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NEW AND EXOTIC WEEDS OF MONTANA

MIGRATION AND DISTRIBUTION OF 100 ALIEN WEEDS IN NORTHWESTERN USA, 1881-1980

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NEW AND EXOTIC WEEDS OF MONTANA

II: MIGRATION AND DISTRIBUTION OF 100 ALIEN
WEEDS IN NORTHWESTERN USA, 1881-1980¹

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INTRODUCTION

In an earlier report (Forcella, F. & S.J. Harvey. 1980. New and Exotic Weeds of Montana, I: Recent Introductions. Montana Dept. Agr., Helena. 42 p.) we provided regional distribution and migration data for 19 species of alien weeds that immigrated to Montana within approximately the last decade, or whose previous introductions did not thrive but subsequent introductions did. In the present report we have analyzed the distributions of 100 alien weeds as they migrated through the five northwestern states (Idaho, Montana, Oregon, Washington and Wyoming). We believe that such analyses allow not only hindsight of each species' history, but insight into its future as well. Furthermore, in an additional report ("Multivariate Analysis of Weed Migrations in Northwestern USA: Identification of Future Problematic Weeds") we have analyzed our numerical data for the 100 weeds depicted below along with 140 additional introduced species by means of polar ordinations and principal components analysis (Whittaker, R.H. et al. 1973. Evaluation of ordination techniques. pp. 287-322. In Ordination and Classification of Communities (R.H. Whittaker, ed.), W. Junk Publ., The Hague, Netherlands). Such analyses permit comparison of the behavior of each weed species with that of all other weed taxa simultaneously. Through these procedures the "infesting qualities" of each weed, relative to other weeds, can be graphically displayed in two-dimensional form. Thus one can judge which of the recently introduced species in any particular state are likely to become noxious weeds in the future. The ninety time-series

distribution maps and ninety migration (infestation) rate diagrams for ninety weed species (plus an additional ten final-distribution maps for as many species), provided in the current report, document the behavior of 100 of the most significant and/or potentially significant introduced weed taxa in the northwestern United States.

METHODS

First-collection-by-county data was recorded for each of 250 alien weed species (known to occur in any one of the five northwestern states) from herbarium specimens at Idaho State Univ., Univ. of Idaho, Montana State Univ., Univ. of Montana, Washington State Univ. and Univ. of Wyoming. In this context approximately 10,000 individual weed plant collections were analyzed for date and location of collection. Herbarium derived data was supplemented by information in an early weed flora (Blankenship, J. 1901. Weeds of Montana. Mont. Agr. Exp. Stn. Bul. 30:2-70), a recent weed survey of Idaho (Baysinger, O. & G. Lee. 1979. Exotic Weed Survey of Idaho, 1979. Univ. of Idaho, Moscow), information from 14 individuals associated with county weed control programs in Montana, and our own collections and observations in Montana, Idaho and eastern Oregon; our fieldwork was primarily concentrated in the western half of Montana (Forcella & Harvey 1980 *ibid.*).

Plant collections by agronomists, botanists and naturalists in the Northwest began, in earnest, in the late 1870's. Thus the documented history of alien weed spread covers approximately

the last century. We divided the previous 100 years into decades: 1881-90, 1891-1900, 1901-10, 1911-20, 1921-30, 1931-40, 1941-50, 1951-60, 1961-70 and 1971-80. For each weed we mapped those northwestern counties infested each decade, and plotted the cumulative number of counties infested at each decade.

RESULTS

On the following pages (pp. 7-96) time-series migration (infestation) maps are presented for 90 species. The maps are arranged in alphabetical order by genus (common names for taxa are provided on each page as well as in the index). Additionally, the current distributions of ten early-introduced weed species, whose distributions have not increased in the recent past, are mapped on page 97. Rates of weed infestation, in graphical form, are provided on pages 99-113 in alphabetical order by genus for 90 species; each species' graph is labeled by its scientific binomial. The reader can make referencing easier by simply becoming familiar with the scientific binomials of the weeds of his/her interest. Scientific/colloquial and colloquial/scientific indices are supplied on pages 114-115 and 116-117 respectively.

