# Plant Assessment Form

**For use with the "Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands" by the California Exotic Pest Plant Council and the Southwest Vegetation Management Association (Warner et al. 2003)**

Printable version, February 28, 2003
(Modified for use in Arizona, 07/02/04)

## Table 1. Species and Evaluator Information

| | |
|---|---|
| **Species name** (Latin binomial)**:** | *Elaeagnus angustifolia* L. (USDA 2005) |
| **Synonyms:** | None identified in USDA (2005). |
| **Common names:** | Russian olive, narrow-leaved oleaster, oleaster, silverberry |
| **Evaluation date** (mm/dd/yy)**:** | 05/6/2003 |
| **Evaluator #1 Name/Title:** | Patty Guertin / Research Specialist (botany) |
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| | |
|---|---|
| **List committee members:** | D. Backer, J. Brock, K. Brown, D. Casper, P. Guertin, M. Quinn, J. Ward, P. Warren |
| **Committee review date:** | 11/21/03 |
| **List date:** | 11/21/03 |
| **Re-evaluation date(s):** | |

**Table 2. Scores, Designations, and Documentation Levels**

| Question | | Score | Documentation Level | Section Scores | Overall Score & Designations |
|---|---|---|---|---|---|
| **1.1** | Impact on abiotic ecosystem processes | **A** | Reviewed scientific publication | **"Impact"**<br>**Section 1 Score:**<br>**A** | **"Plant Score"**<br>**Overall Score:**<br>**High**<br>**Alert Status:**<br>**None** |
| **1.2** | Impact on plant community | **A** | Reviewed scientific publication | | |
| **1.3** | Impact on higher trophic levels | **B** | Reviewed scientific publication | | |
| **1.4** | Impact on genetic integrity | **D** | Observational | | |
| | | | | | |
| **2.1** | Role of anthropogenic and natural disturbance | **A** | Reviewed scientific publication | **"Invasiveness"**<br>*For questions at left, an A gets 3 points, a B gets 2, a C gets 1, and a D or U gets=0. Sum total of all points for Q2.1-2.7:*<br>**17 pts**<br>**Section 2 Score:**<br>**A** | |
| **2.2** | Local rate of spread with no management | **A** | Observational | | |
| **2.3** | Recent trend in total area infested within state | **B** | Observational | | |
| **2.4** | Innate reproductive potential | **B** | Reviewed scientific publication | | |
| **2.5** | Potential for human-caused dispersal | **A** | Other published material | | |
| **2.6** | Potential for natural long-distance dispersal | **A** | Reviewed scientific publication | | |
| **2.7** | Other regions invaded | **C** | Observational | | RED FLAG<br>**NO**<br>Something you should know. |
| | | | | | |
| **3.1** | Ecological amplitude | **A** | Other published material | **"Distribution"**<br>**Section 3 Score:**<br>**B** | |
| **3.2** | Distribution | **C** | Observational | | |

## Table 3. Documentation

| **Question 1.1** Impact on abiotic ecosystem processes *Score:* **A** *Doc'n Level:* **Rev. sci. pub.** |
|---|
| **Identify ecosystem processes impacted:** *Elaeagnus angustifolia* can form extensive monotypic stands along riparian corridors which can alter system hydrology, nutrient cycling of a site, and fuel loads (which increase the potential for catastrophic wildfire) (Howe and Knopf 1991, Paschke 1997, Caplan 2002, Tu 2003). |
| **Rationale:** Research and subsequent publications are focused on areas outside of Arizona.<br>Tu (2003) notes that when *E. angustifolia* spreads throughout riparian woodlands it can connect lowland riparian forests with more open, upland areas; *E. angustifolia* contributes to stabilization of riverbanks against future flooding, changing the system hydrology (Howe and Knopf 1991, Tu 2003).<br>It is suggested that *E. angustifolia* has a higher evapotranspiration rate than the native trees it grows and competes with (Tu 2003). In a New Mexico study, annual evapotranspiration rates were measured to be at their highest on riparian sites having a dense stand of *Tamarix ramosissima*, and sites having a *Populus deltoides* spp. *wislizenia* with an extensive understory of *Tamarix* and *E. angustifolia*, versus a mature *Populus* closed-canopy stand. Although a less dense *Tamarix* stand had a lower annual evapotranspiration rate still (Dahm et al. 2002). Measurements were not taken for individual trees.<br><br>Paschke (1997) notes that species of the genus *Elaeagnus*, actinorhizal plants capable of forming symbiotic relationships with N2-fixing soil actinomycetes, genus *Frankia*, have the potential to add large amounts of fixed nitrogen and carbon to soils, ultimately changing the nutrient content and availability on a site. Simons and Seastedt (1999) report on research comparing litter decomposition and subsequent nitrogen release from *Populus deltoides* versus *E. angustifolia*. *Elaeagnus angustifolia* released more nitrogen per gram of tissue during the 1st year of decay than the *Populus* litter. They note that replacement of the *Populus* on a site with *E. angustifolia* would potentially increase the rate of nitrogen transferred from the litter to the soil. They hypothesize that *E. angustifolia*, by contributing much greater amounts of nitrogen to the soil, may also facilitate invasion by other exotic plant species. |
| **Sources of information:** See cited literature; also see Brock (1998). |

