

Critical species of Odonata in North America

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ABSTRACT

Of the approximately 439 species of Odonata known from North America, north of Mexico, comments on 25 species (6%) of conservation concern are given. Species deemed to be under the most threat are *Ischnura gemina*, *Gomphus sandrius*, *Ophiogomphus australis*, *Stylurus potulentus*, and *Libellula Jesseana*. Two other species not under threat, *Neurocordulia michaeli* and *Somatochlora brevicincta*, are briefly discussed because of their conservation interest. Some geographical clumping of species under threat is discussed, in southeastern Arizona, coastal New England, and the central Gulf of Mexico Coast.

REGIONAL DEFINITION

Canada and the United States north of the Mexican border, including Alaska but not Hawaii. This is the Nearctic biogeographic realm exclusive of the Mexican Plateau.

STATE OF THE ART

The Nearctic Odonata fauna includes approximately 130 species of Zygoptera and 309 of Anisoptera. North Americans are fortunate in having excellent identification guides for both Zygoptera (Westfall & May 1996) and Anisoptera (Westfall & Tennesen 1996; Needham et al. 2000), supplemented by several field guides such as Dunkle (2000). The recent proliferation of field guides and popular magazine articles, along with the activities of the Dragonfly Society of the Americas and numerous websites, has resulted in many more people looking for odonates in North America. The general result has been the location of many more localities, even for rare species. Eventually, continuing development of the landscape due to human population growth will reverse that trend and result in fewer habitats for odonates, unless suitable habitats are purchased and managed for odonates soon. Comments on species of conservation concern are listed below taxonomically by family, then alphabetically within families. English names accepted by the Dragonfly Society of the Americas are also given in Table 1, for readers who may be more comfortable with those. It was very difficult to decide which species to include in

this list; most species could be listed as ‘data deficient’. Numerous species that barely range into the southernmost USA are not included. While many species of conservation concern have small geographic ranges, some species with small ranges are not included because they seem to be common enough to survive present threats. Examples of such species or subspecies include *Lestes dryas stultus* Hagen, 1861 of California and Oregon; *Zoniagrion exclamationis* (Selys, 1876) endemic to California; *Gomphus crassus* Hagen in Selys, 1878 of the midwestern USA; *Gomphus hodgesi* Needham, 1950 of the central Gulf of Mexico coast; *Ophiogomphus susbehcha* Vogt & Smith, 1993 of the Wisconsin-Minnesota border area; and *Macromia pacifica* Hagen, 1861 of the midwestern USA. Many other species, especially rare river-breeding Gomphidae, could have been mentioned (Carle 1979, 1989). The few known but undescribed species or subspecies of the Nearctic, including one to three *Ophiogomphus* and a *Cordulegaster*, are probably rare but are not listed. Among the references, original descriptions, works published before 1975, and websites are not listed.

The difficulty of deciding which species of North American Odonata are at risk is demonstrated by Bick’s (2003) paper, an update of Bick (1983), that appeared as the present manuscript was being written. Only 16 species in our lists are the same; I discuss 11 species that Bick does not, he lists 10 species that I do not. We do however concur on the species most under threat. Bick’s conservation ratings included the following: ‘critically imperiled - endangered’ or ‘Global Status 1 (G1)’ with 5 or fewer occurrences; ‘imperiled - vulnerable’ or ‘G2’ with 6-20 occurrences and likely to become G1 if present threats continue; and ‘rare’ or ‘G3’ with 21-100 occurrences and a small world population. The 10 species discussed and rated by Bick (2003) that are not discussed in the present paper are:

Neoneura aaroni Calvert, 1903

known from 14 counties of Texas and Nuevo Leon, Mexico, rated ‘rare’.

Nehalennia pallidula Calvert, 1913

known from 12 counties of south Florida and a historic record from Texas, rated ‘rare’.

Aeshna persephone Donnelly, 1961

known from 12 counties in four south-western USA states, and Nayarit, Mexico, rated ‘rare’.

