Atriplex glabriuscula var. *glabriuscula*

Smooth Orache

Chenopodiaceae

Atriplex glabriuscula by Anne Thompson, 2022

Atriplex glabriuscula var. glabriuscula **Rare Plant Profile**

New Jersey Department of Environmental Protection
State Parks, Forests & Historic Sites
State Forest Fire Service & Forestry
Office of Natural Lands Management
New Jersey Natural Heritage Program

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Life History

Atriplex glabriuscula var. *glabriuscula* is an annual herb that has traditionally been placed in the Chenopodiaceae, although some taxonomists now include the goosefoot family as part of the Amaranthaceae (e.g. Kartesz 2015, Mubark and Ahmed 2016, ITIS 2022). There are two other named varieties of *Atriplex glabriuscula* (Welsh 2000): *A. glabriuscula* var. *acadiensis* is found in eastern Canada and parts of New England and *A. glabriuscula* var. *franktonii* is only known from a few Canadian provinces (Welsh 2020, POWO 2022, USDA NRCS 2022). Some sources (e.g. Kartesz 2015, NatureServe 2022) retain the varieties as three distinct species (*A. acadiensis*, *A. franktonii*, and *A. glabriuscula*).

Atriplex glabriuscula var. *glabriuscula* plants often grow in circular patches of sprawling stems, although they may sometimes be erect and branched. The thick stems are grooved and have a striped appearance, and they range from 0.1–1.0 meter in length. Reddish and entirely green plants can occur side by side. The somewhat succulent leaves are opposite toward the base of the plant where they can be up to 10 cm long, but the foliage becomes alternate and decreases in size as it goes up the stem. On some plants the leaves can become very fleshy. The primary leaf color on both surfaces is green (as opposed to white or gray below) and the stem leaves have coarse, irregular teeth and are arrow-shaped or triangular.

G. C. Oeder, 1871.

Stephen Moores, 2020.

The inflorescences of Smooth Orache are interrupted spikes of small flower clusters that develop at the end of the main stems and on some axillary branches. Leafy bracts are scattered throughout each inflorescence. Individual flowers are either male or female. The staminate (male) flowers have an inconspicuous calyx and 3–5 stamens while the pistillate (female) flowers lack a perianth but are enclosed by a pair of small (5–13mm) bracteoles that may turn red, brown or black as the plants develop. The floral bracteoles of *A. glabriuscula* var. *glabriuscula* are united up to the middle and become spongy and thickened toward the base where they wrap tightly around the developing fruits. (See Hall and Clements 1923, Fernald 1950, Taschereau 1985, Gleason and Cronquist 1991, Robson 2008, Tiner 2009, Welsh 2020).

Atriplex glabriuscula var. *glabriuscula* is a summer annual that completes its life cycle in a single growing season (Davy and Figueroa 1993). In Great Britain, germination does not begin until at least a month after the spring equinox (Ignaciuk and Lee 1980). The plants flower in the late summer (Welsh 2020) and fruits are shed during the autumn months (Ignaciuk and Lee 1980, Taschereau 1985).

Pollinator Dynamics

Wind pollination is prevalent in the Chenopodiaceae as the plants have inconspicuous flowers that do not attract insects (Zomlefer 1994). Taschereau (1985) characterized *Atriplex glabriuscula* as wind-pollinated, noting that the few insects occasionally observed crawling over the flowers were likely to play a negligible role in pollination.

Self-compatibility is known to occur in *Atriplex* (Zomlefer 1994) and Gleason and Cronquist (1991) indicated that *A. glabriuscula* was mostly self-pollinated. Taschereau (1985) observed that the closely-clustered staminate and pistillate flowers open simultaneously, increasing the likelihood of self-fertilization, and described the species as a facultative self-pollinator.

