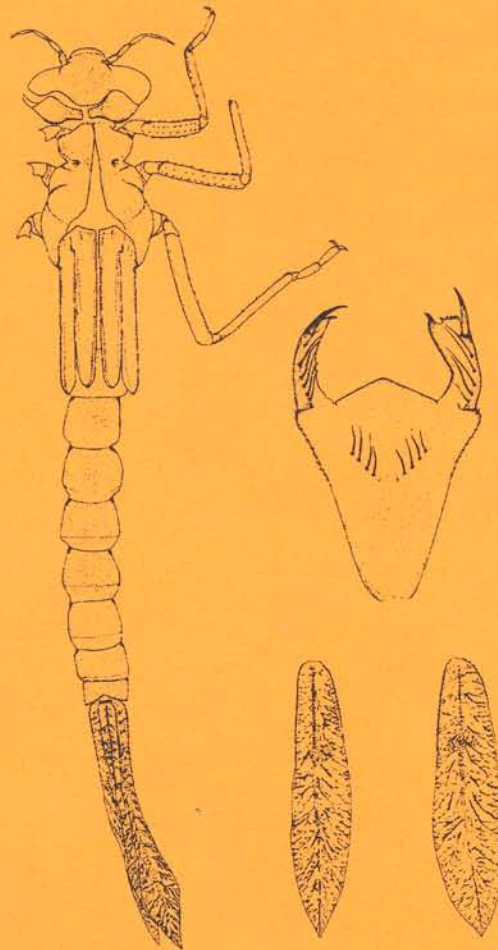


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AT-RISK ODONATA OF CONTERMINOUS UNITED STATES¹

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INTRODUCTION

Bick (1983) discussed 32 species of Odonata at risk in the U.S. and Canada, giving the conservation status of each a Red Book rating. Since then, the Odonata of 10 states have been published by the Dragonfly Society of the Americas, but conservation matters were detailed only for CT (Wagner and Thomas, 1999) and IA (Cruden and Gode, 2000). The present paper considers just mainland U.S. and gives the conservation status of each of 27 at risk taxa a Natural Heritage rating.

Red Book ratings are used only in reference to the literature. Because these terms have been misunderstood, they are defined briefly:

ENDANGERED: Taxa in danger of extinction whose survival is unlikely if the causal factors continue. Odonatists have considered this a legal term assigned only by a government agency not by any individual; the term is not newly assigned herein.

VULNERABLE: Taxa likely to move into "endangered" if the causal factors continue.

RARE: Taxa with small world populations under no known immediate threat.

The Natural Heritage designations and their definitions as used for CT (Wagner and Thomas), IA (Crudent and Gode), NJ (Barlow, 2001) are as follows, substituting G, global for S, state:

G1: "Critically imperiled", 5 or fewer occurrences; judged to be equivalent to endangered.

G2: "Imperiled", 6 to 20 occurrences; judged to be equivalent to vulnerable.

G3: "Rare", 21 to 100 occurrences.

G4: "Common", 100 plus occurrences.

GU: "Status uncertain". More survey data required to resolve rank.

Dunkle's (2000) terms to indicate abundance are given for each of the Anisoptera. He defined these terms as follows without considering Red Book or Natural Heritage ratings:

"Local": the species may be common in small areas but is rare in the landscape as a whole.

"Rare": Species with a rare type of habitat and/or a small geographic range.

"Uncommon": The species is noteworthy wherever found.

"Scarce": A species for which a special search has to be made.

For each of the 27 taxa, distribution, habitat, behavior of adults, and conservation status are discussed. Distribution is stated in general terms in the main text, then with a county list for each taxon in an appendix. At the end of each discussion a Natural Heritage numerical rating is given in parentheses. Sources of information are primarily the published literature, drawing heavily on the many brief notes in the news journal, *ARGIA*, and also on personal communication from colleagues. For brevity, if a citation is used more than once for a particular species, the date is given only the first time. In References, only the first initial of the first given name is used. Because some references, (e.g., Bick (1983) and Needham, et al (2000)) are so often repeated, the dates are omitted in the discussion. The cutoff date for literature pertinent to this paper was March 1, 2003.

Compared with Bick (1983), 11 species are eliminated, five are added. The deleted species are: *Macromia wabashensis* (validity questionable, Garrison, 1997; Needham, et al, 2000); *Somatochlora brevicincta* (primarily a Canadian species); *Gomphus carolinus* (subspecies of *G. parvidens*, Needham, et al); *G. geminatus* (common, Dunkle, 2000); *G. hodgesi*, *G. ozarkensis*, *G. parvidens*, *Ophiogomphus anomalus*, *O. howei*, *O. incurvatus*, *Somatochlora incurvata* (all are too common and/or abundant to include). The added species are: *Enallagma pictum*, *Nehalennia pallidula*, *Gomphus sandrius*, *G. westfalli*, *Ophiogomphus australis*.

This paper includes only U.S. endemics, except for *Neoneura aaroni* and *Aeshna persephone* which are present also in Mexico. *Gomphus lynnae* and *Ophiogomphus susbehcha* are excluded, the first because Paulson (1997) considered it fairly common, the latter because Vogt (pers. comm.)

¹ Bulletin of American Odonatology 7(3): 41-56

found the range limits not firmly established. Even though about a dozen species of *Argia* at the U.S.-Mexico border are of great interest to many Odonatists, few are true U.S. endemics and all are excluded.

U.S. SPECIES AT RISK, THEIR DISTRIBUTION, HABITAT AND CONSERVATION STATUS

***ENALLAGMA PICTUM* MORSE, 1895
SCARLET BLUET**

Westfall and May (1996) recorded this Bluet from: MA, NJ, NY, RI. Since then CT (Wagner and Thomas, 1999) and ME (Donnelly, pers. comm) have been added. In MA, it is present on Cape Cod (Carpenter, 1991); in NY it is only found on eastern Long Island (Donnelly, 1992); in NJ it is essentially confined to the Pine Barrens in small ponds in sandy soil (May and Carle, 1996). Carpenter stated that it was found in "Coastal Plain ponds of Cape Cod ideal habitat . . . adults frequent shorelines where water lilies abound, using the large floating leaves as resting spots." In RI, Carpenter (1998) found *E. pictum* at a sand-bottomed pond with a wide shoreline of emergent *Juncus*, *Scirpus*, etc, with areas of floating *Nymphaea*, and a deep mucky bottom. Wagner and Thomas stated that it perches on lily pads with *E. geminatum* and also *I. kellicotti*; it is a rare local species of special concern in CT. The beach pools of Cape Cod and Long Island seem in danger from beach recreation and nearby housing. But Carpenter (1999) and Brown (2001) reported new sites in RI. Having met the threat of crowded beaches, there seems to be no danger of extinction, so the species is designated RARE, (G3).

County Records:

MASSACHUSETTS: Barnstable, Bristol, Essex, Hampden, Middlesex, Norfolk, Plymouth, Worcester;
MAINE: Androscoggin, Cumberland, Kennebec, Lincoln, Oxford, York;
NEW HAMPSHIRE: Carroll, Hillsborough, Rockingham;
NEW JERSEY: Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Middlesex, Ocean, Salem;
NEW YORK: Suffolk;
RHODE ISLAND: Kent, Providence, Washington

***ENALLAGMA RECURVATUM* DAVIS, 1913
PINE BARRENS BLUET**

The distribution is similar to that of the Scarlet Bluet: MA, NY, NJ, RI (Westfall and May, 1996), and Paulson (2001) added ME. In NJ, it is confined to the Pine Barrens (May and Carle, 1996); in NY, to Long Island (Donnelly, 1992); in MA to Cape Cod (Carpenter, 1991). Carpenter described the habitat as "shallow pond shores where vegetation is plentiful. It is not found in deep clean sandy kettle ponds, but prefers those with muddy deposits and often with dense stands of rushes and Plymouth Gentian." Westfall and May noted that it occurs "only in acid sand-bottomed lakes and ponds, with considerable silt and marginal emergent vegetation." Carpenter considered males to be aggressive, attacking tenerals, mated pairs, single conspecific males and other species, even dead individuals.

