St. Lucie counties along the Atlantic Coast (http://florida.plantatlas.usf.edu).

Biology and Ecology

Tradescantia fluminensis is shade-tolerant (Samoilova et al. 2011) and can grow in light levels of 1% to 90% normal daylight during most of the year (Maule et al. 1995). The species grows most vigorously and attains highest biomass in reduced canopy coverage situations, such as in fragmented forest communities or at forest margins (Standish et al. 2001b). Rates of stem growth were determined to be 0.2–0.3 cm/day in summer and 0.04–0.06 cm/day in winter (60–70 cm/year) in a two-year study conducted in a New Zealand coastal forest (Maule et al. 1995). Apical growth was balanced by basal decay in the Maule et al. (1995) study.

The species thrives in moist conditions including riparian zones and forest margins. It may be able to sequester nutrients from the upper (organic) soil horizon (Standish et al. 2001b). Nitrate (NO_3^-) is stored in shoots and subsequently utilized to sustain growth when external nitrogen supply would otherwise limit growth (Maule et al. 1995).

Tradescantia fluminensis is a larval host plant of the noctuid moth *Mouralia tinctoides* (Eichlin and Cunningham 1978). This moth has a native range from Florida and Texas south to Brazil (Landolt 1993) and is not considered to be a plant pest (Landolt 1993). The plant is also a host for at least five known plant viruses of the genus *Potyvirus* (family Potyviridae) (Standish 2001a, Ciuffo et al. 2005; see Biological Control section below).

Reproduction and Colonization

In its native range of Brazil and Argentina, *T. fluminensis* reproduces by seed as well as vegetatively (M.O.O. Pellegrini *pers. comm*. 06/10/14). However, in Florida and New Zealand the species is completely reliant on vegetative propagation (Kelly and Skipworth 1984a, Butcher and Kelly 2011). Stems break apart easily and each fragment contains at least one node and thus has a high potential for regrowth (Hurrell and Lusk 2012).

Tradescantia fluminensis can colonize new areas by the spread of shoots via flowing water like that of river systems. In New Zealand, a colony was discovered about 2.6 km downstream from the original infestation, with the highest density of plants found along river channels (Hurrell et al. 2012). Fragments of the plant can survive for up to 48 hours in full-strength seawater (Hurrell and Lusk 2012). In addition to water-mediated dispersal, the shoots can also become dispersed lodged in the hooves of cattle (*Bos taurus*) (Ogle and Lovelock 1989). Stems of this species may also become lodged in the feet of domestic chickens (*Gallus gallus*) and dispersed in a similar manner (Standish 2001a).

Tradescantia fluminensis can be spread by the improper disposal of landscape material along roadsides (Hurrell et al. 2012). Dumping of landscape waste is thought to be an important mechanism of long-distance dispersion. However, the relative importance of humans as dispersers of *T. fluminensis* has not been quantified (Butcher and Kelly 2011).

Habitat

In its native range, *T. fluminensis* occurs in rainforests, shaded roadsides, and gardens (Eminağaoğlu et al. 2012); along the banks of waterways (da Conceição Vellozo 1825); and in cultivated areas of Brazil, where it is considered an agricultural weed (Dos Santos and De Araujo 1971 cited in Kelly and Skipworth 1984a). The original description of *T. fluminensis* referred to its occurrence in cleared areas under cultivation (da Conceição Vellozo 1825), suggesting the species was an agricultural weed even back in the mid-1800s. In Turkey it inhabits damp roadside areas and riparian habitats (Eminağaoğlu et al. 2012). In Hawaii, the species occurs in shaded, moist riparian habitats and along shaded forest edges (Staples et al. 2006).

In northern Florida, *T. fluminensis* occurs most often in shady mesic to hydric forests, especially those associated with riparian wetlands (Godfrey and Wooten 1979). It occurs less frequently in well-drained habitats including scrub, sandhill, and upland pine forests (Langeland et al. 2008). Urban settings include shady lawns, greenhouses, and areas used for disposal of landscape and yard waste (Small 1933, Langeland et al. 2008).

