Taxon: Elaeagnus umbellata Thunb. **Family:** Elaeagnaceae

Common Name(s): autumn elaeagnus
autumn olive
Japanese silverberry
spreading oleaster
umbellata oleaster

Synonym(s): Elaeagnus crispa Thunb.
Elaeagnus parvifolia Wall. ex Royle

Assessor: Chuck Chimera **Status:** Assessor Approved **End Date:** 25 Mar 2021

WRA Score: 15.0 **Designation:** H(HPWRA) **Rating:** High Risk

Keywords: Spiny Shrub, Environmental Weed, Dense Stands, Bird-Dispersed, Resprouter

Qsn #	Question	Answer Option	Answer
101	Is the species highly domesticated?	y=-3, n=0	n
102	Has the species become naturalized where grown?		
103	Does the species have weedy races?		
201	Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"	(0-low; 1-intermediate; 2-high) (See Appendix 2)	Intermediate
202	Quality of climate match data	(0-low; 1-intermediate; 2-high) (See Appendix 2)	High
203	Broad climate suitability (environmental versatility)	y=1, n=0	y
204	Native or naturalized in regions with tropical or subtropical climates	y=1, n=0	y
205	Does the species have a history of repeated introductions outside its natural range?	y=-2, ?=-1, n=0	y
301	Naturalized beyond native range	y = 1*multiplier (see Appendix 2), n= question 205	y
302	Garden/amenity/disturbance weed	n=0, y = 1*multiplier (see Appendix 2)	y
303	Agricultural/forestry/horticultural weed	n=0, y = 2*multiplier (see Appendix 2)	y
304	Environmental weed	n=0, y = 2*multiplier (see Appendix 2)	y
305	Congeneric weed	n=0, y = 1*multiplier (see Appendix 2)	y
401	Produces spines, thorns or burrs	y=1, n=0	y
402	Allelopathic		
403	Parasitic	y=1, n=0	n
404	Unpalatable to grazing animals	y=1, n=-1	n
405	Toxic to animals	y=1, n=0	n
406	Host for recognized pests and pathogens	y=1, n=0	y
407	Causes allergies or is otherwise toxic to humans	y=1, n=0	n

Qsn #	Question	Answer Option	Answer
408	Creates a fire hazard in natural ecosystems	y=1, n=0	n
409	Is a shade tolerant plant at some stage of its life cycle		
410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y=1, n=0	y
411	Climbing or smothering growth habit	y=1, n=0	n
412	Forms dense thickets	y=1, n=0	y
501	Aquatic	y=5, n=0	n
502	Grass	y=1, n=0	n
503	Nitrogen fixing woody plant	y=1, n=0	y
504	Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)	y=1, n=0	n
601	Evidence of substantial reproductive failure in native habitat	y=1, n=0	n
602	Produces viable seed	y=1, n=-1	y
603	Hybridizes naturally		
604	Self-compatible or apomictic	y=1, n=-1	n
605	Requires specialist pollinators	y=-1, n=0	n
606	Reproduction by vegetative fragmentation	y=1, n=-1	n
607	Minimum generative time (years)	1 year = 1, 2 or 3 years = 0, 4+ years = -1	3
701	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	y=1, n=-1	n
702	Propagules dispersed intentionally by people	y=1, n=-1	y
703	Propagules likely to disperse as a produce contaminant	y=1, n=-1	n
704	Propagules adapted to wind dispersal	y=1, n=-1	y
705	Propagules water dispersed	y=1, n=-1	y
706	Propagules bird dispersed	y=1, n=-1	y
707	Propagules dispersed by other animals (externally)	y=1, n=-1	n
708	Propagules survive passage through the gut	y=1, n=-1	y
801	Prolific seed production (>1000/m2)	y=1, n=-1	y
802	Evidence that a persistent propagule bank is formed (>1 yr)		
803	Well controlled by herbicides	y=-1, n=1	y
804	Tolerates, or benefits from, mutilation, cultivation, or fire	y=1, n=-1	y
805	Effective natural enemies present locally (e.g. introduced biocontrol agents)		

Supporting Data:

Qsn #	Question	Answer
101	**Is the species highly domesticated?**	**n**
	Source(s)	**Notes**
	Zheng, H., Wu, Y., Ding, J., Binion, D., Fu, W., & Reardon, R. (2004). Invasive Plants of Asian Origin Established in the United States and Their Natural Enemies Volume 1. USDA Forest Service, Morgantown, WV	[Used, but not domesticated] "Elaeagnus umbel/ala is planted as an ornamental. The edible fruits are used to make wine and jam. The leaves can be used to control the cotton aphid, an insect pest. Along with fruits and leaves, roots also have medical uses."

102	Has the species become naturalized where grown?	
	Source(s)	**Notes**
	WRA Specialist. (2021). Personal Communication	NA

