SPECIES: Lonicera spp.

Choose from the following categories of information.

- Introductory
- Distribution and occurrence
- Botanical and ecological characteristics
- Fire ecology
- Fire effects
- Fire case studies
- Management considerations
- References

INTRODUCTORY

SPECIES: Lonicera spp.

- AUTHORSHIP AND CITATION
- FEIS ABBREVIATION
- SYNONYMS
- NRCS PLANT CODE
- COMMON NAMES
- TAXONOMY
- LIFE FORM
- FEDERAL LEGAL STATUS
- OTHER STATUS

AUTHORSHIP AND CITATION:

FEIS ABBREVIATIONS:
LONSPP
LONFRA
LONMAA
LONMOR
LONTAT
LONXYL
LONBEL

SYNONYMS:
None

NRCS PLANT CODES [172]:
LOFR
LOMA6
LOMO2
LOTA
LOXY
Species: Lonicera spp.

LOBE

COMMON NAMES:
- winter honeysuckle
- Amur honeysuckle
- Morrow's honeysuckle
- Tatarian honeysuckle
- European fly honeysuckle
- Bell's honeysuckle

TAXONOMY:
The currently accepted genus name for honeysuckle is *Lonicera* L. (Caprifoliaceae) [18, 36, 54, 59, 82, 83, 93, 133, 161, 189, 190, 191, 197]. This report summarizes information on 5 species and 1 hybrid of *Lonicera*:

- *Lonicera morrowii* A. Gray [18, 39, 54, 60, 83, 161, 186, 189, 190, 197] Morrow's honeysuckle
- *Lonicera tatarica* L. [18, 38, 39, 54, 59, 60, 82, 83, 92, 93, 157, 161, 186, 190, 191] Tatarian honeysuckle
- *Lonicera xylosteum* L. [18, 54, 60, 83, 186] European fly honeysuckle
- *Lonicera × bella* Zabel [54, 60, 83, 133, 186, 190] Bell's honeysuckle. This is a cross between *L. tatarica* and *L. morrowii* that has arisen in cultivation and probably spontaneously in the wild [7, 54, 68, 133, 186]. According to Barnes [7], Bell's honeysuckle is intermediate to its parent species in most characteristics, but "many of these characteristics vary between extremes so that often detection of the hybrid nature of an individual can only be accomplished by looking at a large number of characters." Field observations in Ohio and Michigan suggest that Tatarian honeysuckle is the pollen parent of Bell's honeysuckle [68]. Bush honeysuckle shrubs in southern Vermont were described as a "hybrid complex", with most individuals resembling the Morrow's honeysuckle type, but some apparently more influenced by Tatarian honeysuckle [139]. Barnes [7] illustrates the difficulty often encountered in distinguishing between Bell's honeysuckle and its parent species, and asserts that in many instances Bell's honeysuckle is misidentified in the literature as Tatarian honeysuckle or Morrow's honeysuckle. Chapman and Bessette [25] describe Bell's honeysuckle as the dominant "species" in Adirondack Park, New York, with pure specimens of either Tatarian honeysuckle or Morrow's honeysuckle becoming difficult to find.

When discussing characteristics typical (or likely to be typical) of all 6 of the above taxa, this report refers to them collectively as bush honeysuckle(s). When referring to individual taxa, the common names listed above are used.

Although apparently not widely escaped, additional hybrids may be formed among the abovementioned taxa and others, as described below [60, 72]:

- *Lonicera × minutiflora* Zabel (bunchberry honeysuckle), a cross between *L. morrowii* and *L. × xylosteoides*
- *Lonicera × muendeniensis* Rehd. (Muenden honeysuckle), a cross between *L. × bella* and *L. ruprechtiana* (Manchurian honeysuckle).
- *Lonicera × muscaviensis* Rehd. (Muscovy honeysuckle), a cross between *L. morrowii* and *L. ruprechtiana*.
- *Lonicera × notha* Zabel (Rutarian honeysuckle), a cross between *L. ruprechtiana* and *L. tatarica*.
- *Lonicera × salicifolia* Dieck ex Zabel (willowleaf honeysuckle), a cross between *L. ruprechtiana* and *L. × xylosteoides*. 
- *Lonicera × xylosteoides* Tausch (Vienna honeysuckle), a cross between *L. tatarica* and *L. xylosteum*.

LIFE FORM:
Shrub

FEDERAL LEGAL STATUS:
No special status
OTHER STATUS:
Winter honeysuckle, Amur honeysuckle, Morrow's honeysuckle, Tatarian honeysuckle, and Bell's honeysuckle are ranked as severe threats by the Tennessee Exotic Pest Plant Council [156], and Amur honeysuckle, Morrow's honeysuckle, and Tatarian honeysuckle are ranked as severe threats by the Kentucky Exotic Pest Plant Council [85]. Morrow's honeysuckle is ranked highly invasive, Amur honeysuckle and Tatarian honeysuckle moderately invasive, and winter honeysuckle and Bell's honeysuckle occasionally invasive by the Virginia Department of Conservation and Recreation [182].

U.S. Forest Service Region 8 (Southern Region) lists winter honeysuckle, Amur honeysuckle, Morrow's honeysuckle, and Tatarian honeysuckle as category 1 weeds (exotic plant species that are known to be invasive and persistent throughout all or most of their range within the Southern Region and that can spread into and persist in native plant communities and displace native plant species and therefore pose a demonstrable threat to the integrity of the natural plant communities in the Region). The introduction of category 1 species is prohibited on National Forest System Lands [171].

Morrow's honeysuckle, Tatarian honeysuckle, and Bell's honeysuckle are "high-priority" nonnative invasive plants of the Ottawa National Forest (MI) [170].

DISTRIBUTION AND OCCURRENCE

SPECIES: Lonicera spp.

- GENERAL DISTRIBUTION
- ECOSYSTEMS
- STATES/PROVINCES
- BLM PHYSIOGRAPHIC REGIONS
- KUCHLER PLANT ASSOCIATIONS
- SAF COVER TYPES
- SRM (RANGELAND) COVER TYPES
- HABITAT TYPES AND PLANT COMMUNITIES

GENERAL DISTRIBUTION:
Winter honeysuckle was introduced to the U.S. from eastern China in 1845 [36,74,191]. It is distributed in the eastern U.S. from New York, west to Ohio and south to Alabama and Georgia. It is not reported in New Jersey and Delaware, but does occur in Louisiana, Texas, and Utah [36,83,133,161,182]. According to Virginia Department of Conservation and Recreation [182] winter honeysuckle occurs in the Piedmont region of that state.

Amur honeysuckle
is native to central and northeastern China, Manchuria, the Amur and Ussuri river valleys, Korea, and isolated parts of Japan [98,106]. It was first introduced into the U.S. in 1897/98 [74,106], and by 1931 was available from at least 8 commercial nurseries [106]. For a thorough review of the historical cultivation and dissemination of Amur honeysuckle, from its apparent origins in China to its cultivation in Russia, Europe, and North America, see Luken and Thieret [106].

Amur honeysuckle is distributed in the eastern U.S. from Massachusetts west to North Dakota and south to Texas. However, there are no specific reports of occurrence in Minnesota, South Dakota, or Florida [18,36,43,54,59,83,99,100,122,171,178,186,186]. Amur honeysuckle also occurs in Idaho [135] and southern Ontario [131]. Lorenz and others [95] indicate Amur honeysuckle is climatically adapted to all but the coldest areas in this range, such as northern Maine, New Hampshire, and Vermont, the Adirondack area of New York, and southwestern portions of Michigan's Upper Peninsula (see Site Characteristics). According to Sharp and
Belcher [150] the Amur honeysuckle cultivar 'Rem-Red' is "climatically adapted" from Massachusetts to South Carolina and west to Missouri. Based on a survey of herbaria in eastern North America, Trisel [168] described distribution of "naturalized" Amur honeysuckle from "New Hampshire south to Augusta, Georgia, west to Greenville, Mississippi and Tulsa, Oklahoma, north to Ames, Iowa, and Madison, Wisconsin." Rolfsmeyer and others [137] reported Amur honeysuckle growing outside cultivation in Nebraska and Kansas, but indicate it may not be spreading rapidly in this area. According to Virginia Department of Conservation and Recreation [182], Amur honeysuckle occurs in the Mountain and Piedmont regions of that state.

Morrow's honeysuckle is native to Japan [54,161,186], and occurs throughout the Japanese archipelago (Talewaki 1969 as cited in [7]). According to Hidayati and others [74] it was introduced to the U.S. from Japan in 1875. Morrow's honeysuckle is distributed in the eastern U.S. from Maine west to Minnesota and south to Arkansas, Tennessee, and the Carolinas, as well as in Alabama [18,44,68,76,83,108,122,149,171,172,178,186,197]. It also occurs in Colorado and Wyoming [83,135,189,190], and in the Canadian provinces of New Brunswick, Quebec, Ontario, and Saskatchewan [83]. According to Virginia Department of Conservation and Recreation [182], Morrow's honeysuckle occurs in the Mountain and Piedmont regions of that state.

Most sources indicate Tatarian honeysuckle is native to eastern Europe and adjacent Asia [18,54,59,92,149,157,186,191], although according to Strausbaugh and Core [161] it was introduced from western Asia. In the U.S., Tatarian honeysuckle is reported from Maine south to Virginia and west to Washington, Oregon and California, but not in Missouri or Nevada [13,18,20,35,38,45,59,68,69,83,83,92,93,108,122,135,149,157,161,178,186,190,191,198]. It is also reported in Georgia [111], Alaska [83] and in Canada from Nova Scotia west to Alberta [83,121]. Lorenz and others [95] indicate Tatarian honeysuckle is climatically adapted throughout the northeastern U.S., from Maine south to Virginia and west to Kentucky, Ohio, and Michigan (see Site Characteristics). According to Virginia Department of Conservation and Recreation [182], Tatarian honeysuckle occurs in the Mountain and Piedmont regions of that state.

European fly honeysuckle was introduced from Eurasia [18,54,149,186]. European fly honeysuckle is distributed in the eastern U.S. from Maine west to Wisconsin, and south to Virginia, but it is not reported in West Virginia or Kentucky [18,83,122,149,178]. It is also reported in Oregon, and in the Canadian provinces of New Brunswick, Quebec, and Ontario [83].

Since it appears the native ranges of Morrow's honeysuckle and Tatarian honeysuckle do not overlap, Bell's honeysuckle probably only occurs outside cultivation in North America [68]. According to a review by Barnes [7], initial reports of Bell's honeysuckle in North America date to around the late 1800s to early 1900s, while its parent species, Tatarian honeysuckle and Morrow's honeysuckle, were introduced sometime in the mid-1700s and mid-1800s, respectively. Determining the distribution of Bell's honeysuckle is especially problematic, since it is a hybrid of 2 nonnative parent species and is often difficult to identify [8] (see Taxonomy). A distribution map provided by Barnes and Cottam [8] shows the U.S. distribution of Bell's honeysuckle from Maine west to northeastern Montana, most of the Dakotas, eastern Nebraska and northeastern Kansas, and south to North Carolina, Tennessee, and northern Missouri. There are also records of its occurrence in Colorado east of the continental divide [190], in South Carolina and Wyoming [83,135], and in Washington [135]. In Canada, Barnes and Cottam [8] indicate that Bell's honeysuckle occurs in far southern Quebec and adjacent eastern Ontario, and while less common, is also established in southwestern Manitoba, southern Saskatchewan, and southeastern Alberta. There is also a record of its occurrence in New Brunswick [83]. According to Barnes [7], Bell's honeysuckle is most widespread in New England and around the southern Great Lakes.

USDA Plants database provides state distribution maps of bush honeysuckles, although additional information may have led to more extensive descriptions of distribution in this review.

The following biogeographic classification systems demonstrate where bush honeysuckles could potentially be found based on floras and other literature, herbarium samples, and confirmed observations. Precise distribution information is unavailable. Therefore, these lists are speculative and may be imprecise.

ECOSYSTEMS [52]:
FRES10 White-red-jack pine
FRES11 Spruce-fir
FRES12 Longleaf-slash pine
FRES13 Loblolly-shortleaf pine
FRES14 Oak-pine
FRES15 Oak-hickory
FRES16 Oak-gum-cypress
FRES17 Elm-ash-cottonwood
FRES18 Maple-beech-birch
FRES19 Aspen-birch
FRES20 Douglas-fir
FRES21 Ponderosa pine
FRES22 Western white pine
FRES23 Fir-spruce
FRES24 Hemlock-Sitka spruce
FRES25 Larch
FRES26 Lodgepole pine
FRES27 Redwood
FRES28 Western hardwoods
FRES29 Sagebrush
FRES30 Desert shrub
FRES31 Shinnery
FRES32 Texas savanna
FRES33 Southwestern shrubsteppe
FRES34 Chaparral-mountain shrub
FRES35 Pinyon-juniper
FRES36 Mountain grasslands
FRES37 Mountain meadows
FRES38 Plains grasslands
FRES39 Prairie
FRES41 Wet grasslands
FRES42 Annual grasslands

STATES/PROVINCES: (key to state/province abbreviations)
winter honeysuckle:
UNITED STATES

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Amur honeysuckle:
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CANADA
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**CANADA**

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### Tatarian honeysuckle:
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**CANADA**

| AB | MB | NB | NS | ON | PQ | SK |

### European fly honeysuckle:
**UNITED STATES**

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**CANADA**

| NB | ON | PQ |

### Bell's honeysuckle:
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**CANADA**

| AB | MB | NB | ON | PQ | SK |
BLM PHYSIOGRAPHIC REGIONS [16]:
1 Northern Pacific Border
2 Cascade Mountains
3 Southern Pacific Border
4 Sierra Mountains
5 Columbia Plateau
6 Upper Basin and Range
7 Lower Basin and Range
8 Northern Rocky Mountains
9 Middle Rocky Mountains
10 Wyoming Basin
11 Southern Rocky Mountains
12 Colorado Plateau
13 Rocky Mountain Piedmont
14 Great Plains
15 Black Hills Uplift
16 Upper Missouri Basin and Broken Lands

KUCHLER [91] PLANT ASSOCIATIONS:
K001 Spruce-cedar-hemlock forest
K002 Cedar-hemlock-Douglas-fir forest
K003 Silver fir-Douglas-fir forest
K004 Fir-hemlock forest
K005 Mixed conifer forest
K006 Redwood forest
K007 Red fir forest
K008 Lodgepole pine-subalpine forest
K009 Pine-cypress forest
K010 Ponderosa shrub forest
K011 Western ponderosa forest
K012 Douglas-fir forest
K013 Cedar-hemlock-pine forest
K014 Grand fir-Douglas-fir forest
K015 Western spruce-fir forest
K016 Eastern ponderosa forest
K017 Black Hills pine forest
K018 Pine-Douglas-fir forest
K019 Arizona pine forest
K020 Spruce-fir-Douglas-fir forest
K021 Southwestern spruce-fir forest
K022 Great Basin pine forest
K023 Juniper-pinyon woodland
K024 Juniper steppe woodland
K025 Alder-ash forest
K026 Oregon oakwoods
K027 Mesquite bosques
K028 Mosaic of K002 and K026
K029 California mixed evergreen forest
K030 California oakwoods
K033 Chaparral
K034 Montane chaparral
K035 Coastal sagebrush

K036 Mosaic of K030 and K035
K037 Mountain-mahogany-oak scrub
K038 Great Basin sagebrush
K039 Blackbrush
K040 Saltbush-greasewood
K041 Creosote bush
K047 Fescue-oatgrass
K048 California steppe
K050 Fescue-wheatgrass
K051 Wheatgrass-bluegrass
K053 Grama-galleta steppe
K055 Sagebrush steppe
K056 Wheatgrass-needlegrass shrubsteppe
K057 Galleta-threeawn shrubsteppe
K063 Foothills prairie
K064 Grama-needlegrass-wheatgrass
K065 Grama-buffalo grass
K066 Wheatgrass-needlegrass
K067 Wheatgrass-bluestem-needlegrass
K068 Wheatgrass-grama-buffalo grass
K069 Bluestem-grama prairie
K070 Sandsage-bluestem prairie
K073 Northern cordgrass prairie
K074 Bluestem prairie
K075 Nebraska Sandhills prairie
K076 Blackland prairie
K077 Bluestem-sacahuista prairie
K078 Southern cordgrass prairie
K081 Oak savanna
K082 Mosaic of K074 and K100
K083 Cedar glades
K084 Cross Timbers
K085 Mesquite-buffalo grass
K086 Juniper-oak savanna
K089 Black Belt
K090 Live oak-sea oats
K093 Great Lakes spruce-fir forest
K094 Conifer bog
K095 Great Lakes pine forest
K096 Northeastern spruce-fir forest
K097 Southeastern spruce-fir forest
K098 Northern floodplain forest
K099 Maple-basswood forest
K100 Oak-hickory forest
K101 Elm-ash forest
K102 Beech-maple forest
K103 Mixed mesophytic forest
K104 Appalachian oak forest
K106 Northern hardwoods
K107 Northern hardwoods-fir forest
K108 Northern hardwoods-spruce forest
K109 Transition between K104 and K106
K110 Northeastern oak-pine forest
K111 Oak-hickory-pine
K112 Southern mixed forest
K113 Southern floodplain forest
K114 Pocosin

