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First Confirmed New World Record of *Apocyclops dengizicus* (Lepeshkin), with a Key to the Species of *Apocyclops* in North America and the Caribbean Region  
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ABSTRACT

An adult female of the cyclopoid copepod crustacean *Apocyclops dengizicus* (Lepeshkin) was found in the leaf vase of a northern pitcher plant, *Sarracenia purpurea* Linnaeus, in a freshwater boggy area on the coastal plain of eastern Virginia, USA. This is the first confirmed record of *A. dengizicus*, an Old World species, in the Americas. Species of *Apocyclops* normally inhabit brackish coastal lagoons and salt marshes and inland saline lakes, and finds in continental fresh waters are rare. This is only the second record of a member of the genus from a

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phytotelm (plant cup). We describe this individual, and report a possible second new record of the same species, based on juvenile specimens, from the eastern shore of the Chesapeake Bay in Maryland, USA. *Apocyclops dengizicus* may have been introduced into the region of the Chesapeake Bay by human agency, and may have established viable populations in the region. We review and update records of the other species of *Apocyclops* (*A. dimorphus*, *A. panamensis*, *A. spartinus*, and *Apocyclops* sp.) reported from North America, islands of the Caribbean, and Bermuda, and provide a key for their identification.

### INTRODUCTION

The carnivorous northern pitcher plant, *Sarracenia purpurea* Linnaeus, 1758 occurs from the eastern United States to northern Canada, primarily in habitats dominated by wet infertile soils such as bogs. The vase-shaped leaves fill with water and support a diverse community of aquatic invertebrates which may include copepods (Hamilton, 1998; reviewed by Hamilton, Reid, & Duffield, 2000; and Reid, 2001), amphipods, isopods, cladocerans, and bacteria (Istock, Wasserman, & Zimmerman, 1975), protozoans (Addicott, 1974), rotifers (Petersen et al., 1997), and insects (Fish & Hall, 1978; Rymal & Folkerts, 1982). Prey are attracted to the plant by a combination of leaf shape, leaf coloration, and extrafloral nectar and other olfactory cues. Some organisms attracted to the leaves eventually fall in and drown. These drowned prey provide nourishment for both the plant and its commensal inhabitants.

A single female copepod crustacean attributable to *Apocyclops dengizicus* (Lepeshkin, 1900) was found in a collection of aquatic invertebrates from the leaf vases of northern (purple) pitcher plants in a freshwater boggy area on the coastal plain of eastern Virginia, USA. The find of this copepod was extremely surprising, since species of *Apocyclops* normally occur in brackish coastal lagoons and salt marshes, and in saline lakes in arid continental regions, where they are often the dominant zooplankters. Records

in continental freshwater habitats are rare. Moreover, *A. dengizicus* is an Old World species. We describe the individual found in Virginia, and discuss a possible second new record, based on juveniles, from the Maryland shore of the Chesapeake Bay. We review records of *Apocyclops* from North America and the Antilles, giving a brief overview of the kinds of habitats where they occur, and provide a taxonomic key to aid in their identification.

## MATERIAL AND METHODS

### Collection Sites

The Bear Timber Site in Caroline County, Virginia, is located in the drainage basin of the Mattaponi River, northeast of the North Anna River. The Mattaponi is a tributary of the York River which enters the Chesapeake Bay. The site is a boggy depression, and the water is fresh. The population of *S. purpurea* at the site is believed to be natural, i.e., not introduced. Only plants, not the surrounding sediments, were sampled for invertebrates.

The Wye Island marsh is located on the eastern shore of the Chesapeake Bay in Queen Annes County, Maryland. The marsh, although tidal, is mainly freshwater except for the part immediately adjacent to the bay. Most samples of copepods from the marsh contained typical freshwater species, such as members of the family Parastenocarididae; only samples from within a few meters of the bay contained brackish-water species (C. C. Hakenkamp and J. W. Reid, unpublished data).

### Treatment of Samples

The samples from the Bear Timber site were collected on 15 November 1996, from 40 mature leaves, each of which held approximately 30 ml of fluid. No plants were removed from the site. The fluid in each leaf was stirred with a small tapered spatula to re-suspend debris and organisms, and the liquid and debris were withdrawn using a pipette (0.4 cm internal diameter) fitted with a rubber bulb, according to the method described by Hamilton, Reid, & Duffield (2000).