103	Does the species have weedy races?	
	Source(s)	**Notes**
	WRA Specialist. (2021). Personal Communication	NA

Qsn #	Question	Answer
201	**Species suited to tropical or subtropical climate(s) - If island is primarily wet habitat, then substitute "wet tropical" for "tropical or subtropical"**	**Intermediate**
	Source(s)	**Notes**
	Zheng, H., Wu, Y., Ding, J., Binion, D., Fu, W., & Reardon, R. (2004). Invasive Plants of Asian Origin Established in the United States and Their Natural Enemies Volume 1. USDA Forest Service, Morgantown, WV	"E. umbellata commonly occurs in subtropical and temperate regions at elevations of 20 to 3,000 m."
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 24 Mar 2021]	"Native Asia-Temperate WESTERN ASIA: Afghanistan CHINA: China [Zhejiang Sheng, Hubei Sheng, Gansu Sheng, Jiangsu Sheng, Liaoning Sheng, Shanxi Sheng, Shandong Sheng, Shaanxi Sheng, Sichuan Sheng, Yunnan Sheng, Xizang Zizhiqu] EASTERN ASIA: Korea, Japan [Hokkaidô (w.), Honshu, Kyushu, Shikoku], Taiwan Asia-Tropical INDIAN SUBCONTINENT: Bhutan, India [Himachal Pradesh, Jammu and Kashmir, Manipur, Uttar Pradesh], Nepal, Pakistan"
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 24 Mar 2021]	[Cold stratification is not a prerequisite for germination] "Germination: Autumn-olive seed germination is enhanced by a period of cold stratification. Fowler and Fowler [14] determined germination rates for unstratified seeds were significantly ($p<0.05$) lower than those receiving 8 or more weeks of cold stratification at 41 degrees Fahrenheit (5 °C). Optimal conditions for autumn-olive germination were 16-20 weeks of cold stratification followed by 2 weeks of night/day temperatures of 50/62 degrees Fahrenheit (10/20). These conditions resulted in >90% germination. However, cold stratification is not a prerequisite for germination. "

202	**Quality of climate match data**	**High**
	Source(s)	**Notes**
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 24 Mar 2021]	

203	**Broad climate suitability (environmental versatility)**	**y**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 24 Mar 2021]	"Autumn-olive occurs throughout the eastern United States, from Maine, west to Wisconsin, Iowa, Nebraska, Kansas, Arkansas, and Louisiana, and south into Florida [5,9,26,27,36,38,46,51,57,63,71,75,77,78]. It also occurs in southern and eastern Ontario [4] and Hawaii [73]. Kartesz and Meacham [29] recognize E. umbellata var. parvifolia, with the same distribution as autumn-olive. Northern distribution of invasive autumn-olive populations in North America may be limited by cold intolerance from USDA climate zone 5 north [55], although one cultivar has been described as "hardy" to zone 6 [25]. Autumn-olive is native to Asia and was introduced to North America around 1830 [5,19,51,57,65,71,77]."
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2007. Flora of China. Vol. 13 (Clusiaceae through Araliaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"Thickets; (100–)500–3000 m. Gansu, Hubei, Jiangsu, Liaoning, Shaanxi, Shandong, Shanxi, Sichuan, Xizang, Yunnan, Zhejiang [Afghanistan, Bhutan, India, Japan, Korea, Nepal; naturalized in North America]."
	Plants for a Future. (2021). Elaeagnus umbellata. https://pfaf.org/user/Plant.aspx?LatinName=Elaeagnus+umbellata. [Accessed 24 Mar 2021]	[5 hardiness zones] "USDA hardiness: 3-7"
	Zheng, H., Wu, Y., Ding, J., Binion, D., Fu, W., & Reardon, R. (2004). Invasive Plants of Asian Origin Established in the United States and Their Natural Enemies Volume 1. USDA Forest Service, Morgantown, WV	[Elevation range >1000 m] "E. umbellata commonly occurs in subtropical and temperate regions at elevations of 20 to 3,000 m. Habitat range includes forest edges, thickets, hillside wastelands, and stream banksl"

204	**Native or naturalized in regions with tropical or subtropical climates**	**y**
	Source(s)	**Notes**
	Zheng, H., Wu, Y., Ding, J., Binion, D., Fu, W., & Reardon, R. (2004). Invasive Plants of Asian Origin Established in the United States and Their Natural Enemies Volume 1. USDA Forest Service, Morgantown, WV	"E. umbellata commonly occurs in subtropical and temperate regions at elevations of 20 to 3,000 m."
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to Asia; in Hawai'i originally cultivated, now sparingly naturalized and spreading in mesic to wet, disturbed areas at Volcano village and Kilauea, Hawai'i Volcanoes National Park, Hawai'i."
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 24 Mar 2021]	"Native Asia-Temperate WESTERN ASIA: Afghanistan CHINA: China [Zhejiang Sheng, Hubei Sheng, Gansu Sheng, Jiangsu Sheng, Liaoning Sheng, Shanxi Sheng, Shandong Sheng, Shaanxi Sheng, Sichuan Sheng, Yunnan Sheng, Xizang Zizhiqu] EASTERN ASIA: Korea, Japan [Hokkaidô (w.), Honshu, Kyushu, Shikoku], Taiwan Asia-Tropical INDIAN SUBCONTINENT: Bhutan, India [Himachal Pradesh, Jammu and Kashmir, Manipur, Uttar Pradesh], Nepal, Pakistan"

205	**Does the species have a history of repeated introductions outside its natural range?**	**y**

Qsn #	Question	Answer
	Source(s)	**Notes**
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 24 Mar 2021]	"Autumn-olive occurs throughout the eastern United States, from Maine, west to Wisconsin, Iowa, Nebraska, Kansas, Arkansas, and Louisiana, and south into Florida [5,9,26,27,36,38,46,51,57,63,71,75,77,78]. It also occurs in southern and eastern Ontario [4] and Hawaii [73]. Kartesz and Meacham [29] recognize E. umbellata var. parvifolia, with the same distribution as autumn-olive."
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 24 Mar 2021]	"Naturalized Northern America REGION: Canada, United States Pacific NORTH-CENTRAL PACIFIC: United States [Hawaii]"

301	Naturalized beyond native range	y
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Native to Asia; in Hawai'i originally cultivated, now sparingly naturalized and spreading in mesic to wet, disturbed areas at Volcano village and Kilauea, Hawai'i Volcanoes National Park, Hawai'i. First collected in 1963 (Fosberg 44457, BISH)."
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2007. Flora of China. Vol. 13 (Clusiaceae through Araliaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	"naturalized in North America"
	USDA, Agricultural Research Service, National Plant Germplasm System. (2021). Germplasm Resources Information Network (GRIN-Taxonomy). National Germplasm Resources Laboratory, Beltsville, Maryland. https://npgsweb.ars-grin.gov/. [Accessed 24 Mar 2021]	"Naturalized Northern America REGION: Canada, United States Pacific NORTH-CENTRAL PACIFIC: United States [Hawaii]"

