THE SETH FOREST WATER SCAVENGER BEETLE, A NEW SPECIES OF *HYDROCHUS* (COLEOPTERA: HYDROPHILOIDEA: HYDROCHIDAE) FROM THE CHESAPEAKE-DELMARVA REGION

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Abstract

A **new species**, the Seth Forest water scavenger beetle, *Hydrochus spangleri* Hellman (Coleoptera: Hydrophiloidea: Hydrochidae), is described and illustrated; notes on its biology are included. Known since the 1970's from a single large, vernal pool in Talbot County, Maryland, this apparent Delmarva endemic became a subject of interest and concern when human destruction of its unique habitat in 1982 left the survival of the species open to question. Surveys of depressed wetlands throughout the Delmarva Peninsula during 1997–2002 led to the rediscovery of the beetle at five vernal pools, including the type locality, although abundance there is now relatively low. The pools are all confined to two small forest fragments in Talbot County situated in a predominately agricultural and residential landscape. An additional record, represented by a single specimen collected in 1982 from New Castle County, Delaware, was found in the University of Delaware collection; however, the exact loaction of this site is uncertain.

The existence of the beetle described in this paper has been known to a few Maryland water beetle specialists for nearly three decades, and it was recognized in an unpublished Ph.D. thesis (Hellman 1975). The original specimens of this *Hydrochus* were from a nearly pristine forest vernal pool in Seth State Forest near Easton, Maryland. Noted for supporting a diverse aquatic beetle community, including several regionally rare species (Spangler 1973), the vernal pool was until recently the only known occurrence for the *Hydrochus*. Severe human disturbance to the site in 1982 left little hope for the survival of these insects; the surrounding and overhanging forest canopy was thinned or removed and the pool basin was bulldozed (with enhancement of wood duck nesting habitat as the objective). Subsequent surveys at this and other forested wetlands during the following ten years failed to yield additional specimens and the beetle was feared extinct, as no comparable habitats were known.

In 1997, interest from the Maryland Natural Heritage Program in the conservation status of this undescribed *Hydrochus* and associated beetles led to a survey at Seth State

Forest and other forested wetlands in the Delmarva Peninsula. To our delight, the beetle was ''rediscovered'' at the original site (althought in low numbers) and a second, nearby pool surrounded by mature forest where the beetle was relatively abundant. In 1999, a single specimen collected in 1982 from New Castle County, Delaware, was discovered in the University of Delaware collection. Surveys continued during 1998–2002, yielding records for three additional vernal pools, one in Seth State Forest and two in a nearby forest tract. With new material and information at hand and the need to afford this apparent Delmarva endemic adequate protection under the Maryland Nongame and Endangered Species Conservation Act, we offer the following description and data.

Hydrochus Leach, 1817 [type species: *Silpha elongata* Schaller; designated by Hope 1838] consists of 164 described species worldwide with 26 in the Nearctic Region (Hansen 1999). The only genus in the family as redefined by Hansen (1991), *Hydrochus* species are represented in faunas of all major biogeographic regions. Species of this genus are generally narrow, small (1.5–5.5 mm) with bulging eyes, 7-segmented antennae, and the pronotum with shallow depressions and a narrow base. Identification to species is difficult without male genitalia (Smetana 1988).