Bick listed the species as "vulnerable", but FWS (Donnelly, 1989) removed it from "consideration of being endangered" to "no longer being considered" because of increasing abundance. The range is restricted to the northeastern megalopolis where close association with recreation beaches assures increasing environmental pressure. Yet it can scarcely be rated "endangered" or "vulnerable" because FWS found it increasingly abundant; Carpenter stated that it was abundant on Cape Cod throughout June; Westfall and May noted that it is fairly common in some areas between Cape Cod and NJ; and new populations were found (Brown, 2001) in RI. This species, which seems to be withstanding the pressures of beach disturbance, is designated RARE, understanding that beach recreation is a general threat, (G3).

County Records:

MASSACHUSETTS: Barnstable, Bristol, Plymouth, Worcester;
MAINE: Cumberland, York;
NEW HAMPSHIRE: Hillsborough;
NEW JERSEY: Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Monmouth, Ocean;
NEW YORK: Suffolk;
RHODE ISLAND: Kent, Providence, Washington

***ISCHNURA GEMINA* (KENNEDY, 1917)
SAN FRANCISCO FORKTAIL**

This species is known only from CA (Westfall and May, 1996) where it is endemic to the San Francisco Bay Area (Garrison and Hafernik, 1981a), but recent photographs and sightings

(Biggs, pers. comm.) indicate that the species may extend north-south slightly beyond the Bay Area. There are few details on habitat. Garrison and Hafernik considered the species to be urban, often associated with temporary pools at new construction. The species is indeed urban, being established at Glen Park in the city limits of San Francisco; it has been noted in weedy ditches and near salt water (Biggs, 2000; pers. comm.). Leong and Hafernik (1992) showed that *I. gemina* and its congener *I. denticollis* hybridize, which suggests that it faces an additional threat to its existence.

Bick listed this species as "endangered", and FWS was considering that status (Donnelly, 1989). Westfall and May stated that it is one of our rarest Odonates and undoubtedly deserves "endangered" status. After 18 years listed as "endangered", it seems to have met the challenge of urban life and to be far from extinct. Although there is no evidence of abundance, there are indications of range expansion. Even though this resilient Forktail has coped with urbanization, it is judged to be IMPERILED. New survey data is needed to more sharply define distribution limits, describe the habitat, and to pinpoint all threats, (G2).

County Records:

CALIFORNIA: Alameda, Marin, Monterey, San Francisco, San Mateo, Santa Clara, Santa Cruz, Sonoma

NEHALENNIA PALLIDULA CALVERT, 1913
EVERGLADES SPRITE

The type locality is Dade County, FL, and the species was considered (Dunkle, 1990; Westfall and May, 1996; Daigle, 1994, 1997; Mauffray, 1997c) to be a FL endemic until Flint (2000) reported two females in the Smithsonian collected at Galveston, TX in 1913. In FL, the species is most common in the Everglades (Dunkle) but it is not restricted to that area, five of the nine counties being farther north. Westfall and May stated that the precise habitat is unknown. Daigle stated that in the Everglades the species occurred at dry limestone hammock sinkholes, a sedge marsh, a rock pool, and that it is definitely shade loving. In TX it was probably found in a slough behind the beach at Galveston (Flint).

Westfall and May stated that it is infrequently collected and its conservation status is uncertain, while Daigle noted that it is "rare". Mauffray (1997c) considered the species to be "difficult to

find due to habitat destruction." Much of this destruction was caused by extensive cutting and removal of the invasive *Melaleuca* tree. Daigle stated that the Sprites "avoided the sun at all costs." One could hypothesize that the *Melaleuca* removal is adversely affecting the Everglades population by disturbance and by depriving the insects of critically required shade. In spite of considerable attention given to the Everglades, the larva of *N. pallidula* remains unknown. Many populations are protected by Everglades National Park, and the additional historic TX site (Flint) suggests the possibility that it was once more widespread. This Sprite is designated RARE, (G3).

County Records:

FLORIDA: Collier, Dade, Glades, Hendry, Highlands, Keys, Levy, Monroe, Orange, Palm Beach, Polk, Seminole;
TEXAS: Galveston (historic)

NEONEURA AARONI CALVERT, 1903
CORAL FRONTED THREADTAIL

Westfall and May (1996) recorded this species from TX, Mexico, and Guatemala. Donnelly (pers. comm.) stated that Guatemala is probably an error and that the TX Hill Country is the primary location. Abbott (2001a, b) listed the TX counties and summarized the TX distribution as "widely dispersed in the central and southern portions of the state, extending to the Hill Country west of the Devils River and south to the Gulf Coast." Westfall and May stated that it is "an inhabitant of sheltered pools along the rivers and tributary streams, generally with emergent or floating vegetation or detritus where oviposition occurs." Abbott (2001a) noted that it "prefers protected areas of slow-moving rivers and streams with emergent or floating vegetation, detritus or debris."

In 1994, Daigle stated that the species should not be considered "endangered"; in 1997, he rated it "rare"; and Westfall and May stated that the conservation status is uncertain. Bick rated the species RARE, which should be continued because of sparse populations and no recorded threat, (G3).

County Records:

TEXAS: Bandera, Bexar, Blanco, Caldwell, Goliad, Gonzales, Guadalupe, Kerr, Medina, Nueces, Real, San Patricio, Val Verde, Victoria
Also Nuevo Leon, Mexico

AESHNA PERSEPHONE DONNELLY, 1961
PERSEPHONE'S DARNER

This species occurs from southeastern AZ at the eastern side of the Chiricahua Mountains (Donnelly, 1961) and from southwestern NM (Dunkle, 1995b) north to Central CO (Evans, 1995), and southern UT (Abbott, 2002). Donnelly (1961) stated that "it inhabits mountain streams which are lighted by the sun's rays for only a few hours each day, though it ascends periodically through the forest gloom to the sun-lit mountain slopes." Dunkle (2000) found it at "Mountain streams edged with grass in the oak or pine zone, up to about 6000 ft." Females oviposit on boulders in the middle of creeks. Needham, et al stated, "A southwestern species of desert canyons, most often along partially shaded streams." The larva is unknown.

Bick listed the species as "rare", and Dunkle (2000) noted that it was "uncommon". Without any known threat in a range of low human population, *A. persephone* is considered RARE, (G3). There is a black and white photograph of a male in ARGIA 8(1): 20, April 1, 1996.

County Records:

ARIZONA: Cochise, Coconino, Graham, Maricopa, Pima, Santa Cruz, Yavapai
COLORADO: Mesa
NEW MEXICO: Catron, Grant, Lincoln;
UTAH: Kane.
Also Nayarit, Mexico

GOMPHUS CONSANGUIS SELYS, 1879
CHEROKEE CLUBTAIL

Needham, et al (2000) recorded this Clubtail from AL, GA, NC, TN, and VA. In AL it is found only in the northeast part of the state (Louton, 1982; Tennesen, et al, 1995). The habitat in AL is "small, second order streams, partly wooded (Tennesen, et al, 1995) and "spring-fed moderately flowing forest streams especially where they drain small ponds" (Dunkle, 2000).

Carle (1979) found this species "endangered" in VA; Cook thought it was "threatened" (Bick); and FWS was considering that status (Donnelly, 1989; 1993a). But "endangered" is no longer appropriate after Roble (1995) reported the species in seven new VA counties. Bick, Dunkle, and Tennesen, et al all listed *G. consanguis* as RARE which is appropriate, (G3).

