2022. Proceedings of the Indiana Academy of Science 130(2):123–129

RECENT COUNTY-LEVEL ADDITIONS TO THE VASCULAR PLANT FLORA OF THE LOWER INDIANA WABASH RIVER CORRIDOR

Richard M. Hull[1], **Paul E. Rothrock** and **Eric B. Knox:** Indiana University Herbarium, Bloomington, IN 47408 USA

ABSTRACT. This paper presents 131 additions to the vascular plant floras of Fountain, Gibson, Knox, Parke, Posey, Sullivan, Tippecanoe, Vermillion, Vigo, and Warren Counties in western Indiana. These county records were documented during the first year of a three-year project to document the modern flora of the lower Indiana Wabash River corridor and represent 5.2 percent of the 2,519 voucher specimens collected. All voucher specimens are deposited at the Indiana University Herbarium (IND).

Keywords: county record, flora, herbarium, Indiana, Wabash River

INTRODUCTION

The 523-kilometer span of the Wabash River from Tippecanoe County south to Posey County is Indiana's largest north-south river corridor. At least 1,887 species of vascular plants, or 70.9 percent of the entire Indiana flora, have been historically documented in the Indiana counties located along this stretch of the lower Wabash River (Rothrock 2019; Hull 2022). This is a testament to the diversity of natural regions that occur in this part of Indiana, which includes five of Indiana's 12 natural regions (Homoya et al. 1985). Additionally, remnant habitats containing different high-quality natural communities exist in this river corridor. These include sandstone outcrops, fens, and tall-grass prairies in the Central Till Plain Natural Region; sand barrens and lowland flatwoods in the Southwestern Lowlands Natural Region; and swamp forests in the Southern Bottomlands Natural Region (Homoya 2006).

The vascular plant flora of the lower Wabash River corridor has been well documented, as there are over 15,700 digitized herbarium specimens from Fountain, Gibson, Knox, Parke, Posey, Sullivan, Tippecanoe, Vermillion, Vigo, and Warren Counties published on the Consortium of Midwest Herbaria (CMH 2022). Of these, 9,838 (65.6%) specimens were documented prior to the year 1950, with 6,132 (62.3%) of these specimens documented by Charles and Stella Deam as a basis for the Flora of Indiana (Deam 1940; CMH 2022). The flora of this region is also supplemented by 100 Years of Change in the Distribution of Common Indiana Weeds (Overlease & Overlease 2006), An Annotated Checklist of the Plants of Tippecanoe County, Indiana (McCain 1994), and articles in the Proceedings of the Indiana Academy of Science.

These historical records provide a baseline for current floristic surveys in the lower Wabash River corridor by establishing the region's flora during the early 1900s. Later records began to demonstrate the floristic response to environmental change, but our understanding of this response due to anthropogenic pressures is incomplete because most voucher collecting in the region was completed prior to 1950. Therefore, a modern floristic survey of the lower Wabash River corridor will enable a comparative analysis of change from the early 1900s to the present. The results from this analysis will enable predictions of how the Indiana flora will continue to change, highlight current conservation needs, and establish a baseline for future floristic analyses in the lower Wabash River corridor. The 131 county records discovered during the inaugural field season of this three-year project are presented here.

MATERIALS & METHODS

All 131 county records were documented at one of 43 study sites along the Wabash River corridor in Fountain, Gibson, Knox, Parke, Posey, Sullivan, Tippecanoe, Vermillion, Vigo, and Warren Counties (Fig. 1). All county records were photographed prior to being collected. Herbarium specimens were obtained with permission from landowners and under the stipula-

[1] *Corresponding author:* Richard M. Hull, Department of Biology, Indiana University, Bloomington, IN 47405, 404-844-3448 (phone), 812-855-6705 (fax), richhull@iu.edu.