| **Question 1.2** Impact on plant community composition, structure, and interactions *Score:* **A** *Doc'n Level:* **Rev. sci. pub.** |
|---|
| **Identify type of impact or alteration:** *Elaeagnus angustifolia* can form extensive monotypic stands along riparian corridors; as this change in vegetation occurs native species are displaced, crucial vegetation communities (riparian corridors and wetlands) are impacted along with a species diversity decline on a site, with resultant alterations in the physical architecture of a site (Shafroth et al. 1995, Brock 1998, Lessica and Miles 1999, 2001, Tu 2003). |
| **Rationale:** Research and subsequent publications are focused on areas outside of Arizona. *Elaeagnus angustifolia* can replace native riparian trees on a site through competition and exclusion, thus, interfering with natural plant succession. Biology/ecology of the riparian dominant *Populus* differs from *E. angustifolia. Elaeagnus angustifolia* is able to take better advantage of the alterations effected by river-flow restrictions and, over time, exclude recruitment and establishment of *Populus* seedlings on a ElaeAgnu invaded and dominated site (Shafroth et al. 1995, Brock 1998, Muzika and Swearingen 1998, Lessica and Miles 1999, 2001).<br><br>Shafroth et al. (1995) note that a vegetative change on a site from native riparian species to *E. angustifolia* would change the overall physical structure of a site; a monotypic site of *E. angustifolia* provides a structural habitat intermediate to grasses-low-shrubs type and large trees (large trees being typical of native riparian plant community). Brock (personal communication, 2003) notes that *E. angustifolia* is a facultative riparian tree, and can be found on 500 yr old floodplains. |

**Sources of information:** See cited literature; also see Currier (1982). Also considered personal communication with J. Brock (Professor, Applied Biological Science, Arizona State University-East, Mesa, Arizona, 2003).

**Question 1.3** Impact on higher trophic levels *Score:* **B** *Doc'n Level:* **Rev. sci. pub.**

**Identify type of impact or alteration:** *Elaeagnus angustifolia* has reports of both beneficial and detrimental impacts to higher trophic levels; characteristics which affect insects, wildlife, and humans. Although positive characteristics have been reported, other research has shown that invertebrate and wildlife diversity, richness, and density decreases on *E. angustifolia* dominated sites (often adjacent to native riparian sites) when compared to native riparian community sites.

**Rationale:** All research and publications focused outside of Arizona.

(*Elaeagnus angustifolia*) benefits include:

- is a smaller sized plant which provides structural habitat intermediate to grasses and low shrubs (typical of upland sites) and the larger structural trees (typical of riparian sites) (Knopf and Olson 1984 in Shafroth et al. 1995, Brock 1998).
- provides abundant edible fruit for many birds and mammals (Borell 1962 in Shafroth et al. 1995, Brock 1998).
- provides a spring nectar source for insects/bees (Hayes 1976 in Brock 1998) and moths (J. Brock, personal communication, 2003).
- provides cover and nesting sites (Freehling 1982 in Brock 1998).

(*Elaeagnus angustifolia*) detriments include:

- tends to support fewer invertebrate species than native species do (Knopf and Olson 1984 in Stannard et al. 2002, Brown 1990 in Stannard et al. 2002, Waring and Tremble 1993 in Brock 1998), thus fewer resources are available to higher trophic levels (Brock 1998).
- provides inferior wildlife habitat when compared to native riparian vegetation types (Tesky 1992) with reports of fewer birds, less species richness, fewer foraging guilds, and fewer nesting guilds than sites having native plant species (Knopf and Olson 1984 in Stannard et al. 2002, Brown 1990 in Brock 1998, Stannard et al. 2002).
- Brock (1998) notes work by Kernerman et al. (1992) identifying *E. angustifolia* pollen as affecting public health with pollen as an allergen to many people.

