Economic Impact From Selected Noxious Weeds in Oregon – New Methods, New Numbers

Presentation by Alex Park

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Crop Sciences Department

Project Conducted By:

Primary Authors, Economic Analysis: The Research Group, LLC - Shannon Davis, Dr. Hans Radtke, and Ed Waters

Geospatial Analysis: Oregon Department of Agriculture - Alex Park, Oregon State University – Dr. Doug Johnson

Biological Analysis and Review: ODA Staff – Tim Butler, Tom Forney, Eric Coombs, Glenn Miller, and Carrie Pirosko

Change From Previous Report:

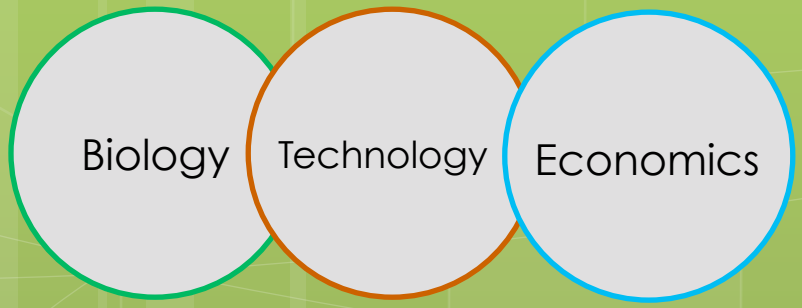
1) Twenty-five of the most worrisome weeds for economic harm and infestation potential for inclusion in this current study
   1) Six additional weeds from previous report

2) Economic numbers are better supported by a more coherent understanding of weed distributions across Oregon

3) Geospatial mapping and modelling are more advanced and allow for potential habitat distributions to be predicted

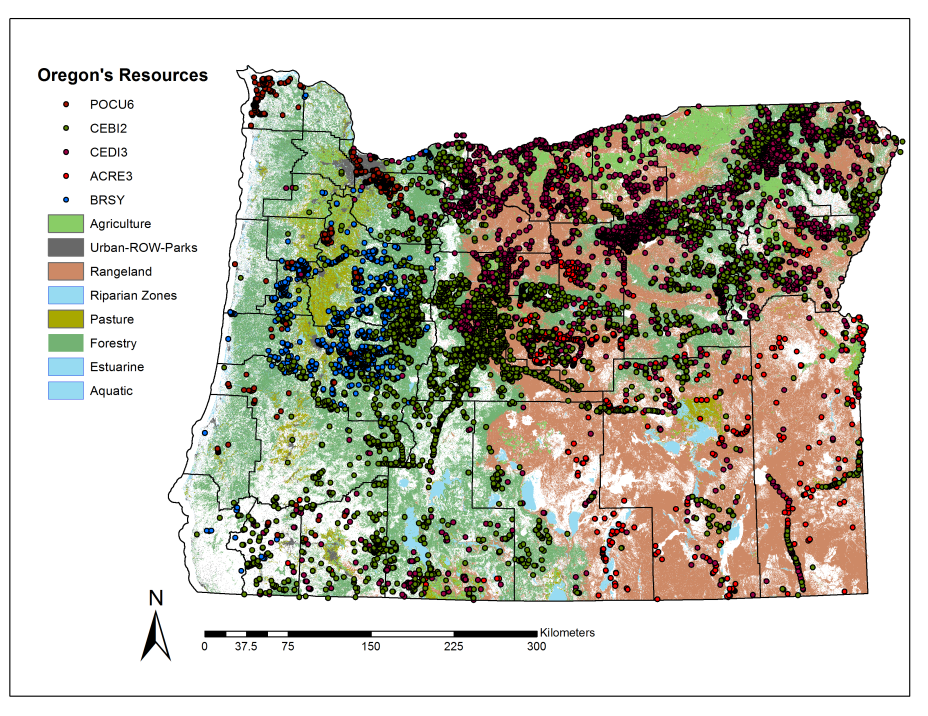
4) Economic and geospatial models are combined to investigate a range of impacts to particular resources with a higher measure of precision

5) Case descriptions for the 25 species are documented to bring clarity for how different prevention and control programs are utilized and have demonstrated success



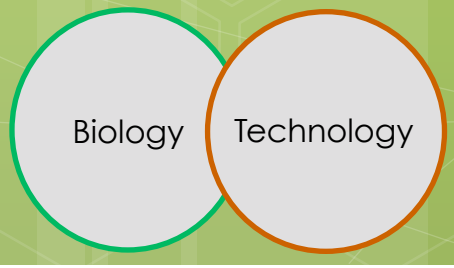
Tools Used:

WeedMapper Database



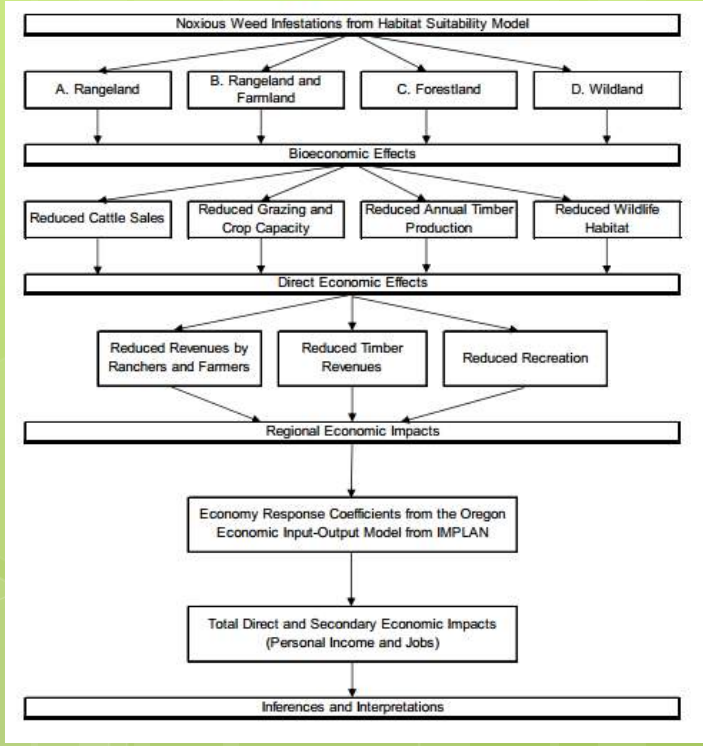
Data provided was collected by partners including **municipal, county, Cooperative Weed Management Areas, Soil Watershed Conservation Districts, Non-Governmental Organizations, and Federal environmental agencies**.

Collection of 350,000+ individual weed locations drove much of the increased precision of the new report.



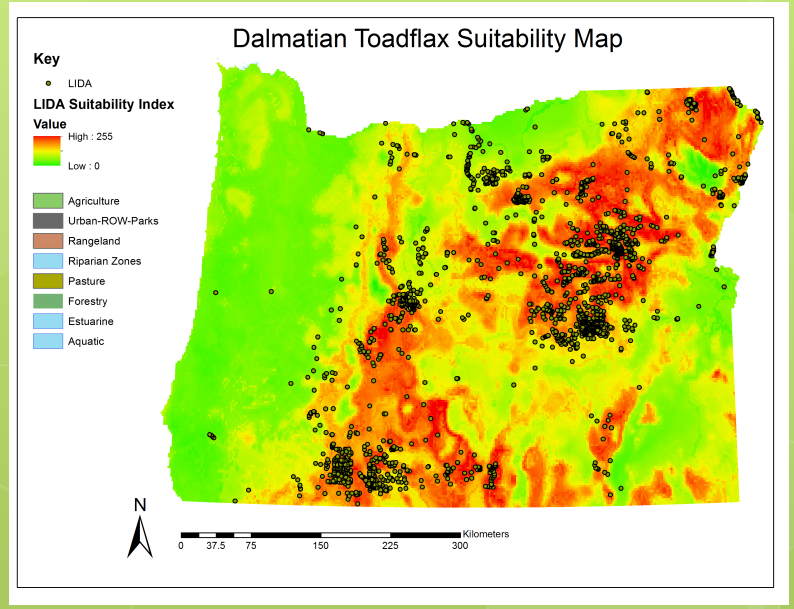
Tools Used:

The IMpact Analysis for PLANning (IMPLAN)Economic Modeler



The input-output modeling system used in the economic analysis

The Kinetic Resource and Environmental Spatial System (KRESS) Modeler developed by Dr. Doug Johnson



WeedMapper drove predictive analysis conducted in KRESS modeler

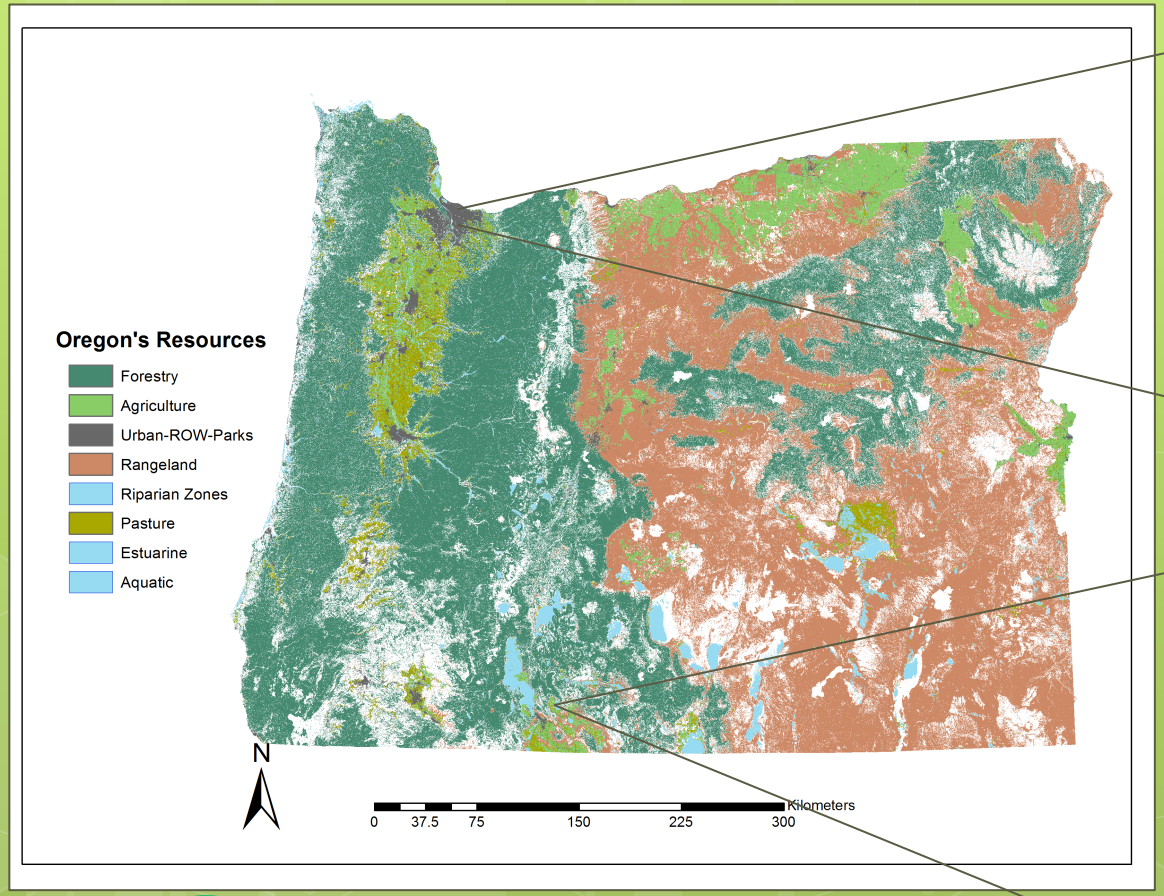
Economics

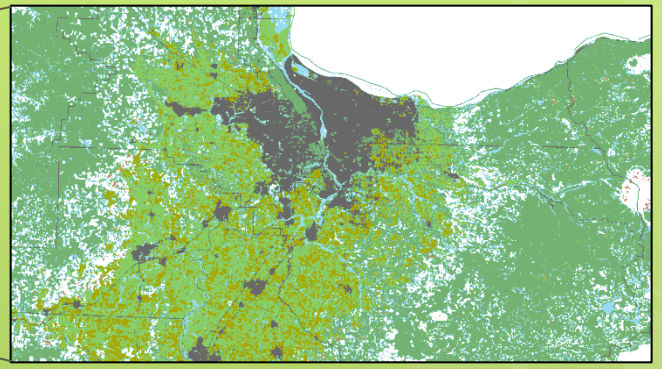
Biology

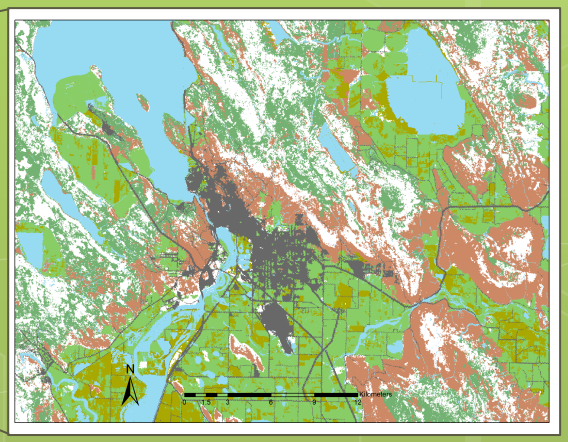
Technology

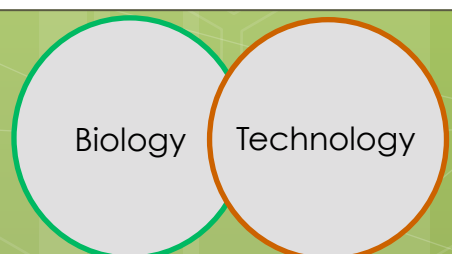
Tools Used:

A statewide land cover grid created by the Oregon Natural Heritage Information Center, then categorized by ODA was utilized in analyzing intersections between the habitat suitability model of the modeled weeds





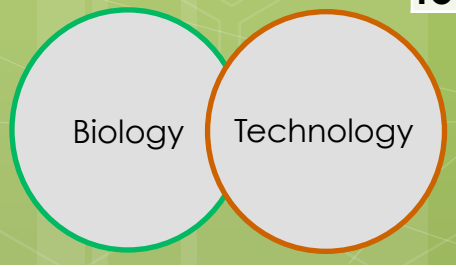




Tools Used:

A statewide land cover grid created by the Oregon Natural Heritage Information Center, then categorized by ODA was utilized in analyzing intersections between the habitat suitability model of the modeled weeds

Resource Impact	Acres	% of state
Pasture	1,651,499	0.026
Rangeland	19,656,961	0.31
Aquatic	478,722	0.007
Estuarine	40,297	0.0006
Forestry	21171673	0.33
Riparian	2,155,217	0.03
Urban-ROW-Recreation	1,446,209	0.02
Agriculture	3,279,259	0.05
Total	**49,879,838**	**0.78**



Invasives Analyzed:

Invasive Choice Rationale:

Capture a **geographically** diverse set of weeds at different **temporal** stages of invasion and success of control impacting a variety of different resources.

