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Return to the 'Great Pine Swamp' of Alexander Wilson

by Matthew R. Halley

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Summary.—During an excursion to a place called the 'Great Pine Swamp' in May 1811, Alexander Wilson (1766–1813) collected specimens of three supposedly new species of wood warbler (Parulidae) and one thrush (Turdidae), which he later described in *American ornithology* vol. 5. Two decades later, John James Audubon (1785–1851) claimed that he had 'followed [Wilson's] track' in 1829 and located the 'Great Pine Swamp' at a logging community on the west bank of the Lehigh River, near the modern village of Rockport, Pennsylvania (PA). Most scholars have assumed that Audubon was correct, that Rockport was indeed the site of Wilson's 'Great Pine Swamp'. However, in June 2023, I used historic maps to retrace Wilson's route and discovered that his 'Great Pine Swamp' was actually in Monroe County, PA, *c.*26 km (16 miles) east of Rockport, on the opposite side of the Lehigh River, in a different physio-geographic province. Here, after two centuries, I resolve the location of the 'Great Pine Swamp' and shed new light on Wilson's and Audubon's published accounts of species they reportedly encountered there.

Alexander Wilson (1766–1813), author of the nine-volume *American ornithology* (1808–14), having just returned from a long expedition to the southern USA, spent the winter of 1810/11 in Philadelphia, Pennsylvania (PA), preparing the illustrations and text accounts for his third and fourth volumes, which would be published in February and September 1811, respectively (Burns 1908). After several months of labour, Wilson wrote on 4 March 1811: 'I have just published my third volume of Amer. Orn. and have got nearly half of the plates of the Fourth finished. I live secluded from the rest of Mankind always poring over birds, or pursuing them in the woods' (Hunter 1983: 385). Thus, after a productive but lonely winter, Wilson turned his focus back to field work. In mid-May 1811, he left Philadelphia on horseback and travelled north to a place he called the 'Great Pine Swamp', in search of new (undescribed) species for his anticipated fifth volume (Wilson 1812a).

On a round-trip journey that lasted about one week, Wilson collected specimens of three supposedly new species of wood warbler (Parulidae) and one thrush (Turdidae), which he subsequently depicted and described in his fifth volume (Wilson 1812a). Ever since, those four species have been subjects of much debate. Tawny Thrush *Turdus mustelinus* Wilson, 1812a, proved to be a taxonomic composite (Halley 2018a). Some authors have suggested that Blue-mountain Warbler *Sylvia montana* Wilson, 1812a, which is often listed among Wilson's unidentified 'mystery birds', may have been based on an unknown hybrid (Parkes 1985, Holt 2004, but see Coues 1872: 105). Another new species, Pine-swamp Warbler *Sylvia pusilla* Wilson, 1812a, was presumably based on females of Black-throated Blue Warbler *Setophaga caerulescens* (J. F. Gmelin, 1789), a sexually dichromatic species, although paradoxically Wilson (1812a: 100–101) stated that he collected specimens of both sexes and the 'plumage of the female [differed] in nothing from that of the male.' Finally, Hemlock Warbler *Sylvia parus* Wilson, 1812a, was probably based on a male Blackburnian Warbler *Setophaga fusca* (J. F. Gmelin, 1789) in first-basic plumage, a solution first proposed

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by Baird *et al*. (1858: 274), although the species is still called 'mysterious' and 'unknown' by some authors (e.g., Burtt & Davis 2013: 157, 289).

Despite a lingering interest in these species, there has been remarkably little discussion about the location of the 'Great Pine Swamp' or Wilson's journey there. George Ord (1781–1866), who completed Wilson's final two volumes, edited the second edition of *American ornithology* (1824–25, see Faxon 1901) and authored one of the first biographies of Wilson, did not mention the expedition (Ord *in* Wilson 1814, 1825). To my knowledge, the first (and practically the last) person to discuss the location of the 'Great Pine Swamp' was John James Audubon (1785–1851), the controversial painter and ornithologist, who claimed that he had 'followed [Wilson's] track' in August 1829, and relocated the 'Great Pine Swamp' near a logging settlement now called Rockport, PA, on the west bank of the Lehigh River. In the second volume of *Ornithological biography*, in his account of Hemlock Warbler *S. parus*, Audubon (1834: 205) wrote:

> 'It is to the persevering industry of Wilson that we are indebted for the discovery of this bird. He has briefly described the male, of which he had obtained but a single specimen. Never having met with it until I visited the Great Pine Forest, where that ardent ornithologist found it, I followed his track in my rambles there, and had not spent a week among the gigantic hemlocks which ornament that interesting part of our country, before I procured upwards of twenty specimens.'

Rockport is located in Carbon County, PA, on the Lehigh River *c*.11 km (7 miles) north, and a couple of degrees west, of the town of Jim Thorpe, which was called 'Mauch Chunk' until 1954. As the name 'Rockport' implies, it is at the base of a steep and rocky gorge, carved by the Lehigh River, and there are no standing wetlands that could plausibly be considered a 'swamp' by today's definition, nor by most definitions of the early 19th century. Audubon (1831: 56) acknowledged this in an essay ('episode') called 'The Great Pine Swamp', which appeared in the first volume of *Ornithological biography*: 'I spent six weeks in the Great Pine Forest—Swamp it cannot be called—where I made many a drawing.' This memorable remark implied that Wilson's (1812a: 100) description of the 'Great Pine Swamp' was exaggerated and unreliable ('a thousand holes, springs and swamps, into which [one] is incessantly plunged').

The word 'swamp' (first used in 1624) was sometimes used by Americans until the mid-18th century to describe places with dense vegetation, irrespective of their wetness (Wallace 1965: 3). However, by 1811, when Wilson visited and wrote about the 'Great Pine Swamp', the 'wet' definition was already mainstream. Webster (1806) had defined the word as 'a marsh, bog, fen, soft watery ground', and, in his expanded dictionary, as 'Spungy land; low ground filled with water; soft wet ground … in the interior country … This is the true meaning of the word' (Webster 1828). The modern dictionary gives a similar definition: 'a wetland often partially or intermittently covered with water, especially … one dominated by woody vegetation' (Merriam-Webster 2023).

In his writings, Wilson used the word 'swamp' exclusively to refer to wet habitats with dense vegetation, including in the English name of the 'Swamp Sparrow' *Melospiza georgiana* (Latham, 1790), which he said inhabits the 'swamps, and reedy borders of our creeks and rivers' (Wilson 1811: 50). He referred to the tidal marshes near Philadelphia as a 'swamp' because they were 'thickly covered with trees, and inundated during [a] great part of the year' (Wilson 1812b: 74); and he clearly distinguished between 'swamp' and 'forest' habitats, when he wrote: 'Instead of rambling through the leafy labyrinths of umbrageous groves, fragrance-breathing orchards, fields and forests, we must now descend into the

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watery morass, and mosquito-swamp' (Wilson 1813: v). Despite this, few scholars have questioned Audubon's (1831) assertion that Rockport, which lacks any standing wetlands, was the site of the 'Great Pine Swamp' of Wilson. Rhodes (2004: 332), one of the few modern authors to discuss Audubon's trip to Rockport, took him at his word and concluded that 'Alexander Wilson had been in the [Great Pine] forest before him; [and that] Audubon followed his predecessor's track.'

In 1829, during Audubon's visit to Rockport, the ancient forests in that region were being felled by the expanding coal and timber industries. His host, 'Mr. Jediah Irish … [had been] chosen by the agent of the Lehigh Coal Company, as their mill-wright, and manager for cutting down the fine trees which covered the mountains around' (Audubon 1831: 54). Another local sawmill, located *c*.6.4 km (4 miles) south-west and upslope of Rockport, was established by Benjamin Romig in 1825, at a settlement called Black Creek (until 1848), now known as Weatherly (Brenckman 1913: 340). As the Lehigh Coal Company envisioned, and as Audubon (1831) foreshadowed, the logging operations quickly expanded and had largely denuded the region by the 1840s, and this was followed by a boom of anthracite coal mining, which attracted my own family to the region.

My great-great-grandparents, Thomas Wilkinson (1863–1936) and Maria (Bell) Wilkinson (1868–1959), immigrated to Weatherly in the 1880s and are buried there at Union Cemetery. My family's homestead ('Stoffa Cabin'), where I collected the neotype of Eastern Wood Pewee *Contopus virens* (Linnaeus, 1766) in August 2022, is near the modern town of Freeland, which was established as a mining village in the 1840s, about 12.5 km (7.8 miles) north-west of Weatherly (Halley 2023a). Thus, because of my family connections to this region, I was already familiar with the area between Weatherly and Rockport—the successional remnants of the 'Great Pine Forest'—before the spring of 2023, when I re-examined Audubon's claims and began my search for the 'Great Pine Swamp' of Wilson.