Impacts

Tradescantia fluminensis has been recognized as a non-native invasive plant in the southeastern United States since 1947 (Langeland et al. 2008) and is now listed as a Category I invasive plant by the Florida Exotic Pest Plant Council (FLEPPC) based on documented ecological damage (FLEPPC 2015). The species is currently not included in the federal noxious weed list or the noxious weed list of the Florida Department of Agriculture and Consumer Services (http://plants.usda.gov/java/noxious). An assessment of *T. fluminensis* in September 2006 by the Institute of Food and Agricultural Sciences (IFAS) Invasive Plant Working Group concluded that this invasive plant is not recommended for any use in northern or central Florida. *Tradescantia fluminensis* has also been documented in natural areas of southern Florida but may not be problematic there although this conclusion is pending further data (IFAS 2016).

The species forms dense monocultures and reduces recruitment of native species in northern Florida (Schmitz et al. 1997) (Figure 2). It was found to out-compete established native *Oplismenus hirtellus* (basketgrass) in a northern Florida study by McMillan (1999), who also found that it reduced the relative abundance and diversity of native plants in test plots in Alachua County floodplain forests and mesic hammocks. *Tradescantia fluminensis* forms a dense layer along the ground, preventing regeneration of native vegetation by shading them and is capable of affecting the long-term viability of forest fragments (Butcher and Kelly 2011). The presence of *T. fluminensis* was associated with a decrease in abundance and species richness of native seedlings in a study by Standish et al. (2001b). It is known to suppress native groundcover species in natural areas (Hurrell and Lusk 2012).

Impacts on forest floor invertebrates were detected in a study by Standish (2004) in New Zealand, where *T. fluminensis* caused a moderate reduction in taxonomic richness. Invaded forests of New Zealand were found to have a decreased diversity of fungus gnats and certain beetles compared to non-invaded forests (Toft et al. 2001).

Tradescantia fluminensis produces litter that decomposes more readily than that of the mixed-species forests where it invades, and the increased rate of litter decomposition can alter nutrient availability compared to non-invaded forests (Standish et al. 2001). The soil moisture regime under *T. fluminensis* stands is greater than under leaf litter of non-invaded forests (Standish 2004).

Management

Chemical

The use of herbicides is considered the only practical means of controlling large infestations of *T. fluminensis* (Standish 2001a, 2001b, 2002). Application methods include vehicle-mounted spraying, backpack spraying, and hand-spraying (Hurrell et al. 2012). *Tradescantia fluminensis* is difficult to control and will likely require more than one herbicide application to achieve satisfactory results. Foliar applications of 0.3% triclopyr amine in water with a non-ionic vegetable oil surfactant (such as Dyne-Amic) added appear to offer the best and most consistent control. This equates to using 6% Brush-B-Gon, 5% Brush Killer, or 1% Garlon 3A, in water and the surfactant. Follow all label directions.

Much of the control studies using herbicides have been conducted in New Zealand using chemicals that are either not registered in the United States, include active ingredients with use restrictions for natural areas in the United States, or have trade names that refer to different active ingredients outside the United States than the same trade name used in the United States. For these reasons, chemical control studies in New Zealand conducted by Kelly and Skipworth (1984b), Standish (2002), and Hurrell et al. (2012) are omitted from this summary.

Physical

Physical removal of the plants requires special care to remove all stem segments in order to prevent regrowth. This labor-intensive method may be a viable option only when controlling small colonies (Standish 2001b). Hand-removal of *T. fluminensis* was found to be more successful than herbicide treatment in terms of reduction of percent coverage in a study comparing herbicide, hand-removal, and shading treatment methods (Standish 2002).

Shading

Standish (2002) found that artificial shading was the most effective means of sustained control of *T. fluminensis* without invasion by other nonindigenous plant species. Artificial shading (three layers of shade cloth stretched over metal frames) reduced light levels to 2%–5% of full sunlight and reduced *T. fluminensis* cover to the equivalent of 40% coverage following 17 months of shading (Standish 2002). Percent cover remained at 100% for unshaded plots.

It is possible that the planting of native woody plants into areas dominated by *T. fluminensis* may decrease coverage of this plant by decreasing the amount of available light over time (Standish 2002). It should be noted that shade-intolerant native forest species may not become established under shade intended to reduce *T. fluminensis* coverage. However, shade-intolerant species may also not become established in areas having higher light levels (10% to 30% full light) if dominated by *T. fluminensis* (Standish 2002).

Biological

There are currently no effective biological control agents being used on *T. fluminensis*. The presence of flavonoids in the leaves of the plant may deter generalist insect herbivores but may lead to adaptation of specialist insects (Standish 2001a). Certain members of the hemiptera family Miridae (plant bugs) hold promise as potential biological control agents. These insects are likely to cause damage to new shoots of *T. fluminesis* (Eyles 1999), resulting in malformed shoots and reduced plant biomass (Standish 2001a).