**Sources of information:** See cited literature; also see Lesica and Miles (1999) and Olson and Knopf (1986). Also considered personal communication with J. Brock (Professor, Applied Biological Science, Arizona State University-East, Mesa, Arizona, 2003).

**Question 1.4** Impact on genetic integrity *Score:* **D** *Doc'n Level:* **Obs.**

**Identify impacts:** *Elaeagnus angustifolia* does not appear to hybridize with any other plants in Arizona.

**Rationale:** No native species of *Elaeagnus* occur in Arizona (Kearney and Peebles 1960). In addition J. Brock (personal communication, 2003) noted that there are no known reports of *E. angustifolia* hybridization in the United States, despite some *Elaeagnus* shrubs available as ornamentals.

**Sources of information:** See cited literature. Also considered personal communication with J. Brock (Professor, Applied Biological Science, Arizona State University-East, Mesa, Arizona, 2003).

**Question 2.1** Role of anthropogenic and natural disturbance in establishment *Score:* **A** *Doc'n Level:* **Rev. sci. pub.**

**Describe role of disturbance:** *Elaeagnus angustifolia* can establish on riparian sites with or without natural disturbance. An aside to this: the anthropogenic alterations to natural hydrologic patterns that

many western rivers have been placed under (damming and restricted flows) generally benefit *E. angustifolia* more than disturbance-dependent native *Populus* spp.

**Rationale:** All research and publications focused outside of Arizona.

During a research study along riparian sites in Montana, it appeared that *E. angustifolia* did not require disturbance to establish (Lessica and Miles 1999, 2001). Recruitment can occur under established trees (both *Populus* and *Salix*, and also *E. angustifolia*) and does not require uncommon flood events (Lesica and Miles 2001). Katz et al. (2001) reported that although *E. angustifolia* can establish on undisturbed plots, numbers of established seedlings were significantly higher on disturbed plots.

An anthropogenic alteration to historic, natural hydrologic regime: the natural disturbance regimes historically associated with native cottonwood gallery forests frequently due to river regulation have been noted to promote the invasion of *E. angustifolia* (Stannard et al. 2002 cited Knopf and Olson 1984, Shafroth et al. 1995, Lesica and Miles 1999); this primarily includes damming and de-watering of streams which in turn reduce flood events (Stannard et al. 2002). Flooding promotes exposure of bare soil and improved establishment of cottonwood seedlings. Stannard et al. (2002) also note that improper irrigation water management can elevate the water table and increase the accumulation of excess salts in soils; these conditions aren't conducive to species disliking saturated, saline soils. High water tables (gleying of soil as an indicator), seasonal or year-long, are common on sites where *E. angustifolia* has invaded.

**Sources of information:** See cited literature.

**Question 2.2** Local rate of spread with no management *Score:* **A** *Doc'n Level:* **Obs**

**Describe rate of spread:** Given research from Montana (see below), a site with mature *E. angustifolia* has the potential to double under 10 years after initial introduction plus the years it takes to reach a mature stand. Lesica and Miles (2001) note that *E. angustifolia* is at its northern limit of naturalized range in North America (in Montana) and may potentially be more invasive in warmer, semi-arid regions of western North America.

**Rationale:** All research and publications focused outside of Arizona.

Tellman (1996) states after 1900 *E. angustifolia* was widely used as a landscape plant in Utah's and Arizona's Mormon communities, being passed among communities as a favorable plant, escaping cultivation to occur at its present distribution. In parts of the western United States it has naturalized and forms extensive monotypic stands along riparian areas (Shafroth et al. 1995). During field research in Montana, Lesica and Miles (2001) report a recruitment rate of 0 to 4.07 recruits per mature tree across 46 stands along the Yellowstone and Marias rivers with a mean of 0.69 recruits per year.

**Sources of information:** See cited literature; also see Christensen (1963), Knoph and Olson (1984), and Stannard et al. (2002). Score based on inference by Working Group members.

**Question 2.3** Recent trend in total area infested within state *Score:* **B** *Doc'n Level:* **Obs.**

**Describe trend:** No published sources found. In a ranking of *E. angustifolia* by Grand Canyon National Park, it was assessed that by area infested this species was 'found in less than 5% of the state' (Ranking of *Elaeagnus angustifolia* at Grand Canyon National Park, Makarick 1999). At the University of Arizona Herbarium, there were *E. angustifolia* specimens from six northern counties in Arizona: Mohave, Coconino, Navajo, Apache, and Yavapai, with one specimen from Pima County (1914) with no location identified.

