Terrestrial Invasive Plant Watch List: New England

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The most up-to-date version is available at: https://github.com/jenica-allen/Invasive-Watch-Lists

Summary

Species distributions are expected to shift with climate change. These range shifts may mean that terrestrial invasive plants currently within United States borders could expand into new states and regions. We created models of current distribution for 896 terrestrial invasive plants in the continental United States and projected their potential distribution with climate change. From these projections, we identified 140 invasive plant species that are not currently present in the six New England states (Connecticut, Rhode Island, Massachusetts, New Hampshire, Vermont, and Maine), but could establish there by 2050 as climate continues to change. The list is not yet prioritized by potential impact or occurrence in adjacent geographic areas. By highlighting potential for future invasion, geographical analyses can inform regional and state-level watch lists and management prioritization in light of climate change.

Invasive Species Range Shifts

Invasive species are one of the greatest threats facing natural systems (Wilcove et al., 1998) and can interfere with regeneration of valuable timber species (Fagan and Peart, 2004), negatively impact ecosystem services (Ehrenfeld and Rodriguez, 2010; Vilà et al., 2011), and reduce native species diversity (Vilà et al., 2011). In many cases, land managers and public agencies must assess risks posed by invasive species and make decisions about current and future management plans. The inherent dynamics of invasive species and changes in distribution and abundance due to climate and land use change complicate identification of high risk areas. Management of these problematic species is costly (Bradshaw et al., 2016; Pimentel et al., 2005) and tools are needed to better identify areas of high risk and prioritize potential control targets in a regional context (Allen and Bradley, 2016; Hauser and McCarthy, 2009; McGeoch et al., 2016).

We used species range models to address the geographic components of invasive species risk. For each of nearly 900 terrestrial plants, we identified the climatic conditions that the species could tolerate based on the climatic conditions of every location where the species has been found (Allen and Bradley, 2016). We use these data to predict the geographic areas where the species is likely to survive. An example range map produced from our models is provided for

Japanese barberry (*Berberis thunbergii*) (Figure 1) and maps for all species in our study are available from UMass Scholar Works (doi: 10.7275/R5FF3Q9X).

Using the relationships discovered between climate and each species' geographic locations, we projected future ranges based on climate from 13 general circulation models (GCMs) for mid-century (2050). GCMs are models that characterize the exchange of energy and matter between the earth's surface and the atmosphere and between different components of the atmosphere, where each GCM represents complex processes in different ways. No one model is correct for all climate characteristics in all parts of the world, so we typically use many to bracket the range of future possible changes in climate. If projections from many models agree, we have higher confidence that the projected event will occur.

Relative Concentration Pathways (RCPs) describe possible trajectories of greenhouse gas emissions (Pachauri and Meyer, 2015) and are used for projecting future climate with GCMs. The analysis we present used RCP 4.5 to represent an intermediate future emissions scenario among 4 possible RCPs.

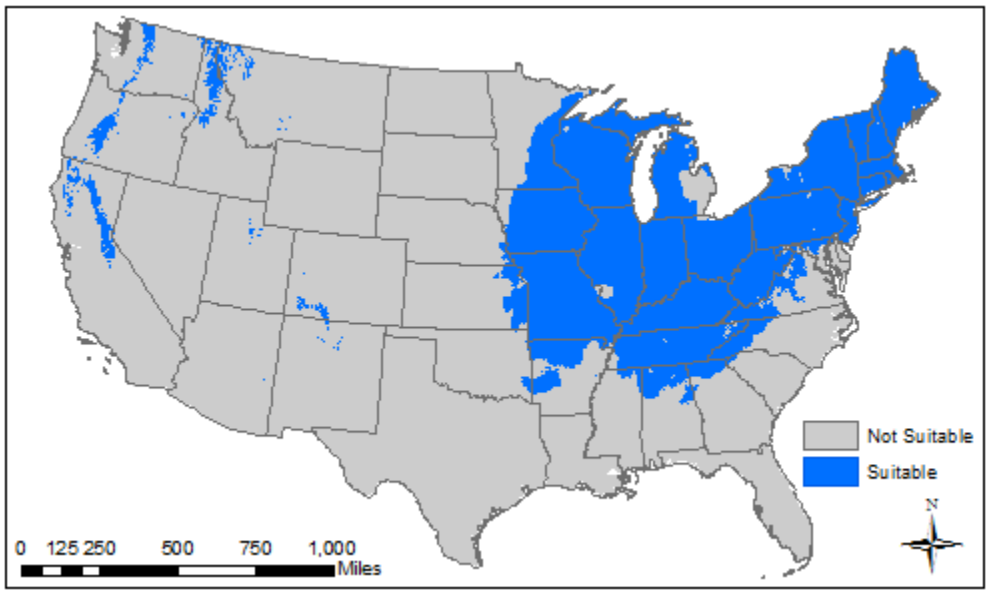

Figure 1: Potential range of Japanese barberry (*Berberis thunbergii*) with current climate.