SAF COVER TYPES:

1 Jack pine
5 Balsam fir
12 Black spruce
13 Black spruce-tamarack
14 Northern pin oak
15 Red pine
16 Aspen
17 Pin cherry
18 Paper birch
19 Gray birch-red maple
20 White pine-northern red oak-red maple
21 Eastern white pine
22 White pine-hemlock
23 Eastern hemlock
24 Hemlock-yellow birch
25 Sugar maple-beech-yellow birch
26 Sugar maple-basswood
27 Sugar maple
28 Black cherry-maple
30 Red spruce-yellow birch
31 Red spruce-sugar maple-beech
32 Red spruce
33 Red spruce-balsam fir
34 Red spruce-Fraser fir
35 Paper birch-red spruce-balsam fir
37 Northern white-cedar
38 Tamarack
39 Black ash-American elm-red maple
40 Post oak-blackjack oak
42 Bur oak
43 Bear oak
44 Chestnut oak
45 Pitch pine
46 Eastern redcedar
50 Black locust
51 White pine-chestnut oak
52 White oak-black oak-northern red oak
53 White oak
55 Northern red oak
57 Yellow-poplar
58 Yellow-poplar-eastern hemlock
59 Yellow-poplar-white oak-northern red oak
60 Beech-sugar maple
61 River birch-sycamore
62 Silver maple-American elm
63 Cottonwood
64 Sassafras-persimmon
65 Pin oak-sweetgum
66 Ashe juniper-redberry (Pinchot) juniper
67 Mohrs (shin) oak
68 Mesquite
69 Sand pine
70 Longleaf pine
71 Longleaf pine-scrub oak
72 Southern scrub oak
73 Southern redcedar
74 Cabbage palmetto
75 Shortleaf pine
76 Shortleaf pine-oak
78 Virginia pine-oak
79 Virginia pine
80 Loblolly pine-shortleaf pine
81 Loblolly pine
82 Loblolly pine-hardwood
83 Longleaf pine-slash pine
84 Slash pine
85 Slash pine-hardwood
87 Sweetgum-yellow-poplar
88 Willow oak-water oak-diamondleaf (laurel) oak
89 Live oak
91 Swamp chestnut oak-cherrybark oak
92 Sweetgum-willow oak
93 Sugarberry-American elm-green ash
94 Sycamore-sweetgum-American elm
95 Black willow
96 Overcup oak-water hickory
97 Atlantic white-cedar
98 Pond pine
100 Pondcypress
101 Baldcypress
102 Baldcypress-tupelo
103 Water tupelo-swamp tupelo
104 Sweetbay-swamp tupelo-redbay
107 White spruce
108 Red maple
109 Hawthorn
110 Black oak
201 White spruce
202 White spruce-paper birch
203 Balsam poplar
204 Black spruce
206 Engelmann spruce-subalpine fir
207 Red fir
210 Interior Douglas-fir
211 White fir
212 Western larch
213 Grand fir
215 Western white pine
216 Blue spruce
217 Aspen
218 Lodgepole pine
219 Limber pine
220 Rocky Mountain juniper
221 Red alder
222 Black cottonwood-willow
223 Sitka spruce
224 Western hemlock
225 Western hemlock-Sitka spruce
226 Coastal true fir-hemlock
227 Western redcedar-western hemlock
228 Western redcedar
229 Pacific Douglas-fir
230 Douglas-fir-western hemlock
231 Port-Orford-cedar
232 Redwood
233 Oregon white oak
234 Douglas-fir-tanoak-Pacific madrone
235 Cottonwood-willow
236 Bur oak
237 Interior ponderosa pine
238 Western juniper
239 Pinyon-juniper
243 Sierra Nevada mixed conifer
244 Pacific ponderosa pine-Douglas-fir
245 Pacific ponderosa pine
246 California black oak
247 Jeffrey pine
248 Knobcone pine
249 Canyon live oak
250 Blue oak-foothills pine
251 White spruce-aspen
252 Paper birch
253 Black spruce-white spruce
254 Black spruce-paper birch
255 California coast live oak

SRM (RANGELAND) COVER TYPES [151]:
101 Bluebunch wheatgrass
102 Idaho fescue
103 Green fescue
104 Antelope bitterbrush-bluebunch wheatgrass
105 Antelope bitterbrush-Idaho fescue
106 Bluegrass scabland
107 Western juniper/big sagebrush/bluebunch wheatgrass
109 Ponderosa pine shrubland
110 Ponderosa pine-grassland
201 Blue oak woodland
202 Coast live oak woodland
203 Riparian woodland
204 North coastal shrub
205 Coastal sage shrub
206 Chamise chaparral
207 Scrub oak mixed chaparral
208 Ceanothus mixed chaparral
209 Montane shrubland
210 Bitterbrush
211 Creosote bush scrub
212 Blackbush
213 Alpine grassland
214 Coastal prairie
215 Valley grassland
217 Wetlands
301 Bluebunch wheatgrass-blue grama
302 Bluebunch wheatgrass-Sandberg bluegrass
303 Bluebunch wheatgrass-western wheatgrass
304 Idaho fescue-bluebunch wheatgrass
305 Idaho fescue-Richardson needlegrass
306 Idaho fescue-slimmer wheatgrass
307 Idaho fescue-threadleaf sedge
308 Idaho fescue-tufted hairgrass
309 Idaho fescue-western wheatgrass
310 Needle-and-thread-blue grama
311 Rough fescue-bluebunch wheatgrass
312 Rough fescue-Idaho fescue
313 Tufted hairgrass-sedge
314 Big sagebrush-bluebunch wheatgrass
315 Big sagebrush-Idaho fescue
316 Big sagebrush-rough fescue
317 Bitterbrush-bluebunch wheatgrass
318 Bitterbrush-Idaho fescue
319 Bitterbrush-rough fescue
320 Black sagebrush-bluebunch wheatgrass
321 Black sagebrush-Idaho fescue
322 C. m. mahogany-bluebunch wheatgrass
323 Shrubby cinquefoil-rough fescue
324 Threetip sagebrush-Idaho fescue
401 Basin big sagebrush
402 Mountain big sagebrush
403 Wyoming big sagebrush
404 Threetip sagebrush
405 Black sagebrush
406 Low sagebrush
407 Stiff sagebrush
408 Other sagebrush types
409 Tall forb
411 Aspen woodland
412 Juniper-pinyon woodland
413 Gambel oak
414 Salt desert shrub
415 C. m. mahogany
416 True mountain-mahogany
417 Littleleaf mountain-mahogany
418 Bigtooth maple
419 Bittercherry
420 Snowbrush
421 Chokecherry-serviceberry-rose
422 Riparian
501 Saltbush-greasewood
601 Bluestem prairie
602 Bluestem-prairie sandreed
603 Prairie sandreed-needlegrass
604 Bluestem-grama prairie
605 Sandsage prairie
606 Wheatgrass-bluestem-needlegrass
607 Wheatgrass-needlegrass
608 Wheatgrass-grama-needlegrass
609 Wheatgrass-grama
610 Wheatgrass
611 Blue grama-buffalo grass
612 Sagebrush-grass
613 Fescue grassland
614 Crested wheatgrass
615 Wheatgrass-saltgrass-grama
704 Blue grama-western wheatgrass
709 Bluestem-grama
710 Bluestem prairie
711 Bluestem-sacahuista prairie
715 Grama-buffalo grass
717 Little bluestem-Indiangrass-Texas wintergrass
718 Mesquite-grama
722 Sand sagebrush-mixed prairie
727 Mesquite-buffalo grass
728 Mesquite-granjeno-acacia
729 Mesquite
730 Sand shinnery oak
731 Cross timbers-Oklahoma
732 Cross timbers-Texas (little bluestem-post oak)
733 Juniper-oak
734 Mesquite-oak
735 Sideoats grama-sumac-juniper
801 Savanna
802 Missouri prairie
803 Missouri glades
804 Tall fescue
805 Riparian
806 Gulf Coast salt marsh
807 Gulf Coast fresh marsh

ALASKAN RANGELANDS
901 Alder
903 Beach wildrye-mixed forb
904 Black spruce-lichen
905 Bluejoint reedgrass
906 Broadleaf forest
908 Fescue
909 Freshwater marsh
910 Hairgrass
912 Low scrub shrub birch-ericaceous
913 Low scrub swamp
914 Mesic sedge-grass-herb meadow tundra
915 Mixed herb-herbaceous
916 Sedge-shrub tundra
917 Tall shrub swamp
920 White spruce-paper birch
921 Willow

HABITAT TYPES AND PLANT COMMUNITIES:
Precise information about habitat types and plant communities where bush honeysuckles may occur is sparse. Information presented below is mostly gleaned from site descriptions where research involving bush honeysuckles took place. It is not likely to be a representative sample, much less an exhaustive review, of bush honeysuckle-invaded habitat types and plant communities in North America. A review by Nyboer [126] indicates that, collectively, bush honeysuckles can colonize a wide array of native habitats within their North American range, including wetland, prairie, and forest communities. It is further asserted that, although individual bush honeysuckle species may differ in their tolerances to various site characteristics, most natural communities within this range are susceptible to invasion by 1 or more species.

Luken [99], Luken and Goessler [103], and Luken and Mattimiro [105] studied Amur honeysuckle populations in northern Kentucky growing along roadsides (open-grown) and within forest stands variously dominated by black locust (Robinia pseudoacacia), American elm (Ulmus americana), slippery elm (U. rubra), sugar maple (Acer saccharum), hackberry (Celtis occidentalis), and white ash (Fraxinus americana). Gould and Gorchov [57], Miller and Gorchov [119], and Swanson and Vankat [163] described Amur honeysuckle as the dominant shrub species growing in the understory of 3 southwestern Ohio hardwood forests. Important overstory species in these forests were a) shagbark hickory (Carya ovata), shellbark hickory (C. laciniosa), elms (Ulmus spp.), and northern red oak (Quercus rubra), b) northern red oak, elms, sugar maple, and American beech (Fagus grandifolia), and c) oaks (Quercus spp.), sugar maple, and hickories (Carya spp.). Amur honeysuckle was also mentioned as occurring in another southwestern Ohio forest dominated by sugar maple along with subdominants American beech, black cherry (Prunus serotina), bitternut hickory (C. cordiformis), yellow-poplar (Liriodendron tulipifera), and ash (Fraxinus spp.) [168].

Tatarian honeysuckle is found in mesic sugar maple- and red maple (Acer saccharinum)-dominated forests in Vermont and Massachusetts [198].

Bell's honeysuckle is found in habitats similar to those where Tatarian honeysuckle and Morrow's honeysuckle occur in Michigan [186]. It occurs in mesic sugar maple- and red maple-dominated forests in Vermont and Massachusetts [198]. Bell's honeysuckle and common buckthorn (Rhamnus cathartica) were the dominant shrub species in an oak (Q. × palaeolithicola) -dominated forest in southern Wisconsin [87]. Bell's honeysuckle is present, but not common, in southeastern Wisconsin shrub-carr communities, which are wet-ground plant communities dominated by tall shrubs other than alder (Alnus spp.), with an understory intermediate between meadow and lowland forest [193]. Barnes and Cottam [8] noted Bell's honeysuckle in all of the 30 terrestrial plant communities located within the University of Wisconsin Madison Arboretum.

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BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: Lonicera spp.

- GENERAL BOTANICAL CHARACTERISTICS
- RAUNKIAER LIFE FORM
- REGENERATION PROCESSES
- SITE CHARACTERISTICS
- SUCCESSIONAL STATUS
- SEASONAL DEVELOPMENT
GENERAL BOTANICAL CHARACTERISTICS:
The following descriptions of bush honeysuckles provide characteristics that may be relevant to fire ecology, and are not meant for identification. Keys for identification are available (e.g. [18,36,54,59,133,161,186,189,190,191]).

Winter honeysuckle is a deciduous or semievergreen shrub, mainly 3.2 to 10 feet (1-3 m), occasionally to 15 feet (4.6 m) tall [36,37,127,133,191]. The crown is an erect but wide-spreading, irregularly rounded, tangled mass of slender recurved branches [37,127,133]. Leaves are 0.6 to 3.5 inches (1.5-9 cm) long and 0.4 to 1.8 inches (1-4.5 cm) wide [36,37,127,133,191]. Flowers are 0.4 to 0.5 inches (1-1.2 cm) long, borne in pairs on short peduncles [191]. Fruit is a berry, 0.25 to 0.4 inches (6.4-10 mm) in diameter [36,37,127,133], with seeds 0.05 to 0.08 inches (1.3-2 mm) long [133].

Amur honeysuckle is an upright, spreading, deciduous shrub, 12 to 20 feet (3.7-6.1 m) tall with hollow branches [36,37,54,131]. Leaves are 1.4 to 3.5 inches (3.5-9 cm) long and 0.5 to 1.5 inches (1.3-3.8 cm) wide [37,54,131]. Fruit is a 0.08 to 0.25 inch (2-6.4 mm) diameter berry [36,37].

Morrow's honeysuckle is a deciduous shrub, 4.9 to 8 feet (1.5-2.4 m) tall and 6 to 10 feet (1.8-3 m) wide [37,152,161,175], "forming a broad, rounded, dense, tangled mound with foliage and branches to the ground" [37]. Leaves are 1 to 2.5 inches (2.5-6.4 cm) long and 0.5 to 1.25 inches (1.3-3.2 cm) wide [37,161]. The fruit is a 0.25 inch (6 mm) diameter berry [37].

Tatarian honeysuckle is an upright deciduous shrub, 3.3 to 12 feet

(1-3 m) tall and 10 feet (3 m) wide [18,37,54,59,93,155,157,161,176,191], often dense with fine branches [157]. Dirr [37] describes the Tatarian honeysuckle crown as "strongly multi-stemmed with the upper branches arching and the overall effect one of a dense, twiggy mass." Twigs are hollow [54], and 0.03 to 0.04 inches (0.8-1 mm) in diameter [157]. Bark has long, flat, thin scales and not much shredding [157], although older stems have shredding bark [59]. Leaves are 0.6 to 2.5 inches (1.5-6.4 cm) long and 0.2 to 1.5 inches (0.5-3.8 cm) wide [37,54,59,157,191]. Flowers are pedunculate and borne in sessile pairs in leaf axils [59,157,191]. Fruits are berries, 0.2 to 0.3 inch (4-8 mm) in diameter, borne singly or in pairs with the bases fused, with 3-6 seeds per fruit [37,59,157,191]. Seeds are about 0.1 inch (2.5-3 mm) long and 0.08 to 0.1 inch (2-2.5 mm) wide [59,157].

European fly honeysuckle is a rounded deciduous shrub with spreading arching branches, 3.3 to 10 feet (1-3 m) tall, 10 to 12 feet (3-3.7 m) wide, with hollow twigs [18,37,54,177].

Bell's honeysuckle is an erect shrub, 4 to 10 feet (1.2-3 m) tall and often at least as wide as it is tall [25,37,133]. It has a round growth habit with spreading, somewhat arching branches [37]. Leaves are 1 to 3 inches (2.5-7.6 cm) long [25]. Fruits are 0.25 to nearly 0.5 inch (6.5-13 mm) diameter round berries [25,37], with 2 to 6 seeds per fruit [37].

Age of Bell's honeysuckle shrubs studied in southern Wisconsin ranged from 12 to 34 years, with a mean of 20.4 years [7].

By excavating numerous Bell's honeysuckle shrubs in Wisconsin, it was determined that most roots occurred at a depth of 0.98 to 5.9 inches (2.5-15 cm), and in many cases extended well beyond crown width [7].

**Physiology:** Barnes and Cottam [8] found no difference in photosynthetic response of Bell's honeysuckle shrubs originating from wet and dry sites, and subjected to shaded and exposed light conditions. Similarly, they detected no difference in photosynthetic response of shrubs from either site to induced water stress.