The samples from Wye Island were taken from water pumped from pipe wells hand-driven into the marsh sediments. Wells driven near the edge of the marsh yielded several euryhaline species of copepods (C. C. Hakenkamp and J. W. Reid, unpublished data), including copepodids belonging to the genus *Apocyclops*.

In the laboratory, each sample was sorted using a dissecting microscope. All copepods were removed, preserved in 70% ethanol, and given an accession number. For description, the adult specimen was transferred gradually to glycerin, then to lactic acid, and finally dissected and mounted on a slide in commercial CMC-10® medium (Masters Chemical Co., Wooddale, Illinois). Drawings were made from the specimen in lactic acid or in CMC-10, using a Wild M30® compound microscope fitted with a drawing tube, at magnifications of 400x and 600x.

The copepod specimens have been deposited in the collections of the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM).

## RESULTS

### *Apocyclops dengizicus* (Lepeshkin, 1900)

Figs. 1-3

#### Material examined

One adult female, from Sample 96-XI 1505A, in leaves of *Sarracenia purpurea* plant in bog at Bear Timber Site, north of the North Anna River near Fort A. P. Hill, Caroline County, Virginia, about 37°55'N, 77°23'W, 15 November 1996, collectors R. Hamilton IV and R. M. Duffield (USNM 298329).

Two stage V copepodid (juvenile) males, from driven wells in tidal marsh, Wye Island, eastern shore of Chesapeake Bay, Queen Annes County, Maryland, about 38°53'N, 76°11'W, 5 October 1990, collector C. C. Hakenkamp (USNM 283902).

### Description of Adult Female

Length, excluding caudal setae, 0.85 mm. Cephalosome and urosome except anal somite (Figs. 1a and 1b) highly sclerotized and sculptured, and covered with rows of tiny pits. Anal somite sparsely, and caudal rami thickly set with tiny spinules. Caudal rami about 4.5 times longer than broad; length relationships of caudal setae as shown in Fig. 1b.

Antennule (Fig. 1c) of 11 segments, segment 8 with 2 shallow grooves possibly representing partial sutures. Antenna (Fig. 1d) composed of 5 segments, endopodite clearly distinct from basipodite; the latter bearing 3 setae. Labrum (Figs. 1e and 1f), margin with 13 teeth between lateral knobs, frontal surface with 2 groups of long hairlike spinules, and caudal (inner) surface with 2 groups of tiny spinules. Gnathobase broken in dissection, but bearing 3 stout spines (Fig. 1g). Mandible (Fig. 1h) without ornamentation on surface; palp with 1 short and 2 long setae. Maxillule (Fig. 2a), segment 1 of palp with 1 proximal and 3 apical and subapical setae, and segment 2 of palp with 3 apical setae. Maxilla (Fig. 2b), basis slightly rugose; claw with row of tiny teeth in middle third. Maxilliped (Figs. 2c and 2d) segments 1-4 bearing 3, 2, 1, and 3 setae respectively; segment 2 also with irregular rows of long hairlike spines on surface.

Legs 1-4 (Figs. 2e-h and 3a-c) with 2-segmented rami; exopodite segments 2 with 3, 4, 4, and 3 spines respectively. Basipodite of leg 1 with slender serrate spine on medial expansion, spine reaching past distal end of endopodite. Legs 1-3, exopodite segment 1 with, and leg 4 exopodite segment 1 without seta on distomedial corner. Couplers (intercoxal sclerites) with 1 or more rows of tiny spinules on surfaces, and tiny spinules along edges of double rounded marginal protrusions.

Leg 5 (Figs. 3d and 3e) consisting of 1 broad, irregularly quadrate free segment, bearing long, stout lateral seta, and short strong spine on distomedial corner. Proximal segment completely fused to somite and represented only by stout seta inserted directly on somite anterior to free segment; transverse row of tiny spines present near base of this seta.

