A tentative list of known hostplant records for *Manduca rustica* (Fabricius, 1775) with comments (Lepidoptera: Sphingidae)

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Abstract: The hawkmoth genus *Manduca* (Hübner, 1807) represents one of the richest and most widely spread New World Sphinginae groups. Some of its predominantly neotropic members are known for their regular migrations towards colder regions, with their larvae being found in different climatic zones. Whereas the widespread *M. sexta* (Linnaeus, 1763) and the nearctic *M. quinquemaculata* (Haworth, 1803) are highly specialized on the Solanaceae and thus synanthropic species typically feeding on cultivated crops, *M. rustica* shows a predilection for woody plants belonging to a rather broad spectrum of botanic families; the available information on foodplant records for its caterpillar – including well-known systematic sources as well as independent newer findings documented on the web – is tentatively listed and commented here, with an attempt of some conclusions in comparison to other hawkmoth relatives with similarly structured hostplant predilections.

Keywords. Lepidoptera, Sphingidae, *Manduca*, Sphinginae, larval hostplants, Neotropical Region, Nearctic Region, ecology, migrations.

Vorläufige Liste der bekannten Futterpflanzen von *Manduca rustica* (Fabricius, 1775) mit Anmerkungen (Lepidoptera: Sphingidae)

Zusammenfassung: Die Schwärmergattung *Manduca* (Hübner, 1807) stellt eine der artenreichsten und am weitesten verbreiteten Sphinginae-Gruppen der Neuen Welt dar. Einige ihrer vorwiegend neotropischen Vertreter sind als regelmäßige Wanderer in kühleren Regionen bekannt, und ihre Raupen werden in verschiedenen Klimazonen gefunden. Während die weitverbreitete *M. sexta* (Linnaeus, 1763) und die nearktische *M. quinquemaculata* (Haworth, 1803) stark auf die Nachtschattengewächse spezialisiert und daher typische Kulturfolger sind, die sich von angebauten Pflanzen ernähren, zeigt *M. rustica* eine Vorliebe für verholzte Gewächse eines ziemlich breiten Spektrums von botanischen Familien; im vorliegenden Beitrag werden die zugänglichen Daten über die Futterpflanzen ihrer Raupen – sowohl aus bekannten systematischen Quellen als auch aus selbständigen neueren Fundbelegen im Internet – versuchsweise aufgelistet und kommentiert, wobei einige Rückschlüsse im Vergleich mit verwandten Schwärmerarten angestrebt werden, die ähnliche botanische Vorlieben zeigen.

Introduction

More than 60 species are currently described within the well-known genus *Manduca* (Tuttle 2007, Kitching 2018), all of which inhabit the New World. Whereas a part of them, and especially the regular migrators, reaching rural, ruderal and densely settled areas, are often seen, well known and therefore also well described as larval instars, others are uncommon, limited to smaller biotopes, with larvae only known to specialists. The caterpillars of a part of them – with a few quite common species – still remain unknown or undescribed, respectively not doubtlessly defined (Dvořák 2015).

The larvae of quite many *Manduca*-species show a clear predilection for the Solanaceae, a family of predominantly herbaceous annual plants especially well established in the warmer areas of the New World, and with many of them serving as cultural plants nowadays. Those species like *M. sexta* and *M. quinquemaculata* – similarly to *Acherontia atropos* (Linnaeus, 1758) in the Old World – could additionally spread and easily become, in a few centuries, most common synanthropic species, following the given opportunities of permanently fresh soft soil with big amounts of juicy foliage (formerly extremely rare and limited, and therefore difficult to find) on cultivated well-grown plants; the need for fresh soft soil, additionally associated with the mostly pioneering plants, can be interpreted by the pupation mode in underground cells – an aspect giving human agriculture an additional importance and explaining the migrating character of many synanthropic species (Dvořák 2016).

