

Chapter Thirty

CURRENT STATUS AND RECENT TRENDS IN PENNSYLVANIA'S WETLANDS

RALPH W. TINER, JR.

Regional Wetland Coordinator
U.S. Fish and Wildlife Service
Northeast Region
Newton Corner, MA 02158

INTRODUCTION

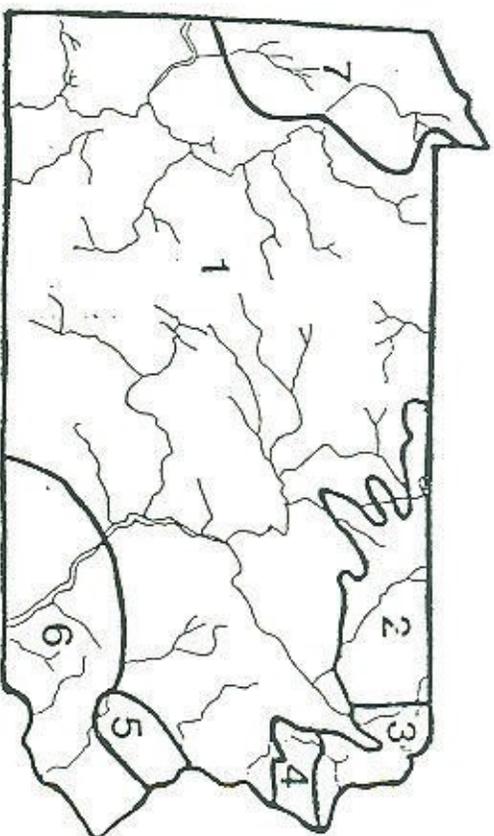
Information on the current status and recent trends in Pennsylvania's wetlands was recently collected by a U.S. Fish and Wildlife Service (FWS) study of wetland trends in the Mid-Atlantic region for the U.S. Environmental Protection Agency (Tiner and Finn 1986). This study involved analyzing aerial photography from the mid-1950s and late 1970s/early 1980s for nearly 800 four-square mile sampling plots randomly selected within 29 strata in a five-state area (DE, MD, PA, VA, and WV). For Pennsylvania, eight sampling strata were used (Figure 1). Of 146 sample plots were evaluated for the state (Table 1). Details of the sampling procedure are presented in Tiner and Finn (1986). The FWS also conducted wetland trends studies of Pennsylvania's Coastal Zone for the

TABLE 1

Number of Plots and Percentage of Each Stratum Sampled in Pennsylvania (Tiner and Finn 1986).

Stratum	# Plots	% of Stratum Sampled
Middle Western Upland Plain	34	4.4
Appalachian Highlands	28	0.3
Poconos #1 (Southern)	17	6.8
Poconos #2 (Northern)	21	5.3
Other Glaciated Northeast	10	1.2
Adirondack—New England Highlands	4	2.1
Atlantic Rolling Plain (Piedmont)	26	2.4
Middle Western Upland Plain	4*	1.3

*Open water plots only.



LEGEND

- 1 Appalachian Highlands
 - 2 Other Glaciated Northeast*
 - 3 Northern Poconos*
 - 4 Southern Poconos*
 - 5 Adirondack—New England Highlands
 - 6 Atlantic Rolling Plain (Piedmont)
 - 7 Middle Western Upland Plain
- * These areas are part of the Appalachian Highlands physiographic region.

FIGURE 1. Major regions of Pennsylvania referenced in this chapter.

Pennsylvania Department of Environmental Resources. The purpose of this chapter is to summarize the results of these studies, since they are the only reliable information on Pennsylvania's wetlands. In the future, the Service's National Wetlands Inventory (NWI) Project will be determining wetland acreage in Pennsylvania on a county basis from existing NWI maps.

