionally recognized one genus and have often ignored the subgenus ranks entirely, whereas southern Europeans have recognized either two genera or, at least, have emphasized the use of subgenus names. Members of *Hygrotus* are very rounded and robust and have the anterior clypeal margin beaded or flattened. Members of *Coelambus* are elongate oval and have the anterior clypeal margin evenly rounded (except in two derived Nearctic species). These two groups are probably not closely related (Miller, 2001), but evidence is not strong at this time, and for the purposes of this report I recognize all *Hygrotus* and *Coelambus* species in one genus.

Hygrotus diversipes is, in some respects, a typical member of the group that includes *Coelambus* species (Figs 1-2). It is moderately large (about 4.5mm length), oval in shape, pale yellowish dorsally and black ventrally. However, it is also a member of a group of *Hygrotus* (the *H. pedalis*-group) that exhibits some unusual characters which are probably synapomorphies. These include in males the median lobe of the aedeagus exceptionally narrow apically in lateral aspect, and the profemora, mesofemora and mesotibiae modified with various emarginations and lobes (e.g. Fig. 3) (Leech, 1966). Of the five species in this group, *H. pedalis* (Fall) occurs in a moderately limited region of central and southern California and *H. thermarum* (Darlington) occurs in relatively high-temperature thermal waters in portions of Oregon, California and Nevada. *Hygrotus fontinalis* Leech is known only from Travertine Hot Springs near Bridgeport in Mono County, California, and *Hygrotus curvipes* is known only from a "shallow, muddy pool at Oakley, Contra Costa County, California" (Leech, 1966). *Hygrotus diversipes* has historically been known only from the type locality and similar sites within about a 20km radius in Natrona County, Wyoming. Thus, each member of this group is relatively limited in distribution or habitat requirements. This is not entirely unusual for members of *Hygrotus*. Although many species are extremely widespread and inhabit a range of habitat types, the genus is known to have representatives that are very limited in range or habitat. In particular, there are an unusual number of species that occur in hot springs or in highly saline prairie pools where no other diving beetles occur. Thus, it seems possible that the historical rareness of *H. diversipes* could be genuine when compared with other Nearctic diving beetles. However, eastern Wyoming represents a prominent geographic gap in the knowledge of diving beetles. Other than casual collecting by a few traveling taxonomists, there has been little collecting effort in this area. This is in contrast to areas of the west such as Alberta, Montana, North Dakota, Utah, Nevada, California, and the Pacific Northwest where diving beetle taxonomists have emphasized collecting efforts. Thus, the historical rarity of *H. diversipes* could simply be an artifact of uneven collecting effort. Nearly 20 species of *Hygrotus* are known to occur or would be expected to occur in eastern Wyoming (see Appendix 1). Of these, *H. sayi*, *H. nubilis*, *H. patruelis*, *H. tumidiventris*, *H. compar* and *H. sellatus* have been previously collected with *H. diversipes*. Each of these other *Hygrotus* species is found in a wide variety of habitat types and is common and widespread. However, some historical collections at some sites include only *H. diversipes* suggesting that the species may have particular habitat preferences or tolerances that do not entirely overlap those of other species.

It should be noted that this report is not peer-reviewed and should not be cited as a publication. It can be cited as an unpublished report.

TAXONOMIC AND COLLECTION HISTORY.

Hygrotus diversipes was described from nineteen specimens collected by H.B. Leech (Leech, 1966). All individuals in the type series were collected from the type locality at Dugout Creek, 8.5 miles northwest of Midwest,