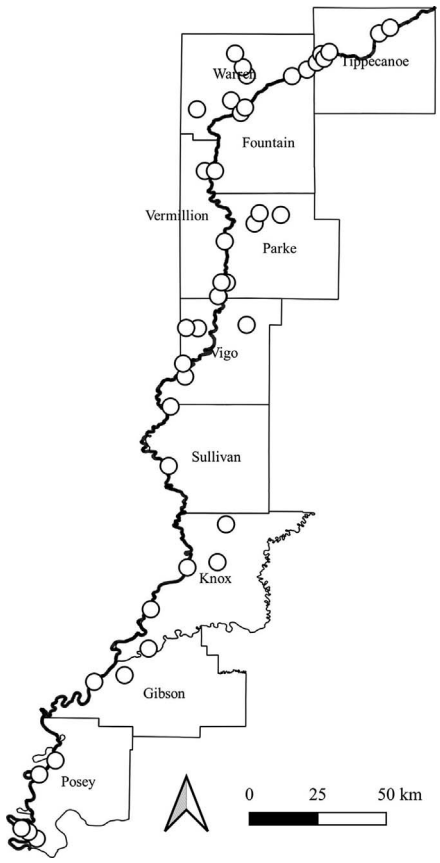

Figure 1.—Locations of the 43 study sites in 10 counties along the lower Indiana Wabash River corridor. The heavy line represents the Wabash River and the circles indicate the locations of the study sites.

tions set forth by the Indiana Department of Natural Resources (INDNR). Special permission was granted to collect diagnostic portions of species listed on the INDNR "Endangered, Threatened, Watch List and Extirpated Plants of Indiana" when population sizes exceeded 10 plants (INDNR 2021). Vouchers are deposited at IND, and voucher data and photographs are available online at CMH. All herbarium specimens were identified by Richard M. Hull, except for several that were identified by either Paul E. Rothrock or Daniel J. Layton. These latter vouchers are properly denoted on the CMH data portal.

To establish the historically recorded flora of each county in the study region, CMH checklists were created for each study county. These checklists were populated with all digitized herbarium specimens from each county that are published on CMH, excluding records published by the author (CMH 2022). Next, each checklist was updated with records from *100 Years of Change in the Distribution of Common Indiana Weeds* (Overlease & Overlease 2006), *An Annotated Checklist of the Plants of Tippecanoe County, Indiana* (McCain 1994), *Plants of Portland Arch Nature Preserve* (Burgette & Knudson 1976), the INDNR Indiana County Endangered, Threatened and Rare Species List (2022), the USDA PLANTS Database (USDA, 2022), and articles in the *Proceedings of the Indiana Academy of Science* (Jackson et al. 1975; Ebinger & Bacone 1980; McClain 1980a, 1980b; Homoya 1982; Aldrich & Homoya 1983; McClain 1983; Post 1984; Homoya et al. 1995; Post et al. 1985; Aldrich et al. 1986; Homoya & Abrell 1986; Homoya 1987; Homoya & Hedge 1990; Tonkovich & Sargent 1993; Mark & Scott 2004; Scott 2009). The taxonomy of each checklist was updated to match that currently used at IND, and dubious records with no herbarium specimen were excluded (Rothrock 2019).

These historical checklists were downloaded and imported into the coding software R, along with the data for all the herbarium specimens collected during the 2021 field season (R Core Team 2021). The first step in identifying county records from this project was to select the first recorded herbarium specimen for each documented species per county out of the project's 2,519 herbarium specimens. The species and county combinations for these records were then checked against the historical record, and species and county combinations that were lacking in the historical record were saved. This list was compared manually against the records maintained by the Biota of North America Program (BONAP), and entries representing species already represented in this database were excluded from the final county records list presented in Appendix 1 (Kartesz 2014). Species that were known to be introduced to sites as part of restoration projects were also excluded from this tally.

RESULTS & DISCUSSION

A total of 131 county records were collected during the 2021 field season (Appendix 1). Knox County, Indiana, had 29 new records, Warren County had 21, and Posey County had 19. Notably, Tippecanoe County gained no new records, while Vigo County added only four.

These differences are largely due to the amount of collecting that occurred in these counties prior to this study, especially in recent years. For example, from 2001 to 2018 Ian MacDonald collected 1,092 herbarium specimens in Vigo County, providing this region with many new records consisting of a wide range of adventive weedy species (CMH 2022). In contrast, Posey County, albeit historically well-documented, lacks many recent collections and consequently gained more county records comprised of recent adventive species (CMH 2022).