Parasitic nematodes of the genus *Meloidogyne* (Tylenchida: Heteroderidae) have been reported associated with *T. fluminensis* (Yeates and Williams 2001), but a successful biological control program has not yet been conducted using nematodes.

Plant pathogens such as fungi hold promise as potential biological control candidates. At least nine fungal taxa have been recorded using *T. fluminensis* as a host (Farr and Rossman 2013), including the rust fungus *Physopella tecta* (synonym *Phakopsora tecta*) (Standish 2001a).

There are at least five plant viruses of the genus *Potyvirus* (family Potyviridae) known to infect *T. fluminensis*: bean yellow mosaic virus-BV, clover yellow vein virus, *T. albiflora* virus, *Tradescantia* mild mosaic *Potyvirus*, and *Tradescantia-Zebrina Potyvirus* (Standish 2001a, Ciuffo et al. 2005). Symptoms of these plant viruses include the presence of necrotic lesions; stunted, shrunken, or distorted leaves; mosaic; and mottling. Although the *T. albiflora* virus originates from a cool temperate climate (southeastern Russia), it may still be a suitable candidate for development as a biocontrol agent (Standish 2001a).

Prevention

A good management strategy for *T. fluminensis* should include actions designed to prevent dispersal through landscape waste dumping, such as by educating the public and/or by modification of the physical environment (Butcher and Kelly 2011). Vulnerable locations, such as lands adjacent to two-lane roadways that have wide shoulders or close to residential areas, should have signage to discourage the dumping of yard waste and should be monitored for evidence of this species. Any occurrences of this plant should be eradicated before it is allowed to spread (Butcher and Kelly 2011).

References

Burns, J.H. 2004. "A comparison of invasive and non-invasive dayflowers (Commelinaceae) across experimental nutrient and water gradients." *Diversity and Distributions* 10(5):387–397.

Burns, J.H., R.B. Faden, and S.J. Steppan. 2011. "Phylogenetic studies in the Commelinaceae subfamily Commelinoideae inferred from nuclear ribosomal and chloroplast DNA sequences." *Systematic Botany* 36(2):268–276.

Butcher, E.R. and D. Kelly. 2011. "Physical and anthropogenic factors predict distribution of the invasive weed *Tradescantia fluminensis*." *Austral Ecology* 36(6):621–627.

Ciuffo, M., V. Masenga, and M. Turina. 2005. "Characterization of a potyvirus isolated from *Tradescantia fluminensis* in northern Italy." *Archives of Virology* 151(6):1235–1241.

Cuevas, J.G., A. Marticorena, and L.A. Cavieres. 2004. "New additions to the introduced flora of the Juan Fernández Islands: origin, distribution, life history traits, and potential of invasion." *Revista Chilena de Histora Natural* 77(3):523–538.

da Conceição Vellozo. J.M. 1825. *Florae Fluminensis, seu Descriptionum Plantarum Praefectura Fluminensi Sponte Nascentium Liber Primus ad Systema Sexuale Concinnatus Augustissimae Dominae Nostrae*. Rio de Janeiro, Brazil.

Eichlin, T.D. and H.B. Cunningham. 1978. *The Plusiinae (Lepidoptera: Noctuidae) of America North of Mexico, Enphasizing Genitalic and Larval Morphology*. Technical Bulletin No. 1567, Agricultural Research Service, U.S. Department of Agriculture, Washington, D.C.

Eminağaoğlu, O., M. Özcan, and S. Kültür. 2012. "Contributions to the leaf and stem anatomy of *Tradescantia fluminensis*: an alien species new to the flora of Turkey." *Artvin Çoruh Üniversitesi Orman Fakültesi Dergisi* 13(2):270–277.

Eyles, A.C. 1999. "Introduced Mirinae of New Zealand (Hemiptera: Miridae)." *New Zealand Journal of Zoology* 26(4):355–372.

Faden, R.B. 1998. "Commelinaceae." Pp. 109–127 in: K. Kubitzki (ed.) *The Families and Genera of Vascular Plants, Volume 4*. Springer-Verlag, Berlin, Germany.

Faden, R.B. 2000. "Commelinaceae." Pp. 170–197 in: Flora of North America Editorial Committee (eds.) *Flora of North America North of Mexico. Volume 22: Magnoliophyta: Alismatidae, Arecidae, Commelinidae (in part), and Zingiberidae*. New York, NY.