Natrona County, Wyoming (presumably where Highway 87 crosses Dugout Creek) on 27 July 1964. The only other taxonomic references to the species are by Anderson (1983), who revised the genus in North America, and Larson et al. (2000), who treated the North American members of the family. Each of these works provided means for identification of the species, but neither added new information to Leech's (1966) original description about the biology or distribution. Until 1985, Leech was the only person known to have collected the species. However, later attempts were made to specifically assess the status of the beetle (see Appendix 3). In 1985 a survey to assess the species was conducted by G. Dahlem and others from the Bureau of Land Management (BLM). Seventy-one specimens of the species were collected by the BLM team at three localities, the type locality at Dugout Creek (18 specimens) and two nearby locations (36 and 17 specimens). Specimens were identified by R. Anderson (Southern Utah State College, Cedar City, Utah), who revised the genus (Anderson, 1983). Subsequently in 1988, another attempt to collect the species was made by W. Fitzgerald and others, also of the BLM. They collected at the type locality and various other localities but did not collect any *H. diversipes* (Anderson also identified their material). In 1992, two surveys were conducted. The first, by L.C. Keenan and T. Howard of Professional Entomological Services Technology, Inc. (PEST), found specimens at the type locality and a single additional location nearby (3 specimens total, identified by R.E. Roughley, University of Manitoba, Winnipeg, Manitoba). The BLM conducted an additional survey in 1992 (led by R.A. Nelson), as well, and found the species in another location nearby (10 specimens total). Finally, PEST conducted another survey in 1993, and found specimens in the same sites as in their 1992 survey. The efforts by both the BLM and PEST were made for the U.S. Fish and Wildlife Service to determine whether to propose listing the species as endangered or threatened. The U.S. Fish and Wildlife Service had designated the species as a Category II species (which means listing the species as threatened or endangered may be appropriate, but data are not available to properly assess its status), and an Exxon CO₂ pipeline was proposed to pass through the immediate vicinity of the type locality. I also collected several specimens from the type locality and a few kilometers upstream in 1996.

Thus, after 1993, the species was known from about 6 individual sites and perhaps 140 specimens collected within about 18 miles, all from Natrona County and all from the type locality or nearby. PEST recommended not listing the species as threatened or endangered, and no additional attempts were made by the BLM, PEST or the U.S. Fish and Wildlife Service to find the species. Although the number of collected specimens is perhaps larger than other relatively rare dytiscids, of species in relatively well-known genera of North American Dytiscidae, *H. diversipes* is one of the rarest. This is particularly true when one considers the several attempts made by various expeditions to collect it.

OBJECTIVES

My objectives for this project were threefold – to 1) establish the current existence of *H. diversipes* at or near the type locality and other localities where the species has been collected previously, 2) attempt to determine whether *H. diversipes* is more geographically widespread (in part, specifically to determine whether *H. diversipes* occurs in areas farther north and east where coal-bed methane extraction could potentially have an effect on populations of the species), and 3) determine the type of habitat or habitats preferred by the species and how widespread the habitat is in Wyoming.

METHODS AND TIME SCHEDULE

To begin with, I searched for *H. diversipes* at and near the type locality near Midwest in Natrona County. From there I surveyed northward and eastward over the course of several days covering much of the area of proposed methane extraction. After this I traveled to Montana State University, Bozeman to consult with M.A. Ivie and D.L. Gustafson and examine their collections for *H. diversipes*. Subsequent to this, I surveyed in areas south and west of the type locality for several days based on the possible presence in this area of the apparent preferred habitat type for *H. diversipes* (see below). In all, I covered several hundreds of miles of areas of eastern and central Wyoming (Fig. 4). In all areas I examined all bodies of water including rain pools, streams, seeps, plunge pools, etc. I used a standard aquatic sweeping net. I also used a black light based on the assumption that *H. diversipes* is a highly vagile species and is likely to appear at lights.

