that "samples of ore and waste rock have tested negative for acid rock drainage [ARD]" and "the area's low annual precipitation and high evaporation rates make it unlikely that there will be sufficient seepage through the waste rock dumps to initiate any chemical reactions for ARD and to transport the products from such reactions, such as elevated concentrations of metals and arsenic, to a receiving resource" (pg. 3-31).

In contrast to creating sources of arsenic contamination, the Project will remediate a source of arsenic contamination by removing the historical gold tailings that currently exist on Soledad Mountain. As discussed above (Sec. 2.4.2), the entirety of the existing historical gold tailings will be used to construct the lower lining of the heap leach pad (Kern County 2010, pg. 3-27). These tailings are a source of arsenic and other metal contamination on Soledad Mountain. For example, the concentration of arsenic in the soil downwind of the historical tailings is three times higher than background soil arsenic levels (Golden Queen and ARCADIS 2008). The use of the tailings by the Project will remediate this existing source of arsenic contamination.

The Petition does not supply substantial scientific information to support its assertion that the Project will result in substantial arsenic contamination that will threaten the Mohave shoulderband. Rather, the Petition misinterprets the scientific studies it references and ignores information provided by other sources it cites. The USGS study, Rytuba et al. (2011), used by the Petition to support its conclusions is not directly relevant to the mining and processing techniques that will be used by the Project. Rytuba et al. (2011), however, do provide evidence to support the conclusion by Kern County (2010) that arsenic contamination will not occur as a result of Project activities. Moreover Kern County (2010) also clearly explains that the Project will remediate a source of existing arsenic contamination by removing existing gold tailings on Soledad Mountain. Thus the Petition's conclusion that arsenic contamination from the Project is a major threat to the Mohave shoulderband is not supported by the information supplied by the Petition and ignores the information provided by Kern County (2010), a document referenced by the Petition.

3. CONCLUSIONS

Based on our review and analyses, we provide the following conclusions with regard to the information provided in the Petition to list the Mohave shoulderband as threatened or endangered. The taxonomy, biology, and range of Mohave shoulderband are not well understood, and the Petition does not provide substantial scientific information to address the paucity of data available regarding the species. The mapping provided by the Petition of potential habitat for the Mohave shoulderband inexplicably excludes potential habitat that is visible on publicly available satellite imagery. This flawed mapping exercise results in the overestimation of threats to the species from habitat destruction associated with the Project. Finally, the analysis of threats provided in the Petition contradicts the information and analysis of Project impacts extensively documented in Kern County (2010) prepared prior to the authorization of Project development, misinterprets available data, ignores relevant information provided by the studies it references, and fails to provide substantial scientific information to substantiate its conclusions.

4. LITERATURE CITED

Anderson, T.K., K.F. Weaver, and R.P. Guralnick. 2007. Variation in adult shell morphology and life-history traits in the land snail *Oreohelix cooperi* in relation to biotic and abiotic factors. Journal of Molluscan Studies73: 129–137.

ARCADIS U.S., Inc. (ARCADIS). 2008. Soledad Mountain Project Human Health Risk Assessment; May. ***Appendix M*** *in* Kern County Planning Department. 2010. Draft Supplemental Environmental Impact Report [Prior SCH # 96061052]: Golden Queen Mining Co. Inc., Soledad Mountain Project. Volume 1, Chapters 1-10. Bakersfield, California. January.

Bempah, C.K., A. Ewusi, S. Obiri-Yeboah, S.B. Asabere, F. Mensah, J. Boateng, H. Voigt. 2013. Distribution of Arsenic and Heavy Metals from Mine Tailings dams at Obuasi Municipality of Ghana. American Journal of Engineering Research 2(5):61-70.

Bequaert, J. C. and W. B. Miller. 1973. The Mollusks of the Arid Southwest with an Arizona Check List. University of Arizona Press. Tucson, Arizona.

Center for Biological Diversity. 2014. Emergency Petition to List the Mohave Shoulderband (*Helminthoglypta (Coyote) greggi*) as Threatened or Endangered under the Endangered Species Act. January 31.

Cook, A. 2001. Behavioral ecology: On doing the right thing at the right time. In: The Biology of Terrestrial Molluscs. G.M. Barker (ed). CABI Publishing, Wallingford, Oxon, U.K.

Criscione, F., M.L.Law, and F. Köhler. 2012. Land snail diversity in the monsoon tropics of Northern Australia: revision of the genus Exiligada Iredale, 1939 (Mollusca: Pulmonata: Camaenidae), with description of 13 new species. Zoological Journal of the Linnean Society 166: 689–722.

Dillon, R.T., S.J. Jacquemin, and M. Pyron. 2013. Cryptic phenotypic plasticity in populations of the freshwater prosobranch snail, *Pleurocera canaliculata*. Hydrobiologia 709: 117-127.

Fairbanks, H.L. and Reeder, R.L. (1980). Two new species of Sonorella (Gastropoda: Pulmonata: Helminthoglyptidae) from the Pinaleño Mountains, Arizona. Proc. Biol. Soc. Wash. 93, 395–404.

Gilbertson, L.H. and W.R. Radke. 2006. A New Species of Sonorella (Pulmonata: Helminthoglyptidae) from Arizona, with Notes on Predation and Evasive Behaviors. American Malacological Bulletin. Vol 21:1-2. Pp. 17-22.

Gilbertson, L.H., D.J. Eernisse, and J.K. Wallace. 2013. A new dartless species of Cahuillus (Pulmonata: Helminthoglyptidae) from the Mojave Desert, California with a reassignment of Eremarionta rowelli unifasciata. Amer. Malac. Bull. 31(1): 57–64.

Golden Queen Mining Co., Inc. 2007. Report of waste discharge for the Soledad Mountain Project; May. ***Appendix R*** *in* Kern County Planning Department. 2010. Draft Supplemental Environmental Impact Report [Prior SCH # 96061052]: Golden Queen Mining Co. Inc., Soledad Mountain Project. Volume 1, Chapters 1-10. Bakersfield, California. January.

Golden Queen Mining Co., Inc. and ARCADIS U.S., Inc. 2008. Soledad Mountain Project Environmental Site Assessment. September. ***Appendix K*** *in* Kern County Planning Department. 2010. Draft Supplemental Environmental Impact Report [Prior SCH # 96061052]: Golden Queen Mining Co. Inc., Soledad Mountain Project. Volume 1, Chapters 1-10. Bakersfield, California. January.

Groves, L.T. 2012. Catalog of recent molluscan types in the Natural History Museum of Los Angeles County. Natural History Museum of Los Angeles County Malacology Section Los Angeles, California. Available at: http://www.nhm.org/site/sites/default/files/malacology/pdf/Malacology%20Type%20List.pdf

Hoffman, J.E. 1990. Status survey of seven land snails in the Mineral Hills and the Pinaleño Mountains, Arizona. Contract number: 20181-88-00973. Arizona: US Fish and Wildlife Service.

Hoffman, J.E. 1995. Status Survey for the Squaw Park Talussnail *Sonorella allynsmithi*. Prepared for U.S. Fish and Wildlife Service, Arizona Ecological Services, Contract Number 20181-1-1422. 18 pp.

Kern County Planning Department (Kern County). 2010. Draft Supplemental Environmental Impact Report [Prior SCH # 96061052]: Golden Queen Mining Co. Inc., Soledad Mountain Project. Volume 1, Chapters 1-10 (Conditional Use Permit No. 27, Map 196; Modification of Conditional Use Permit No. 41, Map 213; Modification of Conditional Use Permit No. 22, Map 214; Nonsummary Vacation of a Portion of New Eagle Road 191-31 3 098). Bakersfield, California. January.

Lang, B.K., and L.H. Gilbertson. 2010. A new species of *Sonorella* (Gastropoda: Pulmonata: Helminthoglyptidae) from southwestern New Mexico, with a revision of the subspecies of *Sonorella hachitana* (Dall). Proceedings of the Biological Society of Washington 123:62–71.

MacKenzie, D. I., J. D. Nichols, G. B. Lachman, S. Droege, J. A. Royle and C. A. Langtimm. 2002. Estimating site occupancy rates when detection probabilities are less than one. Ecology 83: 2248-2255.

Miller, W.B. 1970. A new species of Helminthoglypta from the Mohave Desert. The Veliger 12 (3): 275-278.

NatureServe. 2008. (http://www.natureserve.org/prodServices/pdf/NatureServeStatusAssessmentsListing-Dec%202008.pdf).

NatureServe. 2014. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://explorer.natureserve.org. (Accessed: March 25, 2014).

Pilsbry, H. A. 1939. Land Mollusca of North America (North of Mexico). The Academy of Natural Sciences of Philadelphia Monographs No. 3 Volume 1 (Part 1): 1–573.

Reeder. R.L. and W.B. Miller. 1987. A new *Helminthoglypta* (*Rothelix*) (Gastropoda: Pulmonata: Helminthoglyptidae) from Southern California with comments on its probable evolutionary relationships Southwestern Naturalist 32:261-265.