Faden, R.B. and D.R. Hunt. 1991. "The classification of the Commelinaceae." *Taxon* 40(1):19–31.

Farr, D.F. and A.Y. Rossman. 2013. *Systematic Mycology and Microbiology Laboratory Fungus-Host Database* [online resource]. U.S. Department of Agriculture, Agricultural Research Service. Retrieved 10 March 2013 from http://nt.ars-grin.gov/fungaldatabases/

Flora of Alabama. 2016. "Alabama Plant Atlas". Alabama Herbarium Consortium & The University of West Alabama. http://www.floraofalabama.org/

Florida Exotic Pest Plant Council. 2015. *Florida Exotic Pest Plant Council's 2015 list of Invasive Plant Species* [online resource]. Retrieved April 18, 2016 from http://www.fleppc.org/list/2015FLEPPCLIST-LARGEFORMAT-FINAL.pdf

Godfrey, R.K. and J.W. Wooten. 1979. *Aquatic and Wetland Plants of Southeastern United States. Monocotyledons*. The University of Georgia Press, Athens, GA.

Guézou, A., M. Trueman, C.E. Buddenhagen, S. Chamorro, A.M. Guerrero, P. Pozo, R. Atkinson. 2010. "An extensive alien plant inventory from the inhabited areas of Galapagos." *PLoS ONE* 5(4):e10276.

Institute of Food and Agricultural Sciences. 2016. *Conclusions from the IFAS Assessment of Non-native Plants in Florida's Natural Areas* [online resource]. Retrieved April 18 2016 from http://assessment.ifas.ufl.edu/assessments/tradescantia-fluminensis/.

Hardy, C.R. and J. Ryndock. 2012. "Floral morphology and organogenesis in *Tinantia pringlei*, along with a review of floral developmental variation in the spiderwort family, Commelinaceae." *Botanical Review* 78(4):416–427.

Holm, L., J.V. Pancho, J.P. Herberger, and D.L. Plucknett. 1979. *A Geographic Atlas of World Weeds*. John Wiley & Sons, New York, NY.

Hurrell, G.A. T. Belton, C.S. Lusk, and S.L. Lamoureaux. 2012. "*Tradescantia* management in a New Zealand National Park." *Ecological Management & Restoration* 13(3):311–314.

Hurrel, G.A. and C.S. Lusk. 2012. "Survival of *Tradescantia fluminensis* in sea water." *Ecological Management & Restoration* 13(3):314–316.

Jaeger, E.C. 1944. *A Source-Book of Biological Names and Terms*. Charles C Thomas, Springfield, IL.

Kelly, D. and J.P. Skipworth. 1984a. "*Tradescantia fluminensis* in a Manawatu (New Zealand) forest: I. Growth and effects on regeneration." *New Zealand Journal of Botany* 22(3):393–397.

Kelly, D. and J.P. Skipworth. 1984b. "*Tradescantia fluminensis* in a Manawatu (New Zealand) forest: II. Management by herbicides." *New Zealand Journal of Botany* 22(3):399–402.

Landolt, P.J. 1993. "Suitability of six species of Commelinaceae as larval hosts of *Mouralia tinctoides* (Lepidoptera: Noctuidae, Plusiinae)." *Florida Entomologist* 76(4):572–576.

Langeland, K.A., H.M. Cherry, C.M. McCormick, and K.A. Craddock Burks. 2008. *Identification and Biology of Non-native Plants in Florida's Natural Areas*. SP 257 Gainesville: University of Florida Institute of Food and Agricultural Sciences.

Maule, H.G., M. Andrews, J.D. Morton, A.V. Jones, and G.T. Daly. 1995. "Sun/shade acclimation and nitrogen nutrition of *Tradescantia fluminensis*, a problem weed in New Zealand forest remnants." *New Zealand Journal of Ecology* 19(1):35-46.

McMillan, B.A. 1999. *Tradescantia fluminensis*: *An Exotic Invasive Species in Florida's Mesic Hardwood Forests*. MS thesis, University of Florida, Gainesville, FL.

Missouri Botanical Garden. 2016. "Plant Finder" http://www.missouribotanicalgarden.org/

Ogle, C. and B. Lovelock. 1989. *Methods for the control of wandering Jew (*Tradescantia fluminensis*) at "Rangitawa", Rangitikei District, and notes on other aspects of conserving this forest remnant*. Science and Research Internal Report 56, New Zealand Department of Conservation, Wellington, New Zealand.

