

TABLE 1. Population Distribution in 1622–1624 (and the Probable Distribution from 1617 to 1624)

Estuarine Zone	Massacre Deaths	Living, 1623–1624	Dead, 1623–1624	Total	Percentage of Population
Freshwater	209	289	57	555	28.5%
Oligohaline	145	603	211	959	49.3%
Mesohaline, Polyhaline	0	303	101	431	22.2%

Note:

This table does not include population on the Eastern Shore or on recently arrived vessels.

Virginia colonists resided in the oligohaline and saltwater zones; 28 percent occupied the freshwater—almost a direct reversal of the pattern under Dale, when 68 percent lived in the freshwater zone.

Increased mortality accompanied the shift in population. Several thousand colonists died between 1618 and 1624, and disease was an important cause. Comments on summer sickness and death increasingly punctuated colonial correspondence. But disease was not the sole killer. Indian attacks, starvation, and plague also contributed. While the surviving evidence precludes a precise bill of mortality, some estimates of disease-related deaths can be made from the census of 1623–1624.

Here 1623–1624 is used as a benchmark year for estimating the usual mortality rate from typhoid, dysentery, and salt poisoning from 1618 to 1624. Several bits of evidence suggest these diseases as the principal causes of death in 1623–1624: the reports of summer sickness and death in that year; the absence of other reported causes of mortality; an abundant food supply, making starvation an unlikely cause of death; and the census listing of colonists killed, presumably by the Indians, so that these deaths can be excluded from our disease estimate.⁶⁰ Typhoid and dysentery are also implicated by the spatial

between 1618 and 1622. Massacre casualties on March 22, 1622, were heaviest upriver from Jamestown, and hence I have included them as a more accurate representation of population geography under the Sandys administration.

60. Brown, *First Republic in America*, 569–570; Edmund S. Morgan, *American Slavery, American Freedom: The Ordeal of Colonial Virginia* (New York, 1975), 104–105. The year following the massacre of 1622 was very sickly, but the resultant mortality probably antedated the census of 1623–1624. Tyler, ed., *Narratives of Early Virginia*, 438; Morton, *Colonial Virginia*, I, 83–90.

TABLE 2. Estuarine Zones and Mortality Rates, 1623–1624

Settlements	Estuarine Zone	Percentage Dead	
College Lands	Freshwater	0.0% (0/33)	} 16.7% (50/299)
Neck of Land		9.8% (4/41)	
West & Sherley Hundred		17.9% (10/56)	
Jordan's Journey		16.0% (8/50)	
Flowerdieu Hundred		18.6% (18/63)	
West & Sherley Hundred Island		17.9% (10/56)	
James City & "within the Corporation thereof"	Oligohaline	32.7% (89/272)	} 37.1% (207/558)
"Plantation over against James River"		45.8% (65/142)	
Hogg Island		8.8% (3/34)	
Martin's Hundred		51.0% (26/51)	
Warwick Squarke		40.7% (24/59)	
Elizabeth City }	Mesohaline, Polyhaline	23.3% (98/420)	} 23.3% (98/420)

Note:

This table includes only those settlements returning lists of dead. "Killed" colonists are not here included among the dead.

pattern of death recorded in the census of 1623–1624. Within those settlements reporting deaths during the year, 16.7 percent died in the freshwater zone; 37.1 percent in the oligohaline; and 23.3 percent in the saltier portion of the James estuary (table 2).⁶¹ The match between reality and our estuarine model is good, but not perfect. Freshwater death rates are higher than expected, perhaps reflecting the severe disruptions in this area caused by the massacre of 1622. Another peculiarity is Hog Island in the oligohaline, where only 8.8 percent died. A safer right-bank location, the removal of pollutants toward the north bank by a river meander, and the small population probably combined to make Hog Island a healthy micro-environment. Otherwise the census pattern points toward death by typhoid and dysentery in the oligohaline and the salty lower James.