County Records:

ALABAMA: Blount, Saint Clair;
GEORGIA: Chattooga, Walker;
NORTH CAROLINA: Burke, Davie;
TENNESSEE: Sullivan;
VIRGINIA: Russell, Scott, Washington

GOMPHUS DIMINUTUS NEEDHAM, 1950
DIMINUTIVE CLUBTAIL

The Diminutive Clubtail is recorded (Needham, et al) from a small, primarily Piedmont area (Dunkle, pers. comm.) in GA, NC, SC, and TN. In SC it is found only in two counties distant from each other, and there are no TN records (Donnelly, pers. comm.). Carle and May (1987) gave the habitat as sandy lakes and boggy ponds, with the flight season extending from April 5 to May 23. Dunkle (2000) stated that it likes "Boggy trickles, slow, small streams, and lakes, all with part sand, part silt bottoms, and sphagnum moss margins."

Bick recorded it as "rare"; Dunkle, as "uncommon". Because there seems to be no definite threat, this scarce species of the foothills is designated RARE, (G3).

County Records:

GEORGIA: Richmond;
NORTH CAROLINA: Bladen, Cumberland, Harnett, Hoke, Montgomery, Moore, Richmond, Scotland;
SOUTH CAROLINA: Barnwell, Chesterfield

GOMPHUS SANDRIUS TENNESSEN, 1983
TENNESSEE CLUBTAIL

Tennesen (1994a) in his report to FWS gave details of distribution, habitat, conservation for this critically imperiled species. He recorded it only from a 60 sq. mi. area in south central TN at six small streams flowing into the Duck River of the Tennessee drainage, and his further search at nearby likely streams was negative. The occupied range of *G. sandrius* is very small, approaching that of *G. westfalli*, which seems to have the smallest range of any U.S. Anisoptera. Only a brief summary of Tennesen's habitat data can be given here. The species occupies third order streams, 10 - 60 ft. wide, with a highly variable rate of flow, and with bottoms a mix of small gravel and sand; silt, mud, organic debris are minor. Two years are required from egg to adult, and egg laying probably lasts 3-4 weeks. Dunkle (2000) stated that it inhabits "slow streams with bare bedrock shores." Needham, et al

noted that it is found "along shallow streams of moderate gradient, flowing over exposed bedrock." Tennesen stated that all six localities are surrounded by private lands which are essentially cattle pastures. "Cattle enter the streams . . . disturbing substrates, and dropping wastes. Runoff . . . contributes organic loading and possibly agricultural chemicals." At one point discarded garbage and dead animals were being thrown into one of the streams. No management plans are formally operative; for their formulation, Tennesen urged cooperation with land owners, habitat restoration, and regular Odonata surveys. Without any protected sites in an extremely small total range, threatened by agricultural pollution, and with seemingly declining populations, this "local (Dunkle) species is rated CRITICALLY IMPERILED, (G1).

County Records:

ALABAMA: Colbert;
TENNESSEE: Bedford, Marshall, Maury,
Rutherford, Wilson

GOMPHUS SEPTIMA WESTFALL, 1956
SEPTIMA'S CLUBTAIL

Gomphus septima, described originally from specimens collected in northwestern AL, had not been reported from that state in 62 years and was judged to be extirpated (Krotzer, 2002; Paulson and Dunkle, 1999; Tennesen, et al, 1995). Then surprisingly, Krotzer collected several males and females in AL on May 5, 2002. Needham, et al listed AL, GA, NC, SC, VA (based on a sight record by Carle) and a second subspecies in NJ, NY, PA. Dunkle (2000) stated that it occurs in "AL to NY, mostly NC." Roble (pers. comm.) could not confirm the species in VA. GA and SC records were not verified (Donnelly, pers. comm.). But NC records are substantial (Donnelly and Carle, 2000; Dunkle, 1984, 2000; Kondratieff, 2002). Donnelly and Carle (2002) described *G. s. delawarensis* from the Upper Delaware River in NJ, NY, PA. Thus, the species is known from AL and NC, and also, with a gap of more than 600 km, from NJ, NY, and PA. Tennesen, et al (1995) recorded the species from "medium to large rocky rivers." Dunkle (2000) stated, "Clean, rocky rivers. . . . Away from water perches mostly on the ground or flat on low leaves in fields or sunny spots in forest, but sometimes in trees. Males perch warily on rocks in or near riffles. . . ." Donnelly and Carle noted the "apparent requirement of this species for clean, rocky rivers with muddy and silty reaches. . . ."

G. s. delawarensis

This subspecies was described from approximately 65 males, eight females collected along the Upper Delaware River in three NJ counties, two in NY, one in PA. The describers recorded that during a 20-day period in 1994 at least 42 males, seven females were taken at the River. Also, many exuviae have been collected from the same general area. In all, 21-100 sites are estimated. Additionally, sections of the River with the largest number of sites or occurrences are protected by the National Park Service (Donnelly and Carle). This subspecies, without threat and present at more than 21 sites is rated as RARE, (G3).

County Records:

NEW JERSEY: Mercer, Sussex, Warren;
NEW YORK: Delaware, Orange, Sullivan;
PENNSYLVANIA: Pike, Wayne

G. s. septima

This subspecies is much less abundant and more poorly known than *G. s. delawarensis*. The nominate taxon is recorded only from AL and NC; and in AL only from two counties: Tuscaloosa, the type locality (Paulson and Dunkle), and from adjacent Bibb (Krotzer). In NC, it is reported from 10 counties. This taxon is known from two states, 12 counties and from an estimate of fewer than 20 locations. These meager numbers are from two states where collecting has been very thorough, probably the most exhaustive in the U.S. Donnelly, (1989, 1993a).

Orr (1992) noted that FWS was considering "endangered" or "threatened" status; Tennesen, et al gave "rare" for AL; Dunkle assigned the general rating "rare"; and Bick stated that it is one of the scarcest odonates in the U.S. Because individuals of this taxon have been reported at so few sites, because the subspecies has been lost to a dam at the type locality, and because of the scarcity and general degradation of large, clean, rocky rivers, the rating IMPERILED is given to *G. s. septima*, (G1).

County Records:

ALABAMA: Bibb, Tuscaloosa;
NORTH CAROLINA: Chatham, Cumberland,
Durham, Harnett, Lee, Moore, Orange, Richmond,
Stanly, Union;
VIRGINIA: Lunenburg (sight), Nottoway (sight)

GOMPHUS WESTFALLI CARLE and MAY,
1987 WESTFALL'S CLUBTAIL

This Clubtail is known only from two FL counties: the type locality, Santa Rosa County, Blackwater State Forest, near Holt (Carle & May, Paulson & Dunkle, 1999); and from Eglin Air Force Base in Okaloosa County (Donnelly, pers. comm.) "*Gomphus westfalli* inhabits clean acidic streams and small lakes of the Blackwater River drainage in northwestern Florida. . . . The region is characterized by low sand-hills covered with pine forests, and aquatic habitats in which sphagnum and other typically acid-adapted bog vegetation such as pitcher plants are prevalent. Nymphs of *G. westfalli* are found in the fine silts which overlie the sand bottoms of small streams and spring fed lakes. The known flight season extends from March 10 to April 18 (Carle and May, 1987). Dunkle (2000) stated, "Boggy streams and seepages with muck-bottomed pools." Carle and May wrote: "*G. westfalli*, in particular, is in greater jeopardy than previously believed; although the insect is locally abundant the entire known range is encompassed within a radius of a few kilometers . . . at present the future of the species must be considered highly uncertain." The total range of this species is very likely the smallest of any U.S. Anisoptera.

Dunkle listed the species as "local". This Clubtail, known from only two FL counties at fewer than 20 sites, was considered in jeopardy by the describers. Any disturbance, even a small fire, would be disastrous to this CRITICALLY IMPERILED species, (G1). An intensive survey of Santa Rosa County and vicinity is needed to accurately map the range limits, detail the habitat, and search for new sites and specific threats, (G1).