Seed Dispersal and Establishment

Atriplex glabriuscula var. *glabriuscula* plants produce two kinds of seeds—some are larger (2.5–4 mm wide), softer, and brown while others are smaller (1.5–2.5 mm wide), harder, and black (Ignaciuk and Lee 1980, Gleason and Cronquist 1991, Welsh 2020). The seeds and fruits remain enclosed in the floral bracteoles as they are released. The spongy tissue at the base of the bracteoles makes the fruits well-suited for dispersal by ocean currents (Taschereau 1985) and most propagules can remain buoyant and viable after a month in the water (Ignaciuk and Lee 1980). Bracteole structure is likely to determine the dispersal distances of the *Atriplex* species that favor saline habitats, as those with the longest floatation times can travel farther (Ungar and Khan 2001).

After the fruits have been deposited on land, the bracteoles play an additional role by helping to maintain seed dormancy throughout the winter as they slowly become weakened by abrasion and decay. Dormancy is also likely to be reinforced by high salinity and low temperatures during that period (Ignaciuk and Lee 1980). *Atriplex* seeds require alternating temperatures in order to germinate (Lee and Ignaciuk 1985) and Taschereau (1985) observed that *A. glabriuscula* seeds would not sprout in a greenhouse unless they were exposed to fluctuating weather conditions. The broad span of temperatures typical of late spring days triggers germination when conditions are most favorable for seedling establishment: Weather is warmer, soil salinity is lower, rapid decomposition of algal litter provides nutrients, and the young plants are less likely to be affected by the highest spring tides (Ignaciuk and Lee 1980, Lee and Ignaciuk 1985).

Seed banking has not been reported in *Atriplex glabriuscula*, although the seeds can remain viable for at least 18 months under laboratory conditions (Lee and Ignaciuk 1985). Smooth Orache does not appear to require fungal associations, as the specimens of *A. glabriuscula* examined by Harley and Harley (1987) were non-mycorrhizal.

Habitat

Atriplex glabriuscula var. *glabriuscula* is generally found in saline coastal habitats including sand, pebble, or cobble beaches and salt marshes (Taschereau 1985, Robson 2008, Tiner 2009). Welsh (2020) indicated that Smooth Orache grows at an elevation of 0 meters above sea level and Ignaciuk and Lee (1980) described it as a characteristic strandline species.

Strandline habitat is linear, harsh, and ephemeral. The communities establish at the high tide line where detritus is deposited on the shore, and they are subject to frequent disturbance by water and wind. Such habitat favors species that can rapidly complete their life cycle when conditions are favorable, disperse propagules before the tides and soil salinity rise, and readily establish the following year (Lee and Ignaciuk 1985, Watkinson and Davy 1985, Davy and Figueroa 1993). Nutrient sources are typically limited to sea spray and decomposing detritus (Davy and Figueroa 1993), although at some sites seabird guano makes a significant contribution (Gilham 1953).

Typical characteristics of the marine habitats favored by *Atriplex glabriuscula* var. *glabriuscula* are salinity, high irradiance, and porous substrates with limited water retention (Davy and Figueroa 1993). Species in the genus *Atriplex* include some that use typical photosynthetic processes (C_3 plants) and some that utilize alternate pathways (C_4 plants) (Kadereit et al. 2003). C_4 plants are particularly well-adapted to sunny, arid environments because they are able to achieve greater water efficiency and elevated photosynthetic rates at higher light levels (Black et al. 1969, Downes 1969, Osborne and Freckleton 2009). Some sources list *A. glabriuscula* as a C_4 species (e.g. Collins and Jones 1985) but it is more often identified as a C_3 plant (Ehrlinger and Björkman 1977, Schreiber and Berry 1977, Oakley et al. 2014). *Atriplex glabriuscula* was also reported as a C_3 plant by Lee and Ignaciuk (1985), who experimentally demonstrated that the photosynthetic rate of *A. glabriuscula* dropped during the midday period of highest irradiance in contrast with that of *A. laciniata*, a C_4 species. Nevertheless, *A. glabriuscula* has an uncommon physiological adaptation that makes it particularly well suited to the harsh environments that it inhabits. Ievinsh (2020) found that Smooth Orache plants had an exceptional ability to develop in moderately saline conditions, increasing their aboveground biomass nearly linearly at soil salinity concentrations up to 4.01 g/kg^{-1}, and that higher light intensities promoted a greater accumulation of sodium in the leaves resulting in enhanced growth.