Having isolated these diseases as probable causes of death, we can estimate their usual contribution to Virginia mortality. The annual

61. "Lists of the Living and Dead in Virginia," *Colonial Records of Virginia*, 37–60.

TABLE 3. Estimated Annual Disease Mortality Rates Based on Population Distribution and Estuarine Zone Mortality Rates, 1618-1624

Estuarine Zone	Percentage of Colony Population (1)	Annual Mortality Rate (2)	Percentage of Total Mortality Rate (1 x 2)
Freshwater	28.5%	16.7%	4.8%
Oligohaline	49.3%	37.1%	18.3%
Mesohaline, Polyhaline	22.2%	23.3%	5.2%
Estimated Annual Disease Mortality Rate for Virginia			28.3%

disease mortality rate (table 3) is estimated as the sum of the products of the ecological zone death rates (table 2) and the population distribution for 1618-1624 (table 1). A disease mortality rate of 28.3 percent per year is indicated; for typhoid, dysentery, and salt poisoning alone, 23.5 percent, with the oligohaline contributing 18.3 percent and the saltwater 5.2 percent. In the freshwater zone 4.8 percent died, but the causes are not known.

Argall and the Sandys administration, by redistributing Virginians into the most deadly zones, share the responsibility for the deaths of 24 to 28 percent in any single year. But the gravity of their offense worsened with time; epidemics struck year after year, killing immigrants and seasoned colonists alike. Disease claimed considerably more colonists than 28 percent between 1618 and 1624. The overall contribution of disease to death is estimated from the several censuses and immigration figures, and the basic data are given in table 4.⁶² Between December 1618 and February 1624 about 5,145 persons resided in or immigrated to Virginia; 24.8 percent survived in 1624, 49.3 percent died from disease, and 25.9 percent died from other causes or went back to England. Two of every three deaths resulted from typhoid, dysentery, and salt poisoning. These diseases were the

62. Population estimates for 1618 to 1622 and 1624 are from: Brown, *First Republic in America*, 328-329, 375, 381, 415, 462, 464, 466-467, 503-505, 612; Morgan, *American Slavery, American Freedom*, 412-413; Greene and Harrington, *American Population before the Federal Census of 1790*, 134-136. Immigration estimates are from Brown, *First Republic in America*, see above for pages. Hecht, "The Virginia Colony, 1607-1640," 334-345. The unknown population of April 1623 is estimated by working backwards, i.e., population of February 1624 (1,275) minus immigrants between April 1623 and February 1624 (405) plus deaths during this period (371) equals the population as of April 1623 (1,241). "Lists of the Living and Dead in Virginia," *Colonial Records of Virginia*, 37-60.

TABLE 4. Disease-Related Death Estimates in Virginia, 1618-1624

Time Period	Population at Beginning	Population at End	Immigrants	Overall Mortality Rate ^a	Disease-Related Deaths ^b	Disease Death/Total
Dec. 1618-						
Mar. 1620	600	887	814-914	37.3%-41.4% (527-627/ 1,414-1,514)	402-430 (28.3%)	402-430/ 527-627 (68-76%)
Mar. 1620-						
Mar. 1621	887	843	1,051	56.5% (1,095/1,938)	550(28.3%)	550/1,095 (50.2%)
Mar. 1621-						
Mar. 1622	843	1,240	1,580	48.8% (1,183/2,423)	688(28.3%)	688/1,183 (58.2%)
Mar. 1622-						
Apr. 1623	1,240	1,241	695	35.9% (694/1,935)	347(17.9%) ^c	347/694 (50.0%)
Apr. 1623-						
Feb. 1624	1,241	1,275	405	22.5% (371/1,646)	371(22.5%) ^d	371/371 (100.0%)
Summary:						
Population in Feb. 1624-----				1,275		
Disease-related deaths, 1618-1624-----				2,538		
Other causes of death or return to England-----				1,332		
				Total-----	5,145	
					2,538(3,870 (65.6%)	

Notes:

^aIncludes deaths from all causes as well as those returning to England alive.