There are three basic time-dependent patterns of infestation apparent in the maps and graphs:

Pattern A, a root-function or linear series, is exemplified in the maps by Lolium temulentum (darnel). These are weeds that were present in the Northwest from an early date, and their distributional increases have all reached asymptotes despite the continual linear increase in the number of counties infested by some species. These weeds do not represent threats to regions in the Northwest where they are absent. That is, their migrations have apparently stopped at their current distributional boundaries. The early-introduced weeds shown on page 97 all exhibit type A infestation patterns.

Pattern B, a logistic function, is represented by Bromus tectorum (Downy chess, downy brome, cheatgrass, cheatgrass brome), Cerastium vulgatum (Mouseeear chickweed) and Silene cucubalus (Bladder campion) in the maps and graphs. These weeds increased exponentially within the last century and then reached asymptotes. This asymptote suggests that such weeds will not spread much further than at present.

Pattern C, an exponential series, includes all weeds whose distributions are rapidly increasing at the present time. These are the weeds that represent current and potential future threats to northwestern agriculture. By studying their graphs and time-series distribution maps, one can judge which areas the plant is liable to become a problem in at some later date. The following lists represent those weeds and associated areas where there is some cause for alarm in regard to future colonization and infestation; the lists are by no means exhaustive and should not be construed as such.

<u>Weed Species</u>	<u>Potential Threatened Areas</u>
<u>Abutilon theophrasti</u> (Velvet leaf)	e MT, e WY, s ID, se OR
<u>Atriplex heterosperma</u> (Variable-seeded shadscale)	e MT, s ID
<u>Berteroa incana</u> (Hoary false-alyssum)	e MT, e WY, s ID, e WA, e OR
<u>Carduus acanthoides</u> (Plumeless thistle)	w MT, n & e ID, w WY
<u>Carduus nutans</u> (Musk thistle)	e MT, s ID, n WY
<u>Centaurea diffusa</u> (Diffuse knapweed)	central & sw MT, s ID, nw WY
<u>Centaurea maculosa</u> (Spotted knapweed)	c MT, w WY, s ID, ne OR, e WA
<u>Centaurea repens</u> (Russian knapweed)	c MT, c & n ID, sw & ne WY, neOR
<u>Cirsium vulgare</u> (Bull thistle)	e MT, s ID, e WA, n OR, WY
<u>Crupina vulgaris</u> (Crupina)	w MT, c ID
<u>Cynoglossum officinale</u> (Houndstongue)	nc MT, w WY, s & c ID, e WA, n OR
<u>Euphorbia esula</u> (Leafy spurge)	nc MT, WY, sw & n ID, e WA, nw OR
<u>Filago arvensis</u> (Field filago)	w MT, n & c ID, n WY, w WA
<u>Fumaria officinalis</u> (Fumitory)	c & e MT
<u>Gypsophila paniculata</u> (Baby's breath)	MT, n & c ID, n & w WY
<u>Halogeton glomeratus</u> (Halogeton)	s MT, w WY, s ID, se OR
<u>Hieracium aurantiacum</u> (Orange hawkweed)	nw MT, n ID,
<u>Isatis tinctoria</u> (Dyer's woad)	sw MT, s ID, w WY
<u>Linaria dalmatica</u> (Dalmatian toadflax)	c & e MT, n & w WY, s ID, se WA, ne OR
<u>Onopordum acanthium</u> (Scotch thistle)	s MT, n WY, e & c ID, e OR
<u>Potentilla recta</u> (Sulphur cinquefoil)	w MT, e WA, c ID
<u>Taraxicum laevigatum</u> (Red-seeded dandelion)	sc & w MT, e ID, WY

Abutilon theophrasti

Velvet leaf

7.

≤ 1880-1890

1931-1940

1891-1900

1941-1950

1901-1910

1951-1960

1911-1920

1961-1970

1921-1930

1971-1980

Aegilops cylindrica

Jointed goat grass

8.

Agropyron triticeum

Annual wheatgrass

9.

Agrostis interrupta

Windgrass

10.

Alyssum alyssoides

11.

Pale alyssum

Alyssum desertorum

Desert alyssum

12.

Anchusa officinalis

Common bugloss

14.

≤1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Atriplex heterosperma

Variable-seeded shadscale 15.

1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Bromus japonicus

Japanese brome

19.

≈ 1880-1890

1931-1940

1891-1900

1941-1950

1901-1910

1951-1960

1911-1920

1961-1970

1921-1930

1971-1980

Bromus tectorum

Downy brome (Cheatgrass) 20.