Wetland Indicator Status

Atriplex glabriuscula is a facultative upland species, meaning that it usually occurs in nonwetlands but may occur in wetlands (U. S. Army Corps of Engineers 2020).

USDA Plants Code (USDA, NRCS 2022)

ATGLG

Coefficient of Conservatism (Walz et al. 2018)

CoC = 10. Criteria for a value of 9 to 10: Native with a narrow range of ecological tolerances, high fidelity to particular habitat conditions, and sensitive to anthropogenic disturbance (Faber-Langendoen 2018).

Distribution and Range

Atriplex glabriuscula occurs in North America and western Europe (POWO 2022). The map in Figure 1 depicts the extent of the species in the United States and Canada. Experts disagree about whether *A. glabriuscula* var. *glabriuscula* is native to North America or introduced from Europe, but Welsh (2020) remarked that "there are numerous examples of plant species with amphi-Atlantic distributions, and *A. glabriuscula* might well be one of them."

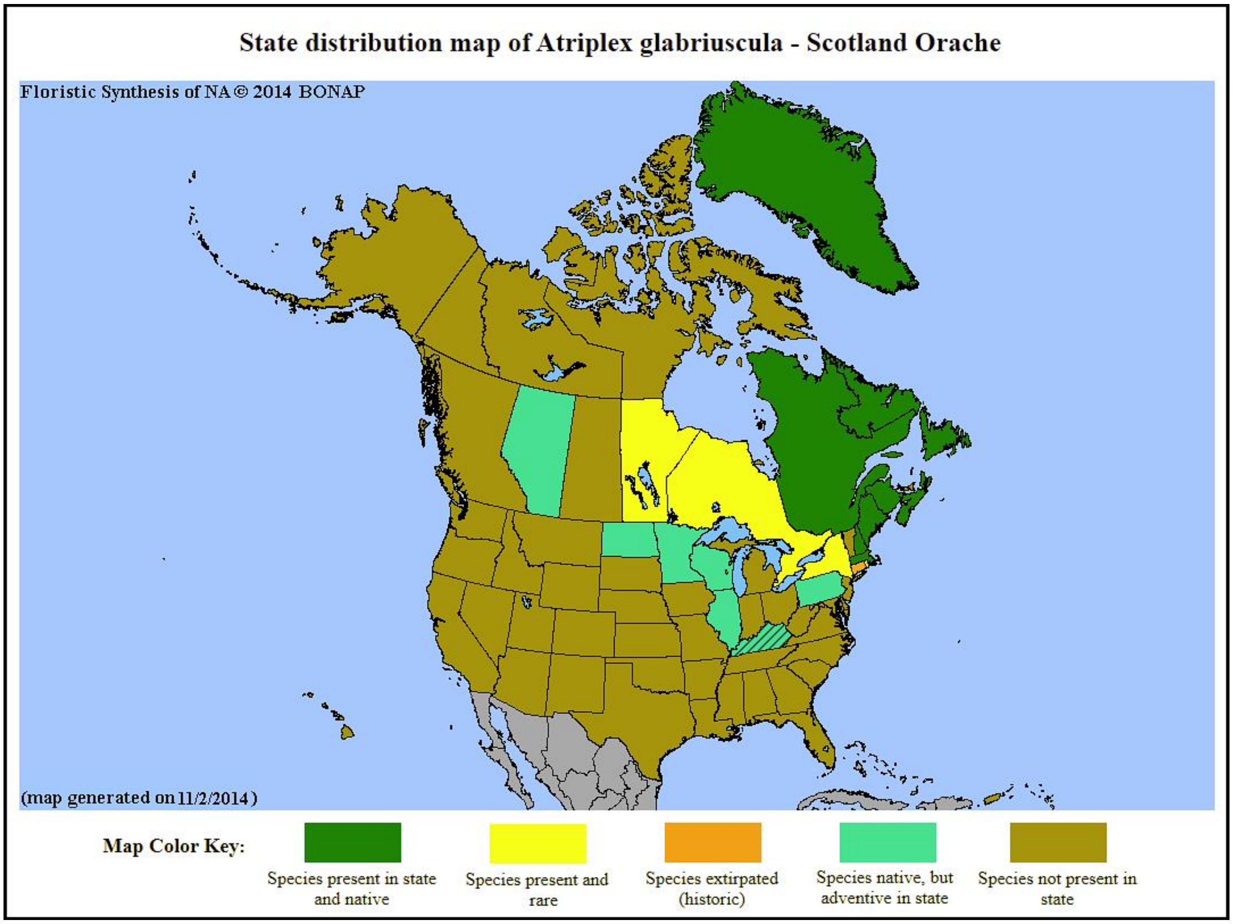

Figure 1. Distribution of A. glabriuscula var. glabriuscula in North America, adapted from BONAP (Kartesz 2015).