^bUsing estimate of 28.4% per year.

^cSince 347 known deaths occurred in the massacre, the remainder are assigned to disease.

^dOverall death rate fell below the disease rate, hence all were assigned to disease.

principal killers in some years, and they were significant contributors in all.⁶³

The leaders of the company and the colony tried desperately to reduce summer mortality but failed because of their misconceptions of its causes. Preventive measures were aimed at the immigrants and not at the environment and at population distribution. Guest houses (hospitals) were established, and immigrant arrivals were scheduled for fall after the sickly summer months, all done on the false assumption that seasoned colonists would survive.⁶⁴ But seasoned colonists stood little chance of survival in the oligohaline zone, as revealed in the muster of 1625. Then 57 settlers gave arrival dates before 1616; 24 resided in the freshes, 25 in the salt, and just 9 in the oligohaline. Older settlers, those arriving before 1620 of all giving arrival dates, made up about one-fifth of the population in the oligohaline, one-third in the saltwater zone, and two-fifths in the fresh.⁶⁵ These spatial and environmental patterns of death went undetected by the company, and that oversight was instrumental in its dissolution.

The demise of the Virginia Company in 1624 signaled a new era in Virginia demography. The old constraints focusing the colony on Jamestown and the oligohaline were relaxed, and mortality fell. Between 1625 and 1634 Virginia's population grew from 1,210 to 4,914,

63. These estimates of annual disease mortality permit an assessment of other causes of death. Morgan, for example, has suggested starvation and malnutrition, occasioned by control of Virginia's food and labor supply by a handful of private capitalists. The most likely years for such crass behavior were 1620 to 1622, when causes other than Indian killings and diseases contributed 40 to 50 percent of all deaths. Morgan, *American Slavery, American Freedom*, 92–107. Note, however, that immigration was also heaviest in these years—suggesting Craven's point of inadequate provisioning of the immigrants by the company. Probably both company and private wheeler-dealers were responsible for the increased death rate; in any case, the critical years were 1620–1622. Wesley Frank Craven, *Dissolution of the Virginia Company: The Failure of a Colonial Experiment* (New York, 1932), 152–153.

64. The company believed in the curative medicine of seasoning, rather than the preventive medicine of settlement dispersal. Craven, *Dissolution of the Virginia Company*, 148–175; Kingsbury, ed., *Records of the Virginia Company*, III, 275, 301–302.

65. John Camden Hotten, ed., *The Original Lists of Persons of Quality; and Others Who Went from Great Britain to the American Plantations, 1600–1700* (New York, 1931), 200–265.

66. Morgan, *American Slavery, American Freedom*, 159, estimates 1,000 immigrants per year. Morgan underestimates the magnitude of declining mortality rates after 1624. A lower death rate is not inconsistent with his literary evidence. Ship captains experienced high mortality (42 percent in 1636) precisely because they plied in the oligohaline zone. And 1,800 deaths in 1636, given the population and increased immigration in

TABLE 5. Population Growth, 1625–1634, under Pre-1625 Disease Mortality Rates and a Fitted Mortality Rate

Date	Pre-1625 Disease Mortality Rate (28.3% per year)		Fitted Mortality Rate (14.2%) for 1625–1634	
	Population & Immigrants	Survivors	Population & Immigrants	Survivors
1625–1626	1,210 + 1,000	1,582	1,210 + 1,000	1,896
1626–1627	1,582 + 1,000	1,849	1,896 + 1,000	2,485
1627–1628	1,849 + 1,000	2,040	2,485 + 1,000	2,990
1628–1629	2,040 + 1,000	2,177	2,990 + 1,000	3,423
1629–1630	2,177 + 1,000	2,275	3,423 + 1,000	3,794
1630–1631	2,275 + 1,000	2,344	3,794 + 1,000	4,113
1631–1632	2,344 + 1,000	2,394	4,113 + 1,000	4,387
1632–1633	2,394 + 1,000	2,430	4,387 + 1,000	4,622
1633–1634	2,430 + 1,000	2,456	4,622 + 1,000	4,824
1634–1635	2,456 + 1,000	2,475	4,824 + 1,000	4,997