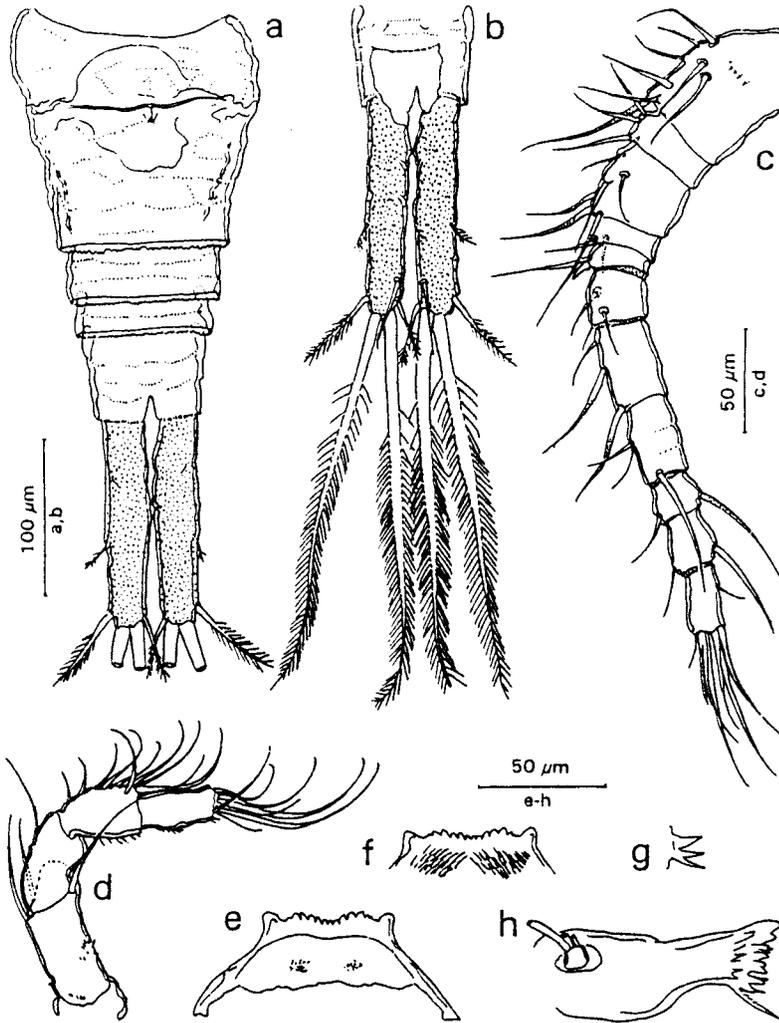


Fig. 1. *Apocyclops dengizicus*, female: a, Abdomen, ventral; b, Anal somite and caudal rami, dorsal; c, Antennule; d, Antenna; e, Labrum, caudal; f, Labrum, frontal; g, Gnathobase (part); h, Mandible.