CURRENT STATUS OF PENNSYLVANIA'S WETLANDS*

In 1979, nearly one-half million acres (498,000 acres \pm 16.4% SE) of wetlands existed in Pennsylvania, including about 431,000 acres of vegetated wetlands and 67,000 acres of nonvegetated wetlands (mostly ponds). In addition, about 685,000 acres of deepwater habitats (lakes and reservoirs) were present. Wetlands

*Note: Tables 2 and 3 summarize statewide results (e.g., estimates of wetland acreages by types and of losses and gains) for Pennsylvania's wetlands from the FWS study (Tiner and Finn 1986). Standard errors (expressed as a percentage of each estimate) are shown for all estimates in these tables as well as in the text.

Wetland Status and Trend Estimates for Pennsylvania (1956-1979) by Individual Type. Estimates Are in Acres and the Standard Error (Expressed as a Percentage of the Estimate) is Given in Parentheses. NOTE: The Estuarine Zone of Pennsylvania was too Small to Statistically Sample, so no Estuarine Estimates Are Given. (Source: Tiner and Finn 1986).

Original Classification	CURRENT CLASSIFICATION										Total Original Surface Area
	Palustrine Forested Wetland	Palustrine Scrub-Shrub Wetland	Palustrine Emergent Wetland	Palustrine Unconsolidated Shore	Palustrine Open Water (Pond)	Other Palustrine Nonvegetated Wetland	Lacustrine Open Water (Lake/Reservoir-Deepwater Habitat)	Agricultural Land	Urban Land	Other Land (e.g., forests and other development)	
Palustrine Forested	170,817 (12.7)	23,486 (43.9)	5,625 (36.4)	178 (97.2)	2,996 (33.1)		1,131 (54.2)	164 (45.7)	1,413 (39.8)	3,139 (31.7)	208,949 (12.3)
Palustrine Scrub-Shrub	30,966 (16.1)	85,942 (52.1)	8,070 (42.9)		4,859 (45.6)		1,523 (58.7)	851 (43.8)	2,608 (58.4)	2,318 (46.7)	137,137 (37.8)
Palustrine Emergent	14,171 (36.7)	24,715 (17.8)	48,916 (18.5)		9,285 (35.4)	64 (98.4)	857 (47.7)	7,018 (30.8)	2,458 (62.2)	5,182 (36.8)	112,666 (13.6)
Palustrine Unconsolidated Shore				1,774 (99.8)							1,774 (99.8)
Palustrine Open Water		726 (91.6)	1,666 (59.6)	11 (90.9)	24,519 (27.8)		23 (95.7)	42 (59.5)	95 (78.9)	1,101 (35.1)	28,183 (25.3)
Other Palustrine Nonvegetated											
Lacustrine							670,434 (22.2)				670,434 (22.2)
Agriculture	1,029 (97.8)	192 (58.3)	971 (57.7)	5 (*)	9,273 (17.4)		202 (97.0)				11,672 (16.7)
Urban	175 (83.4)	361 (62.0)	1,361 (61.2)		2,098 (60.9)	29 (96.6)	7,746 (97.6)				11,770 (65.4)
Other	4,265 (66.7)	3,850 (35.4)	3,692 (56.9)		12,163 (32.8)		2,904 (63.4)			28,204,780 (0.6)	28,231,654 (0.6)
Total Current	221,423 (12.5)	139,272 (34.7)	70,301 (17.0)	1,968 (90.4)	65,193 (19.2)	93 (97.8)	684,820 (21.8)	8,075 (27.8)	6,574 (46.4)	28,216,520 (0.6)	29,414,239 (0)
Recent Change	-12,474 (*)	-2,135 (*)	-2,365 (20.4)	+194 (89.2)	+37,010 (18.7)	-93 (97.8)	-14,386 (64.8)	-3,597 (86.5)	-5,196 (*)	-15,134 (46.9)	

*Standard error of estimate is equal to or larger than estimate.

TABLE 3

Wetland Status and Trend Estimates for Pennsylvania (1956-1979). Estimates Are in Acres and the Standard Error (Expressed as a Percent of the Estimate) is Shown in Parentheses. NOTE: Wetland Types Are Aggregated Within System as Vegetated or Nonvegetated; Also the Estuarine Zone of Pennsylvania Was too Small to Statistically Sample, so no Estuarine Estimates Are Given.