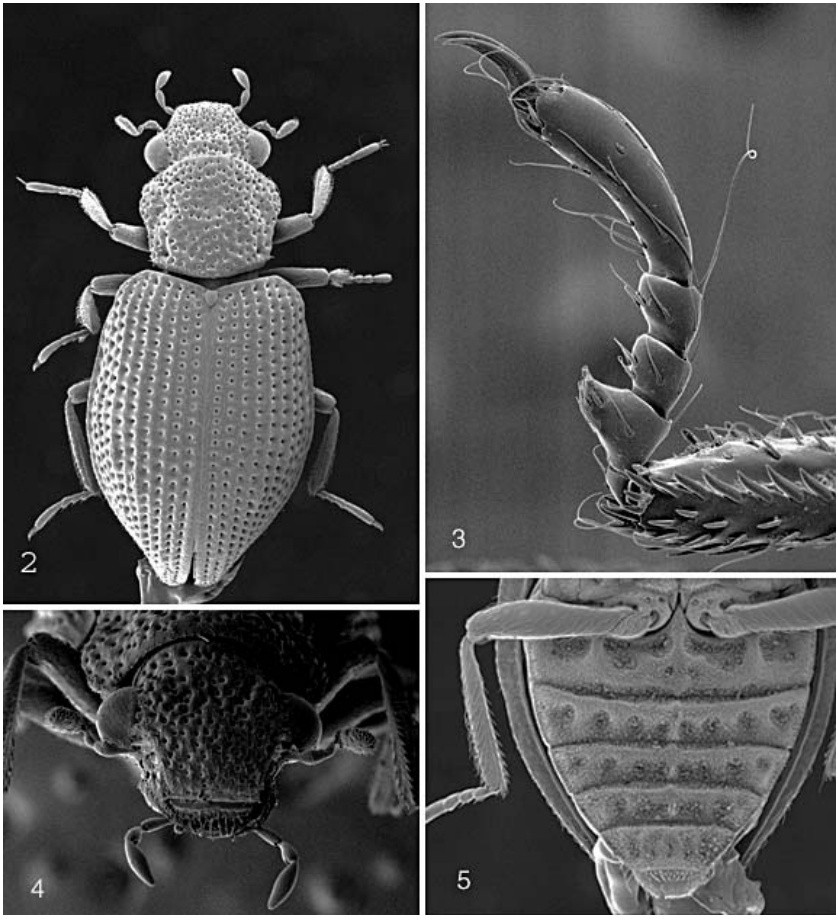
Hydrochus spangleri Hellman, **new species**
(Figs. 1–6)

Description from Holotype. Very small, robust, convex, subelongate in form (Figs. 1, 2). *Color*: Dorsum shiny; ground color of head piceous; pronotum and elytra rufopiceous with apical 1/4 of pronotum and apex of elytra gradually becoming reddish brown; coarse punctation on head and pronotum interspaced with numerous small, round metallic green spots, spots much smaller and denser on clypeus, similar spots on elytral intervals arranged on each interval in a linear series with most spots separated by 2× their width except at base where they become slightly larger and closer; mentum and submentum shiny, piceous; antenna and palps yellow brown with apex of maxillary palpomeres piceous; legs yellow brown with tibiofemoral joints and apex of tarsi piceous; epipleuron yellowish brown with piceous lateral margin. *Head* (Fig. 4): Clypeus slightly convex, discal punctures fine, dense, with several clusters nearly coalesced, most discal punctures interspaced with numerous, fine setae; frontoclypeal suture not sulcate, without posteromedial stem; interocular region rugose, medially depressed behind frontoclypeus then gradually becoming raised and broadened to vertex; submedial depressions very irregular, shallow; discal punctures large, irregularly spaced and often coalesced; minute setal punctures less abundant than those on clypeus; postmidoccipital region not constricted medially at neck; mentum finely, densely punctate, with only slight basomedial depression; submentum sparsely, very finely punctate, without discal foveae. *Pronotum*: Strongly convex, widest at apical 1/3, anterior margin slightly arcuate, anterior angle broadly rounded; lateral margin very strongly declivent, viewed from above rounded and arcuate on apical 1/2, then slightly incurved behind middle and narrowed to base; basal margin medially arcuate; discal punctures coarse, irregularly spaced, dense with some nearly coalesced, most punctures separated by less than diameter of a puncture except near lateral margin where denser and finer punctures within medial fovea appear less dense than surrounding raised areas; anterior fovea indistinct; medial fovea prominent, moderately deep, round, equal to almost 2/5 length of pronotum at midline; mediolateral fovea similar in size but shallower; basomedial fovea indistinct; basolateral fovea small, deep. *Elytron*: Very convex; subelongate, 1/3 longer than wide; lateral margin slightly constricted, straight on apical 1/2 behind humeral angle then slightly explanate medially and arcuate, then abruptly rounded to suture; discal strial punctures coarse,

