

Development of Vegetation on Portsmouth Island, N. C.:
Fourteen Years of Change

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In October, 1973, we collected specimens of vascular plants on Portsmouth Island, North Carolina, and compared the vegetation of the island with that observed in 1959 (see Burk, 1961a). Changes in the flora and vegetation during the 14 year period are of interest for several reasons. Of the segments which comprise the Outer Banks, the chain of barrier islands which extend from Virginia south along the northern half of the North Carolina coast, Portsmouth Island remains least studied. Godfrey (1970) has conducted ecological research on the stretch of Core Banks immediately south of Portsmouth while James Lazell (personal communication) has collected specimens of vascular plants in the course of herpetological investigations; no other botanical studies have been carried out on the island to our knowledge since the work in 1959.

In recent years much controversy has arisen regarding the role of artificially constructed dunes on barrier island systems. The classical concept that such dunes are helpful in maintaining the stability of barrier islands has been assailed in studies (Dolan, 1972a; Dolan, 1972b; Dolan et al, 1973; Godfrey and Godfrey, 1973) which suggest that these structures may indeed contribute to the deterioration of the outer beach and ultimately the entire island ecosystem. Although Portsmouth Island supported a human population from 1757 through the early 1970's, with a peak census figure of 505 in 1850 (Stick, 1958), there has been no extensive construction of dunes there, the village and most

of the buildings being separated from the Atlantic by a few low sand ridges, an expanse of sandflat up to two km wide, and scattered foredunes before the ocean beach. The island is approximately 10 km in length and varies from one to three km in width. A topographic map (U.S. Geological Survey, Portsmouth N.C. quadrant: 1950 ed. photorevised 1970) indicates that during the period 1946-48 through 1970, beach configurations have remained fairly stable with an apparent widening of about 100 m on the ocean side. Permanent human habitation was abandoned more than a year previous to our 1973 work although a number of buildings are used as vacation residences. Free-ranging livestock were removed shortly prior to 1959, when the human population numbered 11.

Figures 1 through 8 compare sites photographed from approximately the same vantage points in 1959 and again in 1973. Figure 9 shows the only trees present on the island in 1959; figure 10 shows a representative stand of Pinus taeda in 1973. Captions to the figures describe the sites in more detail. The most striking changes include (1) increased species richness in all vegetation types, and (2) a marked tendency for shrubs to invade what were formerly areas dominated by dune grasses and for arborescent vegetation to develop in what had been a shrub community. The expansion of shrubs on other portions of the Outer Banks has been attributed to the establishment of artificial dunes (Dolan et al, 1973; Godfrey and Godfrey, 1973).

This is clearly not a factor on Portsmouth; however, the widening of the beach may be.

Previously unlisted species now well represented in the dune-grass community include Andropogon virginicus, Eragrostis spectabilis, Muhlenbergia capillaris, Triplasis purpurea, Strophostyles helvola, Opuntia drummondii, and Gnaphalium obtusifolium. Lonicera japonica is well established on dunes and in the shrub community; Zanthoxylum clava-herculis occurs in several sites with such previously reported shrubs as Myrica cerifera ~~pennsylvanica~~, Ilex vomitoria, and Baccharis halimifolia. These shrubs may reach the height of small trees; Pinus taeda, Juniperus virginiana, and Populus alba range from shrub to arborescent form.

Lazell (personal communication) collected a specimen of Quercus virginiana on Portsmouth Island in 1972 from a tree 18 feet in height and 43½ inches in circumference one foot above the ground. He quotes a former resident of Portsmouth Village who recalled that the "last" live oak, a shade tree surrounded by mowed lawns, was cut down sometime during the previous 20 to 50 years. No specimens of Q. virginiana were seen in 1959; the tree Lazell described was surrounded by numerous seedlings.