Note:

The actual population in 1634 was 4,914. The above calculations assume no natural increase. Some children were born in the colony during the period, but the imbalanced sex ratio favoring males, and other evidence suggests that children contributed little to population growth at this time.

while receiving an estimated 9,000 immigrants.⁶⁶ Although over half of the population died in the nine-year period, this figure obscures the marked improvement in annual mortality. Had the pre-1625 mortality rate of 28.3 percent per year continued, Virginia in 1634 would have numbered 2,456 instead of 4,914. In effect, annual mortality was cut in half (to about 14.2 percent) during the early royal period (see table 5).⁶⁷

Several factors caused the decline in mortality. By far the most important was the shift in population patterns. By 1634 the deadliest zone along the James, including James City, Warwick, and Warros-

that year, produces a mortality rate in between that of the period 1618 to 1624 (28.3 percent) and our post-1624 estimated rate (14.2 percent).

67. Morgan's 1625 to 1640 estimate of 1,000 immigrants per year has been questioned as too high by Menard. He suggests that immigration varied directly with tobacco prices, and therefore Virginia immigration peaked at about 2,000 in 1635–1636 and in preceding years (1625–1635) immigration generally fell substantially below 1,000 per year. If Menard is correct, then annual mortality for the period 1625 to 1634 falls even lower than the 14.2 percent presented here. Russell R. Menard, "Economy and Society in Early Colonial Maryland" (Ph.D. dissertation, University of Iowa, 1975), 167–170.

quyoake counties, contained 45 percent of the total population. But population had spread into healthier zones, including the lower York in the saltwater zone on the south side of the river, the freshwater zone at the head of the James, the lower James, and the Eastern Shore.⁶⁸ The general dispersal of tobacco plantations within all ecological zones also favored survival. Typhoid and dysentery could not become epidemic when settlement was scattered. And as population grew, settlement progressed inland away from the deadliest parts of the James and onto the hills, ridges, and drainage divides where fresh springs provided a safe water supply. Dietary habits probably changed too, with increased consumption of wine, beer, and cider instead of water, and reduced consumption of oysters and clams during May to August when these bivalves concentrated microorganisms. As the "new healthiness" of the country took hold, Virginians and their visitors usually attributed it to climate, improved by forest clearance. More accurately, the spread and dispersal of settlement along with certain dietary adjustments were the keys to life.⁶⁹

Frontier expansion and plantation dispersal continued during the rest of the seventeenth century, with generally beneficial demographic effects. Although travelers commented on the pallid complexions, sickness, and frequent death found in the saltwater environments of the lower estuaries, the population there was generally much healthier than in the freshwater-saltwater transition zone.⁷⁰ When the frontier expanded into the oligohaline zones of the York, Rappahannock, and Potomac rivers, death rates assuredly rose above those

68. "A List of the number of men, women and children . . . Within the Colony of Virginia. Anno Dne, 1634," *Colonial Records of Virginia*, 91.

69. On dispersal and tobacco, see Morton, *Colonial Virginia*, I, 122-133; Hecht, "The Virginia Colony, 1607-1640," 195-207; Craven, *Dissolution of the Virginia Company, 170-171*. In a revealing note, Governor Wyatt in 1623 blamed the colony's ill fortune on "the intemperate drinking of water." "To plant a colony by water drinkers was an inexcusable error in those who laid the first foundation and have made it a received custome," Kingsbury, ed., *Records of the Virginia Company*, IV, 10-11, 453; Wharton, *Bounty of the Chesapeake*, 46; William Ancisz and C. B. Kelly, "Self-Purification of the Soft Clam *Mya arenaria*," *Public Health Reports*, LXX (1955), 605-614.