The range maps from Kartesz (2015) and the USDA PLANTS Database (2022) do not show *A. glabriuscula* var. *glabriuscula* as present in New Jersey. The species was only discovered in the state during 2020 (NJNLT 2020). Figure 2 shows its county distribution according to records in the state's biotics database (NHNHP 2022).

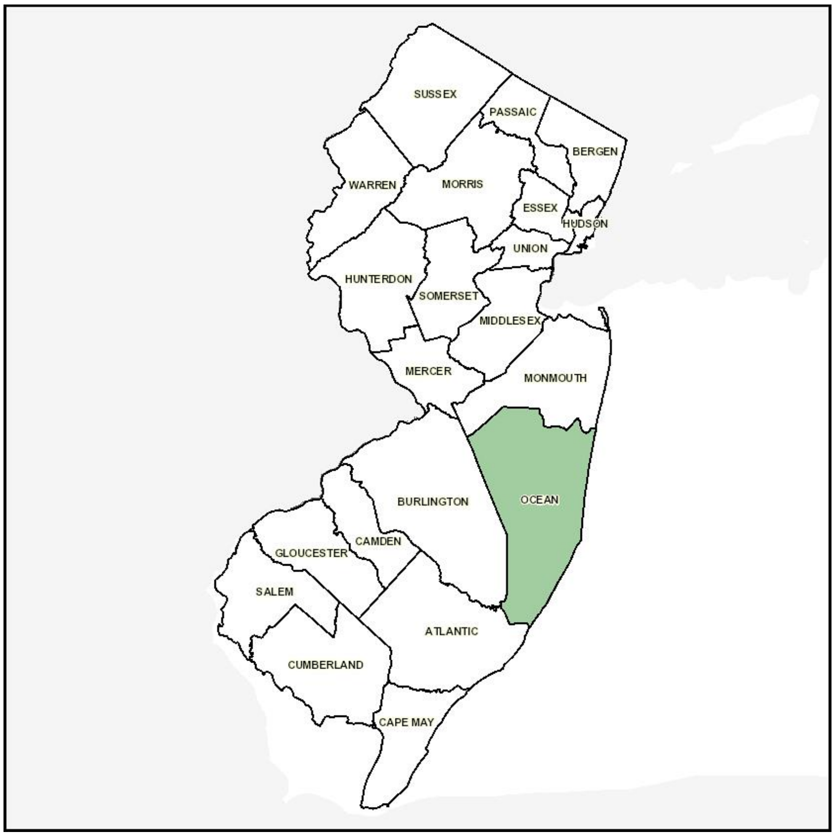

Figure 2. County distribution of A. glabriuscula var. glabriuscula in New Jersey.

Conservation Status

Atriplex glabriuscula var. *glabriuscula* is considered globally secure. The G5 rank means the species has a very low risk of extinction or collapse due to a very extensive range, abundant populations or occurrences, and little to no concern from declines or threats (NatureServe 2022). The map below (Figure 3) illustrates the conservation status of *A. glabriuscula* var. *glabriuscula* in North America. Smooth Orache is critically imperiled (very high risk of extinction) in three states and two provinces, imperiled (high risk of extinction) in one province, vulnerable (moderate risk of extinction) in one province, and possibly extirpated in Virginia. *A. glabriuscula* var. *glabriuscula* is secure, apparently secure, or unranked in most other districts where it occurs, and it is categorized as exotic in Kentucky and Illinois.

