

Forested Wetland Area and Distribution

A detailed look at the South

By Frederick W. Cubbage and Curtis H. Flather

Debate over the classification, protection, and management of forested wetlands has intensified in recent years. Federal agencies have classified US wetlands in various manners, leading to frequent protests by groups favoring more or less stringent criteria. In addition, wetland issues have faced an evolving scope of federal water pollution laws applying to wetland regulation; a unified federal wetland delineation manual whose implementation was opposed by the executive branch and some members of Congress; and introduction of bills to redefine wetlands.

Despite continuing debate, there is still no single definition of wetlands, and very little information is available on their actual area and distribution in the United States, especially forested wetlands. In fact, published estimates of forest wetland acreage have varied widely,

increasing confusion about the implications of permit requirements or management restrictions.

More reliable data on forested wetland extent and trends can clarify our knowledge and contribute to future discussions. Accordingly, this article summarizes the latest data on the acreage and regional distribution of forested wetlands in the United States. Since almost two-thirds are in the South, it also examines the distribution of forest wetland types among southern subregions.

Wetland Definition

The paucity of data on forested wetland area may be attributed partially to the lack of a universally accepted wetland definition. However, it is generally agreed that vegetation, soils, and hydrology are classification attributes. Wetland vegetation is divided into obligate hydrophyte wetland species (greater than a 99% chance of occurring in wetlands), facultative wetland species (67% to 99% chance), and facultative species (33% to 67% chance) (Cowardin et al. 1979). Wetland soils are generally characterized by large amounts of organic material, poor decomposition, mottled gray color, and anaerobic conditions. Wetland hydrology concerns the number of days per year or per growing season that an area is inundated or saturated with water.

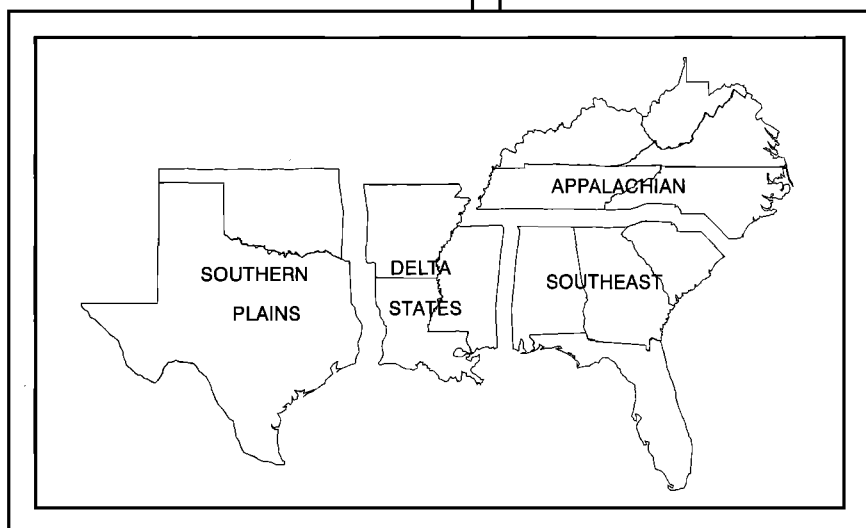
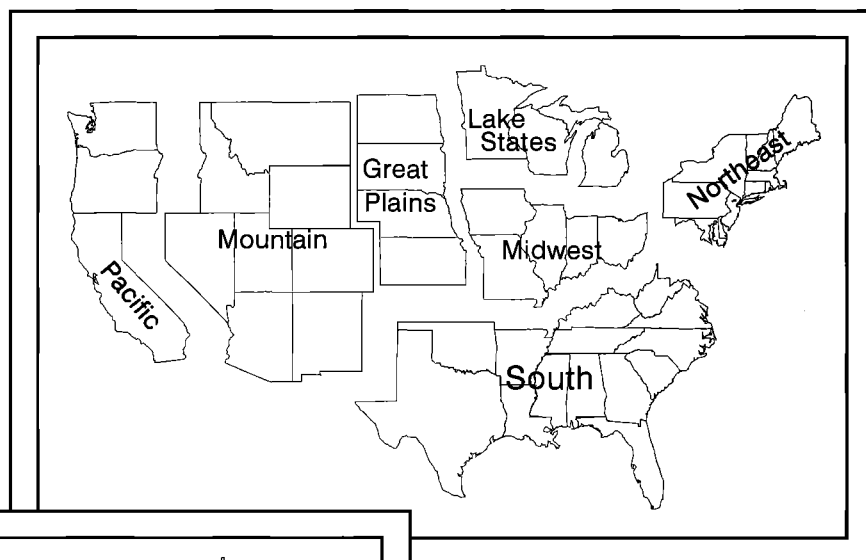
All three criteria are usually needed for an area to be classed as a wetland, though two may be adequate on disturbed sites. However, these characteristics of wetlands remain hotly debated and difficult to apply (Cowardin et al. 1979, Federal Interagency Committee for Wetland Delineation 1989, Cubbage et al. 1990, Cubbage et al. 1993). The 1989 inter-



