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THE ODONATA FAUNA OF BEAR MEADOWS, A BOREAL BOG IN CENTRAL PENNSYLVANIA

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ABSTRACT

Fifty-eight species of Odonata are recorded as occurring at Bear Meadows, a sphagnum bog in Central Pennsylvania Seasonal distribution, relative abundance and habitat preference are discussed.

INTRODUCTION

Bear Meadows is a 520-acre sphagnum bog nestled in the mountains of central Pennsylvania (Figs. 1, 2). It is 56 miles southwest of the nearest terminal moraine of Wisconsin glaciation (1), the location of which makes it a very interesting place to study boreal organisms at or near their southern limit of distribution (2). Botanists are quite familiar with this bog because boreal species, such as balsam fir and black spruce, grow here in association with a flora more typical of Pennsylvania (3,4,5,6). Study of the dragonflies of Bear Meadows has revealed a pattern of association similar to that found with plants.

In the summer of 1931, James G. Needham of Cornell University, one of the preeminent workers on dragonflies, was a visiting professor at the Penn State Nature Camp, located at what is now Alan Seeger State Forest Monument in Huntingdon County. He went with a party of students and faculty to visit Bear Meadows, then difficult of access, because it was said to be an interesting place although little-studied biologically. He caught specimens of *Leucorrhinia hudsonica* and *Somatochlora elongata,* observed the uncommon tree *Prunus alleghaniensis,* and came back to camp effervescing with enthusiasm about the marvelous boreal bog that he had seen, and declaring that he would make a special study of its dragonflies and write a paper on it. For some reason he never did, and this present contribution is a monument to the spirit and character of James G. Needham.

In this report are compiled all known Odonata records for Bear Meadows through 1966. Since collecting has covered all months from May to November, the seasonal distribution of many of the 58 species known from Bear Meadows can be estimated. The data presented in this paper are primarily the authors'; however, included are previously unpublished contributions of a number of collectors: J. Chemsak, C. Cook, T. W. Donnelly, S. W. Frost, J. Gillespie, J. G. Needham, R. A. Raff, J. M. Runner and J. Schmidt.

LOCATION AND DESCRIPTION OF BEAR MEADOWS

Bear Meadows lies about 7 miles south of State College in a protected mountain valley 1824 ft above sea level. A semicircular mountain ridge 500 ft above the valley surrounds the bog except for two openings to the northeast (Fig. 2). Access is by unpaved roads from U.S. Routes 322 and 545.

Palynological studies indicate that Bear Meadows was formed 10,000 years ago when drainage from the area was blocked, creating a shallow lake (6,7). The normal progression of bog formation has proceeded to the point where forest has invaded much of the bog's original area leaving at present a one and one quarter mile open strip along peat-stained Sinking Creek. On either side of this meandering stream, thick mats of sphagnum and peat support marsh grasses, sedges, leatherleaf and extensive stands of high bush blueberries. The invading forest consists primarily of black spruce, hemlock, balsam fir, red maple, black gum and a dense undergrowth of rhododendron. Numerous seepage areas and springs along the edge of the bog feed Sinking Creek.

Despite logging operations in the late 19th century (3) and the annual invasion of blueberry pickers, Bear Meadows has remained generally unaltered. In 1965 Bear Meadows was proclaimed a National Forest Monument

Figure 1. Bear Meadows, view from near the bridge looking west.

by Interior Secretary Udall, which should help maintain this unusual habitat for future study and appreciation.

PROCEDURE

On most collecting trips to Bear Meadows it was attempted to survey the species of Odonata present and to estimate their relative abundance. A few sight records have been included of species seen only on the wing but identified with certainty.