**Rationale:** Brock (personal communication, 2003) notes that *E. angustifolia* seems to presently occupy the habitats it prefers within Arizona, but is increasing in numbers within that range. So total area infested is increasing but not doubling in <10 years.

**Sources of information:** Personal communication with J. Brock (Professor, Applied Biological Science, Arizona State University-East, Mesa, Arizona, 2003). Also considered Makarick (1999. Ranking of *Elaeagnus angustifolia* at Grand Canyon National Park; available at: http://usgssrv1.usgs.nau.edu/swepic/asp/swemp/species.asp).

**Question 2.4** Innate reproductive potential *Score:* **B** *Doc'n Level:* **Rev. sci. pub.**

**Describe key reproductive characteristics:** *Elaeagnus angustifolia* has a strategy having potential for long-distance dispersed seeds that have an afterripening period and dormancy. The seeds are large with endosperm, and can germinate over a range of conditions and soil types, in disturbed or on undisturbed sites, when moisture is sufficient; there is low seedling mortality. The plants can become mature as early as three years (in some reports).

**Rationale:** All research and publications focused outside of Arizona.

Knoph and Olson (1984) report the average seed-bearing age for *E. angustifolia* becomes is between 3 to 5 years old (Knoph and Olson 1984); in Montana, *E. angustifolia* becomes reproductively mature between 7 to 10 years of age, with average age being about 10 years old, with 89% of trees more than 10 years old producing fruit (Lesica and Miles 2001). *Elaeagnus angustifolia* has large seeds with endosperm, enabling establishment in shade or in the open over a wider range of conditions, and can wait to germinate for conditions on a site to become suitable (Shafroth et al. 1995, Lesica and Miles 1999, 2001). Seeds germinate under a wide range of moisture conditions at different times of the growing season (Shafroth et al. 1995 in Lesica and Miles 1999).

*Elaeagnus angustifolia* reproduces primarily from seed, yet vegetative propagation can occur (Muzika and Swearingen 1998 in Tu 2003). *Elaeagnus angustifolia* sprouts from its root crown following fire and other disturbances or damage (Tesky 1992, Lesica and Miles 1999) and can also vegetatively reproduce by layering of branches (Brock 1998). *Elaeagnus angustifolia* can reproduce in shady environments, versus cottonwood's inability to do so (Montana study).

**Sources of information:** See cited literature.

**Question 2.5** Potential for human-caused dispersal *Score:* **A** *Doc'n Level:* **Other pub.**

**Identify dispersal mechanisms:** Human caused dispersal of *E. angustifolia* is presently still high: it is still being promoted for landscape restoration and as an ornamental.

**Rationale:** *Elaeagnus angustifolia* was used in revegetation projects and wildlife food/shelter projects, planted for windbreaks, shelterbelts, erosion control, and is still offered as a horticultural specimen for landscape planting (Stannard et al. 2002). Human-caused dispersal is presently occurring; *E. angustifolia* is presently offered at nurseries in states where it isn't restricted as a noxious weed (Stannard et al. 2002). On the University of Arizona Cooperative Extension, Yavapai County (2000) website it is presently noted as a landscape plant for 'Cold Mountainous Regions (elevation 6000 to 8000 feet).'

**Sources of information:** See cited literature; also see University of Arizona Cooperative Extension, Yavapai County. 2000. Arizona Plant Climate Zones. Available at: http://ag.arizona.edu/Yavapai/anr/hort/climate/zone1.html.

**Question 2.6** Potential for natural long-distance dispersal *Score:* **A** *Doc'n Level:* **Rev. sci. pub.**

**Identify dispersal mechanisms:** With *E. angustifolia* having both a potential to be carried by water and ingested and disseminated by animals, it has a fairly high potential for long-distance dispersal.

**Rationale:** *Elaeagnus angustifolia* has a fruit which is a small cherry-like drupe, which is subsequently eaten and disseminated by many species of birds (Shaforth et al. 1995, Muzika and Swearingen 1998) and animals (Shaforth et al. 1995). As stated previously, *E. angustifolia* 's benefits appear to include

providing abundant edible fruit for many birds and mammals (Borell 1962 in Shafroth et al. 1995, Brock 1998). The outer layer of the seedcoat is impermeable in the digestive tract (Tesky 1992). Stannard et al. (2002) note several reports in which the establishment of plants by fruits consumed by birds has been implied (cited USDA 1974, Shafroth et al. 1995, Lesica and Miles 1999). Stannard et al. (2002) report by personal observation the dissemination of seeds after consumption by coyotes, deer, and raccoons. Stannard et al. (2002) cites Heekin's (personal observation) report that the fruit of *E. angustifolia* float, which indicates a potential for being dispersed by water transport.