County Records:
FLORIDA: Okaloosa, Santa Rosa

***OPHIOGOMPHUS ACUMINATUS* CARLE, 1981 ACUMINATE SNAKETAILED**

Tennessee's (1994a) report is critical for a consideration of the biology and conservation of this species. The distribution essentially is a north-south band of nine counties across western TN, in northwestern AL, one county, and questionably in two southeastern KY counties (Tennessee). Carle (1981) described the habitat as sparse gravel pockets in fissures of a rocky stream bed. Tennessee stated, "The species has been found only in second-order streams that are mostly shaded, with relatively stable substrates and riffle areas . . . It appears that pea-sized and finer gravel is a very

important component Adults require trees for shelter and perch sites." For AL, Tennessee et al (1995) stated that it inhabits small or medium-sized second order undisturbed wooded streams with gravel riffles. Needham, et al wrote that larvae were found "principally in pockets of gravel or coarse sand in clear bedrock streams," and Dunkle (2000) stated that it lives in "Clear, mostly shaded streams with sandy gravel bottoms."

Bick gave a general rating "rare"; Dunkle, recorded it as "uncommon"; and Tennessee et al listed it "rare" in AL. Tennessee considered that logging, agriculture, and mining are major threats, but that the species was not in jeopardy in 1994. It is recorded (Tennessee) from 31 sites, *O. acuminatus* should continue to be listed as RARE, (G3).

County Records
ALABAMA: Colbert;
KENTUCKY: Cumberland, Metcalfe, Monroe;
TENNESSEE: Dickson, Hardin, Hickman,
Houston, Lawrence, Lewis, Perry, Sumner, Wayne

***OPHIOGOMPHUS ARIZONICUS* KENNEDY, 1917 ARIZONA SNAKETAILED**

This "extremely local" species (Michalski, 1995) is recorded (Needham, et al) only for AZ and NM; in AZ it is found only in five scattered counties (Dunkle, 1976; Kennedy, 1917; FSCA collection); and in NM only in the southwestern corner. Dunkle (1976) described the larva, which were collected in clear streams with exposed rocks and gentle rapids, and, in 2000 stated that it lives in "Mountain streams with rocks and silt-bottomed pools, constantly flowing but not torrential. . . . They prefer the wider, shallow, and silted pools."

Bick noted that it was protected by its occurrence in national forests and monuments and listed this Snaketail as "rare" while Dunkle listed it as "local". This species, from only two states and four counties, may be imperiled, but because it is so poorly known, status UNCERTAIN is assigned, (GU). There is a black and white photograph of a male in *ARGIA* 8(1): 20, April 1, 1996.

County Records:
ARIZONA: Apache, Cochise, Coconino, Gila, Greenlee;
NEW MEXICO: Catron, Grant

***OPHIOGOMPHUS AUSTRALIS* CARLE, 1992 SOUTHERN SNAKETAILED**

The Southern Snaketail is recorded (Needham, et al) only from LA and MS; in LA just from two south-easternmost parishes; in MS from one county immediately northward (Carle, 1992; Mauffray, 1997a). Much earlier, Bick had collected larvae from the Tangipahoa River which was wide, swiftly flowing shallow, clear, completely covered with gravel and devoid of vegetation. Carle stated that "Larvae were most often collected from pea-sized gravel in 10-20 cm of water, with areas at the tail of riffles being the most productive. The Tangipahoa River averages less than 10 m wide at the type locality and a few pools reach a depth of 2 m. The substrate is primarily a mixture of sand and pea-gravel." Dunkle (2000) recorded the species from gravel-bottomed streams, Mauffray stated that a gravel substrate is a must, and Needham, et al noted that it is "restricted to small rivers with a fine gravel substrate."

Carle considered *O. australis* among the rarest of the Odonata; Needham, et al, stated that it is one of the rarest *Ophiogomphus*, and Dunkle designated it "local". Carle found that the pristine nature of the streams was so degraded that the species might be in danger of extinction. Mauffray noted that gravel mining has nearly destroyed the habitat in LA, and stated (pers. comm.) that the species should be considered for "endangered" status. Because the habitat of this species is being rapidly reduced by gravel removal and farm water run-off, it is designated CRITICALLY IMPERILED. A survey of the species in southern MS and the eastern parishes of LA is needed, primarily to search for sites in the Tangipahoa River drainage additional to those at or near the type locality, (G1).

County Records:
LOUISIANA: Tangipahoa, Washington;
MISSISSIPPI: Pike

***OPHIOGOMPHUS EDMUNDO* NEEDHAM,
1951 EDMUND'S SNAKETAIL**

Bick, summarizing the species' early history, concluded that it was probably extinct, and Donnelly (1989) noted that FWS listed it as possibly so. However, it certainly was not extinct as collecting in 1994 showed. Donnelly (1994) and Daigle (1994) reported that Vogt (1995) rediscovered the species and discovered the female. He reported it in detail from two NC counties; Mauffray (1998) gave the basic collection data for two GA counties; and Tennessen and Krotzer

(1998) noted the species without giving details from TN. This once supposedly extinct species is now documented from a small area of the Smoky Mountains, in two counties each of GA, NC, and TN.

The habitat is clear, moderately flowing mountain streams where adults fly over shallow riffles and perch on rocks (Tennessen, 1998a; Dunkle, 2000). Vogt recorded larvae from highly aerated riffles and in the adjacent riparian forest listed: Tulip Tree, Sweetgum, Sycamore, Eastern Hemlock, Alder. Dunkle (1995a) noted that the species spends most of its time in trees, which may help to account for its having eluded collectors for so long. The larva is unknown. Carle (1979, 1981) stated that it is "endangered"; Dunkle (1995a, 2000) considered the species "local", listing it as one of the few Odonates of the world needing special conservation attention judged by IUCN. Vogt listed impoundments, channelization, siltation, and pollution as threats, and suggested that the sewage effluents of the small upstream campgrounds should be monitored for lowering of dissolved oxygen. This sparse species of mountain streams, also threatened by clear cutting and vacation home development (Dunkle, pers. comm.), is rated IMPERILED, (G2). A computer aided graphic of this species by K. Tennessen is on the cover of ARGIA 10 (1), April 25, 1995.

County Records:
GEORGIA: Murray, White,
NORTH CAROLINA: Burke, Caldwell;
TENNESSEE: Bradley, Polk

***PROGOMPHUS BELLEI* KNOPF and
TENNESSEN, 1980
BELLE'S SANDDRAGON**

Needham, et al recorded this species only from FL and NC, but Tennessen, et al (1995) also listed the southwestern corner of AL, and Dunkle's (2000) map shows AL, FL, NC. GA and SC are conspicuous distribution gaps. Tennessen, et al stated that it inhabited "sandy lakes and first order sandy, spring-fed streams." Needham, et al noted that it was found "mainly from small, sandy creeks and ditches and clear sandy lakes in the Florida Panhandle and from clear sandhill lakes in North Carolina." Dunkle (2000) stated that it lives in "Sand-bottomed lakes, or open sandy spring-fed trickles." But Vogt (pers. comm.) found *P. bellei* absent from most sand-bottomed FL lakes.

The species was considered to be "rare" (Bick, Tennessen, et al), and Dunkle designated it "local". This Sanddragon is rated as RARE, (G3). A deliberate search in GA and SC is needed to clarify the apparent hiatus in distribution.

County Records:

ALABAMA: Escambia;
 FLORIDA: Calhoun, Gadsden, Gulf, Leon, Liberty, Santa Rosa, Wakulla;
 NORTH CAROLINA: Bladen

STYLURUS POTULENTUS (NEEDHAM, 1942), YELLOW-SIDED CLUBTAIL

This species, recorded (Needham, et al) only from FL and MS, occurs in a Gulf Coast strip from the western FL Panhandle (Dunkle, 1992) to the Pascagoula drainage in southeastern MS (Bick). Mauffray (1997a) expected it in southeastern-most LA. Dunkle (2000) recorded that it is found in "Pristine, sand-bottomed forest streams and rivers. . . . Beginning about 6 p.m. males patrol beats five yards long over open water . . . a forest species not adapted for flying in the open." Mauffray (pers. comm.) wrote, "at streams 5-10 m wide, too deep for wading, accessible only by canoe, always with overhanging marginal vegetation on which the adults perch. The casual collector will probably never collect this species."

