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SHORT COMMUNICATIONS

ENVIRONMENTAL MONITORING POTENTIAL OF THE ODONATA, WITH A LIST OF RARE AND ENDANGERED ANISOPTERA OF VIRGINIA, UNITED STATES

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Odon. are useful environmental monitoring agents. Most spp. show specific responses to environmental disturbances. The nymphal stage is the most reliable for obtaining population information, but the nymphs of many spp. remain undescribed. Adult Odon. can be easily identified, but high adult vagility necessitates careful evaluation of recorded occurrences. High vagility does, however, insure rapid re-establishment in suitable habitats. An unusually high number of Virginia Anisoptera may be considered rare or possibly endangered, many of which are found only in undisturbed habitats, suggesting that they are very sensitive to environmental disturbances. A list of 60 rare and endangered spp. is given in a table along with notes on their status in Virginia. The environmental monitoring potential of the Odon. cannot be fully achieved unless more attention is given to nymphal descriptions, and baseline faunal surveys.

INTRODUCTION

Man's ability to protect and conserve his environment depends largely upon a knowledge of the organisms inhabiting it; basic to this knowledge is information on the distribution and abundance of aquatic organisms. Aquatic organisms are especially important because they comprise the most sensitive component of a living security blanket which functions by signaling unusual forms of environmental disturbance. The Odonata are particularly suited for watershed monitoring because: (1) the Odonata inhabit the entire spectrum of aquatic habitats, (2) the nymphal stage of each species is specific in its ability to tolerate environmental disturbances, (3) the nymphal stage of many species is longer than one year, (4) the nymphs are relatively sedentary, (5) the nymphs and particularly the adults can be easily identified to species,

(6) the high vagility of the adults insures rapid re-establishment in suitable habitats, and (7) the mature males are generally conspicuous while patrolling near their nymphal habitat.

DISCUSSION

The collection of nymphal material is the most reliable method for determining the abundance and distribution of Odonata. However, only about 90 percent of North American Anisoptera are known in the nymphal stage, and this proportion is often much less in other parts of the world. Incomplete or otherwise inadequate species descriptions have created this problem which reduces the environmental monitoring utility of a group. Type series for example, should contain several paratypes among which is preferably included the allotype and reared material with nymphal exuviae; the holotype should be a complete, mature specimen for which the exact date and location of collection are known.

Adult Odonata are more conspicuous and easier to identify than the nymphs, but increased vagility demands a more careful evaluation of recorded occurrences. The collection of teneral adults with associated exuviae certainly indicate a viable population, however, the recording of ovipositing females or of males on territory can result from population overflow from more favorable habitats. Records from feeding or migratory swarms are the least reliable and must be reinforced by additional collecting to determine the status of a suspected population. Field notes are of prime importance when evaluating recorded occurrences and can be easily included on the 3x5 data cards used in most collections. The ease at which experienced collectors can identify dragonfly species in flight should be utilized to assess and record the number of ovipositing females, the number of patrolling males, and the relative abundance of species observed. SCHMIDT (1979) has outlined a procedure for evaluating records of dragonfly occurrence.

The determination of the rare or endangered status of a species is difficult and depends not only on the known distribution and abundance of a species, but also on the stability of known populations. When evaluating the rarity of species inhabiting a region it is necessary to distinguish between species represented by populations at the periphery of their distributions, and species which are rare everywhere. In Virginia several boreal species are found in isolated refugia along the Appalachian mountains, and a smaller number of austral species inhabit the coastal plain. Although these species are not rare if their entire distributions are considered, they serve to identify relic communities which are especially sensitive to environmental change. If the rare boreal and austral species are excluded from consideration, about one-fifth of the remaining anisopteran fauna of Virginia can be considered rare. It is certain that the apparent rarity of some species is related to behavioral

peculiarities which reduce their probability of capture, but in light of the considerable collecting effort expended in recent years it seems improbable that low catchability could explain the high proportion of rare Anisoptera. A closer analysis reveals that fully 75 percent of the rare species inhabit lotic environments, and that most of these are found in relatively undisturbed habitats. These species are very sensitive to unusual environmental disturbances and belong primarily to three ancient families, the Gomphidae, Petaluridae and Cordulegasteridae. The great geologic age of these groups alone would suggest that disturbances which bring their species closer to extinction are truly unusual.