**Sources of information:** See cited literature.

**Question 2.7** Other regions invaded *Score:* **C** *Doc'n Level:* **Obs.**

**Identify other regions:** Only those ecological types also invaded in Arizona.

**Rationale:** No direct evidence, score based on the following (see also 3.1 and 3.2). *Elaeagnus angustifolia* 's range occurs across the United States and into Canada, and the species is extensively naturalized, especially in the western United States. It is most often associated with mesic meadows and floodplain forests, with perennial grasses tending to be predominant in the areas infested (Tesky 1992). Various sources seem to identify the *E. angustifolia* invasion along rivers, streams and irrigation canals, wetlands, in wet meadows, cropland, and fields, roadsides from its southern to northern extent on this continent. From east to west it seems to be located more along roadsides and fields to a more riparian habitat.

**Sources of information:** See cited literature; also see Kearney and Peebles (1960), McDougall (1973), Brown (1994), NPS (2002), and USGS-NPS (2003).

**Question 3.1** Ecological amplitude *Score:* **A** *Doc'n Level:* **Other pub.**

**Describe ecological amplitude, identifying date of source information and approximate date of introduction to the state, if known:** Insufficient information. Sources identifying habitat from native areas were not found. See Worksheet B for current ecological types invaded in Arizona. Introduced to Arizona in 1914 to Pima County (SEINet 2004).

**Rationale:** Within the United States *E. angustifolia* is found along streams, fields, and open areas (Muzika and Swearingen 1998). *Elaeagnus angustifolia* was first cultivated in Germany in 1736 and was introduced into the U.S. in the late 1800s as an ornamental, which later escaped cultivation (Muzika and Swearingen 1998). The first records of *E. angustifolia* being planted in New Mexico, Nevada, and Arizona were from 1903, 1906, and 1909, respectively (Christensen 1963 in Stannard et al. 2002). Tellman (1996) notes that it was in Utah's and Arizona's Mormon communities after 1900 and was being passed between communities as a favorable ornamental species.

*Elaeagnus angustifolia* is native to temperate and tropical western Asia and southeastern Europe (GRIN 2000). *Elaeagnus angustifolia* is present primarily in the central and southern U.S. and also occurs in the eastern U.S. from Virginia to Pennsylvania; in the west it occurs primarily in the Great Basin Desert region at 800 to 2000 feet, along with being abundant in riparian zones of the Great Plants (e.g. Platte River in Nebraska) (Muzika and Swearingen 1998). In the western United States it has become naturalized in areas (Shafroth et al. 1995).

The Soil Conservation Service recommends this plant for wildlife plantings and windbreaks (Muzika and Swearingen 1998). It was widely used as an ornamental by the 1940s in many western U.S. cities and by approximately 1939 was promoted for windbreaks, erosion control, and wildlife; in the Intermountain West, Northern Great Plains and Great Basin states it is primarily used in dryland windbreaks, saline areas, and ornamental plantings (Stannard et al. 2002).

In Virginia typical habitats are disturbed areas, roadsides, pastures and fields in a wide range of soils (Virginia Native Plant Society 1997).

In western North America: invades riparian habitats usually dominated by pioneer woody species such as *Populus* (Katz et al. 2001). It has become naturalized in riparian areas in the western U.S. (Shafroth et al. 1995).

In California *E. angustifolia* is found in disturbed, seasonally moist places, usually below 5,000 feet; common on riparian sites and floodplain forests, sub-irrigated pastures and irrigation ditches, and is also found on drier sites such as railroad beds, fence lines, highway margins, in grasslands (Deiter 2000).

In Nebraska along the Platter River, *E. angustifolia* is a frequent invader of wetland meadows on the river, but is also found in adequately moist upland areas such as prairie sites, and near irrigated fields (Olson and Knopf 1986 in Shafroth et al. 1995).

In Montana *E. angustifolia* has been planted as windbreaks since at least 1953 (1997 Montana Department of Natural Resources and Conservation nursery data in Lesica and Miles 2001) and has naturalized along most of the major rivers occurring in the Great Plains regions of Montana (Olson and Knopf 1986 in Lesica and Miles 2001).

In Oklahoma *E. angustifolia* is found mostly along roadsides and abandoned fields; and is persistent in old shelterbelts and homesites (Oklahoma Biological Survey 1999).

In Virginia, typical habitats are disturbed areas, roadsides, pastures and fields in a wide range of soils (Virginia Native Plant Society 1997).

