Hybridization between *Polygonum mite* Schrank, *P. minus* Huds. and *P. hydropiper* L. in Northern Ireland with comments on their distinction

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ABSTRACT

Polygonum mite Schrank, *P. minus* Huds. and *P. hydropiper* L., in *Polygonum* sect. *Persicaria* (Miller) DC. occur together around Lough Neagh, Northern Ireland. Initial observations of these species had suggested the presence of intermediate plants of possible hybrid origin. Populations from two sites at the Lough were examined for hybridity using multivariate analyses, and by measurement of pollen fertility. Most plants could be assigned to one of the three species, but a few were almost certainly hybrids between *P. mite* and *P. minus* (= *P.* × *wilmsii* G. Beck). *P. hydropiper* did not appear to hybridize with the other species, although *P. mite* and *P. hydropiper* may approach each other in their vegetative morphology. The characters which best distinguish the three species are described and discussed.

INTRODUCTION

Polygonum mite Schrank, *P. minus* Huds. and *P. hydropiper* L. are closely related species within *Polygonum* sect. *Persicaria* (Miller) DC. Of the three, *P. mite* is considered to be the least common, occurring mainly in south-eastern England and Northern Ireland (Perring & Walters 1976). *P. minus* is rather rare, although scattered throughout the British Isles, while *P. hydropiper* is common and widely distributed (Lousley & Kent 1981).

Timson (1965, 1966, 1975) carried out a series of studies on hybridization in sect. *Persicaria*. He found that most species are rarely visited by insects, produce very sticky pollen and are usually self-pollinated before the flower opens. He concluded that interspecific hybridization in sect. *Persicaria* would be rare, but theoretically possible; both *P. mite* and *P. minus* are tetraploids with 2n = 40. Timson also suggested that hybridization could occur between *P. mite* and *P. hydropiper* (2n = 20), the former species being an autopolyploid derivative of *P. hydropiper*. Nevertheless Lousley & Kent (1981) noted that hybrids between each of the three species occur only rarely in Great Britain.

Webb (1984) carried out a survey of *P. mite* in Ireland, including an examination of all extant sheets of Irish material labelled *P. mite* at **TCD**, **DBN** and **BEL**. He concluded that all records for this species prior to 1969 were erroneous, being either *P. minus*, *P. hydropiper* or *P. persicaria* L. Furthermore he concluded that there is only one area in Ireland where *P. mite* could be found, this being the shores of Lough Neagh. Webb and J. R. Akeroyd visited this area in 1979 and found what they thought might be a complex hybrid swarm, which included *P. mite* and *P. minus*. *P. hydropiper* also occurs around the lake, although Webb did not regard it as part of the swarm. In the late summer of 1984, we visited a number of sites around Lough Neagh, and our observations suggested that some material was intermediate in morphology between *P. mite*, *P. minus* and *P. hydropiper*. However it was known that all three species show a wide range of phenotypic variation. Therefore

we decided to investigate these populations in more detail, to establish whether any true hybrids were present.

MATERIALS AND METHODS

Plants were obtained from two sites on the shores of Lough Neagh, these being near Newport Trench harbour, Tyrone, v.c. H36 (GR H298.377) and Sands Bay, Co. Antrim, v.c. H39 (GR J312.372). At each site material of the three species was gathered randomly, and a total of 100 plants was collected and pressed. Voucher material has been deposited in **TCD**. 17 morphological characters (Table 1) were scored from this material, three observations of each character being made from each plant. Mean values per plant were then calculated for each character, and these data were analysed by Principal Components Analysis (PCA) using the BMDP4M PCA program. The data were also subjected to a Stepwise Discriminant Analysis (DSC) using the SPSS-X statistical package, to test the strength of disinctions between the species and to indicate their best distinguishing features (Parnell 1987).