Fig. 1. *Hydrochus spangleri*, dorsal habitus.

deep, round; punctures on apical 1/3 and rows 9–10 become gradually smaller and denser toward margin; setae on intervals very fine, most arranged in single linear series; sutural interval at base slightly wider than others, then gradually becoming slightly wider and subcostate on apical 1/3; remaining intervals regular, narrow and slightly convex except- 4 feebly raised for length of 2 strial punctures at beginnning of apical 1/3, interval 6 slightly raised for length of 3 strial punctures just behind midlength; epipleuron impunctate, smooth, feebly concave on basal 1/2. *Abdomen*: as in Figure 5. *Leg*: Basal tarsomeres of pro- and mesotarsi sharply produced ventrally into short, recurved, broad spur (Fig. 3). *Male genitalia*: as in Figure 6. Maximum length 2.1 mm, maximum width 0.9 mm; maximum width of head across eyes 0.6 mm, minimum interocular distance 0.4 mm; maximum length of pronotum 0.6 mm, maximum width 0.6 mm, minimum width near base 0.6 mm: maximum length of elytra 1.4 mm (n = 38).

Female. Externally identical to male except not having the pro- and metatarsal spurs on basal tarsomeres.



Figs. 2–5. *Hydrochus spangleri*, scanning electron micrographs. **2)** Adult dorsal habitus; **3)** basal tarsomeres of male; **4)** head; **5)** abdomen.

Variation. Specimens vary in length from 2.1–2.4 mm and in width from 0.9–1.2 mm. The color and sculpture is very similar to that of the holotype.

Diagnosis. This species is similar to the North American *H. setosus* Leech, *H. currani* Brown, and *H. brevitarsis* Knisch and *H. brevis* Herbst from northern Europe. The combination of the very minute size, shiny black dorsum, and robust convex form alone would easily separate *H. spangleri* from most species. The rarely or slightly granulate pronotum and the basal tarsomere of the pro- and mesotarsi very sharply produced ventrally into a distinctive short, broad recurved spur of the male separate it from *H. setosus*.

Etymology. This species is named for Paul J. Spangler, the original collector and in acknowledgment of his many contributions toward the taxonomy and biology of aquatic insects.

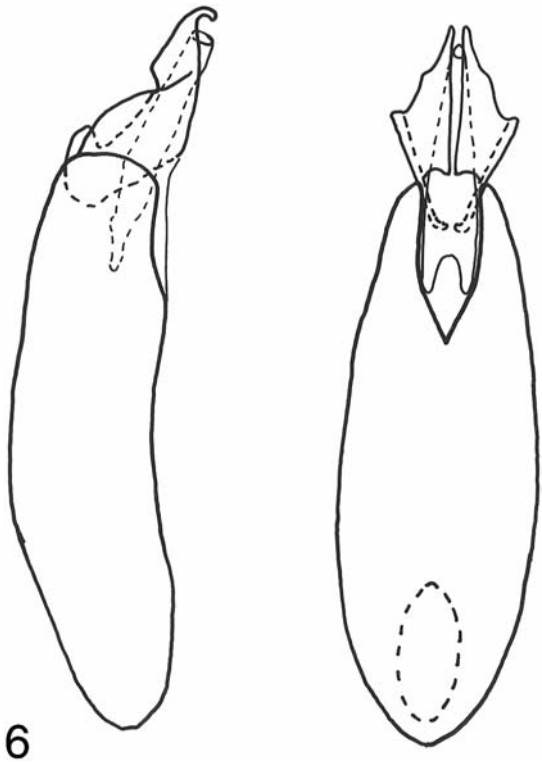


Fig. 6. Male genitalia: left, lateral view; right, dorsal view.