In Arizona, Kearney and Peebles (1960) notes its occurrence in Oak Creek Canyon (5500 feet; Coconino County). McDougall (1973) reports it in Apache, Navajo, and Coconino County (5500 to 7000 feet). *Elaeagnus angustifolia* was observed and included in the USGS-NPS Vegetation Mapping Program in Tuzigoot National Monument Vegetation Descriptions (Yavapai County), namely in the *Populus fremontii-Salix gooddingii* association bordered on the north by the Verde River, and the *Populus fremontii-Prosopis velutina* Woodland (USGS-NPS 2003). *Elaeagnus angustifolia* was found at Canyon de Chelly National Monument (NPS 2002).

**Sources of information:** See cited literature. Also considered information from SEINet (Southwest Environmental Information Network), Arizona herbaria specimen database (available online at: http://seinet.asu.edu/collections; accessed January 2004).

**Question 3.2** Distribution *Score:* **C** *Doc'n Level:* **Obs.**

**Describe distribution:** Occurrence within ecological type is at the highest between 5 to 20% (see Worksheet B).

**Rationale:** See Worksheet B.

**Sources of information:** Based on Working Group member personal knowledge and observations.

### Worksheet A. Reproductive Characteristics

Complete this worksheet to answer Question 2.4.

| | | | |
|---|---|---|---|
| Reaches reproductive maturity in 2 years or less | **Yes** | **No** | **1 pt.** |
| Dense infestations produce >1,000 viable seed per square meter | **Yes** | **No** | **2 pt.** |
| Populations of this species produce seeds every year. | **Yes** | **No** | **1 pt.** |
| Seed production sustained for 3 or more months within a population annually | **Yes** | **No** | **1 pt.** |
| Seeds remain viable in soil for three or more years | **Yes** | **No** | **2 pt.** |
| Viable seed produced with *both* self-pollination and cross-pollination | **Yes** | **No** | **1 pt.** |
| Has quickly spreading vegetative structures (rhizomes, roots, etc.) that may root at nodes | **Yes** | **No** | **1 pt.** |
| Fragments easily and fragments can become established elsewhere | **Yes** | **No** | **2 pt.** |
| Resprouts readily when cut, grazed, or burned | **Yes** | **No** | **1 pt.** |

**Total pts: 4 Total unknowns: 0**

**Score : B**

**Note any related traits:**

### Worksheet B. Arizona Ecological Types

(*sensu* Brown 1994 and Brown et al. 1998)

| Major Ecological Types | Minor Ecological Types | Code* |
|---|---|---|
| **Dunes** | dunes | |
| **Scrublands** | Great Basin montane scrub | |
| | southwestern interior chaparral scrub | |
| **Desertlands** | Great Basin desertscrub | |
| | Mohave desertscrub | |
| | Chihuahuan desertscrub | |
| | Sonoran desertscrub | |
| **Grasslands** | alpine and subalpine grassland | |
| | plains and Great Basin shrub-grassland | **D** |
| | semi-desert grassland | |
| **Freshwater Systems** | lakes, ponds, reservoirs | |
| | rivers, streams | |
| **Non-Riparian Wetlands** | Sonoran wetlands | |
| | southwestern interior wetlands | |
| | montane wetlands | |
| | playas | |
| **Riparian** | Sonoran riparian | |
| | southwestern interior riparian | **C** |
| | montane riparian | |
| **Woodlands** | Great Basin conifer woodland | **C** |
| | Madrean evergreen woodland | |
| **Forests** | Rocky Mountain and Great Basin subalpine conifer forest | |
| | montane conifer forest | **D** |
| **Tundra (alpine)** | tundra (alpine) | |

*A means >50% of type occurrences are invaded; B means >20% to 50%; C means >5% to 20%; D means present but ≤5%; U means unknown (unable to estimate percentage of occurrences invaded).

## Literature Cited

Borell, A.E. 1962. Russian-olive for wildlife and other conservation used. Leaflet No. 517. U.S. Department of Agriculture, Washington, D.C.

Brock, J.H. 1998. Invasion, ecology and management of *Elaeagnus angustifolia* (Russian olive) in the southwestern United States. Pages 123−136 in U. Starfinger, K. Edwards, I. Kowarik, and M. Williamson (eds.), Plant Invasions: Ecological Mechanisms and Human Responses. Backhuys Publishers, Leiden, The Netherlands.

Brown, C.R. 1990. Avian Use of Native and Exotic Riparian Habitats on the Snake River, Idaho. Master's thesis. Department of Fishery and Wildlife Biology, Colorado State University, Fort Collins. 60 p.