Reeder. R.L. and B. Roth. 1988. A new subgenus of *Helminthoglypta* (Gastropoda: Pulmonata: Helminthoglyptidae) with a description of a new species from San Bernadino, California. Veliger 312:252-257.

Roth, B. and F.G. Hochberg. 1992. Two new species of *Helminthoglypta* (Gastropoda: Pulmonata) from Southern California with comments on the subgenus *Charodotes* Pilsbry. Veliger 35:338-346.

Roth, B. 1996. Homoplastic loss of dart apparatus, phylogeny of the genera, and a phylogenetic taxonomy of the Helminthoglyptidae (Gastropoda: Pulmonata). The Veliger 39: 18–42.

Roth, B., and P.S. Sadeghian. 2003. Checklist of the land snails and slugs of California. Santa Barbara Museum of Natural History Contributions in Science No. 3. 81 pages.

Rytuba, J, C. Kim, and D. Goldstein. 2011. Review of samples of sediments, tailings, and waters adjacent to the Cactus Queen Gold Mine, Kern County, California. U.S. Geological Survey Open-File Report 2011-1034. Available at: http://pubs.usgs.gov/of/2011/1034/of2011-1034.pdf.

Singer, M.J. and D.N. Munns. 1987. Soils an introduction. MacMillan Publishing Company. New York. pp. 1-492.

Teshima, H., A. Davison, Y. Kuwahara, and J. Yokoyama. 2003. The evolution of extreme shell shape variation in the land snail *Ainohelix editha*: a phylogeny and hybrid zone analysis. Molecular Ecology 12: 1869–1878.

U.S. Fish and Wildlife Service (FWS). 2013. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition To List the Rosemont Talussnail as Endangered or Threatened. Federal Register 78(60): 18936-18938.

Waters, N.D. 2011. Distribution and ecology of the Phoenix Talussnail, *Sonorella allynsmithi*. Technical Report 264 Nongame and Endangered Wildlife Program, Arizona Game and Fish Department.

Waters, N.D. 2011. Distribution and ecology of the Phoenix Talussnail, *Sonorella allynsmithi*. Technical Report 264 Nongame and Endangered Wildlife Program, Arizona Game and Fish Department.

Weaver, K.F., P.F. Weaver, and R. Guralnick. 2010. Origin, Diversification and Conservation Status of Talus Snails in the Pinaleno Mountains: A Conservation Biogeographic Study. Animal Conservation. 13:306-314.

Willet, G. 1931. Two new Helicoids from the Mojave Desert. The Nautilus 44:123-125.

Williams, B.K., J.D. Nichols, and M.J. Conroy. 2002. Analysis and Management of Animal Populations. Academic Press, New York.

FIGURES

STANDARD HILL

SILVER QUEEN ROAD

SOLEDAD MOUNTAIN

14

MIDDLE BUTTE

MOHAVE TROPICO ROAD

BACKUS ROAD

SIERRA HIGHWAY

90TH STREET

T10N, R13W, Portion of Sections 1, 8, 9, 12, 13, 16-18 & 20,
T10N, R12W, Portion of Sections 5-9, 16-18,
T11N, R12W, Portion of Sections 29, 31-33,
Kern County, California,
Photo Source: Microsoft World Imagery May, 2010
Center for Biological Diversity 2014 (The Petition)

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Tucson, Arizona 85712 (520) 206-9585

N

0 1,500 3,000 Feet

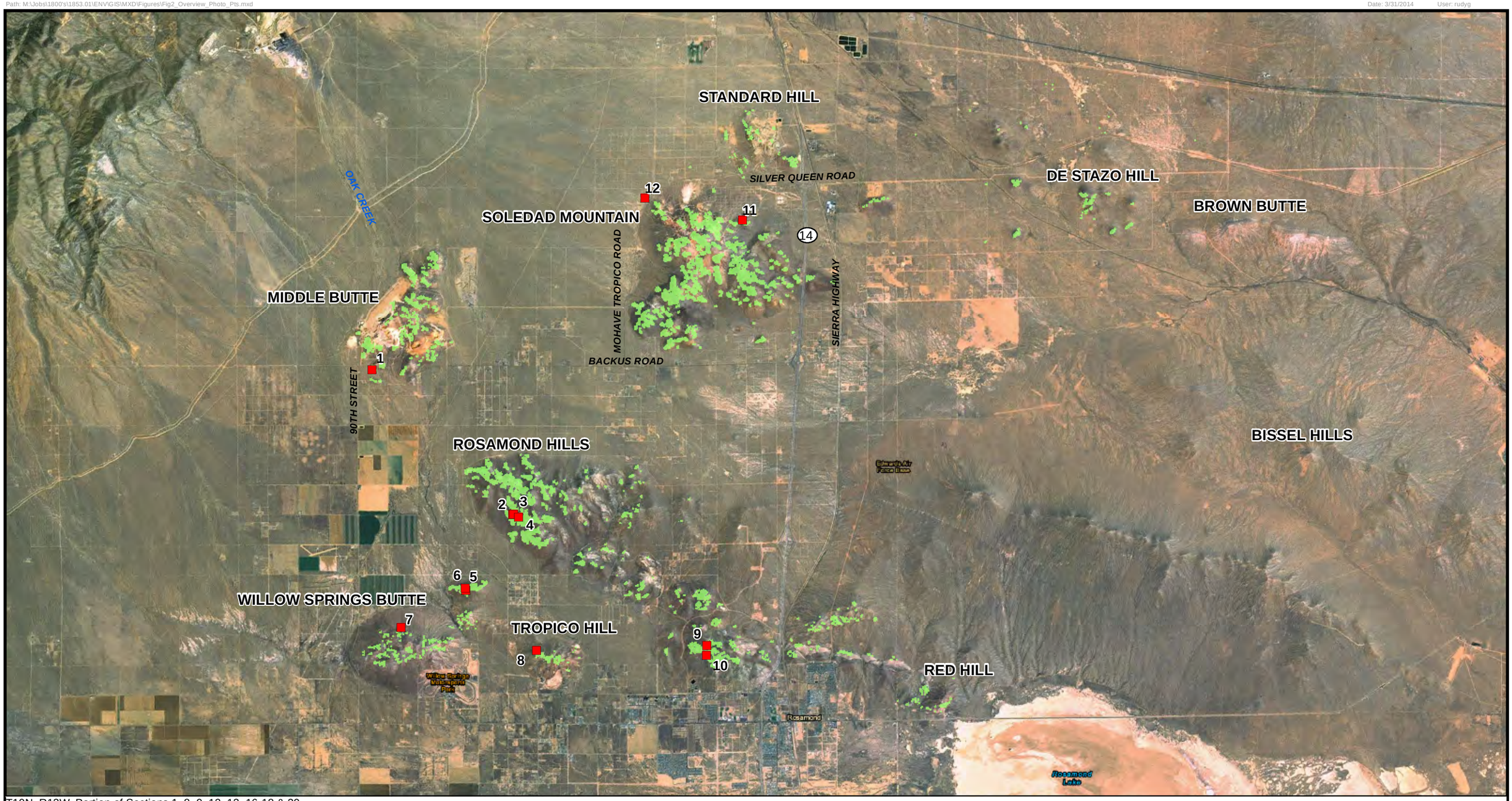
Legend

- Snail Sites Referenced by Petition
- Potential Habitat Digitized from Petition
- Westland Potential Habitat Digitized from Microsoft World Imagery May, 2010

Assessment of Petition to List the
Mohave Shoulderband Snail *(Helminthoglypta greggi)*
as Threatened or Endangered under
the Federal Endangered Species Act

COMPARISON OF MAPPING OF ROCK OUTCROPS

Figure 1



T10N, R13W, Portion of Sections 1, 8, 9, 12, 13, 16-18 & 20,
T10N, R12W, Portion of Sections 5-9, 16-18,
T11N, R12W, Portion of Sections 29, 31-33,
Kern County, California,
Photo Source: Microsoft World Imagery May, 2010

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N

0 4,000 8,000 Feet

Legend

1 Photo Point

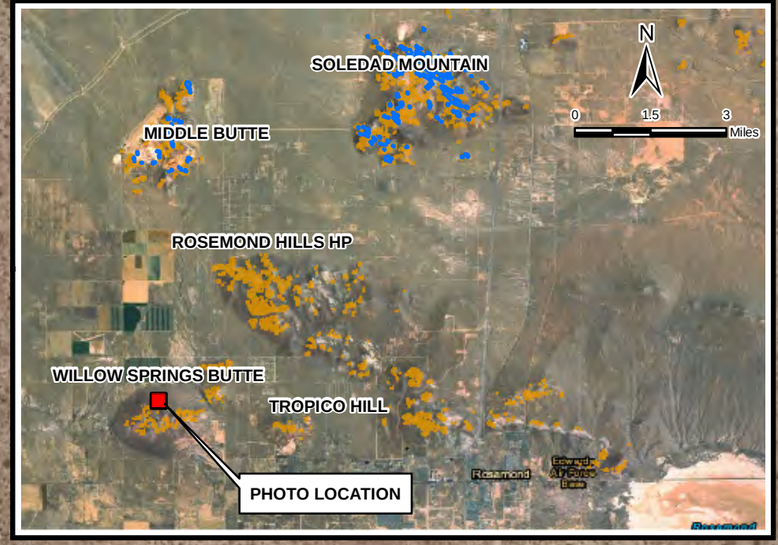
Westland Potential Habitat Digitized from Microsoft World Imagery May, 2010