Overall, 56 of the 131 county records (42.7%) are non-native species, as listed for Indiana by BONAP (Kartesz 2014). These species were likely not present when Deam (1940) published the *Flora of Indiana*, or alternatively, were not naturalized to the point of inclusion in this work. These species represent the most visible impacts of environmental change on the flora of the lower Wabash River corridor.

For the 73 county records representing native species, the reasons why these species were not previously documented are more diverse. It is possible that these species were missed by Deam and subsequent collectors in certain counties, especially in under-documented regions, such as Warren and Knox Counties. In addition to this, nine of the 73 (12.3%) county records representing native species are from the genus *Carex*, a historically under-represented taxonomic group in herbarium collections (Daru et al. 2018). Other species have likely increased in abundance in the study region in recent years to the extent that these species are more easily discovered now than in the past, and other species could have experienced distribution shifts that introduced them to all or parts of the study region. One such example is *Valerianella radiata* (L.) Dufr., which lacks any collections from the entire study area prior to 2005, when it was documented by Ian MacDonald in Vigo County (MacDonald 050506a1). In 2021, this project added this species to the floras of Posey, Gibson, and Knox Counties. This species is likely a beneficiary of environmental change in Indiana, where it reaches its northern range limit (Kartesz 2014). This boundary is now expanding northwards in the state, possibly because of less extreme winter temperatures. Based on current fieldwork, it is apparent that other weedy native species, such as *Diodia virginiana* L. and *Myosotis macrosperma* Engelm., are similarly benefiting from environmental change. We postulate that it is likely that native weedy species will benefit from environmental change more than native non-weedy species in Indiana, since these former species often inhabit sites that are located near human activity and are therefore better prepared for long distance dispersal to similar disturbed habitats that were previously uninhabitable solely due to climate restrictions that are now being weakened. Furthermore, we expect that native species with long-distance dispersal mechanisms, such as wind-dispersed seeds, will also migrate in response to environmental change more effectively than species with short-distance dispersal mechanisms.

Only three of the 131 (2.29%) county records represent species that are included on the INDNR "Endangered, Threatened, Watch List and Extirpated Plants of Indiana" (INDNR 2021). *Napaea dioica* L., a state-threatened species, was discovered for the first time in Vermillion County, at a site about 3 km away from a population Deam documented in Parke County during 1918 (Deam 25802). *Hydrastis canadensis* L., a state watch list species, was found in Warren County by Bob Easter, who assisted in the collection of the county record. *Liatris pycnostachya* Michx., a state-endangered species, was discovered in a prairie restoration in Warren County, where it was not reported as being planted. Despite the possibility that this population was introduced to the site, the prairie restoration is well-established at 20 years old and is near a recently discovered but undocumented natural population of *L. pycnostachya*, so natural dispersal is a viable possibility (Bob Easter, Pers. Comm.).

Two hundred twenty-seven years after Andre Michaux launched the first botanical exploration in what would become present-day Indiana, these 131 county records demonstrate that there are still floristic discoveries to be made in this state (Friesner 1952). These discoveries are made possible due to the vast vascular plant biodiversity of Indiana and its changing environments, the latter of which necessitates a thorough floristic study of the lower Wabash River corridor. As this project progresses it will yield more information on how the flora of this region has responded to environmental change during the past century, allowing for targeted conservation strategies to protect this floristically diverse area of western Indiana.

ACKNOWLEDGMENTS

The authors thank the Indiana Academy of Science for financially supporting this research

project via the Winona Welch Award for Botanical Biodiversity Research, as well as Indiana University's Department of Biology for their support via the Avian, Wildlife, and Habitat Studies Scholarship. We express our gratitude to the Indiana Department of Natural Resources for permitting this research project and allowing the collection of voucher specimens at many properties owned by this organization. We also thank the private landowners who allowed voucher specimens to be collected on their properties. We thank Daniel J. Layton for providing species determinations for several vouchers collected during this research project. Lastly, we thank the Editor of the *Proceedings of the Indiana Academy of Science* as well as two anonymous reviewers for their helpful comments during the preparation of this article for publication.

LITERATURE CITED

Aldrich, J.R. & M.A. Homoya. 1983. Natural barrens and post oak flatwoods in Posey and Spencer Counties, Indiana. Proceedings of the Indiana Academy of Science 93:291–301.

