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Assessing permanency of small potholes by Chironominae communities

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Abstract
Incidence of the subfamily Chironominae (midges) in ponds of known permanence was evaluated as an indicator of permanency by employing the quotient of similarity. On this basis ponds with weak water stability were separated from more permanent ponds. Moderately permanent ponds could not be separated from known permanent ponds.

Resumé
On a cherché à déterminer grâce au quotient de similitude s'il était possible d'utiliser comme indicateur de permanence le nombre de moucherons (chironominés) présents dans un étang reconnu comme permanent. C'est ainsi que l'on a pu distinguer les étangs permanents de ceux dont les eaux sont instables. Il a toutefois été impossible d'établir une distinction entre les étangs modérément constants et les étangs tout à fait constants.

Introduction

An easy method of evaluating wetland habitat on the ground is essential for effective land acquisition and for projecting permanency of brood habitat. This paper deals with a possible technique for the assessment of wetlands. Incidence of the subfamily Chironominae (midges) in ponds of known permanency was evaluated as an indicator of permanency by employing Sorensen's quotient of similarity (Kontkanen, 1958).

The data analysed in this progress note represent a small portion of the material from an ongoing limnological investigation of prairie wetlands.

The ponds

Temporary ponds are those that usually dry up by late July; seasonal ponds either hold water throughout the ice-free season for several consecutive years or have the substrate saturated at freeze-up. Occasionally, seasonal ponds go dry. Permanent ponds are those that have never gone dry.

In 1969, five ponds near Floral, Saskatchewan (52°3'N, 106°31'W), were selected for this study: one temporary (G8), three seasonal (G5, G11, G20) and one permanent (G13). In 1970 temporary pond G21A was added. The ponds ranged in area from 0.15 ha to 2.2 ha. The two temporary ponds had the smallest surface area (Table 1).

Pond G8 was dry by mid July in 1969 and 1970. G21A held water until late August in 1969 and was re-flooded in late September. The remaining ponds held water over winter during the two study years (Table 2).

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The aquatic vegetation common to the seasonal ponds includes *Scolochloa festucacae*, *Scirpus validus*, *Myriophyllum exalbescens*, *Lemna triscula* and *L. minor* and several species of *Carex* and *Eleocharis*. *Potamogeton richardsonii* is found in seasonal and permanent ponds. The main aquatics in G8 are *Carex* spp. and *Polygonum coccineum* and in G21A *Lemna minor* and *Carex* spp. The two temporary ponds are tree-ringed, G8 with *Salix* spp., *Populus tremuloides* and *Amelanchier alnifolia* and G21A primarily with *Salix* sp.

Methods and materials

Emergence traps were used to collect adult Chironominae. Each emergence trap (Fig. 1), modified from Brundin (1949) and Mundie (1956), was constructed from 0.6 mm pressed polyvinyl, an automobile hose clamp and an 8-oz jar with a Bakelite lid. The base of the trap was 0.1 m^2. The traps were suspended from posts of electrical conduit 2.0 cm in diameter. Five sampling stations at 3-m intervals were established at right angles to the pond margin. The first station was placed at a depth of 30 cm. All traps were submerged. As water levels dropped, the trap stations were moved. The operation and limitations of emergence traps are considered by Jonasson (1954), Mundie (1956, 1957) and Palmen (1962).

Samples were collected daily, Tuesday to Friday inclusive each week, from the last week in May through the first week in September. The traps were cleared at the same time each day. All chironomid specimens were preserved in 95% ethyl alcohol. Specimens were identified from keys by Beck and Beck (1969), Curry (1962), Goetghebuer (1937), and Townes (1945). New species were designated a, b, c, etc. Species difficult to identify were mounted on slides using a method outlined in Saether (1969).