Listing Criteria

We applied the following criteria to the range maps produced from our analysis in order to include a species on a state-level watch list:

1. Species is not on the current state invasive plant list or federal noxious weed list.
2. Species has not been observed in the state
3. Current climate model does not predict occurrence in the state
4. At least 85% agreement among climate change models that the species will have suitable climate in the state by 2050 under RCP 4.5.

We then aggregated the state-level watch lists to the New England region.

Watch List

One hundred and forty species were identified as potential range expanders into New England with climate change by mid-century (Table 1). Of those 140 species, only 5 are on the watch lists of all six New England states. Further prioritization of the large list is needed, including by potential impacts and current occurrence in geographically adjacency areas, in addition to analysis of the state-level lists.

This preliminary analysis highlights the utility of geographic modeling for informing state-level watch lists of invasive species. Our methods are a starting point for how species could be prioritized geographically. But, these geographical decisions need to be refined with input of invasive species managers. For example, our current list includes only species absent from each focal state, but we could instead choose to include species present in only a small portion of the state and expanding with climate change. Additionally, geographic analyses could be combined with an evaluation of invasive species impact (e.g., via literature reviews using consistent metrics of impact such as the new EICAT framework; Hawkins et al., 2015) and information about likelihood of species dispersal into New England in order to improve species prioritization. This watch list provides an important illustration of how geographic modeling can inform invasive species prioritization.

Table 1: Invasive plant species likely to expand their range into New England by 2050 with climate change. Columns with state abbreviations indicate whether a species was found on the watch list for that state (1 = yes, 0 = no). The number of states in which a species was found on the watch list is indicated in the final column (ranges from 1 to 6).

Scientific Name	Common Name	Habit	Duration	ME	NH	VT	MA	CT	RI	Num. States
Achyranthes japonica	Japanese chaff flower	forb/herb	Perennial	1	1	0	0	0	0	2
Aegilops cylindrica	jointed goatgrass	grass	Annual	1	0	0	0	0	1	2
Aegilops triuncialis	barbed goatgrass, barb goatgrass	grass	Annual	0	0	0	0	1	0	1
Albizia julibrissin	mimosa	tree	Perennial	1	1	0	0	0	0	2
Allium paniculatum	Mediterranean onion	forb/herb	Perennial	0	0	0	1	0	0	1
Amaranthus blitum var. blitum	purple amaranth, slender amaranth	forb/herb	Perennial	0	0	1	0	0	0	1
Ampelopsis brevipedunculata	Amur peppervine, porcelain-berry	vine	Perennial	0	0	1	0	0	0	1
Anthriscus caucalis	bur chervil	forb/herb	Annual	0	0	1	0	0	0	1
Ardisia elliptica	shoebutton ardisia	tree	Perennial	1	1	0	1	1	1	5
Aralia elata	Japanese angelica tree	tree	Perennial	1	0	0	0	0	0	1
Arum italicum	Italian arum	forb/herb	Perennial	0	0	0	0	0	1	1
Araujia sericifera	white bladderflower	vine	Perennial	1	1	1	1	0	1	5
Asclepias curassavica	bloodflower milkweed	forb/herb	Perennial	1	1	1	1	0	1	5
Avena barbata	slender oat	grass	Annual	0	0	0	1	0	0	1
Bellardia trixago	bellardia	forb/herb	Annual	1	1	1	1	1	1	6
Bromus catharticus	rescuegrass	grass	Annual	0	1	0	0	0	0	1
Brachypodium distachyon	annual false-brome	grass	Annual	0	0	0	1	0	1	2
Briza minor	little quakinggrass	grass	Annual	1	0	0	0	0	0	1
Broussonetia papyrifera	paper-mulberry	tree	Perennial	1	1	0	0	0	1	3
Buddleja davidii	orange eye butterflybush, butterflybush	shrub/subshrub	Perennial	0	0	1	0	0	0	1
Cardaria chalepensis	orbicular whitetop	forb/herb	Annual	0	0	1	0	0	0	1
Carduus tenuiflorus	winged plumeless thistle, slenderflower thistle	forb/herb	Annual	0	0	0	1	0	0	1
Centaurea calcitrapa	red star-thistle, purple starthistle	forb/herb	Biennial	0	0	0	0	1	0	1
Cestrum diurnum	day jessamine	tree	Perennial	1	0	1	1	0	1	4
Centaurea melitensis	Maltese star-thistle, Malta starthistle	forb/herb	Annual	0	0	0	0	1	1	2
Centaurea virgata	squarrose knapweed	forb/herb	Perennial	1	1	1	0	0	0	3
Cinnamomum camphora	camphortree	tree	Perennial	0	0	0	1	0	1	2
Colutea arborescens	bladder senna	tree	Perennial	0	0	1	0	0	0	1
Cortaderia selloana	Uruguayan pampas grass	grass	Perennial	0	0	0	1	0	0	1
Cosmos sulphureus	sulphur cosmos	forb/herb	Annual	1	0	1	0	0	0	2