Gomphus diminutus Needham, 1950

known from 11 counties in three south-eastern USA states, rated ‘rare’.

Gomphus septima Westfall, 1956

the nominotypical subspecies is rated ‘imperiled’, known from 12 counties in Alabama and North Carolina; ssp. *delawarensis* Donnelly & Carle, 2000 is rated ‘rare’, known from eight counties of three northeastern USA states, but only from the Delaware River.

Ophiogomphus arizonicus Kennedy, 1917

known from seven counties in Arizona and New Mexico, but given a rating of ‘uncertain’ status.

Progomphus bellei Knopf & Tennesen, 1980

known from nine counties in three southeastern USA states, rated ‘rare’.

Stylurus townesi (Gloyd, 1936)

known from eight counties in five southeastern USA states, rated 'rare'.

Macromia margarita Westfall, 1947

known from 18 counties in six southeastern USA states, rated 'rare'.

Somatochlora ozarkensis Bird, 1933

known from 25 counties in four central USA states, rated 'rare'.

NORTH AMERICAN ODONATA SPECIES OF CONSERVATION CONCERN

Notes on the species previously listed by IUCN

For North America, 32 species or subspecies have been listed in Red Lists of threatened species (IUCN 2003):

as endangered [EN]:

Erpetogomphus lampropeltis ssp. *lampropeltis* Kennedy, 1918; *Gomphus sandrius*; *Gomphurus lynnae*; *Celaenura gemina*; *Ophiogomphus edmundo*; *Somatochlora hineana*

as vulnerable [VU]:

Aeshna persephone; *Gomphurus consanguis*; *Gomphus septima*; *Enallagma recurvatum*; *Libellula Jesseana*; *Nehalennia pallidula*; *Ophiogomphus acuminatus*; *O. howei* Bromley, 1924; *O. incurvatus* ssp. *alleghaniensis* Carle, 1982; *Progomphus bellei*; *Somatochlora margarita*; *Stylurus potulentus*; *S. townesi*; *Williamsonia lintneri*; *Zoraena sayi*

as lower risk [LR] (= least concern):

Calopteryx angustipennis (Selys, 1853); *Gomphurus modestus* Needham, 1942; *Gomphus diminutus*; *G. hodgesi*; *Hylogomphus geminatus*; *H. parvidens* Currie, 1917; *Macromia margarita*; *Ophiogomphus anomalus* Harvey, 1898; *Somatochlora calverti*; *S. incurvata* Walker, 1918; *S. ozarkensis*

Concerning the species listed above four taxonomic changes have been suggested by Needham et al. (2000) and Westfall & May (1996):

Celaenura is now considered a subgenus for *Ischnura* (*Celaenura*) *gemma*.

Hylogomphus is now considered a subgenus for *Gomphus* (*Hylogomphus*) *geminatus*, and *G.* (*Hylogomphus*) *parvidens*.

Gomphurus is now considered a subgenus for *Gomphus* (*Gomphurus*) *consanguis*, *G.* (*Gomphurus*) *lynnae*, and *G.* (*Gomphurus*) *modestus*.

Zoraena is now considered a subgenus for *Cordulegaster* (*Zoraena*) *sayi*.

These should also be noted:

Nehalennia pallidula apparently is common enough to survive present threats.

Aeshna persephone seems to be more common than previously thought.

Erpetogomphus l. lampropeltis, although it has a small range in southern California, seems not to be under any particular present threat, and its foraging habitat was not burned in the massive 2003 fires in the region.

Table 1. Threatened Odonata species in North America, their common names and their distribution.