Host-plant records and plant families

Similarly to the members of *Coelonia* Rothschild & Jordan, 1903 and *Acherontia* Laspeyres, 1809, the larvae of *M. rustica* have been found feeding on the species of at least 20 different plant families.

The following list intends to present the accessible foodplant records in alphabetical order. The following abbreviations indicate authors of the documenting sources and/or the single finders:

- "bamona" [for "*Butterflies and Moths of North America*"] (= Lotts & Naberhaus 2018),
- "BO" for the platform of Bill Oehlke (= Oehlke 2018),
- "BG" [for BugGuide] (= Van Dyk 2016),
- "GS" [for Growing with Science] (= Gibson 2015),
- "JH" [for the website of Janzen & Hallwachs] (= Janzen & Hallwachs 2009),
- "UF" [for University of Florida] (= Byron & Gillett-Kaufman 2016),
- "WTB" [for the site „*What's That Bug?*"] (= Marlos 2018).

Annonaceae. *Annona squamosa* (BO); no illustrated documentation to date. – *Asimina triloba* (bamona, sighting no. 1094013 by "treedancer" on 4. viii. 2016): one larva has been found on a leaf of this plant (without visible feeding traces) with additional information that an ash tree (Oleaceae) was growing directly over it.

Apocynaceae. *Himatanthus sucuuba* (BO); *Plumeria acuminata* (BO); *Plumeria alba* (BO); no illustrated documentation to date.

Aquifoliaceae. *Ilex cornuta* × *aquifolia* (Nellie Stevens Holly) (BAMONA, sighting 1067070 by Marcia TAYLOR on 29. IX. 2015): freshly emerged moth under the plant with traces.

Asteraceae. *Helianthus annuus* (BG; BO; UF); documented by several pictures in all sources, clearly showing grown up larvae sitting and/or chewing the leaves of the plant, mostly within sunflower fields. Other pictures can be found on the web, on which the larvae sit on plants with smaller leaves and blossoms, indicating the related topinambur, *Helianthus tuberosus,* as additional host.

Bignoniaceae. *Amphilophium crucigerum* (JH); *Amphilophium paniculatum* (JH); *Arrabidaea chica* (JH); *Arrabidaea mollissima* (JH); *Arrabidaea verrucosa* (JH); *Bignonia* sp. (UF); *Bignonia capreolata* (BG); *Campsis radicans* (BG); *Chilopsis linearis* (BAMONA; BG; BO; GS); *Crescentia alata* (JH); *Cydista diversifolia* (JH); *Cydista heterophylla* (JH); *Handroanthus impetiginosus* (JH); *Handroanthus ochraceus* (JH); *Macfadyena* (= *Dolichandra*) *unguis-cati* (GS); *Stizophyllum riparium* (JH); *Tabebuia* sp.; *Tabebuia pallida* for *M. rustica harterti* (BO); *Tabebuia palustris* (JH); *Tabebuia rosea* (JH); *Tecoma stans* (BO); *Tecomaria capensis* (BG); well documented and frequently pictured on all the listed family members. Most often found on single ornamental plants in gardens in southern region of the United States; in the Southwest, *Chilopsis linearis,* an indigenous species of the region, represents a clear predilection in urban as well as in rural areas.

Boraginaceae. *Ehretia anacua* (BO; BG); *Bourreria succulenta* (BG); *Heliotropium* sp. (UF); *Varronia guanacastensis* (JH); *Varronia inermis* (JH).

Convolvulaceae. *Ipopoea carnea* (ABBOTT); *Ipomoea horsfalliae* (BG); *Ipomoea* sp. (BG); *Merremia tuberosa* (JH); *Merremia umbellata* (JH); the last two well documented by breeding in JH, the first one identified by DVOŘÁK in a garden report of the Ellen ABBOTT's Blogspot (ABBOTT 2009).

Cordiaceae. *Cordia alliodora* (JH); *Cordia boissieri* (BG); *Cordia collococca* (JH); *Cordia croatii* (JH); *Cordia panamensis* (JH); *Cordia polycephala* (JH).