To my knowledge, before me, Franklin L. Burns (1868–1946) was the only scholar to surmise, based on a reading of Wilson's published volumes, that the 'Great Pine Swamp' was located somewhere in the '*headwaters* of the Lehigh [River] and Pocono region' (Burns 1908: 183, my italics), but he did not elaborate on the matter, and evidently did not attempt to retrace Wilson's journey. Burns' unpublished diaries, which were loaned to me by the Tredyffrin-Easttown Historical Society (T-EHS), Berwyn, PA, contain no mention of the 'Great Pine Swamp'.

Wilson's expedition to the 'Great Pine Swamp'

The history of Wilson's expedition in May 1811 remains virtually unknown. His principal biographers made no mention of it, even though it yielded four new species for Wilson's work (e.g., Ord *in* Wilson 1814, 1825, Cantwell 1961, Hunter 1983, Burtt & Davis 2013). This is probably because no primary sources from Wilson's trip to the 'Great Pine Swamp' are known (Hunter 1983: 384–387), except possibly for some of his original drawings (reproduced in Burtt & Davis 2013: 153–156), but these may have been drawn from specimens after he returned to Philadelphia. The only available information about Wilson's route and itinerary (and presumably the only information available to Audubon in 1829, excluding hearsay) comes from a few seemingly disparate comments in his published accounts. Arranged chronologically (i.e., not in the order they were published), the following comments provide the clues needed to retrace Wilson's path.

Prior to his arrival at the 'Great Pine Swamp', Wilson observed a pair of Barn Swallows *Hirundo rustica* Linnaeus, 1758, 'On the sixteenth of May, being on a shooting expedition on the top of Pocano mountain, Northampton [county]' (Wilson 1812a: 39), which he later stated was 'between Easton and Wilkesbarre' (Wilson 1813: 53). Then, 'About the twentieth

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Figure 1. Cropped view of a map published by 'J. Reid New York' in 1796, showing the Lehigh River valley, the Blue Mountain Ridge ('Blue Mountains') and major roadways in the region. Encircled letters denote the 'Great Pine Swamp' collecting localities of Wilson (W) and Audubon (A). The road from Easton to 'Wilksbarre' (both towns highlighted with red rectangles), which Wilson travelled in May 1811, crosses the Blue Mountain Ridge at Wind Gap, before turning north-west. That taken by Audubon in 1829 follows the path of the Lehigh River, north-west from Bethlehem, toward the modern town of Jim Thorpe ('Mauch Chunk' to Audubon), which is on the west bank (near the first 'O' in 'NORTHAMPT[ON]') (www.biodiversitylibrary.org, accessed 13 March 2023)

of May, [Wilson] met with numbers of [Tawny Thrushes] in the Great Pine swamp, near Pocano' (Wilson 1812a: 98). Finally, 'On the twentieth of May in returning from an excursion to the Great Pine swamp, [he] spent part of the day in Easton' (Wilson 1812a: 53). Therefore, we may deduce that Wilson's 'Great Pine Swamp' was on the north side of the Pocono Mountain Ridge (i.e., 'beyond Pocano mountain', Wilson 1812a: 44), along the road from Easton to Wilkes-Barre, and within a day's journey on horseback from Easton (Wilson 1812a: 53). These topographic landmarks and the primary roads in this region were marked on many different contemporary maps, published in Philadelphia and New York, which Wilson and Audubon may have consulted. For example, the road between Easton and Wilkes-Barre, which Wilson travelled by horseback in May 1811, and the road between Bethlehem and Mauch Chunk, which Audubon travelled by coach in 1829, both appear on the 1796 'Reid map' (Fig. 1); and the location of the Pocono Mountain Ridge is prominently marked on the 1814 'Carey map' (Fig. 2).

Wilson first needed to cross the Blue Mountain Ridge on his way north from Easton to the 'Great Pine Swamp' (Fig. 2). If he took the path of least resistance, he probably crossed near the modern town of Wind Gap, marked on the Reid map (Fig. 1), where General John Sullivan (1740–95) had, in 1779, enlarged an indigenous trail that penetrated a low-elevation pass (Wallace 1965: 157). This is probably where Wilson collected the (non-extant) holotype of the enigmatic Blue-mountain Warbler *S. montana*, of which he wrote: 'This new species was first discovered near that celebrated ridge, or range of mountains, with whose name I have honored it' (Wilson 1812a: 113). Baird *et al.* (1858: xxxii, 278) and later Coues (1872: 105)

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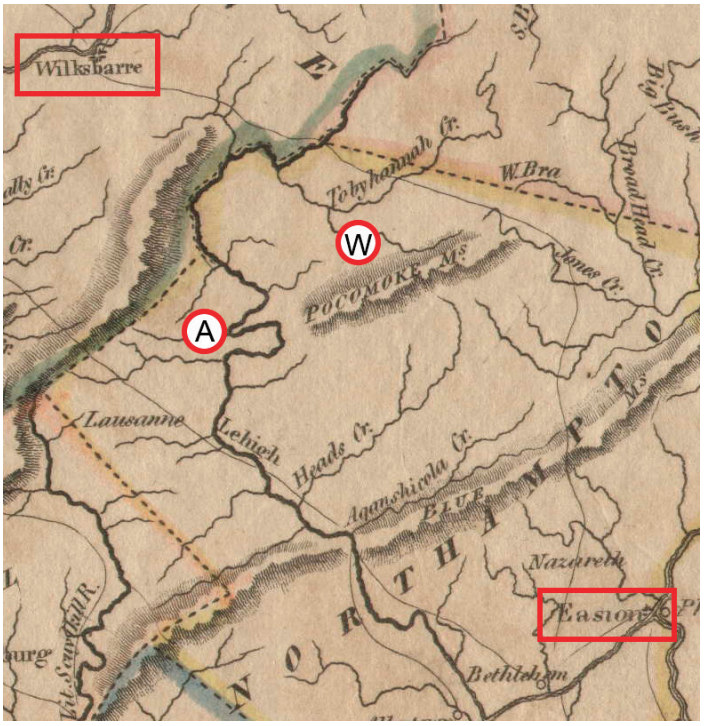

Figure 2. Cropped view of a map published in Mathew Carey's *General atlas* (1814, Philadelphia), which shows the location of the Pocono Mountain Ridge ('Pocomoke Ms') along Wilson's expedition route, between Easton and 'Wilksbarre' (= Wilkes-Barre, PA), which are highlighted with red rectangles. The probable locations of the field sites of Wilson (W) and Audubon (A), on opposite sides of the Lehigh River (thick black line), are denoted by encircled letters (www.biodiversitylibrary.org, accessed 13 March 2023)

erred when they stated that Wilson collected the type of *S. montana* in the 'Blue Mountains of Virginia'.

On the north side of the Blue Mountain Ridge, 'Sullivan's Rd.' (as it was known in Wilson's time) came to a fork near the modern town of Saylorsburg, PA. Wilson evidently took the left side of the fork and headed north-west, following the 'Wechquetank path', another Native American trail that had been widened into a road by that time (Fig. 3; Wallace 1965: 157). That road followed the path of modern Route 115, north-west towards the modern (since 1884) community of Blakeslee, PA. After *c.*17 km (10.5 miles), the road ascends the Pocono Mountain Ridge at a place now known as Poplar Gap (41.000440°N, 75.461892°W). This could be the location of the 'miserable cabin' where Wilson spent the night of 15 May 1811, 'on the top of Pocano mountain' (Wilson 1812a: 39). Inclement weather had arrived, according to Peirce (1846: 93): '[There was a] spell of warm, pleasant weather [in Philadelphia] until the 14th, when the wind changed to south-east, and brought three or four overcast and partly rainy days.'

The following morning (16 May), Wilson continued north (now more slowly) into the 'desolate recesses' of the 'Great Pine Swamp'. Today, we recognise this swampy tract as the watershed of the Tunkhannock Creek, in the headwaters of the Lehigh River, which includes sites now known as Long Pond and Fern Ridge Bog Preserve. Wilson spent the next four days exploring the area, during which time he collected: (1) the holotype of Hemlock Warbler *S. parus*, which he 'met with in the Great Pine swamp … [where it was] almost always [foraging] among the branches of hemlock trees' (Wilson 1812a: 114); (2) three syntypes of Pine-swamp Warbler *S. pusilla*, two females and a male (Wilson 1812a: 100); and (3) an unknown number of syntypes of Tawny Thrush *T. mustelinus*, which he 'met with in the Great Pine Swamp, near Pocano' (Wilson 1812a: 98). Finally, on 20 May 1811, having already secured specimens of four supposedly new species on his excursion,

