

= *Amaranthus brownii* =

Amaranthus brownii is an annual herb in the *Amaranthaceae* family . The plant is found only on the small island of Nihoa in the Northwestern Hawaiian Islands , growing on rocky outcrops at altitudes of 120 ? 215 m (394 ? 705 ft) . It is one of nine species of *Amaranthus* in the Hawaiian Islands , but the only endemic Hawaiian species of the genus . It was first discovered during the Tanager Expedition in 1923 by botanist Edward Leonard Caum . *A. brownii* differs from other Hawaiian species of *Amaranthus* with its spineless leaf axils , linear leaves , and indehiscent fruits .

It is one of 26 vascular plants on Nihoa , 17 of which are indigenous , six alien , and three endemic only to Nihoa , including *A. brownii* , the Nihoa fan palm or loulu , and the Nihoa carnation . *A. brownii* is considered the rarest plant on Nihoa and has not been directly observed on the island since 1983 . Past expeditions collected plant samples and seeds , but no specimens have managed to survive ex situ conservation efforts outside of its native habitat . There are no known plants or seeds from *A. brownii* in any botanical gardens .

Conservation and recovery plans for *A. brownii* have been proposed by the United States Fish and Wildlife Service (FWS) which administers the island of Nihoa as part of the Hawaiian Islands National Wildlife Refuge in the Papahānaumokuākea Marine National Monument . In 1996 , the plant was listed by the FWS as an endangered species . In 2003 , the FWS designated the island of Nihoa as a critical habitat for the plant and it was classified as critically endangered on the IUCN Red List . The plant is one of 51 endangered or threatened plants in the Hawaiian Islands listed under the Endangered Species Act .

= = Taxonomy = =

The species was first collected during a ten day visit to the island of Nihoa by the Tanager Expedition . Botanist Edward Leonard Caum collected the first specimen on June 17 , 1923 , and a second was collected by cartographer Charles S. Judd on June 20 , 1923 . Forest B. H. Brown , botanist of the Bayard Dominick Expedition to the Marquesas Islands (1921 ? 1922) , helped provide descriptions and comments for some of the species described by Erling Christophersen and Caum . They named *A. brownii* after Brown in 1931 with the publication of their paper " Vascular plants of the Leeward Islands , Hawaii " . In the paper they originally described *A. brownii* as one of 20 vascular plant species on the island of Nihoa . The FWS does not recognize a common name .

= = Description = =

A. brownii is the only endemic species of Hawaiian *Amaranthus* in the Hawaiian Islands . It is an herbaceous annual plant that grows to a height of 30 ? 90 cm (0 @. 98 ? 2 @. 95 ft) and has narrow , linear leaves , small green flowers , and fruit that holds a single , dark red seed . *A. brownii* is monoecious ; that is , the male and female flowers are found together on the same plant . It differs from other Hawaiian species of *Amaranthus* with its spineless leaf axils , linear leaves , and indehiscent fruits (fruit which does not open to release seeds when ripe) . The fruits are ovoid and between 0 @. 8 ? 1 mm long and 0 @. 6 ? 0 @. 8 mm wide . The plant is thought to be anemophilous (pollinated by wind) .

= = Distribution and habitat = =

A. brownii has a very limited range ; it is found only on the 0 @. 65 km² (0 @. 25 sq mi) island of Nihoa , located 275 km (171 mi) northwest of Kauai . It is thought that this endemic plant has probably always been rare and restricted to Nihoa . Its habitat is managed by the United States Fish and Wildlife Service and protected as part of the Hawaiian Islands National Wildlife Refuge in the Papahānaumokuākea Marine National Monument . *A. brownii* is one of three endemic and endangered species only found on Nihoa , along with the Nihoa fan palm (*Pritchardia remota*) and the Nihoa carnation (*Schiedea verticillata*) . At least nine other native plant species can be found in

its habitat , including Hawaiian goosefoot (*Chenopodium oahuense*) , lovegrass (*Eragrostis variabilis*) , koali ?awa (*Ipomoea indica*) , goat 's foot (*Ipomoea pes @-@ caprae* ssp. *brasiliensis*) , *Panicum torridum* , naupakas (*Scaevola sericea*) , *Sicyos pachycarpus* , ?ilima (*Sida fallax*) , and Nelson 's horsenettle (*Solanum nelsonii*) .