Bick, noting pollution and channelization, rated this Clubtail "vulnerable" and recorded that Cook considered it "rare", as did Dunkle (2000). Within the species' range are military bases, shipyards, seafood processing establishments, vacation homes, and a major interstate highway. Any of these factors could have a detrimental effect on this Clubtail. A survey is needed to locate all sites, and to determine just how the above developments are threatening this species which is rated IMPERILED, (G2).

County Records:

FLORIDA: Calhoun, Santa Rosa;
 MISSISSIPPI: Greene, Jackson, Pearl River, Perry

STYLURUS TOWNESI GLOYD, 1936
 TOWNES' CLUBTAIL

Needham, et al recorded this Clubtail from AL, FL, MS, NC, SC, and TN. Dunkle's (2000) map shows it widespread in GA and present in TN, but Donnelly (pers. comm.) obtained no modern county records for the latter two states. In FL, it is present

only in the Blackwater River drainage (Dunkle, 1992); in AL, just in the two southernmost counties. Bick stated that the habitat for the early collections was streams. Dunkle (2000) noted that it lives in "Clean, sand-bottomed forest streams and rivers . . . Behavior unusual in that males seldom patrol, and females stay near water even when not mating or egg laying."

Dunkle and Westfall (1982) stated that it was "rare" in FL, as did Bick for the U.S.; FWS was considering "endangered" or "threatened" (Orr, 1992; Donnelly, 1993a); Tennessen, et al noted that there are very few populations in the eastern U.S., and Dunkle rated *S. townesi* as "scarce". Without recorded threat and present in at least five states, this southeastern species is rated RARE (G3). *S. townesi*, *S. potulentus*, *G. westfalli*, all in the FL Blackwater River drainage, make this an important conservation area.

County Records:

ALABAMA: Escambia, Mobile;
 FLORIDA: Okaloosa, FL, Santa Rosa;
 MISSISSIPPI: Wayne;
 NORTH CAROLINA: Columbus, Robeson;
 SOUTH CAROLINA: Greenville

CORDULEGASTER SAYI SELYS, 1854 SAY'S SPIKETAIL

Say's Spiketail is recorded only from FL and adjacent southeastern GA. Mauffray (1995a, b; 1997b) detailed distribution when he announced discovering new locations which brought the total number of sites to an estimated 20. The largest population is in the Jennings State Forest, a protected area southwest of Jacksonville, FL. The essentials of the habitat are silt-bottomed trickles in hardwood forest with weedy fields nearby (Dunkle and Westfall, 1982; Dunkle, 1992, 2000). Mauffray (1997b) stated that *C. sayi* flies no more than a mile from the breeding site, and will be found throughout a strip from Eustis, FL, to Aiken, SC, wherever hardwood seeps are associated with turkey oak sand hills.

Dunkle and Westfall considered the species "threatened" in FL, and Bick stated that it was endangered by one housing development in the city of Gainesville. Dunkle (1995a) reported that IUCN selected this Spiketail as one of only 17 species world-wide that required special conservation attention; and in 2000 he noted the species as "local". Mauffray's reports listed protected areas

harboring *C. sayi* populations. Thus, the safety of the species is assured at least at these locations: Camp Blanding, Fort Stewart, Jennings State Forest, Eglin Air Force Base, and Goldhead and Torreya State Parks. At Possum Creek in Gainesville, a clear threat is upscale housing and attendant landscaping, in places to the creek margin. Even though the *C. sayi* population there is becoming more and more acutely "endangered" (Mauffray, pers. comm.), the species may be safeguarded by newly discovered populations, and by the sanctuary of quite a few protected areas. Also, as yet undiscovered populations are expected across a large area of suitable range (Mauffray, 1997b). This species with an estimated 20 locations, many protected; with new populations expected, and without range-wide threat is rated, RARE (G3).

County Records:

FLORIDA: Alachua, Clay, Columbia, Liberty, Okaloosa, Santa Rosa, Walton;
 GEORGIA: Coffee, Emanuel, Evans, Liberty, Tattnall, Toombs, Wayne

MACROMIA MARGARITA WESTFALL, 1947
 MOUNTAIN RIVER CRUISER

This species of the southern Appalachian Mountains occurs in GA, NC, SC, TN, and VA (Needham, et al); Tennessen added AL (Donnelly, pers. comm.); and Bick summarized the early collections. Dunkle (2000) gave the habitat as "Clean mountain or Piedmont streams and rivers." Daigle (1994) noted that adults flew too high and fast to catch, while Vogt (1995) included this River Cruiser at NC sites with *Ophiogomphus edmundo*.

Carle (1979) found *M. margarita* "endangered"; Bick stated "rare"; Orr (1992), Donnelly (1993a) recorded that FWS was considering "endangered" or "threatened"; and Cook (pers. comm.) judged the species to be "rare", noting (1992) that it was missing in his collection. This "local" (Dunkle) and difficult-to-capture species of southeastern mountain streams, is rated RARE, (G3).

County Records:

ALABAMA: Lauderdale, Marion
 GEORGIA: Lumpkin;
 NORTH CAROLINA: Burke, Caldwell, Cleveland, Davie, Franklin, Granville, Iredell, Macon, Transylvania;
 SOUTH CAROLINA: Pickens;
 TENNESSEE: Blount, Campbell, Hardin, Lewis;
 VIRGINIA: Floyd

SOMATOCHLORA CALVERTI WILLIAMSON
 and GLOYD, 1933
 CALVERT'S EMERALD

This Emerald is recorded (Needham, et al) from AL, FL, SC; it is found primarily in the FL Panhandle and southeastern AL, hardly reaching SC (Dunkle, 1992, 2000); Donnelly (pers. comm.); Tennessen, et al (1995). Dunkle's map shows a thin line across central GA but Donnelly did not confirm that location. Dunkle (2000) stated, "Larval habitat unknown. Probably boggy forest seepages."

Range-wide, Bick, Needham, et al rated the species as "rare"; Dunkle as "uncommon"; and Tennessen, et al listed it as "rare" in AL. This very restricted Emerald, without threat, is considered RARE,(G3). A search of central GA is needed to determine if Dunkle's implied presence there can be supported by specimens from specific localities.

County Records:

ALABAMA: Covington;
 FLORIDA: Franklin, Gadsden, Glades, Jefferson, Leon, Liberty, Okaloosa;
 SOUTH CAROLINA: Allendale

SOMATOCHLORA HINEANA WILLIAMSON,
 1931 HINE'S EMERALD

This much discussed Emerald is listed (Needham, et al) from: AL, IL, IN, MI, MO, OH, WI, but recent attempts to confirm AL, IN, OH have been unsuccessful (Cashatt and Vogt, 2001; Glotzhofer, 1995; Tennessen, 1994; Vogt and Cashatt, 1994). The global distribution, in brief, is limited to four states, IL, MI, MO, and WI, with nine counties and 33 sites (Cashatt, 1999). Habitat information, including chemical detail and adult behavior is given by Cashatt, 2000; Cashatt and Vogt, O'Brien, 2000; Vogt and Cashatt. Unifying habitat features are: shallow wet lands overlying dolomitic limestone bedrock; calcareous water from intermittent seeps, shallow small channels and/or sheetflow. The vegetation is predominantly herbaceous, usually including *Typha*, *Acorus*, and *Carex*, always with forests or shrubs nearby. Water, never acid, varies from pH 7.0 to 8.3. The larvae use burrows of the crayfish, *Cambarus diogenes* during drought and when over wintering (Cashatt and Vogt; O'Brien). When the bogs dry, the Emeralds survive in the burrows where, strangely, they are not eaten (Donnelly, pers. comm.).

Bick, Carle (pers. comm.) listed this species "endangered", and Dunkle considered it "local". "It was listed as Endangered by the United States Fish and Wildlife Services in 1995 (Federal Register 60# 17: 5267-5272) because of its narrow ecological requirements and vulnerability to habitat degradation and destruction" (Cashatt&Vogt). This is the first and only Odonata to be formally assigned such status by the U.S. Government (Cashatt; Daigle, 1995; Needham, et al).