Family/species	Common name	Distribution
Coenagrionidae	Pond Damsels	
<i>Argia leonorae</i> Garrison, 1994	Leonora's Dancer	S-central USA, NE Mexico
<i>pima</i> Garrison, 1994	Pima Dancer	SE Arizona, Sonora
<i>rhoadsi</i> Calvert, 1902	Golden-winged Dancer	S Texas, NE Mexico
<i>sabino</i> Garrison, 1994	Sabino Dancer	Arizona, W Mexico
<i>Enallagma laterale</i> Morse, 1895	New England Bluet	NE USA coast
<i>pictum</i> Morse, 1895	Scarlet Bluet	NE USA coast
<i>recurvatum</i> Davis, 1913	Pine Barrens Bluet	NE USA coast
<i>Ischnura gemina</i> (Kennedy, 1917)	San Francisco Forktail	W-central California
Gomphidae	Clubtails	
<i>Erpetogomphus heterodon</i> Garrison, 1994	Dashed Ringtail	SW USA, Chihuahua
<i>Comphus consanguis</i> Selys, 1879	Cherokee Clubtail	S Appalachian USA
<i>geminatus</i> Carle, 1979	Twin-striped Clubtail	Florida, Alabama
<i>gonzalezi</i> Dunkle, 1992	Tamaulipan Clubtail	S Texas, NE Mexico
<i>lynnae</i> Paulson, 1983	Columbia Clubtail	Oregon, Washington
<i>sandrius</i> Tennessean, 1983	Tennessee Clubtail	S-central Tennessee
<i>westfalli</i> Carle & May, 1987	Westfall's Clubtail	NW Florida
<i>Ophiogomphus acuminatus</i> Carle, 1981	Acuminate Snaketail	Tennessee area
<i>australis</i> Carle, 1992	Southern Snaketail	NE Louisiana area
<i>edmundo</i> Needham, 1951	Edmund's Snaketail	S Appalachian USA
<i>Stylurus potulentus</i> (Needham, 1942)	Yellow-sided Clubtail	Central Gulf Coast
Cordulegastridae	Spiketails	
<i>Cordulegaster sayi</i> Selys, 1854	Say's Spiketail	N Florida, S Georgia
Corduliidae	Emeralds	
<i>Neurocordulia michaeli</i> Brunelle, 2000	Broad-tailed Shadowdragon	Maine, SE Canada
<i>Somatochlora brevicincta</i> Robert, 1954	Quebec Emerald	Maine, Canada
<i>calverti</i> Williamson & Gloyd, 1933	Calvert's Emerald	SE USA
<i>hineana</i> Williamson, 1931	Hine's Emerald	Midwestern USA
<i>margarita</i> Donnelly, 1962	Texas Emerald	Texas, Louisiana
<i>Williamsonia lintneri</i> (Hagen in Selys, 1878)	Ringed Boghaunter	NE USA
Libellulidae	Skimmers	
<i>Libellula Jesseana</i> Williamson, 1922	Purple Skimmer	Florida

Gomphus septima seems to be common enough to survive present threats.

Ophiogomphus howei, though living in threatened big river habitats, is more widespread than previously believed.

Ophiogomphus incurvatus ssp. *alleghaniensis* has a taxonomic status that needs further resolution.

Progomphus bellei can breed in both streams and lakes if those are sand-bottomed. *Stylurus townesi* seems to be only under the general threat of stream degradation.

Additionally five species were listed as priority species for the North American region by Moore (1997):

as monotypic genera confined to one country (USA) only:

Anomalura prognata Hagen, 1861; *Zoniagrion exclamationis*; *Platycordulia xanthosoma* Williamson, 1908

as taxonomically isolated species:

Tachopteryx thoreyi (Hagen in Selys, 1858); *Tanypteryx hageni* Selys, 1879

Concerning the species listed above by Moore (1997) it should be noted that:

Anomalura is now considered a subgenus of *Ischnura*, and *Platycordulia* is considered a subgenus of *Neurocordulia*.

All five species are not under any particular threat.

Species considered for this paper (Table 1)

*Argia leonora*e

Limited range, now known from one site in New Mexico, 13 in Texas, and from adjacent Nuevo Leon State, Mexico (J. Abbott pers. comm.). Its ecology is now better understood, in that it prefers fen-like stands of low sedges or grass through which a shallow layer of visible clear water flows. A few of its sites are protected, but the major threats to privately owned sites are overgrazing by livestock and drawdown of the water table. The larva has not been described. Not listed by Bick (2003).