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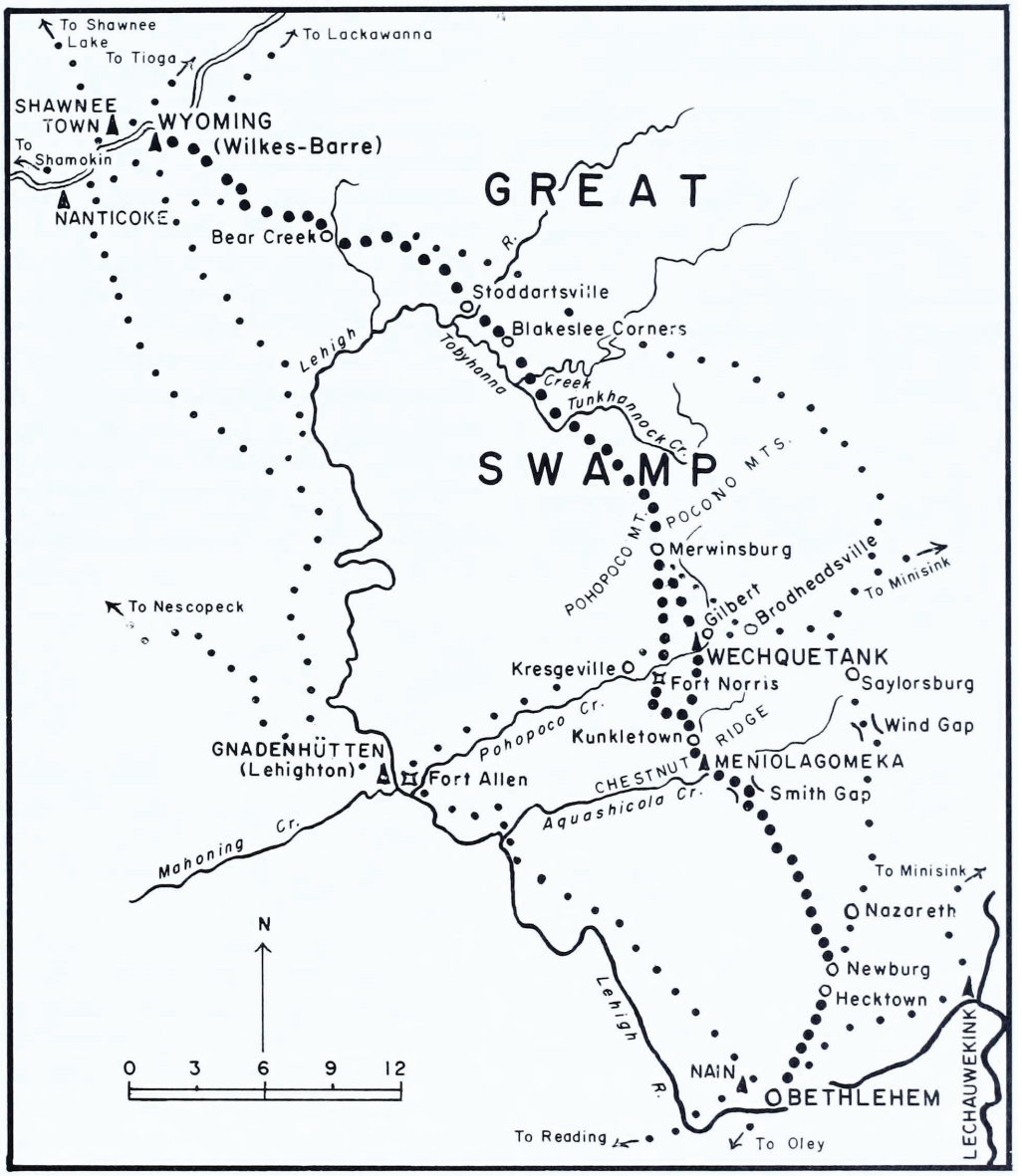

Figure 3. Map of the 'Wechquetank Path' (large dots), reproduced from Wallace (1965: 187), showing the 'Great Swamp' in the Tunkhannock Creek watershed, south-east of Wyoming (Wilkes-Barre), PA. In this map, the 'Great Swamp' encompasses the headwaters of the Lehigh River, including the southern edge of Tunkhannock Creek, just north of the Pocono Mountain Ridge ('Pocono Mts'), where Wilson probably entered the 'Great Pine Swamp'.

Wilson returned to the road and travelled south, retracing his original path to Easton, then to Philadelphia (Wilson 1812a: 53).

Return to the 'Great Pine Swamp'

On 20 June 2023, I drove east from Drums (Stoffa Cabin) to Weatherly, then to Rockport, where I spent about an hour visiting the remnants of the 'Great Pine Forest' along Rockport Road, and along the riverbank at Lehigh Gorge State Park (LGSP) Rockport

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Figure 4. Freshwater wetlands in the Tunkhannock Creek watershed in the vicinity of Wilson's 'Great Pine Swamp', Monroe County, PA, 20 June 2023 (Matthew R. Halley)

Access. As mentioned, these forests are supported by rocky, well-drained soil—a 'Swamp it cannot be called' (Audubon 1831: 56). Audubon's visit to this small community in Carbon County remains a source of pride for its modern residents (e.g., Rabenold-Finsel 2004). An interpretive sign on the main river trail at LGSP Rockport Access, near the site of the historic wharves and lumber mill described by Audubon (1831), states that 'Audubon Spoke for the Trees' and features a reproduction of Pl. 103 from *The birds of America*, depicting two Canada Warblers *Cardellina canadensis* (Linnaeus, 1766). The caption reads: 'While visiting the "Great Pine Swamp," Audubon painted these two small birds on rhododendron blossoms.'

After leaving Rockport, I drove south to Muhlenberg College, Allentown, PA, where I attended the 104th Annual Meeting of the Wilson Ornithological Society (20–23 June). Then, on 23 June, I drove toward Easton and (following Wilson's likely path) crossed the Blue Mountain Ridge at Wind Gap, turned north-west at Saylorsburg, and followed Route 115 north-west to Poplar Gap. After crossing to the north side of the Pocono Mountain Ridge, near the presumed location of the 'miserable cabin' where Wilson stayed on 15 May 1811, there began a marked transition in the landscape from (dry) upland forest to the swampy forested wetlands of the Tunkhannock Creek watershed (Fig. 4). This area, the headwaters of the Lehigh River, is characterised by swampy wetlands and glacial bogs; the habitat is quite different than the dry forests surrounding Rockport. These differences have a geologic basis, owing to their unique glacial histories. Tunkhannock Creek is located in the 'glaciated Pocono Plateau' section of the 'Appalachian Plateaus' physio-geographic province, but Rockport is about 26 km (16 miles) to the west, on the opposite side of the Lehigh River, in the 'Anthracite Upland' section of the 'Ridge and Valley' province (Sevon 2000).

I parked my vehicle on Hypsie Gap Road, on the south side of Tunkhannock Creek near the intersection with Fire Lane (restricted access), and hiked a few hundred metres into the forest on the eastern edge of State Game Lands 38. There, among the hemlocks on the south side of the Tunkhannock Creek, for an unrelated study, I collected an adult male Black-throated Green Warbler *Setophaga virens* (J. F. Gmelin, 1789) and an adult male Blue-headed Vireo *Vireo solitarius* (Wilson, 1810), with appropriate government permits (see Acknowledgements). I later took the specimens to the Delaware Museum of Nature & Science, Wilmington (DMNH, formerly Delaware Museum of Natural History) and prepared them as data-rich study skins with spread wings and frozen tissues (DMNH 85643 and 85646, respectively). These are, to my knowledge, the first bird specimens collected in the vicinity of the 'Great Pine Swamp' (*sensu stricto*) since Wilson's expedition in 1811 (www.VertNet.org, www.iDigBio.org, accessed 27 July 2023).

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Sources of Audubon's 'error'

I have shown, by reconstructing Wilson's expedition route with information readily available to Audubon in 1829, that his claim to have 'followed [Wilson's] track' was not true. This is because Rockport was not the location of the 'Great Pine Swamp' of Wilson. How did Audubon get it so wrong? The third edition of *American ornithology* was then in print, published in 1828 by Harrison Hall in Philadelphia (see Faxon 1901), and Audubon could have consulted the work in one of the many bookstores and libraries there, prior to leaving for Mauch Chunk (see below for timeline discussion). Copies of the earlier editions, which did not differ with respect to the relevant passages, were also likely available.

Nevertheless, a comment in his 'Great Pine Swamp' episode suggests that, instead of consulting Wilson's works, Audubon probably relied on directions provided to him by an unreliable third party: 'Left to my thoughts, I felt amazed that such a place as the Great Pine Forest should be so little known to the Philadelphians, scarcely any of whom could direct me towards it' (Audubon 1831: 57). There is also evidence that Audubon's trip to the 'Great Pine Swamp' (Rockport) was more impulsive than planned. In a letter written at Philadelphia and dated 5 July 1829, less than a month beforehand, Audubon was unable to inform his son Victor where he intended to travel next, and he made no mention of the 'Great Pine Swamp' or Mauch Chunk or Rockport: 'direct [future letters] to the care of Messrs Thos. E. Walker, & Co., merchants here [in Philadelphia], who know all my movements, and will see anything forwarded to wherever I may choose to go to' (Herrick 1917: 424).

