



NORTHERN BAYBERRY

Morella pensylvanica (Mirb.) Kartesz

Plant Symbol = MOPE6

Common Names: bayberry, candleberry, candlewood, candletree, myrique de Pennsylvanie, northern bayberry, small waxberry, swamp candleberry, tallow bayberry, tallowshrub, tallowtree, waxberry

Scientific Names: Previously known as *Myrica pensylvanica* Mirb., the currently accepted name is *Morella pensylvanica* (Mirb.) Kartesz. *Cerothamnus pensylvanica* (Mirbel) Moldenke, *Myrica cerifera* Linnaeus var. *frutescens* Castiglioni, *M. macfarlanei* Youngken

Description

General: Northern bayberry is a native perennial shrub often identified by its strongly aromatic nature. Under ideal conditions, northern bayberry may reach heights of up to 15 feet (4.5 m) and spread laterally via rhizomatous growth up to 10 feet (3 m) (Duncan and Duncan, 1987; MBG, 2017). The often multi stemmed shrub has an upright and rounded growth habit and is deciduous throughout its range, but may remain semi-evergreen at the southern extent or over mild winters throughout the rest of its range (MBG, 2017). The dark green, glossy leaves are alternately arranged and sometimes slightly toothed towards the tips measuring 2-4 in (5-10 cm) long and 0.3-0.5 in (.75-1.25 cm) wide (Silberhorn, 1999). They may be dotted with resin and are tear drop shaped tapering towards the stem. When crushed, they release a strong aromatic fragrance (MBG, 2017). The primary stems are typically light gray like the mature branches which may display a silvery hue. New growth begins green and turns tan after the initial growing season when it takes on the appearance of the more mature branches (Rhodus, n.d.). Northern bayberry is primarily a dioecious (male and female flowers on separate plants) species. Both male and female flowers are inconspicuous catkins; male flowers are yellowish green while female flowers lack both sepals and petals (Brand, 2015). Male catkins (0.4-1.8 cm) are generally longer than female catkins (0.3-1.4 cm) (Moore, 2004). The flowering period usually begins in April, but inflorescences may occur anytime between spring and early summer (Rhodus, n.d.; FNAEC, 1997). Female flowers are wind pollinated, forming clusters of single seeded drupes below leafy stem tips in the summer (Moore, 2004; Silberhorn, 1999). The immature sessile fruits are green and covered with a dense hair (Rhodus, n.d.; Duncan and Duncan, 1987). Upon maturation, the fruits develop a bluish gray color and the hairs become masked by a waxy coating (FNAEC, 1997). The fruit may range from 0.1-0.2 in (2.5-5.5 mm) in diameter (Silberhorn, 1999; Duncan and Duncan, 1987). Fruit, not consumed by wildlife, persists well into winter if (Dickerson, 2002).

Distribution: Northern bayberry is found along the Mid-Atlantic coastal region forming scattered clumps in stable dune areas. It is indigenous to the Eastern United States and Canada occurring from southern Newfoundland south to the coastal plains of North Carolina and inland as far west as Ohio (NPIN, 2013). Towards the extent of its northern range Northern bayberry may incur some damage during extremely harsh years, but can be grown in USDA hardiness zones 3a-8b (MBG, 2017; Dirr, 1998; USDA-NRCS, 2012). For current distribution, please consult the Plant Profile page for this species on the PLANTS Web site.



Northern bayberry (*Morella pensylvanica*). Photo by Scott Snell, USDA-NRCS, Plant Materials Program.