Biology

Table I.1
Noxious Weeds in Current and Previous Study

Species in Current and Previous Study

Current Study	Previous Study
Cordgrass	Spartina
Gorse	
Leafy spurge	
Hawkweeds (meadow and orange)	Yellow, orange hawkweed
Mediterranean sage	
Perennial pepperweed	White top and perennial pepperweed
Purple loosestrife	
Purple starthistle	
Rush skeletonweed	
Scotch broom	
Scotch thistle	
Tansy ragwort	
White top (hoary cress)	White top and perennial pepperweed
Woolly distaff thistle	Distaff thistle
Yellow starthistle	
Knapweeds - Diffuse	
Knapweeds - Meadow	Russian knapweed
Knapweeds -Spotted	
Knapweeds -Squarrose	

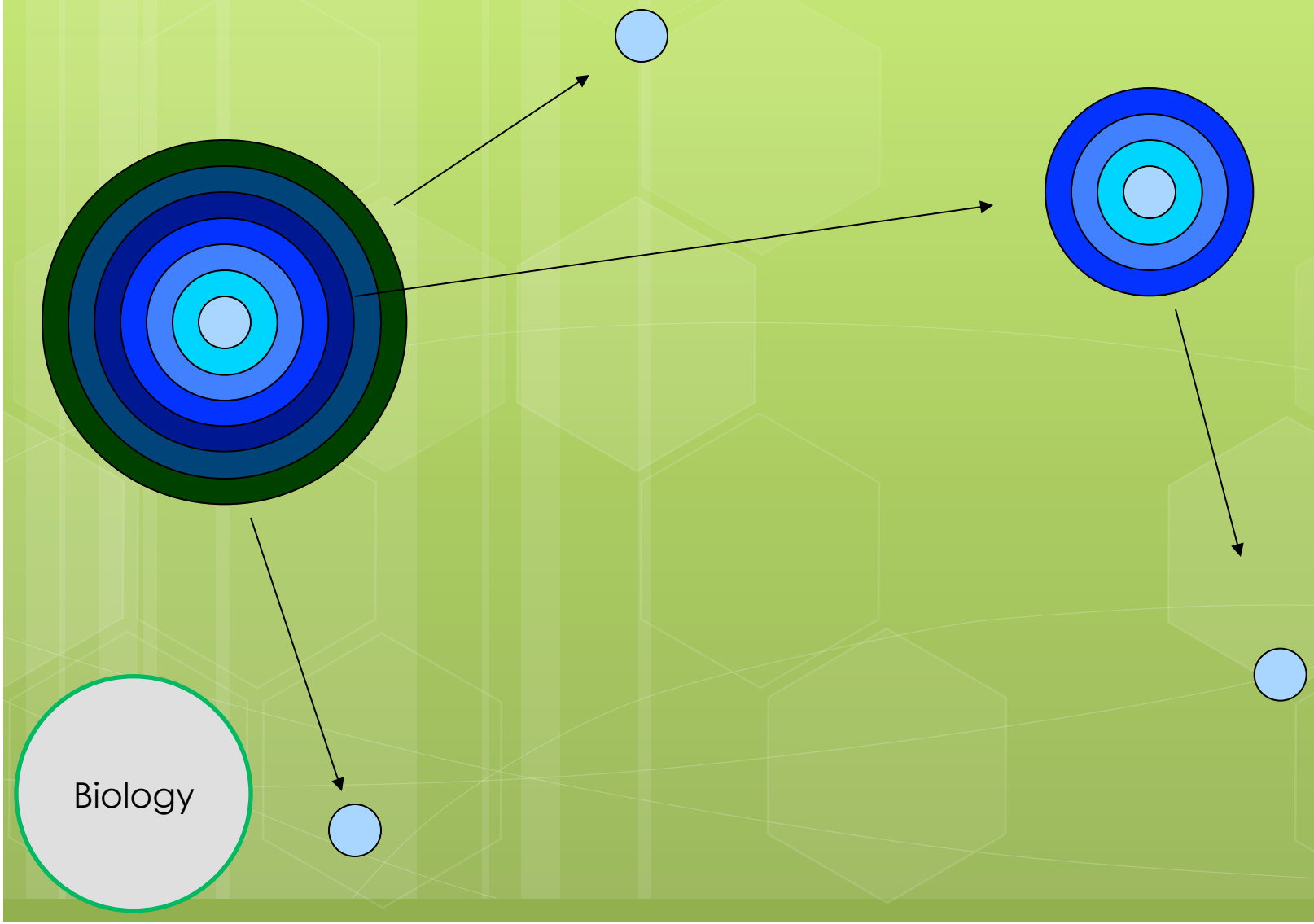
Species in Current Study and Not in Previous Study

Armenian blackberry (Himalayan)
Dalmatian toadflax
Giant hogweed
Japanese knotweed
Kudzu
Paterson's curse

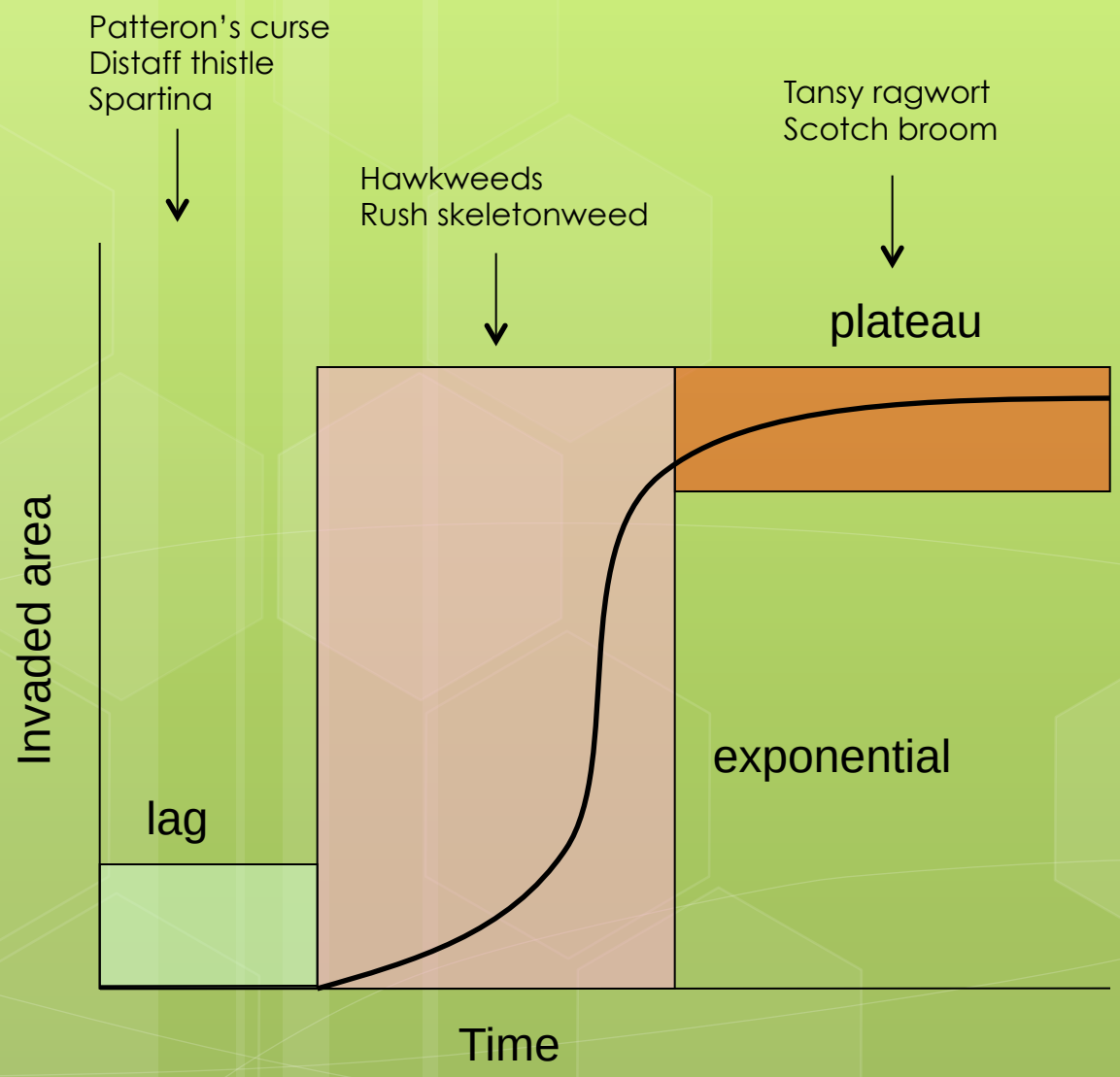
Species in Previous Study and Not in Current Study

Brazilian elodea

Capturing the Invasion: Spatial



Capturing the Invasion: Temporal



Biology

(Credit: Dr. Adam Davis, UIUC)

Cheatgrass (*Bromus tectorum*)

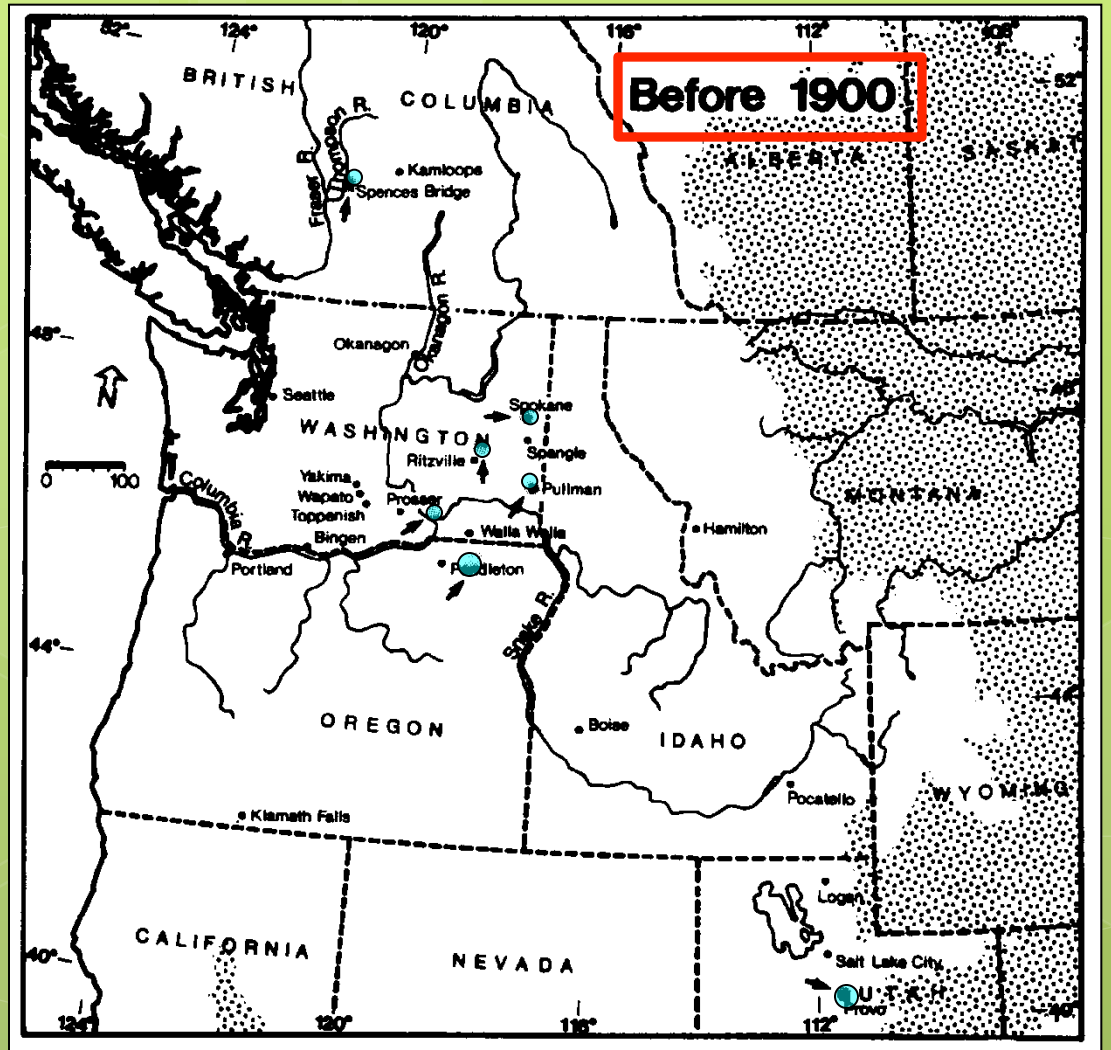


Fig. 1b.

(Credit: Dr. Adam Davis, UIUC)

R. N. Mack (1981)

Biology

Cheatgrass (*Bromus tectorum*)

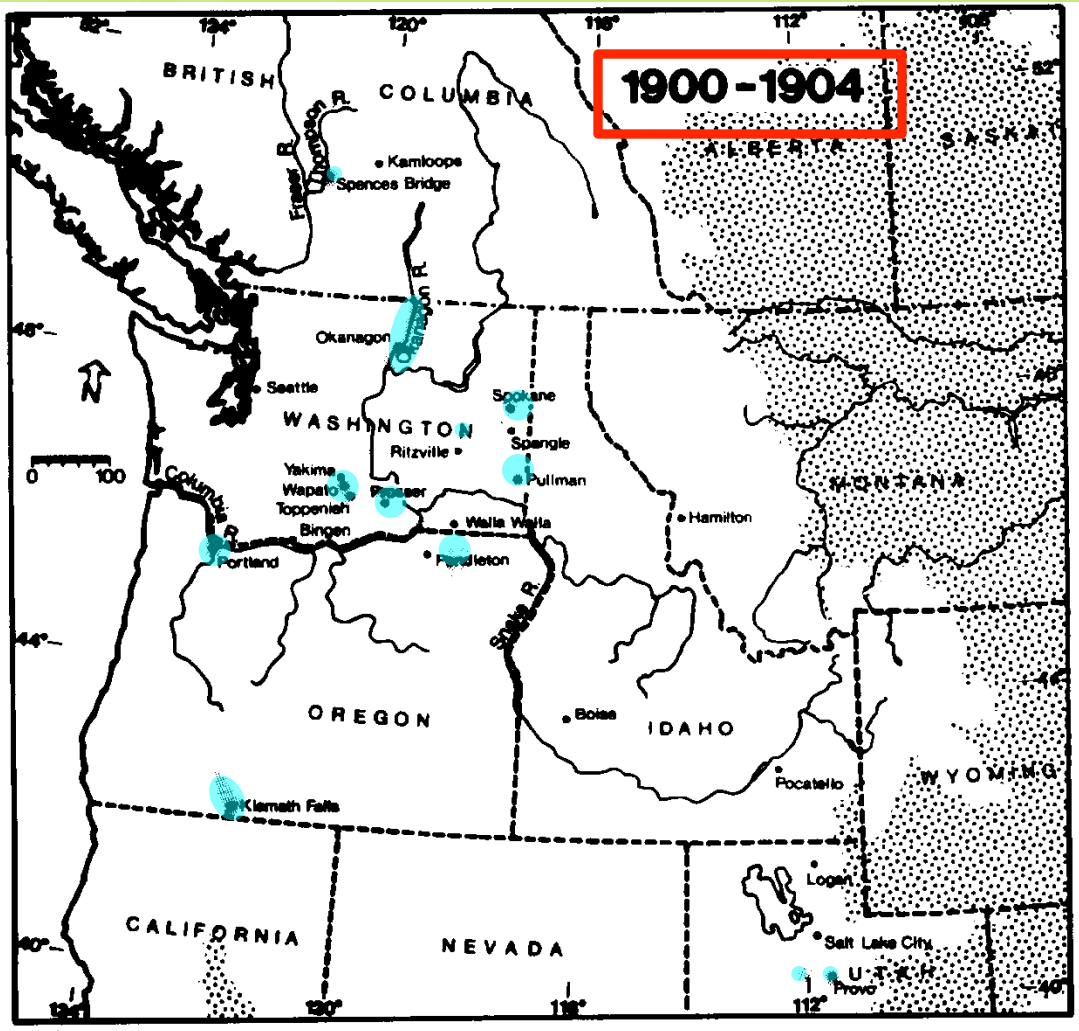


Fig. 1c.