Scientific Name	Common Name	Habit	Duration	ME	NH	VT	MA	CT	RI	Num. States
Cryptomeria japonica	Japanese cedar	tree	Perennial	0	0	1	0	0	0	1
Cruciata pedemontana	piedmont bedstraw	forb/herb	Annual	0	0	1	0	0	0	1
Cuscuta approximata	alfalfa dodder, smallseed alfalfa dodder	vine	Annual	0	1	1	0	0	0	2
Cunninghamia lanceolata	Chinese fir	tree	Perennial	0	0	0	1	1	1	3
Cyperus rotundus	nutgrass, purple nutsedge	grass	Perennial	1	1	1	1	1	1	6
Dactyloctenium aegyptium	crowfootgrass	grass	Annual	0	0	0	1	1	0	2
Datura inoxia	pricklyburr	forb/herb	Perennial	1	0	1	0	0	0	2
Daphne laureola	spurgelaurel	tree	Perennial	0	0	1	0	0	0	1
Dalbergia sissoo	Indian rosewood	tree	Perennial	0	0	0	1	1	0	2
Dioscorea oppositifolia	Chinese yam	vine	Perennial	1	1	1	0	0	0	3
Dipsacus sativus	Indian teasel, Fuller's teasel	forb/herb	Biennial	1	1	1	0	0	0	3
Duchesnea indica	Indian mock-strawberry	forb/herb	Perennial	0	0	1	0	0	0	1
Echinochloa colona	junglerice	grass	Annual	1	1	0	0	0	0	2
Ehrharta erecta	panic veldtgrass	grass	Perennial	0	1	0	1	1	1	4
Elaeagnus pungens	thorny olive	shrub/subshrub	Perennial	0	0	0	1	1	1	3
Eragrostis curvula	weeping lovegrass	grass	Perennial	0	1	0	0	0	0	1
Euonymus fortunei	winter creeper	vine	Perennial	0	0	1	0	0	0	1
Euphorbia oblongata	eggleaf spurge	forb/herb	Annual	1	1	0	0	0	0	2
Fatoua villosa	hairy crabweed, mulberryweed	forb/herb	Annual	0	1	0	0	0	1	2
Foeniculum vulgare	fennel	forb/herb	Perennial	0	0	1	0	0	0	1
Gastridium phleoides	nit grass	grass	Annual	1	0	0	0	0	0	1
Genista monspessulana	French broom	shrub/subshrub	Perennial	0	0	0	0	1	1	2
Glyceria declinata	waxy mannagrass	grass	Perennial	0	0	1	0	0	0	1
Hemarthria altissima	limpograss	grass	Perennial	0	0	0	1	0	0	1
Hedera helix ssp. canariensis	Algerian ivy	vine	Perennial	0	0	0	1	1	1	3
Hibiscus syriacus	rose of Sharon	tree	Perennial	0	0	1	0	0	0	1
Hibiscus tiliaceus	sea hibiscus	forb/herb, shrub/subshrub, tree	Perennial	1	1	1	1	0	1	5
Hypericum calycinum	Aaron's beard	shrub/subshrub	Perennial	0	0	0	0	1	0	1
Ilex crenata	Japanese holly	tree	Perennial	1	0	0	0	0	0	1
Ipomoea coccinea	red morningglory	vine	Annual	1	0	1	0	0	0	2
Kummerowia striata	common lespedeza	forb/herb	Annual	1	0	1	0	0	0	2