Courtesy of USDA Soil Conservation Service

Figure 1 (right). National wetland analysis regions.

Figure 2 (below). Subregions used for analysis of southern forested wetlands.



agency report criteria were withdrawn in 1991, and an older 1987 manual was mandated by the Bush administration for use in 1993.

Wetland Acreage

The difficulties in defining a wetland led to some differences among agency wetland classifications and inventories, but this review indicates that most estimates are reasonably close.

Data on forested wetland areas on nonfederal lands were obtained from the USDA Soil Conservation Service natural resources inventory (NRI) database. This article used data from the 1982 and 1987 NRI surveys to identify forested wetlands by region. The NRI is a national survey of the cover types and land uses across the conterminous United States. It uses the Fish and Wildlife Service Circular 39 (Shaw and Fredine 1956) classification system, which recognized 20 wetland types based primarily on their value to

waterfowl. Data and descriptions from the 1982 survey were published in 1987 (USDA Soil Conservation Service 1987); 1987 data were obtained by special request of relevant computer runs (USDA Soil Conservation Service 1992).

More recent classifications have incorporated broader ecological considerations into wetland definitions. Consequently, the NRI estimates are slightly lower than those based on these newer classifications, such as Cowardin et al. (1979) and Dahl and Johnson (1991). For example, the USDI Fish and Wildlife Service study (Dahl 1990), a widely cited reference that used historical records and modern studies to summarize wetlands trends from the 1780s to the 1980s, used the classification system in Cowardin et al. (1979).

The difference between the NRI data and the more modern wetland classification systems probably is not large. There are about 12.5 million acres of federal wetlands (Flather and Hoekstra 1989).

This brings the total NRI-based wetlands (which only included nonfederal areas) to about 95 million acres. This is about 7% lower than the Dahl and Johnson (1991) estimate of 103 million acres, and the difference would be even less if the conversion of wetlands to federal ownership between 1974 to 1981 were included. Therefore the difference between the NRI estimate—based on Circular 39—and the Fish and Wildlife Service (F&WS) estimate—based on Cowardin et al.—is likely to be less than 5%.

Data from the USDA Forest Service forest inventory and analysis (FIA) also provided useful estimates of forest types that could be classified as wetlands. However, the NRI data generally provided the most consistent basis for examining differences in forested wetland trends among regions for nonfederal ownerships.

Table 1 summarizes US wetland acreage in seven areas based on NRI crop production regions (fig. 1). The F&WS report (Dahl 1990), using wetland definitions from Cowardin et al. (1979), indicated about 104 million acres of wetlands present in the 1980s. The South had the most—57 million acres—followed by the Lake States at 19.6 million acres. A more recent F&WS national wetland inventory (Dahl and Johnson 1991) estimated that there were 103 million acres in the mid-1980s, of which 51.75 million acres were palustrine (freshwater) forested wetlands.

According to the NRI, there were about 81.9 million acres of nonfederal wetlands in the conterminous United

States in 1987, down from 83.1 million in 1982. (Approximately 300,000 acres of this loss was actually land transferred to the federal government and probably remained as wetlands.) The 1987 NRI listed 45.0 million acres as forested wetlands, a drop of nearly 458,000 acres from 1982.