Carduus acanthoides

Plumeless thistle

24.

Centaurea cyanus

Cornflower

27.

≤1880-1890

1931-1940

1891-1900

1941-1950

1901-1910

1951-1960

1911-1920

1961-1970

1921-1930

1971-1980

Centaurea maculosa

Spotted knapweed

29.

≤1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Chorispora tenella

Blue mustard

33.

Cirsium arvense

Canada thistle

34.

1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Cirsium vulgare

Bull thistle

27.

≤ 1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Convolvulus arvensis

Field bindweed

37.

1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

≤1880-1890

1931-1940

1891-1900

1941-1950

1901-1910

1951-1960

1911-1920

1961-1970

1921-1930

1971-1980

1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

≤ 1880 - 1890

1931 - 1940

1891 - 1900

1941 - 1950

1901 - 1910

1951 - 1960

1911 - 1920

1961 - 1970

1921 - 1930

1971 - 1980

Eragrostis cilianensis

Stinkgrass

43.

1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Eragrostis pectinacea

Tufted lovegrass

44.

1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Filago arvensis

Field filago

48.

1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Gypsophila paniculata

Baby's breath

50.

Hordeum geniculatum All.

Mediterranean barley 53.

Hyoscyamus niger

Black henbane

54.

≤1880-1890

1931-1940

1891-1900

1941-1950

1901-1910

1951-1960

1911-1920

1961-1970

1921-1930

1971-1980

1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

1880-1890

1931-1940

1891-1900

1941-1950

1901-1910

1951-1960

1911-1920

1961-1970

1921-1930

1971-1980

Lolium persicum

Persian darnel

63.

1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

≈ 1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Lychnis alba

White cockle

65.

≤1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Melilotus alba

White sweetclover 67.

≤1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Poa bulbosa

Bulbous bluegrass 70.

1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Rumex acetosella

Red sorrel

74.

≤1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Rumex crispus

<1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

Curly dock

75.

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Salsola kali

1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

Russian thistle

76.

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Setaria lutescens

Yellow foxtail

77.

Silene noctiflora

Nightflowering catchfly

79.

≤ 1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Sonchus arvensis

Perennial sowthistle 82.

≤ 1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Tragopogon dubius

Western salsify

87.

≤1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Tragopogon pratensis

Meadow salsify

88.

≤ 1880 - 1890

1891 - 1900

1901 - 1910

1911 - 1920

1921 - 1930

1931 - 1940

1941 - 1950

1951 - 1960

1961 - 1970

1971 - 1980

Tribulus terrestris

Puncture vine

89.

≤1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

1880-1890

1891-1900

1901-1910

1911-1920

1921-1930

1931-1940

1941-1950

1951-1960

1961-1970

1971-1980

Vaccaria segetalis

Cow cockle

92.

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Common mullein

94.

Vicia villosa

Hairy vetch 96.

Agropyron repens

Capsella bursa-pastoris

Chrysanthemum leucanthemum

Echinochloa crusgalli

Festuca octoflora

Hordeum jubatum

Lactuca serriola

Plantago major

Setaria viridis

Xanthium strumarium

Rate of Infestation Graphs for Ninety Weeds

NUMBER OF COUNTIES INFESTED

TIME (YEARS A.D.)

TIME (YEARS A.D.)

TIME (YEARS A.D.)

NUMBER OF COUNTIES INFESTED

TIME (YEARS A.D.)

TIME (YEARS A.D.)

NUMBER OF COUNTIES INFESTED

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Cress, hoary	<i>Cardaria draba</i>	22, 101
Crupina	<i>Crupina vulgaris</i>	39, 104
Dandelion, red-seeded	<i>Taraxacum laevigatum</i>	84, 111
Darnel	<i>Lolium temulentum</i>	64, 108
Darnel, Persian	<i>Lolium perenne</i>	63, 108
Dock, curly	<i>Rumex crispus</i>	75, 110
Falseflax, smallseed	<i>Camaltina microcarpa</i>	21, 101
Fanweed	<i>Thlaspi arvense</i>	86, 112
Fescue, six-weeks	<i>Festuca (Vulpia) octoflora</i>	97
Filaree, redstem	<i>Erodium cicutarium</i>	43, 105
Fiddleneck, small-flowered	<i>Ammi nictitans</i>	13, 100
Filago, Field	<i>Filago arvensis</i>	48, 105
Flixweed	<i>Descurainia sophia</i>	41, 104
Foxtail, green	<i>Setaria viridis</i>	97
yellow	<i>Setaria lutescens</i>	77, 110
Fumitory	<i>Fumaria officinalis</i>	49, 106
Goat grass, jointed	<i>Aegilops cylindrica</i>	8, 99
Halogeton	<i>Halogeton glomeratus</i>	51, 106