**RAUNKIAER [134] LIFE FORM:**

- Phanerophyte
- Hemicryptophyte
- Geophyte

**REGENERATION PROCESSES:**

Bush honeysuckles regenerate from seeds, as well as vegetatively following disturbance.

**Breeding system:**
As of this writing (2005) there is very little available information about bush honeysuckle breeding systems. According to Stephens [157] Tatarian honeysuckle flowers are **perfect**.

**Pollination:** According to Hauser [68] Morrow's honeysuckle, Tatarian honeysuckle, and Bell's honeysuckle are pollinated by bumblebees. Graenicher states [58] Bell's honeysuckle is pollinated by a variety of bees and perhaps by hummingbirds.

**Seed production:**
Information about seed production is sparse, but it is apparent that some bush honeysuckles are capable of producing substantial numbers of seeds. Barnes [7] indicates Bell's honeysuckle produces consistent annual seed crops. A single "typical" Bell's honeysuckle shrub, about 6.6 feet (2 m) tall, growing in southern Wisconsin, produced 3,554 berries in 1 year. Numbers of seeds/fruit, sampled from several shrubs at this site, averaged 5 to 7, indicating that a "typical" plant may produce >20,000 seeds annually [7].

Estimates of annual fruit production for Amur honeysuckle and European fly honeysuckle in southwestern Ohio ranged from 0 to 1.2 million berries per plant, and approximately 400 million berries ha⁻¹ [80]. According to Welsh and others [191], winter honeysuckle fruits are "seldom formed", although no further explanation was provided.

There is some evidence for shrub age and size as determinants of reproductive ability. According to Sharp and Belcher [150], Amur honeysuckle plants begin flowering in the 3rd or 4th year, after which flowers appear on stems 2 years old and older. Deering and Vankat [33] compared reproductive state with shrub age and height within an Amur honeysuckle population in southwestern Ohio. Established shrubs took 3–8 years to reach reproductive age. At age 3 only 5.7% of individuals were reproductive, while >50% were reproductive by age 5. All shrubs ≥8.2 feet (2.5 m) tall were reproductive, while none <3.3 feet (1 m) tall were reproductive. Bell's honeysuckle shrubs may also produce fruit at as young as 3 years of age [7].

**Site characteristics**
may also affect seed production. Amur honeysuckle flowering and fruiting were significantly (p=0.001 and p=0.03, respectively) correlated with light availability in southern Vermont [139].

**Seed dispersal:**
Several sources indicate bush honeysuckle seeds are dispersed primarily by frugivorous birds [7,80,93,126,186]. Bartuszevige and Gorchov [12] showed that a wide variety of bird species consumed Amur honeysuckle fruit in southwestern Ohio. They also confirmed that American robins dispersed viable Amur honeysuckle seed, usually into woodlot edge and fencerow habitats. White-tailed deer may also consume and disperse viable seeds of Tatarian honeysuckle, Morrow's honeysuckle, Bell's honeysuckle, and Amur honeysuckle [180]. Barnes [7] suggests that "many, if not most" fruits fall near the parent plant. For more information see **Importance to Livestock and Wildlife**.

**Seed banking:**
It appears the potential for bush honeysuckles to form seed banks is low, but more research is needed to confirm this assertion and to determine interspecific differences. According to Luken and Mattimiro [105], seeds of Amur honeysuckle are "not long-lived in the soil." Hidayati and others [74] concluded that neither winter honeysuckle, Amur honeysuckle, or Morrow's honeysuckle have the potential to form persistent seed banks. However, Stevens and Jorgensen [158] found 12-year-old Tatarian honeysuckle seed to be still viable. They compared germination in seed stored for 12 years with fresh seed. Stored seeds were kept in a dry, open warehouse where temperatures over a 25-year study period ranged from -21.8 to 100.9 °F (-29.9 to 38.3 °C). Seeds from both lots were germinated over a 16-month period in a refrigerator (34 to 38 °F (1.1-3.3°C)). Germination rates were 57% for fresh seed and 31% for 12-year-old seed.

**Germination:** Bush honeysuckle germination requirements are variable between species.
Winter honeysuckle seeds require warm plus cold stratification prior to breaking dormancy. Although seeds mature in late spring/early summer, they generally will not germinate until late winter/early spring of the following year. A greenhouse study by Hidayati and others [74] indicated that winter honeysuckle seeds germinated while buried under 2 inches (5 cm) of leaf litter or 2.8 inches (7 cm) of soil.

Stratification requirements for Amur honeysuckle seed germination are unclear. According to Luken and Goessling [103], seeds are released in a nondormant condition, and germinate easily in warm, moist conditions. According to Hidayati and others [74], Amur honeysuckle seeds require a period of either warm- or cold stratification. Nevertheless, they are dispersed in fall and may germinate in fall or spring [74,103]. According to Hidayati and others [74], Amur honeysuckle seeds require a period of either warm- or cold stratification. Nevertheless, they are dispersed in fall and may germinate in fall or spring [74,103]. According to Hidayati and others [74], if seeds mature early enough and are subjected to a sufficiently long warm stratification period prior to onset of cold winter temperatures, they may germinate in fall. Late-maturing seeds are cold-stratified over winter, and will germinate in early spring when warm temperatures induce embryo growth.

Light seems to enhance Amur honeysuckle seed germination, but it is not obligatory. In a laboratory experiment, Amur honeysuckle germination was significantly (p<0.01) higher in light (35 µmol m⁻² s⁻¹, 14/10 hour light/dark photoperiod) than in dark (light excluded). Nevertheless, after 88 days, mean cumulative germination ranged from 53.7% to 81.3% in light, and from 31.3% to 55.0% in dark [103]. Hidayati and others [74] found that Amur honeysuckle seeds were not inhibited by burial under 2 inches (5 cm) of leaf litter or 2.8 inches (7 cm) of soil in a greenhouse.

Germination may be enhanced when seeds are separated from the fruit pulp. Bartuszevige and Gorchov [12] found that seeds within intact fruit were significantly less viable (44% germination) than either seeds that were separated from pulp by hand (76% germination) or seeds that had passed through the guts of American robins (86% germination), after 12 weeks of favorable laboratory germination conditions.

Morrow's honeysuckle seeds, which are dispersed in summer, require warm stratification only and typically germinate prior to winter [74]. Germination will occur in light or dark. Hidayati and others [74] found that, while Morrow's honeysuckle seeds germinated more readily under light than in dark under laboratory conditions, they were not inhibited by burial under 2 inches (5 cm) of leaf litter or 2.8 inches (7 cm) of soil in a greenhouse. A greenhouse study by Ruesink [139] demonstrated no effect of shading (25% vs. full light) on germination.

Tatarian honeysuckle seed germination is affected by scarification and cold stratification. Krefting and Roe [89] tested the effects of cold stratification, and ingestion and passage by American robins, on Tatarian honeysuckle seed germination. Unstratified seeds recovered from bird droppings germinated more readily (46%) than unstratified controls (24.5%). Stratification (90 days at 41 to 50 °F (5-10 °C) prior to feeding to birds) resulted in substantial improvement in germination, regardless of whether seeds had passed through bird guts (95% for bird ingested seeds, 92% for stratified controls). Although unstratified seed germinated more rapidly if passed through bird guts, this effect was not detected with stratified seed. Apparently avian frugivory has some positive effect on Tatarian honeysuckle seeds with seedcoat dormancy, while simultaneously, cold stratification is effective for breaking internal dormancy.

According to Barnes [7] Bell's honeysuckle germination is epigeal.

Seeds of Tatarian honeysuckle, Morrow's honeysuckle, Bell's honeysuckle, and Amur honeysuckle remain germinable following passage through the guts of white-tailed deer. Vellend [180] measured 76% germination for seeds collected from deer feces, compared with 81% for fresh-collected seeds.

Seedling establishment/growth:
Bush honeysuckle seedling establishment appears most successful where litter cover and herbaceous competition are sparse [126,185]. Luken [100] found that after clipping established Amur honeysuckle plants in forested and pasture habitats, Amur honeysuckle seedlings established in forested plots at approximately twice the rate of those in pastures. In pasture plots, grasses and forbs were relatively undisturbed, and probably continued suppression of Amur honeysuckle seedlings. Barnes [7] sampled Bell's honeysuckle seedling density and frequency at 4 sites in southern Wisconsin. The site with the highest seedling frequency (39%) was characterized as a red pine (Pinus

resinosas) and eastern white pine (P. strobus)-dominated overstory and a sparse understory. This site had a primarily pine straw litter layer of variable depth over sandy loam and loamy sand soils. Within this site, Bell's honeysuckle seedlings were found within microsites having little to no litter cover. The site with the greatest seedling density (5,280 seedlings acre\(^{-1}\)) contained a "very dense" population of mature Bell's honeysuckle shrubs, with near-continuous cover in some places. Observations indicate that at this site, seedlings occurred mainly under mature Bell's honeysuckle, where litter accumulation and herbaceous competition were sparse. Two other sites each had only 1 and 2 Bell's honeysuckle seedlings total. Among reasons provided for the paucity of seedlings at these sites were lack of soil disturbance, a thick layer of leaf litter from the oak overstory, and strong herbaceous and vine competition. A subsample was obtained from another section within 1 of these seedling-poor sites, where a dense population of mature Bell's honeysuckle shrubs had been eradicated during the previous year. Because of eradication treatments, plant litter and herbaceous competition were sparse. Consistent with other observations, substantial numbers of seedlings (26% occurrence, 2,560 seedlings acre\(^{-1}\)) were found where litter cover and herbaceous competition were sparse and a seed source had been present [7].

However, the relationship between canopy cover and bush honeysuckle seedling establishment and growth is not straightforward. According to a review by Nyboer [126], bush honeysuckles commonly establish under tall shrubs or trees that serve as perch areas for seed-dispersing birds. As discussed above, canopy shading may also suppress strong herbaceous competition and permit greater bush honeysuckle seedling establishment. However, too much shading may result in reduced seedling establishment and growth [98]. Luken and Goessling [103] studied Amur honeysuckle seedling establishment in forest patches dominated by sugar maple, white ash, and American elm in northern Kentucky. Seedling densities were greatest near the edges of forest patches and declined steadily toward their interior. While they were unable to establish a firm causal link between light levels and seedling densities, light levels and seedling densities were significantly positively correlated (\(p<0.05; r = 0.88\)) along transects from forest edge to interior. Ruesink [139] compared Morrow's honeysuckle greenhouse-grown seedlings under full-sun conditions with identical seedlings grown under 25% of full sun. After 50 days, full-sun seedlings were twice as tall and produced 6 times more aboveground biomass. It is likely that in most habitats where seeds are present, such as under the canopy of preexisting bush honeysuckle shrubs or where frugivorous birds find perch sites proximate to fruiting bush honeysuckles, any disturbance that increases light at ground level is likely to release bush honeysuckle seedlings [100].

Deering and Vankat [33] described the age structure and allometric development of a relatively isolated Amur honeysuckle population of recent origin (colonized ~1979) in southwestern Ohio. First-year shrubs averaged 1.3 feet (0.4 m) tall and 2 basal stems per shrub. Most individuals were >3.3 feet (1 m) tall by their 3rd year. For the first 4 years of development, numbers of 1-year-old stems averaged 2.2 to 2.6 per shrub. Individual plants averaged 4.3 total stems per plant by age 3. As shrubs reached reproductive age (beginning at 3-8 years), height growth continued, but recruitment of new stems ceased. With time, resource allocation shifted from new basal stem production and height growth in young shrubs to a balance of height growth, radial growth of existing stems, and reproduction in older shrubs [33].

Asexual regeneration:
Information on asexual regeneration in bush honeysuckles is generally sparse. Studies cited below are specific to Amur honeysuckle and Bell's honeysuckle. Although it seems likely that these traits are shared by other bush honeysuckles, applicability to other taxa is not confirmed. Since Bell's honeysuckle is a hybrid of Morrow's honeysuckle and Tatarian honeysuckle (see Taxonomy), it is likely that either or both of the parent species share the traits discussed for Bell's honeysuckle below. More information is needed to determine similarities and differences in the biology of asexual regeneration in bush honeysuckles.

Amur honeysuckle will sprout from adventitious buds on the root crown in response to stem damage [105,168]. Repeated cutting throughout the growing season results in continued but diminished sprouting (see Physical/mechanical control) [168]. The sprouting response of Amur honeysuckle to any particular stem damage event does not appear to diminish with stem age [105].
Bell's honeysuckle reproduces asexually by root suckering and layering [7]. Barnes [7] studied root suckering and layering in 4 populations of Bell's honeysuckle in Wisconsin. Between 4 and 7% of shrubs sampled exhibited suckers. Suckers were encountered primarily on small shrubs, and those found on large, mature plants were usually within 2 to 3 feet (60-90 cm) of the root crown. Frequency of layering was estimated by examining all branches of sampled shrubs in contact with the soil surface for evidence of root development. Layering frequency varied between sites, with 1 site having 3% of shrubs showing evidence of layering, 2 sites having 9%, and a 4th site 19%. Layering frequency appeared to be positively related to soil moisture and duration of contact between branch and soil, although there were no supporting data. Barnes [7] also indicated that suckering and layering occurred most frequently on sites where Bell's honeysuckle seedling establishment was poorest.

SITE CHARACTERISTICS:
It is likely that sites characteristics where bush honeysuckles occur in North America are generally similar for the 6 species considered in this summary. However, it is difficult to definitively ascertain which species share affinities for which site characteristics, especially when considered across the entire North American range of bush honeysuckle distribution. Information about site characteristics that favor bush honeysuckle establishment, persistence, and spread is often anecdotal. Consequently, the following information describes site characteristics where bush honeysuckles are likely to be found, but should not be considered a comprehensive assessment. More research is needed to determine relationships between various site characteristics and bush honeysuckle invasion.

In the North Carolina Piedmont and Coastal Plain, and in the South Carolina Piedmont, winter honeysuckle is found in woodlands and "waste places" [133]. In north-central Texas it escapes to "forest margins" [36].

According to Luken (personal observation cited in [104]) and Luken and others [98], in its native range, Amur honeysuckle commonly grows on sites with some type of canopy cover (open forests, flood plain forests, periodically disturbed floodplains, riparian habitats and scrub communities). In North America, it is found in both open and wooded habitats [99,131]. In southern Wisconsin, Cochrane [27] described Amur honeysuckle occurrence as mostly in partially shaded fencerows, weedy thickets, and brushy groves, and less frequently in woods [27]. In north-central Texas Amur honeysuckle escapes to "forest margins" [36], in Michigan it is found in "woods (upland and swampy), thickets, banks, fencerows, and often near a landscaped source" [186], and in southwestern Ohio it is mentioned as occurring in pastures and woodlands [18]. Hutchinson and Vankat [79] examined Amur honeysuckle distribution in southwestern Ohio along northerly and westerly transects, emanating from a
supposed central population source from which invasive populations have subsequently dispersed. Their results suggest Amur honeysuckle population spread is closely linked to forest cover and forest connectivity across the landscape. They propose that large expanses of agricultural land act as a barrier to dispersal, perhaps due to habitat constraints on frugivorous birds that disperse seeds. Medley [112] found that Amur honeysuckle density was significantly ($p = 0.001$) correlated with proximity to the edge of a 13 acre (5.2 ha) mature deciduous forest stand in southwestern Ohio. However, Amur honeysuckle stem basal area was also significantly ($p<0.05$) correlated with proximity to stream channels, with some of the largest individuals located near the center of the stand along streambanks.

In Michigan, Tatarian honeysuckle escapes to roadsides, railroads, thickets, lakeshores, riverbanks, and woods [186], and in the northern Great Plains it escapes to open...
woods, stream banks, or brushy pastures[59,157]. It is found in riverbank thickets, along roadsides, and in "waste land" in New England[149], along fence rows and stream banks in Montana and Wyoming[38], and in riparian areas along the Big Sioux River in eastern South Dakota[35]. According to White[193], Tatarian honeysuckle is present, though not common, on poorly-drained shrub-dominated sites in southeastern Wisconsin[193]. Moffatt and McLachlan[121] included Tatarian honeysuckle among indicator species found in disturbed riparian forest in southern Manitoba. It was 1 of 2 nonnative plant species that was significantly (p<0.05) more likely to occur within "urban" or "suburban" sites compared with "rural" (agricultural) or "reference" (undisturbed) sites.