A workshop was held July 12-14, 2000, in Door County, WI to help field biologists recognize *S. hineana* and its habitat (Cashatt). Many adults were seen; 46 were captured in four hours, marked and released for a population study. The large numbers seen and many collected for marking caused some participants to question the Emerald's "endangered" status. Their challenge is justified. O'Brien stated that he had never collected "that many *Somatochloras* of all species TOTAL." Such abundance suggests a secure common species. Moreover, 33 sites (Cashatt) is far too many to qualify the species for critically imperiled (G1) rank; so many sites require that this Emerald be rated as RARE (G3). Also, it occurs in four states; every other species listed herein as G1 is in only one or two states. Anecdotal information suggested a G2 or G3 rating, not G1. With concern, *S. hineana* is rated G3. This is the second of three formerly critically imperiled "flagship" species to be downgraded to G3. A color photograph of this species by T. Cashatt is on the cover of ARGIA 11 (3), Oct. 20, 1999.

County Records:

ALABAMA: Jackson;

ILLINOIS: Cook, Du Page, Will;

INDIANA: Lake;

MICHIGAN: Alpena, Mackinac, Presque Isle;

MISSOURI, Iron, Phelps, Reynolds, Ripley, Shannon, Wayne;

OHIO: Logan, Lucas, Williams;

WISCONSIN: Door, Kewaunee, Ozaukee

SOMATOCHLORA MARGARITA

DONNELLY, 1962 TEXAS EMERALD

The Texas Emerald occurs only in LA and TX (Needham, et al); in LA, just from the Northern Pinelands and the southern part of the Alluvial Area (Dunkle, pers. comm.; Mauffray, 1997a); in TX it is found only in the Longleaf - Loblolly Pine Forest of the eastern part of the state (Abbott, 2001a). The

LA localities are distantly separated, suggesting that the species may be more widespread in the state. Donnelly (1962) described the type locality in TX as low, gently rolling with clear, sandy streams, not conspicuously colored by tannin. Needham, et al stated that this Emerald is characteristic of sandy pinelands. Dunkle (2000) recorded the habitat as "probably forest seepages . . ." and that adults "usually fly near treetops."

Bick listed the species as "rare"; FWS considered it "endangered" or "threatened" (Donnelly, 1993a); and Abbott, et al (1997) noted it as a "species of special concern" in TX. Dunkle listed *S. margarita* as "local"; and Abbott (2001a) has it as "uncommon". With an estimate of only seven localities, this Emerald is rated IMPERILED, (G2). More information on habitat and an accurate count of localities are needed.

County Records:

LOUISIANA: Bienville;

TEXAS: Anderson, Hardin, Montgomery, San Augustine, San Jacinto

SOMATOCHLORA OZARKENSIS BIRD, 1933
OZARK EMERALD

Needham, et al listed the Ozark Emerald from: AR, KS, MO, OK, and TX. However, neither Dunkle (2000) nor Abbott (2001a) recorded it from TX. Beckemeyer (1995) reported it in KS only from the southeastern corner of the state. The type series was collected at a creek with frequent rapids over rounded sandstone boulders bordered by a fringe of willows (Bird, 1933). Dunkle stated that it lives at highland forest streams; and Needham et al, recorded it at woodland streams of the Ozark Plateau.

Bick noted one anomalous record from a stock pond and rated the species as "rare", while Dunkle considered it "uncommon". Without threat, and recorded from at least four states, the rating RARE is again assigned, (G3). Much more information on habitat and a count of localities is needed.

County Records:

ARKANSAS: Calhoun, Crawford, Franklin, Garland, Johnson, Montgomery, Nevada, Perry, Pike, Saline, Sharp, Van Buren, Washington;

KANSAS; Riley, Woodson;

MISSOURI; Crawford, Dent, Iron, Maries, Reynolds, Shannon, Taney;

OKLAHOMA; Latimer, Le Flore, Osage

WILLIAMSONIA LINTNERI (HAGEN IN
SELYS, 1878)
RINGED BOGHAUNTER

Needham, et al recorded this species from: CT, ME, MA, MI, NH, NJ, NY, RI, and WI. In NY, there is only an historic record from Albany County (Donnelly, 1992), and there is no reproducing population in NJ (May and Carle, 1996). Before the species was found in MI and WI, Carpenter (1993) recorded it from "fewer than 30 recent sites globally." Subsequently the species was collected in north central MI (O'Brien, 1999; Ross and O'Brien, 1999) and in central WI (Carpenter and Legler, 1998; Vogt and Purdue, 1999). A very recent record from the Upper Peninsula of MI was reported by Chartier (2003). These two Great Lakes states are far west of the historical western range limit. But Legler (in Carpenter and Legler, 1998) stated, "I can imagine *lintneri* existing here and there between Wisconsin and New England, undetected because it's rare, occurs in low numbers, and has a very early flight period. . . ." Carpenter (1993) summarized the habitat as "cold, acid sphagnum bogs / fens with surrounding Atlantic White Cedar in the south or Black Spruce in the north." Wagner and Thomas (1999) stated, "Breeding occurs in soupy sphagnum pools free of fish." Dunkle (2000) recorded the habitat as "shallow bog pools and acid fens, often with wiry or three-way sedges (*Dulichium*), not overgrown with bushes, but near Atlantic white cedar, black spruce, larch or other forests." He also stated that this Boghaunter is "the earliest non-migratory dragonfly in its range," and that "males are not territorial." Vogt and Purdue found the habitat similar in WI and New England, and noted, "Any poor fen that has abundant, submerged sphagnum sp., is dominated by the wire sedge *Carex oligosperma*, and has the dragonfly *Leucorrhinia hudsonica* in abundance, should be viewed a potential *Williamsonia* habitat." Finally, O'Brien stated that in MI, *W. lintneri* is an early season bog obligate species.

Bick rated *W. lintneri* as "vulnerable"; Orr (1982) listed it as one of 11 northeastern species being considered for "endangered" or "threatened" status by FWS; and Donnelly (1992) noted that it had not been found in NY since the original capture. After the species was found in MI and WI, Carpenter (1993, 2000) increased the number of localities globally from fewer than 30 to 50; and stated that the species should be a candidate for "endangered" status. In CT, Wagner & Thomas (1998) stated that

this Boghaunter is "rare", "local", "critically imperiled"; and Dunkle generalized that it is "local". Prior to 1998, the species was quite generally considered to be "endangered" in its very limited range in the northeastern megalopolis. Then the species' east-west limits became ME to WI, a very wide range wherein new populations can be expected. Extinction across this very broad area is most unlikely; so, by definition, neither "endangered" nor "vulnerable" should be assigned. Brown (2001) recorded that an established RI population more than doubled between 2000 and 2001, and that three new RI populations were found. Thus, there have been range extensions, discovery of new populations, and intrapopulation increase. Also, the apparent rarity of adults results from the early flight season; unless collecting is unusually early, the Ringed Boghaunter will not be found (Vogt and Purdue). The latter two considered ditching and "mossing" were potential threats. They suggested that a 50 m. wide surrounding ring of woodland left uncut may be sufficient protection. Without significant range-wide threat, with as many as 50 sites (Carpenter, 2000), *W. lintneri* is considered RARE, (G3). A color photograph of this species by T. Donnelly is on the cover of ARGIA 11(3), June 15, 1999 and again 15(1), April 5, 2003

County Records:

CONNECTICUT: New London, Windham;
MASSACHUSETTS: Essex, Middlesex, Norfolk,
Plymouth, Suffolk, Worcester;
MAINE: Oxford, York;
MICHIGAN: Chippewa, Kent, Mecosta;
NEW HAMPSHIRE: Hillsborough, Strafford;
NEW JERSEY: Bergen, Passaic;
NEW YORK: Albany (historic);
RHODE ISLAND: Kent, Newport, Providence,
Washington;
WISCONSIN: Adams, Jackson, Juneau