Aldrich, J.R., L.A. Casebere & M.A. Homoya. 1986. The discovery of native rare vascular plants in northern Indiana. Proceedings of the Indiana Academy of Science 95:421–428.

Burgette, D.L. & D.M. Knudson. 1976. Plants of Portland Arch Nature Preserve. Station Bulletin No. 141. Department of Forestry and Natural Resources Agricultural Experiment Station. Purdue University, West Lafayette, Indiana. 23 pp.

CMH (Consortium of Midwest Herbaria). 2022. At: https://midwestherbaria.org/portal/index.php (Accessed 1 January 2022).

Daru, B.H., D.S. Park, R.B. Primack, C.G. Willis, D.S. Barrington, T.J.S. Whitfeld, T.G. Seidler, P.W. Sweeney, D.R. Foster, A.M. Ellison & C.C. Davis. 2018. Widespread sampling biases in herbaria revealed from large-scale digitization. New Phytologist 217:939–955.

Deam, C.C. 1940. Flora of Indiana. W.B. Burford Co., Indianapolis, Indiana. 1236 pp.

Ebinger, J.E. & J.A. Bacone. 1980. Vegetation survey of hillside seeps at Turkey Run State Park. Proceedings of the Indiana Academy of Science 90:390–394.

Friesner, R.C. 1952. The Pioneer Period in the study of Indiana vascular flora. Butler University Botanical Studies 10:144–152.

Homoya, M.A. 1982. Additions to the flora of southern Indiana. Proceedings of the Indiana Academy of Science 92:379–382.

Homoya, M.A. 1987. Additions to the flora of southern Indiana, III. Proceedings of the Indiana Academy of Science 97:449–452.

Homoya, M.A. 2006. A brief survey of the rare terrestrial natural communities and associated vascular flora of the Wabash River corridor in Indiana. Proceedings of the Indiana Academy of Science 115:89–93.

Homoya, M.A. & D.B. Abrell. 1986. Recent additions to the flora of southern Indiana. Proceedings of the Indiana Academy of Science 95:429–432.

Homoya, M.A. & C.L. Hedge. 1990. Additions to the flora of southern Indiana, IV. Proceedings of the Indiana Academy of Science 99:67–72.

Homoya, M.A., D.B. Abrell & J.R. Aldrich. 1985. The natural regions of Indiana. Proceedings of the Indiana Academy of Science 94:245–268.

Homoya, M.A., D.B. Abrell, C.L. Hedge & R.L. Hedge. 1995. Additions to the flora of southern Indiana, V and VI. Proceedings of the Indiana Academy of Science 104:213–221.

Hull, R.M. 2022. Historical Vascular Plant Flora of the Lower Indiana Wabash River Corridor. At: https://midwestherbaria.org/portal/checklists/checklist.php?clid=24028&pid=0 (Accessed 2 September 2022).

INDNR (Indiana Department of Natural Resources). 2021. Endangered, Threatened, Watch List and Extirpated Plants of Indiana. Indianapolis, Indiana. At: https://www.in.gov/dnr/nature-preserves/files/np-etrplants.pdf (Accessed 1 January 2022).

INDNR (Indiana Department of Natural Resources). 2022. Indiana County Endangered, Threatened and Rare Species List. Indianapolis, Indiana. At: https://www.in.gov/dnr/nature-preserves/heritage-data-center/endangered-plant-and-animal-species/county/ (Accessed 26 February 2022).

Jackson, M.T., R.L. Helms & J.O. Whitaker, Jr. 1975. Additions to the flora of Vigo County, Indiana I. Proceedings of the Indiana Academy of Science 85:354–359.

Kartesz, J.T. 2014 (continuously updated). The Biota of North America Program (BONAP). Chapel Hill, North Carolina. At: http://www.bonap.org/napa.html (Accessed 15 May 2022).

Mark, R. & A.G. Scott. 2004. An inventory of the herbaceous plants of the Twin Swamps Nature Preserve, Posey County, Indiana. Proceedings of the Indiana Academy of Science 113:17–25.