Assessment of Petition to List the
Mohave Shoulderband Snail *(Helminthoglypta greggi)*
as Threatened or Endangered under
the Federal Endangered Species Act

MAPPING OF ROCK OUTCROPS AND
PHOTO POINT LOCATIONS
Figure 2

PHOTO INSET

LOCATION MAP



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T10N, R12W, Portion of Sections 5-9, 16-18,
T11N, R12W, Portion of Sections 29, 31-33,
Kern County, California,
Photo Source: Microsoft World Imagery May, 2010
Center for Biological Diversity 2014 (The Petition)

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N

0 100 200
Feet

Legend

- Photo Point
- Potential Habitat Digitized from Petition
- Westland Potential Habitat Digitized from Microsoft World Imagery May, 2010

Assessment of Petition to List the
Mohave Shoulderband Snail *(Helminthoglypta greggi)*
as Threatened or Endangered under
the Federal Endangered Species Act

EXAMPLE OF ROCK OUTCROP
NOT VISIBLE FROM SATELLITE IMAGERY

Figure 3

STANDARD HILL

SILVER QUEEN ROAD

SOLEDAD MOUNTAIN

14

MIDDLE BUTTE

90TH STREET

BACKUS ROAD

MOHAVE TROPICO ROAD

SIERRA HIGHWAY

T10N, R13W, Portion of Sections 1, 8, 9, 12, 13, 16-18 & 20,
T10N, R12W, Portion of Sections 5-9, 16-18,
T11N, R12W, Portion of Sections 29, 31-33,
Kern County, California,
Photo Source: Microsoft World Imagery May, 2010
Center for Biological Diversity 2014 (The Petition)
Note: Note that since the publication of the SEIR, the Project footprint has change slightly. This figure depicts our current understanding of the footprint of disturbance of the Project. CAD files were provided to WestLand by NorWest on March 1, 2014

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N

0 1,500 3,000 Feet

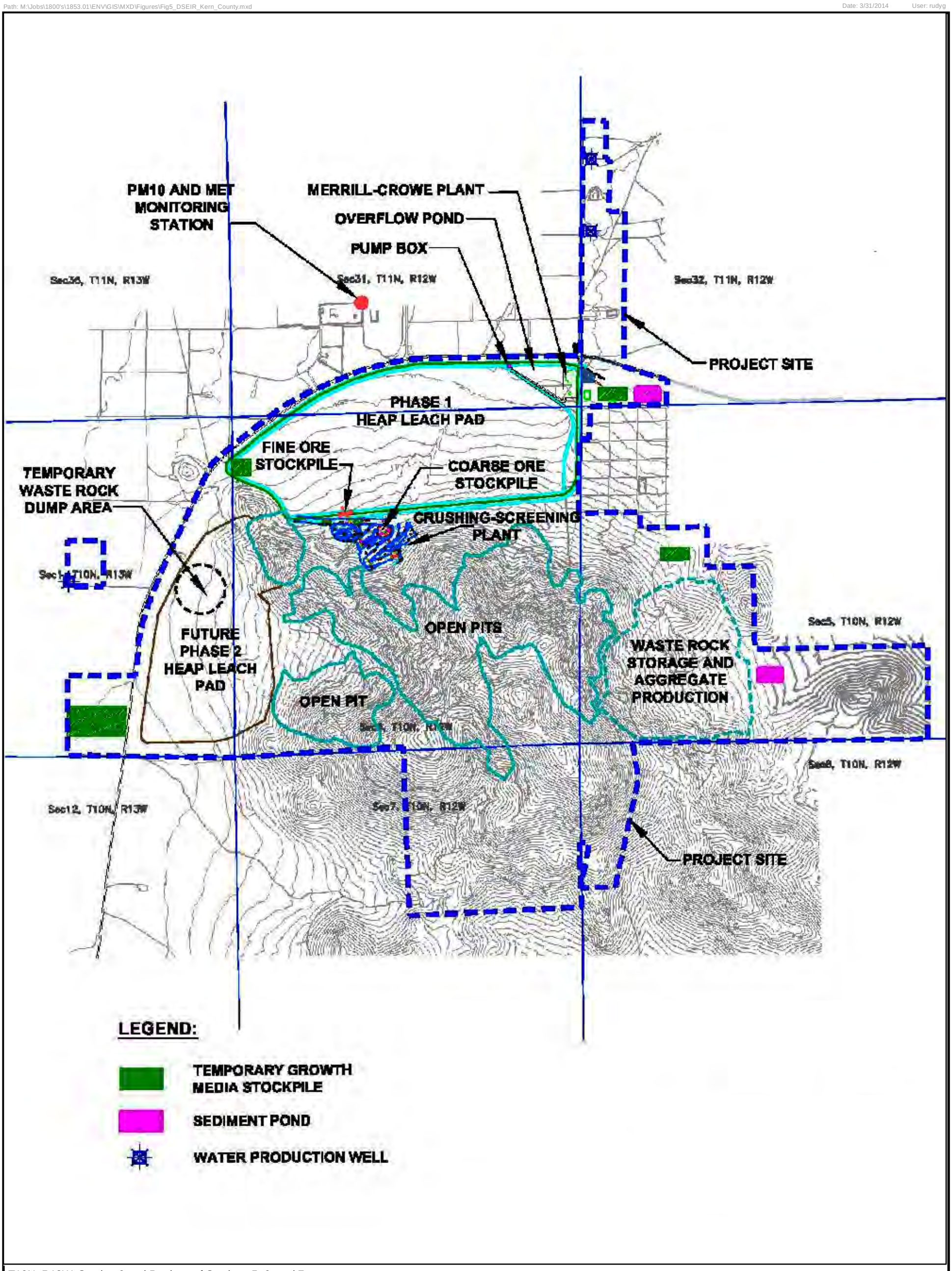
Legend

- Snail Sites Referenced by Petition
- Potential Habitat Digitized from Petition
- Westland Potential Habitat Digitized from Microsoft World Imagery May, 2010
- Disturbance Footprint of Project
- Approved Project Boundary

Assessment of Petition to List the
Mohave Shoulderband Snail *(Helminthoglypta greggi)*
as Threatened or Endangered under
the Federal Endangered Species Act

COMPARISON OF MAPPING OF ROCK OUTCROPS
WITHIN APPROVED PROJECT BOUNDARY AND
DISTURBANCE FOOTPRINT OF PROJECT

Figure 4



T10N, R12W, Section 6 and Portions of Sections 5, 6, and 7,
T10N, R13W, Portion of Sections 1 and 12,
T11N, R12W, Portion of Sections 31 and 32,
T11N, R13W, Portion of Section 36,
Kern County, California,
Data Source: Figure 3-12, Kern County (2010)

Assessment of Petition to List the
Mohave Shoulderband Snail *(Helminthoglypta greggi)*
as Threatened or Endangered under
the Federal Endangered Species Act

SITE LAYOUT AND AREA OF DISTURBANCE OF THE PROJECT;
TAKEN FROM THE DRAFT SUPPLEMENTAL
ENVIRONMENTAL IMPACT REPORT,
KERN COUNTY (2010)

Figure 5

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N

0 1,000 2,000 Feet

ATTACHMENT A

PHOTOPAGES

Photo 1. North-facing rock outcrop to the south of Middle Butte that contains potential habitat for the Mohave shoulderband. This outcrop was not mapped by the Petition as potential habitat.

Photo 2. Rock outcrop on Rosamond Hills with crevices and holes that are potential habitat for the Mohave shoulderband.

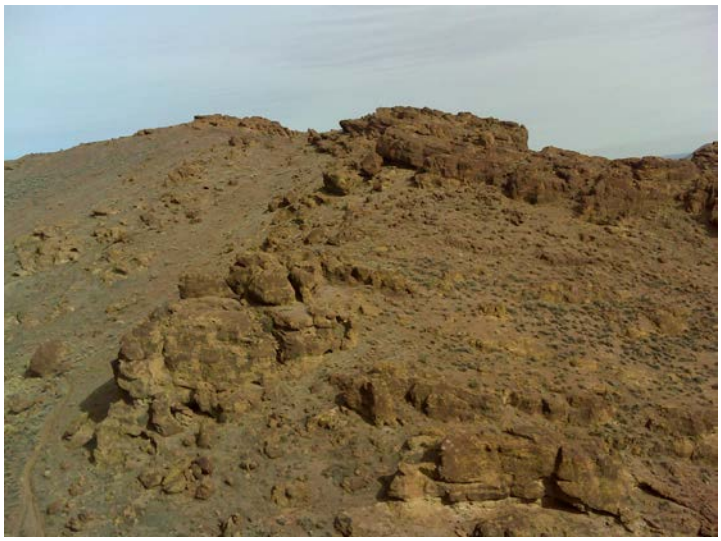

Photo 3. View of rock outcrops that are potential habitat on Rosamond Hills.