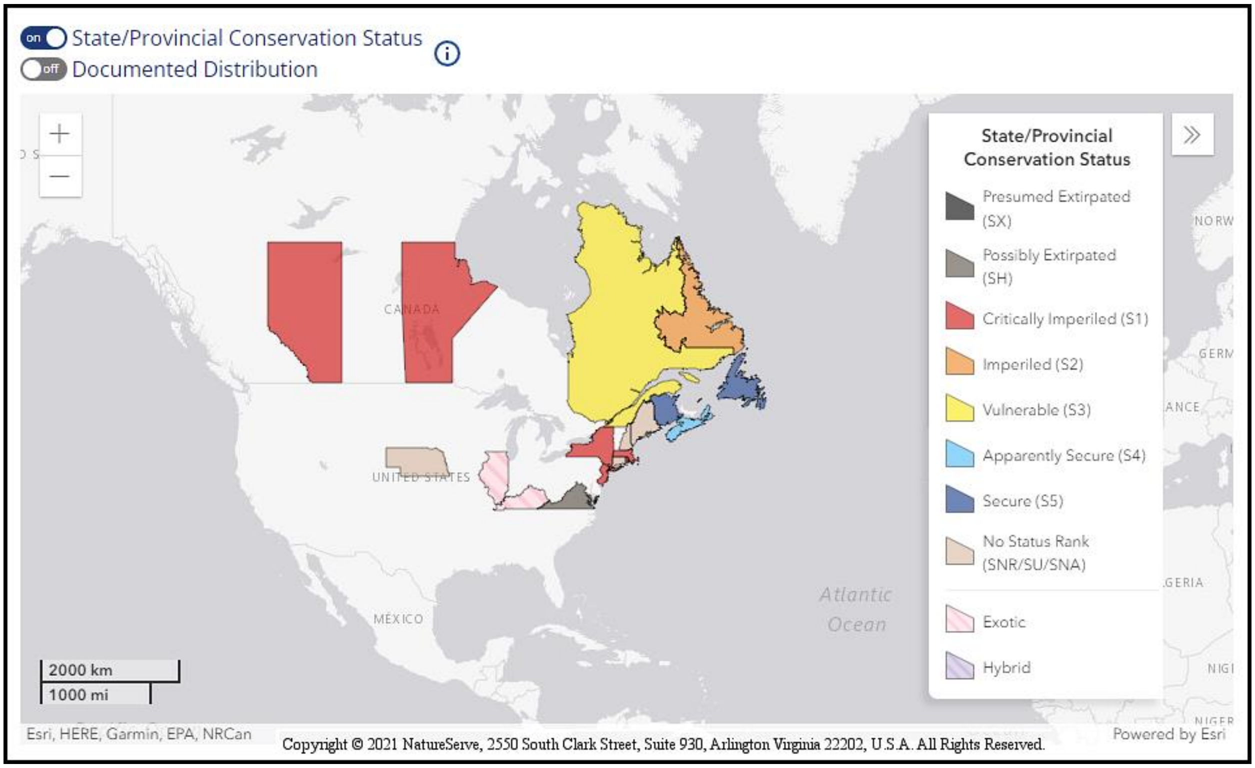

Figure 3. Conservation status of A. glabriuscula var. glabriuscula in North America NatureServe 2022).

Atriplex glabriuscula var. *glabriuscula* is ranked S1.1 in New Jersey (NJNHP 2022), meaning that it is critically imperiled due to extreme rarity. A species with an S1.1 rank has only ever been documented at a single location in the state. *A. glabriuscula* var. *glabriuscula* is also eligible for protection in the portion of the state that falls within the Highlands Preservation Area (HL) (NJNHP 2010).

Threats

Competition with other plants can pose a significant risk to *Atriplex glabriuscula*. Smooth Orache is typically limited to habitats with limited resources where few other species occur. Experimental cultivation in low light conditions dramatically inhibited the development of *A. glabriuscula* plants and also prevented salt-dependent growth increases, suggesting that competition for light could be important in determining the species' distribution in salt marshes (Ievinsh 2020). When a salt marsh was restored in the Bay of Fundy the re-establishment of natural tidal flow increased salinity, causing a die-off of established vegetation that permitted *A. glabriuscula* to colonize the site (Bowron et al. 2011).