302	Garden/amenity/disturbance weed	y
	Source(s)	**Notes**
	CABI. (2021). Elaeagnus umbellata. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"Outside its native range, it can be found naturalized in disturbed sites, thickets, along roads and also planted in gardens and parks (Christenhusz, 2009; USDA-NRCS, 2016). In North America, typical habitats include disturbed areas, roadsides, pastures and fields and it invades grasslands and sparse woodlands, pine plantations, ravines, grazed upland oak forest, and the edge of hill prairies in Illinois and central USA (Ebinger and Lehnen, 1981; Owens and Cole, 2003). In New England, USA, it is found on abandoned fields, abandoned gravel pits, early successional forest, pasture, planted forest, railways, roadsides, paths, urban areas, and is probably most prolific on disturbed or ruderal sites (Munger, 2003)."

303	Agricultural/forestry/horticultural weed	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 24 Mar 2021]	[Invades forest plantations] "Prodigious seed production and widespread seed dispersal by frugivorous birds probably contribute to its invasiveness [55]. An Illinois study reported autumn-olive concentrations of 5,225 stems per hectare in a pine plantation, 27,500 stems per hectare in a grazed upland woods, and 33,975 stems per hectare in hardwood-dominated ravines [10]. Autumn-olive densities of 125,000 plants hectare were recorded in the understory of a yellow-poplar sweetgum plantation in southwestern Indiana in 2000. This population was established from nearby plantings in the early 1970's. Although 90% of these individuals were 2 feet (0.6 m) or less in height, they formed "a nearly impenetrable thicket" and were "commonly the only understory species present" [11]."

304	Environmental weed	y
	Source(s)	**Notes**
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"The shrub has become invasive in the central and eastern USA and is considered as a troublesome alien shrub with the capacity to change ecosystems (Sather and Eckardt, 1987). Spread begins mostly from plantings. Once established in natural habitats, autumn olive competes with and replaces native species, and as a result of its nitrogen-fixing, soil nitrogen levels increase in infertile soils. Sensitive plant species depending on low fertility soils may be threatened by the invasion of autumn olive. The shrub forms extensive thorny thickets that likely affect wildlife. Spread into prairies is of particular concern as the shrub shades out native species."

305	Congeneric weed	y
	Source(s)	**Notes**
	Zouhar, K. (2005). Elaeagnus angustifolia. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). http://www.fs.fed.us/database/feis/. [Accessed]	[Able to colonize & exploit disturbed sites] "In some cases Russian olive invades areas where disturbance results in microsites with favorable conditions, such as road and railroad ditches, and irrigated and/or heavily grazed pastures (e.g. [47,148]). Along the Milk River in Montana and Alberta, the highest densities of Russian-olive were along the reach that had more livestock grazing and beaver harvesting, as both beaver and livestock prefer cottonwood over Russian-olive [140]. Similar observations were made by Lesica and Miles along other Montana rivers [112,113]. Russian-olive is also invasive on sites at later successional stages, due to its shade tolerance and ability to establish in intact ground cover [95,156]."
	CAB International. (2005). Forestry Compendium. CAB International, Wallingford, UK	[Elaeagnus angustifolia] "E. angustifolia has a tendency to spread to areas where it is not desired, necessitating careful monitoring of sites planted with this species as once established, it is difficult to control and nearly impossible to eradicate. It can interfere with agricultural practices, displace native riparian vegetation and choke irrigation ditches (Olson and Knopf, 1986a). For this reason, it has been declared a noxious weed in Utah, USA, and has had to be controlled in Illinois, Colorado, Nebraska and South Dakota (Tesky, 1992)."

Qsn #	Question	Answer
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	[Elaeagnus angustifolia] "Russian olive has become a major invader of floodplain forests in western North America with detrimental impacts on the communities."

401	Produces spines, thorns or burrs	y
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Deciduous shrubs 2-4 m tall; branches slender, spreading, more or less spiny, the young branches densely scaly."

402	Allelopathic	
	Source(s)	**Notes**
	Orr, S. P., Rudgers, J. A., & Clay, K. (2005). Invasive plants can inhibit native tree seedlings: testing potential allelopathic mechanisms. Plant Ecology, 181(2), 153-165	[Possibly Yes] "Overall, results suggest that allelopathy may be one mechanism underlying the negative impacts of tall fescue and autumn olive on other plant species, but that effects can depend strongly upon the source of allelochemicals and the tree species examined."

403	Parasitic	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Deciduous shrubs 2-4 m tall; branches slender, spreading, more or less spiny, the young branches densely scaly." [No evidence]

404	Unpalatable to grazing animals	n
	Source(s)	**Notes**
	Knapp, L. B., Fownes, J. H., & Harrington, R. A. (2008). Variable effects of large mammal herbivory on three non-native versus three native woody plants. Forest Ecology and Management, 255(1), 92-98	"In open environments, twig clipping was common in C. amomum (>50% of individuals affected) but rare in E. umbellata (<10% of individuals affected). Rates of twig clipping in the understory were similar for both species (approximately 30% of individuals affected)." [Palatability lower relative to native species. Although it can be browsed by white-tailed deer, preference for native species can facilitate invasion of E. umbellata]

405	Toxic to animals	n
	Source(s)	**Notes**
	Knapp, L. B., Fownes, J. H., & Harrington, R. A. (2008). Variable effects of large mammal herbivory on three non-native versus three native woody plants. Forest Ecology and Management, 255(1), 92-98	"In open environments, twig clipping was common in C. amomum (>50% of individuals affected) but rare in E. umbellata (<10% of individuals affected). Rates of twig clipping in the understory were similar for both species (approximately 30% of individuals affected)." [Palatability lower relative to native species, but no evidence of toxicity]