Southern Forested Wetlands

According to the NRI, the South contains more than 65% of the nonfederal forested wetlands in the United States, and the East more than 95%. To provide more detail, this review divided the region into smaller areas based on the SCS crop production subregions (fig. 2) and summarized data for both total forested wetlands and by forest type. Table 2 shows total wetland and forested wetland areas by subregion. The Southeast (Alabama, Florida, Georgia, South Carolina) had the greatest wetland area, 21.9 million acres, and the Southern Plains subregion (Texas and Oklahoma) had the least, 3.8 million acres. Florida and Louisiana had the most wetlands, with 11.0 and 8.8

million acres, respectively. West Virginia had the least—102,000 acres.

The 1982 and 1987 NRIs provided the basis for a closer examination of trends in and distribution of southern nonfederal wetland area. Recall that 29.3 million of the 45.0 million acres of the forested wetlands were in the South. In 1987, forested wetlands comprised 77% of the total wetland area in the Appalachian region; 72% of the Southeast wetland totals; 70% of the Delta totals; 39% of the Southern Plain totals; and 69% for all the South.

Tables 1 and 2 also illustrate the loss in total and forested wetlands between 1982 and 1987. As measured by the NRI, total nonfederal wetland acres in the South dropped from 43.1 million acres in 1982 to 42.4 million acres in 1987. In the four SCS crop production subregions that make up the South, total nonfederal wetland acres decreased 692,400 acres from 1982 to 1987. Total forested wetland area decreased 422,000 acres during the same period. The Delta states lost the largest amount of forested wetland—208,100

acres (2.5%). The Appalachian states lost fewer acres (145,900) but a larger percentage—3.2%.

The NRI data were also used to analyze the causes of this loss of forested wetlands—that is, whether they became nonwetlands or nonforested wetlands. About 80,000 acres of forested wetlands in the South changed to urban uses; about 39,000 acres were lost to rural transportation (roads, bridges); 74,300 became cultivated cropland (all located in the Delta and Appalachian subregions); and 13,300 were lost to other farm uses or pastureland. Wetlands that became bodies of water caused the loss of 12,400 acres.

The largest loss of nonfederal wetlands was actually change of ownership to federal lands, not loss of wetlands per se. From 1982 to 1987, 37,000 acres of forested wetlands in the Delta became federally owned, as did 116,200 acres in Appalachia and 40,000 acres in the Southeast, for a total of 193,200 acres. Thus almost one-half of the loss of nonfederal forested wetlands probably remained in wetlands,

Table 1. Estimated wetland acreage in the conterminous United States.

Region	F&WS ¹ Total	Natural Resources Inventory			
		1982 ²		1987 ³	
		Forested	Total	Forested	Total
South	56,909,325	29,770,700	43,118,200	29,348,700	42,426,100
Northeast	9,548,314	5,206,900	7,891,100	5,179,300	7,834,500
Lake States	19,614,792	8,733,000	17,212,300	8,750,300	17,148,800
Midwest	3,552,833	1,169,900	2,851,600	1,146,500	2,828,800
Great Plains	6,610,900	28,000	5,521,300	24,800	5,509,300
Mountain	5,352,250	197,200	3,877,200	198,000	3,583,800
Pacific Coast	2,785,900	353,800	2,638,400	354,100	2,584,400
Total	104,374,314	45,459,500	83,110,100	45,001,700	81,915,700

¹Dahl 1990.

²USDA Soil Conservation Service 1987.

³USDA Soil Conservation Service 1992.

NOTE: 2.47 acres = 1 hectare.

Table 2. Estimates of southern wetland acreage by subregion.

Subregion	F&WS ¹ 1980s total	Natural Resources Inventory			
		1982 ²		1987 ³	
		Forested	Total	Forested	Total
Appalachian	7,953,113	4,576,200	5,912,600	4,430,300	5,733,800
Southeast	24,779,300	15,600,400	21,922,300	15,524,600	21,614,200
Delta states	15,614,800	8,146,700	11,506,600	7,938,600	11,314,500
Southern Plains	8,562,112	1,447,400	3,776,700	1,455,200	3,763,300
Total	56,909,325	29,770,700	43,118,200	29,348,700	42,425,800

¹Dahl 1990 (all wetlands).

²USDA Soil Conservation Service 1987 (nonfederal wetlands only).

³USDA Soil Conservation Service 1992 (nonfederal wetlands only).

unless they were flooded by dams completed in the 1980s (which could not be determined).

