Figs. 1–4. Dichrorampha acuminatana. 1, Wings of male from Steuben, ME. 2, Wings of male from Apetlon, Austria. 3, Genitalia of male from Steuben, ME. 4, Genitalia of male from Apetlon, Austria. Further details are in the Specimens examined section of the text.

The species is widely distributed in western and central Europe (Razowski 1996). Two Palaearctic con­gener, D. vancouverana McDunnough (=D. gue­neeana Obraztsov) and D. petiverella (L.), were previ­ously reported in Maine (Roberts 1991), and sub­sequent collecting there has revealed well estab­lished populations of these species along the immedi­ate coastline wherever undisturbed stands of their na­tive or naturalized foodplant Achillea millefolium L. (Asteraceae) occur. With captures of D. vancouverana in the Pacific Northwest (Miller 1999), coastal distri­bution patterns of the two Palaearctic congeners con­tinue to suggest they are immigrants, although the possibility cannot be ruled out that they represent spotty relics of circumpolar distributions.

Specimens examined. ♂, Steuben, ME (Fig. 1), M. A. Roberts, 15/06/2001, genit. slide prep. MAR2027M (Fig. 3), forewing length 7.0 mm, in M. A. Roberts collection, Steuben, ME; ♂, Wangeroog, Ostfries. Inseln [Germany], 07/09/1949, E. Jäckh, genit. prep. on pin, forewing length 6.0 mm; ♂, Kel­heim, Obfrk. [Germany], 03/08/1952, Jäckh, genit. prep. on pin, forewing length 6.0 mm; ♂, Hannover, Misb Moor [Germany], 29/05/1931, genit. slide prep. WEM 612011, forewing length 6.5 mm; ♂, Apetlon, Burgenland [Austria] (Fig. 2), 11/09/1971, E. Jäckh, genit. slide prep. WEM612012 (Fig. 4), forewing length 5.5 mm. The four Palaearctic specimens are in the U.S. National Museum of Natural History (USNM), Washington, D.C.; we thank J. W. Brown for loaning them.

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Papaipema baptisiae baptisiae (Bird) and Papaipema b. limata Bird (E.L. Quinter, in Hodges 1983).

Papaipema and its relatives form a putatively monophyletic clade of endophagous plant borers in the Apameini (sensu Hodges 1983). Whereas most of the species in this tribe are associated with monocotyledonous plants, species of Papaipema feed and specialize on members of between 22 and 25 plant families (Goldstein 1999). Though well studied, a number of questions remain concerning host plant associations in this group, especially among the relatively few western species (Papaipema attains its highest regional diversity in the eastern United States). In this paper, we present life history data based on recent collecting and rearing efforts for species belonging to the Papaipema birdi (Dyar 1908) and Papaipema harrisi Grote species complexes, and summarize the known host associations for the remaining western Papaipema species and those associated with Apiaceae regardless of geography. Our observations bear on the evolution of umbellifer-feeding in Lepidoptera, and Papaipema in particular and possibly the role of coumarin compounds in mediating the evolution of host association (e.g., Berenbaum 1981, 1983). We also discuss collecting and rearing efforts on eastern umbell-feeding Papaipema species. All larvae encountered were reared on artificial diet, and adult specimens deposited at AMNH and FMNH.

Apiaceous host plant records for Papaipema species. A few species of Papaipema are known to feed on apiaceous plants, and although at least three of these (P. birdi, P. harrisi, and P. eryngii Bird) appear to be specialists on Apiaceae, the others exhibit a broader range of apiaceous and non-apiaceous host use. The P. birdi complex includes an eastern species (P. birdi) and two western species (P. pertinecta Dyar and P. insulidens Bird), all of which are associated with the Apiaceae (= Umbelliferae). Papaipema birdi has been considered oligophagous specialist on apiaceous plants, its primary host being the water hemlock Cicuta maculata L. Prior to the present study, other host records included Stium suave Walt. (Apiaceae), and “other umbellates” (Hessel 1954:60; treating P. birdi as a synonym of P. marginidens, of which there are no known host records), as well as several asteraceous plants (Kwiat 1916). The two other species in the P. birdi complex, P. pertinecta and P. insulidens, each of which have been recorded from both apiaceous and non-apiaceous plants, are western species apparently separated by the Cascade Mountains, with P. pertinecta to the west and P. insulidens to the east. A host of P. insulidens was described by Bird (1921, 1931) as a species of Senecio (Asteraceae). In the field notes of his son (archived at the American Museum of Natural History), the late Junius Bird, the host plant was described as a “large, Dill-like weed,” suggesting an apiaceous plant. The published association of P. pertinecta with Lupinus polyphyllus Lindley (Fabaceae) (see Bird 1926) is curious because only two other Papaipema species are associated with fabaceous plants: the western Papaipema anglica with Psoralea macrostachya DC., and the eastern Papaipema baptisiae with Baptisia tinctoria (L.).

Outside the Papaipema birdi complex, umbellifer-feeding occurs in Papaipema eryngii, a threatened species restricted to prairie wetlands where it specializes on Eryngium yuccifolium, and in the P. harrisi group, comprising P. harrisi and P. verona Smith). Host records for P. harrisi, whose distribution suggest an association with Heracleum lanatum Michx. (Apiaceae) along the Atlantic Coast and an association with Angelica atropurpurea L. (Apiaceae) westward following the Great Lakes (Kwiat 1916, Hessel 1954, Jones & Kimball 1943, Quinter unpublished data). Both of these host species are apiaceous plants. In the Northeast, it is thought that P. birdi and P. harrisi segregate themselves according to host plant, with P. birdi confining itself to Cicuta maculata and P. harrisi to Angelica atropurpurea (see Kwiat 1916, Hessel 1954). Papaipema verona, for which we do not report novel host records, is a western species recorded primarily from species of the umbell genus Heracleum.