RESULTS OF SURVEY

Eastern Wyoming has been subjected to an intense drought over the past several years. However, diving beetles in this area are, in general, well-suited for exploiting small, temporary bodies of water in ordinarily dry habitats, so droughts likely affect them less than species requiring long-term permanence of water. Nevertheless, within the area I surveyed there were extremely large regions that lacked potential collecting sites entirely (i.e. they were entirely dry with no pools or streams that I could find). Also, during the first few days I was conducting the

survey, several extremely intense thunderstorms moved through certain portions of northeastern Wyoming leaving very large amounts of water in the gulches and draws. Although these are ideal habitats for diving beetles, the timing was not very good since these pools require a few weeks to develop a fauna. Thus, conditions were not ideal for collecting diving beetles, in my opinion.

Initially, I collected moderately large numbers of *H. diversipes* from the type locality and nearby. This was reassuring to me in that the species has clearly maintained a viable local population in this area despite even the severe drought conditions. It also encouraged me that I would be likely to find the species at other more distant sites if, indeed, it existed elsewhere. Also, given the relative ease with which I was able to find it in several sites near the type locality, I was also encouraged that if I failed to find it elsewhere, it would be because of a real absence of the species rather than an artifact of problems with my collecting technique. I ultimately sampled over 200 individual sites throughout eastern and central Wyoming. Many of these did not contain diving beetles or contained only the species *Laccophilus maculosus* and/or *Liodessus obscurellus* which are ubiquitous throughout northern North America. If these were the only species present at a site, no collection was kept or recorded. However, roughly 50 sites contained diving beetles in other species (Fig. 5). I collected 43 species of diving beetles (see Appendix 2), or nearly 8% of the North American species. Of the 19-or-so species of *Hygrotus* known to occur or possibly occurring in eastern and central Wyoming (see Appendix 1), I collected 16 (Appendices 1-2). Five of these are new records for Wyoming. *Hygrotus punctilineatus* was entirely unexpected since the known range is substantially farther north. I collected *H. semivittatus* at a couple localities in Wyoming during previous collecting trips, but did not find it on this trip. These localities are far to the east of the known range of this species.

Hygrotus diversipes does not appear to occur in the collections at Montana State University, Bozeman. Gustafson (Department of Biology, MSU) indicated that the habitat, as I described it to him, is relatively widespread in eastern Montana where he has done extensive collecting without having collected *H. diversipes*. However, his emphasis has generally been on lentic waters and has not been specific to diving beetles.

DISTRIBUTION OF *HYGROTUS DIVERSIPES*

I found *H. diversipes* at 6 sites (including the type locality, see Appendix 3, Fig. 5), increasing the total number of known individual sites for this beetle to about 11. Two sites north and east of the previously known sites were notable (i.e. sites significantly distant from known *H. diversipes* sites). One site was near the confluence of the Middle Fork and the Red Fork of the Powder River in a small pool below a culvert where the road crosses a gulch. The other was in pools in a recently flooded gulch along the Upper Powder River Road about 6km north of I-90. This was a much more significant range extension northward of about 56km from the nearest known locality.

I also found *H. diversipes* at a couple notable sites west and southwest of the type locality (see Appendix 3, Fig. 5). These were from a salty portion of Conant Creek in Fremont County and Sand Draw, near Waltman. The former site is an extension of the known distribution west for *H. diversipes* of about 112km.

The known range of *H. diversipes* now includes the Wyoming counties of Natrona, Johnson, and Fremont. The greatest distance between localities is 202.85 km (about 126mi) (Fig. 5). The species is now known from two major drainages, the Powder River (South and Middle Forks, Salt Creek and the main Powder River drainage farther north) and the Wind River (Muskrat Creek and Poison Creek drainages).

HABITAT AND BIOLOGY OF *HYGROTUS DIVERSIPES*

Hygrotus diversipes appears to occur almost exclusively in small, highly mineralized pools in gulches where there is often white crusts of salts along the margins of the water. Apparently these gulches are intermittently flowing and often entirely flooded. I have personally seen the type locality entirely dry and flowing as a significant stream. Thus, these sites are highly disturbed in terms of unpredictable flooding and drying regimes. Substrates in these sites are generally clay with some larger gravel. There is often a species of sedge in some pools and sometimes considerable plant debris. *Hygrotus diversipes* was not found at sites without plant debris nor in adjacent areas with only mineral substrates at sites where the species was collected. This type of salt-gulch habitat was not located north and east of the type locality, which may explain why *H. diversipes* was not found there. Large numbers of the species can occasionally be found at a site. One collection by a previous survey included 36 individuals. My collection at Teapot Creek included about 30 individuals, and it was the most common species present. In other sites, only one or two individuals were collected along with many other diving beetle species. The species has been collected from 18 June-30 September.