Original Classification	CURRENT CLASSIFICATION					Total Original Surface Area	
	Palustrine Vegetated Wetland	Palustrine Nonvegetated Wetland	Lacustrine Open Water (Lake/Reservoir-Deepwater Habitat)	Agricultural Land	Urban Land		Other Land (e.g., forests and other development)
Palustrine Vegetated	412,708 (17.2)	17,382 (33.5)	3,511 (41.6)	8,033 (28.0)	6,478 (47.1)	10,639 (24.1)	458,751 (16.5)
Palustrine Nonvegetated	2,392 (38.3)	26,304 (28.3)	23 (95.7)	42 (59.5)	95 (78.9)	1,101 (35.1)	29,957 (25.8)
Lacustrine			670,434 (22.2)				670,434 (22.2)
Agriculture	2,192 (49.0)	9,278 (17.4)	202 (97.0)				11,672 (16.7)
Urban	1,897 (50.2)	2,127 (60.8)	7,746 (97.6)				11,770 (65.4)
Other	11,807 (42.1)	12,163 (32.8)	2,904 (63.4)			28,204,780 (0.6)	28,231,654 (0.6)
Total Current	430,996 (16.8)	67,254 (19.1)	684,820 (21.8)	8,075 (27.8)	6,573 (46.4)	28,216,520 (0.6)	29,414,238 (0)
Recent Change	-27,755 (31.6)	+37,297 (18.6)	+14,386 (64.8)	-3,597 (86.5)	-5,197 (*)	-15,134 (46.9)	

*Standard error of estimate is equal to or larger than estimate.

occupy about two percent of the state's land surface. Almost 45 percent (or 221,000 acres) of the state's wetlands were palustrine forested wetlands, while scrub-shrub wetlands were next in abundance (28 percent or 139,000 acres). Emergent wetlands were only a third as abundant as the forested wetlands and only half as common as the scrub-shrub wetlands, with 70,000 acres (or 14 percent of the state's wetlands). The remaining freshwater wetlands were made up largely by ponds.

The state's palustrine wetlands were largely concentrated in the northeastern and northwestern corners of the state (Table 4). These two areas, which represent only 17 percent of the state's land area, may be subdivided into four areas: Southern Poconos, Northern Poconos, and Other Glaciated Northeast for the northeastern corner and Middle Western Upland Plain for the northwestern corner. Over a quarter of the state's wetlands were located in the northeastern area and nearly one-fifth occurred in the northwestern corner of the state. Thus, nearly half of the state's wetlands were concentrated in these two areas. The southern Poconos had the highest density of wetlands in the state with 8.4 percent of its area covered by wetland, while the Middle Western Upland Plain northwestern PA) ranked second with 5.1 percent. Most (80 percent) of the state had less than 1.5 percent coverage by wetlands.

TABLE 4
Distribution of Wetlands Throughout Pennsylvania. Wetland Density is Expressed as the Percent of the Geographical Area that is Covered by Wetland.

Wetland Type	Estimated Wetland Average (% Standard Error)	Wetland Density Percentage	% of State's Wetlands
Palustrine Highlands (excluding glaciated northeastern PA)	231,421 (31.7)	1.1%	46
Lancic Rollins Plain (Piedmont)	38,527 (18.6)	1.4%	8
Middle Western Upland Plain	94,044 (18.5)	5.1%	19
Southern Poconos	42,426 (21.4)	8.4%	7
Northern Poconos	36,003 (15.6)	3.8%	9
Other Glaciated Northeastern PA*	52,050 (18.6)	3.0%	10
Wetland—New England Highlands	3,780 (14.2)	0.9%	1

*These areas are part of the Appalachian Highlands physiographic region, but are glaciated and, therefore, have a higher abundance of wetlands than other areas in this region.