70. Gilbert Chinard, ed., *A Huguenot Exile in Virginia, or Voyages of a Frenchman Exiled for His Religion with a Description of Virginia and Maryland* (New York, 1934), 130, 174. Recognition of the freshwater-saltwater transition and its dangers is incipient in Bullock's "flowing of the salt." Clayton thought all saltwater bad, as it impregnated the air and thus damaged the human body. William Bullock, *Virginia Impartially examined, and left to publick view, to be considered by all judicious and honest men* (London, 1649), 4; Edmund Berkeley and Dorothy Smith Berkeley, eds., *The Reverend John Clayton . . . His Scientific Writings and Other Related Papers* (Charlottesville, Va., 1965), 54.

in the saltwater zones. While I cannot prove this statement from the available evidence, the oligohaline zone appears to have been more deadly in the eighteenth century. The spatial pattern of mortality can be crudely reconstructed from a 1725-1726 parish census of births and burials (figure 2).⁷¹ For all four Virginia estuaries, the pattern of mortality hypothesized by the estuarine model for early Virginia remains recognizable a century later. The proportion of burials to births generally is least in the freshwater zone, peaks in the oligohaline zone, and drops slightly in the saltwater zone of the lower estuaries. Left bank (north side) proportions are usually higher than the corresponding right bank (south side). The map's subtleties and its several departures from the model—notably the higher-than-expected mortality levels in the upper Rappahannock, lower James, and the Potomac estuary generally—warrant more attention, but to do so would push us beyond the limited scope of this essay.⁷² More important is the map's suggestion that typhoid and dysentery caused some

71. The census records births and burials for the year beginning April 15, 1725. I have assumed census recording procedures were uniform among Virginia parishes, but undoubtedly these procedures varied markedly. More thorough studies of Virginian demography may reveal whether the parishes departing from the estuarine-disease model reflect actual differences or recording biases in the census. C.O. 5/1320, f. 74, Public Record Office. Parish boundaries are roughly accurate. The four Henrico County parishes are aggregated on the map. Charles Francis Cocke, *Parish Lines, Diocese of Virginia*, Virginia State Library Publications, no. 28 (Richmond, Va., 1967); George Carrington Mason, *Colonial Churches of Tidewater Virginia* (Richmond, Va., 1945). The freshwater-saltwater transition zones are located according to Nichols, "Sediments of the James River," 171-179. Evon Ruzecki, Virginia Institute of Marine Science, personal communication; H. C. Whaley and T. C. Hopkins, *Atlas of the Salinity and Temperature Distribution of Chesapeake Bay*, Chesapeake Bay Institute, Johns Hopkins University, Graphical Summary Reports, nos. 1-2, Ref. 52-4, 63-1 (Baltimore, 1952, 1963); Chinard, *A Huguenot Exile in Virginia*, 174.

72. This geographical pattern of mortality might be explained by other models, such as the Rutmans' malarial endemicity. According to the Rutmans, malarial "morbidity climbs as endemicity rises, since a greater percentage of infectious bites by *Anopheles* leads to symptomatic malarial attacks. Yet the rate of morbidity will be balanced at some point by the rate of immunities in the population and then will begin to decline until, in a hyperendemic situation, morbidity is largely limited to children, non-immune newcomers to the community, and pregnant women." Put geographically this process of endemicity should move roughly with the frontier of settlement, i.e., old settled areas being hyperendemic, newly settled areas having low but rising morbidity, and middle-aged areas having very high morbidity. If I have reasoned correctly, the entire James River area, as the oldest settled zone, should show similarly low values on our map, followed by very high values in the middle-aged tier of Gloucester, Middlesex, Lancaster, Westmoreland, and Northumberland counties, and low values elsewhere. I do not detect such a pattern, and accordingly favor the three-zone estuarine model of enteric diseases. Rutman and Rutman, "Agues and Fevers," *WMQ*, 3d Ser., XXXIII (1976), 37-39, 44-45.