Argia pima

Known from Sonora State, Mexico, and a few streams in southeastern Arizona (Hoekstra & Smith 2000), with recent sites found in the Galiuro Mountains east of the San Pedro River (S. Upson pers. comm.). Many populations are small, and fires leading to elimination of feeding habitat, and to even greater than usual scouring of streams during rainstorms, are always a danger. A few of its sites are protected, except from fire. The larva has not been described. Not listed by Bick (2003).

Argia rhoadsi

Known from one extant site in Texas (J. Abbott pers. comm.), and less than 20 sites in six states of northeastern Mexico south to San Luis Potosi. There is an old record, likely from the lower Rio Grande River in south Texas, where this species has probably been extirpated by the effects of agricultural development. Although it has been found primarily at streams, there are also records from temporary ponds. If it does breed in temporary ponds, it is in much less danger than if it is exclusively a stream breeder. Not listed by Bick (2003).

Argia sabino

The ecology of this species is similar to that of *A. pima* in southeastern Arizona (Hoekstra & Smith 2000), but it prefers streams in steeper, rockier mountain canyons and ranges further south, to Jalisco, Mexico. A few of its sites are protected, and recently new sites for it have been found, in the southern Santa Rita Mountains, and in the Atascosa Mountains (S. Upson pers. comm.). It faces some of the same dangers as *A. pima*, especially the effects of fires. The larva has not been described. Not listed by Bick (2003).

Enallagma laterale

Limited range along the heavily developed northeastern USA coast, where it is most common in acidic sand/mud bottomed coastal plain ponds (Shaffer 1985; Carpenter 1991; Nikula et al. 2003). It is listed as a ‘species of special concern’ in Massachusetts. It faces threats common to many species of odonates, such as development, drawdown of the water table, pollution, off-road vehicles in the littoral zone, and motorboats whose wakes drown emerging adults. Not listed by Bick (2003).

Enallagma pictum

Like *E. laterale*, this species has a limited range along the heavily developed northeastern USA coast. *E. pictum* is also found at coastal plain ponds, but it prefers those with water lilies (*Nuphar* and *Nymphaea*). It is generally more rare than *E. laterale*, and is listed as ‘threatened’ in Massachusetts, where it faces the same problems. Bick (2003) listed this species from 30 counties in six states, and rated it ‘rare’.

Enallagma recurvatum

The range and ecology of this species are similar to those of *E. laterale*, but it is even less common while facing the same threats, such as insecticide drift from cranberry bogs. *E. recurvatum* is absent from most apparently suitable sites, and most populations are small. It is listed as ‘threatened’ in Massachusetts. Bick (2003) listed this species from 19 counties in six states, and rated it ‘rare’.

Ischnura gemina

Endemic to a tiny range in the cool foggy coastal climatic area of San Francisco, California, where it breeds in ponds, seepages, and ditches (Garrison 1981;

Garrison & Hafernik 1981a, 1981b; Hafernik & Garrison 1986; Manolis 2003). Urbanization is a double-edged sword for it, in that development eliminates some habitats, but on the other hand periodic clearing of vegetation from overgrown ditches resets ecological succession to an earlier more favorable stage for the species. Unfortunately, it may eventually be bred out of existence by hybridization with the common *I. denticollis* (Burmeister, 1839) (Leong & Hafernik 1992a, 1992b). Bick (2003) listed this species from eight counties, and rated it as 'imperiled'.

Erpetogomphus heterodon

Known from only a few sites in New Mexico, west Texas, and adjacent Chihuahua, Mexico. Overgrazing and forest fires are the most prominent threats to the watersheds of the streams where it is found. The larva has not been described. Not listed by Bick (2003).