Hazard (1830: 67) mentioned that forested tracts in the Lehigh River gorge (opposite Rockport) were known colloquially by the name 'Pine Swamp' in the early 19th century ('smaller streams, not extending more than six or eight miles … fall into the Lehigh on the east side, passing through what is called the Pine Swamp'). Therefore, it seems plausible that someone in Philadelphia, upon being asked the location of the 'Great Pine Swamp', may have directed Audubon to Mauch Chunk. However, can we reasonably assume that Audubon was unaware that many places in eastern Pennsylvania were (or had been) known by similar names? For example, on the 1756 'Kitchin map', one of the first maps to show the town of Easton (established 1752), the words 'Great Swamp' appeared not over the Lehigh River, which drains into the Delaware River, then into Delaware Bay, but over the Lackawanna River, which drains into the Susquehanna River, into Chesapeake Bay (Fig. 5). In any case, it appears that the primary cause of Audubon's 'error' was that he did not consult Wilson's accounts before he ostensibly 'followed [Wilson's] track'.

Timeline discrepancies

Audubon (1831: 56) stated that he 'spent six weeks in the Great Pine Forest', but some authors have concluded that his trip was much longer. The uncertainty stems from a conflict between primary sources. Severely edited transcripts of entries from Audubon's (now lost or destroyed) diary, published independently by Buchanan (1868) and Maria Audubon (1897), suggest Audubon visited Rockport in the autumn: 'September 1. Having accomplished my purpose in visiting the sea-shore of New Jersey, I returned to Philadelphia, and made preparations to go to the Great Pine Swamp, in Northumberland County, Pennsylvania' (Buchanan 1868: 162); '[October 11]. I returned yesterday from Mauch Chunk' (Audubon 1897: 61). Maria Audubon was so confident of this timeline that she wrote that her grandfather spent 'Six weeks in September and October … in the Great Pine Swamp, or Forest, as he called it' (Audubon 1897: 61).

However, these 'primary' sources conflict with dated inscriptions on five of Audubon's mixed-media 'paintings', in his own handwriting, which give the locality 'Great Pine

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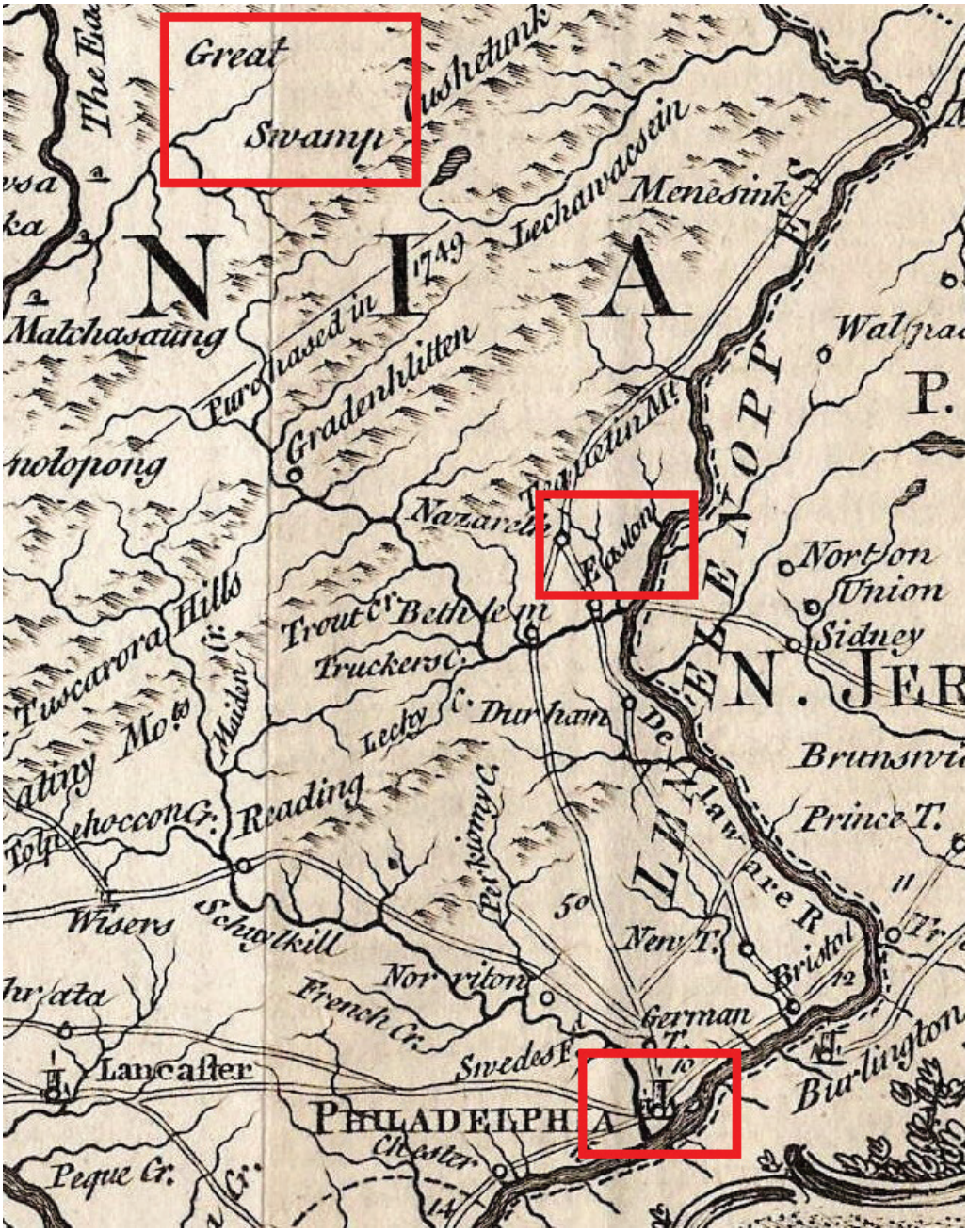

Figure 5. Cropped view of a map published by 'T. Kitchin Gr., printed for R. Baldwin in Pater Noster Row' (1756, London), which shows the Lehigh River valley region prior to colonial development ('Purchased in 1749'). Red rectangles denote Philadelphia (bottom right), Easton (centre) and the 'Great Swamp' (top left). Notably, the 'Great Swamp' label is placed over the Lackawanna River valley, which is part of the Susquehanna River watershed (www.biodiversitylibrary.org, accessed 13 March 2023)

Swamp' and dates ranging between 1 and 20 August [1829]—not September and October. There are also extant letters to his wife and son, which corroborate the August timeline (Fig. 6). In a letter dated 25 August 1829, Audubon wrote: 'Great Pine Swamp Northampton

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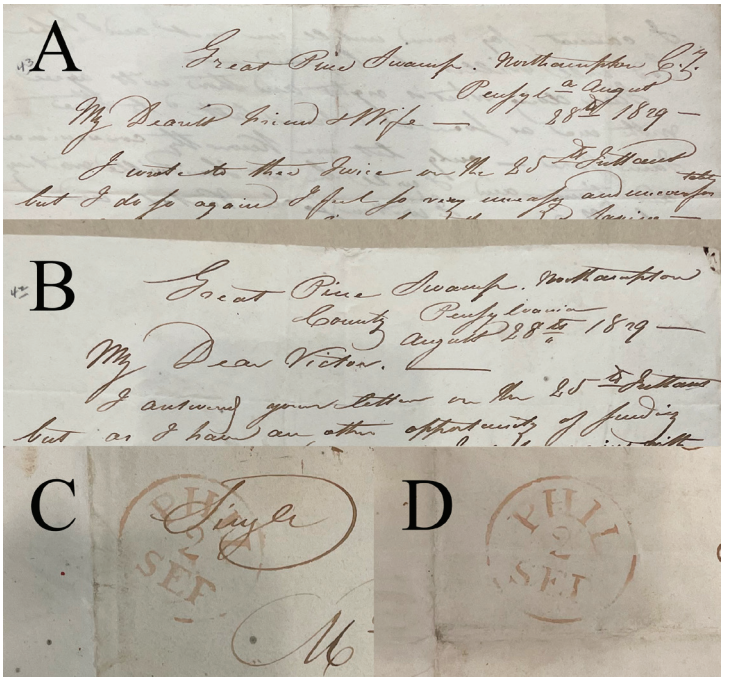

Figure 6. Headings of two letters written by Audubon on 28 August 1829 in the 'Great Pine Swamp', addressed to his wife (A) and son Victor (B), and the postal stamps ('PHIL' = Philadelphia) dated '2 Sept' on their address-bearing faces (C and D, respectively); courtesy of American Philosophical Society Library (Mss.B.Au25) (Matthew R. Halley)

C'y / Pen'a … I have been in this desolate place since the [first] of this month—have made 10 drawings and have now altogether 30 since my arrival' (Corning 1969, 1: 93). Audubon also told William Swainson (1789–1855), in a letter dated 14 September 1829, that he had returned to Camden, New Jersey (i.e., immediately opposite Philadelphia on the Delaware River), on 12 September (Logan 2016: 529).