TABLE 1. CHARACTERS USED IN NUMERICAL ANALYSES

1. Leaf length
2. Leaf width (maximum)
3. Distance between leaf base and widest point on leaf
4. Leaf venation (recorded on a scale of 1–2, where 1 = venation inconspicuous, 2 = venation conspicuous)
5. Mid-stem ochrea tooth length
6. Flower spike posture (recorded on a scale of 1–3, where 1 = erect, 2 = slightly nodding, 3 = nodding)
7. Spike length
8. Number of axillary flowers
9. Perianth length
10. Perianth width (maximum)
11. Perianth colour (recorded on a scale of 1–3, where 1 = red, 2 = pale pink, 3 = pink-green-white)
12. Perianth gland density
13. Nut length
14. Nut width (maximum)
15. Distance between nut base and widest point on nut
16. Degree of shininess of nut surface (recorded on a scale of 1–3, where 1 = shiny, 2 = somewhat shiny, 3 = dull)
17. Degree of roughness of nut surface (recorded on a scale of 1–3, where 1 = smooth, 2 = slightly rough, 3 = very rough)

Pollen fertility, as indicated by stainability tests, was determined using selected material of the species and their possible hybrids. Three to four ripe anthers from each specimen were dissected on a microscope slide and stained in Cotton Blue/Lactophenol for 30 minutes. The numbers of stained and unstained grains were then counted and percentage stainability calculated.

RESULTS

Most of the plants from both populations could be visually assigned to one of the three species (Figs. 1–3), and these findings were confirmed by both PCA (Fig. 4) and DSC. In the PCA, plants visually assigned to *P. mite* made up the largest group of points on the scatter plot, with smaller groups corresponding to *P. minus* and *P. hydropiper*. Principal components 1 and 2 accounted for 54% and 28% of the total variation respectively. The DSC distinguished each species at a 99·9+% level of confidence (all $F>17$, $P<0{\cdot}001$), and the characters picked out by this analysis that would best separate the species are given in Table 2. Using a combination of these it was possible to assign herbarium specimens to a taxon with little difficulty.

A few plants were found at both sites which seemed to be intermediate between *P. mite* and *P.*

FIGURE 1. *Polygonum mite* Schrank from Lough Neagh, Northern Ireland, August 1984, *Parnell & Simpson 73* (**TCD**). Scale bar = 20 mm.

TABLE 2. CHARACTERS WHICH BEST SEPARATE *POLYGONUM MITE*, *P. MINUS* AND *P. HYDROPIPER* (MEASUREMENTS ARE MEAN VALUES ± 95% CONFIDENCE LIMITS)

Character	*P. mite*	*P. minus*	*P. hydropiper*
1. Nut length (mm)	3·03±0·06	2·18±0·12	3·21±0·12
2. Nut width (mm)	1·83±0·43	1·12±0·24	2·20±0·07
3. Nut shininess	very shiny	somewhat shiny	dull
4. Perianth gland shape	flat	—	raised
5. Perianth glands, approx. no. per flower	12	0	83
6. Perianth length (mm)	3·66±0·06	2·48±0·33	4·10±0·15
7. Flower colour	pale pink to purplish-pink	usually reddish	pale pink to greenish-white
8. Spike	slightly nodding	erect	nodding
9. Mid-stem ochrea tooth length (mm)	1·76±0·09	1·67±0·26	0·30±0·16

FIGURE 2. *Polygonum minus* Huds. from Lough Neagh, Northern Ireland, August 1984, *Parnell & Simpson 32* (**TCD**). Scale bar = 20 mm.

FIGURE 3. *Polygonum hydropiper* L. from Lough Neagh, Northern Ireland, August 1984, *Parnell & Simpson 29* (**TCD**). Scale bar = 20 mm.