The plant grows during the moist , winter season from December through July in Nihoa 's coastal dry shrubland habitat in shallow soil on rocky outcrops in exposed areas between 120 ? 215 m (394 ? 705 ft) . At the time of its discovery in 1923 , botanists first observed the plant growing in great quantity on the ridges towards Miller Peak and on eastern ridges of the island . Expeditions in the early and mid @-@ 1960s failed to identify any specimens , but in 1969 , ethnobotanist Douglas E. Yen of the Bishop Museum collected specimens near Miller Peak . Derral R. Herbst and Wayne Takeuchi of the FWS collected the last known specimen on July 27 , 1980 . Carl C. Christensen also visited Nihoa in 1980 to reevaluate endemic species last observed on the Tanager Expedition . Sheila Conant and Mark S. Collins visited Nihoa in 1980 as well ; Conant returned twice in 1981 , first with Mark J. Rauzon and later with Audrey L. Newman . In 1983 , Conant visited the island with Wayne C. Gagné . Conant found *A. brownii* growing on the island in 1981 and 1983 , by which time only two populations of 35 plants were thought to exist : 23 plants were found near Miller Peak and 12 plants in Middle Valley . The two plant populations are separated by a distance of approximately 0 @.@ 4 km (0 @.@ 25 mi) .

Prehistoric Polynesian habitation on Nihoa may have initially led to a decrease in the plant population of *A. brownii* . Major threats to the plant include invasive species , fire , and hybridization with other *Amaranthus* species . Inbreeding is a serious threat , as the small plant population must reproduce within its own circle resulting in genetic defects . *A. brownii* is also forced to compete with the non @-@ native weed (*Portulaca oleracea*) , the plant 's main alien species threat . In 2002 and 2004 , the invasive gray bird grasshopper (*Schistocerca nitens*) presented an even larger threat to *A. brownii* . First recorded on the island in 1977 , the increasing population density of gray bird grasshoppers led to massive defoliation on the island , leaving *A. brownii* at greater risk of predation . In 2004 alone , an estimated 400 @,@ 000 gray bird grasshoppers destroyed almost 90 % of the vegetation on Nihoa .

= = Conservation = =

According to zoologist and conservationist Sheila Conant , *A. brownii* is important due to its uniqueness in the Northwestern Hawaiian Islands as " the only Hawaiian endemic in this large genus which contains many economically and nutritionally important species . " However , in more than a decade of field surveys on Nihoa , no living plants have been identified . Wildlife refuge staff have visited the island during the dry season at least 21 times between 1983 and 1996 . The absence of the plant in recent field surveys might be explained by the time of visit . Because winter surveys of Nihoa tend to be difficult and dangerous due to poor landing conditions , surveys have not been conducted during the moist , winter growing season from December through March when the plant is easiest to find . Most of the surveys have been completed during the summer months , when it is easiest to visit Nihoa , but during this time , the stems of *A. brownii* dry up and cannot be distinguished from other herbaceous plants . A seven @-@ day visit to the island in April 2006 still did not find any specimens but botanists are optimistic that the species has survived . Additional winter surveys are required to accurately assess the conservation status of the plant .

Ex @-@ situ conservation efforts to propagate *A. brownii* by seed in botanical gardens have been unsuccessful . During the 1981 expedition , *A. brownii* seeds were collected by Sheila Conant and presented to the Waimea Arboretum on the Hawaiian island of Oahu and the Kew Gardens in London , England . Although the seeds at the Waimea Arboretum germinated and grew for a while , no plants survived beyond the stage of seedling development . Information about the outcome of the seeds sent to Kew Gardens is unavailable .

A proposal for listing *A. brownii* under the U.S. Endangered Species Act was originally submitted on June 16 , 1976 , but was withdrawn on December 10 , 1979 as out of date and incomplete . It was proposed again on March 24 , 1993 , and was federally listed as an endangered species on August

21 , 1996 . On May 22 , 2003 , the FWS designated 171 acres (69 ha) on the island of Nihoa as a critical habitat for *A. brownii* , as well as *Pritchardia remota* , *Schiedea verticillata* , and two other species also found on Nihoa and other Hawaiian islands , ?ohai (*Sesbania tomentosa*) and *Mariscus pennatifolius* . In the same year , *A. brownii* was internationally classified as critically endangered on the IUCN Red List . As of 2010 , *A. brownii* was one of 51 Hawaiian plant species listed as endangered or threatened under the Endangered Species Act .