Herrick (1917: 426) assumed that all these sources were legitimate and concluded that, 'About ten weeks were spent in the woods, from late July until the 10th of October, when the naturalist returned to Philadelphia and settled again for a time in Camden … Though Audubon said that he spent only six weeks in the forest, the indications upon his drawings imply a longer period.' Likewise, Arthur (1937: 385) accepted the dates in Buchanan (1868) and Audubon (1897) and concluded that 'October was almost half done when Audubon returned to Philadelphia.' Fries (2006: 38), citing Lucy Audubon's (1869) edition of *Life and adventures of John James Audubon* (an edited copy of Buchanan 1868), contended that Audubon's 'visit to the Great Pine Swamp lasted until 1 October', although that date does not appear in the cited work.

How do we reconcile these contradictions? It is true that some of the inscriptions on Audubon's paintings were not written contemporaneously. For example, one of his paintings of Ruffed Grouse *Bonasa umbellus* Linnaeus, 1766, was inscribed with the year '1805', but executed on paper watermarked '1810'. Some scholars have concluded that Audubon intentionally backdated the painting, to claim seniority over Wilson, while others remain incredulous (Pick 2004, Olson & Mazzitelli 2017). However, in this case, there is no evidence of backdating and the dates of the August letters from the 'Great Pine Swamp' are independently corroborated by postage stamps applied in Philadelphia on 2 September (Fig. 6). Therefore, the diary entries published independently by Buchanan (1868: 162) and Maria Audubon (1897: 61) were likely incorrect, but the source of those 'errors' cannot be established without the original diary, which was probably destroyed (Arthur 1937, Halley 2022a).

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Species accounts

For the rest of the paper, I review the published accounts of wood warbler (Parulidae) species that Wilson and Audubon reportedly collected and/or observed at the 'Great Pine Swamp', and use specimens to resolve questionable identifications. I also scrutinise and compare Wilson's and Audubon's behavioural accounts of each species, because Audubon (1831: xviii) professed that '[he] should have less pleasure in presenting to the scientific world a new bird [species], the knowledge of whose habits [he did] not possess, than in describing the peculiarities of one long since discovered.'

BLUE-MOUNTAIN WARBLER *Sylvia montana* Wilson, 1812

Wilson illustrated and described a male that he collected on the Blue Mountain Ridge, probably near Wind Gap (see above). His original illustration (reproduced by Burtt & Davis 2013: 156) was engraved by J. G. Warnicke (*c*.1780–1819) and appeared next to the Hemlock Warbler on Pl. 44 of *American ornithology* (Fig. 7; Wilson 1812a). The specimens are not known to exist. Audubon (1839: 295) stated that he never saw the species in life, and that his own illustration, which was engraved by Robert Havell, Jr. (1793–1878), for Pl. 434 of *The birds of America* (1838), was based on 'a specimen lent to [him] by the Council of the Zoological Society of London that had come from California.' Many possible identifications have been proposed.

Bonaparte (1824: 199, 1828: 82) stated that *S. montana* was a synonym of *Setophaga tigrina* (J. F. Gmelin, 1789), now known as Cape May Warbler, and that synonymy was adopted in Robert Jameson's (1774–1854) edited reissue of *American ornithology* (Wilson & Bonaparte 1831: 147). However, Nuttall (1832: 393) contended that *S. montana* was 'allied to the Pine

Figure 7. Cropped view of Pl. 44 from *American ornithology*, vol. 5 (Wilson 1812a), showing the 'Hemlock Warbler' (left) and 'Blue-mountain Warbler' (right), taken from the second edition, which was produced with the original plates and published in 1824; courtesy of Delaware Museum of Nature & Science (Matthew R. Halley)

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Figure 8. DMNH 32758, study skin of a female Black-throated Green Warbler *Setophaga virens* in first-basic plumage, the most likely identity of Blue-mountain Warbler *Sylvia montana* Wilson, 1812a, collected by Allan R. Phillips in Ithaca, New York, on 5 October 1941; courtesy of Delaware Museum of Nature & Science (Matthew R. Halley)

Warbler' *Setophaga pinus* (Linnaeus, 1766). Brewer (1840: 696) treated *S. montana* as a distinct species, as Wilson and Audubon had done. Baird *et al*. (1858: 278) concurred with Nuttall (1832), stating that 'The relationships [of *S. montana*] to the pine creeping warbler are very close, and it is not unlikely that some states of the autumnal plumage in this, or even in the black poll warbler [*Setophaga striata* (J. R. Forster, 1772)], may furnish a clue to this species.' Turnbull (1869: 18) claimed, without elaboration, that *S. montana* was based on an immature specimen of Cerulean Warbler *Setophaga cerulea* (Wilson, 1810). More recently, Parkes (1985: 91) stated that the 'wing bars, white-spotted tail feathers and streaked sides [of *S. montana*] all suggest a wood warbler of the large genus *Dendroica* [G. R. Gray, 1842], but no species belonging to that genus combines these characters with the sharply delineated yellow forehead and unstreaked back' seen in Wilson's plate.

Coues (1872: 105) and later Ridgway (1902: 784) proposed that Wilson's specimen was an immature Black-throated Green Warbler *S. virens*, and Audubon's (loaned) specimen was probably an immature Townsend's Warbler *S. townsendi* (Townsend, 1837). In my opinion, this explanation, which was overlooked by Parkes (1985) and other modern authors, remains the most plausible. Coues (1872: 105) wrote:

> 'I think myself that it is simply the young of [*S.*] *virens*! of which, it seems, Wilson never recognized an autumnal example. A September specimen of *virens*, before me as I write, agrees almost precisely with Wilson's description—rich yellow olive; front, cheeks, chin and sides of neck yellow; * * two exterior tail feathers white on the inner vanes from the middle to the tip, and edged on the outer side with white, etc. Now [*S.*] *virens* is the only Eastern species, showing this latter feature, that agrees with the other assigned characters at all. It is curious additional evidence that I am right in this surmise, that the original of Audubon's figure, in the British Museum, came from "California;" for I suppose that this specimen was the young of *occidentalis* [i.e., Hermit Warbler *Setophaga occidentalis* (Townsend, 1837)] or *townsendii* [*sic*], some of the plumages of which, as well as can be made out, are with difficulty distinguishable from immature *virens*.'

Hatch-year females of *S. virens* in the DMNH collection, in first-basic plumage, are a close match for Wilson's *S. montana*, including the 'sharply delineated yellow forehead [viewed from the side] and unstreaked back' (Fig. 8, *contra* Parkes 1985: 91). They also

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have a slightly rounded tail (i.e., outer rectrices shorter than inner rectrices), which was mentioned by Wilson (1812a: 113, 'handsomely rounded') and considered by Nuttall (1832: 393), who never saw a specimen of *S. montana*, to be 'a striking external trait of distinction.' If this hypothesis is correct, then Wilson's male (collected in mid-May) merely had a later than average first-cycle pre-alternate moult (Morse & Poole 2020, Pyle 2022). Thus, despite its frequent inclusion among the 'mystery birds' of Wilson and Audubon (e.g., Parkes 1985, Holt 2004), it seems that the identity of the Blue-mountain Warbler was satisfactorily resolved more than a century ago.

BLACK AND YELLOW WARBLER *Sylvia magnolia* Wilson, 1811

An inscription on Audubon's original painting of the 'Black & Yellow warbler' at the New-York Historical Society (N-YHS), now known as Magnolia Warbler *Setophaga magnolia* (Wilson, 1811), states that both subjects were 'males' collected at the 'Great Pine Swamp' on 'Aug^{t} 12th / J.J.A.' (N-YHS 1863.17.123). The sex of the birds is evidenced by broad rectangular white patches on the second rectrix (i.e., the first non-white rectrix from the centre), and the pure black dorsal surface of the upper bird in Audubon's illustration, which are consistent with the breeding plumage (March–August) of adult males in the definitive cycle (Pyle 2022: 617–618). However, the inscription on Pl. 123 of *The birds of America* claims the image shows both sexes (Fig. 9). Audubon (1834: 146–147) repeated this claim three years later, in his text account ('The Female is similar to the male, but somewhat paler underneath'), apparently with full knowledge that his painting had actually depicted two 'males' (N-YHS 1863.17.123). There may have been a selfish motive for this, because Wilson (1811: 63) had written: 'The markings of the female are not known.'

Unbeknown to both Wilson and Audubon, there was already a specimen of the female *S. magnolia* in the collection of Charles Willson Peale (1741–1827), mounted in the Philadelphia Museum, of which he was the proprietor. Peale had described the female (and the male) under the name 'Black and Yellow Warbler' in his unpublished 36th lecture, first delivered publicly in 1799: '…the top of the head is rather browner than in the male; the back a greater

Figure 9. Cropped view of Pl. 123 of *The birds of America* (*c.*1831, see Stone 1906: 301), which features the 'Black & Yellow Warbler. *Sylvia maculosa*. Lath. Male, 1. Female, 2.' Now known as Magnolia Warbler *Setophaga magnolia*, these birds were drawn by Audubon at the 'Great Pine Swamp' and labelled as 'males' on his original painting (N-YHS 1863.17.123); reproduced courtesy of the John James Audubon Center at Mill Grove in Audubon, PA, and the Montgomery County Audubon Collection.