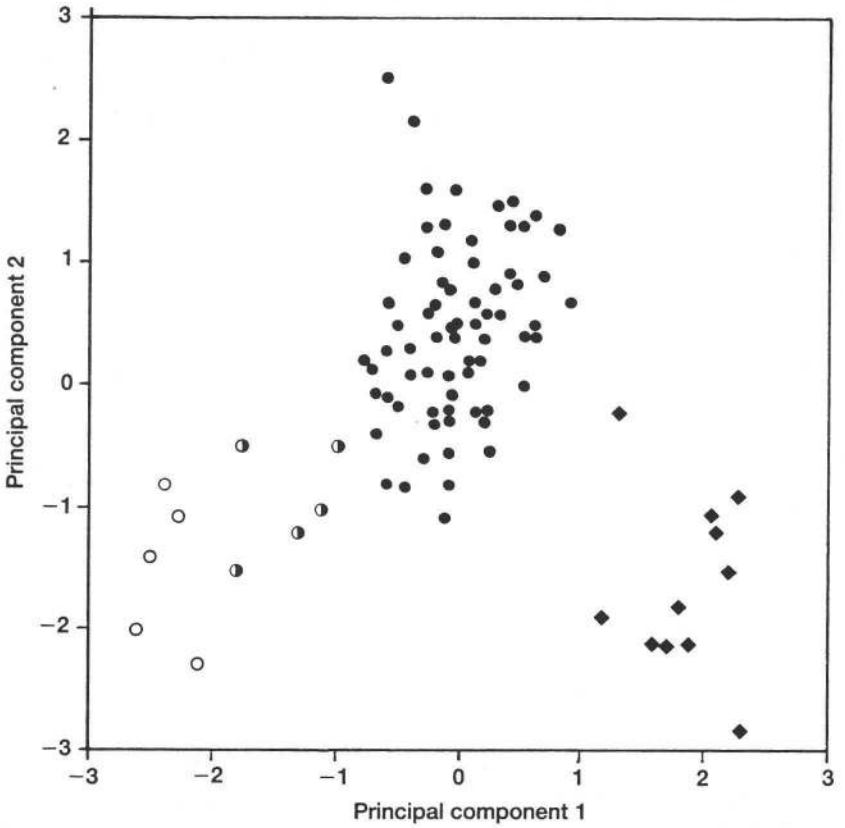

FIGURE 4. Principal components analysis on all plants sampled. ● = *P. mite*, ○ = *P. minus*, ◆ = *P. hydropiper*, ◑ = *P. mite* × *P. minus*.

minus. In particular these plants had fewer flowers than either *mite* or *minus* and produced fewer nutlets. One plant (specimen no. 71) was also found which appeared to be intermediate between *P. mite* and *P. hydropiper*. On the PCA scatter plot five points were located between the *mite* and *minus* groups and these corresponded with the visually intermediate material. One point was also located between the *hydropiper* and *mite* groups, which again corresponded with the visually intermediate plant.

The results of the pollen stainability tests are shown in Table 3. Plants which were not considered to be intermediate showed pollen stainability levels in the range 87·0–99·3%. Those plants which were intermediate between *P. mite* and *P. minus* showed a significantly reduced pollen stainability in the range 76·1–82·4% (*P. mite* (t=6·41) and *P. minus* (t=9·84), both P<0·001). However specimen no. 71, the intermediate between *P. mite* and *P. hydropiper*, at 92·7% did not have significantly reduced pollen stainability (cf. *P. mite* (t=0·76) and *P. hydropiper* (t=0·71), both not significantly different).