The Sorensen quotient of similarity (Kontkanen, 1958) was used to express the degree of similarity in chironomid species occurring within the three pond types. The quotient is expressed as a percentage derived as follows:

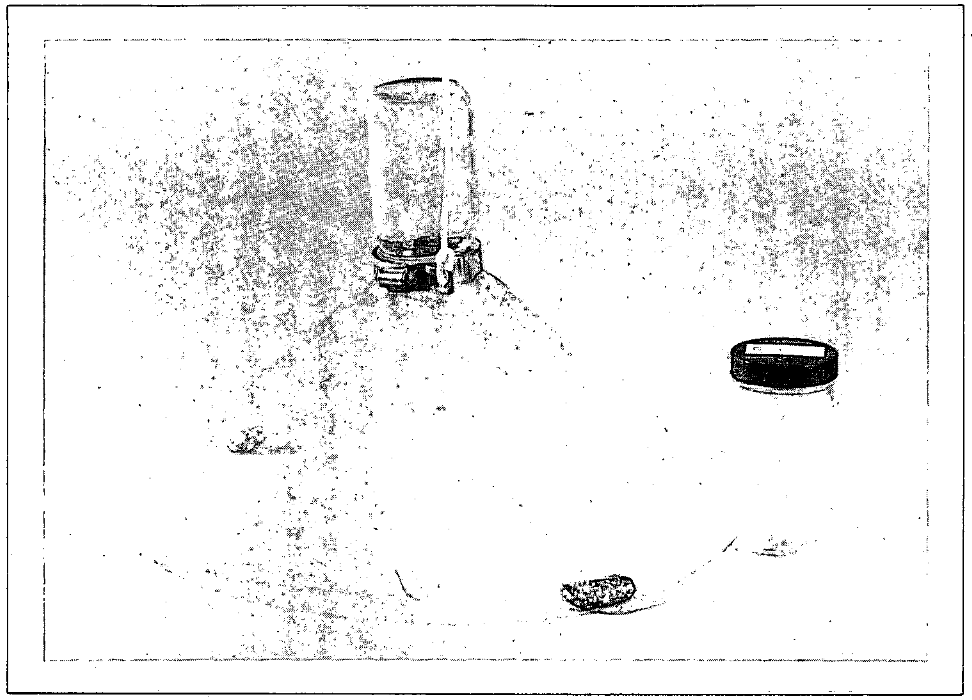
$$\text{Q.S.} = \frac{2J}{a + b} \times 100$$

where a and b are the total number of Chironominae species in two ponds and J is the number of species in common. Quotients were calculated for a complete sampling season and for 1-month and 1-week intervals in an attempt to provide a definition of pond types and to ascertain the minimum data needed for analysis.

Results

Chironominae communities. The dominant Chironominae in the Floral ponds were *Chironomus attenuatus*, *Chironomus tentans*, *Glyptotendipes barbipes*, *Harnischia viridula*, *Parachironomus* sp. a, *Polypedilum* sp. a and *Tanytarsus* sp. a (Table 3).

Figure 1
A 0.1 m^2 emergence trap



All species of Floral Chironominae except *Cryptotendipes* cf. *darbyi* were found in one or more of the seasonal ponds in one or more seasons. The number of species observed in G11 in 1969 declined by seven in 1970; two moderately abundant forms, *Dicrotendipes nervosus* and *Chironomus tentans*, were missing and five species were classed as rare. A similar pattern occurred in ponds G20 and G13, with a decrease of two and four species respectively, all rare. The chironomid community of G5 remained unchanged from 1969 to 1970. The change in chironomid composition of these ponds between years appears, in part, related to their abundance and therefore to their vulnerability to capture by emergence traps. At present, I cannot offer a more precise explanation of the difference in species composition within a pond from one year to the next.

The chironomid fauna of temporary ponds such as G8 and G21A is sparse. Two species were collected at G8 in 1969 and one in 1970. Five species were recorded from G21A in 1970 but only two in common with those in G8, *Tanytarsus* sp. a and *Chironomus attenuatus*. This paucity of Chironominae may provide a key to pond evaluation.