McCain, J.W. 1994. An Annotated Checklist of the Plants of Tippecanoe County, Indiana: A List of the Flowering Plants, Gymnosperms, Ferns and Fern Allies, Bryophytes, Algae, Fungi, and Lichens Without Cultivation in Lafayette and Its Vicinity. Sycamore Audubon Society, West Lafayette, Indiana. 94 pp.

McClain, W.E. 1980a. Additions to the flora of Gibson County, Indiana. Proceedings of the Indiana Academy of Science 90:395–397.

McClain, W.E. 1980b. Additions to the flora of Vermillion County, Indiana. Proceedings of the Indiana Academy of Science 90:398–402.

McClain, W.E. 1983. Additions to the flora of Sullivan County, Indiana. Proceedings of the Indiana Academy of Science 93:343–348.

Overlease, E. & W. Overlease. 2006. 100 Years of Change in the Distribution of Common Indiana Weeds. Purdue University Press, West Lafayette, Indiana. 248 pp.

Post, T.W. 1984. Additions to the flora of Pike and Gibson Counties, Indiana. Proceedings of the Indiana Academy of Science 94:455–456.

Post, T.W., J.A. Bacone & J.R. Aldrich. 1985. Gravel hill prairies of Indiana. Proceedings of the Indiana Academy of Science 94:457–463.

R Core Team. 2021. R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. At: https://www.R-project.org/ (Accessed 1 March 2022).

Rothrock, P. 2019. Indiana. Bloomington, Indiana. At: https://midwestherbaria.org/portal/checklists/checklist.php?clid=3510&pid=124 (Accessed 22 May 2022).

Scott, R.K. 2009. The vascular flora of Turkey Run State Park, Fountain County, Indiana. Proceedings of the Indiana Academy of Science 118:55–75.

Tonkovich, G.S. & M.L. Sargent. 1993. The vascular plants of Fall Creek Gorge Nature Preserve, Warren County, Indiana. Proceedings of the Indiana Academy of Science 102:9–45.

USDA. 2022. Natural Resources Conservation Service. Plants Database. At: https://plants.usda.gov/home (Accessed 2 January 2022).

Manuscript received 14 November 2022, revised 11 January 2023.

Appendix 1.—County records documented via voucher specimens during the 2021 field season. The Coll# indicates Richard M. Hull's collection number for the corresponding voucher specimen deposited at IND for each species and county (Fo = Fountain, Gi = Gibson, Kn = Knox, Pa = Parke, Po = Posey, Su = Sullivan, Ti = Tippecanoe, Ve = Vermillion, Vi = Vigo, and Wa = Warren).

Species (County)	Coll#
Acalypha ostryifolia (Ve)	2980
Alliaria petiolata (Gi)	940
Allium canadense (Kn)	2085
Allium vineale (Kn)	2067
Allium vineale (Wa)	2347
Aquilegia canadensis (Su)	1041
Asclepias verticillata (Su)	2800
Calystegia silvatica (Fo)	2393
Calystegia silvatica (Gi)	2685
Calystegia silvatica (Pa)	2231
Calystegia silvatica (Su)	2659
Calystegia silvatica (Vi)	2788
Calystegia silvatica (Wa)	2434
Carex aggregata (Wa)	2338
Carex albursina (Po)	967
Carex careyana (Pa)	1060
Carex davisii (Su)	2125
Carex frankii (Pa)	2290
Carex granularis (Po)	1945
Carex grayi (Su)	2129
Carex grayi (Ve)	1592
Carex grayi (Wa)	2450
Centaurea stoebe (Ve)	2927
Cerastium nutans (Gi)	925
Clematis virginiana (Wa)	3242
Cornus racemosa (Ve)	2928
Crepis pulchra (Kn)	1407
Daucus carota (Gi)	2679
Daucus carota (Kn)	2075
Desmodium perplexum (Wa)	3163
Dodecatheon meadia (Su)	1042
Enemion biternatum (Kn)	1007
Erigeron philadelphicus (Gi)	924
Erigeron strigosus (Po)	2562
Erigeron strigosus (Ve)	2218
Eryngium yuccifolium (Wa)	2462
Euphorbia davidii (Ve)	2975
Eutrochium purpureum (Kn)	2751
Galinsoga quadriradiata (Su)	2654
Galium circaezans (Kn)	2746
Geum laciniatum (Vi)	2172
Geum laciniatum (Wa)	2456
Glechoma hederacea (Gi)	919
Glechoma hederacea (Su)	1460
Hemerocallis fulva (Gi)	2024
Heuchera richardsonii (Fo)	1710
Hydrastis canadensis (Wa)	2359
Hydrophyllum virginianum (Kn)	1396
Hypericum prolificum (Wa)	2469

Appendix 1.—Continued.