LIBELLULA JESSEANA WILLIAMSON, 1922
PURPLE SKIMMER

Bick listed this Skimmer as insufficiently known, questioning its validity as a good species. It now has become quite generally considered valid without qualification (Garrison, 1977; Paulson and Dunkle, 1999; Dunkle, 2000). The species is recorded only from FL (Needham, et al), where Dunkle (1992) listed it from ten counties both in the Panhandle west to Washington County and in the Peninsula south to Palm Beach. Many specimens have been collected from lakes in Goldhead State

Park, Clay County, where one lake bears the ecologically significant sign, "Old and Fragile." Dunkle (2000) summarized the habitat, "Clear-water, sand - bottomed lakes and ponds edged with maiden-cane grass and Saint-John's-Wort bushes. It requires the most infertile lakes with the sparsest grass. Probably very susceptible to fertilization, eutrophication, and pollution of its native lakes, whereupon it would be replaced by the common Golden-Winged Skimmer." Indeed, Dunkle (1992) stated directly that *L. jesseana* is susceptible to extirpation by eutrophication. Ultimate extirpation is inevitable over the long course of time even at the protected lakes. But this species is more immediately IMPERILED at some unprotected ones where eutrophication is speeded by grazing animals, agricultural chemicals, and the withdrawal of lake water for irrigation. A statewide status survey is needed to pinpoint the dangers at the numerous FL lakes additional to those in Goldhead State Park, (G2).

County Records:

FLORIDA: Bay, Clay, Lake, Marion, Orange, Palm Beach, Putnam, Seminole, Volusia, Washington

SUMMARY

1. The foregoing taxa grouped under Natural Heritage ratings are as follows:

Critically imperiled (G1), three: *Gomphus sandrius*, *G. westfalli*, *Ophiogomphus australis*.

Imperiled (G2), six: *Ischura gemina*, *Ophiogomphus edundo*, *Ophiogomphus s. septima*, *Stylurus potulentus*, *Somatochlora margarita*, *Libellula jesseana*.

Rare (G3), 17: *Enallagma pictum*, *E recurvatum*, *Nehalennia pallidula*, *Neoneura aaroni*, *Aeshna persephone*, *Gomphus consanguis*, *G. diminutus*, *G. septima delawarensis*, *Ophiogomphus acuminatus*, *Progomphus bellei*, *Stylurus townesi*, *Cordulegaster sayi*, *Macromia margarita*, *Somatochlora calverti*, *S. hineana*, *S. ozarkensis*, *Williamsonia lintneri*.

Status uncertain (GU), 1: *Ophiogomphus arizonicus*.

2. Three formerly "flagship" imperiled species, *Cordulegaster sayi*, *Somatochlora hineana*, *Williamsonia lintneri*, no longer in jeopardy

throughout their ranges, are downgraded to G3, rare.

3. The foregoing Anisoptera assigned to Dunkle's (2000, p.17) abundance categories are:

Local (12): *Gomphus sandrius*, *G. westfalli*, *Ophiogomphus arizonicus*, *O. australis*, *O. edundo*, *Progomphus bellei*, *Cordulegaster sayi*, *Macromia margarita*, *Somatochlora hineana*, *S. margarita*, *Williamsonia lintneri*, *Libellula jesseana*.

Uncommon (5): *Aeshna persephone*, *Gomphus diminutus*, *Ophiogomphus acuminatus*, *Somatochlora calverti*, *S. ozarkensis*.

Rare (3): *Gomphus consanguis*, *G. septima*, *Stylurus potulentus*.

Scarce (1): *Stylurus townesi*.

The North American distributions for the foregoing taxa are mostly (20 of 27) southeastern U.S. (Needham, et al, fig.561). Two areas of great conservation significance (Bick) and their at risk species are:

(a) Gulf Coast strip from southeastern LA to the western FL Panhandle counties, *Gomphus westfalli*, *Stylurus potulentus*, *S. townesi*, *Ophiogomphus australis*, *Somatochlora calverti*;

(b) Southeastern Highlands, northeastern AL to southwestern VA, *Gomphus consanguis*, *G. diminutus*, *Ophiogomphus edundo*, *Macromia margarita*.

Gomphidae with 13 species far outnumbers all other families and subfamilies in at-risk species with Corduliinae (5) and Coenagrionidae (4) far behind; each of five other units had only one species.

6. The most frequent habitat for the foregoing taxa is flowing streams (15 taxa), with ponds, lakes (5), and seeps, bogs/fens (5) far behind. Only two taxa occur in both streams and lakes.

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DESCRIPTION OF THE LAST LARVAL INSTAR OF *ISCHNURA FLUVIATILIS* SELYS (COENAGRIONIDAE)¹

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ABSTRACT

The last larval instar of *Ischnura fluviatilis* Selys is described and compared with the species distributed in South America which larvae are known, i.e., *I. capreola* (Hagen) and *I. ramburii* (Selys). In addition, a modification of the Westfall & May (1996, Damselflies of North America, Scientific Publ.) larval key is proposed.

INTRODUCTION

The cosmopolitan genus *Ischnura* Charpentier is represented in the Neotropical region by 12 species; eight of these are recorded in South America, and five are endemic, i.e., *I. cruzi* De Marmels, *I. fluviatilis* Selys, *I. indivisa* (Ris), *I. sobrina* Schmidt and *I. ultima* Ris. *Ischnura fluviatilis* is distributed throughout South America from Venezuela and Ecuador to northern Patagonia (Daigle et al., 1997; De Marmels, 1990; Muzón, 1995; Muzón & von Ellenrieder, 1998; Paulson, 1977). In Argentina it is a common species except in the Andean range, where it is replaced by *I. ultima*, and in Patagonia where it occurs only in the northern boundary (Rio Negro province). In the Paraná River watershed it is sympatric with *I. capreola* (Hagen), being abundant mainly in lentic and temporary limnotopes. Larvae of *Ischnura fluviatilis* were subject of mosquito control studies in Argentina and Bolivia (Campos, 1994; Lien & Tsai, 1986).

From the 12 species recorded in the Neotropics only the last larval instar of *Ischnura capreola*, *I. cervula* Selys, *I. denticollis* (Burmeister), *I. hastata* (Say), *I. posita* (Hagen) and *I. ramburii* (Selys) (Geijskes, 1941; Santos, 1988; Westfall & May, 1996) are known.

The objective of this contribution is to give a description of the last larval instar of *Ischnura fluviatilis* Selys from reared specimens collected in the Argentinean provinces of Buenos Aires and

Salta, and, considering that all known American *Ischnura* larvae are included in Westfall & May (1996) Nearctic key, to propose their inclusion there.

MATERIAL

Exuvia: Argentina, Buenos Aires province: La Plata, El Pescado stream at provincial route 11, 5-10-1989, col. Aguirre & Muzón, 5 ♂♂ 2 ♀♀; Punta Lara, 34°47'03"S 58°00'29"W, 8-9-1997, col. von Ellenrieder & Perez Goodwyn, 1 ♂ 1 ♀; Punta Indio, stream at prov. route 11, km 223, 35°20'35"S 57°11'03"W, 25-11-1998, col. von Ellenrieder & Muzón, 4 ♂♂ 3 ♀♀; La Plata, Los Talas, 3-12-1997, col. von Ellenrieder, 2 ♀♀; Salta province: Dique Campo Alegre, 24°34'46"S 65°22'04"W, 9-1-1998, col. Perez Goodwyn & von Ellenrieder, 1 ♀; same data except 10-4-1996, 1 ♂. The specimens were all reared in laboratory and deposited in the Departamento Científico Entomología, Museo de La Plata.