Qsn #	Question	Answer
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 25 Mar 2021]	[No evidence] "Autumn-olive has been promoted as a beneficial wildlife species and planted in wildlife management areas in the eastern U.S. to provide food and cover [8,9,10,14,20,23]. Fruit remains on the plant until late winter (see Seasonal Development), potentially becoming an important wildlife food during periods of seasonal food scarcity [14]. Fruits are consumed by a variety of wildlife, including songbirds, northern bobwhite, ruffed grouse, mourning doves, ring necked pheasants, wild turkeys, mallards, raccoons, skunks, opossums, and black bears [1,23,57]. Songbirds that eat autumn-olive fruit include: gray catbirds, hermit thrushes, wood thrushes, house finches, American robins, cardinals, cedar waxwings, common grackles, evening grosbeaks, fox sparrows, house sparrows, song sparrows, white-throated sparrows, mockingbirds, myrtle warblers, purple finches, rufous-sided towhees, starlings, tree swallows, and veerys [1,40,58]. Autumn-olive is also browsed by white-tailed deer [65]."
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence

406	Host for recognized pests and pathogens	y
	Source(s)	**Notes**
	Arthur, J. C., & Cummins, G. B. (1933). Rusts of the northwest Himalayas. Mycologia, 25(5), 397-406	E. umbellata is a host of Puccinia coronata, which is a servere pathogen attacking about 700 species of grass including crop species.

407	Causes allergies or is otherwise toxic to humans	n
	Source(s)	**Notes**
	Reich, L. (2009). Landscaping With Fruit. Storey Publishing, North Adams, MA	[Edible uses. No evidence] "For cooking, timing for harvest is not critical. For fresh eating, you want to catch the fruits when their sweetness has peaked, their astringency has plummeted, and all this before they drop. Usually, autumn olives present about a two-week window of opportunity for good fresh eating. Although some varieties rarely get sweet enough for me to eat, I know some children who always relish them. During those final stages of ripening, the pulp (but not the seed) also almost doubles in bulk. The single soft seed within each fruit is hardly noticed and can be eaten along with the fruit. Autumn olives can, no doubt, be cooked into a number of delectable jams, jellies, and tarts."
	Quattrocchi, U. (2012). CRC World Dictionary of Medicinal and Poisonous Plants: Common Names, Scientific Names, Eponyms, Synonyms, and Etymology. CRC Press, Boca Raton, FL	No evidence
	Wagstaff, D.J. (2008). International poisonous plants checklist: an evidence-based reference. CRC Press, Boca Raton, FL	No evidence, although Elaeagnus angustifolia pollen may cause allergies in susceptible individuals

408	Creates a fire hazard in natural ecosystems	n

Qsn #	Question	Answer
	Source(s)	**Notes**
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 25 Mar 2021]	"Fire regimes: The following table lists fire return intervals for communities or ecosystems throughout North America where autumn-olive may occur." [Table of Fire Return Interval Range (years)] suggests that other vegetation may increase fire frequency or risk, and that Elaeagnus umbellata is unlikely to contribute to risk in areas where it is invasive]
	Evans, C.W., D.J. Moorhead, C.T. Bargeron, and G.K. Douce (2006). Invasive Plant Responses to Silvicultural Practices in the South. The University of Georgia Bugwood Network, Tifton GA	"Response to Prescribed Fire Not a control option Not a significant fire hazard Sprouts quickly after fire Colonizes quickly after fire"

409	Is a shade tolerant plant at some stage of its life cycle	
	Source(s)	**Notes**
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 25 Mar 2021]	"Autumn-olive appears best adapted to early-successional habitats in North America. It has been called "moderately" shade tolerant [1], but is thought to be generally absent from areas with very low light intensity, such as under a dense forest canopy [40]. Edgin and Ebinger [11] noted autumn-olive plants were restricted to "open canopy areas" within the interior of an "old-growth" forest along the Wabash River in southwestern Indiana. Based on this observation, they suggested autumn-olive is "not well adapted to low-light conditions."
	Evans, C.W., D.J. Moorhead, C.T. Bargeron, and G.K. Douce (2006). Invasive Plant Responses to Silvicultural Practices in the South. The University of Georgia Bugwood Network, Tifton GA	"Somewhat shade tolerant"
	Knapp, L. B., Fownes, J. H., & Harrington, R. A. (2008). Variable effects of large mammal herbivory on three non-native versus three native woody plants. Forest Ecology and Management, 255(1), 92-98	"The native shrub Cornus amomum (silky dogwood) and the invasive shrub Elaeagnus umbellata (autumn olive) are both classified as shade-intolerant and are found primarily at forest edges"
	WRA Specialist. (2021). Personal Communication	Tolerates some shade, but dense shade may limit ability to spread in Hawaiian Islands

410	Tolerates a wide range of soil conditions (or limestone conditions if not a volcanic island)	y
	Source(s)	**Notes**
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 25 Mar 2021]	"Autumn-olive grows best on deep, relatively coarse-textured soils that are moderately-well to well drained [1,65]. It does less well on very dry soil and usually fails on very shallow, poorly drained, or excessively wet soil. Autumn-olive does not require highly fertile soil, and it appears to thrive equally well on soils ranging from "moderately acid to moderately alkaline" [1]. In Ontario, escaped autumn-olive is found in a variety of dry to mesic sandy, forested and open to sparsely shaded habitats, with soil pH from 5-7. It is most invasive in areas of dry sandy soils. Although it has been cultivated on fine-textured, periodically wet soils, it is generally not invasive on such sites in southern Ontario [4]."