Biology

R. N. Mack (1981)

Cheatgrass (*Bromus tectorum*)

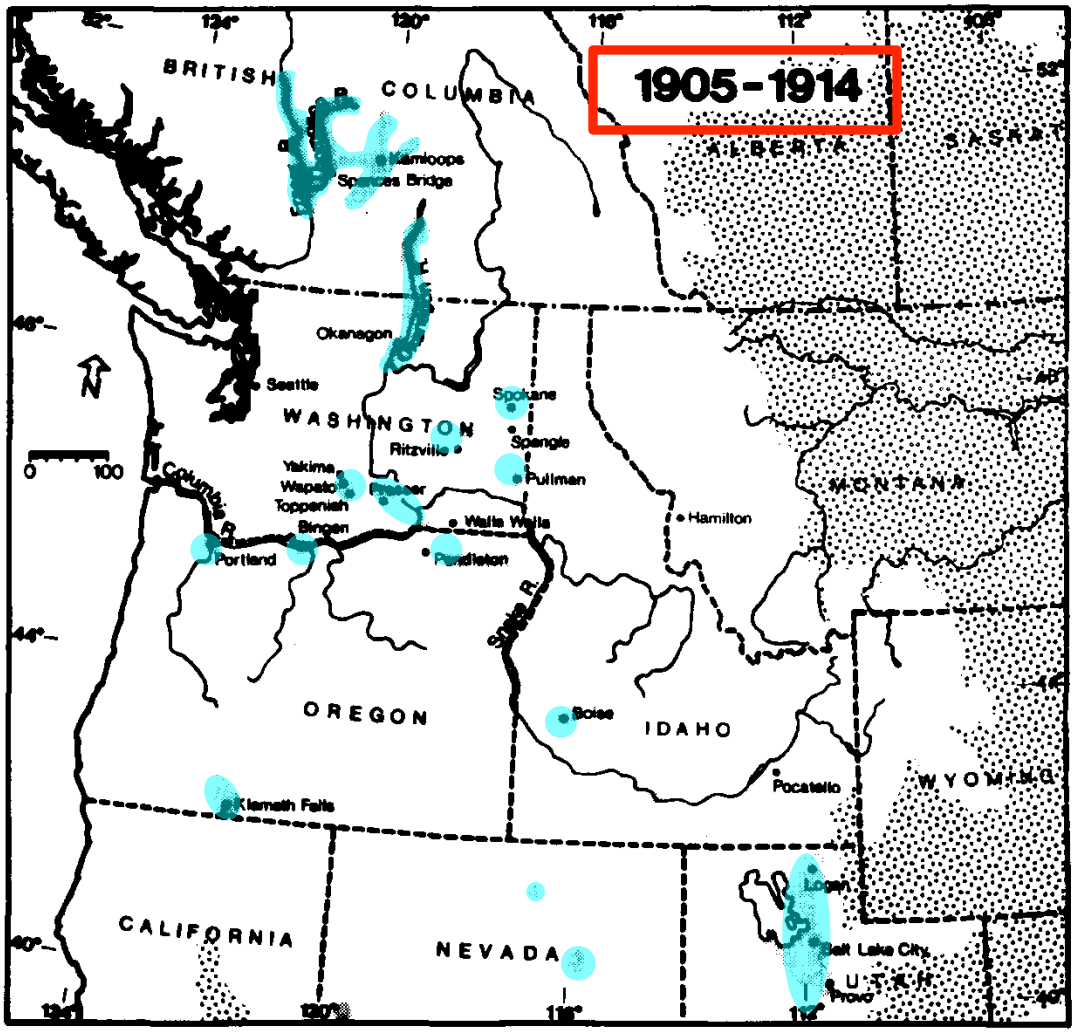


Fig. 1d.

R. N. Mack (1981)

Biology

Cheatgrass (*Bromus tectorum*)

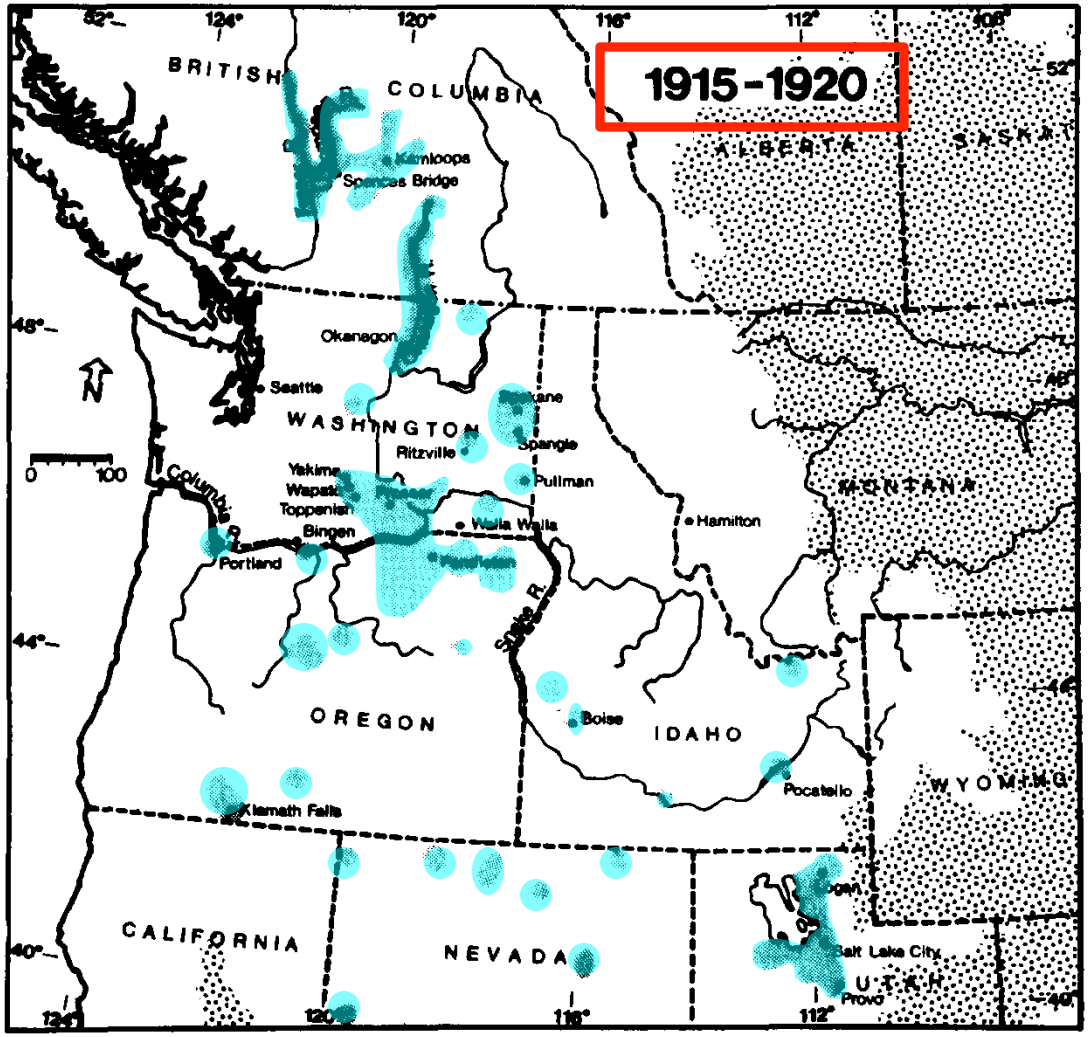


Fig. 1e.

R. N. Mack (1981)

Biology

Cheatgrass (*Bromus tectorum*)

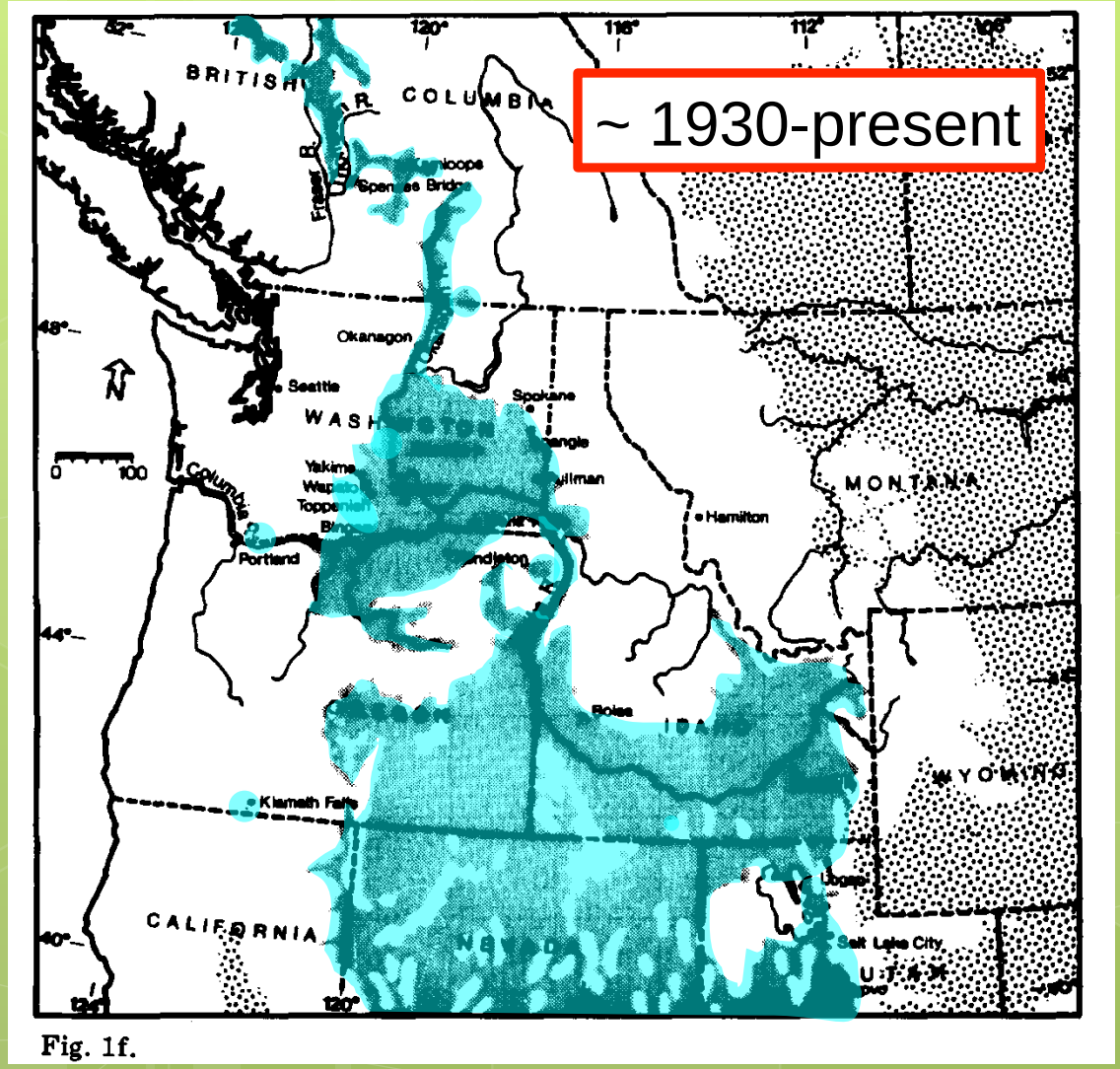


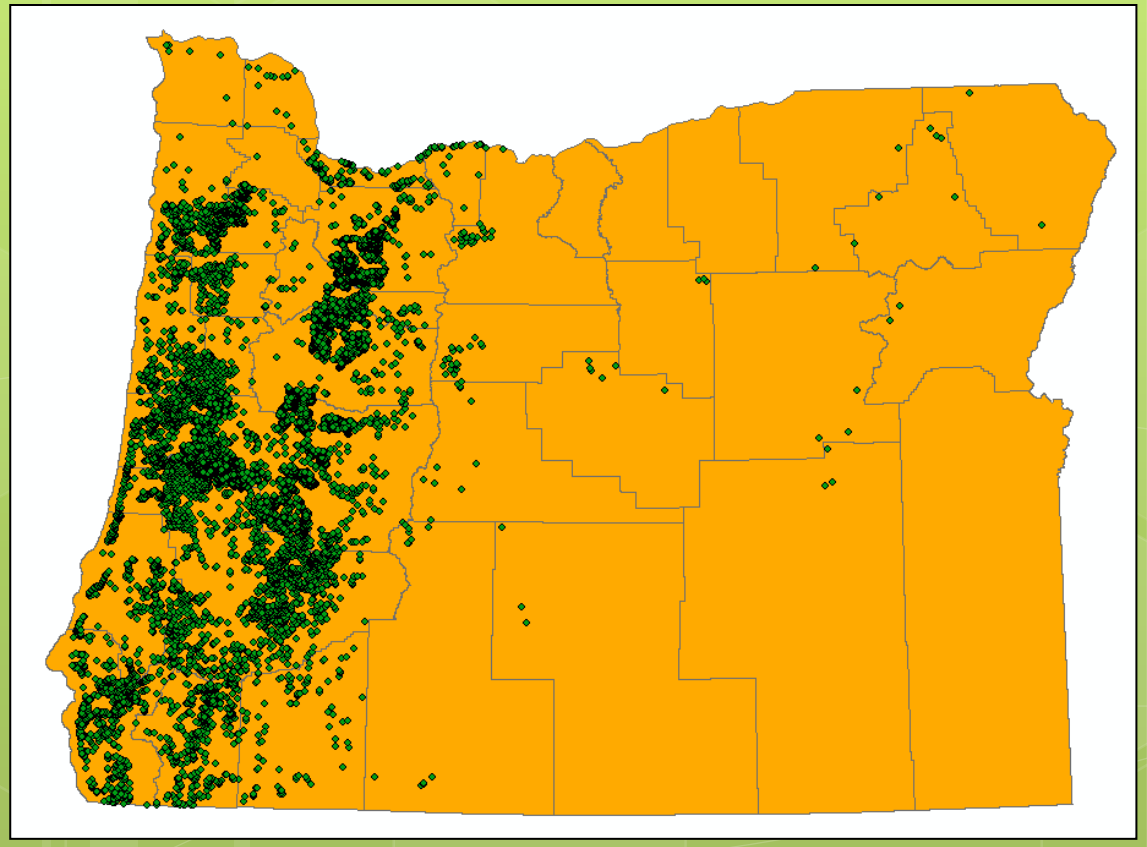
Fig. 1f.

R. N. Mack (1981)

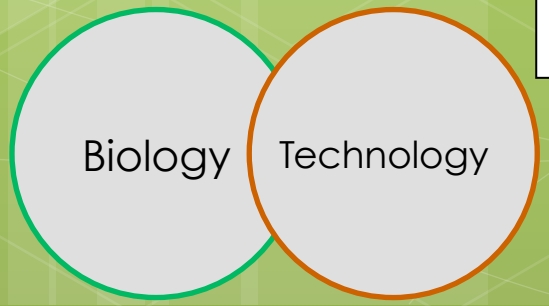
Biology

Habitat Suitability Models: Where could a species thrive?