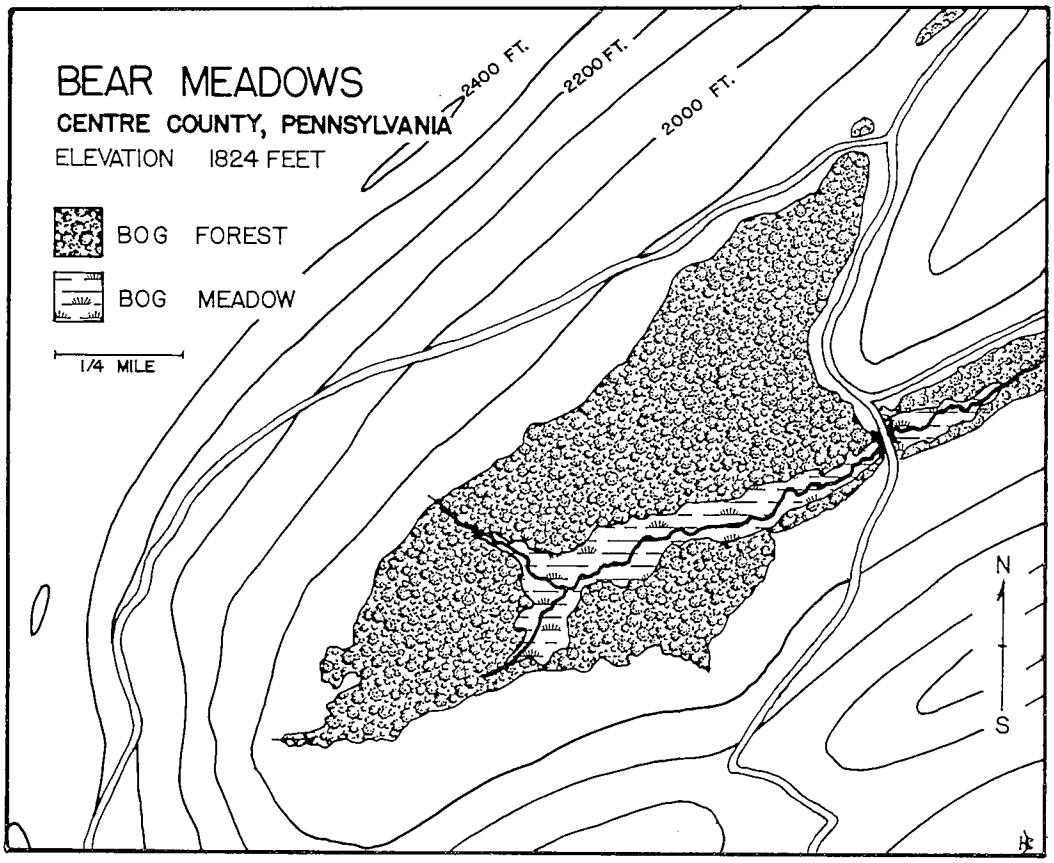
Because of its ready access, the eastern end of the bog adjacent to the bridge (Fig. 2) has received particular attention. This portion of the bog contains a variety of sub-habitats and is consequently populated by numerous species of Odonata. Surveys of the entire bog indicate that collecting in the vicinity of the bridge is most productive and gives a reasonably representative sample of the species present.

Data presented in this paper include those of Needham's 1931 visit and several other early collections, but over 80% of the records are the result of work done since 1953. With the exception of data yielded by a collecting trip by G. H. Beatty in June, 1945 (8), none of the records in this paper has heretofore been reported.

RESULTS

The seasonal distribution, relative abundance and habitat affinities of the 58 species of Odonata from Bear Meadows is summarized in Table 1. The fauna includes 7 species with strong boreal affinities and 12 others with weaker but definite boreal preferences. Ten species have a strong preference for streams and are therefore associated with Sinking Creek rather than the bog. Of the remaining 29 species, 21 are frequent to common in central Pennsylvania and do not show any special preference for bog or stream environments. Eight species must be considered strays from considerable distances. Their presence at Bear Meadows is probably accidental.

Based on relative abundance, 29 or 50% of the species are rare. These are unlikely to be found during their flying season even when searched for. Twelve species are scarce, but are usually collected in small numbers when looked for. Ten species, observed consistently without difficulty during their flying season, are termed common. The 7 species which are found in large numbers during their peak season are classified as abundant.