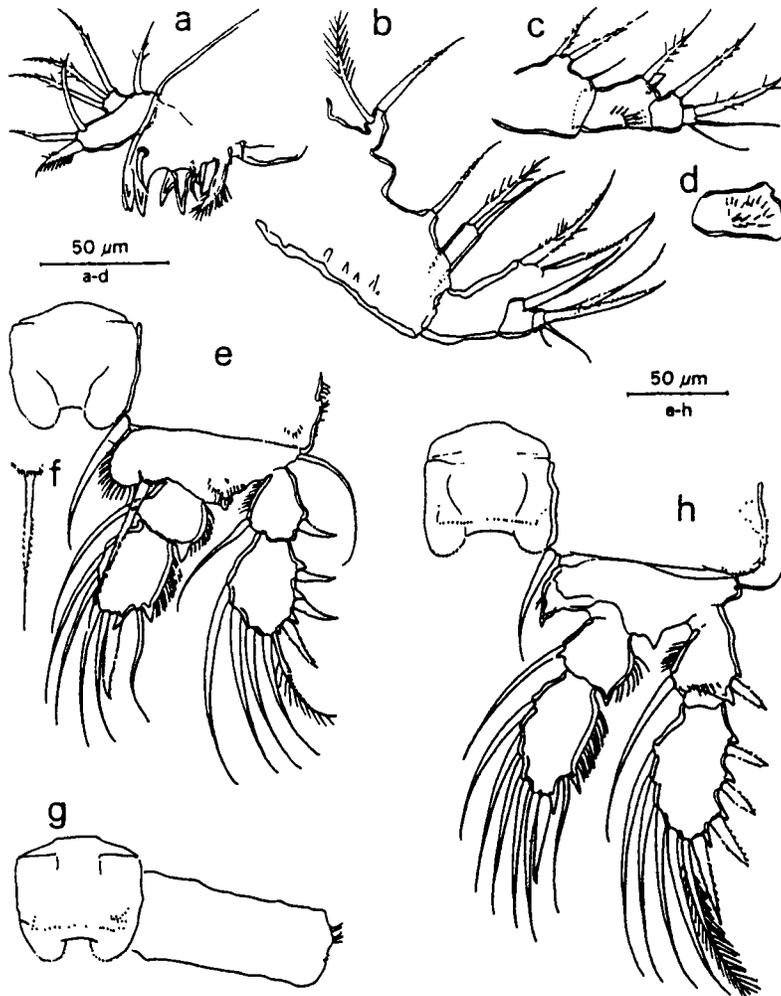


Fig. 2. *Apocyclops dengizicus*, female: a, Maxillule; b, Maxilla; c, Maxilliped; d, Maxilliped, segment 2; e, Leg 1 and coupler, frontal; f, Spiniform seta of leg 1 basipodite; g, Leg 1 coupler, caudal; h, Leg 2 and coupler, caudal.

Leg 6 (Fig. 3f) a broad, sculptured subtriangular plate bearing 3 stout spines.

#### Comments on Juvenile Individuals

Two male stage V copepodids (juveniles) of a large, strongly sclerotized species of *Apocyclops* appeared in driven wells at the bayside edge of a tidal marsh on the eastern shore of the Chesapeake Bay, Maryland. Although the species characters, especially the acute productions of the medial margins of legs 2-4 basipodites, do not appear until the adult stage, several features of

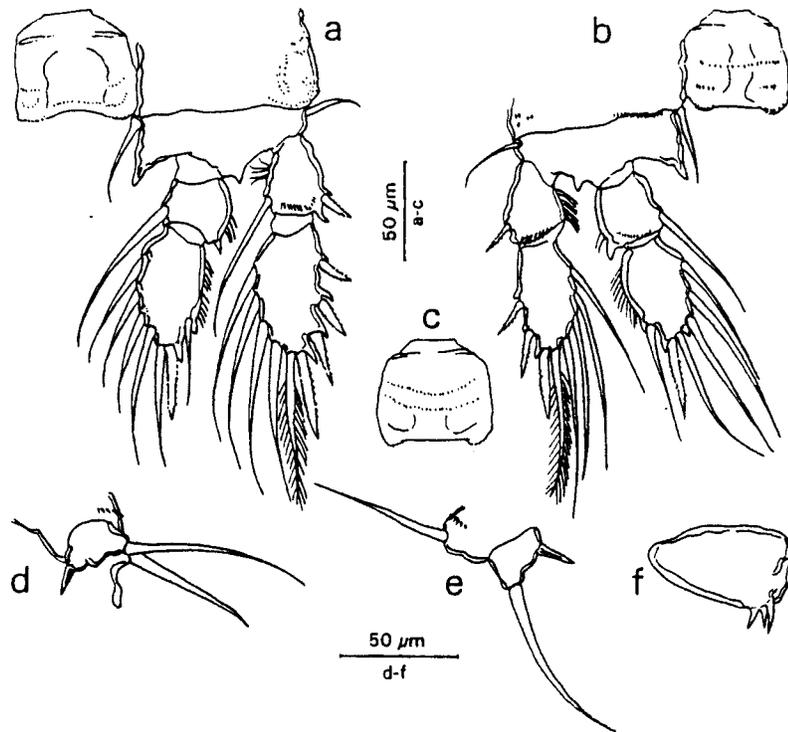


Fig. 3. *Apocyclops dengizicus*, female: a, Leg 3 and coupler, caudal; b, Leg 4 and coupler, caudal; c, Leg 4 coupler, frontal; d, e, Leg 5; f, Leg 6.

these copepodids matched the characters of subadults of *A. dengizicus* as described by Alvarez Valderhaug and Kewalramani (1979). Therefore we tentatively assigned them to this species.