- Using Occurrence/Presence Based Models



Current Scotch broom Distribution



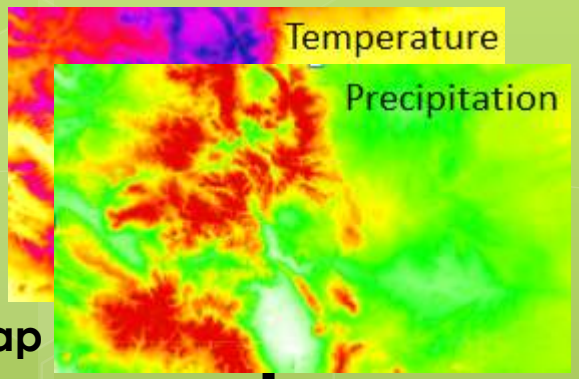
Modeling Process

Occurrences

Spreadsheets

Lat	Lon	Temp	Precip
-105.504	40.35819	5.32	58.4
-107.472	40.498	6.31	47.6

Environmental Layers



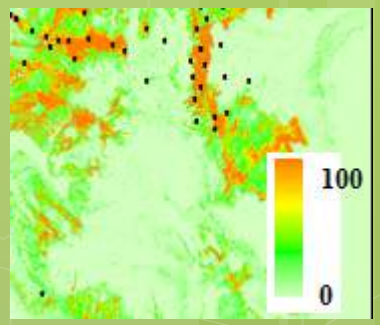
Modeling Algorithm

Model Parameters

Variable	Coefficient	P-Value
Intercept	-1.52	0.064
Annual Precip	-0.05	0.0
Annual Temp.	0.61	0.0

Map Generation

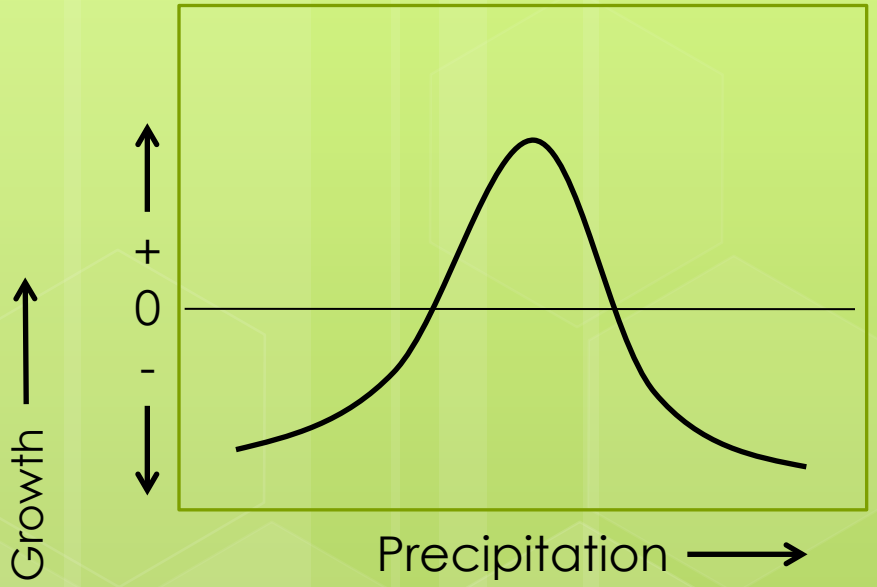
Habitat Suitability Map

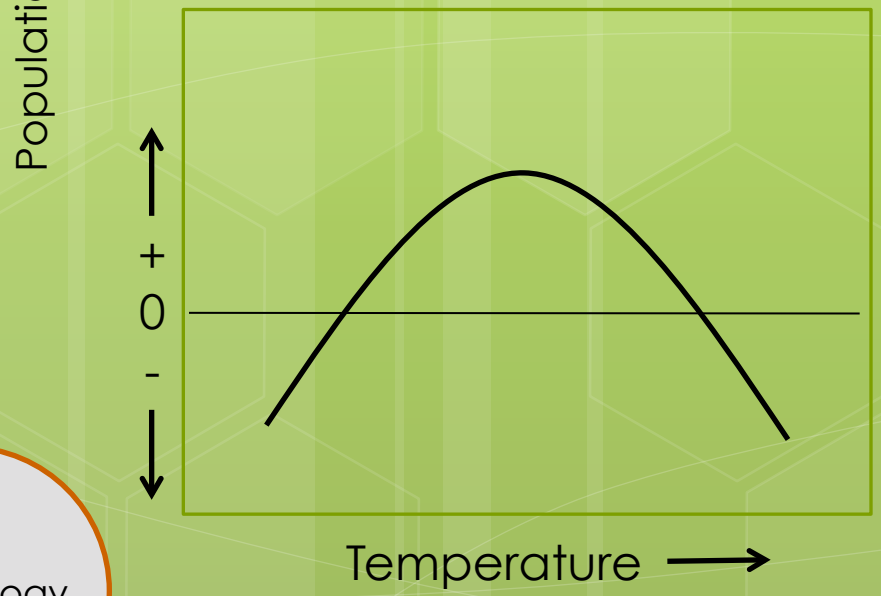


Technology

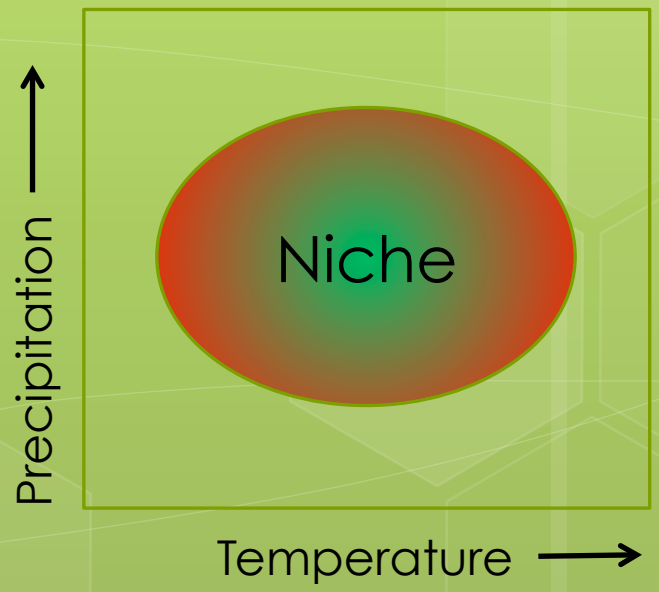
Credit: Jim Graham – OSU/CSU

From the Theory of Biogeography





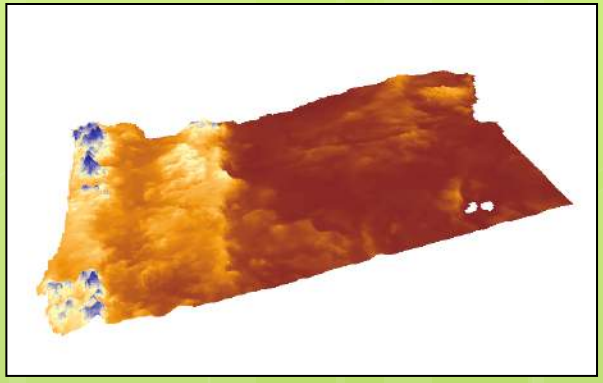
Environmental Space

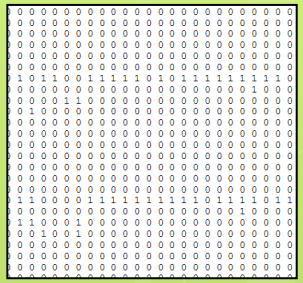


Technology

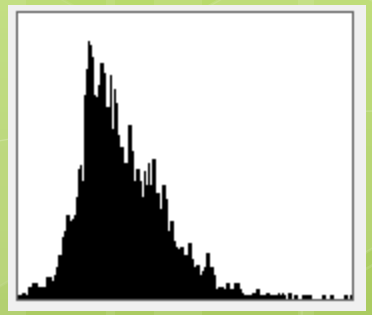
Brown, J.H., Lomolino, M.V. 1998, Biogeography: Second Edition. Sinauer Associates, Sinauer Massachusetts; Slide created by Jim Graham – OSU/CSU

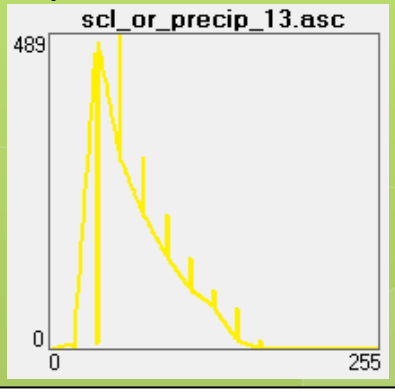
Raster Math: Precipitation



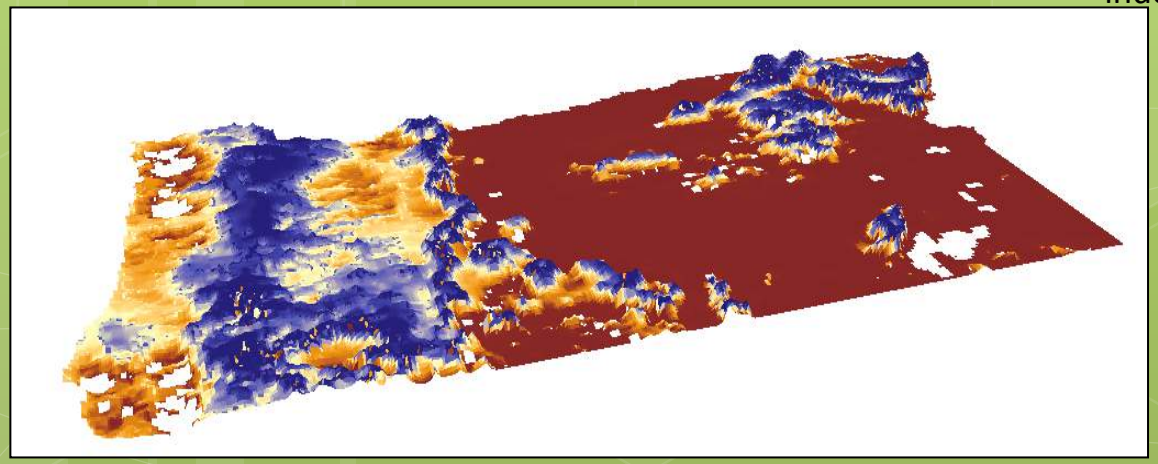


Boolean Logic, binary, 1 AND 0 is presence absence



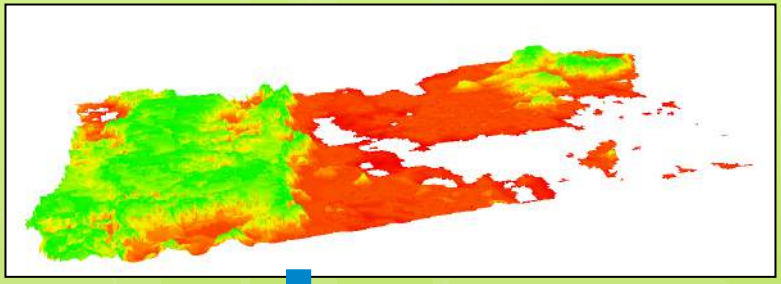


Intercept frequency data is used to generate "relative weights" which are used in the non-linear model to generate probability index (seen below)