RECENT WETLAND TRENDS IN PENNSYLVANIA

Between 1956 and 1979, Pennsylvania had a net loss of about 28,000 acres, or six percent of its vegetated wetlands. This amounted to an average annual net loss of over 1,200 acres. Meanwhile, pond acreage increased by about 130 percent (or roughly 37,000 acres). Tremendous losses in emergent wetlands took place, with a net loss of nearly 42,500 acres which represents a 38 percent loss of this type. Over 1,800 acres of this type were lost annually, on average. These emergent wetland losses were mostly (64 percent) attributed to changes to other vegetated wetland types (i.e., forested and shrub wetlands), while direct human-induced changes to other land and water types were mostly the result of channelization, pond construction and urban development. Net losses of 16,600 acres of emergent wetlands to scrub-shrub wetlands and 8,500 acres of emergent wetlands to forested wetlands were estimated. These losses of emergent wetlands, in fact, contributed to estimated small net gains (but not statistically significant) in the two other vegetated types. Actual conversion of palustrine vegetated wetlands to ponds, lakes, and reservoirs (mostly ponds) accounted for about 46 percent of the human-induced losses. Conversion to farmland, urban development, and other lands (largely due to channelization/drainage projects) were responsible for 17 percent, 14 percent and 23 percent of the losses of vegetated wetlands, respectively.

Slightly more than one-third (9,700 acres \pm 29.7% SE) of the palustrine vegetated wetland losses took place in northeastern Pennsylvania. The heaviest loss (5,300 acres \pm 26.5% SE) was observed in the northern Poconos area, which

TABLE 5
Status of Wetlands by Type Within the Delaware River Estuary Coastal Zone of Pennsylvania in 1986 (Tiner, et al. 1987).

Wetland Types	Average
Riverine Wetlands	
Emergent Wetland (Tidal)	295
Palustrine Wetlands	
Emergent Wetland (Tidal)	210
Forested Wetland (Tidal)	7
Emergent Wetland (Nontidal)	468
Scrub-Shrub Wetland	54
Scrub-Shrub Wetland/Emergent Wetland (Nontidal)	18
Forested Wetland (Nontidal)	62
Aquatic Bed (Nontidal)	15
Unconsolidated Shore (Nontidal)	17
Unconsolidated Bottom (Nontidal)	494
Subtotal (Palustrine)	1,345
Grand Total	1,640

lost about 15 percent of its vegetated wetlands. The northwestern part of the state (i.e., Middle Western Upland Plain) also lost substantially, recently losing about five percent (4,600 acres \pm 37.2% SE) of its vegetated wetlands.

Statewide, pond acreage increased by 37,000 acres due to alteration of vegetated wetlands and conversion of other land types. Forty-two percent of the new pond acreage came from wetlands (mostly from emergent wetlands), while 30 percent came from other land (mainly upland forests) and 23 percent from farmland.

CURRENT STATUS OF WETLANDS IN PENNSYLVANIA'S COASTAL ZONE

Pennsylvania's Coastal Zone is divided into two regions: (1) the Delaware River Estuary Coastal Zone (a 50-square mile area in Delaware and Bucks Counties and the City of Philadelphia) and (2) the Lake Erie Coastal Zone (a 63-square mile area in Erie County). In 1986, the Delaware River Estuary Coastal Zone had 1,640 acres of wetlands (Tiner et al. 1987). Most (1,345 acres or 82 percent) of the wetlands were palustrine wetlands, with the remaining wetlands being riverine tidal wetlands (Table 5). In 1986, the Lake Erie Coastal Zone had 9,974

TABLE 6

Status of Wetlands by Type Within the Lake Erie Coastal Zone (Pennsylvania) in 1986 (Tiner and Anderson 1986).

Wetland Types	1986 Average
Unconsolidated Bottom (Littoral)	5,815
Aquatic Bed (Littoral)	301
Unconsolidated Shore (Littoral)	179
Subtotal	6,295
Palustrine Wetlands	
Unconsolidated Bottom	139
Shrub Wetland	36
Emergent Wetland	100
Scrub-Shrub Wetland	151
Scrub-Shrub/Aquatic Bed	236
Forested Wetland	51
Forested/Emergent Wetland	2,702
Forested/Scrub-Shrub Wetland	64
Subtotal	3,672
Riverine Wetlands	
Unconsolidated Shore	7
Grand Total	9,974

acres of wetlands (Tiner and Anderson 1986). Nearly two-thirds of this acreage was lacustrine wetland associated with the shallow water (littoral) zone of Lake Erie, while the remaining wetland acreage was palustrine wetland (Table 6).