Habitat: Bayberry can grow in wide range of environments and soils, but it grows most vigorously in sandy or peaty and slightly acidic well drained soils receiving full to partial sun (MBG, 2017). Bayberry is a highly salt spray tolerant and moderately saline and drought tolerant shrub. It spreads naturally via rhizomatous growth to sandy soils free of vegetation, it is well adapted to stable dune environments and is less frequently found scattered throughout the primary dunes of the Mid-Atlantic region (Gilman and Watson, 1994; Dickerson, 2002). Near the coast in the dune environment it is often associated with American beachgrass (*Ammophila breviligulata*), seaside goldenrod (*Solidago sempervirens*), eastern poison ivy (*Toxicodendron radicans*), roundleaf greenbriar (*Smilax rotundifolia*), Virginia creeper (*Parthenocissus quinquefolia*), beach plum (*Prunus maritima*), black cherry (*Prunus serotina*), eastern red cedar (*Juniperus virginiana*), rugosa rose (*Rosa rugosa*), and winged sumac (*Rhus copallinum*) (Martin, 1959). Although typically considered a dune plant, northern bayberry also occurs inland thriving in fallow or abandoned agricultural land, along the borders of woodlands, pine barrens, marshes, swamps, and ponds (Duncan and Duncan, 1987; Stalter, 1992). In habitats outside of the dune environment northern bayberry often occurs with saltgrass (*Distichlis spicata*), red maple (*Acer rubrum*), eastern baccharis (*Baccharis halimifolia*), switchgrass (*Panicum virgatum*), and little bluestem (*Schizachyrium scoparium*) (Martin, 1959). Bayberry may also occur in areas completely lacking topsoil such as mined sites, edges of railroads, and roadway cuts (Fordham, 1983). Because it may occur as frequently in wetlands as in non-wetlands, northern bayberry has been assigned a wetland indicator status of facultative for all wetland regions in which it occurs (USACE, 2018).

Adaptation: The genus *Morella* is the largest of the Myricaceae family composed of roughly 50 species distributed widely in North America, Europe, Africa, and Asia (Benson, 2018). Difficulties and some disagreement have arisen regarding the taxonomy of the *Morella* and *Myrica* genera within the Myricaceae family which has resulted in many species (including northern bayberry) being renamed to the *Morella* genus after having been formerly named as a member of the *Myrica* genus (Parra-O, 2002). Further complicating the matter, some taxonomists disagree as to whether northern bayberry and southern bayberry (*Morella caroliniensis*) should be classified as distinct, separate species. Wilbur (2002) claimed that the characteristics used to differentiate the two “seem to be more like tendencies than sharply delineated differences.” This plant guide will regard northern bayberry as a distinct and unique species. Northern bayberry has a high tolerance for salt spray and low water availability making it well adapted to the coastal dune environment. Greenhouse and field studies have shown that bayberry incurs little to no damage from salt spray (Griffiths et al., 2003). Northern bayberry is well adapted to nitrogen poor soils because of a symbiotic relationship between bayberry and the nitrogen fixing bacteria Frankia (Bloom et al., 1989). Fimbel and Kuser (1995) reported that bayberry is estimated to add 15 to 28 lbs per acre of available nitrogen per year to sand dunes of the Mid-Atlantic US. The majority of research on bayberry has focused on the coastal dune environment where the chance for fire is low, limiting information on the effect fire has on the species (Hauser, 2006). Environmental conditions and timing of the burn treatments likely affect the response of bayberry to fire. Dunwiddie (1998) reported a significant decrease in the frequency and coverage of bayberry following spring and summer burn treatments in sandplain grasslands and coastal heathlands of Massachusetts. October burn treatments resulted in increased or unchanged frequency and coverage suggesting that bayberry is more susceptible to fire damage while actively growing but tolerant if burned while dormant.

Uses

Conservation practices: The adaptations that give bayberry its drought tolerance and ability to endure salt spray and saline soils also make it an excellent species to be used for stabilization of coastal sand dunes of the Mid-Atlantic region (Dickerson, 2002). Bayberry is an important successional species that colonizes landward expansion of the dune system beyond the foredune encouraging the recruitment and growth of other woody and vining species to form dense shrub thickets which provide long term stabilization (Wootton et al., 2016; Tiffney and Barrera, 1979). Bayberry may also improve the overall health of the ecosystem by providing microclimates that are beneficial for other native dune plant species. Shumway (2000) reported that both seaside goldenrod and American beachgrass plants displayed increased health and vigor when growing in association with bayberry, including, increased flowering, numbers of flowers, seed produced, plant size, tissue nitrogen concentrations, photosynthetic efficiencies, and mid-day xylem water potentials. Shumway (2000) attributed the improved plant performance of the companion species to the microclimate created by the canopy and increased nitrogen levels beneath bayberry thickets. Shumway and Banks (2001) also reported that bayberry is a valuable constituent of the plant communities that populate the waterlogged soils of interdunal swales, growing best in the drier swales and at the perimeters of the more frequently flooded swales.