Differences in species composition can be attributed to the complexity of aquatic vegetation, to the type of substrate and to water conditions. Four emergence trap stations in G11 and three in G5 were located in emergent vegetation. Additional microhabitats offered by vegetation compared to bare substrate permitted the occurrence of additional species, for example, *Dicrotendipes nervosus* in G5 and G11 and *Polypedilum* sp. b and c in G11.

Water conditions. The daily rate of water loss in a temporary pond such as G8 was 10.5 mm/day, approximately twice the rate for seasonal or permanent ponds (Table 2).

In ponds G8 and G21A conditions for the establishment of midge communities were marginal. The re-flooded substrate of G21A in September 1969 enabled five species of chironomids to survive and hatch the following spring. The small emergence in 1970, 13 specimens in 104 trap nights, suggests a reduction in larval numbers due to variable water conditions and a frozen substrate in the fall of 1969. The absence of water in G8 from mid-July to freeze-up, a period of 120 days in 1968 and 110 days in 1969, limited larval survival and subsequent adult production. One hundred and fifteen adult chironomids representing two species were collected from 120 trap nights in 1969 and seven adults of one species from 140 trap nights in 1970. Patterson and Fernando (1969) report chironomid larvae were able to survive in the absence of water and over winter, although a marked reduction in third and fourth instar larval numbers occurred.

Community analysis. Seventy per cent of the known species occurring in Floral ponds were collected within the first four weeks of sampling, the last week in May to the end of the third week in June, in 1969 and 1970, although the number of specimens was highly variable (Tables 4 and 5). The quotient of similarity was calculated for the season, for the month of June and for the first week of June for 1969 and 1970.

Seasonal ponds (G5, G20, G11) were from 71 to 85% similar to the permanent pond (G13) in 1969 and from 71 to 89% similar in 1970 (Table 6). The temporary ponds had less than 31% index of similarity to the permanent pond (G13) for annual values. I believe that the lack of a more complex Chironominae community reflects the temporary nature of these ponds.

Species lists for a one-week interval do not provide consistent patterns from year to year. For example, only three specimens of one species were captured from G11 in the first three weeks of sampling in 1970. At present I cannot explain the small chironomid emergence from G11 in June 1970.

Temporary ponds have a low index of similarity to both seasonal and permanent ponds, ranging from 0 to 36% over weekly, monthly and seasonal collections (Table 6). Thus separation of temporary ponds from either of the other two types may be accomplished by collecting emerging specimens for four weeks and analysing the similarity of resident chironomid communities. The relationship between communities of temporary ponds is weak, because of the paucity of species in this habitat type. A 33% relationship occurred in a comparison of chironomid fauna for G8 to G21A.

The comparison of seasonal ponds to each other produced values from 50 to 92%, with the exception of data for June 1–7, 1970. The variations in seasonal ponds may result from the non-synchronous emergence of Chironominae, difference in the number of microhabitats or the degree of permanence (age) in the seasonal ponds.

Discussion

The purpose of studying Chironominae inhabiting prairie ponds was to determine whether or not these organisms could provide a quick, practical means of separating ponds into classes related to permanency within a year and over a period of years.

Temporary ponds were distinguished from a known permanent pond using the quotient of similarity. In addition, temporary ponds were differentiated from seasonal ponds. A cursory analysis of 1971 data for an additional 11 temporary wetlands supports this distinction of temporary from seasonal and permanent pond types.

Fluctuating water levels and the length of time a pond has held water influence the composition of seasonal pond vegetation. This affects the availability of habitats for midges and consequently the composition of midge communities. These environmental factors, coupled with the order of emergence, account for most of the variance in percentages of comparison of seasonal to seasonal ponds and seasonal to permanent ponds. Temporary ponds could be distinguished from seasonal and permanent ponds and from each other using the quotient of similarity, but seasonal ponds could not be clearly distinguished from permanent ponds. The results discussed above apply only to data collected during one month or longer; weekly data are too fragmentary to provide a separation of pond types.