Material Examined and Data. Label data are quoted verbatim except for some punctuation (inserted for clarity) and bracketed letters that spell out or interpret abbreviations. A forward slash (/) indicates a break between labels on the same pin. All specimens (except for the holotype) are designated as paratypes with blue labels, ''PARATYPE, Hydrochus spangleri [male or female symbol] J. L. Hellman.''

HOLOTYPE ♂, MARYLAND, Talbot Co[unty]., Seth St[ate]. Forest, June 1974, John L. Hellman / HOLOTYPE Hydrochus spangleri ♂, J. L. Hellman, USNM; Paratypes, 2♂, 4♀, same data; 4♂, 10♀, same data except June 1975; 1♂, MARYLAND: Talbot Co., Easton, 7 May 1972, in woodland pond, P. J. and P. M. Spangler; 3♂, 5♀, same data except 12 VI 1974, P. J. Spangler / Seth State Forest; 6♂, 9♀, MARYLAND, Talbot County, Seth St[ate]. For[est]., 13 May 1976, Spangler et al.; 2♂, 9♀, same data except 11 July 1978, W. E. Steiner; 11♂, 4♀, same data except 3 km SE Easton (Seth Forest), 12 July 1978, P. J. Spangler and W. E. Steiner, colls.; 6♂, 9♀, same data except 38°45′N, 76°02′W, 1 March 1997 / W. E. Steiner, J. M. McCann, J. M. Swearingen collectors; 13♂, 11♀, same data except 5 April 1997, W. E. Steiner et al.; 1♂, same data except (pond 1); 2♂, 8♀, same data except (pond 2), 5 May 1997; 1♂, same data except 10 May 1997, W. E. Steiner / Flooded forest floor with deep leaf litter; 2♂, 3♀, same data except (pond 1); 3♂, 8♀, same data except (pond 2), 26 May 1997 / Margin of shaded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woodland pond with deep leaf litter, colrs. W. E. Steiner and J. M. Swearingen; 1♂, same data except (pond 1), 8 June 1997 / Margin of semi-open woodland pond with deep leaf litter, colrs. W. E. Steiner and J. M. Swearingen; 4♂, 5♀, same data except (pond 2), 13 April 1998 / W. E. Steiner, J. M. McCann, J. M. Hill, T. W. Suman collectors; 8♂, 5♀, same data except (pond 2) / 4 June 1998, Margin of shaded woodland pond with deep leaf litter, coll. J. M. McCann; 1♂, same data except (pond 1), 4 June 1998, dip net / Margin of shaded woodland pond with deep leaf litter, coll. J. M. McCann; 2♂, 7♀, same data except (pond 2) / 23 June 1998, Margin of shaded woodland pond with deep leaf litter, coll. J. M. McCann; 6♂, 5♀, same data except [pond number not given] 18 April 1999, W. E. Steiner et al.; 2♂, 1♀, same data except pool # 1, 38°44′52″N, 76°02′09″W, 18 Apr. 2000, J. M. McCann; 8♂, 5♀, same data except pool # 2, 38°44′59″N, 76°02′06″W; 4♂, 1♀, same data except pool # 3, 38°44′48″N, 76°02′04″W; 1♂, 3♀, MARYLAND: Talbot County, Easton, Swann-Haven Ponds, vernal pool # 1, 38°46′47″N, 76°02′23″W, 27 Apr. 2000, J. M. McCann; 1♂, same data except vernal pool # 3, 38°46′45″N, 76°02′16″W; 1♂, U.S.A., DELAWARE, New Castle Co., Glasgow / Marabou Mead[o]ws, 23-III-1982, coll. Weber and / Donofrio; Hydrochus sp., det. R W Lake 1984.