Ornamental/landscaping: The showiness of the persistent winter fruit has made bayberry valuable as a landscape plant. Its value is increased by its versatility, survivability, and durability. Bayberry may be used in woodland gardens, privacy



An example of northern bayberry male catkins (left) and immature female fruit (right).

screens, garden shrub borders, along roadways, in parking lots or above ground planters (Gilman and Watson, 1994; MBG, 2017). There are several bayberry varieties resistant to disease and insects with improved growth form, foliage abundance, vigor, and survival. Its salt tolerance makes it an ideal choice for sites receiving regular salt applications such as roadsides and parking lots. Gilman and Watson (1994) warn that when used along roadsides plants should be set back from the roadway as unpruned branches tend to droop and may impede traffic.

Wildlife: Winter persistent fruit and late season leaf retention make bayberry valuable food and shelter for wildlife. The fruit is typically above snow accumulations and available throughout the winter to bobwhite quail, ruffed grouse, turkey, ring-necked pheasant, woodpeckers and numerous songbirds (Dickerson, 2002; Chatfield, 2016). Yellow-rumped warblers (*Setophaga coronata*) and tree swallows (*Tachycineta bicolor*) feed regularly on the waxy fruits from autumn through winter and into the spring (Place and Stiles, 1992). The yellow-rumped warbler may subsist primarily on bayberry fruit at certain stopover sites during fall migration (Podlesak et al., 2005). One hundred

percent of the 65 specimens of tree swallows dissected during a vegetation management study at John F. Kennedy International Airport contained bayberry fruit. The removal of bayberry shrubs around the airport resulted in a 75 percent decrease in swallow aircraft strikes (Bernhardt et al., 2009). Fecal seed traps reveal that bayberry fruit becomes an important food source for insectivorous birds along the Mid-Atlantic coast during migration, during winter months *Morella* spp. [bayberry and wax myrtle (*M. cerifera*)] accounted for 99 percent of all seeds collected (Shiftett and Young, 2010). In Massachusetts, bayberry contributes valuable habitat for the rare northern harrier (*Circus hudsonius*), two harrier pairs establish territory and roost at Barney's Joy Point in dense thickets of northern bayberry (Christiansen and Reinert, 1990). Bayberry also attracts squirrels and other small mammals and is an important food source for some larger mammals (Gilman and Watson, 1994). Bayberry and wax myrtle on Assateague Island, MD are an important food source for of sika (*Cervus nippon*) and white-tailed deer (*Odocoileus virginianus*) (Keiper, 1985). Bayberry also provides food and shelter for beneficial insects. A review of honey bee forage literature ranking the nectar and pollen source of wild flowering plant species, ranked bayberry as a minor source for both nectar and pollen (Loose et al., 2005). Loose (2000) also reported that the leafcutter bee (*Megachile addenda*) uses bayberry leaves as a nest building material. Bayberry is a known larval host plant for Columbia silkmoth (*Hyalophora columbia*) (NPIN, 2013).

Ethnobotany

Warning: The wax from bayberry fruit is considered toxic and may be carcinogenic.

Early American settlers used the waxy coating of bayberry fruit to produce highly valuable scented candles that did not sputter or smoke. The candles were labor intensive with each 2 ounce candle requiring 5-10 thousand fruits. The blue green water produced after simmering the wax off the fruit was used to dye homespun cloth (Connor, 1993). The plant materials strong aroma made it attractive for use in the production of sealing wax and soaps (MBG, 2017). Many of the traditional items produced from bayberry fruit by early settlers remain popular today as decorative and useful household items (Bornstein, 1997). Bayberry bark was used as a paste or powder to improve oral hygiene and as an ingredient in mouthwashes to treat canker sores and soft gums (Lewis, 1977 and Orr, 2014). *Morella* spp. were used by various Native American tribes to induce vomiting, treat menstrual problems, purify blood and a kidney aid (Moerman, 1986). The Mi'kmaq used leaf snuff to treat headaches, tea from the leaves as a stimulant, and root bark as a poultice to reduce inflammation (Foster and Duke, 2000). Myricitrin, a strong antioxidant, is found in bayberry bark and is separated and purified using high speed counter current chromatography. Myricitrin is used in food, pharmaceutical, and cosmetic products (Orr, 2014 and Fu et al., 2013). Myricitrin has anti-inflammatory, antimutagenic, diuretic, and antibacterial properties (Foster and Duke, 2000).