Qsn #	Question	Answer
	CABI. (2021). Elaeagnus umbellata. In: Invasive Species Compendium. Wallingford, UK: CAB International. www.cabi.org/isc	"It grows well on a variety of soils including sandy, loamy, and somewhat clayey soils that are moderate acid or alkaline (pH 4.8-6.5), though prefers deep, relatively coarse-textured soils that are moderately to well-drained. It exhibits some drought tolerance, though does not grow well on very wet or dry sites, nor shallow or poorly drained soils. It does do very well on infertile soils because of its nitrogen-fixing ability."

411	Climbing or smothering growth habit	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Deciduous shrubs 2-4 m tall; branches slender, spreading, ± spiny, the young branches densely scaly."

412	Forms dense thickets	y
	Source(s)	**Notes**
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 24 Mar 2021]	"Impacts: In general, invasive autumn-olive impacts native biotic communities in eastern North America by displacing native plants. Invasive populations can supplant native habitat, sometimes forming dense thickets."
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"The shrub forms extensive thorny thickets that likely affect wildlife. Spread into prairies is of particular concern as the shrub shades out native species."

501	Aquatic	n
	Source(s)	**Notes**
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2007. Flora of China. Vol. 13 (Clusiaceae through Araliaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[Terrestrial] "Thickets;(100–)500–3000 m."

502	Grass	n
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	Elaeagnaceae

503	Nitrogen fixing woody plant	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Del Tredici, P. (1995). A nitrogen fixation: the story of the Frankia symbiosis. Arnoldia, 55, 26-31	"All of these plants thrive in poor soils where little else grows. Their ability to fix nitrogen is a significant factor in their survival under conditions that would be inhospitable to ordinary plants." [The importance, distribution, and use of non-leguminous nitrogen-fixing trees and shrubs, with their symbiosis with Frankia , is described. Species covered include Alnus , Myrica pensylvanica , M. cerifera , Comptonia peregrina , Ceanothus americanus , Shepherdia canadenis , Purshia tridentata , Cercocarpus , Casuarina , Elaeagnus umbellata and E. angustifolia .]
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 24 Mar 2021]	"Autumn-olive forms root nodules induced by symbiosis with actinomycetes in the soil. This symbiosis permits the fixation and subsequent utilization of atmospheric nitrogen"

504	**Geophyte (herbaceous with underground storage organs -- bulbs, corms, or tubers)**	**n**
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai'i Press and Bishop Museum Press, Honolulu, HI.	"Deciduous shrubs 2-4 m tall; branches slender, spreading, more or less spiny, the young branches densely scaly."

601	**Evidence of substantial reproductive failure in native habitat**	**n**
	Source(s)	**Notes**
	Wu, Z.Y., Raven, P.H. & Hong, D.Y. (eds.). 2007. Flora of China. Vol. 13 (Clusiaceae through Araliaceae). Science Press, Beijing, and Missouri Botanical Garden Press, St. Louis	[No evidence. Widely distributed] "Thickets; (100–)500–3000 m. Gansu, Hubei, Jiangsu, Liaoning, Shaanxi, Shandong, Shanxi, Sichuan, Xizang, Yunnan, Zhejiang [Afghanistan, Bhutan, India, Japan, Korea, Nepal; naturalized in North America]"

602	**Produces viable seed**	**y**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 25 Mar 2021]	"Seed production: Mature plants can produce about 30 pounds (14 kg) of fruit annually. Thirty pounds of fruit is generally equivalent to about 3 pounds (1.4 kg) of seed, or about 66,000 seeds [65]. Under favorable conditions, autumn-olive can produce fruit by 3 to 5 years of age, usually at about 4 to 8 feet (1.2-2.4 m) in height. Fruit production is reduced by shading [1]." … " Germination: Autumn-olive seed germination is enhanced by a period of cold stratification. Fowler and Fowler [14] determined germination rates for unstratified seeds were significantly ($p<0.05$) lower than those receiving 8 or more weeks of cold stratification at 41 degrees Fahrenheit (5 °C). Optimal conditions for autumn-olive germination were 16-20 weeks of cold stratification followed by 2 weeks of night/day temperatures of 50/62 degrees Fahrenheit (10/20). These conditions resulted in >90% germination. However, cold stratification is not a prerequisite for germination. Fowler and Fowler [14] found 51% of unstratified seeds germinated after 10 weeks of night/day temperatures of 50/62 degrees Fahrenheit (10/20 °C). Jinks and Ciccarese [28] found that >70% of seeds from their "control" group germinated after 8 weeks despite receiving no cold temperature treatment"

603	Hybridizes naturally	
	Source(s)	**Notes**
	WRA Specialist. (2021). Personal Communication	Unknown. No evidence found

604	Self-compatible or apomictic	n
	Source(s)	**Notes**
	Soley, N. M., & Sipes, S. D. (2020). Reproductive biology and pollinators of the invasive shrub Autumn olive (Elaeagnus umbellata Thunberg). Plant Species Biology //doi.org/10.1111/1442-1984.12307	[Mostly outcrossing species with a self-incompatible breeding system] "This study examined the reproductive biology of the invasive nitrogen-fixing shrub Elaeagnus umbellata. Hand-pollination experiments and pollinator-exclusion experiments were performed in four Illinois, U.S.A. populations to determine the breeding system of E. umbellata, and floral visitors were collected to determine pollinators in the invasive range. Although self-compatibility is a trait shown to confer invasiveness, our experiments revealed that E. umbellata is a mostly outcrossing species with a self-incompatible breeding system. Variation does exist in that a small percentage of individuals allow self-fertilization through autogamy. "

605	Requires specialist pollinators	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Soley, N. M., & Sipes, S. D. (2020). Reproductive biology and pollinators of the invasive shrub Autumn olive (Elaeagnus umbellata Thunberg). Plant Species Biology //doi.org/10.1111/1442-1984.12307	"The majority of floral visitors to E. umbellata were generalist pollinators, including bees, flies, and moths. Many of the larger insect visitors are pollinators of E. umbellata based on analysis of pollen on insect specimens, but smaller insects do not pollinate as frequently. Its ability to attract generalist pollinators means that E. umbellata will produce fruit wherever pollinators and mates occur; however, the low fruit set on open-pollinated branches contrasts with the idea of a prolifically fruiting plant. E. umbellata seems to serve as a reliable food source for many ecologically and economically significant insects, including native bumble bees (Bombus), the exotic honey bee (Apis mellifera), and armyworm (Mythimna unipuncta), a crop pest."