DISCUSSION

Sphagnum bogs are among the less common habitat types in the Appalachians and their Odonata faunas undoubtedly require much more study. This investigation of the Odonata of Bear Meadows has extended the known geographical distribution of a number of species. It has also made the populations of other large Pennsylvania bogs at Black Moshannon and Tamarack, in Centre and Clinton Counties respectively, more predictable since several of the species from Bear Meadows, which were unique records for the state, are now known from these other bogs. In the ensuing discussion, the Odonata population of Bear Meadows is divided into groups with similar ecological affinities.

The following species represent typical bog inhabitants and are part of the permanent breeding population.

Gomphaeschna furcillata Say
Somatochlora elongata Scudder
Somatochlora tenebrosa Say
Somatochlora walshi Scudder
Libellula quadrimaculata Linné
Leucorrhinia hudsonica Selys
Nehalennia gracilis Morse

In June, *Gomphaeschna furcillata* is an important though not very conspicuous member of the Bear Meadows fauna. It is a cryptically colored species which blends with trunks of dead trees on which it rests. The edge of the open meadow, especially where Sinking Creek flows into the woods at the eastern end of the bog, is the habitat of imagos of this species; the larvae have never been found at Bear Meadows though frequently sought.

Somatochlora elongata has been taken in few Pennsylvania locations other than Bear Meadows. This, however, is not the southernmost record since it has been reported from Maryland (9), Virginia, and North Carolina (10). *Somatochlora elongata* is not common at Bear Meadows. When found, it is usually patrolling low over the stream, hovering frequently to examine small coves along the bank, a flight pattern more characteristic of Aeshnids.

Since Bear Meadows is within the known geographical range of *Somatochlora tenebrosa,* its presence is of little distributional significance. It flies over the stream or hovers in sunlit clearings.

When *Somatochlora walshi* was first collected at Bear Meadows, it was the only Pennsylvania occurrence and also the southern limit of its known distribution. Subsequently it has been taken at the Black Moshannon and Tamarack bogs north of Bear Meadows but still south of the Wisconsin Moraine. This species is quite common some years. Occasionally it flies over the stream, but more frequently it hovers over marshy pockets in the open meadow and sunny glades of the woodland border.

The golden-flecked wings of *Libellula quadrimaculata* are seen throughout June and July. This typical bog species, circumpolar in distribution, rests on the tips of twigs in the sunshine, flying out to capture small insects and returning to the same perch, a habit of many Libellulas.

Leucorrhinia hudsonica is exceedingly abundant at times. It alights on grass and sphagnum moss near the stream and pools, or on the ground of sunny woodland roads and clearings. This species occurs at Black Moshannon and Tamarack and also, irregularly at a few other central Pennsylvania locations (11).

Nehalennia gracilis is sometimes very abundant, but could go unnoticed because of its small size and habit of flying and perching low among the high marsh grasses.

In addition to the preceding species the following have boreal affinities but are less selective in habitat requirements and therefore occur also in other kinds of habitats in central Pennsylvania.

Aeshna canadensis Walker
Aeshna verticalis Hagen
Gomphus borealis Needham
Epitheca canis McLachlan
Cordulia shurtleffi Scudder
Dorocordulia libera Selys
Libellula semifasciata Burmeister
Sympetrum obtrusum Hagen
Sympetrum rubicundulum Say
Sympetrum semicinctum Say
Chromagrion conditum Hagen
Amphiagrion saucium Burmeister

Of these species only *Cordulia shurtleffi, Sympetrum rubicundulum* and *Chromagrion conditum* are common every year. The others are sporadic in occurrence although they are probably part of the permanent breeding population.

Two species on this list are worthy of discussion. *Gomphus borealis* has been collected on only 3 occasions. It is commonly and locally abundant at Black Moshannon and Tamarack where it congregates on the bare ground, often at the breast of beaver dams. Twice in this century beaver were introduced at Bear Meadows; however, they did not become established (3). Perhaps *Gomphus borealis,* along with the dead spires of drowned trees in the open meadow, is a vestige of short-lived beaver activity.