Photo 4. View of rock outcrops that are potential habitat on Rosamond Hills.

Photo 5. North-facing rock outcrop on an unnamed hill south of Rosamond Hills with crevices that are potential habitat for Mohave shoulderband.

Photo 6. Rock piles and outcrops on an unnamed hill south of Rosamond Hills that contain potential habitat for Mohave shoulderband.

Photo 7. Rock piles and outcrops on Willow Springs Butte that contain potential habitat for Mohave shoulderband. This location was not visible on publicly available satellite imagery (see Figure 3).

Photo 8. View of north-facing rock outcrops on Tropico Hill that contain potential habitat for the Mohave shoulderband.

Photo 9. Rock outcrops in the mid-ground that contain potential habitat for Mohave shoulderband on an unnamed hill northwest of Rosamond.

Photo 10. Rock outcrops on an unnamed hill northwest of Rosamond that contain holes and crevices that are potential habitat for Mohave shoulderband.

Photo 11. Rock outcrop on Soledad Mountain where evidence of Mohave shoulderband was reported by the Petition.

Photo 12. Small rock outcrop at the base of Soledad Mountain where evidence of Mohave shoulderband was reported by the Petition.

Attachment B-1

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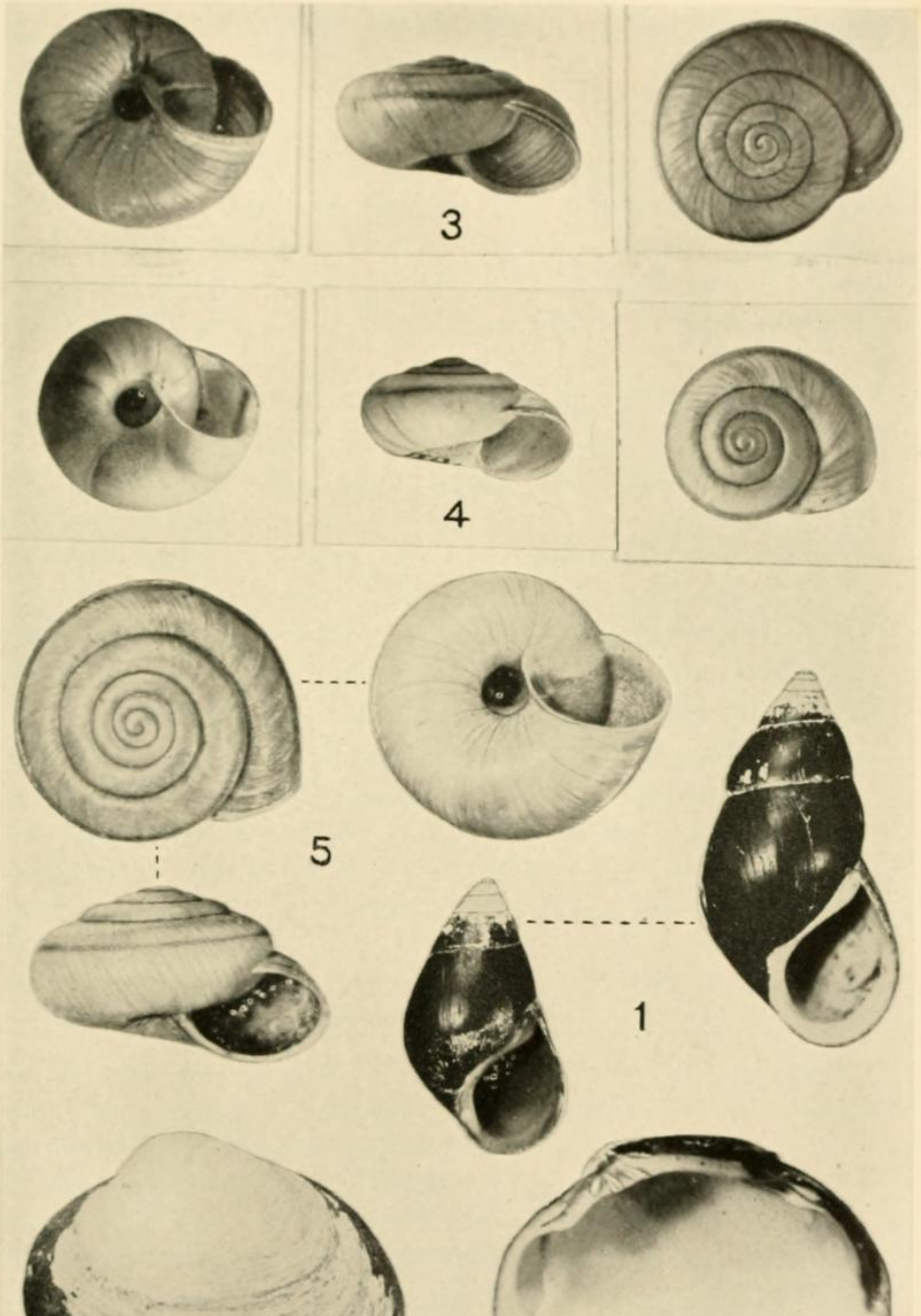

1. Pachychilus schumoi. 2, 2a. Polymesoda zeteki. 3. Helminthoglypta greggi Willett. 4. Micrarionta hutsoni amboiana Willett. 5. Helminthoglypta graniticola arida Pils. & Field (diam. 15.5 mm.)

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Measurements: Maj. diam. 27.5, alt. 18.7, diam. umbilicus 2.0 mm.

Holotype: Cat. No. 6961 of the author's collection. *Paratypes* in the collections of the Academy of Natural Sciences of Philadelphia, Emery P. Chace, and the author.

Type locality: Point St. George, near Crescent City, Del Norte Co., California; occurring alive in some abundance; E. P. and E. M. Chace coll., 25, Aug., 1929.

Remarks: This strongly differentiated maritime race, found under very different habitudinal conditions than the typical form, is so divergent from the other smaller races of *M. fidelis* which have received names as hardly to require any special comparison, and it must doubtless be regarded wholly as an independent offshoot. It is being given more complete treatment in a forthcoming monograph of the Californian snails of this group, but as the appearance of the larger paper has encountered some unanticipated delay, advance notice of this form is felt advisable so that the name may be used in connection with some of the material to be distributed.

TWO NEW HELICOIDS FROM THE MOHAVE DESERT, CALIFORNIA

BY G. WILLETT

MICRARIONTA HUTSONI AMBOIANA, new subspecies. Pl. 7, fig. 4.

Description: Similar in shape and size to *Micrarionta hutsoni hilli* Willett from the Sheep Hole Mountains, about thirty miles to the southward. Differs from *hilli* in somewhat smaller umbilicus, lighter coloration, and narrower and less sharply defined peripherical band. In coloration most like *M. hutsoni desertorum* Pilsbry and Ferriss, but differs from that form in proportionately larger umbilicus and banded periphery. Differs from *M. hutsoni unifasciata* Willett,

from Newberry Springs, in lighter coloration, narrower band, and smaller umbilicus. The color of amboiana is a very light horn—almost white—with a very narrow, brown band at the periphery of the last whorl: color of animal black, with the exception of the middle part of the last whorl, which is smoky gray. Dead, faded specimens of *unifasciata* are very close to living amboiana in coloration, but living specimens of the former are much darker, with wider and more pronounced band.

Measurements of type: Max. diam., 12 mm.; min. diam., 10.3; alt., 6.3; umbilicus, 1.7; number of whorls, 4¼. The largest specimen found (a dead one) has a maximum diameter of 13 mm., and minimum diameter of 10.6.

Type: No. 1029 coll. Los Angeles Museum; paratypes in collection of the writer. The type, two other living specimens and four dead ones were taken by the writer among rocks on a small hill about six miles northwest of Amboy, San Bernardino County, California, February 7, 1931. The type locality is about one mile north of the highway running from Amboy to Needles, and is separated from the ranges of all other known Micrariontas by several miles of desert floor.

HELMINTHOGLYPTA GREGGI, new species. Pl. 7, fig. 3.

Description: Shell thin, rather small, depressed conic in outline; whorls convex, sutures grooved; last whorl descending in front. Aperture nearly round, oblique. Outer lip slightly thickened, reflected, and encroaching somewhat on the umbilicus. Umbilicus small, about one-sixth of minimum diameter of shell. Spiral sculpture absent; entire surface of shell minutely, rather weakly papillated, this papillation being greatly obscured on most of the shell by the crowded growth striae. Periostracum thin, light brown, with a narrow, darker-brown band encircling the periphery.