606	Reproduction by vegetative fragmentation	n
	Source(s)	**Notes**
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 24 Mar 2021]	"Asexual regeneration: Solecki [53] and Szafoni [59] indicated burned, mowed, and cut plants "resprout vigorously." The Invasive Plant Atlas of New England website [37] reports that if autumn olive is cut, "it resprouts abundantly," and burning only results in resprouting "from the stump."
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"Seeds are abundantly produced and dispersed by frugivorous birds and mammals (Kohri et al., 2011)."

607	Minimum generative time (years)	3
	Source(s)	**Notes**
	Evans, C.W., D.J. Moorhead, C.T. Bargeron, and G.K. Douce (2006). Invasive Plant Responses to Silvicultural Practices in the South. The University of Georgia Bugwood Network, Tifton GA	"Matures in 3-5 years on good sites"
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 24 Mar 2021]	"Under favorable conditions, autumn-olive can produce fruit by 3 to 5 years of age, usually at about 4 to 8 feet (1.2-2.4 m) in height. "

Qsn #	Question	Answer
701	**Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)**	**n**
	Source(s)	**Notes**
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 25 Mar 2021]	[Bird and mammal dispersed] Occurs in heavily-trafficked areas, but lack means of attachment] "Autumn-olive fruits are single-seeded drupes, 0.2 to 0.4 inches (4-10 mm) in diameter, produced on pedicels " … "Seed dispersal: Seeds are dispersed by frugivorous birds and, to a lesser extent, small mammals [11,37,40]." … " autumn-olive may be found in New England: abandoned field, abandoned gravel pit, early-successional forest, edge, pasture, planted forest, railroad right-of-way, roadside, utility right-of-way, vacant lot, yard, or garden. It is probably most prolific on disturbed or ruderal sites"

702	**Propagules dispersed intentionally by people**	**y**
	Source(s)	**Notes**
	Zheng, H., Wu, Y., Ding, J., Binion, D., Fu, W., & Reardon, R. (2004). Invasive Plants of Asian Origin Established in the United States and Their Natural Enemies Volume 1. USDA Forest Service, Morgantown, WV	"Elaeagnus umbellata is planted as an ornamental. The edible fruits are used to make wine and jam. The leaves can be used to control the cotton aphid, an insect pest. Along with fruits and leaves, roots also have medical uses"
	Reich, L. (2009). Landscaping With Fruit. Storey Publishing, North Adams, MA	[Cultivated intentionally] "The silver-flecked, pea-sized red fruits each have a single seed surrounded by soft flesh that is sweet-tart and very pleasant to eat when thoroughly ripe right off the bush. Some varieties bear yellow fruits."

703	**Propagules likely to disperse as a produce contaminant**	**n**
	Source(s)	**Notes**
	Randall, R.P. (2017). A Global Compendium of Weeds. 3rd Edition. Perth, Western Australia. R.P. Randall	"Dispersed by: Humans, Escapee"
	Weber, E. (2017). Invasive Plant Species of the World, 2nd Edition: A Reference Guide to Environmental Weeds. CABI Publishing, Wallingford, UK	"Seeds are abundantly produced and dispersed by frugivorous birds and mammals (Kohri et al., 2011)." [No evidence of dispersal as a produce contaminant]

704	**Propagules adapted to wind dispersal**	**y**
	Source(s)	**Notes**
	Kohri, M., Kamada, M., & Nakagoshi, N. (2011). Spatial–temporal distribution of ornithochorous seeds from an Elaeagnus umbellata community dominating a riparian habitat. Plant Species Biology, 26(2), 174-185	"Its fruits, which ripen in autumn, are mainly dispersed by birds (Fukui 1995, 1996) and mammals (Koike & Masaki 2008)."

705	**Propagules water dispersed**	**y**
	Source(s)	**Notes**

Qsn #	Question	Answer
	Kohri, M., Kamada, M., & Nakagoshi, N. (2011). Spatial–temporal distribution of ornithochorous seeds from an Elaeagnus umbellata community dominating a riparian habitat. Plant Species Biology, 26(2), 174-185	[Secondarily dispersed by water along riparian corridors] "Elaeagnus umbellata is highly heliophytic and does not appear as a result of succession, but rather tends to establish linear-form colonies on bare gravel bars after experiencing late autumnal floods. It does not form a permanent seed bank (Nakagoshi 1985), a gap detection habit is not present, and all seeds germinate only in spring (Kohri et al. 2002). This indicates that hydrochory (sensu Johansson et al. 1996) acts as a secondary seed dispersal mechanism (Kohri et al. 2000, 2002; Kohri 2008) to a wider area, and this natural disturbance appears to be effective in creating new safe sites for seed germination (e.g. Bill et al. 1997; Kudoh & Whigham 1997). Therefore, the hydrogeomorphic properties of the river and plant life-history traits, particularly on seed dispersal appear to be important in structuring this type of community. Previous studies have shown that the establishment years for the present population of E. umbellata correspond to the occurrence of floods with a daily average discharge exceeding 1000 m3/sec over the period from 1 October to 31 December in every year between 1979 and 1995 in the Yoshino River (Kohri 2008)."