Paratypes are deposited in the Museum of Comparative Zoology, the Natural History Museum (London), the American Museum of Natural History, the California Academy of Sciences, the Field Museum of Natural History, the University of Delaware, and the Florida State Collection of Arthropods.

Known Distribution. The species is known from five vernal pools in Talbot County, Maryland. Three of the pools occur in Seth State Forest (SSF Pools 1–3) and two are located approximately 3.5 km to the north, in a forest tract referred to as Swann-Haven Woods (SHW Pools 1–2). The pools at Seth State Forest are within 300–400 m of each other and the two pools at Swann-Haven Woods are separated by only 150 m. Given their close proximity and the potenital for genetic exchange, we treat these five occurrences as two localities. A single record also exists from New Castle County, Delaware, near Glasgow; the exact location is uncertain.

Hydrochus spangleri is known only from the three localities on the Delmarva Peninsula, while other Atlantic coast species of *Hydrochus* are usually more widespread (Hellman 1975).

Habits, Habitat, and Seasonal Occurrence. *Hydrochus spangleri* is apparently restricted to forest vernal pools. The type locality (SSF Pool 1) is an unusually large (0.2 ha), deep (1.5 m) oval-shaped pool where complete water downdraw has never been observed, even during periods of drought. Presumably, as with other similar depressional wetlands on the Atlantic coastal plain, basin flooding occurres primarily through water-table mounding and groundwater inflow (Phillips and Shedlock 1993; Lide *et al.* 1995).

Prior to the severe disturbance in 1982, the area immediately surrounding SSF Pool 1 was a mature, closed-canopy deciduous forest dominated by 38–63 cm diameter at breast height (dbh) *Acer rubrum* L. (Aceraceae), *Fagus grandifolia* Ehrh. (Fagaceae), *Nyssa sylvatica* Marshall (Cornaceae), *Liquidambar styraciflua* L. (Hammamelidaceae), and *Quercus alba* L. (Fagaceae). The forest canopy over the pool was mostly closed (Fig. 7), although small stands of *Cephalanthus occidentalis* L. (Rubiaceae)

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Figs. 7–9. **7)** Biotope at the type locality, ''pond 1,'' July 1978 (photo. W. E. Steiner, Jr.); **8)** biotope at the type locality, ''pond 1,'' June 1997 (photo. Bill Johnson); **9)** biotope at the type locality, ''pond 1,'' March 1997 (photo. J. M. McCann).

occurred along some of the pool margins. Emergent vegetation was lacking and the substrate consisted of a thick, firm clay loam overlaid with dense leaf litter deposits. Today, as shown in Figures 8 and 9, the pool canopy is open with emergent vegetation (mainly *Juncus effusus* L. [Junaceae]) and small, dense patches of *C. occidentalis*, *Leucothoe racemosa* L. (Ericaceae), and *Clethra alnifolia* L. (Clethraceae) occurring along most of the pool margin. The forest surrounding the pool is a mix of dense young (10–15 years old) *Pinus taeda* L. (Pinaceae) and a closed canopy, 25–40 cm dbh deciduous forest dominated by *A. rubrum*, *L. styraciflua*, and *F. grandifolia*. During a survey in 1986, no *H. spangleri* or other beetle species considered unique to forest vernal pools (*e.g., Hoperius planatus* Fall [Dytiscidae]) were found. Although the habitat and beetle assemblage have since shown evidence of some recovery, relative abundance of *H. spangleri* remains low compared to pre-1982 levels and SSF Pool 2. Moreover, the beetle seems to be confined only to those pool margins where some canopy cover remains and the substrate consists of shaded leaf litter deposits with no emergent vegetation. The landscape surrounding Seth State Forest is dominated by large agricultural fields, small forest tracts and scattered, low-density residential development.