Until recently (8) *Epitheca canis* was not known south of New York State. Studies in central Pennsylvania have shown this species to be relatively common and widespread although it has been taken only twice at Bear Meadows. In central Pennsylvania this species emerges before *Epitheca cynosura.* On May 19, 1963 it was flying in great numbers in a boggy area at the head of Stone Valley Dam Recreation Area in Huntingdon County. Males patrolled territories 10 to 20 ft in diameter in which they hovered, chasing away other males of the same species. The frequency of this species in Pennsylvania suggests that it will be discovered south of this state in the future.

Another portion of the Odonata population at Bear Meadows is associated with the flowing water of Sinking Creek rather than the bog. These species are:

Basiaeschna janata Say
Boyeria vinosa Say
Epiaeschna heros Fabricius
Aeshna umbrosa Walker
Cordulegaster disastatops Selys
Cordulegaster maculatus Selys
Lanthus parvulus Selys
Helocordulia uhleri Selys
Calopteryx amata Hagen
Calopteryx maculata Beauvois

Boyeria vinosa, Aeshna umbrosa, Cordulegaster diastatops and *Helocordulia uhleri* are frequent to common most years and can be captured quite easily as they patrol up and down the stream, *Calopteryx maculata* is often encountered along the stream where it rests on overhanging grasses or sticks. It is most common downstream from the bridge where the current becomes swifter.

Basiaeschna janata, Cordulegaster maculatus Lanthus parvulus and *Calopteryx amata* are probably strays from nearby streams where they are frequently found. None of these has

been taken more than twice at Bear Meadows. *Epiaeschna heros* has been seen on 4 occasions but never captured. It is probably an elusive but permanent resident of Bear Meadows.

The remaining species are for the most part ubiquitous in central Pennsylvania, having either wide habitat tolerance or propensity for wanderlust.

Anax junius Drury
Epitheca cynosura Say
Libellula julia Uhler
Libellula luctuosa Burmeister
Libellula pulchella Drury
Libellula lydia Drury
Erythemis simplicicollis Say
Pachydiplax longipennis Burmeister
Leucorrhinia frigida Hagen
Leucorrhinia intacta Hagen
Sympetrum vicinum Hagen
Lestes congener Hagen
Lestes forcipatus Rambur
Lestes rectangularis Say
Argia violace Hagen
Nehalennia irene Hagen
Enallagma civile Hagen
Enallagma ebrium Hagen
Enallagma hageni Walsh
Ischnura posita Hagen
Ischnura verticalis Say

With the exception of *Sympetrum vicinum* and *Enallagma hageni* which are abundant and *Argia violacea* which is common, the species on this list are scarce at Bear Meadows although all are common at other central Pennsylvania locations. It seems likely, therefore, that many of the individuals seen or collected are strays from other habitats. This does not exclude the possibility that they occasionally complete their life cycle at Bear Meadows. In some cases this is probable.

Enallagma hageni is probably the most abundant species at Bear Meadows possibly being exceeded by *Nehalennia gracilis* which is much less conspicuous. The former species occurs by the thousands during the peak of its flying season. It is mainly found skimming over the water.

The following do not fall into any of the preceeding categories:

Tachopteryx thoreyi Hagen
Somatochlora linearis Hagen
Dorocordulia lepida Hagen
Libellula auripennis Burmeister
Libellula axilena Westwood
Archilestes grandis Rambur
Lestes dryas Kirby

Somatochlora linearis, Dorocordulia lepida, Libellula auripennis, and *Libellula axilena* are not known from anywhere within about 100 miles of Bear Meadows. These species have been collected only once. They are therefore, not considered part of the permanent breeding population. *Archilestes grandis* represents a noteworthy case. It was first observed September 23, 1961. On the 19th of October that year it was quite common. The breeding population appears to have been ephemeral since the only subsequent observation is a doubtful sight record in 1962. The fact that this species flies late in the year when collecting trips are infrequent may indicate that in most years *Archilestes grandis* has been overlooked. Oddy enough, boreal Bear Meadows is one of the northernmost location for this species even though a more austral environment might be expected as the northernmost station of a southern species.

