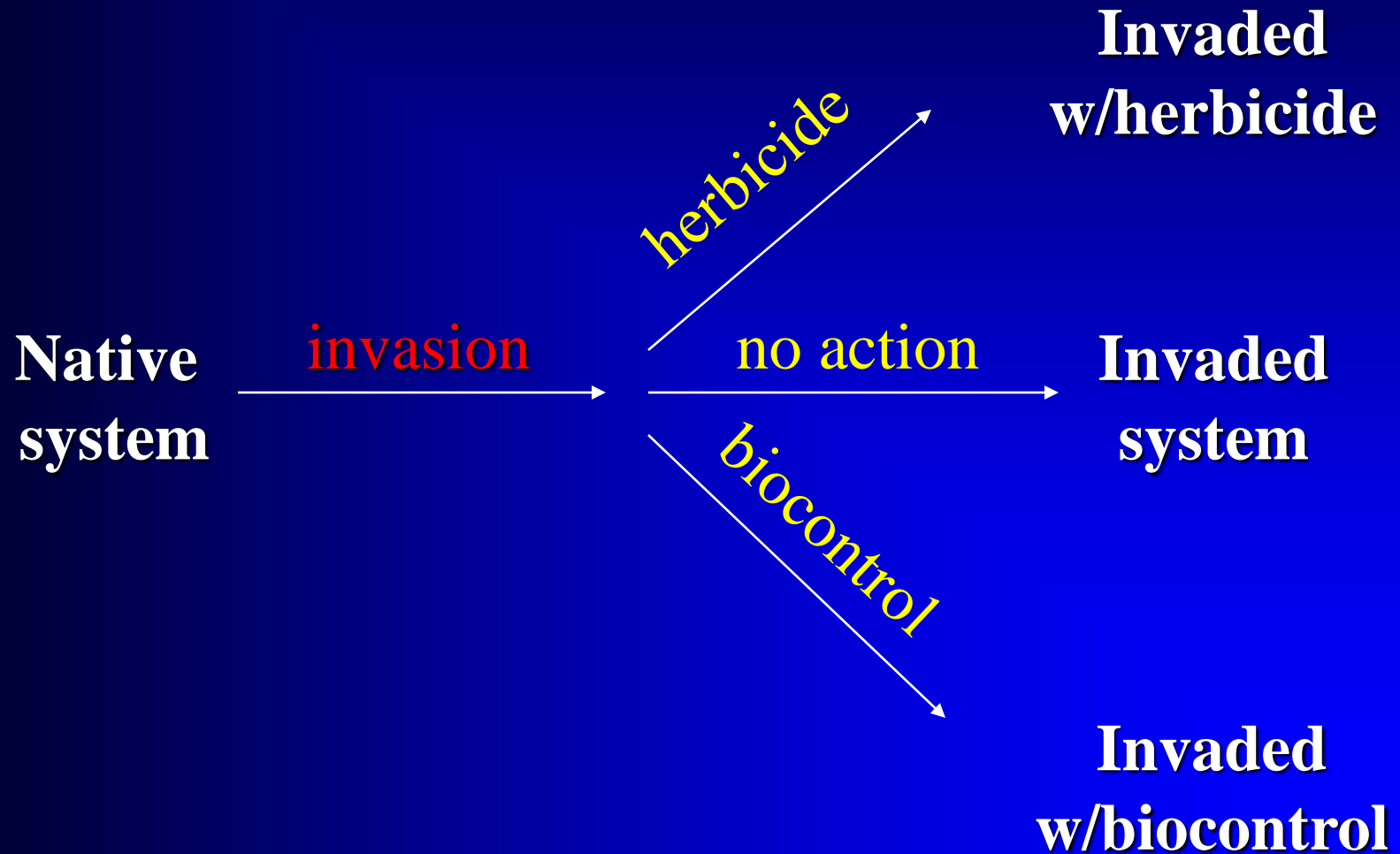


# The Ecology and Management of Plant Invasions: The Role of Restoration

Dean Pearson and Yvette Ortega

USFS Rocky Mountain Research Station, Missoula, MT

# Ecology & Management of Invasive Weeds



**Native  
system**

**Disturbance**

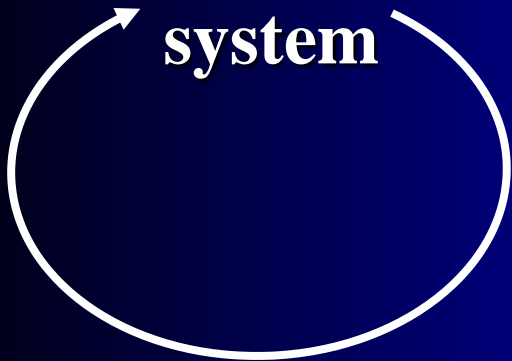


**Native  
system**

**Disturbance**



**Native  
system**



**Invasion**



**Native  
system**

**Invasion**



**Native  
system**



**Invaded  
system**

**Invasion**



**Native  
system**



**Invaded  
system**





We're not in  
Kansas  
anymore, Todo!!