An additional 152,500 acres were still classed as wetlands but were no longer forested. More than 100,000 acres were lost in the Delta states alone, including 36,600 acres converted to bush management and 37,500 acres in pasture and hayland management.

Southern Classes and Species

The 1982 NRI also collected data from an intensive sample that could be used to classify forested wetland areas by types. The high-intensity sample, although not giving the same totals as the overall 1982 data, does provide more interesting breakdowns of forested wetland areas.

The 26.8 million acres of forested wetlands in the South were divided into five classes per Shaw and Fredine (1956): freshwater basins and flats, almost 15 million acres (56%); wooded swamps, 10.2 million acres (38%); bogs, 1.0 million acres; mangrove swamps, 0.35 million; and shrub swamps, 0.23 million. Al-

most 80% of the Delta states' nonfederal forested wetlands were freshwater basins. About one-half of the Southeast's forested wetlands were wooded swamps, and it also had 99% of the mangrove swamps.

The intensive data also allowed a breakdown into broad and specific forest types. By broad forest type, oak-gum-cypress comprised 48.5% (13.0 million acres) of the total in the South. Oak-hickory (19.6%), oak-pine (14.5%), and loblolly-shortleaf pine (7.1%) types constituted the largest share of the remainder, a total of 11.0 million acres. Southern pine types comprised 10.2% of all nonfederal wetlands, or about 2.7 million acres. The greatest share of wetland pine and oak-pine types occurred in the Southeast—3.7 million acres.

The breakdown into specific forest types provides more interesting detail (*table 3*). The baldcypress-water tupelo type is the largest single forest type, at 4.3 million acres (16.0%) of all nonfederal forest wetlands in the South. The pure pine types are a relatively minor share (10.2%), with most of them in the Southeast.

Other Studies

Various other studies have used USDA Forest Service Forest Inventory and Analysis (FIA) data to estimate forested wetland trends for the United States or for parts of the South. Abernethy and Turner (1987) used the FIA forest type groups and local types (oakgum-cypress, elm-ash-cottonwood, black spruce) that denote forested wetlands to estimate US trends. They found that forested wetlands in the South had decreased about 6.8 million acres from 1940 to 1980. They estimated that the Southeast had lost 1.1 million acres and the South Central had lost 4.6 million acres.

In a more recent analysis, Tansey and Cost (1990) used FIA data to estimate forest wetland areas in the Southeast (Florida, Georgia, South Carolina, North Carolina, and Virginia). They then compared the accuracy of estimates using forest type data alone with estimates based on the official three-part (soils, hydrology, vegetation) wetland criteria. They examined the timberland areas in the Southeast that are classed similar to the palustrine (freshwater) forest and scrub/

Table 3. Forested wetland areas by region and specific forest type, 1982.

Forest type	SCS crop region									
	Appalachian		Southeast		Delta states		Southern Plains		Southern total	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Baldcypress/water tupelo	494,900	12.18	2,463,100	17.32	1,277,400	17.87	61,100	4.55	4,296,500	16.05
Swamp chestnut/cherrybark	302,900	7.45	1,556,700	10.95	1,582,400	22.14	331,300	24.67	3,773,300	14.09
Sweetbay/swamp tupelo	549,700	13.53	2,183,000	15.35	584,800	8.18	64,000	4.77	3,381,500	12.63
Mixed hardwoods	101,700	2.50	1,877,700	13.20	926,400	12.96	175,600	13.08	3,081,400	11.51
Loblolly/hardwood	331,100	8.15	1,304,800	9.18	524,300	7.34	403,400	30.04	2,563,600	9.57
Loblolly pine	266,300	6.55	653,600	4.60	181,900	2.54	69,300	5.16	1,171,100	4.37
Sweetgum/yellow poplar	205,000	5.04	737,000	5.18	37,900	0.53	0	0.00	979,900	3.66
Slash/hardwood	8,000	0.20	789,800	5.55	100,600	1.41	0	0.00	898,400	3.36
White/red oak, hickory	428,800	10.55	168,500	1.18	195,900	2.74	13,600	1.01	806,800	3.01
Slash pine	2,700	0.07	556,700	3.91	144,100	2.02	15,000	1.12	718,500	2.68
Pond pine	586,700	14.44	50,900	0.36	0	0.00	0	0.00	637,600	2.38
Sugarberry/elm/ash	19,400	0.48	99,700	0.70	475,600	6.65	10,300	0.77	605,000	2.26
Overcup oak/water hickory	3,200	0.08	70,900	0.50	400,200	5.60	39,200	2.92	513,500	1.92
Nonstocked forest	187,400	4.61	170,800	1.20	71,000	0.99	22,800	1.70	452,000	1.69
Oak-gum-cypress	61,200	1.51	175,100	1.23	119,700	1.67	37,400	2.79	393,400	1.47
Yellow poplar/oak	84,300	2.07	163,200	1.15	15,000	0.21	0	0.00	262,500	0.98
Willow	20,300	0.50	19,000	0.13	175,500	2.46	3,900	0.29	218,700	0.82
Sycamore/pecan/elm	22,600	0.56	78,900	0.55	68,400	0.96	33,400	2.49	203,300	0.76
Other oak-pine	17,700	0.44	107,300	0.75	57,600	0.81	3,900	0.29	186,500	0.70
Shortleaf/oak	28,600	0.70	78,600	0.55	32,800	0.46	25,700	1.91	165,700	0.62
Other types	261,300	6.43	869,400	6.11	161,400	2.26	30,600	2.28	1,322,700	4.94
Total	4,064,200	100.00	14,219,700	100.00	7,147,900	100.00	1,342,900	100.00	26,774,700	100.00