DISCUSSION

Our initial observations showed that as well as the three species studied, *P. persicaria* L. and *P. lapathifolium* L. were also present at both sampling sites. Webb (1984) drew attention to the difficulty in separating the two latter species from the others, particularly *P. mite*, and suggested that

TABLE 3. PERCENTAGE POLLEN STAINABILITY OF *POLYGONUM* SPECIMENS FROM LOUGH NEAGH

Specimen no.	% stainability	Identity
38	88·7	*mite*
40	89·2	*mite*
72	94·2	*mite*
73	92·2	*mite*
75	87·0	*mite*
28	94·4	*minus*
29	97·4	*minus*
32	92·0	*minus*
34	92·2	*minus*
45	98·1	*minus*
58	93·6	*minus*
19	82·3	*mite* × *minus*
30	80·7	*mite* × *minus*
35	78·9	*mite* × *minus*
49	76·1	*mite* × *minus*
D20	85·7	*mite* × *minus*
6	99·2	*hydropiper*
8	94·7	*hydropiper*
21	93·7	*hydropiper*
22	90·7	*hydropiper*
23	98·0	*hydropiper*
71	92·7	*hydropiper*

P. persicaria was also part of the hybrid swarm at Lough Neagh. Furthermore Timson (1966) had indicated that hybrids could occur between *P. persicaria* and *P. mite* or *P. minus*. However, we found *P. persicaria* and *P. lapathifolium* to be readily distinguishable from the others, including *P. mite*; the denser spike and small black patches on the leaves of *P. persicaria* and the possession of both these features, together with pedicel glands in *P. lapathifolium*, were very distinctive. In addition we found no evidence of hybridization between *P. persicaria* or *P. lapathifolium* with the other species, and for this reason we concentrated on *P. mite*, *P. minus* and *P. hydropiper*.

Five of the plants we sampled fall between pure *P. mite* and pure *P. minus*, and these intermediates are almost certainly the hybrid *P. mite* × *P. minus* (= *P.* × *wilmsii* G. Beck; Fig. 5). Do hybrids with *P. hydropiper* also occur? The plant which was morphologically intermediate between *P. mite* and *P. hydropiper* did not have reduced pollen stainability and also produced a similar number of flowers and nutlets to *P. hydropiper*. This is almost certainly not a hybrid, because an F_1 hybrid would be triploid (2n=30) and, presumably, highly sterile. Therefore it would seem that Webb (1984) was correct when he indicated the potential presence of hybridization in sect. *Persicaria* around Lough Neagh, but with hybrids only occurring between *P. mite* and *P. minus*, and not all species present.

Out of the three species studied, *P. hydropiper* is supposedly the easiest to recognize. Webb (1984) and others (Tutin 1987; Lousley & Kent 1981) have indicated that the possession of glands on the perianth of *P. hydropiper* is, apart from its taste, one of the key characters allowing its separation from both *P. minus* and *P. mite*. Surprisingly we found that virtually all of the *P. mite* plants also had perianth glands, and initially we thought these were similar to those on *P. hydropiper*. This led us to believe at first that such plants might have been hybrids. However on closer examination we found the glands to be smaller, fewer in number and almost flat compared with those on *P. hydropiper*. Similar glands were also found on the perianth of British and European material of *P. mite*, despite the fact that these glands are not mentioned in standard works on *Polygonum* (Tutin 1987; Lousley & Kent 1981). However the differences in gland structure and number are further key characters, identified by DSC, separating *P. mite* from *P. hydropiper*. We also found that some of the other characters used to separate all three species, such as nut size and

FIGURE 5. *Polygonum mite* Schrank × *P. minus* Huds. from Lough Neagh, Northern Ireland, August 1984, *Parnell & Simpson D20* (**TCD**). Scale bar = 20 mm.

leaf length:breadth ratio are rather more variable than previously thought (Webb 1984 and pers. comm.) Both these latter characters are useful for distinguishing *P. minus* from both *P. hydropiper* and *P. mite*, but not for separating the last two from each other. This is particularly emphasized by the leaf length:breadth ratio, so that the leaves of *P. minus* are up to 8·5 times as long as broad whereas those of the other two species are up to 4·5–4·8 times as long as broad. The leaf shapes and sizes of *P. hydropiper* and *P. mite* may thus be very similar. Therefore, as is often the case, it is best to use a combination of the characters given in Table 2 to delimit the species, rather than rely on only a single character.

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