Species inhabiting environments threatened with disturbance and species which are known from only a small number of individuals are considered possibly endangered. *Ophiogomphus howei*, for example, was known from only three adult specimens before the discovery of the New River population. A search along 200 m of river bank resulted in a removal estimate of 1287 exuviae indicating that *O. howei* is much more abundant than expected, however, it is listed as possibly endangered because its known habitat is a few large unpolluted and undammed rivers of Eastern North America. Not surprisingly the original odonate fauna of many large rivers in Virginia persists only near the confluence of undisturbed tributaries. Of the five populations of *Gomphus rogersi* known to me the Virginia population is among the most viable. A careful search of the habitat after the period of emergence yielded 23 *G. rogersi* exuviae in the first pass and 9 exuviae on the second, giving a removal estimate (CARLE & STRUB, 1978) of 35 for the cohort; the species is also listed as possibly endangered. Species such as *G. rogersi* which inhabit spring brooks or seepage areas are generally not threatened by industrial pollution, but by disturbances related to land use such as the construction of farm ponds and housing developments. It is clear that Odonata are potentially useful in environmental monitoring, but this potential cannot be fully realized until more attention is given to nymphal descriptions, and to base line faunal surveys.

The rare and endangered status of Virginia Anisoptera is reported in Table I. A total of 60 anisopteran species are considered rare in Virginia, of which 31 are primarily boreal or austral in distribution. Of the remaining species 11 are considered to be local in occurrence, being characterized by widely separated, but generally locally abundant populations. Ten species are considered rare everywhere, being characterized by widely separated populations which are seldom abundant. Eight species are considered possibly endangered either because of their apparent extreme rarity, or because of threatened habitats, or both. Eight species which are not yet known from Virginia have been included on the list as Virginia is within their expected distributions.

Table I

Rare and endangered Anisoptera of Virginia: (A) austral species, — (B) boreal species, — (L) locally distributed species, — (R) rare species, — and (E) possibly endangered species; each followed by the number of known Virginia populations.

Taxa	Status	Taxa	Status
Petaluridae		*Anax longipes*	A, 2
Tachopteryx thoreyi	L, 7	*Coryphaeschna ingens*	A, 1
		Gomphaeschna furcillata	B, 1
Gomphidae			
Aphylla williamsoni	A, 1	**Cordulegasteridae**	
Arigomphus furcifer	B, 1	*Cordulegaster erronea*	E, 2
Erpetogomphus designatus	A, 3	*Taeniogaster obliqua*	L, 8
Gomphus adelphus	E, 0		
G. apomyius	R, 0	**Corduliidae**	
G. brevis	B, 1	*Cordulia shurtleffi*	B, 3
G. borealis	B, 1	*Epicordulia regina*	A, 1
G. carolinus	R, 0	*Helocordulia selysii*	L, 4
G. consanguis	E, 1	*Neurocordulia molesta*	L, 0
G. descriptus	L, 2	*Somatochlora georgiana*	R, 1
G. fraternus	B, 1	*S. provocans*	R, 1
G. parvidens	R, 1	*S. williamsoni*	B, 1
G. quadricolor	B, 2	*Tetragoneuria canis*	B, 1
G. rogersi	E, 1	*T. semiaquea*	A, 1
G. septima	E, 0	*T. spinosa*	L, 2
G. ventricosus	R, 1		
Lanthus parvulus	L, 1	**Macromiidae**	
Ophiogomphus aspersus	R, 2	*Macromia margarita*	E, 0
O. carolinus	R, 1		
O. carolus	B, 3	**Libellulidae**	
O. emundo	E, 0	*Celithemis martha*	L, 1
O. howei	E, 1	*C. ornata*	A, 1
O. mainensis	B, 1	*C. verna*	A, 1
Stylurus amnicola	R, 1	*Ladona exusta*	B, 1
S. notatus	B, 1	*L. julia*	B, 2
S. scudderi	B, 1	*Leucorrhinia frigida*	B, 1
		L. hudsonica	B, 1
Aeshnidae		*L. proxima*	B, 1
Aeshna canadensis	B, 2	*Libellula axilena*	A, 3
A. constricta	B, 2	*L. flavida*	L, 2
A. mutata	R, 2	*Nannothemis bella*	L, 0
A. tuberculifera	L, 7	*Sympetrum obtrusum*	B, 2
A. verticalis	B, 1		

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