CONCLUSIONS

Based on my collecting effort in Wyoming from 6-24 August 2002 and other historical data, I conclude that *H. diversipes* is genuinely rare. This conclusion is based on a definition of "rare" wherein the species is relatively

restricted in habitat and geography compared with other diving beetles. I suspect that the species is more widespread than current records indicate simply because the habitat is probably more widespread, but the habitat appears to be extremely patchy, and I did not find much similar habitat north and east of the type locality (perhaps partly because of the ongoing drought). The habitat appears to be more common south and west of the type locality. I recommend that future efforts to survey for this species focus on a concerted search for additional sites with habitat similar to that at the type locality (see above). My collecting efforts were comprehensive given the circumstances, but because of the intense drought and recent flooding in some areas, it is possible that my collecting results do not very accurately reflect the typical range or status of the species in this area. The region remains relatively little known for most aquatic insect species, including diving beetles.

PEST, Inc. recommended not listing the species as endangered or threatened based on their assessment and collecting efforts. As a systematist, I do not believe myself qualified to make an assessment about the possible impact of coal-bed methane extraction on the long-term status of the species. The species does occur in habitats that are exceptionally disturbed by frequent, unpredictable flooding regimes, nearby mineral exploration and extraction, power lines, gas pipelines, cattle grazing, and a major highway. However, I do not feel comfortable making any claims about the possible effects of additional broad-scale mineral or fossil fuel exploration or extraction in areas where the beetle occurs.

LITERATURE CITED

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Appendix 1**List of *Hygrotus* species in central and eastern Wyoming**

(* = collected during survey, ! = new Wyoming record collected during survey, † = new Wyoming record previously collected by KBM, not collected during survey)

*!*H. acaroides* (LeConte)

**H. marklini* Gyllenhal

**H. compar* (Fall)

H. dissimilis Gemminger and Harold

**H. diversipes* Leech

**H. impressopunctatus* (Schaeffer)

**H. infuscatus* (Sharp)

*!*H. masculinus* (Crotch)

**H. nubilus* (LeConte)

**H. patruelis* (LeConte)

*!*H. punctilineatus* (Fall)

*!*H. salinarius* Wallis

**H. sayi* Balfour-Browne

**H. sellatus* (LeConte)

†*H. semivittatus* (Fall)

H. suturalis (LeConte)

**H. tumidiventris* (Fall)

**H. turbidus* (LeConte)

*!*H. unguicularis* (Crotch)

Appendix 2
Species of Dytiscidae collected during survey

Agabus disintegratus (Crotch)
A. griseipennis LeConte
A. obsoletus LeConte
A. tristis Aubé
Colymbetes incognitus Zimmerman
Copelatus chevrolati Aubé
Coptotomus longulus LeConte
Dytiscus alaskanus Balfour-Browne
D. marginicollis LeConte
Hydroporus appalachiensis Sherman
Hydroporus tademus Leech
Hydroporus sp.
Hygrotus acaroides (LeConte)
H. compar (Fall)
H. diversipes Leech
H. impressopunctatus (Schaeffer)
H. infuscatus (Sharp)
H. marklini (Gyllenhal)
H. masculinus (Crotch)
H. nubilus (LeConte)
H. patruelis (LeConte)
H. punctilineatus (Fall)