Measurement of type, in millimeters: Max. diam., 13.5; min. diam., 11.8; alt., 6.8; umbilicus, 2; number of whorls, 4¾. The largest specimen found has a maximum diameter of 14.6, and minimum diameter of 12.3.

Type: No. 1031, coll. Los Angeles Museum. Paratypes in

collection of the writer and A.N.S.P. The type and 24 additional specimens were collected by the writer and his wife in rock slides on the side of a hill, three and one-half miles south of Mohave, Kern Co., California, February 23, 1931. This hill is an isolated outlier to the southeast of the Tehachapi Range, and the type locality is about one-half mile west of the Mohave-Los Angeles highway.

Remarks: The affinities of this shell are plainly with the Mohavean group of Helminthoglyptas hitherto known only from the Victorville region. The distance from the type locality of greggi to the nearest of these species, *H. mohaveana* Berry, is something over fifty miles, and no species of helicoid has been reported from the intervening territory to date. *Greggi* is apparently about the size of *H. graniticola* Berry, but differs from that species in much more depressed form, and wider and more open umbilicus. From *H. mohaveana* Berry it differs in smaller size, more depression and much lighter papillation. From *H. crotalina* Berry, which it resembles in general outline, *greggi* is distinguished by much smaller size, more prominent banding, glossier surface and lighter papillation.

So far as is known to the writer, the closest described helicoid to the type locality of *greggi* is the species recently named *Micrarionta micrometalleus* by Dr. S. S. Berry (Ann. & Mag. Nat. Hist., VI, 1930, p. 189), which is found in Last Chance Canyon, about twenty-five miles northeast of Mohave. A series of this interesting little shell in the writer's collection seem to have more of the aspect of a stunted *Helminthoglypta* than of a *Micrarionta*. The examination of the animal, however, may confirm Dr. Berry's determination.

It is a pleasure to name this species in honor of Dr. W. O. Gregg, the well-known student of California shells.

Los Angeles Museum, Los Angeles, California, February 25, 1931.

Attachment B-2

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A New Species of *Helminthoglypta* from the Mojave Desert

BY

WALTER B. MILLER

Department of Biological Sciences, University of Arizona, Tucson, Arizona 85721

(Plate 41; 2 Text figures)

In 1930, S. S. Berry described a new species of desert snail from the El Paso Mountains of the northern Mojave desert of California. With only shell characters for diagnosis, he named it *Micrarionta (Eremarionta) micrometalleus* S. S. Berry, 1930. Subsequently he dissected adult specimens and determined that the anatomical characters were those of *Sonorella*. The shell characters, however, were different from those of other known *Sonorella,* and in 1943 he established a new subgenus *Mohavelix* to accommodate species of *Sonorella* with small, thin, subdiscoid, and widely umbilicated shells. Accordingly, *M. (E.) micrometalleus* became *Sonorella (Mohavelix) micrometalleus* (Berry), the type and only species of *Mohavelix*.

Since 1964 I have been intensively studying *Sonorella* and in 1967 I submitted a revision of the genus to the University of Arizona as my doctoral dissertation. I became increasingly convinced that *Sonorella (Mohavelix) micrometalleus* did not share a close phylogeny with other *Sonorella, i. e.,* they did not evolve from the same immediate pre-*Sonorella* ancestor, and eventually proposed (Miller, 1968) that *Mohavelix* should be raised to generic rank. The phylogeny of *Mohavelix* has remained obscure, however, with the most credible hypothesis being its derivation from some ancestral *Eremarionta,* possibly close to *Eremarionta aquaealbae* Berry, 1922.

While attempting to obtain live specimens of *Mohavelix micrometalleus* from the arid southern slopes of the El Paso Mountains (the type locality is in the southern part of Last Chance Canyon) in early January 1969, I decided to search for more suitable rockslides on the more humid northern slopes of the range. I was rewarded by finding a gigantic north-facing slide which yielded 95 dead shells and 10 live specimens, of which 3 were adult. They looked in all respects like *M. micrometalleus*. Jubilant over this new find in a prolific locality, I was totally astonished to find that the anatomy revealed these snails to be a new species of *Helminthoglypta,* described below. The discovery of this population of *Helminthoglypta* in the El Paso Mountains, with shell and certain anatomical characters remarkably similar to those of *M. micrometalleus,* has now afforded a more credible hypothesis for the derivation of this species. This hypothesis is also discussed below.

Helminthoglypta micrometalleoides W. B. Miller, spec. nov.

(Plate 41, Figures 1 and 2; Text figure 1)

Description of Holotype: Shell very small for the genus, depressed, discoid, thin, light-brown, with a darker brown spiral band on the well-rounded shoulder; widely umbilicate, the umbilicus contained about 6 times in the diameter of the shell. Embryonic shell of about $1\frac{3}{4}$ whorls, with faint, microscopic wrinkles. Post-embryonic whorls with minute granular wrinkles and papillae. Body whorl with spirally-descending, long, hyphen-like papillae occasionally confluent to form long threads, superimposed over the radial ridges, persisting into the umbilicus; periostracum thin, silky-lustrous. The last whorl descends slightly to the scarcely expanded, thin peristome; aperture oblique, relatively large.

Shell Measurements: Height 5.6 mm, maximum diameter 10.9 mm, umbilicus 1.7 mm. Number of whorls $4\frac{1}{4}$.

The animal: The animal, when extended, has a dark-grey to black body wall, with scattered white glandular papillae. The mantle collar shows a thick mat of white mucus glands, giving the collar an overall whitish appearance; the area around the pneumostome is chalk-white. The mantle above the lung is pigmented with small, black, closely-spaced spots.

The Genitalia: The genitalia (Text figure 1) are typical for the genus. The penis is strongly swollen in the middle where the internal tube, detached from the external wall, becomes thickened and forms a papilla which can be likened to a very short verge. Anteriorly, it consists of a hollow, eversible sac. Distally, it merges into the epiphal-

lus where the internal tube becomes completely adnate to the external wall. The epiphallus is of uniform diameter and is equipped with a moderately long epiphallic caecum at its distal end. The penial retractor muscle originates on the floor of the lung and is inserted on the epiphallus near the penial end. The vagina is short, equal in length to the saccular proximal end of the penis. The free oviduct is longer than the vagina. The long spermathecal duct gives rise to a diverticulum about halfway along its length; the diverticulum is about equal in length to that part of the spermathecal duct posterior to their junction. The globular spermatheca is bound by connective tissue to the posterior end of the uterus. The muscular dart sac is small, globular, and situated at the summit of a longer atrial sac; it contains a short, conical dart. The two side-by-side mucus bulbs join proximally into a single duct which enters the atrial sac at its junction with the dart sac; distally, each mucus bulb connects with a thin, glandular, U-shaped duct which passes into a broad, thin membrane enveloping the entire dart apparatus and much of the lower genitalia. Dimensions, in millimeters, of distinctive structures follow:

Penis	5.0 mm
Epiphallus	7.0 mm
Epiphallic caecum	8.0 mm
Penial retractor	3.5 mm
Spermathecal duct	14.5 mm
Spermathecal diverticulum	8.5 mm
Vagina	2.0 mm
Free oviduct	3.0 mm

Type Locality: El Paso Mountains, Kern County, California, in north-facing, high rockslide of small rocks, between crag outcroppings on south side of Iron Canyon Road, at a point 3 miles up the canyon from the junction of the road with the Garlock-Goler highway (W. B. Miller, 5 January 1969).

Disposition of Specimens:

Holotype: deposited in the California Academy of Sciences, Geology Type Collection, no. 13169.