In Michigan, Bell's honeysuckle is found in habitats similar to those of Tatarian honeysuckle and Morrow's honeysuckle[186]. It is found along roadsides and "scrub areas" bordering human habitation in the Adirondacks[25], and in thickets and "waste places" in New England and the Piedmont of North Carolina[133,149]. A review by Barnes[7] indicates a wide range of sites may support Bell's honeysuckle populations in Wisconsin, including roadsides, fencerows, pastures or fields, railroad rights-of-way, lake, river, or stream banks, and wooded areas, particularly within openings or edges of woods. Barnes[7] showed that Bell's honeysuckle distribution within the University of Wisconsin Madison Arboretum was aggregated. He reasoned that the observed patterns of distribution were strongly influenced by site characteristics favorable to seedling establishment (see above).

**Soils and topography:**

Soil requirements and tolerances vary among bush honeysuckles, but most taxa seem to grow best on well-drained sites.

Winter honeysuckle prefers moist but well-drained, loamy soil[127].

Amur honeysuckle performs best on moist, well-drained sites, but is adaptable to "poor" soils, compacted soils, various soil pHs, restricted root zones, drought and salt spray[17]. According to Vogel[185] the lower pH limit for Amur honeysuckle is 5.0. It escapes to calcareous slopes in north-central Texas[36], and grows in thin prairie soils over dolomite in southern Wisconsin[27]. Amur honeysuckle generally occurs in mesic habitats in Virginia[182]. According to Sharp and Belcher[150] the Amur honeysuckle cultivar 'Rem-Red' is "adapted" to deep, well-drained, fertile, sandy loam to clay loam soils, and is not "adapted" to droughty or wet soils. Lorenz and others[95] indicate that 'Rem-Red' "grows in medium-fertility, acid, clayey, loamy, and sandy soils, and tolerates somewhat poorly drained soil."
Morrow's honeysuckle prefers loamy, well-drained, moist soil [175]. In Virginia, it generally occurs in mesic habitats [182]. Vogel [185] reports that the lower pH limit for Morrow's honeysuckle is 5.0.

Barnes [7] indicates Tatarian honeysuckle occurs on a wide variety of soil types in central Asia. According to Lorenz and others [95], it "grows in medium-fertility, acid, clayey, loamy, and sandy soils, and tolerates moderately well-drained soil." Tatarian honeysuckle grows on peat and muck soils [110]. White [193] reports that it is present, though not common, on poorly-drained shrub-dominated sites in southeastern Wisconsin [193]. Tatarian honeysuckle generally occurs in mesic habitats in Virginia [182]. According to Vogel [185] the lower pH limit for Tatarian honeysuckle is 5.0. Tatarian honeysuckle is considered salt sensitive [166].

European fly honeysuckle performs best on moist, well-drained sites, but is adaptable to "poor" soils, various soil pHs, restricted root zones, drought, and salt spray, but is not tolerant of wet sites or poorly drained sites [17].

Mature Bell's honeysuckle shrubs were found growing over a variety of soils at the University of Wisconsin Madison Arboretum including: a) a droughty, infertile, loamy sand, b) a well- to moderately well drained, moderately fertile, silt loam, c) an imperfectly- to poorly drained silt loam, and d) a muck soil where the water table was at or near the surface in spring [7]. In a reciprocal transplant common garden experiment in southern Wisconsin, Barnes and Cottam [8] successfully transplanted Bell's honeysuckle shrubs at 2 sites with quite different soils. The wet site had muck soils with water-retaining capacity of 260% dry weight and organic matter content 64%, while the dry site was a loamy sand soil with water-retaining capacity of 50% dry weight and 2% organic matter. Survival of transplants, 50% at the dry site and 68% at the wet site, was not significantly different. Transplant origin (wet site or dry site) also did not affect performance at either common garden, indicating no evidence of ecotypic differentiation between populations based on soil type. Bell's honeysuckle generally occurs in mesic habitats in Virginia [182].

**Climate:** Winter honeysuckle is adapted to USDA zones 4-8 [37,114,127,173].

Amur honeysuckle distribution appears to be limited by drought and cold. Trisel [168] observed that during summer droughts in southwestern Ohio Amur honeysuckle leaves can become severely wilted, while native trees remain unaffected. However, based on unpublished data, it was further indicated that affected shrubs can fully recover from wilting with no apparent damage or mortality following rehydration. Trisel [168] also hypothesized that susceptibility to drought may result from its shallow root system, and that drought intolerance may be more pronounced in unshaded areas. Lorenz and others [95] characterize the Amur honeysuckle cultivar 'Rem-Red' as having "fair drought tolerance."

According to Trisel [168], Amur honeysuckle range expansion to the west and north may be limited by moisture and winter temperature. Several sources indicate that it is adapted to USDA zones 2-8 [17,37], or 3-8 [115,174]. Analysis of herbaria records by Trisel [168] indicates Amur honeysuckle "escapes" become limited in USDA zones 4-5 (winter low temperatures of -20.2 to -31 °F (-29 to -35 °C)). Lorenz and others [95] provide a map of plant hardiness zones of the northeastern U.S., based on average annual minimum temperature, and refer to these as "areas of climatic adaptation" where various plant species are recommended for planting for "conservation" purposes. They indicate that while some species "may grow in zones other than the ones indicated, maximum conservation effectiveness occurs within these zones." Based on this information, Amur honeysuckle is climatically adapted throughout the northeastern U.S. where average annual minimum temperature ranges from 20 to -30 °F (-6.7 to -34 °C).

Morrow's honeysuckle is adapted to USDA zones 4-6 and warmer parts of zone 3 [37,116,175].

Several sources indicate that Tatarian honeysuckle is adapted to USDA zones 3-8 [117,128,176], or 2-8 [37]. Lorenz and others [95] provide a map of plant hardiness zones of the northeastern U.S., based on average annual minimum temperature, and refer to these as "areas of climatic adaptation" where various plant species are recommended for planting for "conservation" purposes. They indicate that while some species "may grow in zones other than the ones indicated, maximum conservation effectiveness occurs within these zones." Based on this information, Tatarian honeysuckle is climatically adapted throughout the northeastern U.S. where average...
Annual minimum temperature ranges from 20 to -40 °F (-6.7 to -40 °C). Tatarian honeysuckle is apparently winter hardy in valleys of western Montana [93]. Lorenz and others [95] characterize Tatarian honeysuckle as having "fair drought tolerance."

European fly honeysuckle is adapted to USDA zones 4-6 [17,37,118]. Bell's honeysuckle is adapted to USDA zones 4-7 [37]. Average annual precipitation throughout the North American range of Bell's honeysuckle is between 9.8 and 59 inches (250-1500 mm), and average frost-free period is 80 to 240 days [8].

SUCCESSIONAL STATUS:
Bush honeysuckles are likely to occur across a variety of successional habitats within their North American range [152]. Luken and McKnight [101] suggest that Amur honeysuckle can dominate habitats ranging from recently disturbed areas to mature forest.

Several studies document the influence of bush honeysuckles in old-field succession. Foster and Gross [50] examined woody plant establishment following abandonment of cultivation in a southwestern Michigan old-field habitat. Tatarian honeysuckle established in the 3rd season following abandonment. Average density increased steadily from 6.7 stems/acre in the year of establishment, to 91.1 stems/acre 4 years later (7 years following abandonment of agriculture). Fike and Niering [47] documented nearly 40 years of vegetation change in an old-field habitat in southeastern Connecticut. This site was cultivated until about 1945 and grazed until 1951. The initial survey in 1954 indicated a continuous perennial herbaceous cover with scattered woody plants <3.3 feet (1 m) tall. By 1960 the herbaceous community had decreased slightly and tree species were becoming more established. Presence of Morrow's honeysuckle (<1% cover) was first recorded in 1973, in conjunction with development of a thicket community of small trees, shrubs, and woody vines. This woody stratum was 13 to 20 feet (4-6 m) in height and had >40% cover. By 1983 Morrow's honeysuckle cover increased to 10% in a community characterized as "a young hardwood forest", with tree cover of 90%, shrub/vine cover of 85%, and herbaceous cover decreasing to about 40%. By the end of this study in 1993, there was a relatively continuous tree canopy 40 to 59 feet (12-18 m) in height, a 3.3 to 6.6 feet (1-2 m) high shrub stratum contributing about 50% cover, and 10% herbaceous cover. Morrow's honeysuckle was the dominant shrub species at 24% cover. Vankat and Snyder [179] examined floristics of a chronosequence of nearby stands corresponding to old-field/deciduous-forest succession in southwestern Ohio. Amur honeysuckle was present, but not common, in a 10-year-old goldenrod (Solidago spp.)- and fescue (Festuca spp.)-dominated old field, and in an approximately 50-year-old goldenrod-dominated old field with a sparse white ash-black cherry tree stratum. Amur honeysuckle was codominant in the understory (3.3 to 9.8 feet (1-3 m) tall) with sugar maple, and codominant in the ground layer (<3.3 feet (1 m)) with jewelweed (Impatiens capensis), in an approximately 90-year-old sugar maple-slippery elm forest. Vankat and Snyder [179] concede that conclusions about successional status of Amur honeysuckle, based on the above data, are limited by the study design. Nevertheless, Amur honeysuckle was common in a young closed-canopy forest stand, sparse in 2 old fields with some woody plant composition but no closed canopy, and absent from a 2-year-old abandoned agricultural field and an old-growth American beech-sugar maple forest.

It appears that bush honeysuckle establishment is often facilitated by some form of habitat disturbance [152]. In forested habitats, Amur honeysuckle performs best near edges and in canopy gaps, where light levels are favorable [98].

Once established, the ability of bush honeysuckles to persist and spread within various successional habitats is less clear. Hutchinson and Vankat [78] assert that late successional forests dominated by shade-tolerant tree species such as sugar maple and American beech are more resistant to Amur honeysuckle invasion, probably due to low light levels near the forest floor. Luken [101] suggested forest patches having complete canopy closure can resist Amur honeysuckle invasion, but if canopy gaps are created, Amur honeysuckle can establish and persist. Bush honeysuckle populations, once established, can persist for many years. Age of Bell's honeysuckle shrubs studied in southern Wisconsin ranged from 12 to 34 years, with a mean of 20.4 years [7].
There are suggestions that bush honeysuckles could alter successional trajectories in ways that favor their persistence. Collier and others [29] hypothesized that Amur honeysuckle invasion may alter patterns of forest succession in southwestern Ohio. If development of a dense Amur honeysuckle shrub layer suppresses establishment of shade-tolerant tree seedlings, recruitment of mid- and late successional tree species may be inhibited. Hypothetically then, as older canopy trees die, closed-canopy forests could change to open-canopy woodlands or even Amur honeysuckle-dominated shrublands. Luken [100] demonstrated that Amur honeysuckle dominance in the shrub layer of northern Kentucky hardwood forests can suppress advance regeneration of overstory species. Woods [198] came to a similar conclusion after finding a significant (p<0.01) negative correlation between Tatarian honeysuckle cover and tree seedling (<3.3 feet (1 m tall)) density (in this study Tatarian honeysuckle and Bell's honeysuckle were not distinguished, although the text referred only to Tatarian honeysuckle (see Taxonomy)). In contrast, tree seedlings 3.3 to 6.6 feet (1-2 m) tall were not significantly (p<0.05) related to Tatarian honeysuckle cover. Woody seedlings in this larger size class frequently overtopped Tatarian honeysuckle. Examination of growth rings revealed that establishment of these larger seedlings predated Tatarian honeysuckle invasion. It was speculated that persistent Tatarian honeysuckle cover could suppress advance regeneration of overstory species, possibly leading to changes in canopy composition or even conversion of forests to more open canopies or shrublands. Gorchov and Trisel [55] provide direct evidence that Amur honeysuckle invasion can inhibit tree seedling establishment in southwestern Ohio. For further discussion, see Impacts.

**Shade tolerance:**

Most sources characterize bush honeysuckles as intermediate in shade tolerance, adapted to grow in full sun to partial shade conditions [17,95,127,173,174,175,177,185]. Descriptions of Amur honeysuckle shade tolerance range from shade intolerant [98] to intermediate [185] to tolerant [174] to "amazing" shade tolerance [37].

Virginia Department of Conservation and Recreation [182] indicates the following light regimes for bush honeysuckles occurring in Virginia:

<table>
<thead>
<tr>
<th></th>
<th>Full Sun</th>
<th>Part Sun</th>
<th>Shade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter honeysuckle</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Amur honeysuckle</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Morrow's honeysuckle</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Tatarian honeysuckle</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Bell's honeysuckle</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

One reason often cited for an apparent competitive advantage of bush honeysuckles over native shrubs (see Impacts) is the ability of bush honeysuckles to respond rapidly to changes in light availability. While bush honeysuckles have some ability to establish and persist in relatively low light environments, growth is typically greatest under high light availability. For example, Harrington and others [66] found Bell's honeysuckle aboveground growth rates were significantly (p=0.0008) higher in open habitat than under a mature closed-canopy hardwood forest. Amur honeysuckle can respond to gap formation in otherwise shaded habitats via phenotypic plasticity in photosynthetic capability of shade-grown leaves, as well as by rapid stem elongation and production of new leaves with even greater photosynthetic capacity [98]. Luken and others [104] compared performance of Amur honeysuckle shrubs with the indigenous shade-tolerant northern spicebush (*Lindera benzoin*), under shade and full sun. They transplanted forest-grown plants into pots and grew them in a greenhouse under full sun, 25% full sun, or 1% full sun treatments. Relative stem growth rates (integrated over an 11-week period) under the 1% full sun treatment were similar for both species. Amur honeysuckle stem growth was greatest under full sun, while maximum stem growth for northern spicebush occurred under the 25% full sun treatment. Amur honeysuckle stem growth was substantially greater than spicebush under both the 25% and 100% full sun treatments. Observed differences in leaf-level morphology and physiology, and biomass allocation indicate that Amur honeysuckle has a much greater ability than spicebush to acclimate and respond to enhanced light levels that might occur following forest canopy disturbance. This trait, coupled with an ability to tolerate heavy shade comparable to native shade-tolerant shrubs such as spicebush, indicates Amur honeysuckle may be highly competitive under a range of conditions, and may persist under a variety of successional stages and pathways in eastern deciduous forests.
SEASONAL DEVELOPMENT:
A reason often cited for an apparent competitive advantage of bush honeysuckles over native shrubs (see Impacts) is the advantage of longer leaf display. Barnes [7] compared Bell's honeysuckle leaf lifespan with that of several native shrub species in southern Wisconsin. Average period for functional leaves on Bell's honeysuckle shrubs at this site was May 18 to October 30. The following table provides observed duration from fully expanded leaves to the time when 50% of leaves are no longer green for sympatric shrub species in southern Wisconsin.

<table>
<thead>
<tr>
<th>Days</th>
<th>Bell's honeysuckle</th>
<th>gray dogwood (Cornus racemosa)</th>
<th>red-osier dogwood (Cornus sericea)</th>
<th>American hazel (Corylus americana)</th>
<th>chokecherry (Prunus virginiana)</th>
<th>common buckthorn</th>
<th>red raspberry (Rubus idaeus)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>169</td>
<td>111</td>
<td>111</td>
<td>111</td>
<td>140</td>
<td>165</td>
<td>160</td>
<td></td>
</tr>
</tbody>
</table>

Trisel [168] studied leaf phenology of Amur honeysuckle and some sympatric tree and shrub species in southwestern Ohio. During all 3 years studied, Amur honeysuckle displayed fully expanded leaves for significantly (p<0.001) longer than all native species (except northern red oak and slippery elm whose small sample size precluded comparison). Amur honeysuckle was always the 1st species to expand leaves and the last to lose them. During 1994, Amur honeysuckle began leaf expansion in March and retained leaves into late November. The following table provides, for each species studied, the mean number of days between the initial and last census date during which expanded green leaves accounted for >50% of that individual's total number of leaves.