RECENT WETLAND TRENDS IN PENNSYLVANIA'S COASTAL ZONE

Delaware River Estuary

Since the mid-1970s, a net loss of 184 acres of palustrine wetlands took place within the Delaware River Estuary Coastal Zone (Tiner et al. 1987). During this period, there was no net change in riverine tidal wetlands (Table 7).

Palustrine nontidal emergent wetlands experienced the greatest net losses (129 acres), amounting to a 22 percent loss. The causes of this loss were varied, but most of the loss (68 percent) was attributed to sewage treatment plant facilities near the Philadelphia International Airport. Highway construction for 1-95 was responsible for 13 percent of the loss. Other causes of emergent wetland loss were dredged material disposal (8 percent), industrial developments (4 percent), and unknown activities (7 percent).

A net loss of 36 acres of freshwater ponds (palustrine unconsolidated bottom) was also significant. This represents a seven percent loss. Industrial developments and dredged material disposal accounted for 32 percent and 24 percent of pond losses, respectively. Thirteen percent of the losses were attributed to sewage treatment plant facilities, while highway construction (8 percent) and commercial developments (4 percent) were other major causes of pond loss.

TABLE 7

Wetland Trends Within the Delaware River Estuary Coastal Zone of Pennsylvania Between the Mid-1970s and 1980 (Tiner et al. 1987).

Wetland Types	Net Change
Riverine Wetlands	
Emergent Wetland (Tidal)	No change
Palustrine Wetlands	
Emergent Wetland (Tidal)	No change
Forested Wetland (Tidal)	No change
Emergent Wetland (Nontidal)	129 acres lost
Scrub-Shrub Wetland	No change
Scrub-Shrub Wetland/Emergent Wetland (Nontidal)	6 acres lost
Forested Wetland (Nontidal)	6 acres lost
Aquatic Bed (Nontidal)	No change
Unconsolidated Shore (Nontidal)	7 acres lost
Unconsolidated Bottom (Nontidal)	36 acres lost
Net Change in Palustrine Wetlands	184 acres lost

Net losses of other palustrine wetlands were seven acres of nonlittoral unconsolidated shore (due mostly to vegetative succession to emergent wetland), six acres of mixed shrub and emergent wetland (due to unknown activities), and six acres of forested wetland (due mostly to commercial development).

Lake Erie

Table 8 summarizes the net changes in wetlands in the Lake Erie Coastal Zone between the mid-1970s and 1986. In general, only minor net changes occurred during this period. Small net losses of three wetland types (i.e., palustrine scrub-shrub/emergent wetlands, lacustrine littoral unconsolidated bottom and palustrine scrub-shrub wetlands) were observed. In contrast, three types of lacustrine wetlands experienced slight net gains, whereas six other wetland types did not change.

Specific wetland changes in the Coastal Zone are outlined in Table 9. Urbanization, mostly housing developments, caused about 70 percent of the wetland losses and little of the wetland gains or changes in type. By contrast, agricultural activities were responsible for about 93 percent of the wetland gains, 3 percent of the changes in wetland type, and about 30 percent of the wetland losses. Largely by abandoning farming of one large area of wet soils in springfield, the net effect of agriculture on wetlands in the Lake Erie Coastal Zone was an increase of 25.2 acres since the mid-1970s.

TABLE 8
Wetland Trends Within the Lake Erie Coastal Zone (Pennsylvania) from the Mid-1970s to 1986 (Tiner and Anderson 1986).