Hawkweed, orange	<i>Hieracium aurantiacum</i>	52, 106
Henbane, black	<i>Hyoscyamus niger</i>	54, 106
Houndstongue	<i>Cynoglossum officinale</i>	40, 104
Knapweed, diffuse	<i>Centaurea diffusa</i>	28, 102
Russian	<i>Centaurea repens</i>	30, 102
spotted	<i>Centaurea maculosa</i>	29, 102
Kochia	<i>Kochia scoparia</i>	57, 107
Lettuce, prickly	<i>Lactuca serriola</i>	97
Lovegrass, tufted	<i>Eragrostis pectinacea</i>	45, 105
Medic, black	<i>Medicago lupulina</i>	66, 108
Mullein, common	<i>Verbascum thapsus</i>	94, 113
moth	<i>Verbascum blattaria</i>	93, 113
Mustard, blue	<i>Chorispora tenella</i>	33, 103
haresear	<i>Conringia orientalis</i>	36, 103
tall hedge	<i>Sisymbrium locustii</i>	81, 111
tumble	<i>Sisymbrium altissimum</i>	80, 111
Oxeye-daisy, field	<i>Chrysanthemum leucanthemum</i>	97
Pennycress	<i>Thlaspi arvense</i>	86, 112
Pepperweed, field	<i>Lepidium campestre</i>	59, 107
yellowflower	<i>Lepidium perfoliatum</i>	60, 107
Plantain, broadleaf	<i>Plantago major</i>	97
Puncturevine	<i>Tribulus terrestris</i>	89, 112
Quack grass	<i>Agropyron repens</i>	97
Salsify, meadow	<i>Tragopogon pratensis</i>	88, 112
western	<i>Tragopogon dubius</i>	87, 112
Shadscale, variable-seeded	<i>Atriplex heterosperma</i>	15, 100
Shepherdspurse	<i>Capsella bursa-pastoris</i>	97
Sorrel, red	<i>Rumex acetosella</i>	74, 110
Sowthistle, marsh	<i>Sonchus uliginosus</i>	83, 111
perennial	<i>Sonchus arvensis</i>	82, 111
Spurge, Cypress	<i>Euphorbia cyparissias</i>	46, 105
leafy	<i>Euphorbia esula</i>	47, 105
Starthistle, purple	<i>Centaurea calcitrapa</i>	26, 102
Starthistle, yellow	<i>Centaurea solstitialis</i>	31, 103
Sticktight, European	<i>Lappula echinata</i>	58, 107
Stinkgrass	<i>Eragrostis cilianensis</i>	44, 105
St. Johnswort	<i>Hypericum perforatum</i>	55, 107
Sweetclover, white	<i>Melilotus alba</i>	67, 109
yellow	<i>Melilotus officinalis</i>	68, 109
Tansey	<i>Tanacetum vulgare</i>	84, 111
Teasel	<i>Dipsacus sylvestris</i>	42, 104
Thistle, bull	<i>Cirsium vulgare</i>	35, 103
Canada	<i>Cirsium arvense</i>	34, 103
musk	<i>Carduus nutans</i>	25, 102
plumeless	<i>Carduus acanthoides</i>	24, 101
Russian	<i>Salsola kali</i>	76, 110
Scotch	<i>Onopordum acanthium</i>	69, 109
Toadflax, dalmation	<i>Linaria dalmatica</i>	61, 108
yellow	<i>Linaria vulgaris</i>	62, 108
Velvet leaf	<i>Abutilon theophrasti</i>	7, 99
Vetch, common	<i>Vicia sativa</i>	95, 113
hairy	<i>Vicia villosa</i>	96, 113
Wheatgrass, annual	<i>Agropyron triticeum</i>	9, 99
Whitetop	<i>Cardaria pubescens</i>	23, 101
Windgrass	<i>Agrostis interrupta</i>	10, 99
Woad, Dyer's	<i>Isatis tinctoria</i>	56, 107