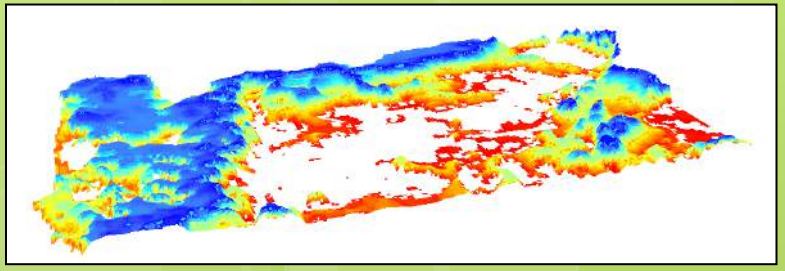


Technology

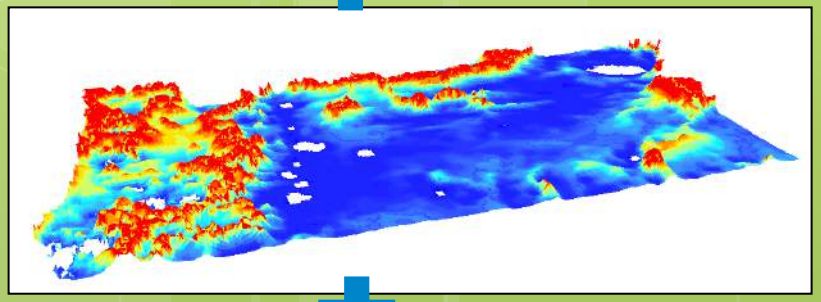
Add It All Up



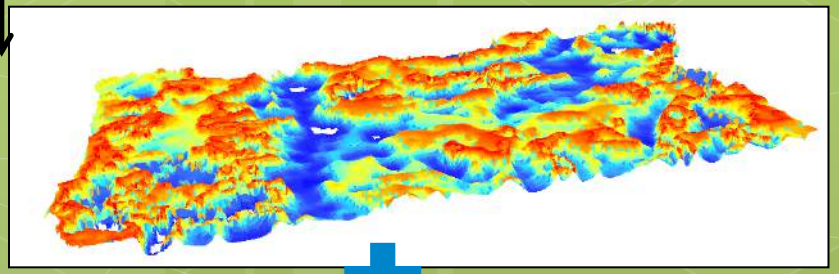
Wet days



Temp min



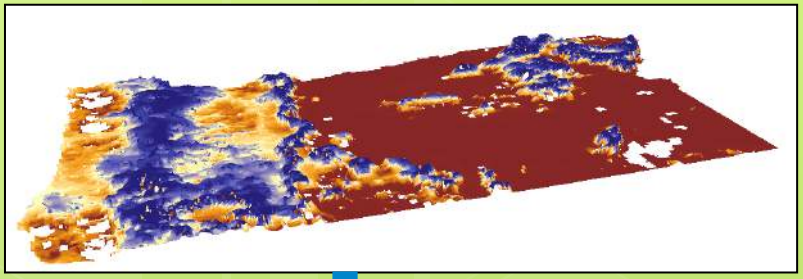
Temp mean



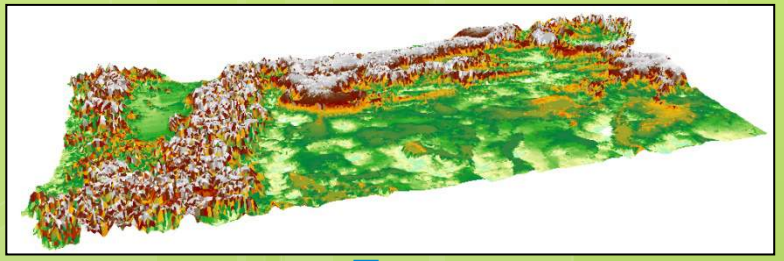
Temp max

The model scales 0-256 then adds them up

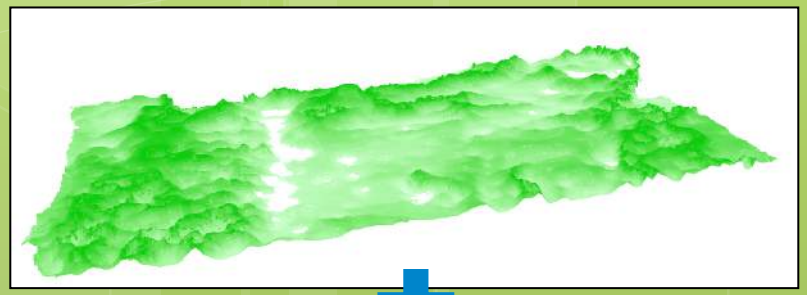
Technology



Precipitation



Elevation

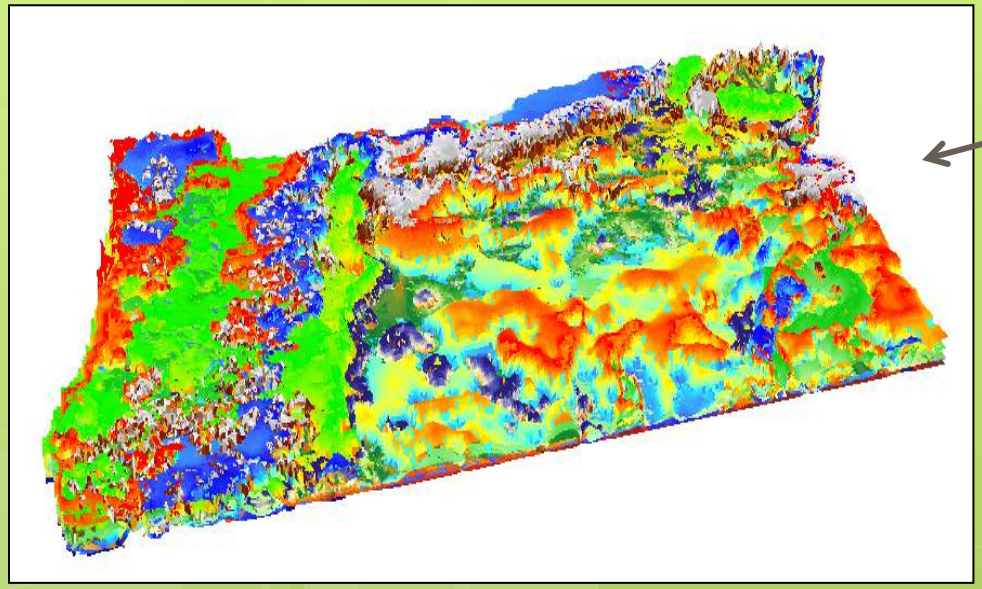


Growing degree days over 50 f

Freeze free data

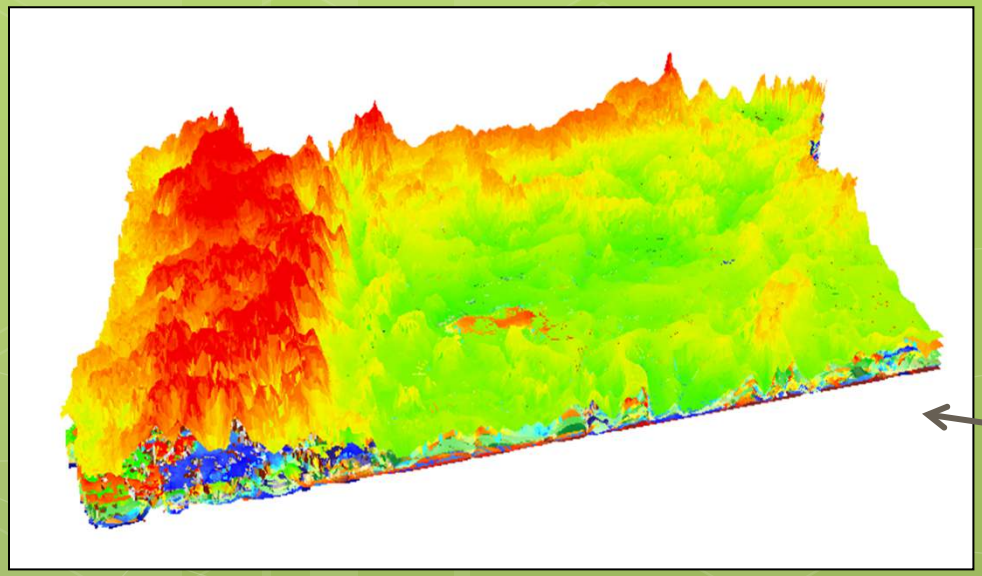
Technology

Final Product: Added Then Averaged



All additions Stacked on each other

KRESS generates a gradient from low to High probability of suitability, based on where it grows today to predict where it could grow in the future based on the environmental realities of where it currently grows

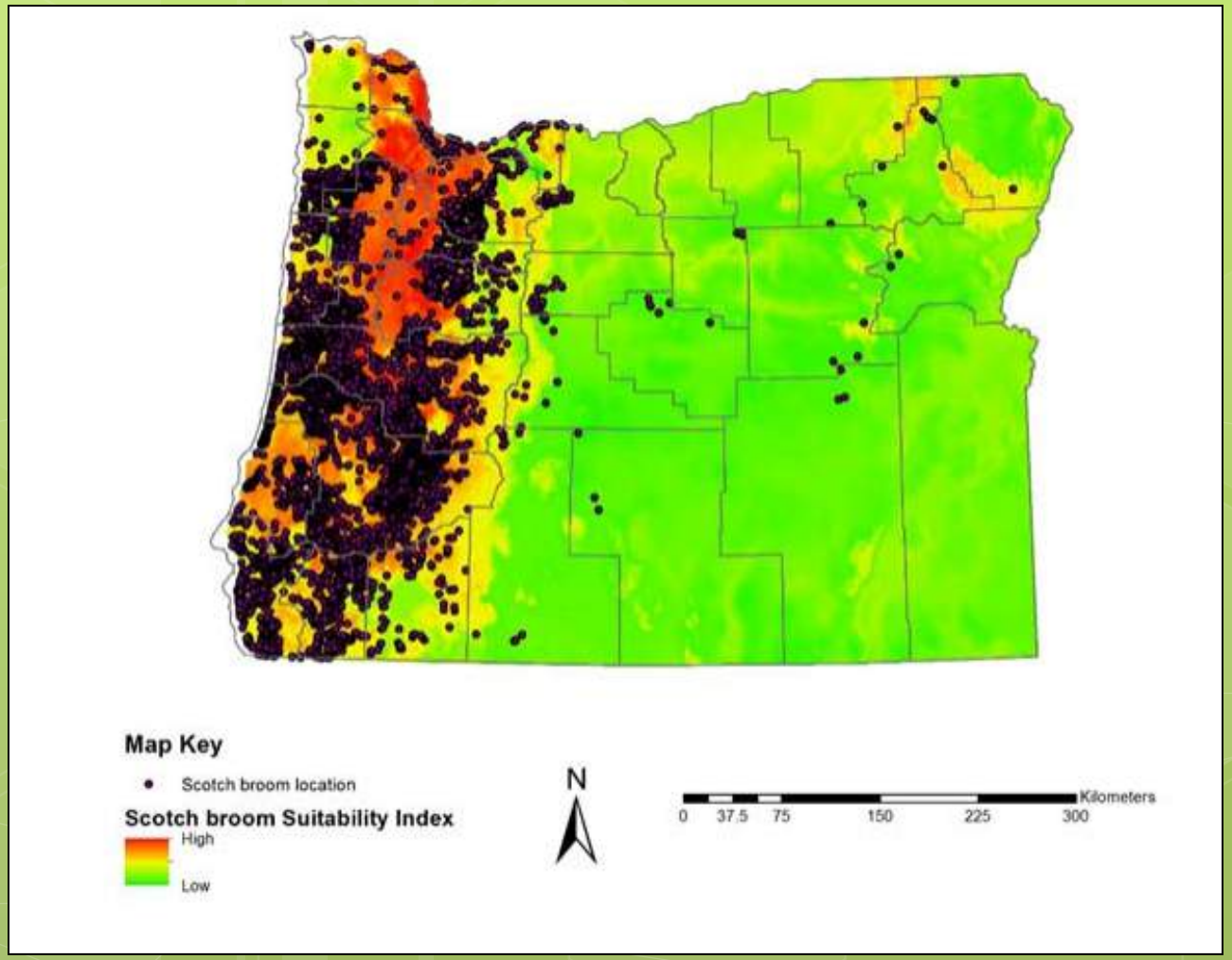


Final KRESS output

Technology

Scotch Broom: Spatial + Economic Model

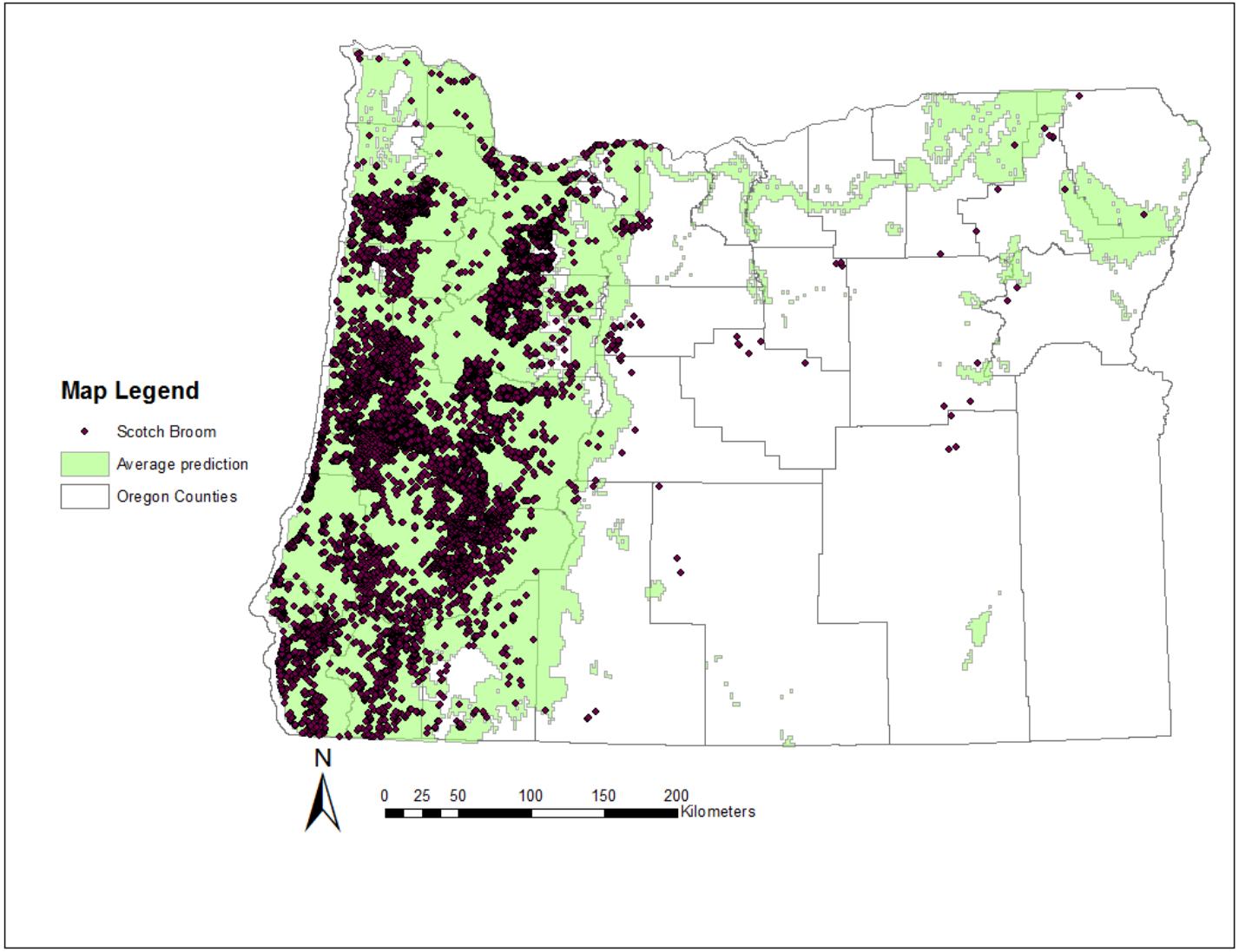
1) Raw prediction model for scotch broom with known infestations overlaid



Technology

Scotch Broom: Spatial + Economic Model

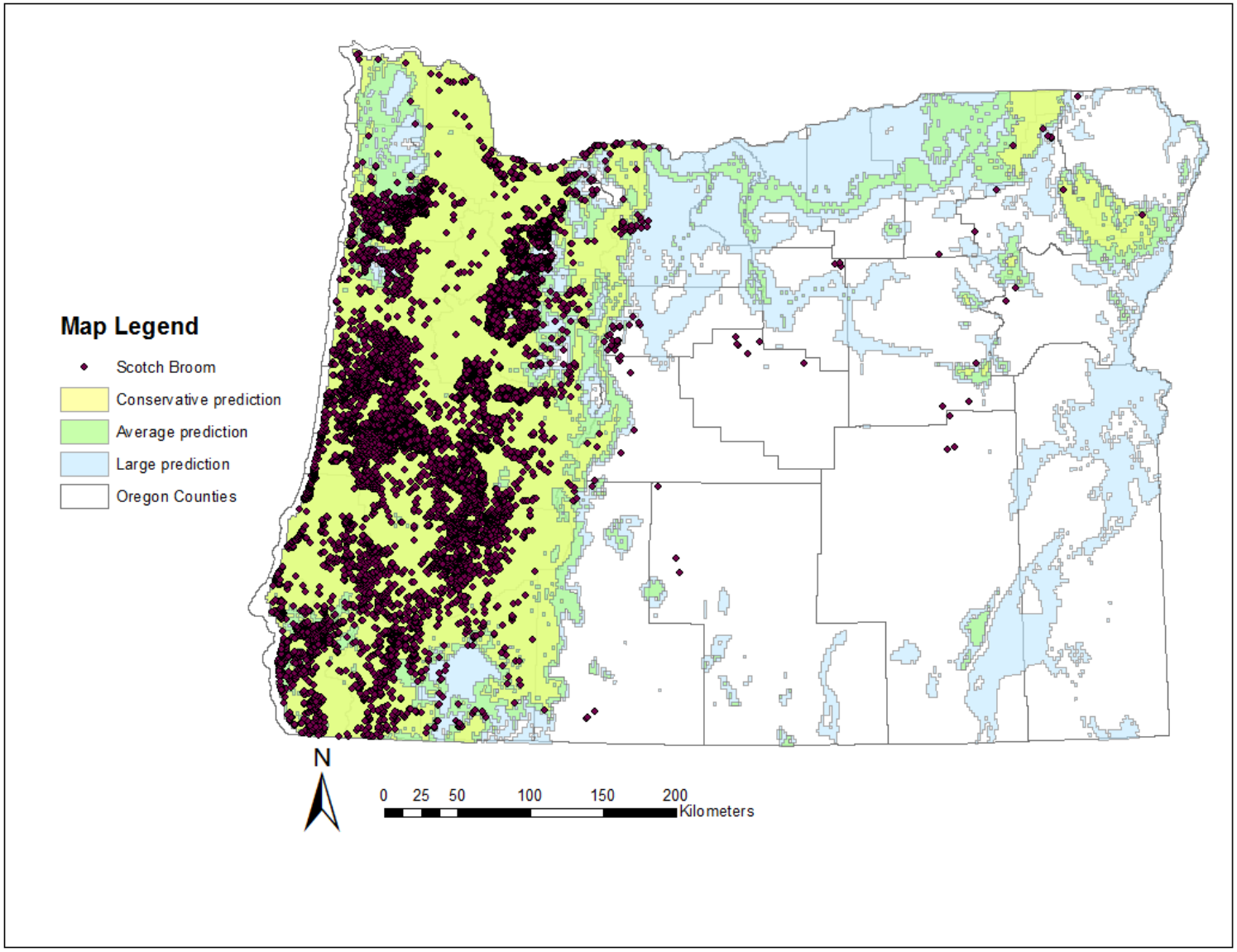
1) Impacts forestry operations, can increase management costs in urban areas and ROWs