## DISCUSSION

The small genus *Apocyclops* sensu Lindberg (1942) includes species belonging to two distinct morphological groups. The *panamensis*-group includes slender species without obvious somitic ornamentation except for spines on pediger 5; with the medial corners of legs 2-4 basipodites rounded and only slightly extended; and with relatively long slender swimming legs bearing long setae. These are: *A. panamensis* (Marsh, 1913; synonyms *A. viduus* Kiefer, 1933 and *A. distans* Kiefer, 1956), widely distributed from the coast of Massachusetts, USA, to the Atlantic and Pacific coasts of South America; *A. royi* Lindberg, 1940, reported from India and China; *A. borneoensis* Lindberg, 1954, from Borneo, China, and Malaysia; *A. procerus* Herbst, 1955, from Brazil, Nicaragua, and Peru; *A. japonensis* Ito, 1957, from Japan; and *A. spartinus* Ruber, 1968, from the USA Atlantic coast. In unpublished theses, Arnofsky (1996) and Botelho (2000) each illustrated a previously undescribed species of the *panamensis*-group from New World locations.

The *dengizicus*-group includes two species with stout, heavily sclerotized bodies showing conspicuous somitic ornamentation (irregular sculpturing, pitting, and tiny spinules), the medial corners of legs 2-4 basipodites produced into long acute points, and relatively short stout swimming legs and setae: the Old World *A. dengizicus* (Lepeshkin, 1900), and the New World *A. dimorphus* Kiefer, 1931. *Apocyclops dimorphus* was described by Kiefer (1931, 1934) from the Salton Sea in California, USA. Later, Rylov (1948), Monchenko (1974), and Kiefer himself (1949, 1967) relegated *dimorphus* to synonymy with *A. dengizicus*. Because the two taxa were for so long regarded as synonymous, several reports from North America have used the name *dengizicus* (Table 1). However, both Arnofsky (1996) and Botelho (2000), basing their evaluations primarily on morphometric and morphological micro-characters respectively, have argued

convincingly that the two taxa represent distinct species. We based our determination of the adult specimen from Virginia on the redescription of *A. dengizicus* by Monchenko (1974) and Mirabdullayev & Stuge (1998); on material of this species from Uzbekistan donated to the National Museum of Natural History by I. M. Mirabdullayev; and on advice from M. J. C. Botelho (pers. comm. to JWR, March 2000) regarding the distinctions between *A. dengizicus* and *A. dimorphus*.

In the Americas, *A. dimorphus* has been recorded from California, USA; Haiti; and Coahuila, Mexico (Table 1). A new record from Texas, USA is given in Table 1.

*Apocyclops dengizicus* occurs widely in the Old World, including the type locality in Lake Selety-Tengiz (Dengiz) in Kazakhstan, and also in Australia, Egypt, India, Iran, Iraq, Libya, Malaysia, Uzbekistan, and the Caspian Sea (records reviewed by Rylov (1948); Kiefer (1967); Monchenko (1974); Dussart & Defaye (1985); Arnofsky (1996); Mirabdullayev & Stuge (1998); and Botelho (2000)).

Species of *Apocyclops* often dominate the plankton of brackish coastal lagoons, saline inland lakes in arid regions, and sometimes coastal salt marshes in tropical and temperate zones worldwide. Yeatman (1983) made the only previous report of a member of this genus in a phytotelm, i.e., *Apocyclops* cf. *borneoensis* in a treehole in Fiji.