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar maple</td>
<td>166</td>
<td>163</td>
</tr>
<tr>
<td>Ohio buckeye (Aesculus glabra)</td>
<td>111</td>
<td>136</td>
</tr>
<tr>
<td>pawpaw (Asimina triloba)</td>
<td>166</td>
<td>165</td>
</tr>
<tr>
<td>bitternut hickory</td>
<td>152</td>
<td>153</td>
</tr>
<tr>
<td>eastern redbud (Cercis canadensis)</td>
<td></td>
<td>151</td>
</tr>
<tr>
<td>American beech</td>
<td>170</td>
<td>157</td>
</tr>
<tr>
<td>white ash</td>
<td>157</td>
<td>155</td>
</tr>
<tr>
<td>blue ash (Fraxinus quadrangulata)</td>
<td>162</td>
<td>155</td>
</tr>
<tr>
<td>northern spicebush</td>
<td>171</td>
<td>167</td>
</tr>
<tr>
<td>Amur honeysuckle</td>
<td>238</td>
<td>207</td>
</tr>
<tr>
<td>black cherry</td>
<td>198</td>
<td>194</td>
</tr>
<tr>
<td>northern red oak</td>
<td>174</td>
<td>169</td>
</tr>
<tr>
<td>slippery elm</td>
<td>181</td>
<td>184</td>
</tr>
<tr>
<td>blackhaw (Viburnum prunifolium)</td>
<td>195</td>
<td>185</td>
</tr>
</tbody>
</table>

Harrington and others [65] demonstrated phenological differences in carbon gain between Bell's honeysuckle and the native shrub gray dogwood in southern Wisconsin. Under the canopy of a mature deciduous forest where understory light was about 4-6% of ambient levels, Bell's honeysuckle shrubs made approximately 47% of their annual carbon gain (35% in spring and 12% in fall) during two 2-week periods when gray dogwood was leafless. Leaf emergence in Bell's honeysuckle was around April 10, approximately 2 weeks prior to gray dogwood. Bell's honeysuckle retained leaves until around November 10, about 2 weeks longer than gray dogwood.

Reported flowering dates for bush honeysuckles:
<table>
<thead>
<tr>
<th>Location</th>
<th>blooming period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adirondacks</td>
<td>May-June</td>
</tr>
<tr>
<td>southern Appalachians ([144,145,146,147])</td>
<td>May-June</td>
</tr>
<tr>
<td>Blue Ridge Mountains (TN, VA) [197]</td>
<td>May-June</td>
</tr>
<tr>
<td>Connecticut ([173,174,175,176,177])</td>
<td>early spring mid-spring mid-spring May</td>
</tr>
<tr>
<td>Great Plains [59]</td>
<td>May-June</td>
</tr>
<tr>
<td>north-central Great Plains [157]</td>
<td>late April-May</td>
</tr>
<tr>
<td>northern Illinois [26]</td>
<td>mid-May to mid-June</td>
</tr>
<tr>
<td>Michigan</td>
<td>spring [114]</td>
</tr>
<tr>
<td>Minnesota [54]</td>
<td>May-June</td>
</tr>
<tr>
<td>New England [149]</td>
<td>May mid-May to mid-June mid-May to early June</td>
</tr>
<tr>
<td>eastern Canada and northern New England [81]</td>
<td></td>
</tr>
<tr>
<td>southern New England [81]</td>
<td></td>
</tr>
<tr>
<td>North Carolina Piedmont [133]</td>
<td></td>
</tr>
<tr>
<td>North Carolina Piedmont and Coastal Plain; South Carolina Piedmont [133]</td>
<td>February-early April</td>
</tr>
<tr>
<td>northeastern U.S. [95]</td>
<td></td>
</tr>
<tr>
<td>northeastern U.S. and adjacent Canada [54]</td>
<td></td>
</tr>
<tr>
<td>Ohio</td>
<td>May-June [17]</td>
</tr>
<tr>
<td>southwestern Ohio [80]</td>
<td></td>
</tr>
<tr>
<td>western Oregon [127,128]</td>
<td>December-March</td>
</tr>
<tr>
<td>southeastern U.S. [165]</td>
<td>January-February</td>
</tr>
<tr>
<td>north-central Texas [36]</td>
<td>January-April March</td>
</tr>
<tr>
<td>West Virginia [161]</td>
<td>May-June</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>May-June [54]</td>
</tr>
<tr>
<td>southeastern Wisconsin [58]</td>
<td></td>
</tr>
<tr>
<td>Wildlife Management District of Canada [54]</td>
<td></td>
</tr>
</tbody>
</table>
Reported fruiting dates for bush honeysuckles (This information represents a general guideline. Fruiting dates vary among sites and years. Observations of "fruiting" are typically subjective and may refer to fruit formation or ripening):

<table>
<thead>
<tr>
<th>Species</th>
<th>Winter honeysuckle</th>
<th>Amur honeysuckle</th>
<th>Morrow' honeysuckle</th>
<th>Tatarian honeysuckle</th>
<th>European fly honeysuckle</th>
<th>Bell's honeysuckle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adirondacks [25]</td>
<td></td>
<td>Winter honeysuckle</td>
<td></td>
<td></td>
<td></td>
<td>August</td>
</tr>
<tr>
<td>southern Appalachians [144,145,146,147]</td>
<td></td>
<td>August-September</td>
<td>June-July</td>
<td>June-July</td>
<td></td>
<td>June to mid-summer</td>
</tr>
<tr>
<td>Connecticut [173,174,175,176,177]</td>
<td>mid-summer</td>
<td>late summer</td>
<td>late summer</td>
<td>July-August</td>
<td>August</td>
<td></td>
</tr>
<tr>
<td>Great Plains [59]</td>
<td></td>
<td></td>
<td>mid-summer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>north-central Great Plains [157]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>southern New Jersey [150]</td>
<td></td>
<td>October-November</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North Carolina Piedmont and Coastal Plain; South Carolina Piedmont [133]</td>
<td>April-May</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>northeastern U.S.</td>
<td></td>
<td>late fall [95]</td>
<td>July [95], October</td>
<td>August [81]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ohio [17]</td>
<td></td>
<td>September</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>southwestern Ohio [80]</td>
<td></td>
<td>early June-early September</td>
<td>early June-early September</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western Oregon [127]</td>
<td>late spring</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wisconsin [7]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>late June-late September</td>
</tr>
</tbody>
</table>

Amur honeysuckle and Bell's honeysuckle fruit can persist on the plant well into winter [12, 97, 150, 185], while Morrow's honeysuckle and Tatarian honeysuckle fruit abscise soon after ripening [150, 185].

FIRE ECOLOGY

SPECIES: Lonicera spp.

- **FIRE ECOLOGY OR ADAPTATIONS**
- **POSTFIRE REGENERATION STRATEGY**

FIRE ECOLOGY OR ADAPTATIONS:
Information about the fire ecology of bush honeysuckles is lacking.

Fire adaptations:
Although no information could be found regarding the evolutionary relationship between fire and bush honeysuckles in their native ranges, it appears that bush honeysuckles are adapted to survive fire by shielding perennating buds below the soil surface on roots and/or the root crown. Postfire sprouting has been documented [7, 75, 87, 102, 126, 152] (see Fire Effects), although it is unclear if all bush honeysuckle taxa discussed possess similar abilities.
Fire regimes:
Information about bush honeysuckles and fire regimes is lacking. Research is needed that examines the interactions of fire and bush honeysuckles, effects these interactions may have on native communities and ecosystems, and effects on their respective fire regimes. For example, bush honeysuckles are present in oak-dominated communities in the eastern U.S. [57,87,119,163]. Historically, fire has been an important ecological influence in oak forests, woodlands, and savannas [34]. Understanding the response of bush honeysuckles (and other nonnative species) to periodic fire could be critical for management and restoration efforts in these and other areas.

The following table lists fire return intervals for communities or ecosystems throughout North America where bush honeysuckles may occur. This list is presented as a guideline to illustrate historic fire regimes and is not to be interpreted as a strict description of fire regimes for bush honeysuckles. For further information on fire regimes in these communities or ecosystems see the corresponding FEIS summary for the dominant taxa listed below.

<table>
<thead>
<tr>
<th>Community or Ecosystem</th>
<th>Dominant Species</th>
<th>Fire Return Interval Range (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>silver fir-Douglas-fir</td>
<td><em>Abies amabilis-Pseudotsuga menziesii</em> var. <em>menziesii</em></td>
<td>&gt; 200</td>
</tr>
<tr>
<td>grand fir</td>
<td><em>Abies grandis</em></td>
<td>35-200 [1]</td>
</tr>
<tr>
<td>maple-beech-birch</td>
<td><em>Acer-Fagus-Betula</em></td>
<td>&gt; 1,000</td>
</tr>
<tr>
<td>silver maple-American elm</td>
<td><em>Acer saccharinum-Ulmus americana</em></td>
<td>&lt; 35 to 200</td>
</tr>
<tr>
<td>sugar maple</td>
<td><em>Acer saccharum</em></td>
<td>&gt; 1,000</td>
</tr>
<tr>
<td>sugar maple-basswood</td>
<td><em>Acer saccharum-Tilia americana</em></td>
<td>&gt; 1,000 [187]</td>
</tr>
<tr>
<td>California chaparral</td>
<td><em>Adenostoma</em> and/or <em>Arctostaphylos</em> spp.</td>
<td>&lt; 35 to &lt; 100 [129]</td>
</tr>
<tr>
<td>bluestem prairie</td>
<td><em>Andropogon gerardii</em> var. <em>gerardii-Schizachyrium scoparium</em></td>
<td>&lt; 10 [90,129]</td>
</tr>
<tr>
<td>Nebraska sandhills prairie</td>
<td><em>Andropogon gerardii</em> var. <em>paucipilus-Schizachyrium scoparium</em></td>
<td>&lt; 10</td>
</tr>
<tr>
<td>bluestem-Sacahuista prairie</td>
<td><em>Andropogon littoralis-Spartina spartinae</em></td>
<td>&lt; 10 [129]</td>
</tr>
<tr>
<td>silver sagebrush steppe</td>
<td><em>Artemisia cana</em></td>
<td>5-45 [73,132,199]</td>
</tr>
<tr>
<td>sagebrush steppe</td>
<td><em>Artemisia tridentata/Pseudoroegneria spicata</em></td>
<td>20-70 [129]</td>
</tr>
<tr>
<td>basin big sagebrush</td>
<td><em>Artemisia tridentata</em> var. <em>tridentata</em></td>
<td>12-43 [140]</td>
</tr>
<tr>
<td>mountain big sagebrush</td>
<td><em>Artemisia tridentata</em> var. <em>vaseyanana</em></td>
<td>15-40 [3,22,120]</td>
</tr>
<tr>
<td>Wyoming big sagebrush</td>
<td><em>Artemisia tridentata</em> var. <em>wyomingensis</em></td>
<td>10-70 (40**) [181,201]</td>
</tr>
<tr>
<td>coastal sagebrush</td>
<td><em>Artemisia californica</em></td>
<td>&lt; 35 to &lt; 100</td>
</tr>
<tr>
<td>saltbush-greasewood</td>
<td><em>Atriplex confertifolia-Sarcobatus vermiculatus</em></td>
<td>&lt; 35 to &lt; 100 [129]</td>
</tr>
<tr>
<td>plains grasslands</td>
<td><em>Bouteloua</em> spp.</td>
<td>&lt; 35 [129,199]</td>
</tr>
<tr>
<td>blue grama-needle-and-thread grass-western wheatgrass</td>
<td><em>Bouteloua gracilis-Hesperostipa comata-Pascopyrum smithii</em></td>
<td>&lt; 35 [129,138,199]</td>
</tr>
<tr>
<td>blue grama-buffalo grass</td>
<td><em>Bouteloua gracilis-Buchloe dactyloides</em></td>
<td>&lt; 35 [129,199]</td>
</tr>
<tr>
<td>cheatgrass</td>
<td><em>Bromus tectorum</em></td>
<td>&lt; 10 [130,192]</td>
</tr>
<tr>
<td>California montane chaparral</td>
<td><em>Ceanothus</em> and/or <em>Arctostaphylos</em> spp.</td>
<td>50-100 [129]</td>
</tr>
<tr>
<td>Species</td>
<td>Common Name</td>
<td>Habitat</td>
</tr>
<tr>
<td>---------------------------------------------</td>
<td>------------------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>sugarberry-America elm-green ash</td>
<td>Celtis laevigata-Ulmus americana- Fraxinus pennsylvanica</td>
<td>&lt; 35 to 200 [187]</td>
</tr>
<tr>
<td>curlleaf mountain-mahogany*</td>
<td>Cercocarpus ledifolius</td>
<td>13-1,000 [5,143]</td>
</tr>
<tr>
<td>mountain-mahogany-Gambel oak scrub</td>
<td>Cercocarpus ledifolius- Quercus gambelii</td>
<td>&lt; 35 to &lt; 100 [129]</td>
</tr>
<tr>
<td>Atlantic white-cedar</td>
<td>Chamaecyparis thyoides</td>
<td>35 to &gt; 200 [187]</td>
</tr>
<tr>
<td>blackbrush</td>
<td>Coleogyne ramosissima</td>
<td>&lt; 35 to &lt; 100</td>
</tr>
<tr>
<td>northern cordgrass prairie</td>
<td>Distichlis spicata-Spartina spp.</td>
<td>1-3 [129]</td>
</tr>
<tr>
<td>beech-sugar maple</td>
<td>Fagus spp.-Acer saccharum</td>
<td>&gt; 1,000 [187]</td>
</tr>
<tr>
<td>California steppe</td>
<td>Festuca-Danthonia spp.</td>
<td>&lt; 35 [129,160]</td>
</tr>
<tr>
<td>black ash</td>
<td>Fraxinus nigra</td>
<td>&lt; 35 to 200 [187]</td>
</tr>
<tr>
<td>Ashe juniper</td>
<td>Juniperus ashei</td>
<td>&lt; 35</td>
</tr>
<tr>
<td>western juniper</td>
<td>Juniperus occidentalis</td>
<td>20-70</td>
</tr>
<tr>
<td>Rocky Mountain juniper</td>
<td>Juniperus scopulorum</td>
<td>&lt; 35 [129]</td>
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<tr>
<td>cedar glades</td>
<td>Juniperus virginiana</td>
<td>3-22 [63,129]</td>
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<tr>
<td>tamarack</td>
<td>Larix laricina</td>
<td>35-200 [129]</td>
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<tr>
<td>western larch</td>
<td>Larix occidentalis</td>
<td>25-350 [2,10,31]</td>
</tr>
<tr>
<td>creosotebush</td>
<td>Larrea tridentata</td>
<td>&lt; 35 to &lt; 100 [129]</td>
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<tr>
<td>yellow-poplar</td>
<td>Liriodendron tulipifera</td>
<td>&lt; 35 [187]</td>
</tr>
<tr>
<td>wheatgrass plains grasslands</td>
<td>Pascopyrum smithii</td>
<td>&lt; 5-47+ [129,132,199]</td>
</tr>
<tr>
<td>Great Lakes spruce-fir</td>
<td>Picea-Abies spp.</td>
<td>35 to &gt; 200</td>
</tr>
<tr>
<td>northeastern spruce-fir</td>
<td>Picea-Abies spp.</td>
<td>35-200 [40]</td>
</tr>
<tr>
<td>southeastern spruce-fir</td>
<td>Picea-Abies spp.</td>
<td>35 to &gt; 200 [187]</td>
</tr>
<tr>
<td>Engelmann spruce-subalpine fir</td>
<td>Picea engelmannii-Abies lasiocarpa</td>
<td>35 to &gt; 200 [1]</td>
</tr>
<tr>
<td>black spruce</td>
<td>Picea mariana</td>
<td>35-200</td>
</tr>
<tr>
<td>conifer bog*</td>
<td>Picea mariana-Larix laricina</td>
<td>35-200 [40]</td>
</tr>
<tr>
<td>blue spruce*</td>
<td>Picea pungens</td>
<td>35-200 [1]</td>
</tr>
<tr>
<td>red spruce*</td>
<td>Picea rubens</td>
<td>35-200 [40]</td>
</tr>
<tr>
<td>pine-cypress forest</td>
<td>Pinus-Cupressus spp.</td>
<td>&lt; 35 to 200 [1]</td>
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<tr>
<td>jack pine</td>
<td>Pinus banksiana</td>
<td>&lt; 35 to 200 [40]</td>
</tr>
<tr>
<td>Rocky Mountain lodgepole pine*</td>
<td>Pinus contorta var. latifolia</td>
<td>25-340 [9,10,164]</td>
</tr>
<tr>
<td>Sierra lodgepole pine*</td>
<td>Pinus contorta var. murrayana</td>
<td>35-200 [1]</td>
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<tr>
<td>shortleaf pine</td>
<td>Pinus echinata</td>
<td>2-15</td>
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<tr>
<td>shortleaf pine-oak</td>
<td>Pinus echinata-Quercus spp.</td>
<td>&lt; 10 [187]</td>
</tr>
<tr>
<td>Colorado pinyon</td>
<td>Pinus edulis</td>
<td>10-400+ [49,56,84,129]</td>
</tr>
<tr>
<td>slash pine</td>
<td>Pinus elliottii</td>
<td>3-8 [187]</td>
</tr>
<tr>
<td>Jeffrey pine</td>
<td>Pinus jeffreyi</td>
<td>5-30</td>
</tr>
<tr>
<td>western white pine*</td>
<td>Pinus monticola</td>
<td>50-200 [1]</td>
</tr>
<tr>
<td>longleaf-slash pine</td>
<td>Pinus palustris-P. elliottii</td>
<td>1-4 [124,187]</td>
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<tr>
<td>Species</td>
<td>Common Name</td>
<td>Range</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>--------------------------------------------------</td>
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<tr>
<td>Lonicera spp.</td>
<td></td>
<td></td>
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<tr>
<td>Pinus palustris-Quercus spp.</td>
<td>longleaf pine-scrub oak</td>
<td>6-10 [187]</td>
</tr>
<tr>
<td>Pinus ponderosa var. ponderosa</td>
<td>Pacific ponderosa pine*</td>
<td>1-47 [1]</td>
</tr>
<tr>
<td>Pinus ponderosa var. scopulorum</td>
<td>interior ponderosa pine*</td>
<td>2-30 [1,6,94]</td>
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<tr>
<td>Pinus ponderosa var. arizonica</td>
<td>Arizona pine</td>
<td>2-15 [6,30,148]</td>
</tr>
<tr>
<td>Pinus pungens</td>
<td>Table Mountain pine</td>
<td>&lt; 35 to 200 [187]</td>
</tr>
<tr>
<td>Pinus resinosa</td>
<td>red pine (Great Lakes region)</td>
<td>10-200 (10**)</td>
</tr>
<tr>
<td>Pinus resinosa-P. strobus-P. banksiana</td>
<td>red-white-jack pine*</td>
<td>10-300 [40,70]</td>
</tr>
<tr>
<td>Pinus rigida</td>
<td>pitch pine</td>
<td>6-25 [21,71]</td>
</tr>
<tr>
<td>Pinus serotina</td>
<td>pocosin</td>
<td>3-8</td>
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<tr>
<td>Pinus serotina</td>
<td>pond pine</td>
<td>3-8</td>
</tr>
<tr>
<td>Pinus strobus</td>
<td>eastern white pine</td>
<td>35-200</td>
</tr>
<tr>
<td>Pinus strobus-Tsuga canadensis</td>
<td>eastern white pine-eastern hemlock</td>
<td>35-200</td>
</tr>
<tr>
<td>Pinus strobus-Quercus rubra-Acer rubrum</td>
<td>eastern white pine-northern red oak-red maple</td>
<td>35-200</td>
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<tr>
<td>Pinus taeda</td>
<td>loblolly pine</td>
<td>3-8</td>
</tr>
<tr>
<td>Pinus taeda-P. echinata</td>
<td>loblolly-shortleaf pine</td>
<td>10 to &lt; 35</td>
</tr>
<tr>
<td>Pinus virginiana</td>
<td>Virginia pine</td>
<td>10 to &lt; 35</td>
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<tr>
<td>Pinus virginiana-Quercus spp.</td>
<td>Virginia pine-oak</td>
<td>10 to &lt; 35</td>
</tr>
<tr>
<td>Platanus occidentalis-Liquidambar styraciflua-Ulmus americana</td>
<td>sycamore-sweetgum-American elm</td>
<td>&lt; 35 to 200 [187]</td>
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<tr>
<td>Pleuraphis jamesii-Aristida purpurea</td>
<td>galleta-threeawn shrubsteppe</td>
<td>&lt; 35 to &lt; 100</td>
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<tr>
<td>Populus deltoides</td>
<td>eastern cottonwood</td>
<td>&lt; 35 to 200 [129]</td>
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<tr>
<td>Populus tremuloides-Betula papyrifera</td>
<td>aspen-birch</td>
<td>35-200 [40,187]</td>
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<tr>
<td>Populus tremuloides</td>
<td>quaking aspen (west of the Great Plains)</td>
<td>7-120 [1,62,113]</td>
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<tr>
<td>Prosopis glandulosa var. glandulosa</td>
<td>Texas savanna</td>
<td>&lt; 10 [129]</td>
</tr>
<tr>
<td>Prunus serotina-Acer saccharum</td>
<td>black cherry-sugar maple</td>
<td>&gt; 1,000 [187]</td>
</tr>
<tr>
<td>Pseudotsuga menziesii var. glauca</td>
<td>Rocky Mountain Douglas-fir*</td>
<td>25-100 [1,3,4]</td>
</tr>
<tr>
<td>Pseudotsuga menziesii var. menziesii</td>
<td>coastal Douglas-fir*</td>
<td>40-240 [1,123,136]</td>
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<tr>
<td>Pseudotsuga menziesii var. menziesii-Lithocarpus densiflorus-Arbutus menziesii</td>
<td>California mixed evergreen</td>
<td>&lt; 35</td>
</tr>
<tr>
<td>Quercus spp.</td>
<td>California oakwoods</td>
<td>&lt; 35 [1]</td>
</tr>
<tr>
<td>Quercus-Carya spp.</td>
<td>oak-hickory</td>
<td>&lt; 35</td>
</tr>
<tr>
<td>Quercus-Pinus spp.</td>
<td>northeastern oak-pine</td>
<td>10 to &lt; 35 [187]</td>
</tr>
<tr>
<td>Quercus-Nyssa-spp.-Taxodium distichum</td>
<td>oak-gum-cypress</td>
<td>35 to &gt; 200 [124]</td>
</tr>
<tr>
<td>Quercus-Pinus spp.</td>
<td>southeastern oak-pine</td>
<td>&lt; 10 [187]</td>
</tr>
<tr>
<td>Quercus agrifolia</td>
<td>coast live oak</td>
<td>2-75 [61]</td>
</tr>
<tr>
<td>Quercus alba-Q. velutina-Q. rubra</td>
<td>white oak-black oak-northern red oak</td>
<td>&lt; 35 [187]</td>
</tr>
<tr>
<td>Quercus chrysolepis</td>
<td>canyon live oak</td>
<td>&lt;35 to 200</td>
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</tbody>
</table>
Species: Lonicera spp.