Considering the variation in community structure of seasonal ponds, the lengthy sampling period and the difficulty in identifying species, I suggest this technique has limited value for classifying ponds, at least over the short term.

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Table 1
Physical parameters of six Floral ponds based on water levels, May 1969

		Temporary		Seasonal			Permanent
		G8	G21A	G5	G20	G11	G13
Maximum depth (cm)		86	86	120	110	175	250
Surface area (ha)		0.17	0.15	1.20	0.38	2.20	1.00
Rate of water	1969	10.5	–	4.6	5.8	6.3	6.2
loss (mm/day)	1970	9.4	5.8	3.7	4.9	4.2	5.8

Table 2
Presence or absence of water in study ponds*

	Temporary		Seasonal			Permanent
Year	G8	G21A	G5	G20	G11	G13
1962	0	0	–	0	0	X
1963	0	0	–	0	0	X
1964	0	–	0	0	0	X
1965	0	0	0	X	X	X
1966	0	0	X	X	X	X
1967	0	0	X	X	X	X
1968	0	0	X	X	X	X
1969	0	X†	X	X	X	X
1970	0	X†	X	X	X	X

*–, no record; X, presence of water at freeze-up; 0, absence of water at freeze-up.
†Dry substrate flooded late September.

Table 3
Chironominae of six ponds at Floral, Saskatchewan, in 1969 and 1970

	Temporary			Seasonal						Permanent	
	G8		G21A*	G5		G20		G11		G13	
Species	1969	1970	1970	1969	1970	1969	1970	1969	1970	1969	1970
Chironomus attenuatus	+†	+	+	+	+	+	+	+	+	+	+
Chironomus tentans	–	–	–	+	+	+	+	+	–	+	+
Einfeldia pagana	–	–	+	–	–	–	–	+	–	–	–
Cryptochironomus fulvus	–	–	–	–	–	+	–	–	–	+	–
Cryptotendipes cf. darbyi	–	–	–	–	–	–	–	–	–	+	–
Dicrotendipes nervosus	–	–	–	+	+	–	–	+	–	–	–
Glyptotendipes lobiferus	–	–	–	+	+	–	–	+	+	+	–
Glyptotendipes barbipes	–	–	+	+	+	+	+	+	+	+	+
Harnischia viridula	–	–	–	+	+	+	+	+	+	+	+
Parachironomus sp. a	–	–	–	+	+	+	+	+	+	+	+
Polypedilum simulans	–	–	–	+	+	–	–	–	–	+	+
Polypedilum sp. a	–	–	–	+	+	+	+	+	–	+	+
Polypedilum sp. b	–	–	–	–	–	–	–	+	+	–	–
Polypedilum sp. c	–	–	–	–	–	–	–	+	–	–	–
Tanytasus sp. a	+	–	+	+	+	+	+	+	+	+	+
Tanytasus sp. b	–	–	–	+	+	+	+	+	–	+	–
Tanytasus sp. c	–	–	–	+	+	+	+	+	+	+	+
Tanytasus sp. d	–	–	+	+	+	+	–	+	–	–	–
Totals	2	1	5	13	13	11	9	15	8	13	9

*G21A not sampled in 1969.
†Plus sign (+) indicates that Chironominae occurred.

Table 4
Percent cumulative capture of Chironominae species in Floral ponds

		Ave. no. trap nights/ week	Week															Total no. species
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Pond*	Year		May	June				July					August				Sept.	
G8	1969	20	50	50	100	100	100		100									2
	1970	20	100	100		100	100	100	100	100								1
G21A	1970	8	20	100		100	100	100	100	100	100	100	100	100	100	100		5
G5	1969	20	15	69	77	92	92		92	100	100	100	100	100	100	100	100	13
	1970	20	23	77		77	77	77	85	85	100	100	100	100	100	100	100	13
G20	1969	20	73	91	91	91	91		91	91	91	91	91	91	91	100	100	11
	1970	20	22	100		100	100	100	100	100	100	100	100	100	100	100	100	9
G11	1969	20	67	87	87	87	93		93	93	93	100	100	100	100	100	100	15
	1970	20	0	13		13	66	88	88	88	100	100	100	100	100	100	100	8
G13	1969	20	23	46	54	69	69		92	100	100	100	100	100	100	100	100	13
	1970	20	44	56		78	89	89	100	100	100	100	100	100	100	100	100	9

*G8 and G21A are temporary; G5, G20, and G11 are seasonal; G13 is permanent.