Technology

Scotch Broom: Spatial + Economic Model

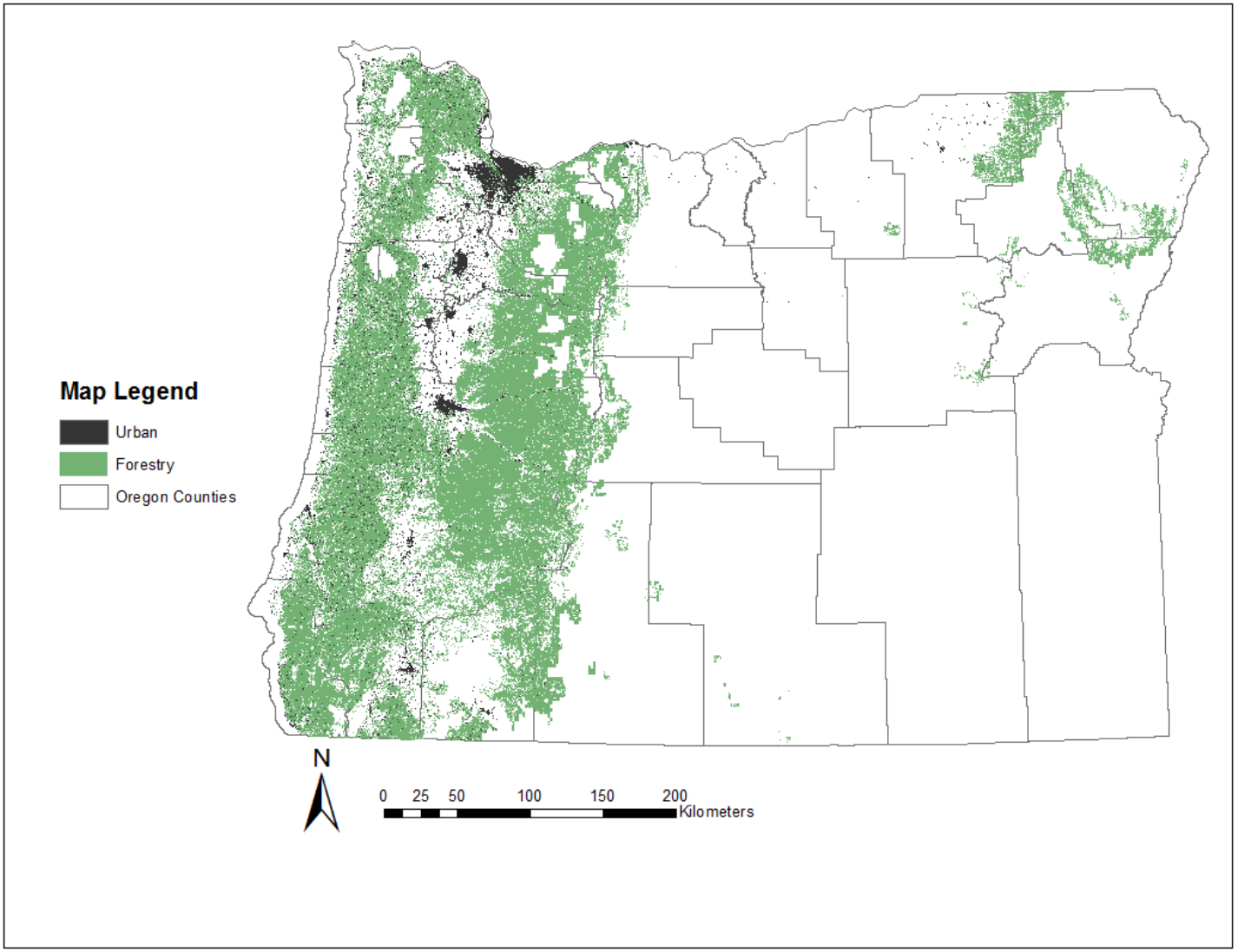
1) Varying levels of suitability can be analyzed



Technology

Scotch Broom: Spatial + Economic Model

1) Impacts forestry operations, can increase management costs in urban areas and ROWs

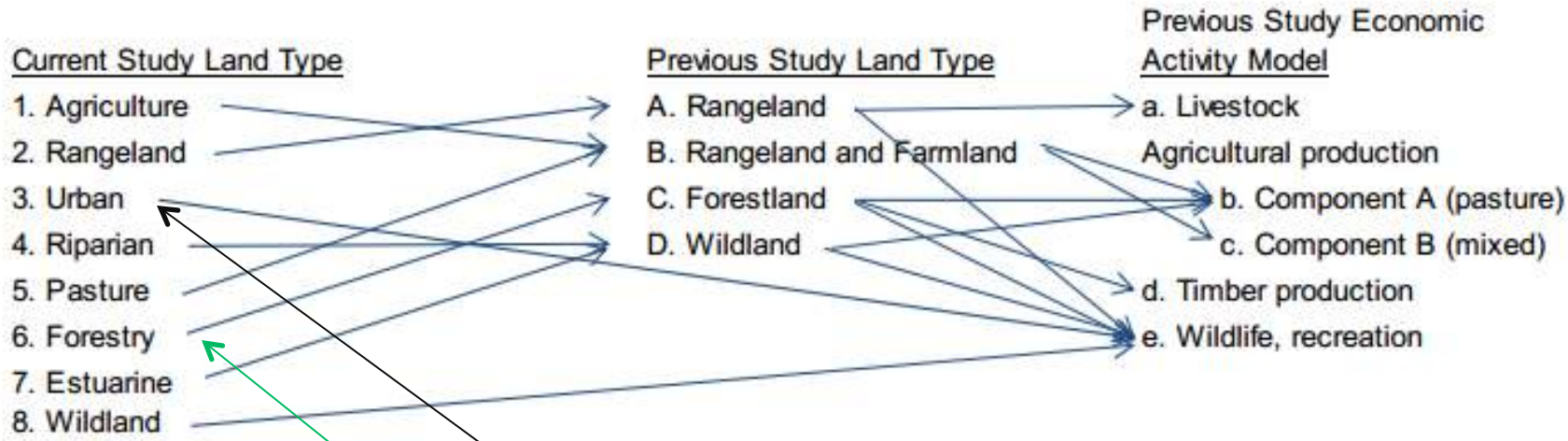


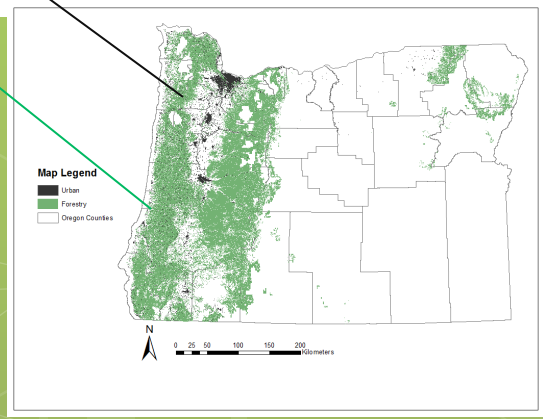
Technology

Scotch Broom: Spatial + Economic Model

1) Acreage from current and predicted acres feed economic model

Table I.2
Crosswalk of Current Study and Previous Study Land Types
and Associations With Economic Activity Models





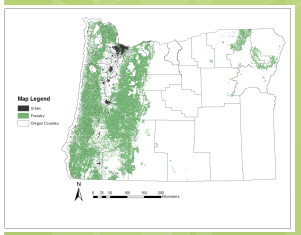
Technology

Economics

Scotch Broom: Spatial + Economic Model

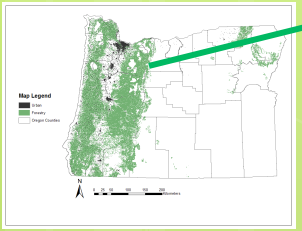
Current Study and Previous Study Infestation Land Types and Association With Economic Model

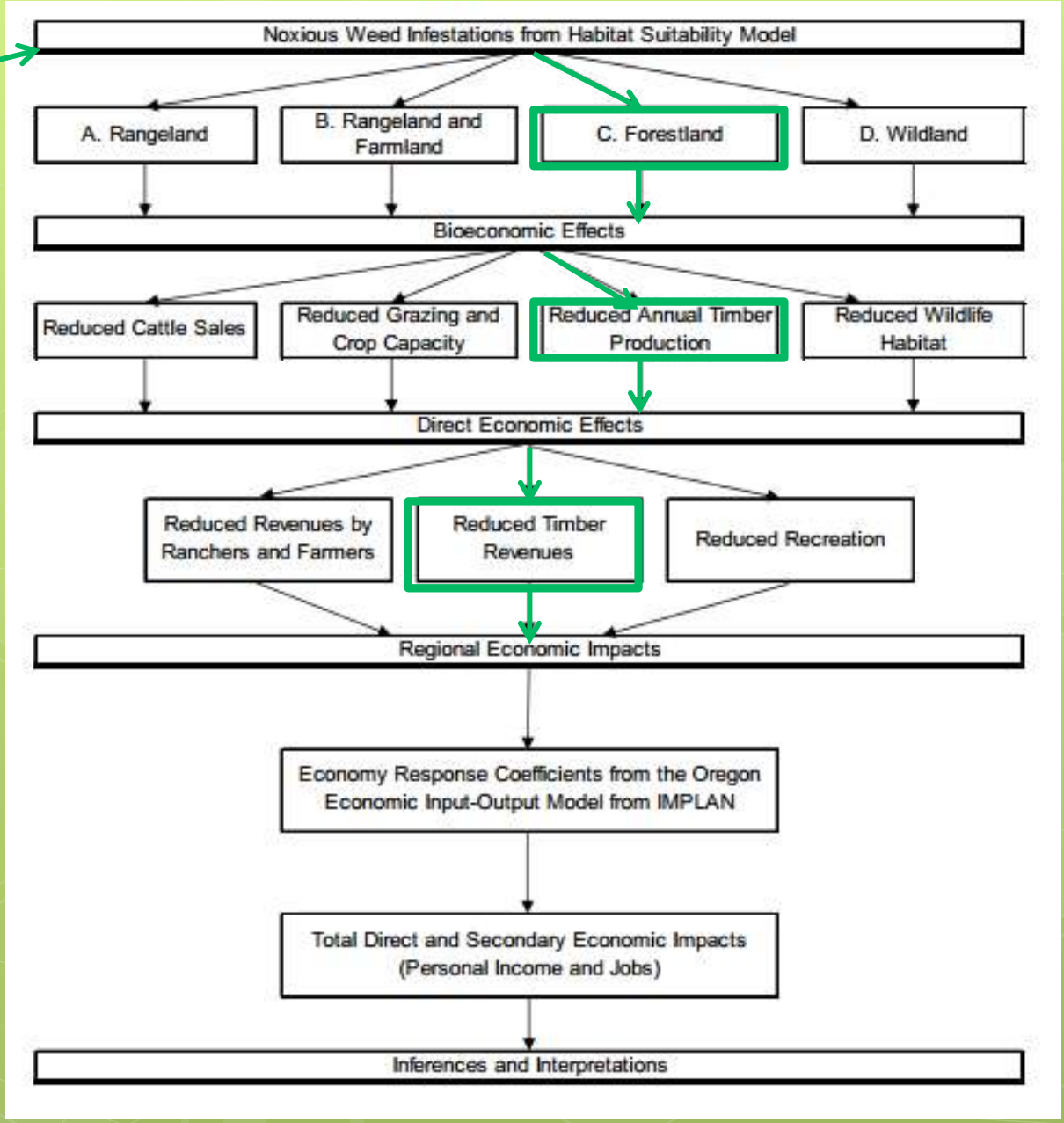
Current Study		Previous Study	
Species	Land Type	Land Type	Economic Model
Armenian blackberry (Himalayan)	1, 3, 4, 5, 6	***C***	***b, d, e***
Cordgrass	7	D	c, e
Dalmatian toadflax	2, 3, 4, 8	***A***	***a, b, e***
Giant hogweed	3	***B***	***b, c***
Gorse	3, 5, 6, 8	C	b, d, e
Japanese knotweed	3, 4	***A***	***a, b, e***
Kudzu	3	***A***	***b, e***
Leafy spurge	2, 4, 5, 8	A	a, b, e
Hawkweeds (meadow and orange)	3, 4, 8	A	b, e
Mediterranean sage	2	A	b, e
Paterson's curse	1, 2	***A***	***a, b, e***
Perennial pepperweed	2, 4, 5	A	a, b, e
Purple loosestrife	4, 8	D	e
Purple starthistle	2	A	none
Rush skeletonweed	1, 2	B	b, c
Scotch broom	3, 6	C	b, d, e
Scotch thistle	2, 3	A	a, b, e
Tansy ragwort	5, 8	B	a, b, c, e
White top (hoary cress)	1, 2, 5	A	a, b, e
Woolly distaff thistle	2	A	a, b, e
Yellow starthistle	2, 3, 5	A	a, b, e
Knapweeds - Diffuse	2, 3, 5	A	b, e
Knapweeds - Meadow	3, 5, 8	A	b, e
Knapweeds -Spotted	2, 3, 5	A	b, e
Knapweeds -Squarrose	2	A	b, e



Economics

Scotch Broom: Spatial + Economic Model





Economics

Economic Analysis Assumptions

Methods

The assumed affected economic activities for the analyzed weed species were associated with **four land types**:

1) **Rangelands**: livestock loss, reduced cattle foraging, and reduced wildlife grazing.
2) **Farmlands**: seed loss and reduced aquaculture.
3) **Forestland**: reduced timber production.
4) **Wildlands**: wildlife and fish stressor that lowers hunting, fishing, and boating recreational uses.

Economic model parameters specific to the analyzed weeds include the following:

1) Plant coverage factor.
2) Degradation factor of the economic activity.
3) Land production factors.

Economics

(Credit: Shannon Davis, The Research Group, LLC)

Economic Analysis Assumptions

1) Economic analysis to be limited to measurements of regional economic impacts (REI) using the metrics for business sales, personal income, and jobs

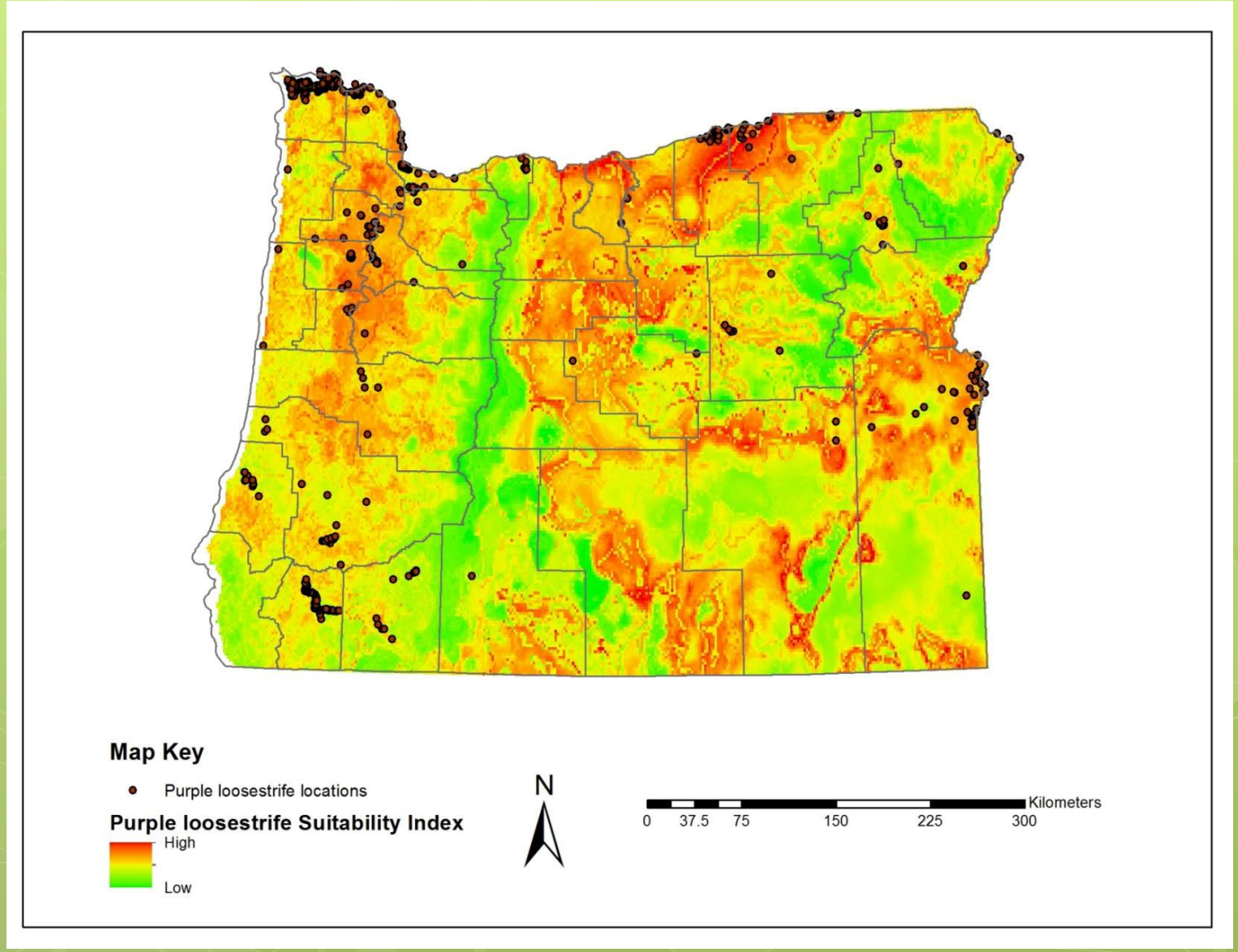
2) Supplement economic impact descriptions with explanations and estimated costs for different control approaches including none; prevention; early detection and rapid response (EDRR); and, long-term maintenance.