<table>
<thead>
<tr>
<th>Species</th>
<th>Scientific Name</th>
<th>Fire Return Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>blue oak-foothills pine</td>
<td>Quercus douglasii-P. sabiniana</td>
<td>&lt;35 [1]</td>
</tr>
<tr>
<td>northern pin oak</td>
<td>Quercus ellipsoidalis</td>
<td>&lt;35 [187]</td>
</tr>
<tr>
<td>Oregon white oak</td>
<td>Quercus garryana</td>
<td>&lt;35 [1]</td>
</tr>
<tr>
<td>bear oak</td>
<td>Quercus ilicifolia</td>
<td>&lt;35 [187]</td>
</tr>
<tr>
<td>California black oak</td>
<td>Quercus kelloggii</td>
<td>5-30 [129]</td>
</tr>
<tr>
<td>bur oak</td>
<td>Quercus macrocarpa</td>
<td>&lt;10 [187]</td>
</tr>
<tr>
<td>oak savanna</td>
<td>Quercus macrocarpa/Andropogon</td>
<td>2-14 [129,187]</td>
</tr>
<tr>
<td>shinnery</td>
<td>Quercus mohriana</td>
<td>&lt;35 [129]</td>
</tr>
<tr>
<td>chestnut oak</td>
<td>Quercus prinus</td>
<td>3-8</td>
</tr>
<tr>
<td>northern red oak</td>
<td>Quercus rubra</td>
<td>10 to &lt;35</td>
</tr>
<tr>
<td>post oak-blackjack oak</td>
<td>Quercus stellata-Q. marilandica</td>
<td>&lt;10</td>
</tr>
<tr>
<td>black oak</td>
<td>Quercus velutina</td>
<td>&lt;35 [187]</td>
</tr>
<tr>
<td>interior live oak</td>
<td>Quercus wislizenii</td>
<td>&lt;35 [1]</td>
</tr>
<tr>
<td>blackland prairie</td>
<td>Schizachyrium scoparium-Nassella</td>
<td>&lt;10 [187]</td>
</tr>
<tr>
<td>little bluestem-grama prairie</td>
<td>Schizachyrium scoparium-Bouteloua spp.</td>
<td>&lt;35 [129]</td>
</tr>
<tr>
<td>redwood</td>
<td>Sequoia sempervirens</td>
<td>5-200 [1,48,162]</td>
</tr>
<tr>
<td>southern cordgrass prairie</td>
<td>Spartina alterniflora</td>
<td>1-3 [129]</td>
</tr>
<tr>
<td>baldcypress</td>
<td>Taxodium distichum var. distichum</td>
<td>100 to &gt;300</td>
</tr>
<tr>
<td>pondcypress</td>
<td>Taxodium distichum var. nutans</td>
<td>&lt;35 [124]</td>
</tr>
<tr>
<td>western redcedar-western hemlock</td>
<td>Thuja plicata-Tsuga heterophylla</td>
<td>&gt;200 [1]</td>
</tr>
<tr>
<td>eastern hemlock-yellow birch</td>
<td>Tsuga canadensis-Betula alleghaniensis</td>
<td>&gt;200 [187]</td>
</tr>
<tr>
<td>western hemlock-Sitka spruce</td>
<td>Tsuga heterophylla-Picea sitchens</td>
<td>&gt;200 [1]</td>
</tr>
<tr>
<td>elm-ash-cottonwood</td>
<td>Ulmus-Fraxinus-Populus spp.</td>
<td>&lt;35 to 200 [40,187]</td>
</tr>
</tbody>
</table>

*fire return interval varies widely; trends in variation are noted in the species review
**mean

POSTFIRE REGENERATION STRATEGY [159]:
Tall shrub, adventitious bud/root crown
Small shrub, adventitious bud/root crown
Geophyte, growing points deep in soil
Ground residual colonizer (on-site, initial community)
Crown residual colonizer (on-site, initial community)
Initial off-site colonizer (off-site, initial community)
Secondary colonizer (on-site or off-site seed sources)

FIRE EFFECTS

SPECIES: Lonicera spp.

- IMMEDIATE FIRE EFFECT ON PLANT
- DISCUSSION AND QUALIFICATION OF FIRE EFFECT
PLANT RESPONSE TO FIRE

DISCUSSION AND QUALIFICATION OF PLANT RESPONSE

FIRE MANAGEMENT CONSIDERATIONS

IMMEDIATE FIRE EFFECT ON PLANT:
Fire may top-kill bush honeysuckle plants, and is likely to kill seedlings and unhealthy plants [75,126,152]. However, perennating tissues on roots and root crowns are often protected from fire damage by soil. By excavating numerous Bell's honeysuckle shrubs in Wisconsin, it was determined that most roots occurred at a depth of 0.98 to 5.9 inches (2.5-15 cm) and in many cases extended well beyond crown width [7].

Fire may also kill seeds [23,24], although this is not confirmed.

DISCUSSION AND QUALIFICATION OF FIRE EFFECT:
Barnes [7] observed the effects of fire on 2 populations of Bell's honeysuckle at the University of Wisconsin Madison Arboretum. At 1 site, all leaves and buds on 9 of 12 shrubs were "apparently" killed by a fire in early May. Some "dormant buds" did survive on 3 individuals and were actively growing by late May, although location of these buds was not discussed. No further information was provided on fire effects or burn characteristics. At another site, a late-summer surface fire burned through a Bell's honeysuckle thicket, leaving scorched bark on basal stems and killing but not consuming leaves. Basal and aerial sprouts began to appear within 3 weeks postfire, and some plants produced new leaves that summer. Although it appears that some plants were top-killed, all plants survived. Only 2 of 30 sampled plants produced fruit 1 year postfire.

Kline and McClintock [87] conducted 2 consecutive annual mid-April prescribed burns in an oak (Q. × palaeolitica) -dominated forest in southern Wisconsin, where Bell's honeysuckle was common in the shrub layer. "Most of the individuals resprouted from the base, but the resprouts were not very vigorous. Some completely dead honeysuckles were observed" in the 1st postfire year.

PLANT RESPONSE TO FIRE:
Although information about asexual regeneration is relatively sparse, it is apparent that sprouting is a common response to mechanical stem damage in bush honeysuckles (see physical/mechanical control). Similarly, bush honeysuckles can also produce sprouts in response to damage from fire [7,75,87,102,126,152].

Bush honeysuckles may establish from bird-dispersed seed after fire. Since snags, surviving trees, or tall shrubs are often present in postfire environments where bush honeysuckles are likely to found (see habitat types and plant communities) and provide perches for frugivorous birds, bush honeysuckle postfire seedling establishment may occur in this environment.

DISCUSSION AND QUALIFICATION OF PLANT RESPONSE:
Kline and McClintock [87] observed Bell's honeysuckle sprouting from the base following prescribed fire, but "resprouts were not very vigorous". Barnes [7] observed fire effects on 2 populations of Bell's honeysuckle at the University of Wisconsin Madison Arboretum. All 12 shrubs observed at 1 site resprouted from "the rootstock". At the other site, a late-summer surface fire burned through a Bell's honeysuckle thicket, leaving scorched bark on basal stems and killing but not consuming leaves. All plants subsequently sampled had survived and had produced "basal sprouts" by early the following summer.

FIRE MANAGEMENT CONSIDERATIONS:
It appears that in many fire-adapted communities prescribed fire may be useful for controlling bush honeysuckles. According to several sources [75,126,152], spring prescribed burning may kill bush honeysuckle seedlings and top-kill larger plants, although results have been mixed. Maine Natural Areas Program [108] recommends burning during the growing season for most effective control. Regardless of season, it appears that a single prescribed fire is usually not sufficient to eradicate invasive bush honeysuckle populations. Because postfire sprouting is likely,
Species: Lonicera spp.

subsequent prescribed burns conducted annually or biennially for several years may be necessary \[75,126,152\]. Solecki \[154\] recommends annual or biennial spring burning for 5 or more years to control bush honeysuckles.

Annual spring prescribed burns were conducted for 5 years at Pipestone National Monument, a mosaic of dry, mesic, and wet grassland, shrubland, and woodland in southwestern Minnesota. Fire "intensity" was generally considered "low to moderate," except during the 1st year when high fuel levels were present. Objectives of this project were to assess the efficacy of using prescribed fire to control nonnative woody and herbaceous plants and to enhance native plant diversity, abundance, and cover. Tatarian honeysuckle was among several woody species, both native and nonnative, that had increased in a draw, suppressing herbaceous prairie plants. Five years of annual prescribed burning reduced Tatarian honeysuckle cover in sampled quadrats. Preburn cover in the first 2 years was 1.2%. Postburn cover in the first 2 years was 1.9% and 0.8%, respectively. Preburn cover in year 3 was 0.1%, and postburn cover in year 5 was 0.0%. Descriptions of fire effects on Tatarian honeysuckle were limited to noting "adverse" effects. It was not clear if 5 years of spring burning had eliminated Tatarian honeysuckle from the site, although the data indicate this possibility \[14\].

Kline and McClintock \[87\] conducted 2 consecutive annual mid-April prescribed burns in an oak (\(Q. \times\) palaeolithicola) -dominated forest in southern Wisconsin (burn prescriptions are available in \[87\]). One objective was to determine effectiveness of prescribed burning for controlling invasive Bell's honeysuckle and common buckthorn, which composed a "nearly continuous, almost impenetrable" shrub layer. Mean cover of Bell's honeysuckle and common buckthorn, measured in early July, was 85% in prefire year 1, 56% and 38% following each respective burn, and 41% in the 1st postfire year. "Most of the individuals resprouted from the base, but the resprouts were not very vigorous. Some completely dead honeysuckles were observed" in the 1st postfire year.

Prescribed fire may be less effective for controlling particularly vigorous populations, such as those growing under full sunlight. According to Williams \[194\], prescribed burning has shown "some promise" for controlling bush honeysuckles growing in open habitats. But Luken \[102\] asserted that repeated burning to control bush honeysuckles is ineffective on open sites, due to vigorous sprouting (see Control).

As of this writing (2004) there is no information available about using prescribed fire in combination with other control methods. However, it seems likely that combinations of burning, herbicides, and physical/mechanical control methods may be useful, especially when consideration is given to the current and future desired condition of native communities on the site. For information about invasiveness and control of bush honeysuckles, see Impacts and Control.