Gomphus consanguis

This species occurs in rather pristine spring fed streams in the southern Appalachian Mountains. It seems sensitive to disturbances of the watersheds of its stream habitat, such as those resulting from residential development and logging, not to mention damming of rivers (Carle 1991). Insecticides, such as those used for Gypsy Moth control, are also likely a threat. Bick (2003) listed this species from about 17 counties in five states, and rated it 'rare'.

Gomphus geminatus

Known from less than 20 streams in the Florida Panhandle and immediately adjacent Alabama. The major threat to its populations is the general residential development of the area, although it is found in some nature preserves. Bick (2003) did not list this species. Its status is similar to that of *G. westfalli* because it too is taxonomically similar to another species, in this case *G. parvidens* Currie, 1917, which has a narrowly separated geographic range extending into the Carolinas.

Gomphus gonzalezi

Known from only two rivers in southernmost Texas, and a couple of rivers in Mexico, south to San Luis Potosi. Like *Argia rhoadsi*, it is barely a member of the USA fauna, but even in Mexico it has a limited range. It is threatened by the intensive agricultural and urban development in the Rio Grande Valley on both the USA and Mexican sides of the river. The larva has not been described. Bick (2003) did not list this species.

Gomphus lynnae

Known only from two rivers in Oregon and one in Washington (D. Paulson pers. comm.; Paulson 1996). Presumably, overgrazing, fires, and pollution are the major threats to the watersheds where it is found. Bick (2003) did not list this species.

Gomphus sandrius

Known from only a few limestone bottomed tributaries of the Duck River in south-central Tennessee, a total of eight sites in five counties (K. Tennessen pers. comm.). Tennessen (1994) has conducted an extensive survey for the species, and noted that its population appeared to be rapidly declining, and that it is unlikely to be found outside its known range. Its natal streams are unprotected and flow through private agricultural lands, where cattle grazing of the stream banks and insecticide use are routine. The author knows of no other rare species, although there may be some, in the area that would be likely to cause a nature conservation entity to purchase any of these watersheds. Although the species is endangered, formally listing it as such could cause a backlash from local landowners who might fear government interference with how they use their land. The larva has not been described. Bick (2003) concurs that this species is 'critically imperiled'.

Gomphus westfalli

With a tiny range of about 2.5 km diameter in the northwestern Florida Panhandle, this species is fairly well protected due to the fact that some of the few streams where it is found are in a State Forest. Patchy summer burning to maintain an open understory in surrounding pine forest would benefit this species. Bick (2003) listed this species as 'critically imperiled'. It is very similar as both adults and larvae to *G. diminutus* of the Carolina area, which itself is none too common, but may be retained as a separate species until the unlikely event that intermediate populations are found in Georgia.

Ophiogomphus acuminatus

This species has a small range in west-central Tennessee and immediately adjacent Kentucky and Alabama. While its larvae are certainly susceptible to disturbance of the gravel bottom streams where they live, an extensive survey found the species in more than 30 streams, with a few stream segments protected (Tennessen 1994). Hopefully the species will continue to survive in spite of cattle access to stream channels, clear-cut lumbering with planting of pine monocultures, and gravel mining from stream beds. Bick (2003) listed this species from 13 counties, and rated it 'rare'.

Ophiogomphus australis

Known from a tiny range in three gravel bottom rivers, located in eastern Louisiana and adjacent southwestern Mississippi. These rivers are not protected, and are disturbed by gravel mining (Mauffray 1997) and lumbering, so the species is in real danger of extinction. Bick (2003) concurs that this species is 'critically imperiled'. However, its taxonomic relationship with the more widespread but still rare *O. incurvatus* Carle, 1982 needs clarification. Populations of *Ophiogomphus* in Alabama and northwest Florida, between the ranges of *O. australis* and *O. incurvatus*, are mostly known only as larvae (K. Tennessen pers. comm.).