Heliotropiaceae. *Tournefortia maculata* (JH).

Lamiaceae. *Aegiphila costaricensis* (JH); *Aegiphila elata* (JH); *Aegiphila martinicensis* (JH); *Callicarpa americana* (BG; BO; UF); *Clerodendrum paniculatum* (BAMONA); *Clerodendrum speciosum* (JH); *Clerodendrum thomsoniae* (BAMONA); *Gmelina arborea* (JH); *Ocimum basilicum* (BG; BO; WTB); *Aloysia virgata* (BAMONA); *Aloysia wrightii* (BO); *Aloysia gratissima* (BG); *Cornutia grandifolia* (JH); *Hyptis obtusifolia* (JH); *Hyptis verticillata* (JH); *Salvia eremostachya* (BAMONA); *Trichostema dichotomum* (BO; UF); *Vitex agnus-castus* (BG; WTB); *Vitex cooperi* (JH).

Lindneriaceae. *Torenia fournieri* (BG).

Lythraceae. *Lagerstroemia indica* (BO; UF).

Malvaceae. *Gossypium herbaceum* (BO); *Helicteres baruensis* (JH); *Helicteres guazumifolia* (JH).

Muntingiaceae. *Muntingia calabura* (JH).

Oleaceae. *Chionanthus virginicus* (UF); *Fraxinus* sp. (BAMONA; UF; DODGE 2015); *Fraxinus americana* (BG); *Jasminum* sp. (BG; UF); *Ligustrum japonicum* (BO); *Ligustrum lucidum* (BAMONA; BG), sighting 1135032 from 17. VIII. 2017 by Mary POOLE; *Ligustrum ovalifolium* (BO); *Ligustrum sinense* (BG; UF; BAMONA); *Ligustrum vulgare* (BO); *Olea europaea* (Florida) (UF; GILLETT-KAUFMAN et al. 2015); *Osmanthus heterophyllus goshiki* (WOODLANDGNOME); *Syringa vulgaris* (BAMONA; BG; BO; UF).

Onagraceae. *Fuchsia* sp. (WTB, 5. XI. 2010).

Pedaliaceae. *Sesamum indicum* (BO; UF).

Plantaginaceae. *Russelia sarmentosa* (JH).

Rubiaceae. *Gardenia* sp. (UF); *Gardenia jasminoides* (BAMONA; BG; BO); *Genipa americana* (JH); *Uncaria tomentosa* (GS).

Scrophulariaceae. *Buddleja davidii* (BG; BO); *Buddleja* sp. (BAMONA, no. 1096717; SPEAKE 2017); *Leucophyllum frutescens* (BAMONA; BG).

Verbenaceae. *Callicarpa acuminata* (JH); *Citharexylum berlandieri* (BG); *Citharexylum spinosum* (BAMONA); *Duranta erecta* (BG; BO; BAMONA: one sighting on „*Ligustrum variegatum*" with no. 1101399 obviously shows a *Duranta* plant); *Lantana* sp. (UF); *Lantana camara* (O; BAMONA: 1020501, 1028352, 1068666); *Lippia alba* (BG; BO); *Lippia bracteosa* (JH); *Lippia oxyfilaria* (JH); *Stachytarpheta frantzii* (JH); *Stachytarpheta jamaicensis* (JH).

Comments

A predilection for woody perennial plants (shrubs, smaller trees — with only a few exceptions including stronger growing annual plants) of minor or moderate toxicity is evident. Thus it may be surprising to find some Apocynaceae listed among *M. rustica*'s hostplants as well, as Sphinginae are generally not known to feed on mostly highly poisonous plants from this family, which represents a group of favourite hosts for many genera of the Macroglossinae subfamily on the other side.