Status

Threatened or Endangered: Bayberry is considered exploitable/vulnerable in New York and endangered in Ohio (USDA-NRCS, 2018).

Wetland Indicator: FAC (USACE, 2018).

Weedy or Invasive: Bayberry may spread aggressively via rhizomatous growth and display allelopathic effects (Collins and Quinn, 1982).

This plant may become weedy or invasive in some regions or habitats and may displace desirable vegetation if not properly managed. Please consult with your local NRCS Field Office, Cooperative Extension Service office, state natural resource, or state agriculture department regarding its status and use.

Please consult the PLANTS Web site (<http://plants.usda.gov/>) and your state's Department of Natural Resources for this plant's current status (e.g., threatened or endangered species, state noxious status, and wetland indicator values).

Planting Guidelines

One to two year old bare root or containerized plants are recommended for all purposes. Existing vegetation should be controlled prior to planting as bayberry does not compete well with established vegetation. Bayberry shrubs planted in weed free (plowed and harrowed) sites have significantly higher survival rate than shrubs planted in untreated sites (Cook and Edminster, 1944). Adding mulch to a newly installed planting provides additional moisture retention and weed control (Dickerson, 2002). Fertilizer is not recommended, as the additional nutrients may encourage weed growth and increase weed competition. The preferred soil pH is 6.0-6.5 (USDA-NRCS, 2012). Any soil amendments should be based on the results of soil nutrient analysis tests. Consult your local agricultural extension service for guidance. Plant spacing is variable and based on site conditions and planting purpose. General guidelines for dune plantings are to plant in groupings with plants two to three feet apart. Border and hedge row plantings are planted as one or two rows of plants with three to four feet between plants. A single row planted at the same spacing is sufficient for roadway plantings (Dickerson, 2002; MBG, 2017; USDA-NRCS, 2012). If fruit production is desirable for ornamental, wildlife benefits, or other purposes; male and female plants must be planted near one another to achieve successfully pollination. For a good fruit set, it is recommended that 20 percent of the shrubs planted should be male (Brand, 2015). Sex of seedlings cannot be determined until the plant reaches maturity (three to four years), where seed production is a high priority it is best to purchase commercially available sexed varieties.

Management

Plantings installed in natural areas, dune construction sites or revegetation sites require no follow up maintenance. Other applications may require maintenance depending on site conditions and the purpose of the planting. Bayberry may need regular maintenance if planted close to the road to prevent drooping branches can hang low impeding traffic flow. Gilman and Watson (1994) recommend setting the shrubs far enough back from the road to avoid the issue or regular pruning. They recommend heading the top of the shrubs twice a year to prevent lanky branches which tend to sag. Heavy pruning is generally discouraged as it may reduce plant vigor and result in die back (Dickerson, 2002; USDA-NRCS, 2012).

Pests and Potential Problems

No significant problems with pests or diseases of northern bayberry have been documented (Gilman and Watson, 1994).

Environmental Concerns

Encroachment by bayberry may reduce or displace native coastal grasslands dominated by little bluestem (*Schizachyrium scoparium*). This shift is attributed to litter accumulation, shading, and the vigorous vegetative spread of northern bayberry (Collins and Quinn, 1982; Rogers, et al., 1985). Collins and Quinn (1982) suggest that bayberry may display allelopathic effects that contribute to the displacement of little bluestem.

Control

Please contact your local agricultural extension specialist or county weed specialist to learn what works best in your area and how to use it safely. Always read label and safety instructions for each control method. Trade names and control measures appear in this document only to provide specific information. USDA NRCS does not guarantee or warranty the products and control methods named, and other products may be equally effective.

Prescribed burn treatments implemented while bayberry is actively growing reduce frequency and coverage. Mow treatments reduce frequency and coverage if performed while bayberry is actively growing, dormant mowing had little or no effect (Dunwiddie, 1998). Areas browsed by domestic sheep have also shown significantly reduced frequency and coverage compared to unbrowsed areas (Dunwiddie, 1997).