Scientific Name	Common Name	Habit	Duration	ME	NH	VT	MA	CT	RI	Num. States
Lactuca serriola	prickly lettuce	forb/herb	Biennial	1	1	0	0	0	0	2
Leucojum aestivum	summer snowflake	forb/herb	Perennial	0	0	1	0	0	0	1
Lespedeza bicolor	shrubby lespedeza	shrub/subshrub	Perennial	1	1	1	0	0	0	3
Lespedeza cuneata	sericea lespedeza	shrub/subshrub	Perennial	0	0	1	0	0	0	1
Leontodon taraxacoides	lesser hawkbit	forb/herb	Biennial	0	0	1	0	0	0	1
Ligustrum amurense	Amur privet	shrub/subshrub	Perennial	1	0	1	0	0	0	2
Linum bienne	pale flax	forb/herb	Perennial	0	0	1	0	0	0	1
Linaria genistifolia	broomleaf toadflax	forb/herb	Perennial	1	0	1	0	0	0	2
Liriope spicata	creeping liriope	forb/herb	Perennial	0	0	0	1	1	1	3
Lonicera fragrantissima	sweet breath of spring	shrub/subshrub	Perennial	1	1	1	0	0	0	3
Lonicera standishii	Standish's honeysuckle	shrub/subshrub	Perennial	1	0	1	0	0	0	2
Ludwigia grandiflora ssp. grandiflora	large-flower primrose-willow	forb/herb	Perennial	0	0	1	0	0	0	1
Ludwigia grandiflora ssp. hexapetala	large-flower primrose willow, water primrose	forb/herb	Perennial	1	1	0	0	0	0	2
Lythrum hyssopifolia	hyssop loosestrife	forb/herb	Annual	1	0	0	0	0	0	1
Malcolmia africana	Malcolm stock	forb/herb	Annual	0	0	0	0	1	0	1
Mahonia bealei	leatherleaf mahonia	shrub/subshrub	Perennial	0	0	0	1	1	1	3
Mesembryanthemum nodiflorum	slenderleaf iceplant	forb/herb	Annual	0	0	0	0	1	0	1
Medicago polymorpha	burclover, California burclover	forb/herb, vine	Annual	0	1	0	0	0	0	1
Mentha pulegium	pennyroyal	forb/herb	Perennial	0	1	0	0	0	0	1
Mirabilis jalapa	common four-o'clock	forb/herb	Perennial	1	0	1	0	0	0	2
Microthlaspi perfoliatum	thoroughwort pennycress	forb/herb	Annual	1	1	1	0	0	0	3
Miscanthus sinensis	Chinese silvergrass	grass	Perennial	0	0	1	0	0	0	1
Microstegium vimineum	Nepalese browntop, Japanese stiltgrass	grass	Annual	0	0	1	0	0	0	1
Momordica charantia	balsamapple	vine	Annual	1	1	0	0	0	0	2
Mosla dianthera	miniature beefsteakplant	forb/herb	Annual	0	0	0	1	1	0	2
Muscari neglectum	starch grape hyacinth	forb/herb	Perennial	1	1	0	0	0	0	2
Nandina domestica	sacred bamboo	shrub/subshrub	Perennial	0	0	0	0	1	0	1
Oplismenus hirtellus ssp. undulatifolius	basketgrass, wavyleaf basketgrass	grass	Perennial	1	1	0	0	0	1	3
Paulownia tomentosa	princesstree	tree	Perennial	1	1	1	0	0	0	3
Persea americana	avocado	tree	Perennial	0	0	0	1	0	0	1
Petrorhagia dubia	hairypink	forb/herb	Annual	0	0	0	1	1	1	3
Perilla frutescens	perilla mint	forb/herb	Annual	0	0	1	0	0	0	1