No threats have been reported for the newly-established colony of *Atriplex glabriuscula* var. *glabriuscula* in New Jersey (NJNHP 2022). On eastern Long Island in New York, where the species has been recorded since 1990, human disturbance and stands of Common Reed (*Phragmites australis* ssp. *australis*) have been identified as concerns (NYNHP 2022). *A. glabriuscula* is also imperiled in some European locations: The species is regionally endangered on the shores of the Baltic Sea in Helsinki and near threatened throughout Finland (Vähä-Piikkiö et al. 2004) and pebble beaches—one substrate favored by the plants—are reported to be a rare and declining habitat worldwide (Randall 2004).

Climate change can be expected to affect *Atriplex glabriuscula* var. *glabriuscula* in multiple ways, although local outcomes may vary. Different models of climate change impacts in the Netherlands forecast a reduction ranging from 84.6–94.3% in the regional distribution of the species (van Treuren et al. 2020). In New Jersey, *A. glabriuscula* is likely to experience higher temperatures, more intense storm events, and rising seas (Hill et al. 2020). Smooth Orache may have some tolerance to elevated temperatures: Experimental work by Schreiber and Berry (1977) found that heat damage substantial enough to reduce photosynthetic activity only began at temperatures of 42^{o} C. Because *A. glabriuscula* is well-suited for ephemeral shoreline habitats the species may adapt to sea level rise if it can colonize new sites as the former ones become inundated. However, severe storms that alter the coastal landforms may prove to be a greater threat, particularly if they occur during a critical life phase that prevents the plants from fully developing or dispersing viable seeds. At certain times of year, tidal surges could also result in the deposition of propagules at sites that are not conducive to seedling development.

Management Summary and Recommendations

New Jersey's only known population of *Atriplex glabriuscula* var. *glabriuscula* occurs on preserved land and no immediate management needs have been identified (NJNHP 2022). Recommended considerations for monitoring visits include an assessment of whether the colony is expanding, stable, or declining. The potential for emerging threats from competition, invasive species, or human activities should also be noted.

Although the life cycle and habitat requirements of *A. glabriuscula* are fairly well understood there are a few areas where additional information might be useful. For example, seeds that become too deeply buried in the substrate to detect the alternating temperature cycles of spring do not germinate (Ignaciuk and Lee 1980), but it is not known how long the propagules are able to persist and remain viable while awaiting suitable conditions. It is also unclear whether the two kinds of seeds produced by *A. glabriuscula* vary in their requirements for germination. In other *Atriplex* with two seed types some species (e.g. *A. patula*) showed a difference in the germination responses of brown and black seeds while others (*A. littoralis*, *A. prostrata*) did not (Taschereau 1985). Studies of seed longevity and germination strategies could provide some insight regarding whether Smooth Orache is likely to persist in climate-altered habitats or whether ex situ seed storage and propagation should be considered in regions where the species is imperiled.

Synonyms

The accepted botanical name of the species is *Atriplex glabriuscula* Edmondston var. *glabriuscula*. Orthographic variants, synonyms, and common names are listed below (Welsh 2020, ITIS 2022, POWO 2022, USDA NRCS 2022).

Botanical Synonyms	**Common Names**
Atriplex babingtonii J. Woods	Smooth Orache
Atriplex glabriuscula var. *oblanceolata* Vict. & J. Rousseau	Scotland Orache
Atriplex hastata var. *oblanceolata* (Vict. & J. Rousseau) B. Boivin	Northeastern Saltbush
Atriplex patula ssp. *glabriuscula* (Edmondston) H. M. Hall & Clements	Bracted Orache
Atriplex patula var. *oblanceolata* (Vict. & J. Rousseau) B. Boivin	Glabrous Orache
	Glabrous Saltbush
	North Seacoast Atriplex
	Maritime Orache

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