In 1951 a collector visiting Bear Meadows for the first time collected specimens of *Tachopteryx thoreyi, Dorocordulia lepida, Libellula cyanea* and *Enallagma ebrium.* These species have never been collected at Bear Meadows before or since, although over 92 collecting trips have been made there. All but *Dorocordulia lepida* are known from central Pennsylvania. The specimens referred to have been examined and are correctly identified. Certainly this is an example of the unpredictability of collecting results.

In the United States, at least, very few definite, circumscribable locations have had their Odonata faunas and populations studied continuously over a long period of time. Although collections have admittedly been irregular, the 30-odd years of study of Bear Meadows dragonflies yields a more comprehensive picture of what the fauna there actually consists of than is available for any other location or environmental unit in North America. For animals as vagile as Odonata it is only when comings and goings are averaged out over a considerable period of time, that the composition of the truly resident fauna emerges, as indicated by more frequent collection-symbols on Table 1, while the sporadic or accidental occurrences stand out as being of a quite different nature. Succession in dragonfly populations goes on, just as it does in the more easily observed and documented forest and vegetation composition, and it is hoped that accumulation of future data will make it possible to throw more light on successional stages in the Odonata fauna of Bear Meadows.

TABLE 1. *The seasonal distribution, relative abundance, and habitat affinities of the odonata of Bear Meadows, Pennsylvania.*

Month	MAY		JUNE				JULY				AUGUST				SEPTEMBER				OCTOBER				Relative abundance[2]	Habitat affinity
Quarter[1]	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4		
No. of collections	1	2	6	6	14	7	3	10	7	11	3	0	6	5	3	0	4	3	1	2	2	1		
1. Gomphaeschna furcillata		[3]X	X	X	X	X	X	X															3	sphagnum bogs
2. Basiaeschna janata					X																		1	streams
3. Boyeria vinosa								X	X	X	X	—	X	X	X	—	X						3	shady streams with rapids
4. Epiaeschna heros			X	—	X	X																	1	small woodland streams
5. Aeshna canadensis							X	—	X	X	X	—	X	X	X								2	boggy streams & lakes
6. ——— umbrosa								X	X	X	X	—	X	X	X	—	X	X	X	X	X		3	woodland streams
7. ——— verticalis									X	X	X	—	X	X	X	—	X						2	boggy streams & lakes
8. Anax junius	X				X	X		X															1	still waters & slow streams
9. Cordulegaster diastatops			X	X	X	X	X	X	X														3	spring runs & brooks
10. ——— maculatus				X																			1	rapid woodland streams
11. Tachopteryx thoreyi[4]					X																		1	spring bogs
12. Lanthus parvulus					X																		1	small spring-fed streams
13. Gomphus borealis			X	X	X																		1	beaver ponds, slow streams
14. Epitheca canis			X																				1	boggy ponds — streams
15. ——— cynosura			X	—	X	X																	1	ponds & streams
16. Helocordulia uhleri		X	X	—	X	X	—	X															3	rapid streams & rivers
17. Somatochlora elongata									X	X	X	—	X	X									2	boggy streams & rivers
18. ——— linearis													X										1	woodland streams
19. ——— tenebrosa									X	X	X	—	X	X	X	—	—	X					2	boggy streams
20. ——— walshi					X	X	—	X	X	X	X	—	X	X									3	boggy streams
21. Cordulia shurtleffi		X	X	X	X	X	X	X	X														3	boggy ponds & streams
22. Dorocordulia lepida[4]					X																		1	swamps & bogs
23. ——— libera					X	X	—	X	X	X													1	boggy ponds
24. Libellula auripennis					X																		1	coastal waters, etc.
25. ——— axilena					X																		1	coastal waters
26. ——— cyanea[4]					X																		1	standing water
27. ——— julia			X	X	X	X																	2	woodland ponds & marshes
28. ——— luctuosa									X														1	ponds
29. ——— lydia			X	X	X	X	X	X	X	X	X	—	X	X									2	standing water
30. ——— pulchella			X	X	—	X	X	—	X	X	X	—	X	X									2	ponds
31. ——— quadrimaculata		X	X	X	X	X	X	X	X	X	X												3	sphagnum bogs
32. ——— semifasciata			X	—	X	—	X	X	—	X													1	marshy ponds

TABLE 1. *(continued)* . . .