Table 5
The number of species and specimens captured each week on each of six ponds in 1969 and 1970

Pond*		Ave. no. trap nights/ week	Week 1 May	2 June	3 June	4 June	5 June	6 July	7 July	8 July	9 July	10 July	11 August	12 August	13 August	14 August	15 Sept.
G8	1969 spp.	20	1	1	2												
	specimens		11	99	5												
	1970 spp.	20		1													
	specimens			7													
G21A	1970 spp.	8	1	5													
	specimens		3	10													
G5	1969 spp.	20	2	9	5	8	7		2	8	4	9	1	4	5	2	1
	specimens		2	91	32	84	209		7	24	16	20	1	11	11	2	1
	1970 spp.	20	3	10		2	4	2	6	5	8	6	6	8	7	4	5
	specimens		5	46		3	28	13	52	39	31	44	166	44	26	17	13
G20	1969 spp.	20	8	10	5	3	1		4		2	2	2	3	3	2	5
	specimens		207	208	38	5	1		5		5	4	4	5	4	4	8
	1970 spp.	20	2	9		3	1	2	3	4	1	1	5	6	7	7	5
	specimens		49	157		7	3	2	9	9	2	2	14	9	53	21	60
G11	1969 spp.	20	10	12	2	7	8		5	7	10	5	6	5	4	1	2
	specimens		108	244	6	87	114		8	20	19	10	50	57	11	4	3
	1970 spp.	20		1			5	3	3	4	5	6	5	3	1		
	specimens			3			145	33	6	7	11	16	13	11	1		
G13	1969 spp.	20	3	4	5	6	6		8	12	9	8	6	9	5	3	3
	specimens		6	9	8	54	34		12	34	59	106	89	43	19	20	8
	1970 spp.	20	4	4		7	7	7	9	5	6	5	7	7	7	5	5
	specimens		49	69		60	61	95	554	59	92	91	320	340	382	85	100

*G8 and G21A are temporary; G5, G20, and G11 are seasonal; G13 is permanent.

Table 6
Percent similarity analysis of Chironominae communities in Floral ponds for 1969 and 1970. Analysis includes within and between pond type comparisons

June 1–7

1969	G13	G11	G20	G5
G8	0	16	18	0
G5	33	50	67	
G20	29	55		
G11	25			

1970	G13	G11	G20	G5	G21A
G8	0	0	20	0	33
G21A	22	0	29	27	
G5	43	18	63		
G20	46	0			
G11	0				

June 1–30

1969	G13	G11	G20	G5
G8	18	27	33	31
G5	80	92	86	
G20	63	61		
G11	55			

1970	G13	G11	G20	G5	G21A
G8	22	29	20	0	33
G21A	31	36	29	27	
G5	67	63	63		
G20	82	80			
G11	72				

May 25–Sept. 5

1969	G13	G11	G20	G5
G8	27	24	31	27
G5	85	79	83	
G20	83	77		
G11	71			

1970	G13	G11	G20	G5	G21A
G8	20	22	20	14	33
G21A	29	31	29	11	
G5	82	67	82		
G20	89	71			
G11	71				

NOTE:
A, comparison of temporary to permanent.
B, comparison of temporary to seasonal.
C, comparison of temporary to temporary.
D, comparison of seasonal to permanent.
E, comparison of seasonal to seasonal.

	G13	G11	G20	G5	G21A
G8 G21A	A		B		C
G5 G20 G11	D	E			