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tinge of green & spotted with black; less black on the breast; in general the colours [are] less vivid. These were found in the vicinity of Philadelphia. They are a scarce bird.' (Halley in press). In his lectures, Peale refrained from supplying new Linnaean names for undescribed species. In the original description of *S. magnolia*, Wilson (1811: 63) cited 'Peale's Museum No. 7783', presumably referring to Peale's adult male, and used Peale's English name for the species, 'Black and Yellow Warbler', which Sophonisba Peale (1786–1859) had likely painted on the wooden frame attached to the glass display case, in 1803, before Wilson's first visit to the museum (Halley 2022b: 235).

AUTUMNAL WARBLER *Sylvia autumnalis* Wilson, 1811

Wilson (1811, Pl. 23) based his description of this 'plain little species' on specimens he collected in Philadelphia, during autumn migration, and his description and plate are insufficient to distinguish between the immature (i.e., first-basic plumage) Bay-breasted Warbler *Setophaga castanea* (Wilson, 1810) and Blackpoll Warbler *S. striata*. Wilson probably had specimens of both and classified them as one species (Trippe 1868). The relevance to the present study is that Audubon (1831) claimed to have observed a nesting pair of *S. autumnalis* in the 'Great Pine Swamp' in August 1829—an utterly impossible claim, if we concede (as Audubon eventually did, see below) that *S. autumnalis* was based on hatch-year (immature) individuals.

Nine years before his visit to Rockport, according to an extant diary, Audubon wrote on 12 October 1820: 'Shot an Autumnal Warbler as Mr. A. Wilson is pleased to designate the young of the Yellow rumped Warbler; this was a young male in beautiful plumage for the season, and I drew it, as I feel perfectly convinced that Mr. Wilson has made an error in presenting the bird as a new species' (Deane 1910). However, 11 years later, Audubon (1831: 447) not only agreed with Wilson, that *S. autumnalis* was a distinct and sexually monochromatic species ('The female resembles the male in external appearance.'), he further claimed to have found them breeding in multiple locations:

> 'I have found it breeding in the immediate vicinity of the Cayuga Lakes, and on the borders of Lake Champlain, in retired parts of the woods … I have also found it in the lofty forests of that portion of Pennsylvania usually called the Great Pine Swamp. The nest, like that of many other Sylviae, is partially conical and pensile, and is formed of the soft bark of vines, lined with the down of various plants. The eggs are from four to six, of a white colour, tinged with red, and sprinkled with brownish dots at the larger end. The nest is usually placed in the fork of a bush. I have found the female sitting as late as the 20th of August, and therefore conclude that this species raises two broods in the season, although I have had no opportunity of finding the nest and eggs at an earlier period.'

This entire paragraph appears to have been fabricated, as evidenced by multiple highly improbable claims. First, both *S. castanea* and *S. striata* are sexually dichromatic during the breeding season, whereas Audubon (1831: 447) claimed to have observed sexually monochromatic pairs of hatch-year birds ('The female resembles the male') breeding in non-breeding plumage. Audubon even retroactively conceded that the birds in his plate were immature, which proves his anecdotes were invented: 'The bird described under the name of *Sylvia autumnalis* by Wilson, Bonaparte, Nuttall, myself, and all the compilers, is only the young of [Hemlock Warbler] *Sylvia parus*' (Audubon 1839: 457). Second, the nesting season (especially the incubation stage) is typically concluded, in both *S. castanea* and *S. striata*, by late August, when Audubon claimed to have observed the behaviours.

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Third, there is no suitable breeding habitat for either species near Rockport in modern times, nor apparently historically by Audubon's (1831: 56) own admission: 'Swamp it cannot be called'. To my knowledge, there is no confirmed breeding record of *S. castanea* in Pennsylvania (McWilliams & Brauning 2000: 371) and the only *S. striata* breeding records come from an extralimital population first described by Gross (1994) in an isolated boreal conifer swamp dominated by spruce (*Picea rubens*, *P. mariana*), *c*.60 km (37.4 miles) northwest of Rockport (Zawatski *et al*. 2019). Wilson (1812b: 101), who did not see nesting activity, nevertheless speculated that *S. striata* (i.e., based on his knowledge of the adult) 'doubtless breeds both here [in Pennsylvania] and in New Jersey, having myself found it in both places during the summer'. Wilson's 'summer' observations may simply refer to late migrants because *S. striata* is the last warbler species to pass through the Philadelphia region, and transient males are often heard singing in late May and early June, when the 'summer' nesting season of resident birds is well underway (e.g., Halley & Croasdale 2018, Halley 2023b).

K. Kaufman (*in litt.* 2023) alerted me to yet another incongruity in Audubon's account of the migration of *S. autumnalis*. Audubon (1831: 447) claimed that the species 'makes its appearance in great numbers, in the lower parts of Louisiana, early in March', but neither *S. castanea* nor *S. striata* arrives in Louisiana until April, nor do they migrate north in their autumn (non-breeding) plumage. Wilson (1811: 40) had committed a similar error, underestimating the arrival date of *S. striata* in Philadelphia by about three weeks, when he stated that it 'arrives in Pennsylvania about the twentieth of April'. As mentioned, *S. striata* is the last warbler species to arrive in Philadelphia during the spring migration, in modern and historical times: '[*S. striata* is] bringing up the rear of the migrations. Occurs at Philadelphia, May 10–June 1' (Stone 1894: 135). Wilson may have received his inaccurate information about *S. striata* from Peale, who stated in his unpublished lectures (*c*.1799) that 'They visit us early in the spring and most probably [go] further northward to breed' (Halley in press). However, there is no easy explanation, beyond invention, for Audubon's report of 'great numbers' in Louisiana in March.

HEMLOCK WARBLER *Sylvia parus* Wilson, 1812

Wilson (1812a) described a male that he collected 'in the Great Pine swamp … [where it was] almost always [foraging] among the branches of hemlock trees' (Fig. 7; Wilson 1812a: 114). The original drawing of *S. parus*, hand-coloured by Wilson, shares the page with Blue-mountain Warbler *S. montana* and the extinct Passenger Pigeon *Ectopistes migratorius* Linnaeus, 1766 (reproduced by Burtt & Davis 2013: 156). Relying solely on Wilson's account, Stephens (1817: 726) and Latham (1823: 216) included *S. parus* in their compilations, and Bonaparte (1824: 200), who likewise did not see a specimen, considered it to be 'closely allied to several [other *Sylvia* species], but apparently distinct from all.'

Thus, in 1829, when Audubon visited Rockport, the female of *S. parus* was unknown and the male was known only from Wilson's description and plate. A mostly erased graphite inscription at the lower left of Audubon's original painting reads 'Great Pine Swamp / Aug 12th — / J.J.A.', and an inscription in brown ink is in the lower centre: 'Hemlock Warbler. Male, 1. F, 2. / Sylvia parus. — / Great Pine Swamp Augt 12th / J.J.A.' (N-YHS 1863.17.134). Audubon's illustration, as engraved by Havell, appeared on Pl. 134 of *The birds of America* in 1832 (Fig. 10). In his text account, Audubon (1834: 206–207) stated that the birds in his illustration were an 'Adult Male' and 'Adult Female … The Female resembles the male, but is rather paler.' However, Baird *et al*. (1858: 274) identified the birds in Audubon's painting (and the single individual in Wilson's Pl. 44) as immature male Blackburnian Warblers *Setophaga fusca* (Müller, 1776), in first-basic (autumn) plumage:

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Figure 10. Cropped view of Pl. 134 of *The birds of America*, which features the 'Hemlock Warbler. / *Sylvia parus*. Wils. / Male, 1. Female, 2.' 'Engraved, coloured, and printed by R. Havell, London, 1832.' Reproduced courtesy of the John James Audubon Center at Mill Grove in Audubon, PA, and the Montgomery County Audubon Collection.

> 'An autumnal male is like the female, the single white band on the wing replaced by two [like in Wilson's and Audubon's drawings]; the black stripes on the sides much larger and more conspicuous; the upper parts glossed with yellowish; the throat orange yellow, passing insensibly into purer yellow behind … It is this plumage that I consider to be the *Sylvia parus* of Wilson and Audubon, their descriptions agreeing exactly with specimens before me of [late] summer [*S. fusca*].'

Specimens in DMNH confirm that *S. fusca* males in first-basic plumage possess the morphological characters of *S. parus* (Fig. 11). This means there is nothing especially 'mysterious' about the Hemlock Warbler (*contra* Burtt & Davis 2013: 157), except that Wilson's male (collected in mid-May) had a moult schedule later than average, as it evidently had not yet undergone its (partial) first-cycle pre-alternate moult, which typically occurs from March to early May (Morse 2020, Pyle 2022). Next, with this identification in mind (i.e., *S. fusca* male in first-basic plumage), we can critically re-examine Audubon's (1834) behavioural 'observations' of *S. parus*. As in his account of *S. autumnalis*, Audubon (1834: 206) again claimed to have observed a nest attended by two 'adults' in what we now know to be immature male plumage (Baird *et al*. 1858: 274). The timing of his observations (August) is also suspicious because, in Pennsylvania, the breeding season of *S. fusca* begins shortly after the arrival of the birds on their breeding grounds (mid-April to early May) and first clutches are typically initiated by late May or early June (Morse 2020). Females are single-brooded but may try one or more replacement clutches if early attempts are

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Figure 11. DMNH 49326, study skin of male Blackburnian Warbler *Setophaga fusca* in first-basic plumage, the most likely identity of Hemlock Warbler *Sylvia parus* Wilson, 1812a, collected by George M. Sutton in Brooke County, West Virginia, on 10 September 1937; courtesy of Delaware Museum of Nature & Science (Matthew R. Halley)

unsuccessful; in either case, breeding is typically concluded by late July, by which time adults have begun their definitive pre-basic moult (Morse 2020). These facts cast doubt on Audubon's 'observations'.