Ophiogomphus edmundo

Not seen for many years after the original description, and feared extinct. It is now known from four streams and rivers in the southern Appalachian Mountains. It suffers from the usual threats to its forested habitats, such as lumbering, residential development, damming, insecticides, and forest fires. The larva has not been described. Bick (2003) listed this species from six counties in three states, and rated it as 'imperiled'.

Stylurus potulentus

This species may be in real danger of extinction because its range is so small, four counties in coastal Mississippi to three counties in northwest Florida, and because it seems to require absolutely pristine sand-bottomed streams. Only one of its seven known stream habitats is (somewhat) protected. It is apparently threatened by the continuing rapid and inexorable development of the Gulf Coastal Plain. Bick (2003) gave this species an 'imperiled' rating.

Cordulegaster sayi

Known from only six counties in northern Florida and eight in Georgia (W. Mauffray and J. Daigle pers. comm.). It has exacting habitat requirements, with open fields for foraging located near forested seepage breeding habitats (Dunkle 1989, 1992, 1994; Hipes et al. 2001). Fortunately, almost all of its known sites are protected in State Parks, a State Forest, and military bases. Bick (2003) rated this species as 'rare'.

Neurocordulia michaeli

This recently described but elusive and crepuscular species is now known from at least three rivers in New Brunswick and 30 in Maine (P. Brunelle pers. comm.). This is an unusual geographic range for an odonate, but since most of these rivers have good water quality, the species may be deemed to be secure, and it was rightly not listed by Bick (2003).

Somatochlora brevicincta

Known for many years only from a few sites in Quebec (Walker & Corbet 1975), it has recently been found at three sites in New Brunswick, one in Newfoundland, four in Nova Scotia, and six in Maine (P. Brunelle pers. comm.; Brunelle 1998). Even more surprisingly, it is now known from six sites in the Rocky Mountain Trench of British Columbia, 3,000 km west of its nearest known eastern locale (R. Cannings pers. comm.; Cannings 2002). It must occur at scattered sites across Canada between these two areas, and because of the remoteness of most of its localities, the species is probably secure in spite of its exacting fen and bog habitat requirements, and it was rightly not listed by Bick (2003). The larva has not been described.

Somatochlora calverti

Adults of this species are known from a few sites in six counties of the Florida Panhandle, a site in adjacent Alabama, and one disjunct site in southeastern South Carolina. Adults have been collected in State Parks and State Forests in Florida, but its larval habitat has not been found. Probably the larvae, which have not been described, live in sandy and boggy forest seepages. Bick (2003) listed this species as 'rare'.

Somatochlora hineana

The only odonate currently listed as 'federally endangered' in the USA, and a recovery plan has been written (U.S. Fish & Wildlife Service 2001). Collected in Ohio and Indiana, then not seen for many years, it was feared to be extinct. Although the total area of its fen habitats is small, the species has recently been found at an incredible 53 sites, some of which are protected; nine in Illinois, 15 in Michigan, 13 in Missouri, and 16 in Wisconsin (E. Cashatt and T. Vogt pers. comm.; Steffens 1998; Mead 2003; Soluk & Moss 2003). It has not been rediscovered in Ohio (Glotzhofer & McShaffrey 2002) or Indiana (Curry 2001) despite special searches, but there is an anomalous 1978 record from northeastern Alabama (Tennesen et al. 1995). Interestingly, it has been found that the larvae can survive winter or drought in crayfish (*Cambarus diogenes*) burrows (Vogt & Cashatt 1994; Cashatt & Vogt 2001). Genetic studies indicate several separated metapopulations (Purdue et al. 1996). Bick (2003) downgrades the status of this species to 'rare'.

Somatochlora margarita

The status of this species is similar to that of *S. calverti*. It has a limited range, known from five sites in east Texas, and one in Louisiana (J. Abbott pers. comm.). Adults have been collected in National Forests (Price 1989), but its larval habitat is unknown. As for *S. calverti*, presumably the larvae, which have not been described, live in sandy and boggy forest seepages within pine forests. Bick (2003) rated this species as 'imperiled'.