H. salinarius Wallis
H. sayi Balfour-Browne
H. sellatus (LeConte)
H. tumidiventris (Fall)
H. turbidus (LeConte)
H. unguicularis (Crotch)
Ilybius fraterculus LeConte
I. seriatus (Say)
Laccophilus maculosus Say
L. proximus Say
Liodessus obscurellus (LeConte)
Neoporus dimidiatus (Gemming and Harold)
N. undulatus (Say)
Nebrioporus macronychus (Shirt and Angus)
Oreodytes congruus (LeConte)
Platambus semivittatus (LeConte)
Rhantus binotatus (Harris)
R. gutticollis (Say)
R. sericans Sharp
Stictotarus griseostriatus (DeGeer)
S. striatellus (LeConte)
Thermonectes nigrofasciatus (Aubé)

Appendix 3
***Hygrotus diversipes* collection data**

Historical localities

- 1) WY: Natrona Co., Dugout Creek, 8.5 miles northwest of Midwest, T41N, R80W, Sec36 SE¼, (Type locality)
 H.B. Leech (27 July 1964)
 L.C. Keenan and T. Howard, P.E.S.T., Inc. (11 August 1992, August 1993)
 G. Dahlem, BLM (18 June 1985)
 K.B. Miller, Cornell University (20 July 1995)
- 2) WY: Natrona Co., Dead Horse Creek, T39N, R81W, Sec2 SW¼ NE¼, 43°22'40.4"N 106°32'20.5"W
 G. Dahlem, BLM (18 June 1985)
- 3) WY: Natrona Co., Cloud Creek at 33 Mile Road, T38N, R82W, Sec14 NE¼ NW¼, 43°15'49.5"N 106°39'27.9"W
 W. Fitzgerald, BLM (30 September 1992)
 G. Dahlem, BLM (18 June 1985)
- 4) WY: Natrona Co., Cloud Creek at Wild Horse Road, T39N, R82W, Sec23 SW¼ NW¼, NW¼ SW¼,
 43°20'6.3"N 106°39'27.9"W
 W. Fitzgerald, BLM (30 September 1992)
- 5) WY: Natrona Co., Hay Draw, , T41N, R79W, Sec31 NE¼, 43°29'15.5"N 106°23'11.1"W
 L.C. Keenan and T. Howard, P.E.S.T., Inc. (11 August 1992, August 1993)
- 6) WY: Natrona Co., Government Cr, plunge pool in gulch, ~13mi W Midwest, 43°24'57.7"N 106°26'23.4"W
 K.B. Miller, Cornell University, (10 August 1996, 13 August 1996, 22 August 1996)

Localities from K.B. Miller Wyoming survey of Dytiscidae, 6-24 August 2002

- (type locality, same as 1 above) Wyoming: Natrona Co., Dugout Cr. at I25, small muddy pools in gulch, some dead plant material, 43°28.677'N 106°24.726mW, 1466m (7 August 2002)
- 7) WY: Johnson Co., ~5km E Barnum, pool in gulch, 43°38.845'N 106°49.804'W, 1522m (7 August 2002)
 - 8) WY: Johnson Co., pools in streambed (gulch), Flying E Cr. and Rd. 195 (Upper Powder R. Rd), 44°15.581'N 106°09.955'W, 1232m (9 August 2002)
 - 9) WY: Natrona Co., Teapot Cr. ~10km S Midwest. small, trickling, salty creek, some emergent veg., 43°19.204'N 106°14.311'W, 1534m (9 August 2002)
 - 10) WY: Fremont Co., Conant Cr. reedy, salty spring, 42°58.147'N 107°57.116'W, 1625m (17 August 2002)
 - 11) WY: Natrona Co., Sand Draw near Waltman, salty pool, much veg., 43°03.384'N 107°12.106'W, 1821m (17 August 2002)



Fig. 1. *Hygrotus diversipes*, left lateral habitus.



Fig. 2. *Hygrotus diversipes*, dorsal habitus. Fig. 3. *Hygrotus diversipes*, male left front leg.