Hydrochus spangleri was first found at SSF Pool 2 on 1 March 1997. Located approximately 200 m north-northeast of SSF Pool 1, the pool lacked any recent disturbance and habitat conditions appeared similar to those at SSF Pool 1 prior to 1982; *i.e.,* mature, closed canopy deciduous forest dominated by large (25–68 cm dbh) *A. rubrum*, *N. sylvatica*, *L. styraciflua*, and *F. grandifolia*, and scattered large trees are growing directly in the pool basin. The pool was well shaded, lacked emergent or dense shrub vegetation (except for a few areas with thick *Smilax rotundifolia* L. [Liliaceae]) and the pool bottom contained dense leaf litter deposits and a thick, firm clay loam substrate. Although of similar size and shape as SSF Pool 1, this pool is shallower (~1 m maximum depth) and, typical of vernal pools in the region, it experiences a complete summer-fall drawdown during most years. Figure 10 depicts habitat conditions with near maximum water levels on 1 March 1997. Conditions during partial and nearly complete drawdown are shown in Figure 11.

On 18 April 2000, during a systematic survey of depressional wetlands throughout Seth State Forest, five *H. spangleri* were collected in a third vernal pool (SSF Pool 3) just 150 m SE of the type locality. Unlike SSF Pools 1 and 2, this wetland was a small (15 m × 7 m), very shallow (10 cm max. depth), relatively ephemeral and lacked a discrete basin. It occurred within a mature, mesic, closed-canopy mixed deciduous-pine forest. The mid- and understory growth was moderately dense and dominated by *Vaccinium corymbosum* L. (Ericaceae) and *Toxicodendron vernix* (L.) Ktze. (Anacardiaceae). The west edge of the pool was about 20 m east of a recent clearcut with dense *P. taeda* regeneration.

On 27 April 2000, *H. spangleri* was discovered in two additional forest vernal pools in Swann-Haven Woods (SHW Pool 1—four *H. spangleri*; SHW Pool 2—one collected), a small forest tract located 3.5 km north of Seth State Forest. SHW Pool 1 measured 30 × 25 m in size with a maximum water depth of 1 m and mostly closed forest canopy. The pool was oval to semicircular with a discrete basin, lacked any emergent or dense shrub vegetation, and contained a firm clay bottom with dense leaf litter deposits. It was situated in a mature, mesic deciduous forest dominated by 30–50 cm dph *A. rubrum*, *L. styraciflua*, and *Q. alba* with a mostly sparse mid- and understory. Althought located just 75 m from an agricultural field, the pool showed no signs of recent disturbance. Located approximately 140 m to the southeast and abutting the agricultural field, SHW Pool 2 was larger, measuring 70 × 50 m with a discrete oval basin and maximum depth of 1.2 m. Recent signs of disturbance from farming equipment and off-road vehicle traffic was evident. The surrounding forest was similar

Figs. 10–11. 10) Biotope at the type locality, ''pond 2,'' near maximum water level, March 1997 (photo. J. M. McCann); **11)** biotope at the type locality, ''pond 2,'' low water level, June 1997 (photo. Bill Johnson).

to that around SHW Pool 1 but, because of the adjacent field, the canopy over the pool was mostly open and dense emergent (mainly *Polygonum* sp. [Polygonaceae]) and shrub (*C. occidentalis*, *Salix* sp. [Salicaceae]) vegetation occurred throughout most of the pool basin. The pool substrate was firm to mucky and thick leaf litter deposits were lacking. A large, expanding residential development and agricultural fields surrounded most of Swann-Haven Woods.

The New Castle County, Delaware site, where a single specimen was taken in 1982, has not been visited by the authors; information indicates that land use of the area may prevent any further study.