However, as caterpillars of *Acherontia atropos,* a species with a similarly polyphagous character as *M. rustica,* have been reported to feed on *Nerium oleander* several times in the literature (e.g. MAZZEI et al. 1999) and a recent finding from Italy (VOLPENERA 2009) — documenting a L_2-larva of *A. atropos* accidentally found and then successfully grown on oleander until pupation — brings additional evidence for this host in *A. atropos,* occasional occurrence of *M. rustica* larvae on some less (i.e., not extremely) poisonous representatives of this family (as e.g. *Apocynum, Vinca, Tabernaemontana, Nerium, Amsonia, Thevetia, Trachelospermum*) should not be excluded either.

Nevertheless, highly poisonous Apocynaceae plants with abundant latex, associated with specific adaptation in *Pseudosphinx tetrio* (LINNAEUS, 1771) and a few species of *Isognathus* FELDER & FELDER, 1862, but not supported

by, e.g. larvae of an Appocynaceae-specialist like *Daphnis nerii* (Linnaeus, 1758) do not seem to be probable hostplants of *M. rustica,* and should therefore rather be considered as erroneous, due to some misunderstanding or confusion with the caterpillars of the mentioned Dilophonotini tribes.

Interestingly, *Acherontia* Laspeyres, 1809 seems to be the only gender of Acherontiina with a species recorded on an Apocynaceae plant so far, as this is not yet evident for any member of the closely related *Coelonia* Rothschild & Jordan, 1903 in spite of their similar preferences, and no other Old World Sphinginae, not even a member of the highly polyphagous *Psilogramma* Rothschild & Jordan 1903, has ever been reported on a member of this family.

One of the most striking peculiarities of *Manduca rustica* – in comparison with other migrating and/or widely spread *Manduca* species – is the fact that its larvae are not known to have ever been found on a species of Solanaceae so far, in striking contrast to the other two regularly occuring widespread relatives *M. sexta* and *M. quinquemaculata,* for which the Solanaceae represent the (almost) only family of foodplants. No documented finding of any larva of both latter relatives is known from a Bignoniaceae, Convolvulaceae, Oleaceae, Verbenaceae or any other representative of a shrubby plant or tree (with the exception of the Solanaceae family) either, which seems to make evident that the contrast in the foodplant spectrum represents a systematic difference between the two (and more) *Manduca*-types proposed by Dvořák (2015).

This is essentially different in the Acherontiini, the widespread representatives of which – with the striking exception of *Agrius* – are known to occur on both tree and shrubby plants as well as annual Solanaceae; larvae of *Acherontia*- and *Coelonia*-species are parallel found on all cultivated solanaceous crops typical for *M. sexta* and *M. quinquemaculata* and the representatives of all the arbustous plant families typical for *M. rustica* – and many other plant families (Attié et al. 2010, Dvořák 2016, 2017). Compared to *Manduca, Acherontia* and *Coelonia,* the representatives of the Asian *Psilogramma* show a clearer predilection for woody plants (compare with Pittaway & Kitching 2018 for *Psilogramma* species), which can be assumed for all members of the "*Psilogramma* genus-group", including *Macropoliana* Carcasson, 1968 (Africa) and *Notonagemia* Zolotuhin & Ryabov, 2012 (Asia), and is typical for the Cocytiina, all members of which seem to be woodland species.

Whereas no Solanaceae are currently present among *M. rustica*'s known hosts, its caterpillars have been found feeding on *Ipomoea carnea* from the Convolvulaceae family; this finding was a surprise for me, since I rather expected this species feeding exclusively on woody plants similar to *Psilogramma* members in Asia.

However, *I. carnea,* which I recognized on the photo documentation of Ellen Abbott's blog (Abbott 2009), could also be considered as a rather shrubby endurant plant, not like the other related, predominantly low growing members of the genera *Ipomoea* or *Convolvulus,* characteristic for ruderal areas; but several other Convolvulaceae are listed among *M. rustica*'s hosts by Janzen, mostly from the genus *Merremia,* which are clearly pioneer low growing ruderal plants, and additionally other *Ipomoea* species of this type. On the other hand, basil (*Ocimum basilicum,* Lamiaceae) is an often and well-documented host as well, thus further indicating that the limit between herbaceous and woody plants in this species should eventually be considered rather putative and fluent.