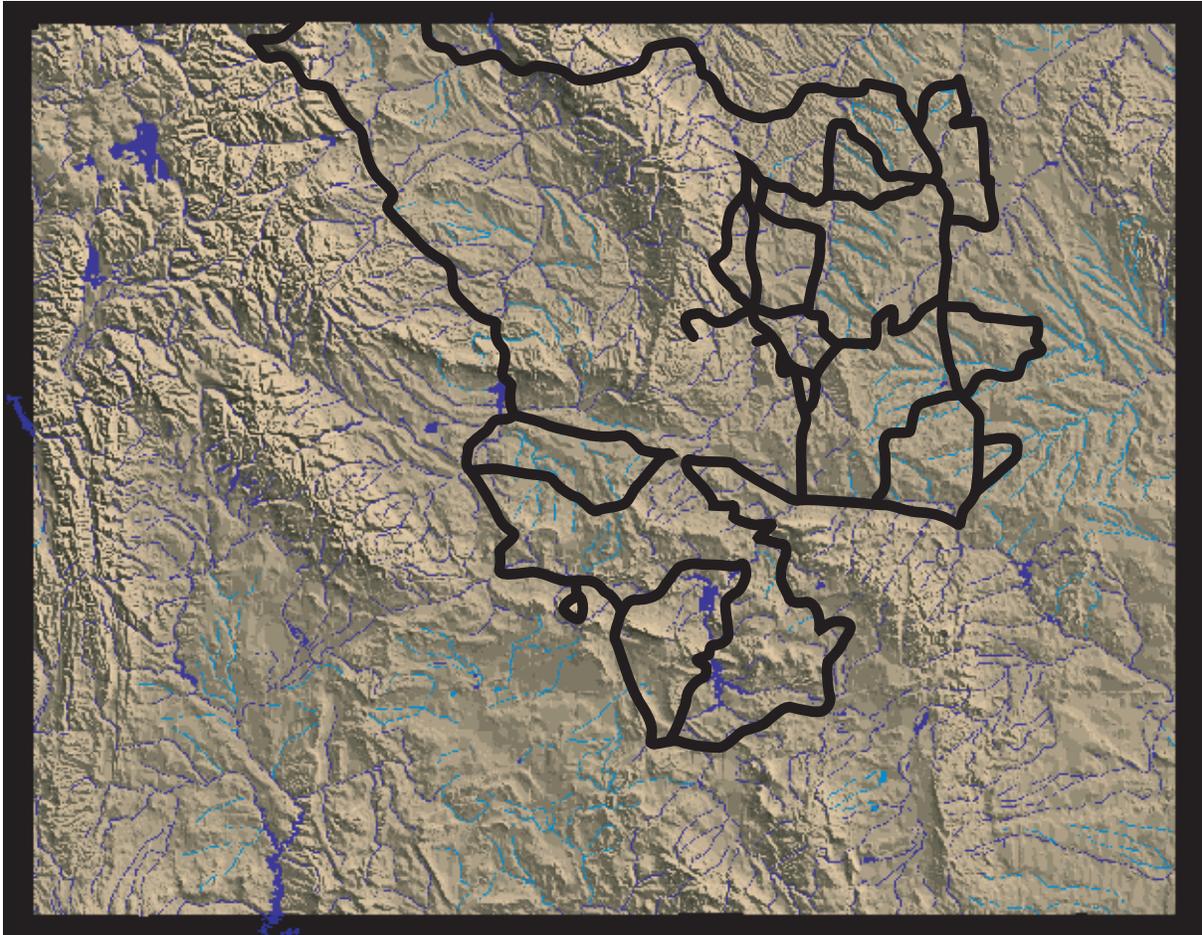


Fig. 4. Survey route.