Recent field collections. During 1995, we examined several eastern USA sites for larvae of both P. birdi and P. harrisi. Visits to wetlands in western Connecticut and Massachusetts with dense populations of Angelica atropurpurea yielded only two Papaipema larvae (Papaipema harrisi has become decidedly rare in New England and is considered extirpated from Massachusetts). However, visits to a calcareous sedgemeadow complex in Otsego County, New York yielded more than two dozen Papaipema larvae from both Angelica atropurpurea and Cicuta maculata. All larvae collected from C. maculata and A. atropurpurea at the upstate New York site proved to be P. birdi. Although reports of “other umbellates” than Cicuta maculata and Stium suave occur in the literature (e.g., Kwiat 1916), our collections appear to be the first documentation of Angelica atropurpurea as a host for P. birdi. Although Kwiat (1916) reported non-apiaceous hosts for P. birdi, it is conceivable that the taxonomic confusion that typically surrounds Papaipema has resulted in erroneous reporting of hosts subsequent to that publication.

Our findings in the northwestern United States extended the known host ranges of P. pertinecta and P. in-
These represent the least well-known *Papaipema* species for which published host records exist; their close resemblance to *P. birdi* as well as the informal description by Junius Bird of a "large, dill-like" host for *P. insulidens* suggested that apiaceous plants might fall within the host spectra of one or both of these two western species in the *birdi* complex. An additional southwestern species, *Papaipema angelica* Smith, 1899 has remained uncollected in recent decades despite our knowledge of its life history and host affiliation (Bird 1931). Although several dozen specimens of *P. pertinax* exist in the Oregon State University insect collection (which now includes the private collection of the late Elmer Griepentrog), we have been unable to verify the association of *P. pertinax* with any species of *Lupinus*. We thoroughly examined the botanical holdings at OSU to identify sites likely to support strong populations of various western lupines, but we found no *Papaipema* at any of these, and apparently no western collectors have observed or reared *P. pertinax* from *Lupinus* since Bird’s (1926) second-hand account of the association. However, several dozen *P. pertinax* were reared from a variety of plants, mostly apiaceous, at six sites in Tillamook, Clatsop, and Lincoln counties (Table 1). Like its eastern relative *P. birdi*, *P. pertinax* appears to feed primarily in apiaceous plants; but unlike its eastern associate, *P. pertinax* also feeds in non-apiaceous plants.

In three weeks of field work in eastern Washington and Idaho, we failed to collect *P. insulidens* from its recorded host, *Senecio hydrophilus* Nutt. We examined sites suggested by the literature, museum labels, and the hand-written field notes and sketches of Junius Bird indicating large apiaceous host plants in Whitman County, Washington. Near localities visited by Junius Bird, several stands of *Conium maculatum* L. ( Apiaceae), which matched his description and sketch, were checked without success. Thirteen larvae of *P. insulidens* were discovered and reared from *Heracleum maximum* Bartr. (Apiaceae) at Steptoe Butte at an elevation of 2500–3000'. Although we could not verify many published host associations of the two western members of the *Papaipema birdi* complex, we did take them on other hosts, apiaceous and otherwise. One possibility is that the dill-like host plant of *P. insulidens* referred to by Junius Bird was not apiaceous at all, but the introduced tansy ragwort *Senecio vulgaris*, one of the host plants from which we reared *P. pertinax*.

The reported host associations of the western *P. sauzalitae* (Grote) are atypically diverse for *Papaipema*, and include members of the asteraceous plant genera *Arctium*, *Cirsium*, and *Cynara* as well as *Castilleja* (Scrophulariaceae), and *Rumex* (Polygonaceae) (Crumb 1956). Peter McEvoy (pers. com.) of Oregon State University reports an association of *P. sauzalitae* with *Senecio* (Asteraceae) as well. Our collecting efforts yielded but a single specimen, from the exotic *Cirsium vulgaris*. However, California material at the Essig Museum includes specimens from Inverness Park (Marin Co.) where larvae were observed in *Heracleum maximum*, *Artemisia douglasiana* Bess. in Hook. (Asteraceae), and *Ribes* sp. (Grossulariaceae), suggesting that *P. sauzalitae* may be polyphagous (J. Powell pers. com.). If this is the case, the member species of each of the primary umbellifer-feeding *Papaipema* species groups (the *harrisi-verona-sauzalitae* group...
complex and the birdi-pertincta-insulidens complex, have broadened their host usage to include both composites and umbels on the west coast.

The association of P. pertincta with apiaceous and non-apiaceous plants is noteworthy for two reasons. First, this species parallels P. insulidens in having a wider range of non-apiaceous recorded hosts than expected, given the apparently tighter associations of their eastern relatives (P. birdi and P. sauzalitae, respectively) with umbels. Second, based on available DNA sequence data, P. pertincta is nearly indistinguishable from P. birdi (Goldstein 1999). We can not, therefore, rule out the possibility of P. pertincta’s feeding facultatively on Lupinus, though we were unable to recover larvae from any fabaceous plants and it is clear that the species is not thus restricted.

Although both facultative and obligate association with asteraceous plants is common among Papaipema species, umbel-feeding is less common. The parallel variation in host breadth among umbel-feeding Papaipema species is thus noteworthy, and suggests a profitable line of inquiry for further work on host use specialization in this group.

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