Economics

(Credit: Shannon Davis, The Research Group, LLC)

Case Study From Report: Purple Loosestrife

1) Impacts riparian areas, can impact productivity of fisheries and recreation



Case Study From Report: Purple Loosestrife

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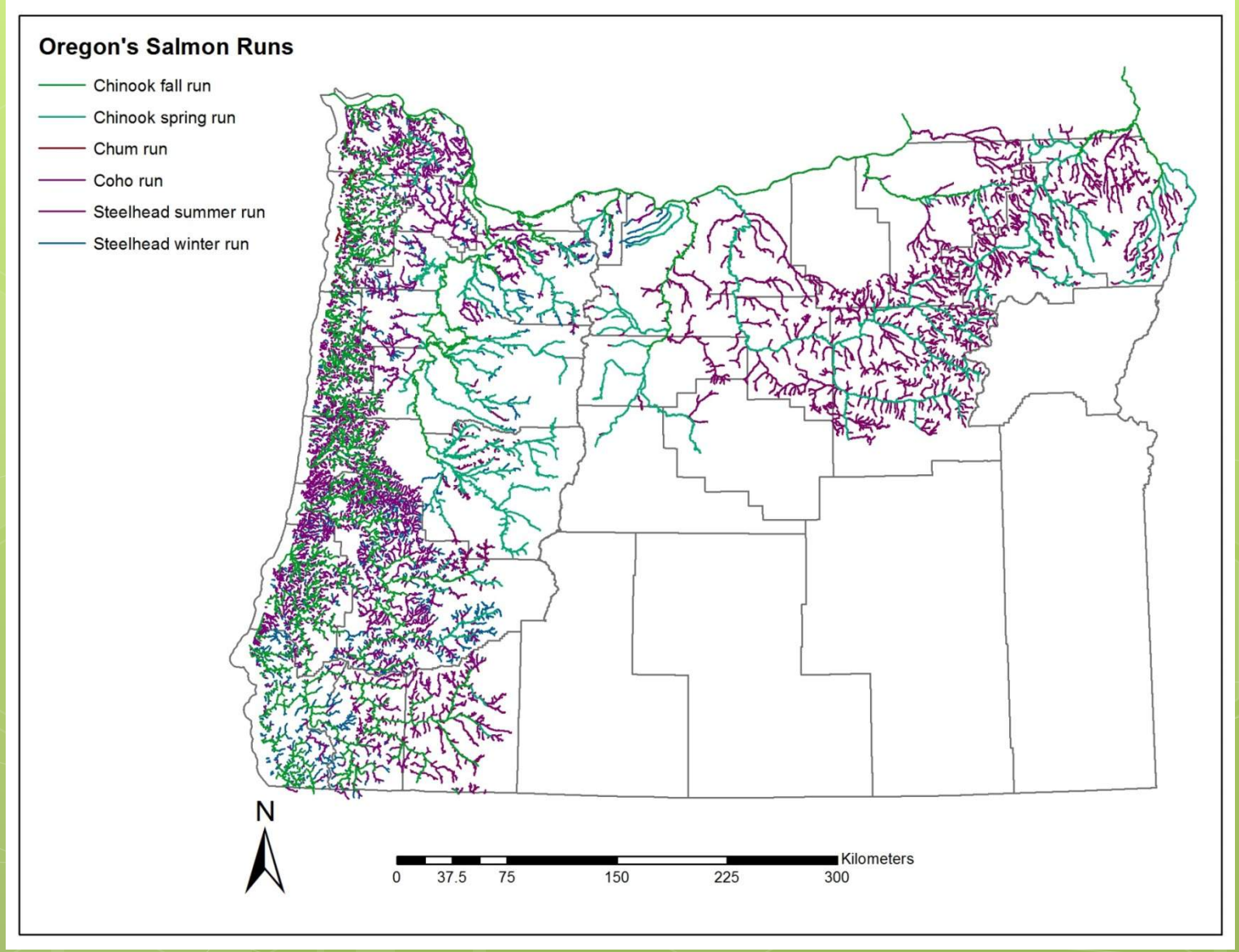

Case Study From Report: Purple Loosestrife

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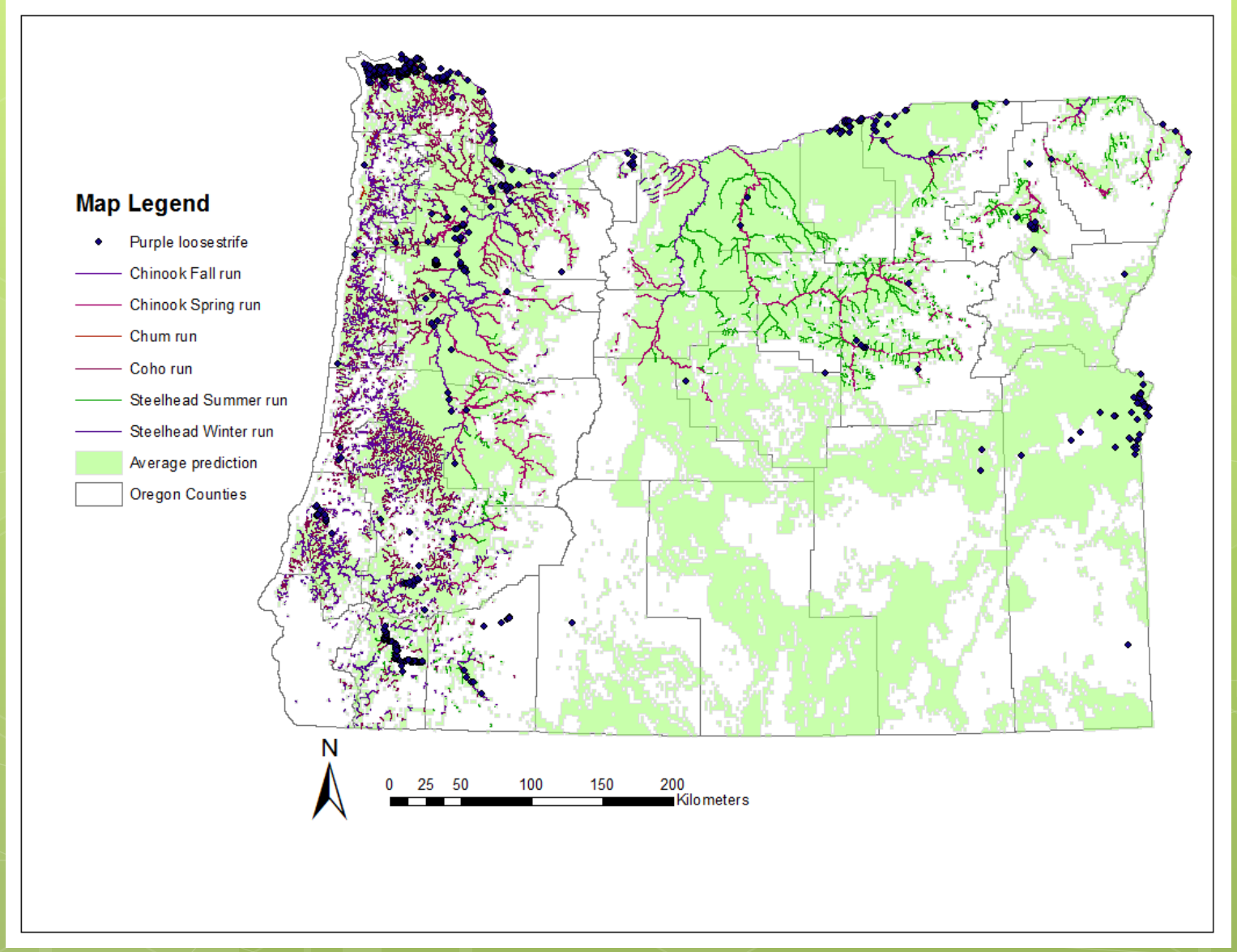
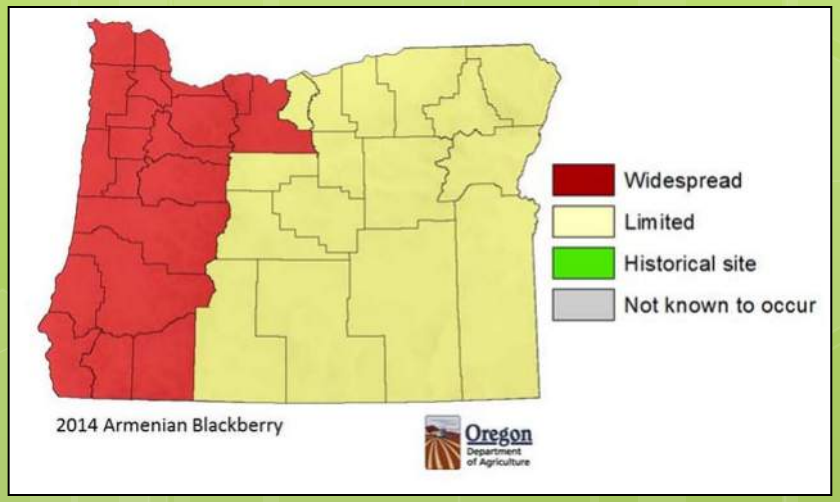
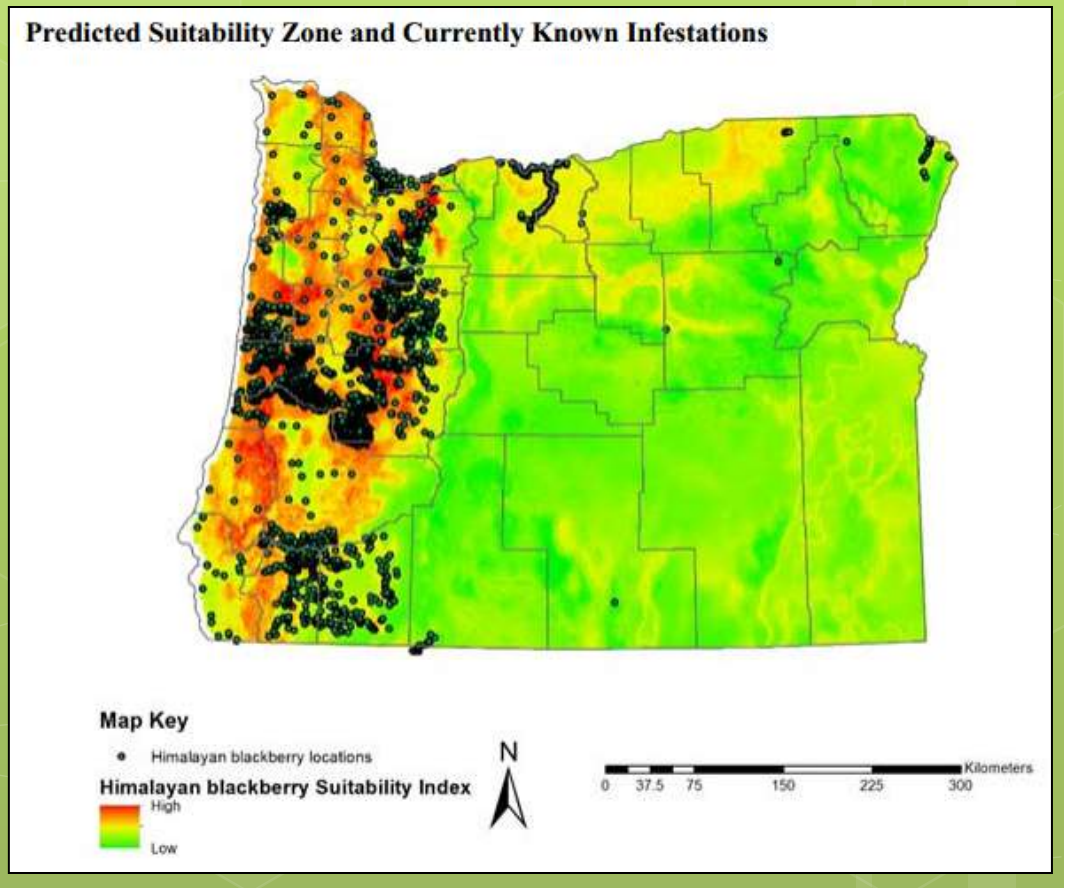


Case Study From Report: Armenian blackberry

Current Infestation		Susceptible Infestation	
Acres	Economic Impact	Acres	Economic Impact
1,638,000	$40,133,000	10,106,000	$268,382,000

Notes: The susceptible acres are from the KRESS model environmental variables using the "mean" statistical assumptions. Annual economic impact is measured by personal income in 2012 dollars and includes the "multiplier" effect.

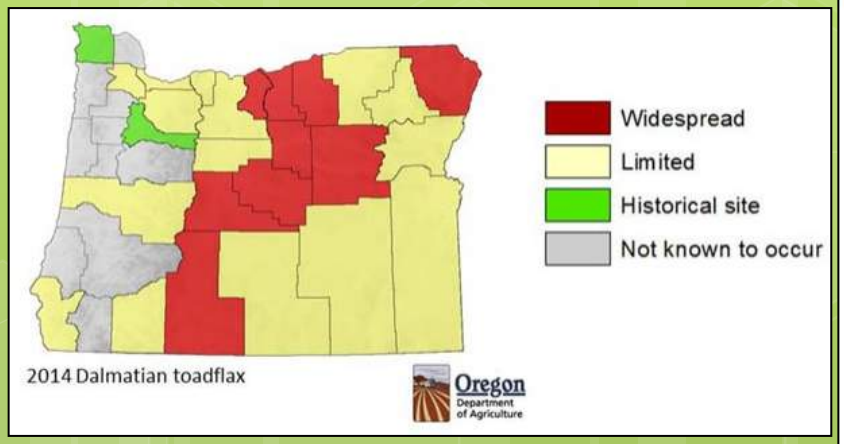


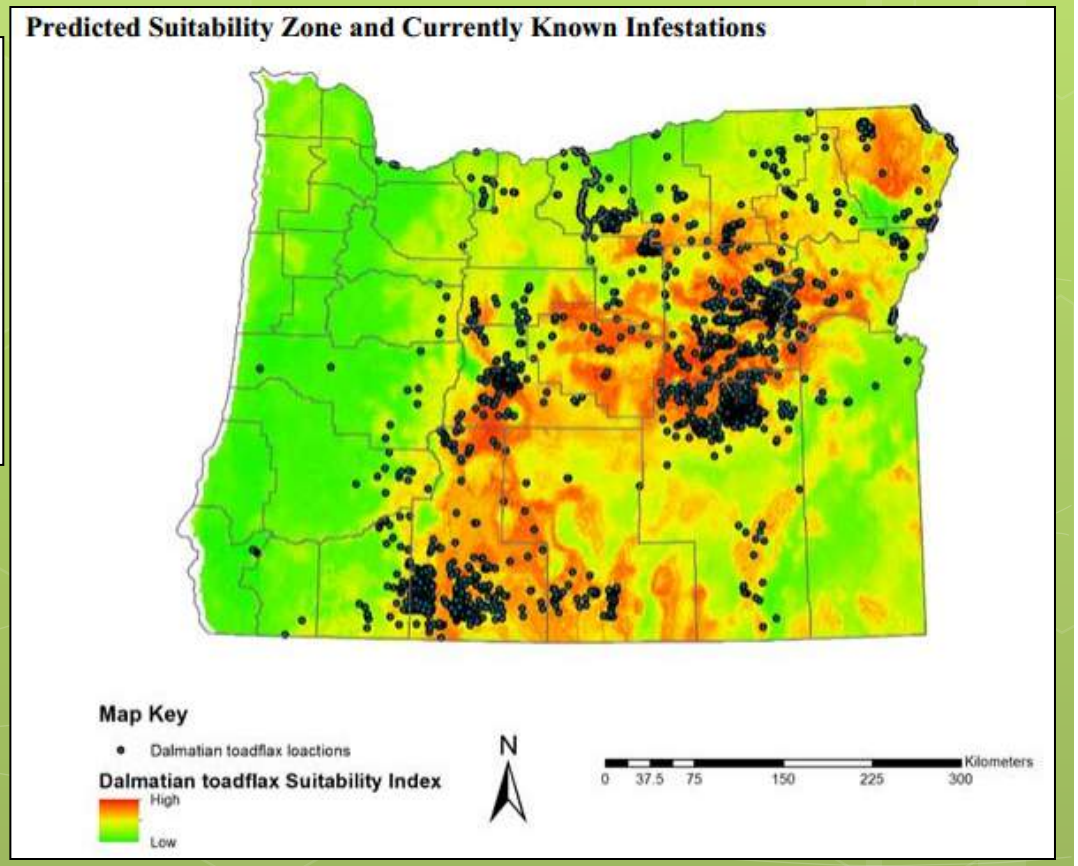


Case Study From Report: Dalmatian toadflax

Current Infestation		Susceptible Infestation	
Acres	Economic Impact	Acres	Economic Impact
345,000	$254,000	31,724,000	$20,335,000

Notes: The susceptible acres are from the KRESS model environmental variables using the "mean" statistical assumptions. Annual economic impact is measured by personal income in 2012 dollars and includes the "multiplier" effect.