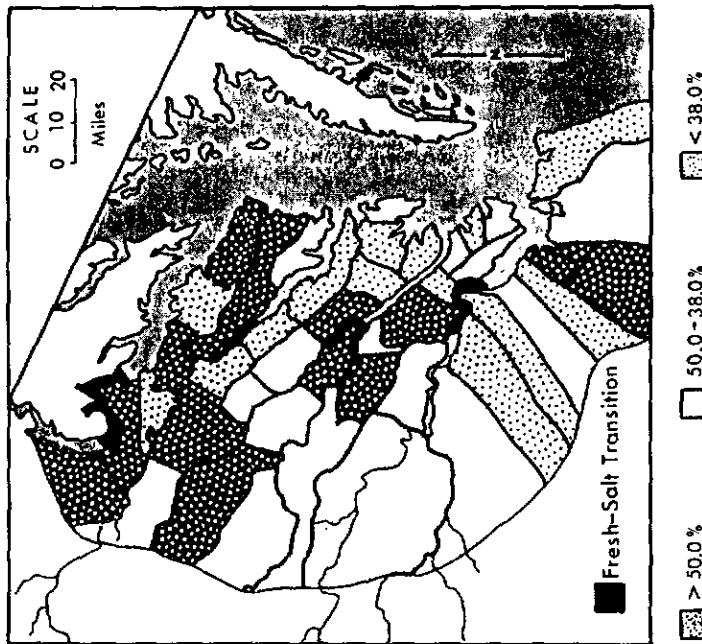
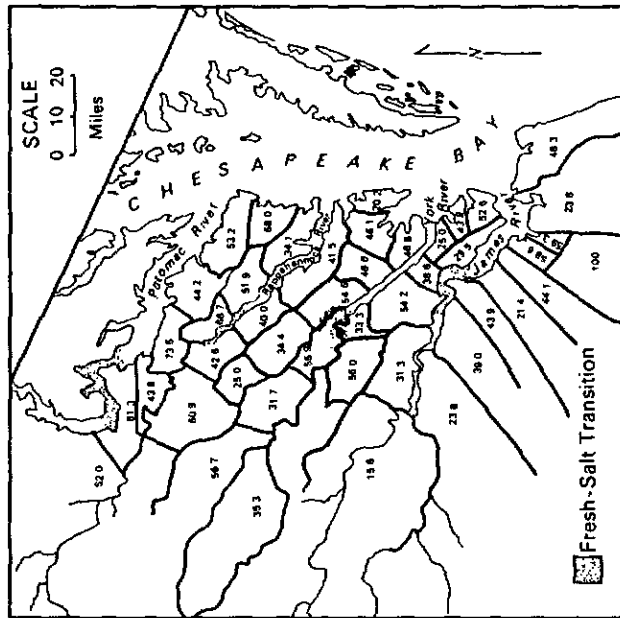


FIGURE 2. Proportion of Burials to Births, 1725-1726: Virginia Parishes

eighteenth-century mortality, perhaps enough to account for the high rates of the oligohaline zone and the intermediate rates in the salt-water zone.

The demographic history of early Virginia is both sad and tragic. Sad because so many died; tragic because they died needlessly. Smith, Dale, and others knew that epidemics of typhoid, dysentery, and salt poisoning were recurrent; they knew that these epidemics were spawned by a contaminated water supply in the vicinity of Jamestown and the freshwater-saltwater transition on the James estuary. They knew that dispersing in the summer or shifting permanently into the freshwater zone were the only ways to save lives. And they knew that scattered settlements required the protection of an aggressive Indian policy. Smith and Dale saved lives, but their insights were abandoned with the arrival of new colonial leaders or a new company administration. Jamestown was reclaimed, mortality rose, and the painful environmental learning process began again at ground level. The Sandys administration never learned. The nexus of environment and mortality confounded and eluded them. They mistakenly believed that the seasoning process would eventually take hold and Virginia's population would grow. But typhoid and dysentery were no respecters of flawed theories of immunity. From a demographic standpoint, the best thing that happened in early Virginia was the dissolution of the company with its fixation on Jamestown.