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**MANAGEMENT CONSIDERATIONS**

**SPECIES: Lonicera spp.**

- **IMPORTANCE TO LIVESTOCK AND WILDLIFE**
- **OTHER USES**
- **IMPACTS AND CONTROL**

**IMPORTANCE TO LIVESTOCK AND WILDLIFE:**

Although it appears bush honeysuckles are typically planted for other purposes, they may provide some value for wildlife and are occasionally planted for this use. According to Sharp and Belcher \[150\], Tatarian honeysuckle has been planted for summer wildlife food in the eastern U.S., and Luken and Thieret \[106\] state Amur honeysuckle has been planted in the eastern U.S. for wildlife habitat "improvement."

White-tailed deer browse bush honeysuckle twigs and foliage \[150\]. Vellend \[180\] confirmed the presence of Tatarian honeysuckle, Morrow's honeysuckle, Bell's honeysuckle, and Amur honeysuckle seeds in white-tailed deer scat in central New York, but it is unclear if fruits were eaten purposely or inadvertently. Bush honeysuckle fruits are borne in leaf axils, so white-tailed deer that are browsing on leaves and twigs are also likely to ingest
fruits in season. While Velland [180] did not specify which plant parts are selected by deer, he inferred that leaves and twigs are purposely browsed, and it is obvious that fruits are at least not avoided.

Tatarian honeysuckle is browsed by eastern cottontail [64,150]. Small mammals eat fallen bush honeysuckle fruit in late winter and early spring [150]. Deer mice extract and consume Amur honeysuckle seeds from intact fruits. However, it is speculated that relative presence or absence of Amur honeysuckle has little effect on small mammal forage habitat quality, and conversely, small mammal seed predation probably has little influence on Amur honeysuckle fecundity [195].

Bush honeysuckle fruits are eaten at least occasionally by songbirds, and avian frugivory is thought to be an important bush honeysuckle seed dispersal mechanism. Amur honeysuckle fruits are eaten at least occasionally by songbirds, especially in winter, and Tatarian honeysuckle fruits are eaten by songbirds in summer, soon after maturity (see Seasonal Development) [64,95,150]. Bartuszevige and Gorchov [12] studied avian Amur honeysuckle seed dispersal in southwestern Ohio. Out of 17 bird species captured near fruiting Amur honeysuckle shrubs, 12 were found to have consumed fruit. American robin, cedar waxwing, European starling, hermit thrush, and northern mockingbird defecated viable Amur honeysuckle seed. American tree sparrow, Carolina chickadee, dark-eyed junco, northern cardinal, song sparrow, tufted titmouse, and white-throated sparrow displayed evidence of consuming fruit, but without evidence of passing viable seed. Species that showed no evidence of Amur honeysuckle frugivory included brown creeper, Carolina wren, downy woodpecker, golden-crowned kinglet, and white-breasted nuthatch. Eastern bluebirds were also observed eating Amur honeysuckle fruit, but were not captured in the study [12]. Wild turkey, ruffed grouse, northern bobwhite, and ring-necked pheasant use Amur honeysuckle for food [150].

Palatability/nutritional value:
As of this writing (2005) very little information is available concerning palatability/nutritional value of bush honeysuckles. Analysis of Amur honeysuckle and European fly honeysuckle fruit in southwestern Ohio showed C:N ratios ranging from 29:1 to 56:1 (mean = 41.1, SD = 9.17) and percent lipid ranging from 4.53% to 5.01% (mean = 4.78%, SD = 0.20) [80].

Although avian frugivory is thought to be an important seed dispersal mechanism, preference for bush honeysuckle fruit as a food source is unclear. McRae [111] noted Tatarian honeysuckle as a major dietary component of northern bobwhite, especially after mid-February, at 2 northwestern Georgia piedmont upland forest sites. Apparently the raisin-like fruit of Tatarian honeysuckle is not necessarily a preferred late-season food, but provides available forage for songbirds when preferred foods are scarce [150]. According to Dirr [37], birds will consume Amur honeysuckle fruit if other food is unavailable.

Ingold and Raycraft [80] examined 115 individuals of 26 bird species for evidence of Amur honeysuckle and European fly honeysuckle frugivory in southwestern Ohio between mid-September and mid-November. Nine species (American robin, gray-cheeked thrush, Swainson’s thrush, gray catbird, cedar waxwing, northern cardinal, purple finch, American goldfinch, and white-throated sparrow), and 21 of 82 individuals representing these species, showed evidence of feeding on fruits. Sixteen species (35 total individuals) exhibited no evidence of Amur honeysuckle/European fly honeysuckle fruit consumption (Carolina chickadee, tufted titmouse, brown creeper, white-eyed vireo, red-eyed vireo, Tennessee warbler, magnolia warbler, bay-breasted warbler, ovenbird, common yellowthroat, yellow-breasted chat, indigo bunting, American tree sparrow, field sparrow, fox sparrow, and song sparrow). The low proportion of species (and individuals within these species) found to be feeding on Amur honeysuckle and European fly honeysuckle fruit led to questions concerning forage quality, especially since these fruits were abundant and conspicuous in the study area.

Although information is sparse, in some cases bush honeysuckle frugivory may be harmful to birds. Casual observations indicate that Tatarian honeysuckle fruit can be toxic to birds [15], but this is not confirmed. There is some evidence to indicate birds that eat bush honeysuckle fruit may experience changes in feather coloration. Apparently Morrow’s honeysuckle fruit contains the carotenoid rhodoxanthin, which causes normally yellow tail feather bands in cedar waxwings to appear orange. Similar yellow-to-orange changes in feather color have been described in Kentucky warblers and white-throated sparrows, perhaps also as a result of bush honeysuckle fruit
consumption. While no definitive impact has yet been established as a result of this phenomenon, subtle differences in coloration within species may affect behavior such as mate selection [196].

**Cover value:**
Bush honeysuckles probably provide some cover for wildlife. Amur honeysuckle provides nesting sites and protection for songbirds from late spring to late fall, and cover for rabbits [150]. Tatarian honeysuckle provides year-round cover for birds and small mammals [95].

However, indirect effects of bush honeysuckle invasion on wildlife may be difficult to predict. Schmidt and Whelan [141] examined the effect of Amur honeysuckle invasion on nest predation of American robins in northern Illinois deciduous woodlands. Nests built in Amur honeysuckle had significantly (p<0.001) higher daily nest mortality rate compared with nests built in native species. Reasons offered for increased nest predation in Amur honeysuckle included lower nest height (compared with many native shrubs and trees), absence of sharp thorns (compared with native hawthorns (*Crataegus* spp.)), and branch architecture that may facilitate predator (e.g. raccoon) movement. Unfortunately, Amur honeysuckle may provide more attractive nest sites due to its early leaf flush (see **Seasonal Development**) and sturdy branches. In fact, American robins significantly (r²=0.912, p<0.01) increased their use of Amur honeysuckle over the 6-year study period. Wood thrush also nested in Amur honeysuckle, although use was apparently limited by competition from American robins.

**OTHER USES:**
Winter honeysuckle has been cultivated as an early-flowering ornamental with very fragrant flowers [114,191]. It has also been recommended as a hedge or screen plant [37].

Amur honeysuckle has been cultivated as an ornamental in North America [106,131,150], and as of 1996, was still commercially available [106]. Beginning in the 1960s, USDA Soil Conservation Service developed and distributed the Amur honeysuckle cultivar 'Rem-Red' for use as an ornamental shrub, promoted as valuable for wildlife and as useful for soil conservation and as a windbreak, border, hedge, or screen [95,150]. Amur honeysuckle, along with Tatarian honeysuckle and Morrow's honeysuckle, is among species recommended for use in strip mine site reclamation [77,185]. Amur honeysuckle makes a very productive honey plant [26]. However, due to its invasive propensity in natural and seminatural woodlands, Clark [26] recommends against its use outside urban areas where it is already an established part of the flora.

Tatarian honeysuckle has been cultivated as an ornamental [18,150,191], and Dirr [37] provides a list of 14 available cultivars. It has been recommended as a windbreak, shelterbelt, or hedge species [28,53,95,110,157,169], especially in areas with extreme seasonal temperatures [142]. Tatarian honeysuckle has been characterized as useful for range restoration and soil stabilization [109], and has been used for streambank reclamation [188].

Bell's honeysuckle has been used for landscape and ornamental purposes in the northern U.S. [8].

**IMPACTS AND CONTROL:**
**Impacts:**
Throughout many areas of North America, bush honeysuckles are considered invasive and a threat to native habitats and plant communities. They can escape, establish, and persist outside cultivation, and may continue to spread into adjacent areas [32,108,152,157]. Barnes and Cottam [8] described Bell's honeysuckle as escaped and occupying "a significant extent of territory" in the northern U.S., where it is reproducing, increasing in some areas, and spreading to new areas. Barton and others [11] examined abundance of nonnative woody and semiwoody plants in rural western Maine along transects representing field edges, abandoned railroad right-of-way edges, roadsides, and riparian sites. Of 12 nonnative species measured, bush honeysuckles (Morrow's honeysuckle, Tatarian honeysuckle, and Bell's honeysuckle counted together) occurred along the greatest number of transects and had the 2nd greatest number of total patches and patches/km in the study. Amur honeysuckle has been the target of eradication efforts in north-central Kentucky and south-central Ohio because it "dominates nature reserves to the exclusion of endemic species" [105].
A variety of impacts has been ascribed to bush honeysuckle invasion. Most impacts are associated with their competitive dominance, potentially resulting in displacement of native species. Collier and others [29] compared native vegetation growing under Amur honeysuckle crowns with plants growing outside Amur honeysuckle influence in hardwood forest stands near Oxford, in southwestern Ohio. For all species combined, mean species richness was 53% lower, and mean cover 63% lower, in plots beneath Amur honeysuckle crowns. According to Luken and McKnight [101], dense Amur honeysuckle thickets in forest and open sites are "associated with a near complete absence of ground cover species." One study in a northern Kentucky hardwood forest described a monospecific Amur honeysuckle shrub layer with nearly 100% canopy coverage, mean maximum subcanopy light levels of 1% of full sun, and a sparse ground layer flora composed mainly of suppressed Amur honeysuckle seedlings and saplings [96]. Bell's honeysuckle, along with common buckthorn, composed a "nearly continuous, almost impenetrable" shrub layer in an oak (Quercus palaeolithicola) -dominated forest in southern Wisconsin [87].

Competition, especially for light, is the most commonly described means by which bush honeysuckles impact native plants. For example, Barnes [7] found light levels beneath dense Bell's honeysuckle thickets in southern Wisconsin were between 0.32 and 0.8% of light in the open. He also observed (without data) a greater abundance and larger size of sun flecks under gray dogwood thickets compared with Bell's honeysuckle. It was suggested that gray dogwood, a common native shrub species in southern Wisconsin, has a more limited shading effect than does Bell's honeysuckle. Klein [86] noted interference associated with shading of Amur honeysuckle upon pride of Ohio (Dodecatheon meadia), a native forest understory herb that performs best under the open canopy of mature trees.

It is likely that interference from dense bush honeysuckle populations can suppress advance regeneration of native tree seedlings. Yost and others [200] studied vegetation of an urban woodland in New York containing abundant Amur honeysuckle. Their survey revealed a significant negative correlation (r=−0.21, p<0.05) between tree seedling density and Amur honeysuckle cover. Collier and others [29] compared native vegetation growing under Amur honeysuckle crowns with plants growing outside Amur honeysuckle influence, in hardwood forest stands near Oxford, in southwestern Ohio. For tree seedlings (≤1 m tall), mean species richness was 41% lower and mean density was 68% lower in plots beneath Amur honeysuckle crowns. Every tree species had lower seedling abundance beneath Amur honeysuckle crowns. Hutchinson and Vankat [78] investigated impacts of Amur honeysuckle invasion in southwestern Ohio hardwood forests. They found tree seedling density to be inversely related to Amur honeysuckle cover (r² = 0.118, p < 0.001). When Amur honeysuckle cover was ≥15%, seedling densities were nearly always <0.5 m⁻², but when Amur honeysuckle cover was <15%, seedling densities varied greatly. Tree seedling species richness was also inversely related to Amur honeysuckle cover (r² = 0.152, p<0.0001). When Amur honeysuckle cover was >50%, the number of species was usually ≤8, but when Amur honeysuckle cover was <50%, richness was highly variable, ranging from 0 to 15 species. Luken [100] studied the response of woody seedlings to removal of dominant Amur honeysuckle shrubs in a northern Kentucky hardwood forest. Following 4 years of repeated clipping of established Amur honeysuckle plants, plus removal of Amur honeysuckle seedlings in the last 2 years of the study, seedling density and frequency of woody seedlings other than Amur honeysuckle were significantly (p<0.01) greater than in plots where Amur honeysuckle was not controlled. Woods [198] studied invasion of bush honeysuckles (in this study Tatarian honeysuckle and Bell's honeysuckle were not distinguished, although the text referred only to Tatarian honeysuckle (see Taxonomy)) in 3 sugar maple-dominated stands in Vermont, plus a red maple-dominated forest in northwestern Massachusetts. He found tree seedling (<1 m tall) density declined significantly (p<0.01) with increasing Tatarian honeysuckle cover. Average seedling density at all sites was >5 m⁻² where Tatarian honeysuckle was not present, but was <1 m⁻² when Tatarian honeysuckle cover was >90%. It was suggested that understory dominance by bush honeysuckles, as was observed, could ultimately alter successional patterns in forests typical to these. Gorchov and Trisel [55] detected effects of Amur honeysuckle interference, aboveground and belowground, that reduced survival of native tree seedlings in the understory of a southwestern Ohio deciduous forest. Seedlings of sugar maple, black cherry, northern red oak, and white ash were transplanted into treatment plots consisting of Amur honeysuckle shoot interference removal (pruning), Amur honeysuckle root interference removal (trenching), both pruning and trenching, and control plots where Amur
honey suckle interference effects were not manipulated. Amur honeysuckle basal area within treatment plots (prior to pruning) averaged 3.36 (± 0.16) m² ha⁻¹. Because of excessive mortality ascribed to white-tailed deer browsing, an additional cohort of sugar maple (only) seedlings was planted and protected from browsing (caged), and survival and growth data for these were subsequently analyzed according to previous procedures. Above-ground interference of Amur honeysuckle with tree seedlings appeared more important than below-ground interference, although both were detected. Pruning significantly (p≤0.05) increased survival for all species except black cherry, while trenching + pruning significantly (p≤0.05) increased survival for sugar maple (caged) and black cherry.

Even if seedlings of shade tolerant tree species can establish, interference from dense bush honeysuckle populations may still impact recruitment into mid-story or subcanopy status. Medley [112] studied distribution of Amur honeysuckle in a 13 acre (5.2 ha) sugar maple- and white ash-dominated deciduous forest in southwestern Ohio. Amur honeysuckle was the most important woody understory species, based on its mean density (3,361 individuals ha⁻¹), frequency (95% of sample points), and basal area (1.89 m² ha⁻¹). There was a significant (p<0.05) negative relationship between Amur honeysuckle and sugar maple sapling densities (>1 m tall; <10 cm dbh).

There is also evidence that invasive bush honeysuckles can negatively impact native herbs. Collier and others [29] compared native vegetation growing under Amur honeysuckle crowns with plants growing outside Amur honeysuckle influence, in hardwood forest stands near Oxford, in southwestern Ohio. Eighty-six percent of herb species had lower abundance beneath Amur honeysuckle crowns. Hutchinson and Vankat [78] found herbaceous cover was inversely related to Amur honeysuckle cover (r²=0.494, p<0.0001) in southwestern Ohio hardwood forests. Woods [198] studied invasion of bush honeysuckles (in this study Tatarian honeysuckle and Bell's honeysuckle were not distinguished, although the text referred only to Tatarian honeysuckle (see Taxonomy)) in 3 sugar maple-dominated stands in Vermont. He found herb species richness and herbaceous cover both declined significantly (p<0.05) with increasing Tatarian honeysuckle cover.

Gould and Gorchov [57] examined the effect of Amur honeysuckle presence on survival to reproductive age, and fecundity, of 3 native forest understory annual forbs. These were stickywilly (Galium aparine), an early-season shade-intolerant, pale touch-me-not (Impatiens pallida), a mid-season semishade-tolerant, and Canadian clearweed (Pilea pumila), a late-season shade-tolerant. Forbs were outplanted into treatment plots where Amur honeysuckle was either a) present, b) removed, or c) previously absent. Resident herb and seedling competitors were removed from all treatment plots at 6-10 day intervals throughout the experiment, and large mammalian herbivores were excluded. Survival of stickywilly and pale touch-me-not was significantly greater (p<0.05) in removal plots than in present plots at 1 of 2 sites. Fecundity of all 3 species (# seeds per surviving individual) was significantly greater (p<0.05) in removal plots than in present plots at both sites. Fecundity of pale touch-me-not and Canadian clearweed were also significantly greater (p<0.05) in absent plots than in present plots (absent plots were only feasible at 1 site). Survival of the shade-tolerant species Canadian clearweed was not affected by Amur honeysuckle presence, but fecundity was reduced. While speculative, this may be interpreted as a relatively less severe impact of Amur honeysuckle invasion on shade tolerant herb-layer species, compared with more shade intolerant species.