*Apocyclops dengizicus* usually inhabits brackish to hypersaline inland waters. In Australia, it is known as a highly vagile, eurytopic species (Knott & Jasinska, 1998). Its well-studied congener, *A. dimorphus*, is equally adaptable; Dexter (1993) found that animals from the Salton Sea population were able to survive and reproduce at salinities from 0.5 to 68 g/l, and to survive for 60 days at 107 g/l. In Haiti, *A. dimorphus* was found in a small pool in a freshwater marsh (pH 8.3), which may have received water from a large nearby salt pond that also contained the species (Kiefer, 1936). *Apocyclops dimorphus* never appears in the plankton of the Aransas Ship Channel in Texas, which is sampled regularly; there, its preferred habitat may be small mudflat ponds, which undergo wide fluctuations in temperature and salinity (E. Buskey, pers. comm. to JWR, February 2000).

Members of *Apocyclops* are easily cultured, e.g., on marine yeast (James & Al-Khars, 1986), green algae (Alvarez Valderhaug & Kewalramani, 1979), or a mixture of *Paramecium caudatum* and *Chilomonas* (Dorward & Wyngaard, 1997). It is possible that they are able to compete successfully with other invertebrates for the sparse algae in the pitcher plants, and, like other cycloids, to consume facultatively small invertebrates and bits of plant detritus.

The appearance of *A. dengizicus* in the Chesapeake drainage basin, an area of intense shipping and other human activity, as well as its absence from major inland saline lake systems in the Americas, such as those in central Canada (e.g., Hammer, 1993) or the Argentine Chaco (e.g., Ringuelet, 1958), lead us to speculate that it was introduced here by human agency. Populations of *A. dengizicus* may have become established in small, isolated brackish waterbodies around the bay, and one such population may have been the source for the individual found in the freshwater bog. We expect that sampling in similar small waterbodies near the bay will result in new finds of this species. We also expect that it will disperse widely and rapidly into appropriate brackish-water locations along the North American east coast.

Members of the *panamensis*-group, especially *A. panamensis* itself, are commonly recorded from North America and the Antilles (Table 1). Ruber (1968) and Petkovski (1988) previously reviewed the literature and records of New World species of *Apocyclops*. Because of changing concepts of the genera *Cyclops*, *Metacyclops*, *Microcyclops*, and *Apocyclops*, species of *Apocyclops* have been listed in the literature under all these names (as both genus and subgenus), leading to much confusion. Therefore we believe that the nomenclatural and distributional information in Table 1 will be helpful to nonspecialists. We take this opportunity to list additional, previously unpublished records from material deposited in the National Museum of Natural History and determined by JWR.

We also provide a key to assist in the identification of females of the species reported from the same area. The characters in the key are based primarily on those developed by Botelho (2000) in her world review of the

genus, and on personal observations by JWR. However, because of the wide distribution of many species and their highly adaptive nature, their actual ranges may be much wider than is currently understood. Moreover, there is always the chance of introductions of exotic species. Therefore we strongly recommend that determinations be verified by comparison with published taxonomic descriptions.

Two unpublished species, one reported from California, USA by Arnofsky (1996) and the other from Louisiana, USA and San Salvador by Botelho (2000), were not included in the key or in Table 1.

**Key to named species of *Apocyclops* in North America  
and the Caribbean Region**

1. Swimming legs 1-4, medial margins of basipodites extended into long spiniform structures; terminal spine of leg 4 endopodite about as long as distal segment; large robust animals, with obvious sculpturing on body surface ..... *dengizicus*-group (2)
  - Swimming legs 1-4, medial margins of basipodites rounded and little extended; terminal spine of leg 4 endopodite about half as long as distal segment; small slender animals, body surface usually appearing smooth ..... *panamensis*-group (3)
2. Body somite bearing leg 5, with row of tiny spines present anterior to insertion of lateral seta on somite; leg 1 basipodite with tiny spines present near spiniform expansion between rami ..... *dengizicus*
  - Body somite bearing leg 5, with no spines near insertion of lateral seta; leg 1 basipodite with no spines in area between rami .... *dimorphus*
3. Free segment of leg 5 naked ..... *panamensis*
  - Free segment of leg 5 covered with tiny spines ..... *spartinus*

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Table 1. Geographical and habitat records of species of *Apocyclops* from North America, Caribbean islands, and the Bahamas. National Museum of Natural History, Smithsonian Institution (USNM) catalog numbers are provided for previously unpublished records.