Seeds and Plant Production

Bayberry shrubs may be started vegetatively or from seed. Vegetative propagation is achieved by cuttings or division of suckering plants (Brand, 2015). Semi-hardwood cuttings root moderately well with a hormone treatment (NPIN, 2013). Dirr (1998) reported some rooting success by taking cuttings in mid-June and treating with indole-3-butyric acid (IBA). Cuttings treated with 0 or 1000 ppm IBA failed to root. Cuttings treated with 2500, 5000, or 10000 ppm IBA rooted at 36, 53, and 46 percent.

Seed is hand harvested in the fall from September to October. Seed is stored in cold (4.4°C) dry conditions with the waxy coating remaining on the fruit. When the seed is ready to be planted, remove the waxy coating from the fruit to increase germination rates (Fordham, 1983). The waxy coat may be removed by physical agitation or for small lots a simple rubbing board. Larger lots can be processed efficiently using a brush machine with stiff bristles and a 7/64 in (2.8 mm) square mesh mantle. Chaff should be separated from the seed prior to storage. Seed can be quickly cleaned using an air/screen separator with a 12/64 in (4.76 mm) top screen and a 1/12 in (2.12 mm) bottom screen. Higher purity can be achieved by further cleaning with a continuous blowing separator or a spiral separator. There are approximately 55,000 seeds/lb (Dirr, 1998; Van der Grinten, 2007).

Bayberry seed requires a cold moist stratification period to break dormancy. A 90 day stratification at 1.1-4.4°C is recommended (Van der Grinten, 2007). This can be achieved by fall sowing outdoors or placing in a temperature controlled environment for the duration of the stratification period. If stratifying the seed in a controlled environment, seed should be mixed with a medium such as damp sand, sphagnum moss, or peat moss to retain moisture (Fordham, 1983). For outdoor seed stratification fall seeded raised beds are recommended. Clean, weed free seed beds should be seeded at a rate of four grams of pure live seed per square foot after the soil temperature is below 4.4°C (Dickerson, 2002). Seed should be packed with a roller after broadcasting to ensure good seed to soil contact. Seed should then be covered with a 1-1.5 in (2.5-3.8 cm) layer of clean sand followed by a layer of weed free mulch such as salt hay (*Spartina patens*). The mulch should be removed in early spring prior to seedling emergence. Consider weed control options as necessary to increase vigor of the bayberry seedlings. Seedlings should be harvested after one growing season in the fall or spring while dormant (Fournier, 1993).

It is important to note that northern bayberry easily hybridizes with both wax myrtle and southern bayberry where these species' ranges overlap (FNAEC, 1997). All three species are wind pollinated requiring a seed production location with an adequate distance between species to avoid unintentional hybridization. Lorenz et al. (1991) reported that bayberry shrubs will not produce seed until after two to three growing seasons. The bayberry seed production plot at the Cape May Plant Materials Center was planted in 2002 and consists of 34% female shrubs. The production plot has yielded an average annual production of 5.4 lbs of cleaned seed per female shrub from 2010-2015.

Cultivars, Improved, and Selected Materials (and area of origin)

Some nurseries offer sexed selections of northern bayberry that are readily available:

1. 'Bobzam', commonly sold as Bobbee, is a selection developed by Lake County Nursery. Bobzam is a female clone selected as a more compact shrub and for its leaves that are larger, glossier, and more wavy than wild bayberry shrubs (Chatfield, 2016).
2. 'Morton' Silver Sprite (IL) is a female clone selected for a more compact growth pattern than is common for wild bayberry with the parent plant measuring only 5 ft tall after 15 growing seasons. 'Morton Male' Silver Sprite (IL) is the male clone counterpart to provide pollination for Morton. Morton Male also displays a relatively compact growth habit and the two cultivars' flower periods coincide to increase the likelihood of successful pollination and good fruit production (Ault, n.d.).
3. 'Myda' and 'Myriman' are sometimes available. Myda is a female clone selected for higher fruit production and Myriman is the male counterpart clone for pollination.
4. 'Northern Girl' is a female cultivar selected for heavy fruit set (Ogren, 2015). Northern Girl is not readily available commercially.
5. 'Wildwood' (NJ and NC) is a non-sexed, somewhat commercially available cultivar developed and released by the Cape May Plant Materials Center, USDA-NRCS in 1993. Wildwood is a cross of four wild collections that exhibited superior disease and insect resistance, seedling vigor, survival rate, and foliage abundance (USDA-NRCS, 2012).