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it is a crucial part of the most productive lands in some regions.*

shrub group as used by the F&WS and Cowardin et al. (1979), and the forest group of the estuarine system. These basically comprise freshwater forested wetlands and forested saltwater wetlands.

Tansey and Cost classed the FIA forested plots into four groups. Category 1 met the vegetative requirements (greater than 50% stocking with wetland species) and the hydrological requirements. Category 2 met the vegetation requirement but had no evidence of water. Category 3 showed evidence of flooding but had less than 50% hydrophytic vegetation. Category 4 was composed of well-drained uplands. Using this approach, the authors found 9.6 million acres in Category 1 wetlands; 4.9 million acres in Category 2; 11.9 million acres in Category 3; and 44.2 million acres in Category 4. They noted that data were collected during the dry 1980s so little flooding was likely, and pine plantations were not included in the analysis. Of all the forested wetlands, 86% were in the Coastal Plain. Deep swamps comprised 8% of the wetland area, and 15% were flatwoods. By wetland forest type, 68% were classed as bottomland hardwoods, 18% as other hardwood types, 5% as pond pine sites, and 9% as other pine types (Tansey and Cost 1990).

The authors found that using general forest type or physiographic class to estimate forest wetland area could misestimate the area and would probably not gauge distribution among types accurately. For instance, nearly 29% of all bottomland hardwood stands in the Southeast are on well-drained mesic sites such as broad floodplains. Thus one cannot use forest types alone as reported in FIA publications to accurately estimate forested wetland area trends. Instead, the original FIA plots must be screened according to the current federal criteria for vegetation, hydrology, and soils.

According to Dahl (1990), the United States lost almost one-half its original wetlands from the 1780s to the 1980s. The total wetland area in the southern states also decreased by about half, from 112 million acres to 57 million acres. Furthermore, Dahl et al. (1991) estimated that palustrine (freshwater) forested wetlands in the conterminous

United States decreased from 55.15 million acres in the mid-1970s to 51.75 million in the mid-1980s. This represents a loss of 3.4 million acres of forested wetlands in 10 years, or a 6.2% decrease.

The NRI data showed that the US mainland lost 457,800 acres (1.0%) of forested wetlands from 1982 to 1987 and the South lost 422,000 acres (1.4%)—although 193,200 of these southern acres just shifted into federal ownership and may not have been lost as wetlands.

Management Implications

Partly in response to indicators of wetland losses, Section 404 of the Amendments to the Federal Water Pollution Control Act of 1972 mandated control of dredge and fill operations in the nation's waters and wetlands. Twenty years later, we are still debating the definition of a wetland, the extent of the silvicultural exemption to the Section 404 permit requirements, and whether we are losing significant amounts of wetland area. The wetland areas estimated here are relatively consistent between sources and should correspond well with the old 1987 federal wetland delineation manual, which was mandated for use in 1993.