Species previously not observed in the Portsmouth Island saltmarsh include Salicornia europaea, Limonium carolinianum, Cynanchium palustre, Aster racemosus, A. subulatus, and A. tenuifolius. Although a few fresh-water pools were observed in 1959, more extensive fresh-water marsh is now developed with,

on different sites, Typha latifolia, Setaria magna, and Scirpus americanus prominent. Mikania scandens occurs in a number of community types.

Species persistent or spreading from former cultivation include Gladiolus x gandovensis, Canna x generalis, Daubentonia punicea, Ipomoea batatas, and Oxalis rubra. Ipomoea batatas, the sweet potato, was widely cultivated on Portsmouth Island during the 19th century (Dunbar, 1958). Several herbaceous species, including Osmunda regalis and Boehmeria cylindrica, have established themselves beneath the frameworks of disintegrating buildings. A variety of sites within the village present the aspect of typical early stages of old-field succession, with Andropogon virginicus, Eupatorium capillifolium, and Solidago microcephala particularly prominent.

Other taxa not seen in 1959, occurring mostly on sites disturbed by man in 1973, included Agrostis stolonifera, Digitaria sanguinalis, Sphenopholis obtusata, Allium bivalve, Chenopodium ambrosioides, Galactea sp., Acalypha gracilens, Solanum carolinianum, and Lactuca canadensis. A total of 38 species were collected in 1973 which were not seen in 1959; most of the species previously listed were observed on the latter trip. While some of the additions to the island flora, particularly fall-blooming Compositae, were probably overlooked in 1959, we are convinced that a substantial number reflect an increase in species richness since that time.

Several factors undoubtedly have contributed to the increased floristic diversity and successional development. Among these are the widening of the ocean beach and the removal of both grazing livestock and year-round human occupants (who, according to Lazell's informant, harvested live oak for use in smoking fish). Perhaps equally important has been the near-absence of major hurricanes passing over the Outer Banks between 1962 and 1973 coupled with a change in peak storm activity to the winter season when vegetation is in a more dormant state.

The period immediately prior to the 1959 collection was marked by a number of hurricanes of unusual intensity; these and subsequent climatic events are documented in U.S. Weather Bureau Climatological Data; National Summaries 1950-73 (vols. 1-24). The 1954 season was described as the most destructive on record to that date and 1955 broke the 1954 records, with four major storms affecting the area in an 11 month period. 1956 and 1957 were extremely mild hurricane seasons; one storm in 1958 paralleled the coast with a center east of Cape Lookout, passing out to sea beyond Hatteras and causing considerable damage. Hurricane Donna in 1960 went inland near Morehead City and crossed back over the Outer Banks near the Virginia line, causing damage worse than any of the 1954-55 storms. From 1961 through the 1973 period, hurricane effects on the Outer Banks were negligible except for extensive overwash south of Portsmouth Island and beach erosion northward associated with Hurricane Ginger in 1971.

(Dolan, 1973; Godfrey and Godfrey, 1973). However, a recent analysis (Hayden, 1975) indicates that the duration and frequency of extratropical storms generating high waves increased, as did the length of the winter storm wave season, in the period 1965-1970. U.S. Weather Bureau records (cited above) also indicate cooler winter temperatures at Hatteras through the period following 1959 when compared with the period 1953-1959.

Recent developments in the theory of island biogeography are useful in interpreting floristic events on Portsmouth Island. The diversity of oceanic islands has been interpreted as an equilibrium with balanced species immigrations and extinctions (MacArthur and Wilson, 1967). During early successional states, the rate of extinction tends to decrease in areas of varied topographies, resulting in an increase in the total biota. We have compared floras based on collections assumed to be relatively complete and prepared at discrete time intervals from Shackleford Banks, south of Portsmouth Island on the Outer Banks, and from Ocracoke, directly north. Shackleford has been essentially in equilibrium during the period 1916, when Lewis (1917) collected 239 vascular plant species, through 1966-68 when Au (1970) collected 273. Lewis did not collect in the fall and states that therefore certain elements may have been missing from his list. Our analysis of Au's list indicates that 171 species were persistent since 1916, with 68 extinctions from the island and 102 invasions through the period. Shackleford

was uninhabited throughout the interval, though severely grazed by feral livestock.