Cultivars should be selected based on the local climate, resistance to local pests, and intended use. Consult with your local land grant university, local extension or local USDA NRCS office for recommendations on adapted cultivars for use in your area.

Literature Cited

- Ault, J. n.d. Chicagoland Grows Plant Introduction Program. [Online]. Available at <http://www.chicagolandgrows.org/shrubs/bayberry.php> (accessed 30 July 2018). Chicago Botanic Garden, Chicago IL. The Morton Arboretum, Lisle, IL.
- Benson, D.R. 2018. Frankia and Actinorhizal plant Website. [Online]. Available at <http://web.uconn.edu/mcbstaff/benson/Frankia/Myricaceae.htm> (accessed 12 October 2018). University of Connecticut, Storrs, CT.
- Bernhardt, G.E, Z.J. Patton, L.A. Kutschback-Brohl, and R.A. Dolbeer. 2009. Management of bayberry in relation to tree-swallow strikes at John F. Kennedy International Airport, New York. *Human-Wildlife conflicts* 3(2): 237-241.
- Bloom, R.A., M.P. Lechevalier, and R.L. Tate III. 1989. Physiological, chemical, morphological, and plant infectivity characteristics of Frankia isolates from *Myrica pensylvanica*: correlation to DNA restriction patterns. *Appl. Environ. Microbiol.* 55(9): 2161-2166.
- Bornstein, A.J. 1997. Myricaceae. In: Flora of North America Editorial Committee, eds. Flora of North America. Vol. 3. Oxford University Press, New York. p. 430-434.
- Brand, M.H. 2015. *Myrica pensylvanica*, Northern Bayberry, Candleberry [Online]. Available at <http://www.hort.uconn.edu/plants/detail.php?pid=292> (accessed 7 August 2018). Univ. of Connecticut Plant Database, Dept. of Plant Science and Landscape Architecture, Storrs, CT.
- Chatfield, H. 2016. Shrub of the Week: Northern Bayberry. [Online]. Available at <https://bygl.osu.edu/node/554> (accessed 30 July 2018). Buckeye yard & Garden online, College of Food, Agricultural, and Environmental Sciences, Ohio State Univ. Extension, Columbus, OH.
- Christian, D.A. and S.E. Reinert. 1990. Habitat use of the northern harrier in a coastal Massachusetts shrubland with notes on population trends in southeastern New England. *J. Raptor Re.* 24(4): 84-90.
- Collins, B.S. and J. A. Quinn. 1982. Displacement of *Andropogon scoparius* on the New Jersey Piedmont by the successional shrub *Myrica pensylvanica*. *Am. J. Bot.* 69(5): 680-689.
- Connor, S. 1993. *New England natives: A celebration of people and trees*. Harvard University Press, Cambridge, MA.
- Cook, E.B. and F.C. Edminster. 1944. Survival and growth of shrubs planted for wildlife in New York. *J. Wildl. Manage.* 8(3): 185-191.
- Dickerson, J. 2002. Plant fact sheet for *Morella pensylvanica*, bayberry. USDA-Natural Resources Conservation Service, New York State Office, Syracuse, NY.
- Dirr, M.A., 1998. *Manual of woody landscape plants*. Stipes Publishing, Champaign, IL.
- Duncan, W.H. and M.B. Duncan. 1987. *The Smithsonian guide to seaside plants of the Gulf and Atlantic coasts*. Smithsonian Institution Press. Washington, D.C.
- Dunwiddie, P.W. 1997. Long-term effects of sheep grazing on coastal sandplain vegetation. *Nat. Areas J.* 17(3): 261-264.
- Dunwiddie, P.W. 1998. Ecological management of sandplain grasslands and coastal heathlands in southeastern Massachusetts. In: Pruden, Teresa L.; Brennan, Leonard A., eds. *Fire in ecosystem management: shifting the paradigm from suppression to prescription: Proceedings, Tall Timbers fire ecology conference; 1996 May 7-10; Boise, ID. No. 20*. Tallahassee, FL: Tall Timbers Research Station: 83-93.
- FNAEC (Flora of North America Editorial Committee). 1997. *Flora of North America Volume 3*. [Online]. Available at http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=233500794 (accessed 2 Aug. 2018). Flora of North America Association.
- Fimbel, R.A. and J.E. Kuser. 1995. Competitive and mutualistic interactions between pitch pine, bayberry, and their symbionts. *Soil Sci.* 160(1): 69-76.
- Fordham, A.J. 1983. Of birds and bayberries: seed dispersal and propagation of three *Myrica* species. *Arnoldia.* 43(4): 20-23.
- Foster, S. and J.A. Duke. 2000. *Eastern/Central medicinal plants and herbs*. Houghton Mifflin Company, Boston.
- Fournier, M. 1993. Commercial Production Procedure for 'Wildwood' bayberry (*Myrica pensylvanica*), 'Ocean View' beach plum (*Prunus maritima*), and 'Sandy' rugosa rose (*Rosa rugosa*). USDA-Natural Resources Conservation Service, Cape May Plant Materials Center. Cape May, NJ.