Summarized data are based on statistical samples, which are most accurate for the largest land areas. Standard error for the national NRI total wetland estimate is $\pm 2.5\%$; for the F&WS estimate it is $\pm 3.3\%$. To reduce the uncertainty of specific state wetland estimates, data were aggregated into several broad regions. Data on specific forest types will have the largest associated errors due to sampling intensity, field misidentification, or recording mistakes; they should be used most cautiously.

The NRI-based estimates indicate that the South has about 26.7 (intensive 1982 data) to 29.3 million (1987 data) acres of nonfederal forested wetlands, of which almost 25% is in southern pine or pine-hardwood. However, these pine wetland types comprise only about 7.4% of the total 89 million acres of pine and pine-hardwood types in the South.

According to the NRI data for nonfederal forestlands, several specific forest management types are apt to include most of the southern pine forested wet-

lands—longleaf pine, slash pine, loblolly pine, pond pine, slash-hardwood, loblolly-hardwood, shortleaf-oak, and longleaf-scrub oak. If all of these were subject to federal regulation of some type, they would total 6,588,400 acres or 24.6% of all southern forested wetlands. There is little debate over natural pine management on most acres, where harvesting and regeneration generally fall under the Section 404 silvicultural permit exemption.

Harvest, intensive site preparation, and planting is the most contentious question regarding silvicultural operations in wetlands. Minor or major drainage during harvesting and regeneration also are points of disagreement. Debates have been hottest in the 600,000 acres of pond pine in Virginia and the Carolinas; 700,000 acres of slash pine in the Southeast and Delta; 1.2 million acres of loblolly throughout the South; and a fraction of the 3.5 million acres of slash/loblolly pine-hardwood throughout the South. However, this area is small compared to the estimated 26 million acres of pine plantations, 38 million acres of natural pine, and 25 million acres of mixed pine-hardwood in the South (USDA Forest Service 1988).

These estimates help clarify the substance of the wetland protection debates. Most interest groups, government agencies, and private landowners in the South agree that some degree of protection should be afforded to wetland forest management and harvest of wetland hardwoods. These areas usually are very wet and could be environmentally sensitive and valuable. Thus there is less conflict concerning use of about 20 million of the 26 million acres of southern forested wetlands.

The remaining 6.5 million acres of pine or pine-hardwood types comprise a smaller amount of wetlands area than commonly believed. Debate will continue over intensive management, harvest, regeneration, and drainage in pine plantation management. While the wetland plantation area may be modest overall in the South, it is a crucial part of the most productive lands in some regions. Much of the more than 500,000 acres of pond pine in the Appalachian region

could be converted to productive plantations; they have been the focal point of a lawsuit between environmental groups and a forest industry in North Carolina. The 3.7 million acres of loblolly types and 1.6 million acres of slash types also are crucial. These areas, though less than 5% of the total softwood area, are important because timber removals already are close to timber growth in the region. Similar conditions exist in other regions of country, such as commercially important black spruce softwoods in the Northeast

and the Lake States.

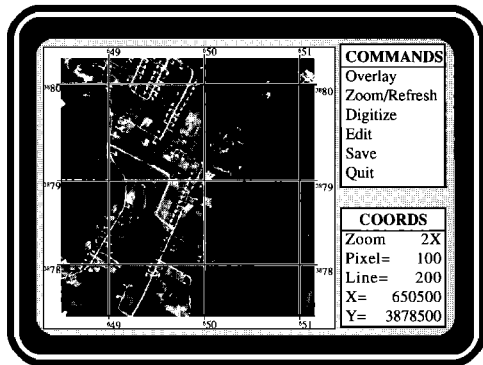
The basic agreement between the NRI and Dahl (1990) forested wetland estimates places reasonable boundaries on the extent of forested wetlands in the United States. Debates over forested wetlands protection and management will continue as wetlands definition and delineation become clearer and the silvicultural exemption is better defined. The estimates provided here should clarify the magnitude of the issues involved by region and by forest type. **JOE**

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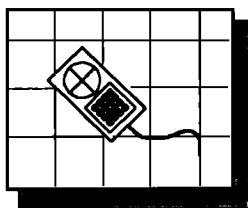
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