Solanaceae may be excluded as hosts for other reasons, e.g. high level of toxicity or other chemical contents not palatable to the species; among them *Cestrum* and other genera of woody representatives would be more probable hosts than herbaceous species, but no documented finding of this common hawkmoth species on any of them is currently known – whereas larvae of numerous other *Manduca*-species of *sexta*-type (*M. pellenia* (Herrich-Schäffer, [1854]), *M. hannibal* (Cramer, 1779), *M. ochus* (Klug, 1836) etc.) are commonly found on those.

Acknowledgments

Thanks to Darryl Alan Birdsall, Graz, for his grammatical proofreading of the manuscript. Thanks also to Wolfgang A. Nässig, Frankfurt am Main, for useful advice and essential support in defining the sources.

References

Abbott, E. (2009): Stuff from Ellen's head [*M. rustica* larva on *Ipomoea carnea*]. – URL: ellenshead.blogspot.de/ 2014/09/ itsrather-pleasant-out-there-this.html (last accessed: 9. viii. 2018).

Attié, M., Kitching, I. J., & Veslot, J. (2010): Patterns of larval hostplant usage among hawkmoths (Lepidoptera: Sphingidae) from La Réunion with a comparison of the Mascarenes with other regions of the world. – Revue d'Ecologie (La Terre et la Vie), Paris, **65:** 3–44. – URL: documents.irevues. inist.fr/ handle/2042/54303 (last accessed: 20. ix. 2018).

Byron, M. A., & Gillett-Kaufman, J. L. (2016): *Manduca rustica* (Fabricius). Featured Creatures. – Institute of Food and Agricultural Sciences, University of Florida. – URL: entnemdept.ufl.edu/ creatures/ ORN/ Manduca_rustica. htm (last accessed: 9. viii. 2018).

Dodge, G. (2015): Nature watch. [*M. rustica* larva on ash; sighting from 27. viii. 2015.] – URL: www.natureblog.org/another-sphinx-an-odd-named-butterfly-and-a-homegrown- mantid/ (last accessed: 9. viii. 2018).

Dvořák, B. (2015): Einige Bemerkungen zu den Präimaginalstadien des neotropischen Schwärmers *Manduca albiplaga* (Walker, 1856) (Lepidoptera: Sphingidae). – Entomologische Zeitschrift, Schwanfeld, **125** (2): 121–125.

—— (2016): Verbreitung der Acherontiini-Genera im Lichte der Verpuppungsweise: Die Vertreter von *Coelonia* und *Megacorma* als Nichtwanderer (Lepidoptera: Sphingidae). – Nachrichten des Entomologischen Vereins Apollo, Frankfurt am Main, N.F. **36** (2): 109–116.

—— (2017): Une tentative d'inventaire des plantes-hôtes pour le sphinx afro-tropical *Coelonia fulvinotata* (Butler, 1875) (Lepidoptera: Sphingidae). — Bulletin de la Société Entomologique de France, Paris, **122** (3): 305–310.

—— (2018): Bemerkungen zur Verhaltensweise und Phänologie der Raupen von *Pseudosphinx tetrio* (Linnaeus, 1771) und verwandten Dilophonotini-Genera (Lepidoptera: Sphingidae): wer ahmt wen nach? — Nachrichten des Entomologischen Vereins Apollo, Frankfurt am Main, N.F. **38** (4): 183–190.

Gibson, R. (2015): Growing with science blog. A place for science and nature exploration. Caterpillars on *Chilopsis linearis* and *Macfadyena unguis-cati*. — URL: blog. growingwithscience. com/tag/manduca-rustica-caterpillar/ (last accessed: 20. viii. 2018).