- Fu, Y., Z. Li, J. Si, Q. Chang, Z. Li, and R. Pan. 2013. Separation and purification of myricitrin from bayberry tree bark by high-speed counter-current chromatography. *J. of Liquid Chromatography & Related Technologies* 36(11): 1503-1512.
- Gilman, E.F. and D.G. Watson. 1994. *Myrica pensylvanica* Northern Bayberry Fact Sheet ST-411. U.S. Department of Agriculture, Forest Service.
- Griffiths, M.E. and C.O. Orians. 2003. Responses of common and successional heathland species to manipulated salt spray and water availability. *Am. J. Bot.* 90(12): 1720-1728.
- Griffiths, M.E. and C.O. Orians. 2003. Salt spray differentially affects water status, necrosis, and growth in coastal sandplain heathland species. *Am. J. Bot.* 90(8): 1188-1196.
- Hauser, A.S. 2006. *Morella pensylvanica*. In: Fire Effects Information System, [Online]. Available at <https://www.fs.fed.us/database/feis/plants/shrub/morpen/all.html> (accessed 15 October 2018). U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory.
- Keiper, R.R. 1985. Are sika deer responsible for the decline of white-tailed deer on Assateague Island, Maryland? *Wildl. Soc. Bull.* 13: 144-146.
- Lewis, W.H. 1977. Medical botany. John Wiley & Sons, New York. 515 p.
- Loose, J.L. 2000. The relationships between native bee communities and floral resources in Massachusetts cranberry bogs. M.S. thesis, University of Maine, Orono.
- Loose, J.L., F.A. Drummond, C. Stubbs, S. Woods, and S. Hoffman. 2005. Conservation and management of native bees in cranberry. Maine Agricultural and Forest Experiment Station Technical Bulletin 191. University of Maine, Orono.
- Lorenz, D.G., W.C. Sharp, and J.D. Ruffner. 1991. Conservation plants for the Northeast. Program Aid 1154. USDA - Soil Conservation Service, Washington, DC.
- MBG (Missouri Botanical Garden). 2017. Gardening Help – *Myrica pensylvanica*. [Online]. Available at <http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=e310> (accessed 7 Aug. 2018). Missouri Botanical Garden, St. Louis, MO.
- Martin, W.E. 1959. The vegetation of Island Beach State Park. *Ecological Monographs* 29(1): 2-46.
- Moerman, D.E. 1986. Medicinal plants of Native America. 2 Vols. Technical Report 19. University of Michigan Museum of Anthropology, Ann Arbor, MI. 910 p.
- Moore, G. 2004. *Morella caroliniensis*. In: Francis, John K., ed. Wildland shrubs of the United States and its territories: thamnian descriptions: volume 1. Gen. Tech. Rep. IITF-GTR-26. San Juan, PR: U.S. Department of Agriculture, Forest Service, International Institute of Tropical Forestry; Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 502-504.
- NPIN (Native Plant Information Network). 2013. *Morella pensylvanica*. [Online]. Available at https://www.wildflower.org/plants/result.php?id_plant=mope6 (accessed 07 September 2018). Lady Bird Johnson Wildflower Center. The Univ. of Texas at Austin.
- Ogren, T.L. 2015. The allergy-fighting garden: stop asthma and allergies with smart landscaping. Ten Speed Press, New York.
- Orr, S. 2014. The new American herbal. Crown Publishing Group, New York.
- Parra-O, C. 2002. New combinations in South American Myricaceae. *Brittonia* 54(4): 322-326.
- Place, A.R. and E.W. Stiles. 1992. Living off the wax of the land: Bayberries and yellow-rumped warblers. *The Auk* 109(2): 334-345.
- Podlesak, D.W., S.R. McWilliams, and K.A. Hatch. 2005. Stable isotopes in breath, blood, feces and feathers can indicate intra-individual changes in the diet of migratory songbirds. *Oecologia* 142: 501-510.
- Rhodus, T. n.d. Ohio State Pocket Gardener. [Online]. Available at https://hvp.osu.edu/pocketgardener/source/description/my_nica.html (accessed 7 Aug. 2018). College of food, agricultural, and environmental sciences, OH State Univ. Columbus, OH.
- Rogers, G.F., J.M. Robertson, W.D. Solecki, and M.K. Vint. 1985. Rate of *Myrica pensylvanica* (bayberry) expansion in grassland at Gateway National Recreation Area, New York. *Bulletin of the Torrey Botanical Club.* 112(1): 74-78.
- Shiflett, S.A. and D.R. Young. 2010. Avian seed dispersal on Virginia barrier islands: Potential influence on vegetation community structure and patch dynamics. *Am. Midl. Nat.* 164(1): 91-106.
- Shumway, S.W. 2000. Facilitative effects of a sand dune shrub on species growing beneath the shrub canopy. *Oecologia* 124: 138-148.