Species	Location	Habitat (salinity, given without units; or chlorinity)	References
<i>A. dengizicus</i>	USA: Virginia: Caroline Co.	<i>Sarracenia</i> leaf in boggy depression (0)	Present report <sup>15</sup>
<i>A. cf. dengizicus</i>	USA: Maryland: Queen Annes Co.: Wye Island	Marsh; driven wells at edge of bay (2-10)	Present report <sup>15</sup>
<i>A. dimorphus</i>	USA: California: Salton Sea	Artificial inland saline lake (27.8-73)	Kiefer (1931 <sup>1</sup> , 1934 <sup>2</sup> ), Johnson (1953 <sup>4</sup> ); Carpelan (1961 <sup>4</sup> ); Yeatman (1963 <sup>4</sup> ); Reid (1991); Dexter (1993 <sup>1</sup> , 1995 <sup>1</sup> )
	Haiti	Saline coastal pond (4.1) and nearby pool (2) and freshwater swamp (0)	Kiefer (1936 <sup>2</sup> )
	Mexico: Coahuila: Cuatro Ciénegas	Inland saline lakes	Zamudio Valdéz (1991)
	USA: Texas: Port Aransas	Laboratory culture of <i>Brachionus</i> rotifers at Univ. Texas Marine Science Institute; probably from saline pools in nearby mudflats	1999, coll. E. Buskey, det. J. W. Reid (USNM 298326) <sup>15</sup>

Table 1. Continued

Species	Location	Habitat (salinity, given without units; or chlorinity)	References
<i>A. panamensis</i>			
Aruba		Small, slightly brackish pool in stream	Kiefer (1933 <sup>7</sup> )
Barbuda		Well (chlorinity 1700 mg/l)	Pesce (1985 <sup>16</sup> )
Barbuda: Coco Point		?	31 May 1989, coll. M. B. Nathan, det. J. W. Reid (USNM 250582) <sup>13</sup>
Belize: Dangriga		Cattail ( <i>Typha</i> ) marsh near coast	9 July 1987, coll. F. D. Ferrari, det. J. W. Reid (USNM 234122) <sup>13</sup>
Bermuda: Spittal Pond		?	Yeatman (1963 <sup>8</sup> )
Bonaire		Pool in cave (chlorinity 4402 mg/l)	Pesce (1985 <sup>16</sup> )
Cayman Islands: Grand Cayman		Sublittoral sand behind barrier reef (marine bay)	Pesce (1985 <sup>16</sup> )
Cayman Islands: Cayman Brac, Grand Cayman, Little Cayman		Coastal saline ponds (0.2-33.8)	Suárez Morales, McLelland, and Reid (1999)
Cuba		Coastal lakes	Straskraba et al. (1969); Smith and Fernando (1978 <sup>11</sup> , 1980 <sup>11</sup> ); Collado, Fernando, and Septon (1984)
Guadeloupe		Drainage canal near coast	Dussart (1983 <sup>6</sup> )
Haiti		Saline coastal lakes (1.03, 7.48)	Kiefer (1936 <sup>7</sup> )

Table 1. Continued

Species	Location	Habitat (salinity, given without units; or chlorinity)	References
<i>A. panamensis</i>	Jamaica	Saline pool in cave (chlorinity 2928 mg/l)	Pesce (1985) <sup>16</sup>
	Jamaica: Black River Morass in Middle Quaters River, and in Salt Spring River	?	22 March 1994, coll. W. Janetzky, det. J. W. Reid (USNM 264202-264204, 264213, 264217, 264222, 264226) <sup>15</sup>
	Mexico: Guerrero	Brackish coastal lagoon	Comita (1951)
	Mexico: Sinaloa: El Mescal, Esquinapa	?	Lindberg (1955)
	Mexico: Yucatán: Mérida	Small freshwater pond	Suárez Morales et al. (1996)
	St. Croix; Big Princess Swamp	Brackish water in swamp	6 February 1935, coll. H. A. Beatty, det. J. W. Reid (USNM 79810) <sup>15</sup>
	San Andrés Island	Saline lake in cave (26-30)	Sket (1988) <sup>18</sup>
	San Andrés Island	Brackish pools in caves	Peckovski (1988)
	Santo Domingo	?	Dussart and Defaye (1985) <sup>17</sup>
	Tobago	?	Reid (1991)
	Tobago: Argyle Lake	Lake by sea	9 September 1990, coll. M. Schotte, det. J. W. Reid (USNM 250992) <sup>15</sup>