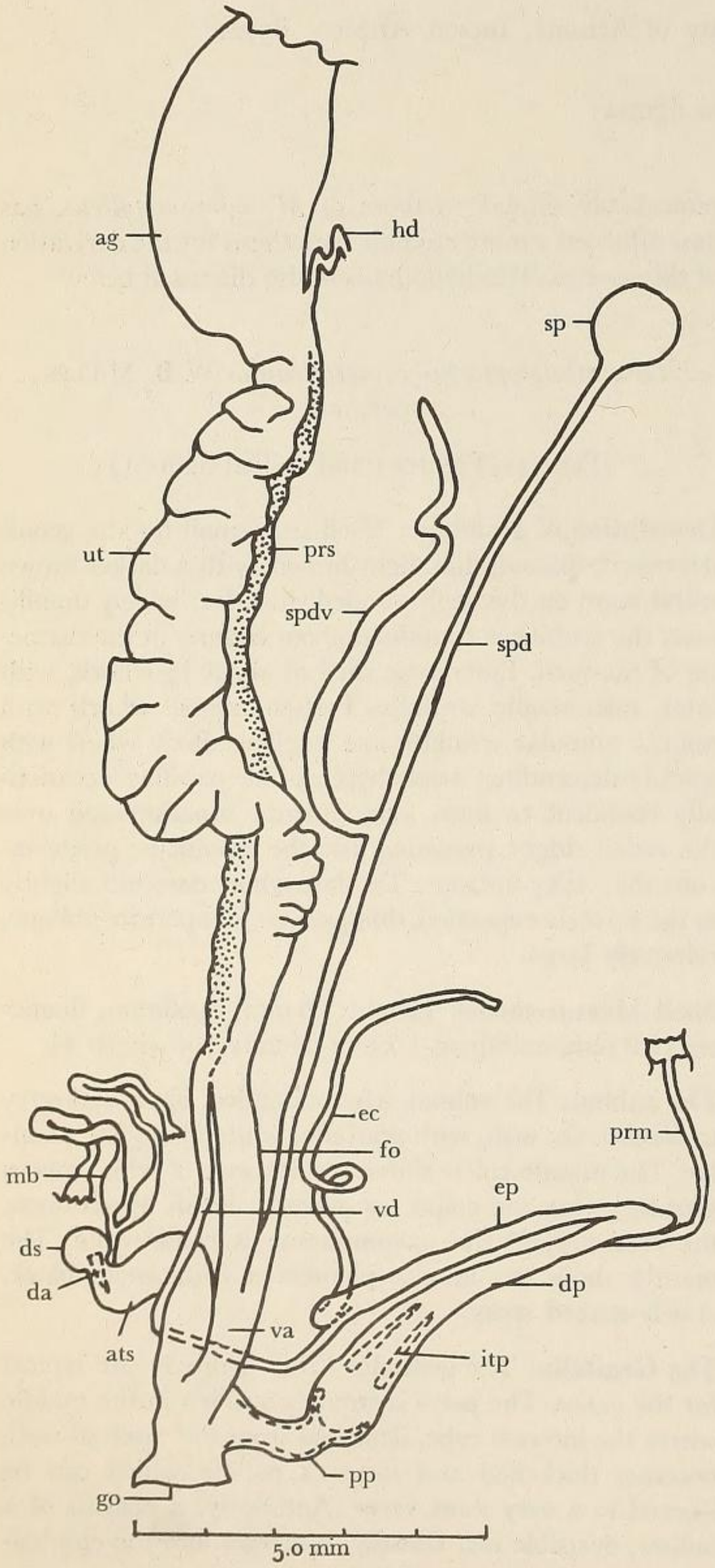


Figure 1

(⟵ adjacent column)

Helminthoglypta micrometalleoides W. B. Miller, spec. nov.

Lower genitalia of holotype; drawing made from projection of stained whole mount. Scale in millimeters

ag albumen gland ats atrial sac da dart
dp distal part of penis ds dart sac
ec epiphallic caecum ep epiphallus fo free oviduct
go genital orifice hd hermaphroditic duct
itp internal tube of penis mb mucus bulb
pp proximal part of penis prm penial retractor muscle
prs prostate sp spermatheca spd spermathecal duct
spdv spermathecal diverticulum ut uterus
va vagina vd vas deferens

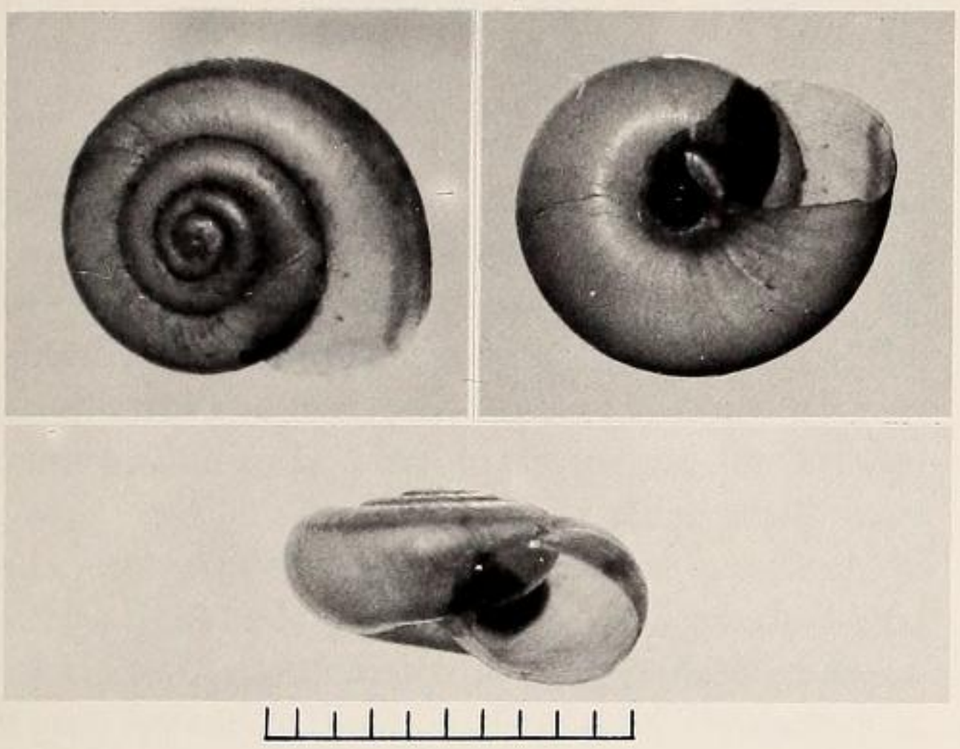


Figure 1

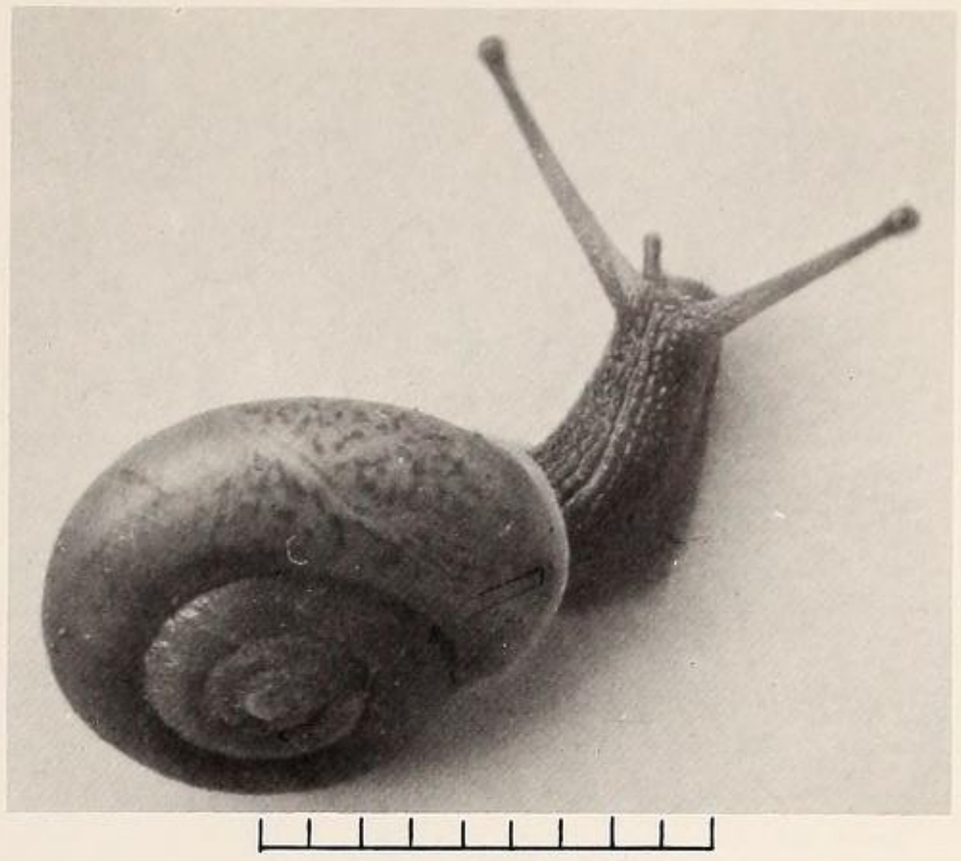


Figure 2

Figure 3

Figure 4

Figures 1, 2: *Helminthoglypta* ***micrometalleoides*** W. B. MILLER, spec. nov. Holotype. California Academy of Sciences, Geology Type collection no. 13169. El Paso Mountains, Kern County, California. Scale in millimeters

Figures 3, 4: *Mohavelix micrometalleus* (BERRY, 1930). El Paso Mountains, Kern County, California. Scale in millimeters

Paratypes: in the Invertebrate Museum, Department of Biological Sciences, University of Arizona, and in the private collection of the author.

Remarks: *Helminthoglypta micrometalleoides* is the smallest species of *Helminthoglypta* described to date. Examination of approximately 100 paratypes (not all adults) reveals a remarkable constancy of characters. The maximum diameter of the shell varies only from 9.3 mm in the smallest adult to 11.3 mm in the largest. Shell sculpture depends on the age of the shell; older shells have worn embryonic whorls and papillae. The umbilical diameter varies from as large as to slightly larger than that of the holotype. The genitalia from three dissected specimens do not appear to provide diagnostic characters to distinguish this species from other desert helminthoglypts. The peculiarly shaped penis is a characteristic of all known and dissected desert helminthoglypts, as reported by W. O. Gregg (*in litt.*).