Williamsonia lintneri

This is an assuredly rare bog and fen-breeding species, but it has been found at numerous sites in its limited coastal New England range, and more recently and surprisingly 800 km west (Legler et al. 1998; Ross & O'Brien 1999) as disjunct populations in three counties each in Michigan and Wisconsin. However, it has not been found at many sites where it might be expected (Donnelly 1992), and its populations are very small at some of its known habitats. Fortunately, some of its sites are protected, and Bick (2003) gave this species a 'rare' rating. Its sole congener, *W. fletcheri* Williamson, 1923, is more widespread, as well as more common, than *W. lintneri*. These two species occur together at some sites.

Libellula Jesseana

Endemic to Florida, this species is known from the most infertile sand bottomed lakes in nine counties of the Peninsula and two counties of the eastern Panhandle.

Since adults are morphologically identical to those of the common *L. auripennis* Burmeister, 1839, the taxonomy of this species needs clarification, although it does seem to have a slightly different ecology with a shorter flight season. It breeds in the most nutrient-poor lakes, where emergent grass is sparse, although its larva has not been described. The lovely clear-water sand-bottomed lakes of Florida are being developed at an alarming rate. Runoff of fertilizers from the lawns of housing developments, resulting in even mild eutrophication, is likely to cause increased density of emergent grasses, shifting those habitats in favor of *L. auripennis*. Possibly pulling out patches of emergent grass at overgrown lakes could create habitat for *L. jesseaana*, but this would be labor intensive and has not been tried. Very few of the lakes where *L. jesseaana* occurs are (somewhat) protected, in a State Park and National Forest. I concur with Bick (2003) in rating this species as 'imperiled'.

DISCUSSION, CONSERVATION PRIORITIES, AND RECOMMENDATIONS

Some threats to the species listed above, and their specific or implied remedies are given in the above accounts. Some other generalities can be given as follows.

Two of the zygopterans, *Argia pima* and *A. sabino*, commented on above occur in southeastern Arizona. Most perennial streams in that arid landscape are already protected in various refuges, or at least occur on public land. The main concerns for these species are to prevent overgrazing of the stream banks, and to create a patchy fire regime so that whole watersheds are not burned at once.

Four species, *Enallagma laterale*, *E. pictum*, *E. recurvatum*, and *Williamsonia lintneri*, occur in coastal New England (May & Carle 1996; Wagner & Thomas 1999). These species are listed with various degrees of threat in practically every state in which they occur, and conservation agencies have been and still are attempting to ameliorate those threats.

Ischnura gemina presents a special case, in that listing it, for example as 'endangered' in California or in the USA, would do little good. Since it is hybridizing with *I. denticollis*, the only recourse would be to transplant a population outside the range of *I. denticollis* – New England, Vancouver Island, New Zealand? Transplantation will almost certainly not occur because of all the problems that have resulted from introduced species in the past. Captive breeding is probably also not a viable alternative because of the intensive labor and costs involved.

Six species, all seepage or stream breeders, including *Gomphus geminatus*, *G. westfalli*, *Ophiogomphus australis*, *Stylurus potulentus*, *Cordulegaster sayi*, and *Somatochlora calverti*, occur in the central Gulf of Mexico coastal area. This area could definitely benefit from the establishment of more reserves, especially ones encompassing entire stream watersheds, because it is rapidly being developed. When establishing such reserves, a rise in sea level due to global warming should be kept in mind. Numerous other rare species of odonates as well as other animals and plants occur in this area as well.

For all of the species listed in this article the will and the means to reduce or prevent the various threats to their populations must be found, such as purchasing and

managing habitat (Dunkle 1995), preventing denudation of plant cover including overgrazing or clearcut lumbering (Rith-Najarian 1998), appropriate patchy fire regimes rather than massive conflagrations, reduction of insecticide use, maintaining underground water sources, stopping unnecessary damming of streams and rivers, preventing channelization or mining of stream channels, reducing eutrophication, and prevention of water and air pollution.

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