Scientific Name	Common Name	Habit	Duration	ME	NH	VT	MA	CT	RI	Num. States
Pennisetum polystachion	mission grass	grass	Perennial	1	1	0	0	0	0	2
Pennisetum setaceum	crimson fountaingrass	grass	Perennial	1	0	0	1	1	1	4
Phyllostachys aurea	golden bamboo	grass	Perennial	0	0	0	1	1	0	2
Polygonum argyrocoleon	silversheath knotweed	forb/herb	Annual	0	0	1	0	0	0	1
Polycarpon tetraphyllum	fourleaf manyseed	forb/herb	Annual, Biennial, Perennial	0	0	1	0	0	0	1
Poncirus trifoliata	trifoliate orange	tree	Perennial	1	1	1	1	1	1	6
Polypogon viridis	water-bent	grass	Perennial	0	0	0	1	0	0	1
Prunus lusitanica	Portugal laurel	tree	Perennial	0	0	0	1	0	0	1
Pseudognaphalium luteoalbum	Jersey cudweed	forb/herb	Annual	0	0	0	0	1	1	2
Pseudelephantopus spicatus	dog's-tongue	forb/herb	Perennial	0	0	0	1	0	1	2
Pueraria montana var. lobata	kudzu	vine	Perennial	1	1	1	0	0	0	3
Pyrus calleryana	Callery pear (Bradford pear)	tree	Perennial	1	1	1	0	0	0	3
Pyracantha coccinea	scarlet firethorn	shrub/subshrub	Perennial	1	1	1	0	0	0	3
Quercus acutissima	sawtooth oak	tree	Perennial	1	1	1	1	1	1	6
Ranunculus ficaria	fig buttercup, lesser celandine	forb/herb	Perennial	0	0	1	0	0	0	1
Rapistrum rugosum	turnipweed	forb/herb	Annual	1	1	1	0	1	1	5
Rhodotypos scandens	jetbead	shrub/subshrub	Perennial	0	0	1	0	0	0	1
Ricinus communis	castorbean	shrub/subshrub	Perennial	1	0	0	0	0	0	1
Rosa wichuraiana	memorial rose	shrub/subshrub	Perennial	1	0	1	0	0	0	2
Salvia aethiopis	Mediterranean sage	forb/herb	Biennial	1	1	1	0	1	0	4
Salix caprea	goat willow	shrub/subshrub	Perennial	0	0	1	0	0	0	1
Sacciolepis indica	glenwoodgrass	grass	Annual	0	0	0	1	1	1	3
Senecio jacobaea	stinking willie, tansy ragwort	forb/herb	Perennial	0	0	1	0	0	0	1
Sesbania punicea	red sesbania	shrub/subshrub	Perennial	1	1	1	1	1	1	6
Silene gallica	English catchfly	forb/herb	Annual	0	0	1	0	0	0	1
Solanum pseudocapsicum	Jerusalem-cherry	shrub/subshrub	Perennial	1	1	1	0	0	1	4
Spartium junceum	Spanish broom	shrub/subshrub	Perennial	0	0	0	0	0	1	1
Sphaerophysa salsula	alkali swainsonpea, swainsonpea	shrub/subshrub	Perennial	0	0	1	1	1	1	4
Tamarix aphylla	Athel tamarisk	tree	Perennial	0	1	1	1	1	1	5
Tagetes minuta	muster John Henry, wild marigold	forb/herb	Annual	0	1	0	0	0	0	1
Tamarix ramosissima	saltcedar	tree	Perennial	0	0	0	1	0	0	1

Scientific Name	Common Name	Habit	Duration	ME	NH	VT	MA	CT	RI	Num. States
Trifolium subterraneum	subterranean clover	forb/herb	Annual	0	0	1	0	0	0	1
Tribulus terrestris	puncturevine	forb/herb, vine	Annual	0	1	0	0	0	0	1
Urochloa distachya	tropical signalgrass	grass	Perennial	1	1	0	0	0	0	2
Vaccaria hispanica	cow soapwort	forb/herb	Annual	0	0	1	0	0	0	1
Verbena bonariensis	tall vervain	forb/herb	Perennial	1	1	1	0	1	1	5
Veronica hederifolia	ivyleaf speedwell	forb/herb	Annual	0	0	1	0	0	0	1
Vitex agnus-castus	lilac chastetree	shrub/subshrub	Perennial	0	0	0	1	1	0	2
Viburnum dilatatum	linden viburnum	shrub/subshrub	Perennial	0	0	1	0	0	0	1
Vicia hirsuta	tiny vetch	vine	Annual	1	0	0	0	0	0	1
Vinca major	big periwinkle	vine	Perennial	1	1	1	0	0	0	3
Vicia sativa ssp. nigra	garden vetch	forb/herb	Annual	0	1	0	0	0	0	1
Vitis vinifera	wine grape	vine	Perennial	0	1	1	0	0	0	2
Wisteria floribunda	Japanese wisteria	vine	Perennial	0	0	1	0	0	0	1
Wisteria sinensis	Chinese wisteria	vine	Perennial	1	1	0	0	0	0	2
Xanthium spinosum	spiny cocklebur	forb/herb	Annual	0	0	1	0	0	0	1
Youngia japonica	Asiatic hawksbeard	forb/herb	Annual	0	0	0	1	1	1	3

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