Helminthoglypta micrometalleoides appears to be most closely related to *H. fisheri* (BARTSCH, 1904) of the Panamint Mountains and to *H. greggi* WILLETT, 1931, of Soledad Mountain. It can be readily distinguished from these other species by the much smaller shell diameter. The El Paso Mountains are situated geographically between the above localities. In field diagnosis, *H. micrometalleoides* can be easily mistaken for *Mohavelix micrometalleus*. The size, shape, color, texture, and general appearance of the shell are the same for both species (Plate 41, Figures 3 and 4). Microscopic examination of fresh shells reveals that *M. micrometalleus* has an embryonic sculpture of thickly-set, spirally arranged, hyphen-like papillae similar to *Eremarionta*. The post-embryonic sculpture is more papillose and radially wrinkled than that of *H. micrometalleoides* and the periostracum is less glossy. The adult genitalia provide the major diagnostic difference between *Helminthoglypta* and *Mohavelix*. *Mohavelix* (Text figure 2) has simplified genitalia similar to *Sonorella*. The atrial sac, dart sac mucus glands, and spermathecal diverticulum are all missing, while the epiphallic caecum is reduced to a vestige; the penis has a short verge at its distal end. It is most interesting to note, however, that the remaining structures, such as penis, epiphallus, spermathecal duct, vagina, free oviduct, and uterus have the same relative dimensions as in *H. micrometalleoides*.

Concerning the phylogeny of *Helminthoglypta micrometalleoides*, it appears most likely that this species evolved from a common ancestor of the desert helminthoglypts. It is debatable that all described species of desert helminthoglypts are good biological species, with fully established reproductive isolation; hybridizing experiments be-

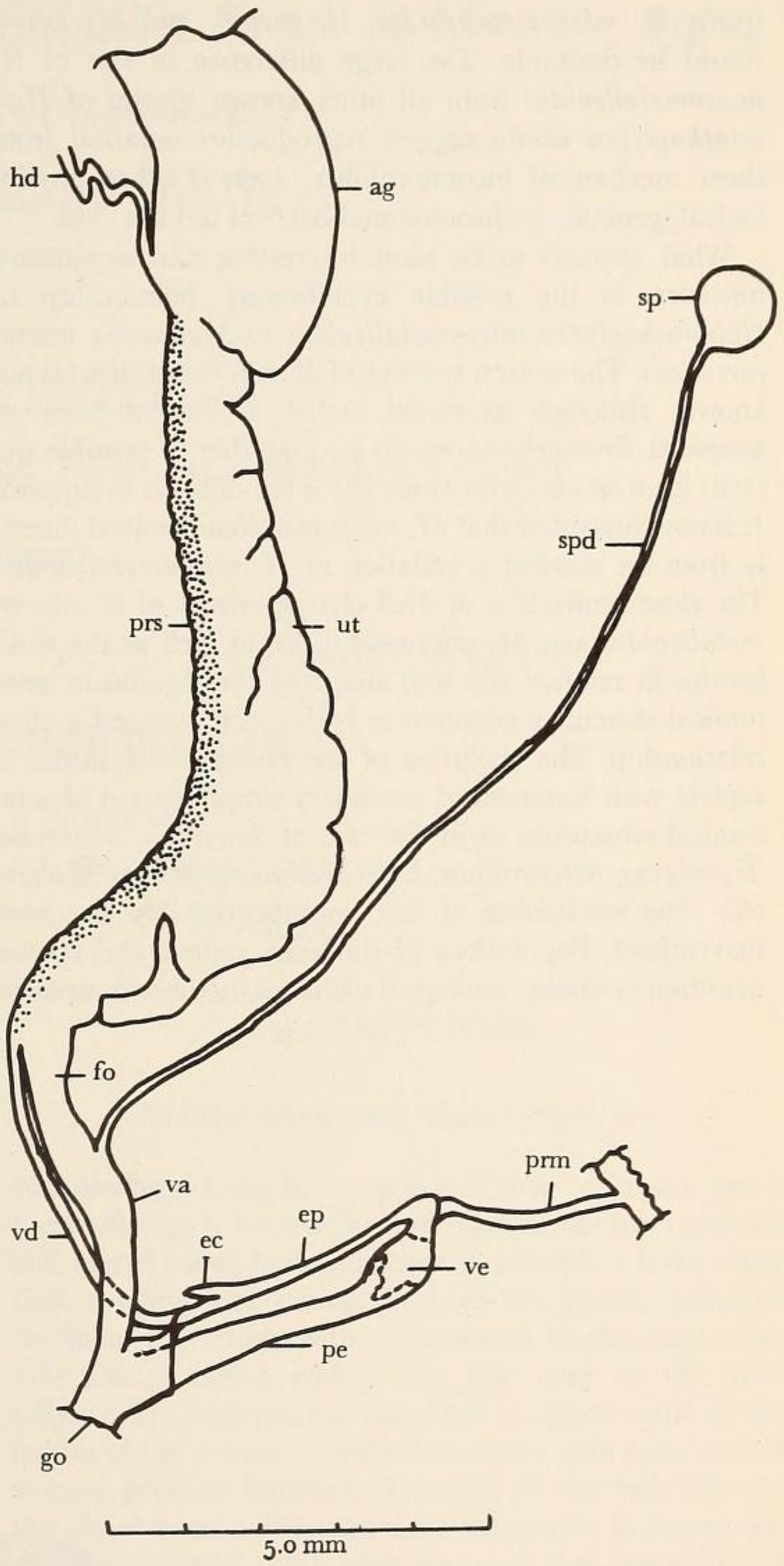


Figure 2

Mohavelix micrometalleus (BERRY, 1930)

Lower genitalia; drawing made from projection of stained whole mount. Scale in millimeters

ag	albumen gland		ec	epiphallic caecum	
ep	epiphallus	fo	free oviduct	go	genital orifice
hd	hermaphroditic duct		pe	penis	
prm	penial retractor muscle		prs	prostate	
sp	spermatheca	spd	spermathecal duct	ut	uterus
va	vagina	vd	vas deferens	ve	verge

tween *H. micrometalleoides, H. greggi,* and *H. fisheri* would be desirable. The large difference in size of *H. micrometalleoides* from all other known species of *Helminthoglypta* would suggest reproductive isolation from sheer mechanical incompatibility, even if other physiological, genetic, or chromosomal barriers did not exist.

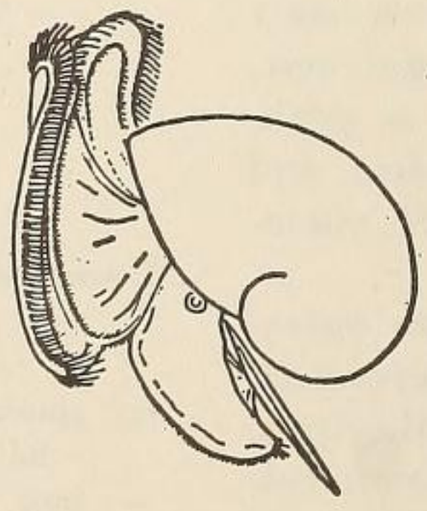
What appears to be most interesting and significant, however, is the possible evolutionary relationship of *Helminthoglypta micrometalleoides* to *Mohavelix micrometalleus*. The nearest relative of *M. micrometalleus* is not known, although, as stated earlier, a descent from an ancestral *Eremarionta* would be plausible; a possible descent from an ancestral *Sonorella* is too difficult to support. It is now suggested that *M. micrometalleus* evolved directly from an isolated population of *H. micrometalleoides*. The close similarities of shell characteristics of *H. micrometalleoides* and *M. micrometalleus,* as well as the similarities in relative size and shape of the significant anatomical structures common to both species suggest a close relationship. The evolution of the Helminthoglyptidae is replete with instances of secondary simplification of anatomical structures, as in the case of *Sonorelix, Sonorella, Tryonigens, Micrarionta, Eremarionta,* as well as *Mohavelix*. The mechanism of this simplification has not been determined. Populations of different genera and species are often in similar ecological niches, sometimes sympatric, and the adaptive advantages of a simplified reproductive system are not apparent. Genetic drift is the most likely mechanism in desert populations where marginal isolates are periodically and frequently subjected to prolonged drought to the point where individual numbers become critically low. Chromosomal breakage, inversion, reduction, or translocation could account for large losses of structures, which, fortunately, are not fatal.

It is hoped that studies of the chromosomes of *Helminthoglypta micrometalleoides* and *Mohavelix micrometalleus* can be undertaken in the near future. Also, gross comparison of proteins by chromatography or electrophoresis might yield data on the extent of relationship between the two species.

The specific name is chosen to indicate the close resemblance between the two species.