Wetland Type	Net Change
Upland Types	
Palustrine Wetlands	
Unconsolidated Bottom (Littoral)	7 acres lost
Aquatic Bed (Littoral)	No change
Unconsolidated Shore (Littoral)	1 acre gained
Net Change in Lacustrine Wetlands	
Lacustrine Wetlands	
Unconsolidated Bottom	5 acres gained
Aquatic Bed	No change
Palustrine Wetland	6 acres gained
Scrub-Shrub Wetland	3 acres lost
Palustrine Wetland/Aquatic Bed	10 acres lost
Scrub-Shrub Wetland/Emergent Wetland	No change
Forested Wetland	5 acres gained
Forested/Emergent Wetland	No change
Forested/Scrub-Shrub Wetland	No change
Net Change in Palustrine Wetlands	
Palustrine Wetlands	3 acres gained
Unconsolidated Shore	No change

TABLE 9

Wetland Changes in the Lake Erie Coastal Zone Between 1975/77 and 1986 (Tiner and Anderson 1986).
NOTE: All Changes Are the Result of Human Activities.

Type of Change	Wetlands Affected	Cause of Change	# of Wetlands Affected	Total Acreage of Change
Loss (Converted to Upland)	Palustrine Unconsolidated Bottom	Agriculture	3	2.4
	Palustrine Forested Wetland	Agriculture	1	8.1
	Palustrine Scrub-Shrub Wetland	Agriculture	1	3.1
	Palustrine Forested Wetland	Urban (Housing, Commercial Development & Mining)	3	11.2
Gain (From Upland)	Palustrine Scrub/Shrub/Emergent Wetland	Urban (Housing)	1	13.3
	Palustrine Emergent Wetland	Urban (Housing)	1	0.8
	Lacustrine Littoral Unconsolidated Bottom	Urban (Marina Breakwater)	1	6.3
	Palustrine Unconsolidated Bottom	Agriculture (Pond Construction)	11	5.4
Changes in Wetland Type	Palustrine Forested Wetland to Palustrine Unconsolidated Bottom	Agriculture (Channel Widening)	1	0.3
	Palustrine Forested Wetland to Palustrine Emergent Wetland	Agriculture (Abandoned Farming of Wet Soils)	1	33.1
	Palustrine Forested Wetland to Palustrine Scrub-Shrub/Emergent Wetland	Urban (Altered Drainage Patterns)	1	3.0
	Palustrine Forested Wetland to Palustrine Unconsolidated Bottom	Agriculture (Pond Construction)	3	2.2
Changes in Wetland Type	Palustrine Forested Wetland to Palustrine Emergent Wetland	Agriculture (Clearing & Partial Drainage)	1	6.2
	Lacustrine Littoral Unconsolidated Bottom to Lacustrine Littoral Unconsolidated Shore	Urban (Deposition)	1	0.9

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Chapter Thirty-One

FUTURE OF PENNSYLVANIA WETLANDS

DANIEL A. DEVLIN and WALTER M. TZILKOWSKI

Department of Environmental Resources

Pennsylvania Bureau of Forestry

P.O. Box 1467

Harrisburg, PA 17120

and

School of Forest Resources

The Pennsylvania State University

University Park, PA 16802

Attempting to predict with certainty the future of Pennsylvania's wetlands is like gazing into a crystal ball. The clarity of the picture depends on how deep into the ball we look. The ball's surface representing the near future is clear, whereas the deeper we gaze into the ball, the more unclear the picture becomes. One point on the future of wetlands is clear and salient—the future will bring change. All biological systems, including wetlands, are constantly undergoing changes either from natural or man-made causes. Our task is to attempt to predict these changes and determine the forces driving them.

The term wetland has undergone changes. Today's scientific definitions of wetlands are different than those used 40 or as recently as 20 years ago. Despite various definitions and disagreement on a technically accurate definition, one concept has remained constant—the presence of water. Water is the driving force behind wetlands and is the common denominator in any definition.

The most commonly used definition and widely accepted classification system for wetlands are those used by the U.S. Fish and Wildlife Service (Cowardin et al. 1979). This classification recognizes five major wetland and deepwater habitat systems: marine, estuarine, lacustrine, riverine and palustrine. The latter three systems represent nearly all of Pennsylvania's wetlands.

The U.S. Fish and Wildlife Service classification includes the lacustrine (deepwater habitats) and riverine (wetlands within river and stream channels) systems that are generally not included in traditional wetlands terminology.