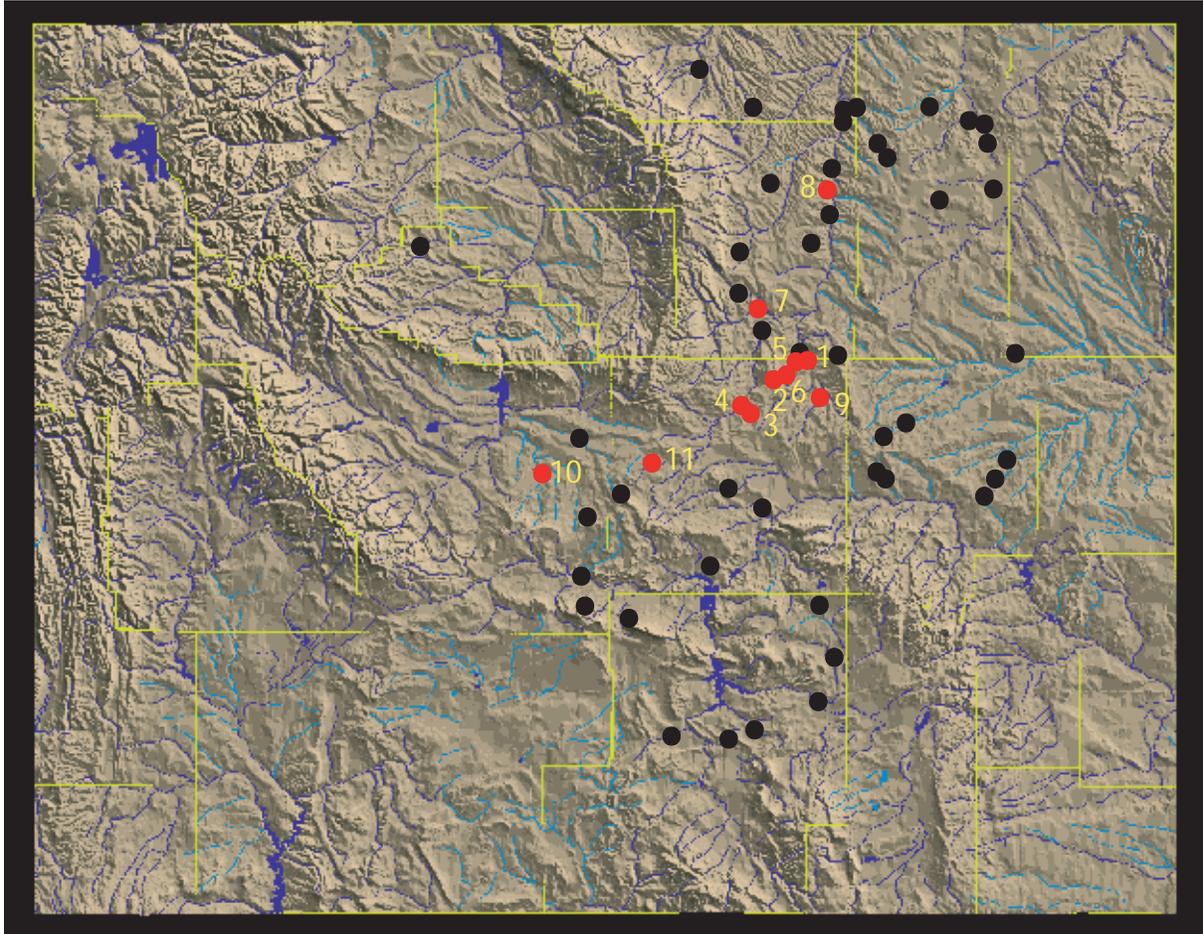


Fig. 5. Sites where specimens of Dytiscidae were collected during survey (excluding numerous sites where only the species *Liodesus obscurellus* and/or *Laccophilus maculosus* were collected). Red dots indicate sites where *Hygrotus diversipes* was collected during this survey or by previous collectors. Numbers correspond with numbered sites in Appendix 3.