Janzen, D. H., & Hallwachs, W. (2009): The known Sphingidae of Costa Rica, Area de Conservación Guanacaste (ACG), Northwestern Costa Rica. — URL: janzen.sas.upenn.edu /caterpillars/ checklists/ sphingidaelist.htm, *Manduca rustica* (last accessed: 20. ix. 2018).

Gillett-Kaufmann, J. L., Allan, S. A. & Buss, L. J. (2015): *Manduca rustica* (Lepidoptera: Sphingidae) damage on olive (*Olea europaea*; Lamiales: Oleaceae) trees in Florida. — Florida Entomologist, Gainesville, **98** (4): 1260–1261.

Kitching, I. J. (2018): Sphingidae taxonomic inventory. — URL: sphingidae.myspecies.info/taxonomy/term/1660 (last accessed: 20. viii. 2018).

Lotts, K., & Naberhaus, T. (2018): Butterflies and moths of North America (bamona), *Manduca rustica*. — URL: www. butterfliesandmoths.org/species/Manduca-rustica (last accessed: 20. viii. 2018).

Marlos, D. (2018): Blog "What's that bug?" *Manduca rustica* records. — URL: www.whatsthatbug.com/2010/09/04/rustic-sphinx-hornworm/ (last accessed: 20. viii. 2018).

Mazzei, P., Morel, D. & Panfili, R. (1999): Moths and butterflies of Europe and North Africa. *Acherontia atropos*. — URL: www. leps.it/ indexjs.htm? SpeciesPages/ AcherAtropos.htm (last accessed: 20. ix. 2018).

Oehlke, B. (2018): Tribus Sphingini. — URL: www.silkmoths.bizland.com/Sphinx/trsphingini.htm [direct link to *Manduca rustica:* www.silkmoths.bizland.com/Sphinx/mrustrus.htm (last accessed: 20. ix. 2018).

Pittaway, T., & Kitching, I. J. (in association with F. Lin) (2018): Sphingidae of the Eastern Palearctic (including Siberia, the Russian Far East, Mongolia, China, Taiwan, the Korean Peninsula and Japan). — URL: tpittaway.tripod.com/china/p_men.htm (last accessed: 20. ix. 2018).

Speake, C. (2017): "Tobacco Hornworm (*Manduca sexta*)"; [contribution from 7. v. 2017 in the blog "The Gardening Cook". The second photo with a larva of *M. rustica* found on *Buddleja* sp.]. — URL: thegardeningcook.com/tobacco-hornworm-caterpillar/ (last accessed: 20. ix. 2018).

Tuttle, J. P. (2007): The hawk moths of North America, a natural history study of the Sphingidae of the United States and Canada. — Washington D.C. (Wedge Entomological Research Foundation), 253 pp.

Van Dyk, J. (2016): Species *Manduca rustica* — Rustic Sphinx. Bug guide, Iowa State University, Department of Entomology. URL: bugguide.net/node/view/3774/bgimage (last accessed: 20.06.2018).

"WoodlandGnome" (2014): Hummingbird moth. Forest garden. Tips, tricks and tools for gardening in a forest community. ("The largest caterpillar I've ever seen is munching my *Osmanthus goshiki* shrub. It has been identified by Bostjan Dvorak as *Manduca rustica*"). — URL: forestgardenblog. wordpress. com/ 2013/08/05/hummingbird-moth/ (last accessed: 20. ix. 2018).

Volpenera, D. (2009): "Uno Sfingide dagli strani gusti", [contribution to the platform "*Natura Mediterraneo*" on 1. vii. 2009 documenting a larva of *A. atropos* (L_2) found and grown (to L_5) on *Nerium oleander*. — URL: www. naturamediterraneo. com /forum /topic.asp? TOPIC_ID=85681 (last accessed: 20. ix. 2018).

Received: 3. vii. 2018

 ISSN 0723-9912