LITERATURE CITED

BERRY, SAMUEL STILLMAN
1930. New helicoid snails from the Mohave Desert. Ann. Mag. Nat. Hist. **10** (6) : 187 - 193
1943. On the generic relationships of certain Californian xerophile snails. Trans. San Diego Soc. Nat. Hist. **10** (1) : 1 - 24
MILLER, WALTER BERNARD
1968. New *Sonorella* from Arizona. The Nautilus **82** (2) : 50 - 63



Attachment B-3

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The Veliger 31(3/4):252–257 (October 3, 1988)

THE VELIGER

A New Subgenus of *Helminthoglypta* (Gastropoda: Pulmonata: Helminthoglyptidae) with the Description of a New Species from San Bernardino County, California

by

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Abstract. ***Coyote,*** a new subgenus of *Helminthoglypta,* is described; it is characterized by a prominent bulge at the anterior end of the upper penial chamber and a papillose shell. It includes the so-called "Mojave Desert Series" and the polytypic *Helminthoglypta petricola* from the San Bernardino, San Gabriel, and Santa Ana mountains, California. The type species, *Helminthoglypta* (***Coyote***) ***taylori***, sp. nov., is described from near the headwaters of the Mojave River, San Bernardino County, California.

INTRODUCTION

This paper continues a series of studies of new helminthoglyptid taxa from southern California based in part on land snails originally collected by the late Wendell O. Gregg (1898–1979). The other papers in the series include GREGG & MILLER (1976), MILLER (1985), REEDER (1986), REEDER & MILLER (1986a, b, 1987, 1988), ROTH (1987a), and ROTH & HOCHBERG (1988, this issue). As a result of earlier studies, Gregg and Walter B. Miller determined that the subgenus *Charodotes* Pilsbry, 1939, of the genus *Helminthoglypta* Ancey, 1887, was based on erroneous information about the structure of the upper chamber of the penis. MILLER (1981, 1985) synonymized *Charodotes* with the nominate subgenus. Gregg and Miller further determined that there were at least two distinct groups of species in *Helminthoglypta* (in addition to the nominate subgenus) that deserved subgeneric recognition. The first of these was described as *Rothelix* Miller, 1985; it is characterized by a relatively short and narrow upper penial chamber; a large, sausage-shaped, lower chamber with a post-medial constriction; and a vagina that opens into the atrial sac near its posterior end.

The second group consists of species united in the possession of a distinctive, prominent bulge at the anterior end of the upper, double-tubed chamber of the penis. This group includes the "Mojave Desert Series" of PILSBRY (1939), the polytypic *Helminthoglypta petricola* (Berry, 1916) of the San Bernardino, San Gabriel, and Santa Ana mountains, and a number of other species from ranges peripheral to the Mojave Desert.

One such peripheral species was discovered by Dwight W. Taylor and Gregg in April 1950, along the headwaters of the Mojave River near the town of Cedar Springs in the San Bernardino Mountains. Miller and Gregg obtained additional material in 1963 from a locality which, along with the town of Cedar Springs, was later inundated by the waters of Silverwood Lake, impounded by Cedar Springs Dam. Fortunately, field investigations by Miller and Roth in early 1986 revealed that the species continues to thrive in a limited area below Cedar Springs Dam, and

the species is described herein, along with the subgenus to which it belongs.

Terminology for the elements of the reproductive system follows that of MILLER (1985), except that what MILLER (1985) referred to as the upper and lower "parts" of the penis are here called the upper and lower chambers of the penis.

SYSTEMATICS

Family HELMINTHOGLYPTIDAE Pilsbry, 1939

Helminthoglypta Ancey, 1887

Type species: *Helix tudiculata* A. Binney, 1843, by original designation.

Coyote Reeder & Roth, subgen. nov.

Type species: *Helminthoglypta* (***Coyote***) ***taylori*** Reeder & Roth, sp. nov.

Diagnosis: Shell medium-sized to small for the genus, depressed, umbilicate, with varying degrees of papillose sculpture. Reproductive system distinguished by a prominent bulge at the anterior end of the upper, double-tubed chamber of the penis.

All members of ***Coyote*** exhibit a prominent swelling at the anterior end of the upper, double-tubed chamber of the penis where it joins the lower, saccular chamber (Figure 1). This bulge is caused by a pronounced thickening of the walls of the inner tube of the penis, usually accompanied by enlarged, glandular pilasters along the widening lumen. The bulge projects permanently into the lower chamber, forming a short penis-papilla. While some specimens of *Helminthoglypta, sensu stricto,* occasionally exhibit a small penis-papilla in the lower part of the penis as a result of the process used in preparing anatomical whole mounts, they do not have the characteristic thickened walls of the anterior part of the inner tube shown by the species of ***Coyote***.

In addition to the distinctive anatomy, all species of ***Coyote*** have papillose sculpture, ranging from a dense, overall papillation (*e.g., Helminthoglypta mohaveana* Berry, 1927), to the regular, discrete tubercles of *Helminthoglypta petricola.* The malleated sculpture of *Helminthoglypta tudiculata, Helminthoglypta fairbanski* Reeder & Miller, 1986, and others of that group does not appear in species of ***Coyote***. The clothlike sculpture of *Helminthoglypta nickliniana* (Lea, 1838) and its relatives is also absent from ***Coyote***. Although some incised spiral lines occur in *H. petricola,* no species of ***Coyote*** exhibits the prominent grooves found in *Helminthoglypta fieldi* Pilsbry, 1930, *Helminthoglypta ayresiana* (Newcomb, 1861), and some other members of the *Helminthoglypta traskii* (Newcomb, 1861) group.

Based on an examination of their reproductive systems, the following additional species and subspecies are assigned to this subgenus:

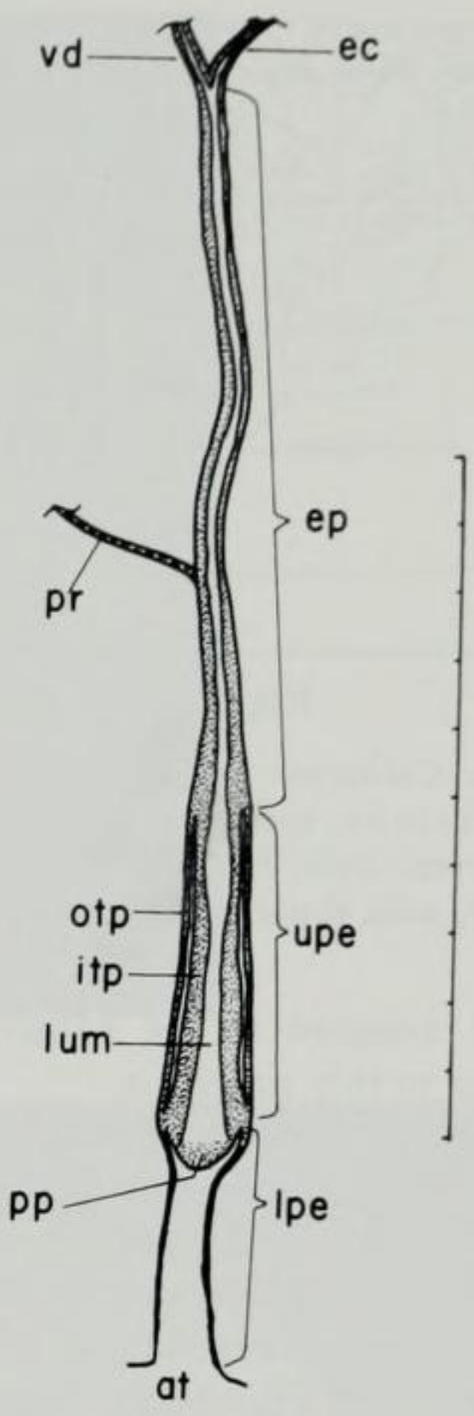

Figure 1

Helminthoglypta (***Coyote***) ***taylori*** Reeder & Roth, sp. nov., holotype SBMNH 34945, penis and epiphallus; drawn from projection of stained whole mount. Scale line = 10 mm. Abbreviations: at, atrium; ec, epiphallic caecum; ep, epiphallus; itp, inner tube of penis; lpe, lower chamber of penis; lum, lumen of penis; otp, outer tube of penis; pp, penis-papilla; pr, penial retractor muscle; upe, upper chamber of penis; vd, vas deferens.

Helminthoglypta fisheri (Bartsch, 1904)
H. petricola (Berry, 1916)
  H. p. zechae (Pilsbry, 1916)
  H. p. sangabrielis (Berry, 1920)
  H. p. orotes (Berry, 1920)
H. graniticola Berry, 1926
H. mohaveana Berry, 1927
H. crotalina Berry, 1928
H. jaegeri Berry, 1928
H. fontiphila Gregg, 1931
H. greggi Willett, 1931
H. isabella Berry, 1938
H. micrometalleoides Miller, 1973
H. concolor Roth & Hochberg, 1988.

The reproductive anatomy of *Helminthoglypta caruthersi* Willett, 1934, is unknown and the species has not been collected since its original discovery. However, based on shell characters and geography, it also probably belongs to the subgenus ***Coyote***. In addition, the middle Miocene (Barstovian) *Helminthoglypta alfi* Taylor, 1954, which