PINE-SWAMP WARBLER *Sylvia pusilla* Wilson, 1812

Wilson's (1812a) illustration of *S. pusilla*, engraved by Alexander Lawson (1772/73–1846) for Pl. 43 of *American ornithology* (Fig. 12), is a clear match for an adult female Black-throated Blue Warbler *Setophaga caerulescens* (J. F. Gmelin, 1789). Wilson (1810, Pl. 15) had already depicted and described the adult male in his second volume, under the name 'Black-throated Blue Warbler / *Sylvia canadensis*'. When preparing that account, Wilson apparently copied the catalogue number ('Peale's Museum No. 7222') and nomenclature (English and Latin species names) from the painted frame in the Philadelphia Museum (Halley 2022b: 235). In his 36th lecture (*c*.1799), Peale had described the 'Black-throated Blue Warbler' and

Figure 12. Cropped view of Pl. 43 from *American ornithology* vol. 5 (Wilson 1812a), showing the 'Pine-swamp Warbler', taken from the second edition, produced with the original plates and published in 1824; courtesy of Delaware Museum of Nature & Science (Matthew R. Halley)

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associated it with the name *Motacilla canadensis* Linnaeus, 1766 (Halley in press).[1] Wilson (1810: 115) admittedly '[knew] little of this bird' when he moved it to the genus *Sylvia* Scopoli, 1769 (i.e., his experience was limited to stopover sites), and he must have consulted Linnaeus's (1766) account directly because he correctly cited '*Motacilla canadensis* Linn. *Syst.* 336' among the synonyms, correcting Peale's error (see footnote).

Wilson (1812a: 100) did not cite a 'Peale number' or list any synonyms in his original description of *S. pusilla*, because he thought his specimens from the 'Great Pine Swamp' were novel (i.e., not in Peale's collection or described in any published works). However, as in *S. magnolia* (see above), there is evidence that Wilson overlooked a female specimen of *S. caerulescens* mounted in the Philadelphia Museum before his arrival. In his 36th lecture (*c*.1799), Peale wrote: 'Brown Warbler. This is a female. I do not know the male. I have given it for the present this name [i.e., chosen not to apply a Linnaean name], as all the upper parts are brown; a single white bar on the wings; the throat, breast and all the under parts are a sallow white. Found near Philad[elphi]a' (Halley in press). Modern ornithologists use the single white 'bar' or 'spot' on the wings as a field mark to distinguish *S. caerulescens*, especially females, from other sympatric species of Parulidae (Pyle 2022).

To my knowledge, there is no evidence that Wilson attended Peale's lectures, which mostly occurred during 1799–1803, before Wilson ramped up his ornithological studies (Hunter 1983); the two men did not meet until spring 1804 (Halley 2022b: 235). Therefore, it is notable that Wilson (1812a: 100) independently emphasised that 'immediately below the primary coverts [on the wing of *S. pusilla*] there is a single triangular spot of yellowish white', the same field mark Peale highlighted in his 'Brown Warbler' description more than a decade earlier (Halley in press). Wilson had previously noted that 'the primaries [of *S. canadensis* are] marked with a spot of white immediately below their coverts' (Wilson 1810: 115). However, like Peale before him, Wilson failed to realise that *S. canadensis* and *S. pusilla* were simply the male and female, respectively, of a single species—or so historians and ornithologists have assumed ever since Audubon (1839).

Wilson thought he had examined males and females of both *S. canadensis* and *S. pusilla*, so he had no reason to suspect that they were the same species. After describing an adult male *S. canadensis* in detail, Wilson (1810: 116) wrote that 'The female is more of a dusky ash on the breast; and in some specimens nearly white.' His type series of *S. pusilla* also included specimens of both sexes: 'I shot three, one male and two females. I have no doubt that they breed in these solitary swamps … The plumage of the female differs in nothing from the male' (Wilson 1812a: 100–101). By 1811, Wilson was an experienced collector and preparator, certainly capable of distinguishing the sexes via dissection in May, when testes and ovaries are becoming enlarged and unlikely to be confused. Indeed, before he travelled to the 'Great Pine Swamp', Wilson (1810: 51) had already demonstrated a sophisticated knowledge of this subject, which he had gained by dissecting 'many hundreds' of Bobolinks *Dolichonyx oryzivorus* (Linnaeus, 1758), which enabled him to correct an old error in Catesby (1731). Given his experience in this area, is it safe to assume that the female-like 'male' specimen of *S. caerulescens* that Wilson (1812a) collected in the 'Great Pine Swamp' was merely a sexing error?

[1] Linnaeus (1766) separately described two species under the name *Motacilla canadensis*, the first (Linnaeus 1766: 334) bearing a citation to Brisson's (1760: 524, Pl. 27, f. 1) 'Le Figuier cendré de Canada', which is a synonym of Yellow-rumped Warbler *Setophaga coronata* (Linnaeus, 1766), and the second (Linnaeus 1766: 336) to Brisson's (1760: 527, Pl. 27, f. 6) similarly named 'Le Petit Figuier cendré de Canada', which is a preoccupied (by the first *S. canadensis* description) senior synonym of *S. caerulescens* (J. F. Gmelin, 1789). In his lecture, Peale cited the first *M. canadensis* description, evidently in error because he also cited 'Pl. Enl. 685' (Daubenton 1765–81), which depicts an adult male Black-throated Blue Warbler (Halley in press).

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Figure 13. Four recent (2015–20) study skins of Black-throated Blue Warbler *Setophaga caerulescens* with 'female-like' plumage and original (dissection) data indicating the presence of testes, and one historical 'female-like' specimen with '♂' on label. (A) ANSP 194201, hatch-year male ('skull not oss., bursa 3×1 mm, testes 2×1 mm', recorded by Robert J. Driver) collected 9 September 2011 in Ocean County, NJ; (B) ANSP 208203, hatch-year male ('2 testes, 2 mm × 2 mm / skull not ossified … bursa 3×3 [mm]', recorded by Dana Stott Cohen) collected 2 October 2020 in Philadelphia, PA; (C) ANSP 207898, hatch-year possible male ('possible teste 1×1 mm, [left] only, yellow. Skull 10% oss., bursa 2×2 mm', recorded by Therese A. Catanach) collected November 2019 in Philadelphia, PA; (D) ANSP 203119, second-year male ('2 testes 1×1 mm, skull ossified … no bursa', recorded by Dana Stott Cohen) collected 5 May 2015 in Philadelphia, PA; (E) ANSP 37215, male ('♂') collected by 'Dr. [S. W.] Woodhouse' on 7 October 1840 in Pennsylvania. Woodhouse's original label identifies the specimen as 'Sylvicola sphagnosa / young of [S.] canadensis' (Matthew R. Halley)

Ever since Audubon (1839: 458), ornithologists have universally assumed that *S. caerulescens* is a strictly sexually dichromatic species, with the sexes being clearly distinguishable starting in first-basic plumage, and lacking the delayed plumage maturation in immature males that is widespread in Parulidae (e.g., Nuttall 1840, Baird *et al.* 1858, Coues 1872: 98, Lyon & Montgomerie 1986, Covino *et al.* 2020, Terrill *et al.* 2020, Pyle 2022). However, during my research for this paper, I found five specimens in the collection of the Academy of Natural Sciences of Drexel University, Philadelphia (ANSP), which have the olive-brown plumage typical of *S. caerulescens* females in first-basic plumage, but original data indicating that they are males (Fig. 13). I also found a sixth female-like 'male' study

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skin in the Carnegie Museum of Natural History, Pittsburgh (CM P16331). Two of the ANSP specimens are modern (data-rich) study skins with frozen tissues and measurements of the testes, recorded by experienced preparators (ANSP 194201, 203119). Both were salvaged window-strikes; one was (like Wilson's) collected during the spring migration, and the other during autumn migration. If the gonad data are correct, then these specimens must lead us to believe that some *S. caerulescens* males in first-basic plumage are indistinguishable from females. If so, Wilson may have been the first to discover this phenomenon, but he mistook it for taxonomic variation.