We employed two sampling techniques during our surveys: dip-netting and the flotation method. The latter technique involved stirring and agitating the submerged leaf litter along the pool margin by hand and holding it submerged for about 1 minute causing *Hydrochus* and other beetles to float to the surface where they were easily

visible and captured with a fine-mesh net. Dip-netting was applied along the pool margin as well as in deeper, more interior portions of the pool. Using the two techniques, only one of 66 *H. spangleri* adults was obtained using a dip-net, all others were found by the flotation method. These observations suggest that adult *H. spangleri* was restricted to shallow areas (<30 cm depth) along the outermost pool margins. This zone of occurrence was dynamic, changing as pool water levels rose and receded.

During 1 March to 21 November 1997, 66 *H. spangleri* were collected during 13 visits to SSF Pools 1 and 2, and, on several occasions, numerous others were observed. The earliest occurrence of the beetle was 1 March when it was found to be very abundant in SSF Pool 2, moderately so in flooded forest near SSF Pool 2, and must less so in SSF Pool 1. Abundance was greatest from that date through May; populations showed rapid decline in May and no beetles were found after 8 June (but records from SSF Pool 1 in the years prior to disturbance, beetles were common in July). Sampling at SSF Pool 1 in the fall of 1997 and 1998 and in January 2002 yielded no specimens (and SSF Pool 2 has been dry at these times). Where adult beetles are to be found during this period is somewhat puzzling, and the immature stages remain to be discovered. Attempts to get eggs from captive adults have not been successful. Also, in an attempt to determine if adult or immature life stages occurred in the exposed pool basin substrate during summer drawdown periods, we collected soil and leaf litter samples at SSF Pools 1 and 2 in September 1998. This was during a period of severe drought and SSF Pool 1 was completely dry and SSF Pool 2 nearly so. Samples were ''floated'' in water and sieved, and although carefully searched for *H. spangleri*, none were found.

Also enigmatic is the lack of evidence for flight. While the beetles appear to possess functional hind wings, none were observed to take flight, even when held out of the water for some time. No *H. spangleri* have ever been taken at black lights, even when sheets were suspended in the drying basin of SSF Pool 2; at least 28 other species of aquatic beetles, including other *Hydrochus* species, were captured in this manner on four evenings during May–August 1997. Nearly all of the aquatic beetle species known from these ponds from hand-collecting have been repeatedly taken over the years at black lights operated at the ponds, but *H. spangleri* has not been detected in this manner. This may be a factor in explaining its rarity in collections.

Hydrochus spangleri sites occur along the periphery of a region on the Delmarva Peninsula that contains an estimated 1,500–2,500 geologic deposits known as Carolina bays (also known locally as Delmarva bays) (Stolt and Rabenhorst 1987*b*). Occurring from Florida to New Jersey, Carolina bays are seasonally to semi-permanently inundated wetlands, ranging in size from a few to several thousand hectares with maximum water depths of up to 3 m (Stolt and Rabenhorst 1987*a*, Richardson and Gibbons 1993). Although highly variable, they are typically ovate-shaped, contain an encircling sandy rim and support a distinct vegetational gradient with an open, forb-dominated center, adjacent graminoid then shrub zones, and an outer forested zone (Tyndall *et al.* 1990; Tyndall 2000). Bays on the Delmarva Peninsula are 16,000–21,000 years old and probably originated during the late Pleistocenec as interdunal depressions or blowouts in sandy barrens (Sirkin *et al.* 1977; Stolt and Rabenhorst 1987*b*; Markewich and Markewick 1994). Althought relatively small with a nearly closed forest canopy and lacking many of the typical physical (well-defined sandy rim) and vegetative features (gradient of vegetation zones) of Carolina bays, the *H. spangleri* sites are probably of similar origin and the Delmarva Peninsula's isolation from other regions with Carolina bays might explain the apparent endemism of this aquatic beetle. Much remains to be learned about the ecological requirements of *H. spangleri* and vernal pool communites in general, but the beetle's limited distribution within the Delmarva region may be due, in part, to its apparent intolerance for forest

removal and avoidance of vernal pools with dense shrub and emergent vegetation and lack of dense leaf litter deposits.

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