Orchard, A.E. 1994. *Flora of Australia, Volume 49, Oceanic Islands 1*. Australian Government Publishing Service, Canberra, Australia.

Panigo, E., J. Ramos, L. Lucero, M. Perreta, and A. Vegetti. 2011. "The inflorescence in Commelinaceae." *Flora* 206(4):294–299.

Samoilova, O.P., V.V. Ptushenko, I.V. Kuvykin, S.A. Kiselev, O.S. Ptushenko, and A.N. Tikhonov. 2011. "Effects of light environment on the induction of chlorophyll fluorescence in leaves: A comparative study of *Tradescantia* species of different ecotypes." *Biosystems* 105(1):41–48.

Schmitz, D.C., D. Simberloff, R.H. Hofstetter, W. Haller, and D. Sutton. 1997. "The ecological impact of nonindigenous plants." Pp. 39–61 In: D. Simberloff, D.C. Schmitz, and T.C.

Brown (eds.) *Strangers in Paradise: Impact and Management of Nonindigenous Species in Florida*. Island Press, Washington, D.C.

Small, J.K. 1933. *Manual of the Southeastern Flora, Being Descriptions of the Seed Plants Growing Naturally in Florida, Alabama, Mississippi, Eastern Louisiana, Tennessee, North Carolina, South Carolina and Georgia*. University of North Carolina Press, Chapel Hill, NC.

Standish, R.J. 2001a. *Prospects for Biological Control of* Tradescantia fluminensis *Vell. (Commelinaceae)*. Science Internal Series 9, New Zealand Department of Conservation, Wellington, New Zealand.

Standish, R.J. 2001b. *The Ecological Impact and Control of an Invasive Weed* Tradescantia fluminensis *in Lowland Forest Remnants*. Ph.D. Dissertation, Institute of Natural Resources, Massey University, Palmerston North, New Zealand.

Standish, R.J. 2002. "Experimenting with methods to control *Tradescantia fluminensis*, an invasive weed of native forest remnants in New Zealand." *New Zealand Journal of Ecology* 26(2):161–170.

Standish, R.J. 2004. "Impact of an invasive clonal herb on epigaeic invertebrates in forest remnants in New Zealand." *Biological Conservation* 116(1):49–58.

Standish, R.J., A.W. Robertson, and P.A. Williams. 2001. "The impact of an invasive weed *Tradescantia fluminensis* on native forest regeneration." *Journal of Applied Ecology* 38(6):1253–1263.

Staples, G.W., D.R. Herbst, C.T. Imada. 2006. "New Hawaiian plant records for 2004. In: N.L. Evenhuis, and L.G. Eldredge (eds.) Records of the Hawaii Biological Survey for 2004–2005, Part 2: Notes." *Bishop Museum Occasional Papers* 88(1):6–9.

Tan, K. 1984. *Commelina* L. pp. 554–555. In: P.H. Davis (ed.) *Flora of Turkey and the East Aegean Islands. Volume 8*. Edinburgh University Press, Edinburgh, Scotland.

Thaman, R.R., F.R. Fosberg, H.I. Manner, and D.C. Hassall. 1994. *The Flora of Nauru*. Atoll Research Bulletin No. 392, National Museum of Natural History, Smithsonian Institution, Washington, DC.

Toft, R.J., R.J. Harris, and P.A. Williams. 2001. "Impacts of the weed *Tradescantia fluminensis* on insect communities in fragmented forests in New Zealand." *Biological Conservation* 102(1):31–46.

Tolkach, V.F., A.Kh. Chuyan, and A.V. Krylov. 1990. "Characterization of a potyvirus isolated from *Tradescantia albiflora* in a southern locality of the Soviet far east." *Byulleten' Glavnogo Botanicheskogo Sada* 157:76–80.

Wilcock, R.J., J. Costley, R.J. Cowles, B. Wilson, and P. Southgate. 1991. "Stream run-off losses and soil and grass residues of triclopyr applied to hillside gorse." *New Zealand Journal of Agricultural Research* 34(3):351–357.

Wunderlin, R.P. and B.F. Hansen. 2003. *Guide to the Vascular Plants of Florida*. University Press of Florida, Gainesville, FL.

Yeates, G.W. and P.A. Williams. 2001. "Influence of three invasive weeds and site factors on soil microfauna in New Zealand." *Pedobiologia* 45(4):367–383.