DESCRIPTION

Head: Broad, widest at the eyes level, lateral margin slightly concave. Hind lobe rounded and slightly prominent, with few setae. Antenna 7-segmented (0.41: 0.82: 1: 0.65: 0.47: 0.41: 0.23). Labium (Fig. 4) triangular, almost as wide as long, reaching caudad to 2nd coxae; median lobe prominent, uncleft, finely serrated; sides of dilated portion with 7-8 setae. Premental setae 4 (22%), 5 (67%) or 6 (11%) on each side, the internal ones shorter. Labial palp with 5 (18%), 6 (76%) or 7 (6%) setae, movable hook slightly curved, as long as 0.76 palp length; anterior margin with end hook well developed, and 3 teeth, the external with 3-4 denticles; inner margin finely serrated. Mandibular formula (Figs. 2-3) (sensu Watson, 1956): L 1234 y ab, R 1234 y a.

Thorax: Prothorax and pterothorax without dark pattern. Wing pads reaching the anterior margin of

¹ Bulletin of American Odonatology 7(3): 57-60

the 4th abdominal segment. Legs relatively long and pale.

Abdomen: Cylindrical, long and slender; without dark pattern. Dorsal surface of segments with setae uniformly distributed (Fig. 1). Female cerci in lateral view (Fig. 7) slightly slanting downward. Male cerci in lateral view (Fig. 8) strongly slanting downward, dorsal margin sinuous; inner margin in posterolateral view slightly concave (Fig. 9). Gills (Figs. 5-6) narrow, lanceolate with acuminate tips. Nodus not well marked. Dorsal margin of median gill with 26-27 stiff setae, extending about basal 0.34 of gill length; ventral margin with 15-16 setae, extending about 0.22 of gill length. Dorsal margin of lateral gills with 17-16 stiff setae, extending about 0.22 of gill length; ventral margin with 30-32 setae, extending about 0.36 of gill length. Tracheae dark, membrane unpigmented, except for a central dark spot at the nodus level.

Measurements (in mm): Head maximum length 1.66 ± 0.28 ; max. width 3.04 ± 0.28 . Prementum max. length 2.06 ± 0.09 ; max. width 1.66 ± 0.07 . Wingpads length: inner 3.22 ± 1.25 , external 3.4 ± 0.28 ; femora length: I 1.49 ± 0.16 , II 2.13 ± 0.24 , III 2.94 ± 0.27 ; tibiae length: I, 1.73 ± 0.13 ; II, 2.07 ± 0.18 ; III, 2.7 ± 0.17 . Gills length: median 5.33 ± 0.62 ; lateral 5.4 ± 0.55 .

Comments: The description is in agreement with the generic characteristics given by Geijskes (1941) and Westfall & May (1996). The last larval instar of *Ischnura fluviatilis* can be differentiated from *I. capreola* by its mandibular formula (one molar tooth instead of two in the right mandible), dorsal surface of abdominal segments with setae uniformly distributed (confined along apex in *I. capreola*), size (femur III shorter than 2 mm in *I. capreola*, longer than 2.7 mm in *I. fluviatilis*) and gills color pattern; from *I. ramburii* by gill color pattern and ratio of dorsal and ventral series of stiff setae (more than twice in *I. ramburii*, less than twice in *I. fluviatilis*). In order to include *Ischnura fluviatilis* in the larval key proposed by Westfall & May (1996, pag. 450), we propose a modification of the couplet 11, as follows:

11 (9'). Gills usually with 3 to 8 dark crossbands at and beyond the nodus, although sometimes faint and hard to see, especially distally; gills often somewhat stalked, the part proximal to the nodus somewhat narrowed; head width less than 2.9 mm; palpal setae almost always 5; male cerci with medial margins straight or concave and nearly

parallel or divergent downward; eastern
..... *posita*

11' Gills generally with no more than 2 or 3 dark crossbands (occasionally 4 in *I. cervula*); gills always widening gradually from the base; head width usually 2.9 mm or more; often with 6 palpal setae on at least one palpus; male cerci variable but most often with medial margins in posterior view either strongly convex or convergent downward (except *I. verticalis*); mostly western (except *I. verticalis*)..... 12

11". Gills without dark crossbands, occasionally with a central dark spot at nodus level; gills not stalked, lanceolate; head width approximately 3 mm, usually 6 (5 to 7) palpal setae; medial margin of male cerci sinuous; South America, from Venezuela and Ecuador to 42° S in Argentina..... *fluviatilis*

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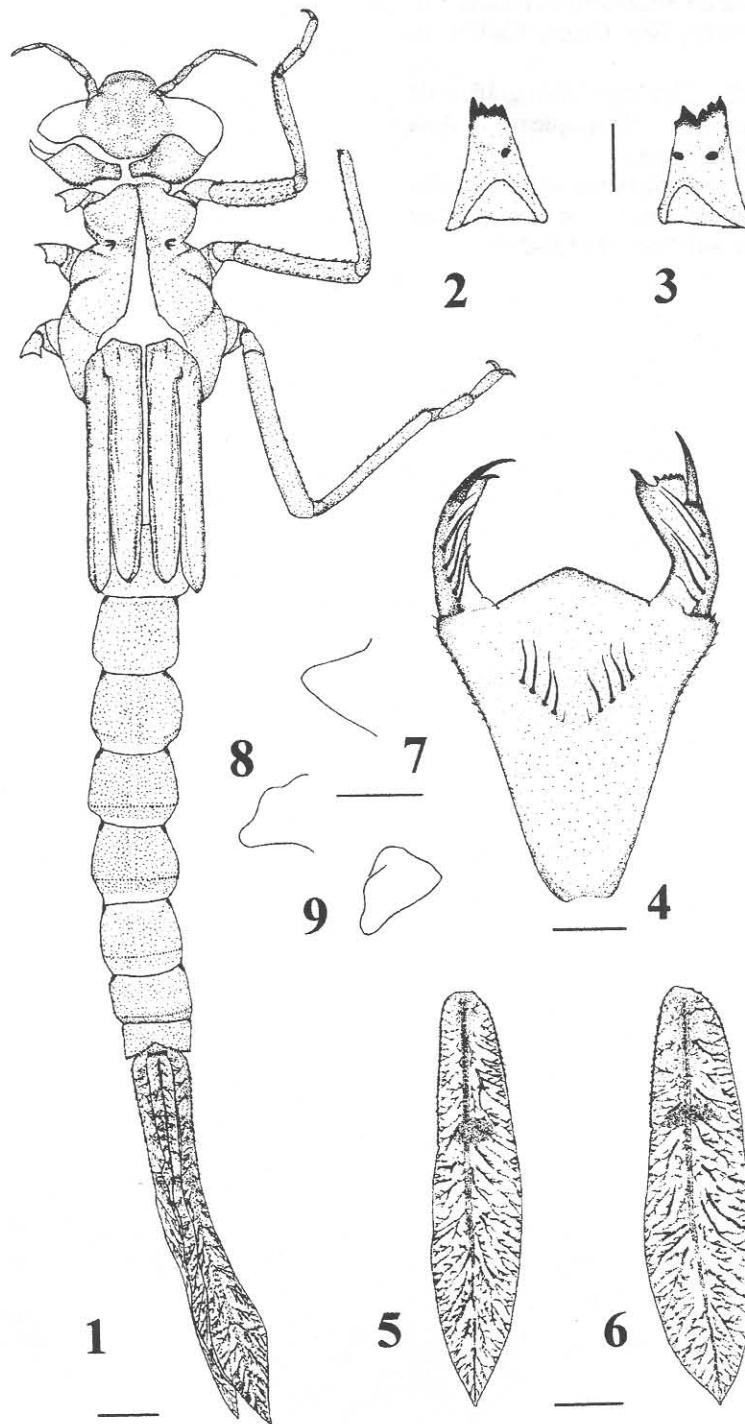


Figure 1-9, *Ischnura fluviatilis* Selys, last larval instar. 1: dorsal view, 2: right mandible, inner view. 3: left mandible, inner view, 4: prementum, dorsal view, 5: median gill, lateral view, 6: lateral gill, lateral view, 7: female cercus, lateral view, 8: male cercus, lateral view, 9: male cercus, posterolateral view. Bars: figs. 1, 5-6, scale: 1 mm, figs. 2-4, scale: 0.5 mm, figs. 7-9, scale: 0.2 mm.

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