- Shumway, S.W. and C.R. Banks. 2001. Species distributions in interdunal swale communities: The effects of soil waterlogging. *Am. Midl. Nat.* 145: 137-146.
- Silberhorn, G.M. 1999. Common plants of the Mid-Atlantic coast. The Johns Hopkins Univ. Press, Baltimore, MD.
- Stalter, R. 1992. Barrier island botany. Wm. C. Brown Publishers, Dubuque, IA.
- Tiffany, W.N., Jr. and J.F. Barrera. 1979. Comparative growth of pitch and Japanese black pine in clumps of the N₂-fixing shrub, bayberry. *Bot. Gaz.* 140(Supplement): S108-S109.
- US Army Corps of Engineers (USACE). 2018. National Wetland Plant List v3.3 – Species Detail Tool. [Online]. Available at http://wetland-plants.usace.army.mil/nwpl_static/v33/species/species.html?DET=001100 (accessed 11 Oct. 2018). USDOD-Army Corps of Engineers. Washington, DC.
- USDA-NRCS. 2012. Release brochure for bayberry ‘Wildwood’ (*Morella pensylvanica*). USDA-Natural Resources Conservation Service, Cape May Plant Materials Center. Cape May, NJ.
- USDA-NRCS. 2018. Plants Database – *Morella pensylvanica* (Mirb.) Kartesz northern bayberry. [Online]. Available at <https://plants.usda.gov/core/profile?symbol=mope6> (accessed 16 October 2018). USDA-Natural Resources Conservation Service.
- Wilbur, R.L. 2002. The identity and history of *Myrica caroliniensis* (Myricaceae). *Rhodora* 104(917): 31-41.
- Wootton, L., J. Miller, C. Miller, M. Piik, A. Williams, and P. Rowe. 2016. Dune Manual. New Jersey Sea Grant consortium.
- Van der Grinten, M. 2007. Propagation protocol for production of Container (plug) *Morella pensylvanica* Lionel plants. [Online]. Available at <https://nprn.rngr.net/renderNPNProtocolDetails?selectedProtocolIds=myricaceae-morella-1000&referer=wildflower> (accessed 11 Oct. 2018). Native Plant Network, US Department of Agriculture, Forest Service, National Center for Reforestation, Nurseries, and Genetic Resources.

Citation

- Snell, S.C. 2019. Plant Guide for northern bayberry (*Morella pensylvanica*). USDA-Natural Resources Conservation Service, Cape May Plant Materials Center, Cape May, NJ.

Published 07/2019

For more information about this and other plants, please contact your local NRCS field office or Conservation District at <http://www.nrcs.usda.gov/> and visit the PLANTS Web site at <http://plants.usda.gov/> or the Plant Materials Program web site: <http://plant-materials.nrcs.usda.gov>.

PLANTS is not responsible for the content or availability of other Web sites.

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at [How to File a Program Discrimination Complaint](#) and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.

Helping People Help the Land