Since 2019, when this hypothesis came to mind, I have prepared 11 specimens of *S. caerulescens* in 'female-like' plumage including a group of six hatch-year migrants that collided with windows in Philadelphia on 2 October 2020 (ANSP 208100–208105), an after-hatch-year individual that I collected on its breeding ground in Tioga County, PA, on 20 July 2019 (ANSP 35988), a hatch-year individual that I collected during autumn migration at Little Creek Wildlife Area, Kent County, Delaware (DE), on 26 September 2022 (DMNH 85696), and three DE window-strikes salvaged on 12 October 2019 (DMNH 85781), 16 May 2020 (DMNH 85695) and 11 October 2022 (DMNH 85782). The birds were female in each case, as evidenced by the presence of an ovary. Nevertheless, a much larger sample will be needed before this hypothesis can be confidently rejected, if the 'female-like' phenotype occurs at low frequency in the population of hatch-year males (e.g., see Bleiweiss 2001, on detection of rare 'transexual phenotypes' in Trochilidae). The ANSP specimens could also be sexed molecularly to test this hypothesis. For now, I encourage preparators to carefully examine the gonads of all *S. caerulescens* in first-basic plumage that come to hand.

After Wilson (1812a), Stephens (1817: 722) and Latham (1823: 215) included *S. pusilla* in their compilations, relying solely on his account. Then, Bonaparte (1824: 199) found the name *pusilla* preoccupied in the genus *Sylvia* and published a replacement name, *Sylvia sphagnosa* Bonaparte, 1824, which was subsequently used by Audubon (1834: 279). Audubon was, until 1838 or 1839, admittedly ignorant of the fact that (setting aside the aforementioned hypothesis about female-like males) *S. sphagnosa* was merely based on the female of *S. caerulescens* (see Audubon 1839: 458), and this is critical context for interpreting his earlier account (Audubon 1834: 279):

> 'In the early part of May, I have found [*S. sphagnosa*] in New Jersey, as well as in Pennsylvania, particularly in the Great Pine Forest, where I drew a pair of them, and found their nest … The nest that I found in the Pine Forest was placed in one of the forks of a small bush, not more than five feet from the ground … The female was so gentle that I put my hand close over her before she moved; and when she did so, she flew only a few feet, returning to her eggs whenever I retired a few yards. The male expressed his sorrow by a low tweet, but made no attempt to molest me.'

The birds in Audubon's original painting of 'Pine Swamp Warbler / *Sylvia sphagnosa*, Bonap.' (N-YHS 1863.17.148), which he claimed were attending a nest with eggs, are both in the 'female-like' plumage of *S. caerulescens* (Fig. 14). Audubon's (1831: 260) description of an 'Adult Male' is a match for the typical 'female-like' plumage (e.g., 'rich olive-green [on the dorsal surface] … Cheeks and sides of the neck olivaceous … under parts ochre-yellow, tinged with brown below the wings'); and, like Wilson, Audubon (1834: '260' = 280) asserted that 'The female [*S. sphagnosa*] resembles the male, but is paler in its tints.' However, even if a small percentage of males have female-like phenotypes in first-basic plumage (see above), there is no evidence that second-year males in female-like plumage engage in breeding. No 'female-female' pairs have been documented in *S. caerulescens*, despite decades of

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Figure 14. Cropped view of Pl. 148 of *The birds of America*, which features the 'Pine Swamp Warbler. / *Sylvia sphagnosa*. Bonap. / Male, 1. Female, 2.' 'Engraved, coloured, and printed by R. Havell, London, 1832.' Reproduced courtesy of the John James Audubon Center at Mill Grove in Audubon, PA, and the Montgomery County Audubon Collection.

intensive research of colour-banded populations (Holmes *et al*. 2020). Also, the inscription on Audubon's painting bears the date 'August 11th' (N-YHS 1863.17.148), which is late in the breeding season for *S. caerulescens*, when most nests are attended by successful pairs attempting a second or (rarely) third brood (Holmes *et al*. 2020). These facts cast doubt on Audubon's 'observations'.

Five years after publishing his 1834 account, Audubon realized that the adult female of *S. caerulescens* was practically identical to the species he had previously distinguished as *S. sphagnosa* (Audubon 1834), which Wilson (1812a) had called *S. pusilla*. In the face of evidence that one species had been confounded for two, Audubon (1839) published a correction that undermined his original claims. Audubon (1839: 458) now claimed that the 'Adult male' and 'Adult female' that appeared in Pl. 148 of *The birds of America* (1832), which, according to his 1834 account had been attending a nest with eggs, were merely 'the young of the Black-throated Blue Warbler' (i.e., hatch-year birds, and therefore non-breeders). Audubon (1839: 458) then attempted to shift the blame onto Wilson: 'the female of [*S. caerulescens*] resembles them so much that I looked upon it as of a species distinct from the male. I have no doubt that this error originated with Wilson, who has been followed by all of our writers. Now, however, [*S. sphagnosa*] must be erased from our Fauna' (Audubon 1839: 458).

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As discussed above, 'this error' (i.e., mistaking hatch-year birds for breeders) cannot have originated with Wilson, whose specimens were collected in May (during spring migration) and who did not claim (like Audubon 1834) to have witnessed them breeding in the 'Great Pine Swamp', although he suspected they did. Arthur (1937: 383), like most of Audubon's biographers, lacked expertise in systematic (specimen-based) ornithology and simply assumed that Audubon's ornithological statements were true: '[Audubon's] pine swamp warbler, which [Wilson] supposed was a new species, proved to be the young of the black-throated blue warbler.' However, there are only two plausible explanations for the 'female-like' male specimen depicted in Pl. 43 of *American ornithology* (Fig. 12), and neither involves the conflation of age- and sex-related plumages. Either (1) Wilson collected a male in first-basic plumage that was indistinguishable from a female, which led him to believe that *S. pusilla* was a distinct species; or (2) he mis-sexed his 'male' specimen, which was actually a female.

Audubon's dishonesty

The problematic anecdotes and 'facts' exposed here, among the accounts of species Audubon supposedly encountered in the 'Great Pine Forest' (Rockport), should not be interpreted in isolation. In the pages immediately following his 'Great Pine Swamp' episode, Audubon (1831: 52–65) described the 'Bird of Washington' for the second time, an invented species based on plagiarised images and fabricated data and anecdotes (Halley 2020). In July 1830, as he was preparing these problematic accounts, Audubon conceded in a letter to Bonaparte: 'To no one on Earth have I spoken so openly as I now do to you … [who] knows better than any Man[,] being the best judge[,] that I am not a Learned Naturalist—I am only, and that not to a very great extent[,] a *Practical* one … I am no Scholar of any kind and I have no pretensions' (Stroud 2000: 115). After two centuries, many of Audubon's confidently presented 'observations' continue to appear plausible to outside observers, despite the cumulative onslaught of new evidence that demonstrates the limits of his knowledge and extent of his scientific misconduct (e.g., Woodman 2016, Halley 2018a,b, 2020, 2022a, 2023c). This paper adds to the pile, and I continue to encourage scholars to regard the works of Audubon with caution, when it comes to statements of supposed fact.

Conclusion

After two centuries, I relocated Wilson's 'Great Pine Swamp' in the Tunkhannock Creek watershed, Monroe County, PA, by reconstructing and personally retracing his 1811 expedition route. In so doing, I demonstrated beyond reasonable doubt that Audubon's (1834: 205) claim to have 'followed [Wilson's] track' was not true. Furthermore, I used study skins to clarify the identities of Wilson's (1812a) much-debated new species from this region, and detailed many improbable observations in Audubon's (1831, 1834, 1839) relevant ornithological accounts. During this process, I also uncovered preliminary evidence that some immature males of *Setophaga caerulescens*, in first-basic plumage, are indistinguishable from females. If confirmed, this finding may expand our understanding of the species' natural history.

Acknowledgements

This paper is dedicated to the memory of my grandmother, Dorothy Mae Stoffa (1931–2023), née Murman, who passed away on the morning of 22 June 2023, during my trip to the 'Great Pine Swamp.' She was a professional nurse, a mother of four, the daughter of a coal miner and homemaker, and the granddaughter of Thomas & Maria Wilkinson of Weatherly (see text). She was the sole proprietor of Stoffa Cabin, from 1999 until her death. On 20 June, during our last conversation, while she was receiving hospice care, I told her the story of the 'Great Pine Swamp' and my plan to retrace Wilson's path. She was delighted by the

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prospect and optimistic that I would succeed. Kenn Kaufman, Ashley Kempken, Robert Prŷs-Jones, and two anonymous reviewers critiqued early versions of the manuscript. John O. Senior and the T-EHS board loaned me the Frank L. Burns papers. Nathan H. Rice and Jason D. Weckstein (ANSP) and Serina S. Brady (CM) provided access to study skins in their respective collections. Historic specimens collected and prepared by Allan R. Phillips and George M. Sutton were used to confirm the identities of Wilson's *S. montana* and *S. parus*, respectively. Modern specimens mentioned in this paper were collected or salvaged under US Fish & Wildlife Service (USFWS) Migratory Bird permit nos. MBPER0036206, MB019575-1; PA Game Commission special use permit no. 55967; and DE Division of Fish & Wildlife permit no. 2022-WSC-037.

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