Brown, D.E. (ed.). 1994. Biotic Communities: Southwestern United States and Northwestern Mexico. University of Utah Press, Salt Lake City. 342 p. [Plus companion 60-inch by 48-inch map, Biotic Communities of the Southwest].

Brown, D., F. Reichenbacher, and S. Franson, S. 1998. A Classification of North American Biotic Communities. University of Utah Press, Salt Lake City. 141 p.

Caplan, T. 2002. Controlling Russian olives within cottonwood gallery forests along the Middle Rio Grande floodplain (New Mexico). Ecological Restoration 20:138−139.

Christensen, E.M. 1963. Naturalization of Russian olive (*Elaeagnus angustifolia* L.) in Utah. American Midland Naturalist 70:133−137.

Currier, P.J. 1982. The Floodplain Vegetation of the Platte River: Phytosociology, Forest Development, and Seedling Establishment. Doctoral dissertation. Iowa State University, Ames.

Dahm, C.N., J.R. Cleverly, J.E. Allred Coonrod, J.R. Thibault, D.E. McDonnell, and D.J. Gilroy. 2002. Evapotranspiration at the land/water interface in a semi-arid basin. Freshwater Biology 47:831−843.

Dieter, L. 2000. *Elaeagnus angustifolia* L. Pages 175−178 in C.C. Bossard, J.M. Randall, and M.C. Hoshovsky (eds.), Invasive Plants of California's Wildlands. University of California Press, Berkeley.

Freehling, M.D. 1982. Riparian Woodlands of the Middle Rio Grande Valley, New Mexico: A Study of Bird Populations and Vegetation with Special Reference to Russian-Olive (*Elaeagnus angustifolia*). Report to the US Fish and Wildlife Service, Albuquerque, New Mexico. 35 p.

[GRIN] Germplasm Resources Information Network. 2000. Grin Taxonomy. United States Department of Agriculture, Agricultural Research Service, The Germplasm Resources Information Network. Available online at: http://www.ars-grin.gov/npgs/tax/index.html; accessed May 2003.

Hayes, B. 1976. Planting the *Elaeagnus* Russian and autumn olive for nectar. American Bee Journal 116:74 and 82.

Howe, W.H., and F.L. Knopf. 1991. On the imminent decline of Rio Grande cottonwoods in central New Mexico. Southwest Naturalist 36:218−224.

Katz, G.L., J.M Friedman, and S.W. Beatty. 2001. Effects of physical disturbance and granivory on establishment of native and alien riparian trees in Colorado, U.S.A. Diversity and Distributions 7:1−14.

Kearney, T.H., and R.H. Peebles (and collaborators). 1960. Arizona Flora. 2nd edition with supplement by J.T. Howell and E. McClintock and collaborators. University of California Press, Berkeley. 1085 p.

Kernerman, S.M., J. McCoullough, J. Green, and D.R. Ownby. 1992. Evidence of cross-reactivity between olive, ash, privet, and Russian olive tree pollen allergens. Annals of Allergy 69:493−496.

Knoph, F.K, and T.E. Olson. 1984. Naturalization of Russian olive: implications to Rocky Mountain wildlife. Wildlife Society Bulletin 12:289−298

Lesica, P. and S. Miles. 1999. Russian olive invasion into cottonwood forests along a regulated river in north-central Montana. Canadian Journal of Botany 77:1077−1083.

Lesica, P., and S. Miles. 2001. Natural history and invasion of Russian olive along eastern Montana rivers. Western North American Naturalist 61:1−10.

McDougall, W.B. 1973. Seed Plants of Northern Arizona. The Museum of Northern Arizona, Flagstaff. 594 p.

Muzika, R., and J.M. Swearingen. 1998. Russian Olive; *Elaeagnus angustifolia* L. Plant Conservation Alliance, Alien Plant Working Group. Available online at: http://www.nps.gov/plants/alien/fact/elan1.htm; accessed May 2003.

[NPS] National Park Service. 2002. Canyon de Chelly Inventory, 2002 Interim Report. National Park Service, Southern Colorado Plateau Inventory and Monitoring Network. Available online at: http://www.nature.nps.gov/im/units/nw21/files/2002CACHplantreport.pdf.

Oklahoma Biological Survey. 1999. *Elaeagnus angustifolia* L. Available online at: http://www.biosurvey.ou.edu/shrub/elan.htm; accessed May 2003.

Olson, T.E., and F.L. Knopf. 1986. Naturalization of Russian-olive in the western United States. Western Journal of Applied Forestry 1:65−69.