706	Propagules bird dispersed	y
	Source(s)	**Notes**
	Kohri, M., Kamada, M., & Nakagoshi, N. (2011). Spatial–temporal distribution of ornithochorous seeds from an Elaeagnus umbellata community dominating a riparian habitat. Plant Species Biology, 26(2), 174-185	"The dispersal efficiency and potential distribution of ornithochorous seeds of Elaeagnus umbellata in a riparian habitat were evaluated to clarify this species' establishment site in relation to the disturbance regime of the floodplain. Fruit removal by avian frugivores was monitored using fruit bags, and the spatial distribution of excreted seeds was quantified by seed traps set randomly on a gravel bar as an isolated seed source in the Yoshino River throughout an autumn fruiting season. Although more than 45% of the fruits remained on the twigs in the fruit bags, almost all fruits on the control twigs without fruit bags were exploited by the beginning of January. The fruit removal rate and seed dispersal distance were positively correlated with an increase in wintering bird species and their abundance. Intact bird-dispersed seeds of E. umbellata were trapped within a 400-m range and damaged seeds were limited to traps set within 50 m from the seed source. Frugivore behavior, such as feces excretion on rocks near water drinking sites and perching on surrounding woodland, greatly influenced the spatial and temporal dispersal pattern of the seed rain. In the present study, the avian frugivores showed upstream seed dispersal; thus, in years with stochastic autumnal floods, secondary dispersal via hydrochory downstream may be facilitated. The intensive seed dispersal in E. umbellata indicates that the present distribution of parent trees in the restricted elevation range of the gravel bars is the result of survival through disturbance, rather than seed dispersal limitation."

707	Propagules dispersed by other animals (externally)	n
	Source(s)	**Notes**

Qsn #	Question	Answer
	Kohri, M., Kamada, M., & Nakagoshi, N. (2011). Spatial–temporal distribution of ornithochorous seeds from an Elaeagnus umbellata community dominating a riparian habitat. Plant Species Biology, 26(2), 174-185	"The size of the fruits is less than the maximum gape width (sensu Levey 1987) of major frugivores in Japan, such as the brown-eared bulbul, H. amaurotis (Fukui 1995); therefore, the fruits are swallowed whole."

708	Propagules survive passage through the gut	y
	Source(s)	**Notes**
	Williams, S. C., & Ward, J. S. (2006). Exotic seed dispersal by white-tailed deer in southern Connecticut. Natural Areas Journal, 26(4), 383-390	"Autumn olive was the only other fruiting species in the top 10, as it had five seedlings in five different pellet groups. Deer have been known to browse autumn olive foliage (I.M. Ortega, foraging ecologist, University of Connecticut, pers. comm.) and may either accidentally ingest or directly target the fruits."
	Kohri, M., Kamada, M., & Nakagoshi, N. (2011). Spatial–temporal distribution of ornithochorous seeds from an Elaeagnus umbellata community dominating a riparian habitat. Plant Species Biology, 26(2), 174-185	"From observations of marked feces on the boulder stones at the gravel bar at the study site, all seeds derived from bird feces, tracked by marking on the boulder stones at the locations shown in Figure 3 (black triangles), in late autumn 1999 had successfully germinated in April 2000, but all those seedlings had washed away by the end of October 2000."

801	Prolific seed production (>1000/m2)	y
	Source(s)	**Notes**
	Kohri, M., Kamada, M., & Nakagoshi, N. (2011). Spatial–temporal distribution of ornithochorous seeds from an Elaeagnus umbellata community dominating a riparian habitat. Plant Species Biology, 26(2), 174-185	"Elaeagnus umbellata grows to 7 m tall and is distributed in open sites. After fragrant clusters of bell-shaped corolla flowers bloom in late April to early May, the fruits (pseudocarps) start to ripen and turn orange to red in late September to October, and become juicy. One stem (5 cm in diameter) bears approximately 5000 fruits, and for a 3-m tall individual as a whole, approximately 10 000 fruits are produced per year (Kohri et al. 2002)."
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 25 Mar 2021]	"Seed production: Mature plants can produce about 30 pounds (14 kg) of fruit annually. Thirty pounds of fruit is generally equivalent to about 3 pounds (1.4 kg) of seed, or about 66,000 seeds [65]. Under favorable conditions, autumn-olive can produce fruit by 3 to 5 years of age, usually at about 4 to 8 feet (1.2-2.4 m) in height. Fruit production is reduced by shading [1]."

802	Evidence that a persistent propagule bank is formed (>1 yr)	
	Source(s)	**Notes**
	Kohri, M., Kamada, M., & Nakagoshi, N. (2011). Spatial–temporal distribution of ornithochorous seeds from an Elaeagnus umbellata community dominating a riparian habitat. Plant Species Biology, 26(2), 174-185	"It does not form a permanent seed bank (Nakagoshi 1985), a gap detection habit is not present, and all seeds germinate only in spring (Kohri et al. 2002)."

Qsn #	Question	Answer
	Beauchamp, V. (2013). Edges, exotics and deer: The seed bank of a suburban secondary successional temperate deciduous forest. Applied Vegetation Science, 16(4), 571-584	[Does not appear in seed bank despite being common in region] "Little information exists on Elaeagnus umbellata seed banks (Munger 2003) but seeds of the congener E. angustifolia can remain viable for up to 3 yr in the laboratory (Katz & Shafroth 2003). Elaeagnus umbellata is common at the MPEA but never appeared in the seed bank." … "exotic species management is a major focus of the MPEA, and one encouraging result is that many of the most problematic exotic species, including B. thunbergii, R. multiflora, C. orbiculatus, L. japonica and E. umbellata, had small or nonexistent seed banks. This suggests that volunteer efforts to control these species via removal may be successful."