Ocracoke, however, has shown a marked increase in floristic diversity in recent years. We have compared lists of vascular plant species collected on Ocracoke in 1898 (Kearney, 1898) and in 1951 (Rondthaler, 1952) with previously unpublished collecting data from Ocracoke used in preparation of a flora of the Outer Banks (Burk, 1961b). Our analysis of vascular plant species on the three lists is as follows:

1898 collection	130
1951 collection	101
persistent since 1898	50
extinctions since 1898	80
invasions since 1898	51
1959-60	158
persistent since 1898	33
persistent since 1951	22
extinctions since 1951	46
invasions	
invasions since 1951	74
reinvasions from 1898	29

Many of the species new in 1959-60 are ruderals; their advent is almost certainly related to the greater number of human visitors to the island resulting from the ferry service initiated from Hatteras to Ocracoke in the mid 1950's and the concomitant

construction of a surfaced road from the ferry slip south to Ocracoke Village. We have observed similar trends on islands of morainal origin off the Massachusetts coast, with uninhabited Penikese in an equilibrium since 1923 following a growth phase related to the removal of livestock and human occupants and adjacent Cuttyhunk in a clear phase of expansion from the late 1920's to the present, again a result of the cessation of grazing (Burk and Lauermann, 1975; Lauermann and Burk, 1975; Lauermann and Burk, in press; O'Neill, 1975). The flora of Portsmouth Island would seem to be in a growth phase similar to that observed on Ocracoke and Cuttyhunk; it is perhaps significant that this phase occurs in the absence of deliberate attempts by man to stabilize the island.

Nomenclature in this paper follows Radford, Ahles, and Bell (1968); specimens of all species collected have been deposited in the herbarium of Smith College.

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Fig. 1. Dunes at the western margin of the sandflat facing south in 1959. Spartina patens is the dominant grass with few associated species. Note curve of road.

Fig. 2. Approximate site of Fig. 1 photographed in 1973. Grasslands show more diversity with Muhlenbergia capillaris, Uniola paniculata, Gnaphalium obtusifolium, and Solidago sempervirens abundant with Spartina patens. Shrubs including Myrica cerifera and Baccharis halimifolia show a marked invasion.

Fig. 3. Portsmouth Village photographed from dunes at western edge of sandflat in 1959. Note position of church and telephone pole. Dominant foreground species include Spartina patens, Uniola paniculata, Croton punctatus, and Hydrocotyle umbellata. The shrub is Myrica cerifera.

Fig. 4. Portsmouth Village in 1973 photographed from approximate site of Fig. 3. Structures except for church steeple and telephone pole are obscured by growth of shrubs, including Myrica cerifera, Ilex vomitoria, and Baccharis halimifolia, and trees including Pinus taeda and Juniperus virginiana. Foreground includes Muhlenbergia capillaris, Triplasis purpurea, and Gaillardia pulchella in addition to 1959 species.

Fig. 5. Road in Portsmouth Village, 1959, with dense growth of Juncus roemerianus on margins, Spartina patens in track. Shrubs include Juniperus virginiana, Ilex vomitoria, and Baccharis halimifolia.

Fig. 6. Site of Fig. 5 in 1973. Pinus taeda, Juniperus virginiana, and Baccharis halimifolia obscure houses and all but steeple of the church.

Fig. 7. Portsmouth Island post office in 1959. The building was still in use at this time.

Fig. 8. Post office in 1973. The building, though repainted, is no longer used. Adjacent shrubs include Juniperus virginiana and Baccharis halimifolia.

Fig. 9. Stand of salt-spray damaged Juniperus virginiana on a hummock in the marsh in 1959. These were the only trees on the island at that time. The marsh is dominated by Juncus roemerianus.

Fig. 10. Invasive Pinus taeda with Juniperus virginiana and Ilex vomitoria opposite the post office in 1973. The trees are approximately 20 feet in height.