Miller and Gorchov [119] studied the effects of Amur honeysuckle presence on growth, reproduction and survival of 3 native forest understory perennial forbs over 5 growing seasons. Species studied included narrowleaf wild leek (Allium burdickii), a spring ephemeral, and the full-season species rue anemone (Thalictrum thalictroides) and downy yellow violet (Viola pubescens var. pubescens). They found Amur honeysuckle presence generally reduced growth and reproduction of target species, but not their survival. These effects appeared cumulative, often manifesting only after several years of treatment. They surmised the lack of treatment effect on forb survival may indicate perennial herbs are less impacted by Amur honeysuckle presence than are some annual forest understory forbs [57] and tree seedlings [55], although exclusion of browsing mammals may also have contributed to sustained survival in this experiment. They also caution that despite no demonstrable impact on survival in this study, reductions in growth and reproduction of individual perennial herbs by invasive shrubs, such as was demonstrated here with Amur honeysuckle, will likely reduce population sizes over time.
These results could be viewed within the context that Amur honeysuckle is simply filling a functional niche often filled by native shrubs, and is not really impacting native plant diversity in any novel way. Miller and Gorchov [119] and Gould and Gorchov [57] considered the possibility that native shrubs may also suppress herb-layer vegetation, although native shrubs were described as "very sparse" at these sites. In contrast, Amur honeysuckle density at one site was 0.7 shrubs m⁻². Collier and others [29] asserted that native shrubs are generally uncommon in southwestern Ohio forests, citing Braun (1916, 1950) and Vankat (personal observation). Assuming their assertion is correct, observed negative impacts of Amur honeysuckle on native flora in otherwise shrub depauperate forests may be altering species composition and understory structure in ways that diverge from historic conditions. More research is needed that examines the comparative effects of bush honeysuckles vs. native shrubs in suppressing herbs and woody seedlings within various eastern North American forest types.

Some evidence indicates that where native shrubs and invasive bush honeysuckles co-occur, bush honeysuckles may be stronger competitors. Medley [112] studied distribution of Amur honeysuckle in a 13 acre (5.2 ha) sugar maple- and white ash-dominated deciduous forest in southwestern Ohio. Amur honeysuckle was the most important woody understory species, based on its mean density (3361 individuals ha⁻¹), frequency (95% of sample points), and basal area (1.89 m² ha⁻¹). Instances of high species richness (>10 spp. per plot) of native woody plants and high basal areas (>1 m² ha⁻¹) of the most common native shrubs northern spicebush and blackhaw corresponded with Amur honeysuckle basal areas <4 m² ha⁻¹. When Amur honeysuckle basal areas were >5 m² ha⁻¹, woody plant species diversity and basal areas of common native shrubs were generally lower (≤ 10 spp. per plot, and <1 m² ha⁻¹, respectively). Barnes [7] determined that Bell's honeysuckle is generally a stronger competitor than the native shrub gray dogwood where they co-occur in southern Wisconsin. Although no mechanisms for this apparent competitive advantage were directly determined, emphasis was placed on differences in leaf phenology.

Extended leaf longevity may be important for light competition among understory plants of deciduous forests. Whether competition is between bush honeysuckles and native shrubs, forbs, or tree seedlings, early leaf emergence and/or late senescence in bush honeysuckles may permit exploitation of unutilized light resources prior to canopy leaf emergence and following canopy leaf fall [65] (see seasonal development). Miller and Gorchov [119] have proposed that summer herbs (i.e. those that grow primarily after canopy leaf emergence) are less impacted by early-leafing invasive shrubs, such as Amur honeysuckle, than those that fix most of their carbon before canopy leaf emergence. Barnes [7] observed that dense Bell's honeysuckle thickets had a very sparse herbaceous component compared with native shrub thickets in southern Wisconsin. He asserted that the effects of Bell's honeysuckle on herbs was similar to that of woody evergreens, in that they can suppress herb-layer development by casting shade throughout the effective seasonal range of most herbaceous species. In comparison, leaf development in most native shrubs occurs later in spring, generally allowing sufficient light for growth and reproduction of spring ephemeral herbs.

Other potential impacts of bush honeysuckle invasion include changes in herbivory pressure on native plants, allelopathy, and altered ecosystem processes. Trisel [168] found herbivory on Amur honeysuckle leaves was substantially less than for many native trees and shrubs in southwestern Ohio. This indicates that, as bush honeysuckles become increasingly dominant within a habitat, native species may encounter a corresponding increase in herbivory, which may contribute to their displacement. Laboratory and greenhouse experiments also indicate Amur honeysuckle may have allelopathic effects on herbs and woody seedlings, but more research is needed to distinguish between resource competition and allelopathy in the field [125,168]. There are also suggestions that bush honeysuckle invasion could have ecosystem level effects. According to Luken and Thieret [97], net primary production of dense open-grown Amur honeysuckle thickets (up to 1350 g m⁻² yr⁻¹ in northern Kentucky) may have large impacts on carbon and nutrient budgets of invaded sites.

Research has also provided some insight into why certain habitats may be more or less susceptible to bush honeysuckle invasion and its impacts. Hutchinson and Vankat [78] assert that late-successional forests dominated by shade tolerant tree species such as sugar maple and American beech are more resistant to Amur honeysuckle invasion, probably due to low light levels near the forest floor. They investigated impacts of Amur honeysuckle
invasion in the interior of hardwood forest stands in southwestern Ohio. They found that Amur honeysuckle cover was inversely related to tree basal area ($r^2=0.151$, $p<0.0001$) and tree canopy cover ($r^2=0.292$, $p<0.0001$). Amur honeysuckle cover commonly exceeded 50% only in stands with basal area $<30$ m$^2$/ha, and was rarely $<50\%$ when tree canopy cover was $<85\%$.

Evidence from southwestern Ohio indicates that the severity of bush honeysuckle invasion may be related to proximity to established source populations and time since invasion. Hutchinson and Vankat [78] investigated impacts of Amur honeysuckle invasion in hardwood forest stands near Oxford, in southwestern Ohio. Amur honeysuckle cover was positively related to estimated time since invasion ($r^2=0.172$, $p<0.0001$) and was $>50\%$ only in stands invaded $\geq 12$ years. Collier and others [29] compared native vegetation growing under Amur honeysuckle crowns with plants growing outside Amur honeysuckle influence, also in hardwood forest stands near Oxford, Ohio. Species richness for all taxa, as well as species richness and density of tree seedlings, was significantly ($p<0.0001$) lower in forests where Amur honeysuckle had been present for $\geq 16$ years, compared with forests where Amur honeysuckle was present $\leq 10$ years. Hutchinson and Vankat [78] also found that Amur honeysuckle cover was also inversely related to distance from Oxford ($r^2=0.133$, $p<0.0006$). Stands with $>50\%$ cover were mostly $\leq 3.1$ miles (5 km) from Oxford. Amur honeysuckle was planted in Oxford in the 1960s and these populations were considered the primary source for invasion in the study area.

**Control:** Because bush honeysuckles are capable of sprouting and suckering (see asexual regeneration), control efforts may require sustained effort for several years [75,108]. Deering and Vankat [33] recommend prioritizing control efforts toward newly established populations, before rapid population growth begins.

Control methods that create soil disturbance may provide opportunities for seedling establishment of bush honeysuckles or other invasive species [154]. Luken and McKnight [101] suggest that where dense Amur honeysuckle thickets substantially reduce herb-layer coverage, removal of this shrub layer may result in erosion and/or colonization by other invasive species. If target plants have reached reproductive age, it may be necessary to subsequently remove numerous seedlings from the area [43,44,45,46] (see Regeneration Processes). Control methods that increase light levels at ground level may result in increases in bush honeysuckle seedling establishment [100]. Luken and Mattimiro [105] suggested that Amur honeysuckle seeds are not long-lived, and elimination of adult populations should be followed by control of the subsequent, if short-lived, flush of seedlings.

Eradicating established bush honeysuckle plants may be more effective in forested than open environments. An experiment in northern Kentucky examined the relative response of forest-grown vs. open-grown Amur honeysuckle plants to repeated clipping. Plants in both populations were clipped at their bases in July, and resprouts were subsequently clipped each July for the next 3 years. One year after the initial clipping there were no significant ($p\geq 0.05$) differences between populations in stem (ramet) density or shrub (genet) density as a percentage of the pretreatment populations, due to vigorous sprouting from cut stems. However, following 2 additional years of clipping, percent stem density and percent shrub density of open-grown Amur honeysuckle were significantly ($p<0.05$) greater than for the forest-grown populations. During the 3 year treatment period, 70% of forest-grown adult plants were killed by repeated clipping, while only 10% of adult plants from pasture plots were killed. In fact, stem density of open-grown plants continued to increase throughout the treatment period, with annual clipping resulting in stem densities approaching 3 times the original level. Percent of pretreatment net primary production (NPP) was significantly ($p<0.05$) different between forest- and open-grown populations for all 3 years. Open-grown populations maintained NPP at between 15 and 25% of pretreatment levels throughout the experiment, while NPP of forest-grown populations fell to $<5\%$ of pretreatment levels during this time [100,105]. Although speculative, it is logical that bush honeysuckle sprouting in response to other control methods (e.g. chemical, fire) might follow a similar pattern. Open-grown plants, being comparatively more productive than forest-grown plants [99], are likely able to obtain and store greater carbohydrate levels, both prior and subsequent to repeated clipping, and therefore may be more resilient under various control treatments [105].

While it is possible that different bush honeysuckle species may respond differently to various control methods, there is no evidence that effectiveness of control methods varies by species.
Prevention: As Brooks and others [19] have reasoned, the effort required for exclusion of invasive nonnative plants is often much lower than for control and eradication of established populations, especially when impacts from invasions require restoration efforts. Further, potential for successful management is greatest when invasions are controlled early.

A review by Nyboer [126] indicates bush honeysuckle introduction is usually facilitated by habitat disturbance. Consequently, avoiding or minimizing disturbance is likely to reduce the chance for bush honeysuckles to become established. Where disturbance is unavoidable, careful monitoring and rapid eradication of new seedlings is easier, less costly and more likely to be successful compared with managing a full-blown invasion.

Planting bush honeysuckles for any reason is probably ill-advised. Since seeds are dispersed by birds, seemingly innocuous plantings such as in residential landscaping can easily provide a seed source for invasion of nearby natural areas.

Integrated management: No information is available on this topic.

Physical/mechanical: Cutting bush honeysuckle stems may eliminate existing plants [23,24,105,108,168] and is effective in temporarily reducing seed production [108]. However, cutting established plants usually results in sprouting [43,44,45,46,75,100,108] (see asexual regeneration). According to Luken and Mattimiro [105], single cuttings that are subsequently abandoned can produce populations from sprouts that are denser and more productive than pretreatment populations. Repeated cutting as the primary control method may be effective, especially in forested habitats, but is probably not feasible for open-grown plants (see Control above) [100,105].

The frequency, duration, and seasonality of repeated cutting treatments required for effective control are unclear. Luken [100] indicates 3+ years of treatments may be necessary in forested habitats. Luken and Mattimiro [105] suggest cutting at least annually, or more frequently if possible. According to the Maine Natural Areas Program [108], cutting should be done in early spring and in late summer or early fall. Trisel [168] compared treatments for eradication of Amur honeysuckle in a southwestern Ohio second-growth hardwood forest. Amur honeysuckle stems were cut (3.9 inches (10 cm) above ground)) in early October. New shoots were subsequently surveyed and clipped every 2 weeks until mid-November, and again from early June to early November the following year. No immediate posttreatment sprouting was apparent in fall, but all treated shrubs exhibited regrowth by early June the following season. Sprouting continued following commencement of clipping treatments in June but diminished substantially over the course of the growing season. The percentage of shrubs with live sprouts began to decline from 100% in late July and by early November only 10% showed signs of continued regrowth. Average numbers of live stems per shrub was 3.15 before treatment, 3.1 in early June, reached a maximum of 13.8 in early July, then declined to 2.0 by early November. In a separate experiment Amur honeysuckle stems were cut (3.9 inches (10 cm) above ground) in mid-April. New shoots were subsequently surveyed and clipped every month from June until October. Final mortality in this experiment was only 7% [168].

Bush honeysuckles may be controlled by pulling and/or digging to remove entire plants [17,23,24,75,126,152]. Seedlings are often easily pulled, especially when soils are moist [17,75,108,126,152,154]. Since bush honeysuckle roots are typically shallow (see General Botanical Characteristics), small- to medium-sized plants can often be dug or pulled [17,75]. Todd [167] reported no regrowth of bush honeysuckle shrubs in northern Illinois following control by either hand pulling small individuals when soils were wet, or by cutting near ground level and "pulling" the following year. Trisel [168] achieved complete control of established Amur honeysuckle by severing all shrubs below the root crown. However, all of the root crown and as much of the root system as possible should be removed to minimize sprouting and suckering (see asexual regeneration) [43,44,45,46,126,152,168].

Sprouts and suckers may be further controlled with herbicides [43,44,45,46,75,105,126,152]. Applying herbicide to cut stumps can increase mortality [23,24,67,126,152,168] (see Chemical control methods below).

According to Trisel [168], severed shrubs can take root if they are discarded with roots contacting the ground.

Fire: See Fire Management Considerations.

Biological: Although not purposely introduced for the purposes of biological control, *Hyadaphis tataricae* is a nonnative aphid that feeds on a variety of bush honeysuckles in North America (for an analysis of taxa-specific susceptibility see Herman and Chaput [72]) [183, 184]. *H. tataricae* feeding results in dwarfing and folding of terminal leaves, stunted terminal growth, and development of "witches brooms" [23, 24, 107, 183]. This lowers plant vigor and may prevent flowering and fruit development [23, 24, 184]. Voegtlin and Stoetzel [184] indicate that it is not expected to provide widespread, effective control of bush honeysuckles. However, according to U.S. Geological Survey Northern Prairie Wildlife Research Center [23, 24], *H. tataricae* is still expanding its North American range and "may eventually reach levels that will provide control."

Grazing/browsing: As of this writing (2004), very little information is available concerning browsing as a bush honeysuckle control method. Qualitative observations indicate Tatarian honeysuckle is tolerant of browsing, although subject to reduced fruit production in response [41]. Another observation indicates Tatarian honeysuckle was locally eliminated following 3 years of heavy browsing [81].

Regardless of browse tolerance, heavy livestock traffic in areas where bush honeysuckle seeds are present may encourage bush honeysuckle invasion by disturbing soil and reducing herbaceous competition, thereby providing suitable sites for seedling establishment [153].

Chemical:
Herbicides may be effective for controlling invasive bush honeysuckles. However, control with herbicides is temporary, as it does not change conditions that allow infestations to occur [201]. Glyphosate is the most commonly mentioned chemical for use against bush honeysuckles, applied either as a foliar spray [75, 154, 168] or to cut stumps [43, 44, 45, 46, 67, 88, 154, 168]. Triclopyr has also shown effectiveness [75]. Most references discuss chemical control of Amur honeysuckle, but it is likely that these methods are also effective against other bush honeysuckle species. See the Weed Control Methods Handbook for considerations on the use of herbicides in natural areas and detailed information on specific chemicals.

Application of herbicide to cut stumps can provide effective control while minimizing risk of damage to associated native species [43, 44, 45, 46, 88]. Herbicide should be applied immediately after cutting, for best results [75, 126]. Mechanical injection into intact stems is also effective [67]. Hoffman and Kearns [75] recommend 2 cuts/applications per year, 1 in early spring followed by another in early autumn. Others have found single early spring treatments effective [67, 168].

Spraying herbicide on foliage may also be effective. While some sources indicate spraying just after flowering is most effective [75, 154], early spring application has also been effective [168]. Spraying herbicide in early spring, when bush honeysuckles are actively growing but most native plants are still dormant, can minimize risk to nearby natives [75, 168].

Cultural:
If desired vegetation is scarce or absent, bush honeysuckle control may be of little value. Planting native species following bush honeysuckle removal can provide a desirable composition of groundcover, shrubs, and understory trees, and may also mitigate reinvasion by bush honeysuckles and other nonnative invasive plant species [23, 24, 67, 152].

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