Species (County)	Coll#
Ipomoea lacunosa (Ve)	2982
Iris virginica (Su)	1458
Krigia cespitosa (Po)	1289
Lactuca biennis (Fo)	3097
Lactuca serriola (Wa)	3129
Lespedeza bicolor (Kn)	2760
Lespedeza cuneata (Po)	2572
Leucojum aestivum (Po)	984
Liatris pycnostachya (Wa)	2472
Lysimachia ciliata (Ve)	2264
Mazus pumilus (Po)	1374
Medicago lupulina (Su)	2137
Medicago sativa (Kn)	2103
Mentha spicata (Su)	2799
Napaea dioica (Ve)	2252
Ornithogalum nutans (Po)	1308
Packera obovata (Kn)	1415
Persicaria longiseta (Fo)	2278
Persicaria longiseta (Gi)	2016
Persicaria longiseta (Kn)	2081
Persicaria longiseta (Po)	1875
Persicaria longiseta (Ve)	2961
Persicaria longiseta (Wa)	2340
Phacelia purshii (Wa)	1157
Physalis longifolia (Wa)	3228
Physalis pubescens (Ve)	2965
Plantago lanceolata (Kn)	2072
Plantago rugelii (Kn)	2062
Plantago virginica (Pa)	1646
Polygonatum biflorum (Su)	1040
Polymnia canadensis (Su)	2817
Ranunculus micranthus (Kn)	1030
Ranunculus micranthus (Po)	956
Ranunculus sardous (Po)	1378
Ranunculus sceleratus (Su)	1450
Rorippa palustris (Kn)	2080
Rorippa sylvestris (Kn)	1431
Rorippa sylvestris (Po)	1255
Rorippa sylvestris (Wa)	3222
Rosa rubiginosa (Pa)	1588
Rosa rubiginosa (Su)	2148
Rubus occidentalis (Fo)	1612
Ruellia strepens (Wa)	3030
Rumex crispus (Kn)	2066
Salvia lyrata (Fo)	1714
Sedum ternatum (Kn)	1004
Senna marilandica (Vi)	2778
Silene latifolia (Kn)	1398
Silene latifolia (Pa)	2239
Silene noctiflora (Ve)	2224
Sisymbrium officinale (Po)	1311
Smilax ecirrhata (Wa)	1136
Smilax rotundifolia (Fo)	2272
Solidago gigantea (Fo)	2910
Stellaria media (Kn)	900
Stellaria media (Po)	826

Appendix 1.—Continued.

Species (County)	Coll#
Taraxacum erythrospermum (Kn)	907
Taraxacum erythrospermum (Po)	981
Taraxacum officinale (Gi)	937
Taraxacum officinale (Kn)	1424
Thalictrum dasycarpum (Su)	1457
Thalictrum dasycarpum (Ve)	2251
Thalictrum thalictroides (Wa)	1160
Tipularia discolor (Kn)	2745
Torilis arvensis (Gi)	2017
Tradescantia ohiensis (Wa)	1853
Trifolium campestre (Gi)	2027
Trifolium campestre (Ve)	2219
Trifolium dubium (Po)	1377
Trifolium dubium (Vi)	1512
Trifolium hybridum (Kn)	2104
Trifolium hybridum (Wa)	2461
Trifolium pratense (Kn)	1430
Valeriana pauciflora (Po)	1364
Valerianella radiata (Gi)	1349
Valerianella radiata (Kn)	1395
Valerianella radiata (Po)	1273
Verbascum thapsus (Kn)	2079
Verbascum thapsus (Su)	2150
Verbascum thapsus (Ve)	2220
Veronica hederifolia (Kn)	1001
Veronica serpyllifolia (Po)	982