Table 1. Continued

Species	Location	Habitat (salinity, given without units; or chlorinity)	References
<i>A. panamensis</i>	USA: Florida: Everglades	Coastal lagoon (13.3-15.4)	Davis (1948) <sup>12</sup> ; Davis and Williams (1950) <sup>12</sup>
	USA: Florida: Sugarloaf Key	Slough	Yeatman (1963) <sup>8</sup>
	USA: Florida: St. Andrews Bay complex, Panama City	?	Yeatman (1963) <sup>8</sup>
	USA: Georgia: Sapelo Island	Salt marsh	August 1994, coll. T. Snell, det. J. W. Reid (USNM 264173) <sup>13</sup>
	USA: Louisiana	Salt marshes, brackish lagoons	Cuzon du Rest (1963 <sup>8</sup> ); Nasci, Hare, and Vecchione (1987 <sup>9</sup> )
	USA: Louisiana: New Orleans	Freshwater swale, sometimes flooded with brackish water	Reid and Marten (1994)
	USA: Massachusetts	<i>Spartina</i> marshes	Yeatman (1960 <sup>8</sup> , 1962 <sup>8</sup> , 1963 <sup>9</sup> ); Ruber et al. (1994)
	USA: New Jersey	<i>Spartina</i> marsh	Brickman (1972) <sup>8</sup> , <sup>13</sup>
	USA: Texas: Orange Co.: Neches River	?	Yeatman (1963 <sup>8</sup> )

Table 1. Continued

Species	Location	Habitat (salinity, given without units, or chlorinity)	References
<i>A. spartinus</i>	USA: New Jersey	Brackish impoundments in <i>Spartina patens</i> marshes	Ruber (1968 <sup>14</sup> ); Ruber et al. (1994)
	USA: Delaware	<i>Spartina patens</i> marshes	Ruber (1968 <sup>14</sup> )
	USA: Massachusetts: Woods Hole	Freshwater pond near ocean	4 October 1881, coll. R. Rathbun, det. J. W. Reid (USNM 59658) <sup>15</sup>
	USA: Massachusetts: Falmouth: Quisset Pond	Small brackish-water pond near ocean	7 July 1926, coll. C. B. Wilson, det. J. W. Reid (USNM 60292, 250974) <sup>15, 16</sup>

<sup>1</sup> As *Apocyclops dengizicus*.<sup>2</sup> As *Cyclops (Metacyclops) dengizicus*.<sup>3</sup> As *Apocyclops dimorphus*.<sup>4</sup> As *Cyclops dimorphus*.<sup>5</sup> As *Cyclops (Metacyclops) dimorphus*.<sup>6</sup> As *Metacyclops distans*.<sup>7</sup> As *Cyclops (Metacyclops) victus*.<sup>8</sup> As *Cyclops panamensis*.<sup>9</sup> As *Cyclops (Metacyclops) panamensis*.<sup>10</sup> As *Metacyclops (Apocyclops) panamensis*.<sup>11</sup> As *Microcyclops panamensis*.<sup>12</sup> As *A. panamensis tannica*, now considered a synonym of *A. panamensis* s. str.

<sup>13</sup> Possibly *A. spartinus*; cf. comments by Ruber et al. (1994).

<sup>14</sup> As *Cyclops (Apocyclops) spartinus*.

<sup>15</sup> Previously unpublished record.

<sup>16</sup> Wilson (1932) reported *Microcyclops varicans* (G. O. Sars) from Quisset Pond, but his figure of a "variant" female fifth leg (Wilson, 1932: figure 194d) is that of an *Apocyclops*. Indeed, specimens of *A. spartinus* were found in this sample from Quisset Pond collected by Wilson.

<sup>17</sup> We were unable to confirm this record in the primary literature.

<sup>18</sup> As *Apocyclops distans*.