Month	MAY		JUNE				JULY				AUGUST				SEPTEMBER				OCTOBER				Relative abundance[2]	Habitat affinity
Quarter[1]	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4		
No. of collections	1	2	6	6	14	7	3	10	7	11	3	0	6	5	3	0	4	3	1	2	2	1		
33. Erythemis simplicicollis										X			X										1	ponds
34. Sympetrum obtrusum										X					X	—	X						1	ponds
35. ——— rubicundulum						X	X	X	X	X	X	—	X	X	—	—	X						4	ponds & bogs
36. ——— semicinctum										X	—	—	X	X	X	—	X						2	bog ponds & streams
37. ——— vicinum										X	—	—	X	X	X	—	X	X	X	X	X		4	ponds
38. Pachydiplax longipennis					X			X					X										1	standing water
39. Leucorrhinia frigida					X																		1	ponds & bogs
40. ——— hudsonica		X	X	X	X	X	X	X	X	X													4	sphagnum bogs
41. ——— intacta	X	—	X	X	X	X																	2	ponds
42. Calopteryx amata										X													1	swift woodland streams
43. ——— maculata			X	—	X	X	X	X	X	X	X	—	X	X	X	—	X	X					4	streams
44. Archilestes grandis																	X	—	—	—	X		1	small streams
45. Lestes congener															X	—	X	X	—	—	X		2	ponds
46. ——— dryas[4]								X															1	temporary pools, etc.
47. ——— forcipatus							X						X										1	marshy ponds
48. ——— rectangularis									X	X	—	—	X	—	X								1	woodland ponds
49. Argia violacea					X	X	X	X	X	X	X	—	X	X									3	streams & lakes
50. Amphiagrion saucium			X	—	X	X	—	X															2	spring runs & bogs
51. Nehalennia gracilis		X	X	—	X	X	X	X	X	X	X	—	X	X	X	—	X						4	sphagnum bogs
52. ——— irene		X	X	—	X			X			X												2	swampy ponds
53. Chromagrion conditum			X	X	X	X	X	X	X	X	X												4	spring brooks & pools
54. Enallagma civile																	X			X	X		1	ponds, lakes, streams
55. ——— ebrium[4]					X																		1	marshy ponds & streams
56. ——— hageni			X	X	X	X	X	X	X	X	X	—	X	X									4	boggy ponds, streams, etc.
57. Ischnura posita						X								X	X								1	slow streams & ponds
58. ——— verticalis			X	X	X	X	—	X	X	X	X	—	X	X	X	—	X	X					3	all standing waters
No. of species observed	2	7	22	14	34	25	16	24	23	25	19	—	22	19	14	—	13	6	2	3	5	0		

1. Quarters refer to divisions of months: 1 - 1st-7th, 2 - 8th-15th, 3 - 16th-23rd, 4 - 24th-end.
2. Relative abundance: 1 - Rare, 2 - Scarce, 3 - Common, 4 - Abundant. Terms are defined in text.
3. An "X" indicates that species was collected or recorded during that quarter; A "—" indicates probable but unconfirmed presence of a species during that quarter.
4. Species reported by collectors other than the authors.

ACKNOWLEDGMENTS

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CORRECTIONS

p.130, 1st line of introduction: read 320 for 520

p.130, 5th line of introduction: read "making it" for "the location of which makes it"

p.136: insert, as footnote 5 to TABLE 1, "Nomenclature and order of taxa follow G.H. & A.F. Beatty's Check List and Bibliography of Pennsylvania Odonata (12)"

p.137: add, at end of references, "12. Beatty, G.H. & A.F. 1968. *Penna. Acad. Sci. Proc.* 42:120."