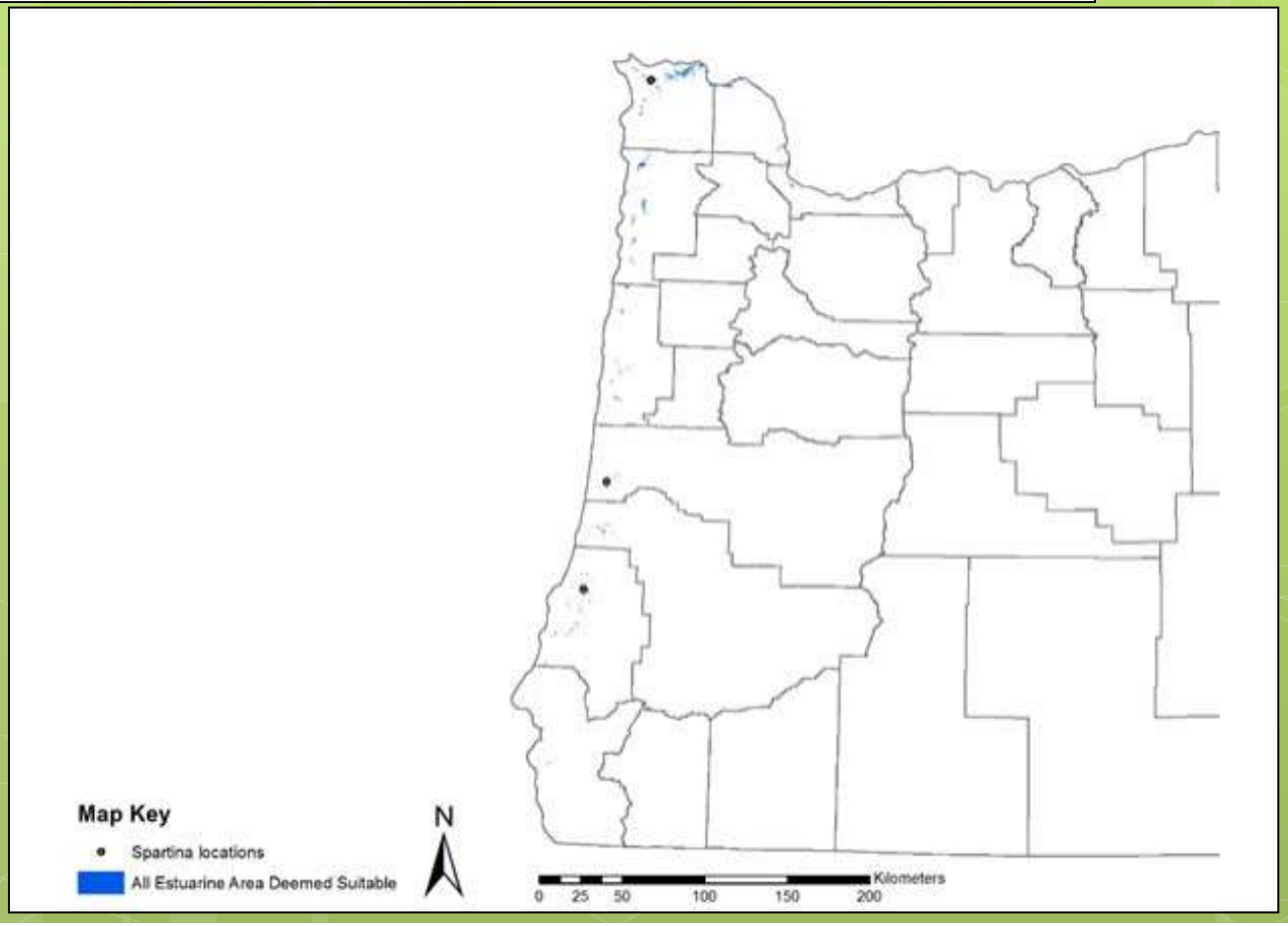




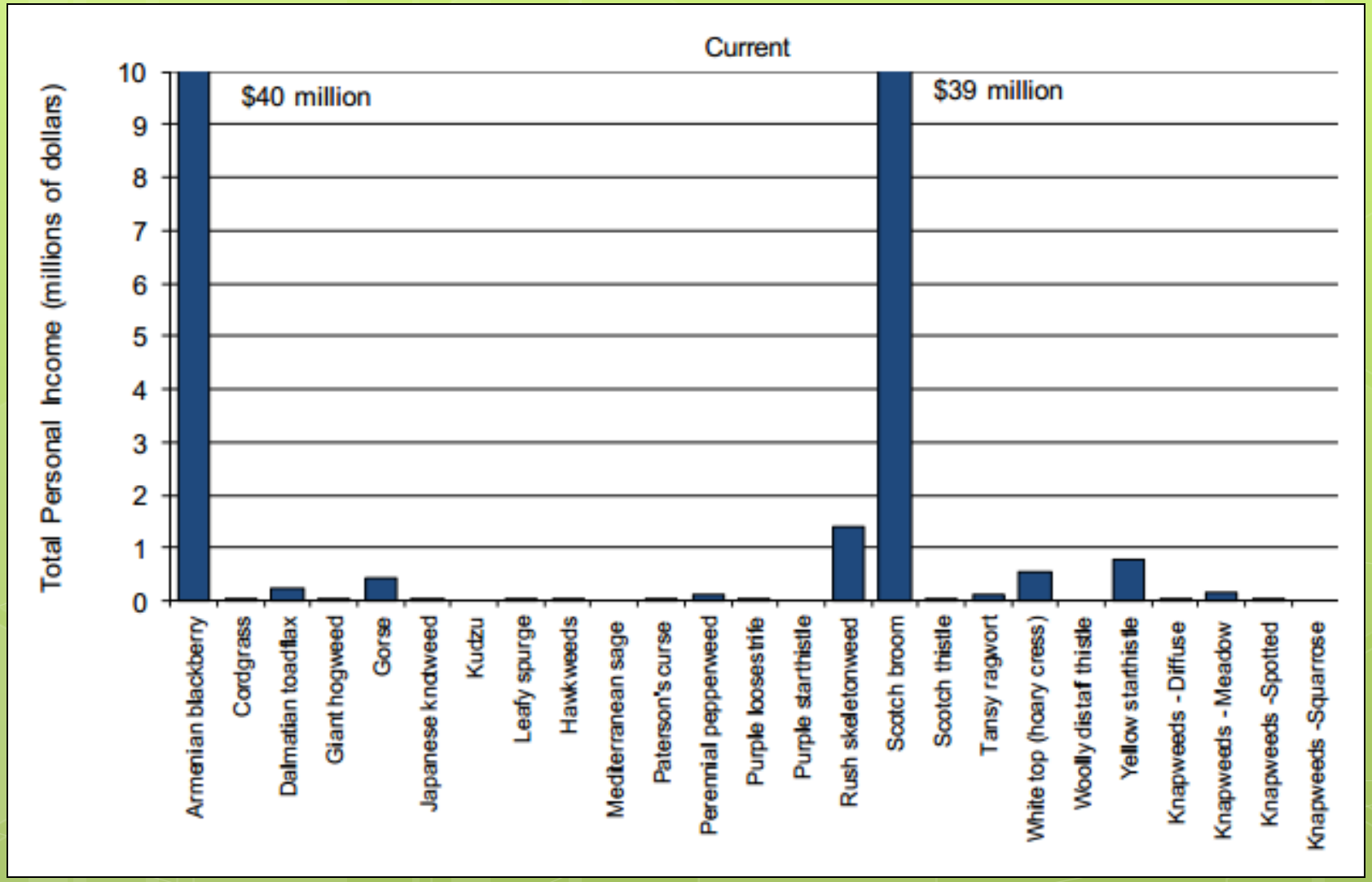
Case Study From Report: Spartina

Current Infestation		Susceptible Infestation	
Acres	Economic Impact	Acres	Economic Impact
<500	$1,000	40,000	$40,223,000

Notes: The susceptible acres are from the KRESS model environmental variables using the "mean" statistical assumptions. Annual economic impact is measured by personal income in 2012 dollars and includes the "multiplier" effect.

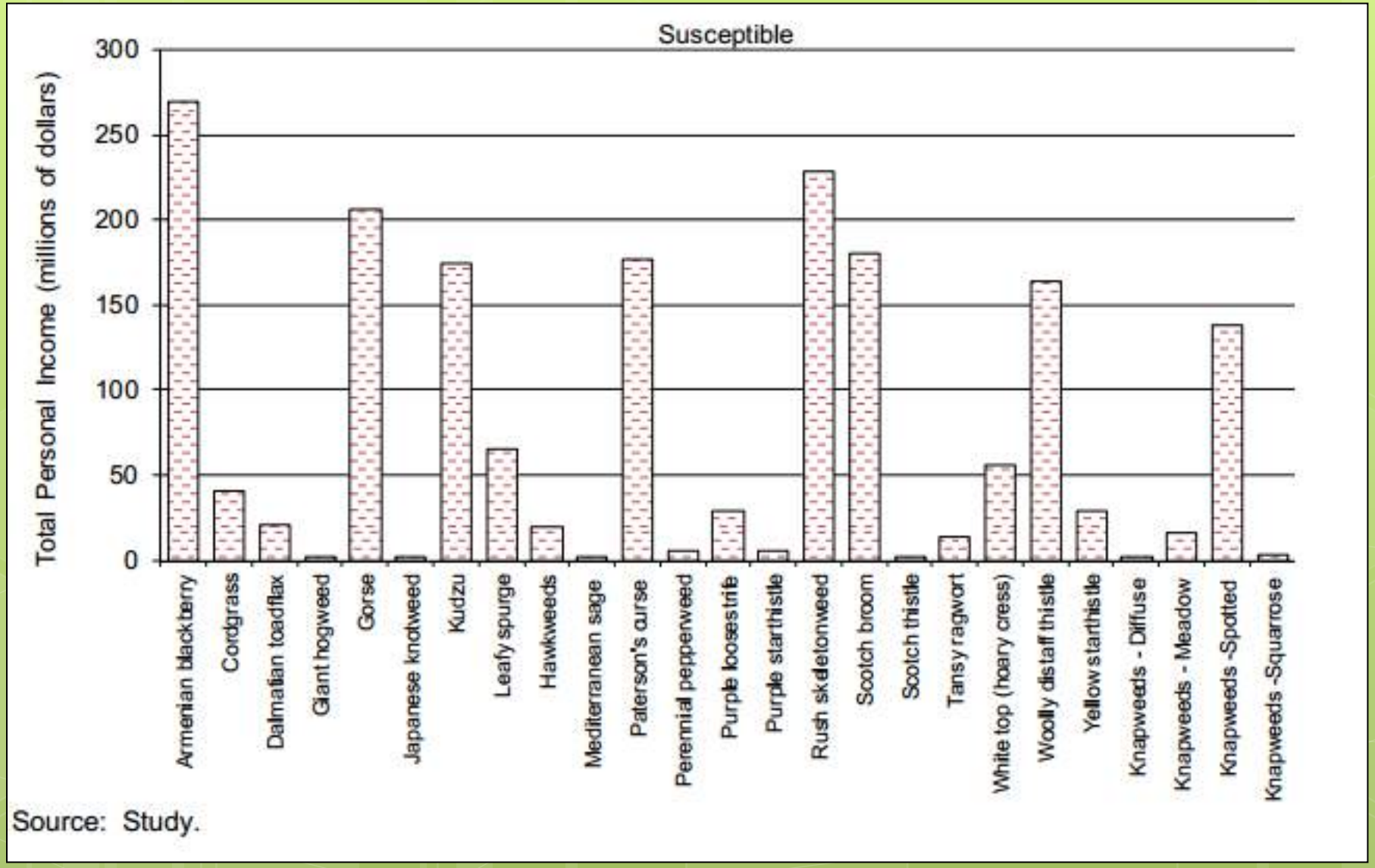


Results: Current Impacts



Estimated annual loss of almost **$83.5 million** personal income from 25 selected weed species. That is the equivalent to the loss of about **1,900** jobs in the private sector.

Results: Potential Future Impacts



If left unchecked, there is a potential annual loss between **$1.5 billion** and **$2.4 billion** personal income and **40,800 jobs**.

Results

1) Two of the 25 selected weeds, **Armenian blackberry and Scotch broom**, are widespread and contribute $79.6 million to the current overall economic impact.

2) The **remaining 23** species are limited in distribution and are under intensive management, or less impactful to important resources, thus contributing to less than five percent of total current impacts.

3) For the six species analyzed for susceptible areas in the previous study (tansy ragwort, distaff thistle, leafy spurge, purple starthistle, hawkweeds, and spartina), the current study economic impacts from susceptible areas is $305.0 million as **compared to the previous study** $68.7 million.

4) While methods differ between the two studies on the estimation of susceptible habitat, an inference is that there is a **growing threat** from the six species.

(Credit: Shannon Davis, The Research Group, LLC)

Results

1) Biological control and prevention programs are shown to be beneficial and can have a **high return on the investment** from these types of activities.

2) For example, the previous study found that biological control of tansy ragwort has a $13 return for every $1 investment and prevention programs have a benefit to cost ratio of 34 to one.

Discussion: Necessity of Public Agencies

1) To preserve the economic development that comes from private landowners and public resource managers land uses.

2) To overcome the effects of externalities. Some weeds might be introduced for beneficial purposes, but have spill-over negative effects. The background research, establishment, monitoring, and maintenance costs can be prohibitive for any single individual or even single industry.

(Credit: Shannon Davis, The Research Group, LLC)

Report Release

Final report currently in Final Draft stage with minor edits occurring

Release date: January 1, 2015

Distribution: Will be posted online for download at the ODA Noxious Weed Program Site

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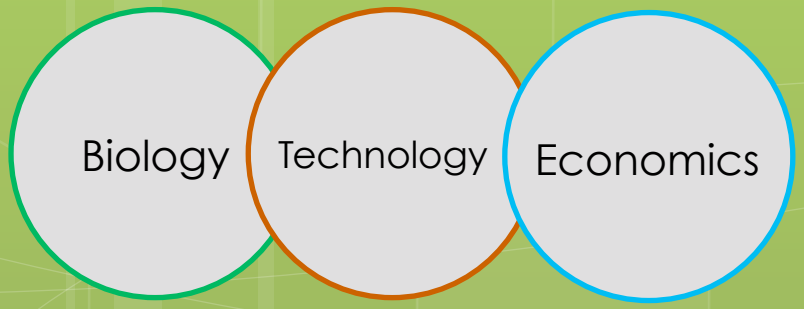
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