Paschke, M.W. 1997. Actinorhizal plants in rangelands of the western United States. Journal of Range Management 50:62−72.

Shafroth, P.B., G.T. Auble, and M.L. Scott. 1995. Germination and establishment of the native plains cottonwood (*Populus deltoides* Marshall subsp. *monilifera*) and the exotic Russian-olive (*Elaeagnus angustifolia* L.). Conservation Biology 9:1169−1175.

Simons, S.B., and T.R. Seastedt. 1999. Decomposition and nitrogen release from foliage of cottonwood (Populus deltoides) and Russian-olive (Elaeagnus angustifolia) in a riparian ecosystem. Southwestern Naturalist 44:256−260.

Stannard, M., D. Ogle, L. Holzworth, J. Scianna, and E. Sunleaf. 2002. Technical Notes: History, Biology, Ecology, Suppression and Revegetation of Russian-Olive Sites (*Elaeagnus angustifolia* L.). Plant Materials No. 47, U.S. Department of Agriculture, Natural Resources Conservation Service, Boise,

Idaho; Bozeman, Montana; and Spokane, Washington. 14 p. Available online at: http://usgssrv1.usgs.nau.edu/swepic/factsheeets/Russian_olive.pdf; accessed May 2003.

Tellman, B. 1996. Stowaways and invited guests: how some exotic plants reached the American southwest. 1996 Symposium Proceedings, California Exotic Pest Plant Council.

Tesky, J.L. 1992. *Elaeagnus angustifolia*. In Fire Effects Information System. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available online at: http://www.fs.fed.us/database/feis/plants/tree/elaang/all.html; accessed May 2003.

Tu, M. 2003. *Elaeagnus angustifolia*. Element Stewardship Abstract. The Nature Conservancy. Available online at: http://tncweeds.ucdavis.edu/esadocs/documents/elaeang.html; accessed May 2003.

[USDA] U.S. Department of Agriculture. 1974. Seeds of Woody Plants in the United States. Agric. Handbook No. 450. U.S. Department of Agriculture.

[USDA] U.S. Department of Agriculture, Natural Resources Conservation Service. 2005. The PLANTS Database, Version 3.5. Available online at: http://plants.usda.gov. Data compiled from various sources by Mark W. Skinner. National Plant Data Center, Baton Rouge, Louisiana.

[USGS-NPS] U.S. Geological Survey-National Park Service. 2003. Tuzigoot National Monument Vegetation Descriptions. U.S. Geological Survey and the National Park Service, Vegetation Mapping Program. Available online at: http://biology.usgs.gov/npsveg/tuzi/descript.html.

Virginia Native Plant Society. 1997. Autumn Olive (*Elaeagnus umbellata* Thunberg), Russian Olive (*Elaeagnus angustifolis* L.). Available online at: http://www.vnps.org/invasive/inveleag.htm; accessed May 2003.

Waring, G.L., and M. Tremble. 1993. The Impact of Exotic Plants on Faunal Diversity Along a Southwestern River. Unpublished report to The Nature Conservancy. 33 p.

Warner, P.J., C. Bossard, M.L. Brooks, J.M. DiTomaso, J.A. Hall, A. M. Howald, D.W. Johnson, J.M. Randall, C.L. Roye, M.M. Ryan, and A.E. Staton. 2003. Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands. Available online at: www.caleppc.org and www.swvma.org. California Exotic Pest Plant Council and Southwest Vegetation Management Association. 24 p.

### Other References of Interest not Cited in the Text

Bovey, R.W. 1965. Control of Russian olive by aerial application of herbicides. Journal of Range Management 18:194-195.

Brock, J.H. In Press. *Elaeagnus angustifolia* (Russian olive) seed banks from invaded riparian habitats in northeastern Arizona.

Carmen, J.G., and J.D. Brotherson. 1982. Comparisons of sites infested and not infested with saltcedar (*Tamarix pentandra*) and Russian olive (*Elaeagnus angustifolia*). Weed Science 30:360–364.

Johnson, W.C. 2002. Riparian vegetation diversity along regulated rivers: contribution of novel and relict habitats. Freshwater Biology 47:749–759.

Seigel, R.S., and J.H. Brock. 1990. Germination requirements of key southwestern woody riparian species. Desert Plants 10:3–8, 34.

Williams, R.D., and S.H. Hanks. 1976. Hardwood Nurseryman's Guide. Agric. Handbook No. 473. U.S. Department of Agriculture, Forest Service, Washington, D.C. 78 p.