803	Well controlled by herbicides	y
	Source(s)	**Notes**

Qsn #	Question	Answer
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 25 Mar 2021]	"Chemical: Several herbicides have been used alone or in combination to provide effective control of autumn-olive, including glyphosate, triclopyr, 2,4-D, and dicamba. This is not intended as an exhaustive review of chemical control methods. For more information regarding appropriate use of herbicides against invasive plant species in natural areas, see The Nature Conservancy's Weed control methods handbook. For more information specific to herbicide use against autumn-olive, see The Nature Conservancy's Element Stewardship abstract of autumn olive and the Connecticut Invasive Plant Working Group (CIPWG) and Illinois Nature Preserves Commission websites. Dicamba and 2,4-D have been used as a foliar application to effectively control autumn-olive [35,53,59]. Triclopyr has also been used effectively on resprouts following cutting [53]. Because this method is conducted during the growing season, and because 100% coverage of foliage is recommended for most effective control, Szafoni [59] suggests that foliar application is best suited to shorter plants. For larger plants, basal-bark application of triclopyr or 2,4-D can control invasive autumn-olive [11,35,53]. Basal-bark treatment is the application of herbicide solution directly to the bark the lower portion of woody plants. Herbicide then penetrates the bark and is absorbed by the plant [53]. Rather than a broad band application, a thin line of herbicide applied around the entire circumference of the stem 6-12 inches (15-30 cm) above the ground is sufficient, and less likely to harm nearby, desirable plants [53,59]. Direct application of glyphosate to cut stumps can also be effective, particularly late in the growing season (July-September) [53,59]. According to Szafoni [59], reduced application rates of 10-20% solution (compared with 50-100% recommended on some glyphosate product labels) are sufficient for effective treatment of cut stems. Careful application of herbicide directly to target plants can reduce damage to nearby, desirable vegetation [59]. Multiple herbicide treatments may be required to completely kill all plants. Edgin and Ebinger [11] describe treating an invasive population of autumn-olive in Illinois with basal-bark applications of triclopyr during springs of 1996 and 1997. A subsequent search in early summer 1997 yielded no evidence of live autumn-olive in treated areas. But by 2000, autumn-olive had re-established within these same treated areas. Because a dense population of well-established autumn-olive remained in an area adjacent to treatment plots, many of the newly established plants were assumed to have originated from the seed bank or from seeds transported into the plots by birds after herbicide treatments. But nearly 11% of the larger stems (2.6 to 4.9 feet (80 150 cm) tall) had an "enlarged basal caudex" and were considered to be resprouts that were only top-killed by the herbicide treatment."

804	Tolerates, or benefits from, mutilation, cultivation, or fire	y
	Source(s)	**Notes**
	Munger, G. T. (2003). Elaeagnus umbellata. In: Fire Effects Information System, [Online]. USDA, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory. https://www.fs.fed.us/database/feis/plants/shrub/elaumb/all.html. [Accessed 24 Mar 2021]	"Asexual regeneration: Solecki [53] and Szafoni [59] indicated burned, mowed, and cut plants "resprout vigorously." The Invasive Plant Atlas of New England website [37] reports that if autumn olive is cut, "it resprouts abundantly," and burning only results in resprouting "from the stump."

Qsn #	Question	Answer
	Evans, C.W., D.J. Moorhead, C.T. Bargeron, and G.K. Douce (2006). Invasive Plant Responses to Silvicultural Practices in the South. The University of Georgia Bugwood Network, Tifton GA	"Autumn olive re-sprouts vigorously, making any control work difficult and allowing it to re-grow rapidly after disturbance."
	Stark, C. (2000). Control of Elaeagnus umbellata–(Autumn Olive). Restoration and Reclamation Review 6(3): 1-6	"There are several major problems in controlling autumn olive. First, when considering control in these areas, one should not only look at the specific area, but also areas adjacent that have large seed producing populations of autumn olive, because the removal of plants on site will only be a temporary solution if seed inputs continue (Darlington 1994). Plants will continue to be seeded in from adjacent areas, causing a reoccurring control issue. Secondly, mowing, cutting, girdling, or fire does not kill or even slow down autumn olive, but seems to encourage thicker stronger growth (Kuhns 1986)." … "Fire may be partially successful in killing seedlings in natural communities where fire is already part of the management of that community, but fire should not be used if not already occurring as a management practice. Fire may only kill a small percentage of seedlings and will not kill established autumn olive plants."

805	**Effective natural enemies present locally (e.g. introduced biocontrol agents)**	
	Source(s)	**Notes**
	Wagner, W.L., Herbst, D.R.& Sohmer, S.H. (1999). Manual of the flowering plants of Hawaii. Revised edition. University of Hawai‘i Press and Bishop Museum Press, Honolulu, HI.	[Unknown] "in Hawai'i originally cultivated, now sparingly naturalized and spreading in mesic to wet, disturbed areas at Volcano village and Kilauea, Hawai'i Volcanoes National Park, Hawai'i."

Summary of Risk Traits:

High Risk / Undesirable Traits
• Able to spread in regions with temperate to tropical climates
• Naturalized on Hawaii Island, and elsewhere in North America, Europe and Australia
• A disturbance adapted weedy shrub to small tree that impacts agriculture and the natural environment
• Related species are invasive
• Spiny branches
• Host of Puccinia coronata, a pathogen of important crop species
• Tolerates many soil types
• Forms dense, impenetrable thickets
• Nitrogen fixing, may modify soil chemistry and fertility
• Reproduces through prolific seed production
• Reaches maturity in 2-3 years
• Seeds dispersed by birds, other frugivorous animals, water, and intentionally cultivated
• Resprouts after fires of low to moderate severity

Low Risk Traits
• Non-toxic
• Thrives in full sun (dense shade may limit fruit production)
• Largely self-incompatible
• Not reported to spread vegetatively
• Herbicides may provide effective control