**Invasion**



**Native  
system**



**Invaded  
system**

**Invasion**



**Native  
system**



**no action**



**Invaded  
system**

**Invasion**



**Native  
system**



*herbicide*



*no action*



**Invaded  
system**

**Invasion**



**Native  
system**



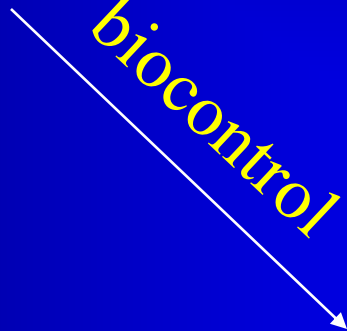
*herbicide*



*no action*



*biocontrol*



**Invaded  
system**



**Invasion**



**Native  
system**



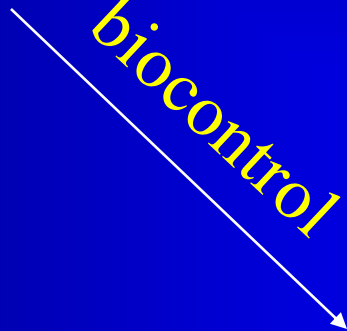
*herbicide*



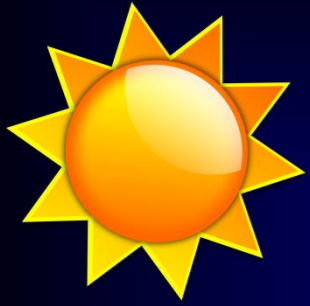
*no action*



*biocontrol*



**Invaded  
system**



Climate change

**Native  
system**

**invasion**



Eutrophication

**herbicide**

**no action**

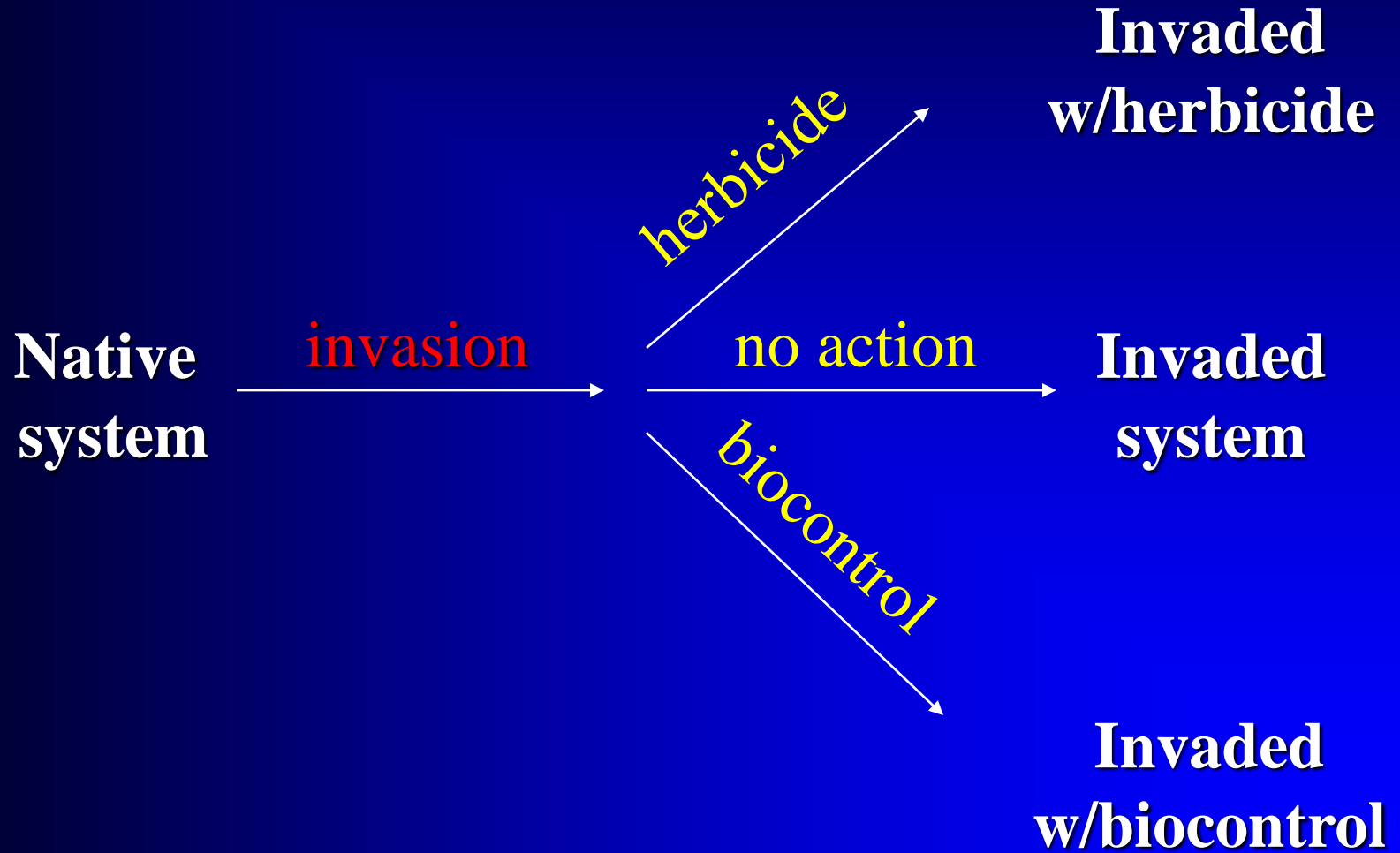
**biocontrol**

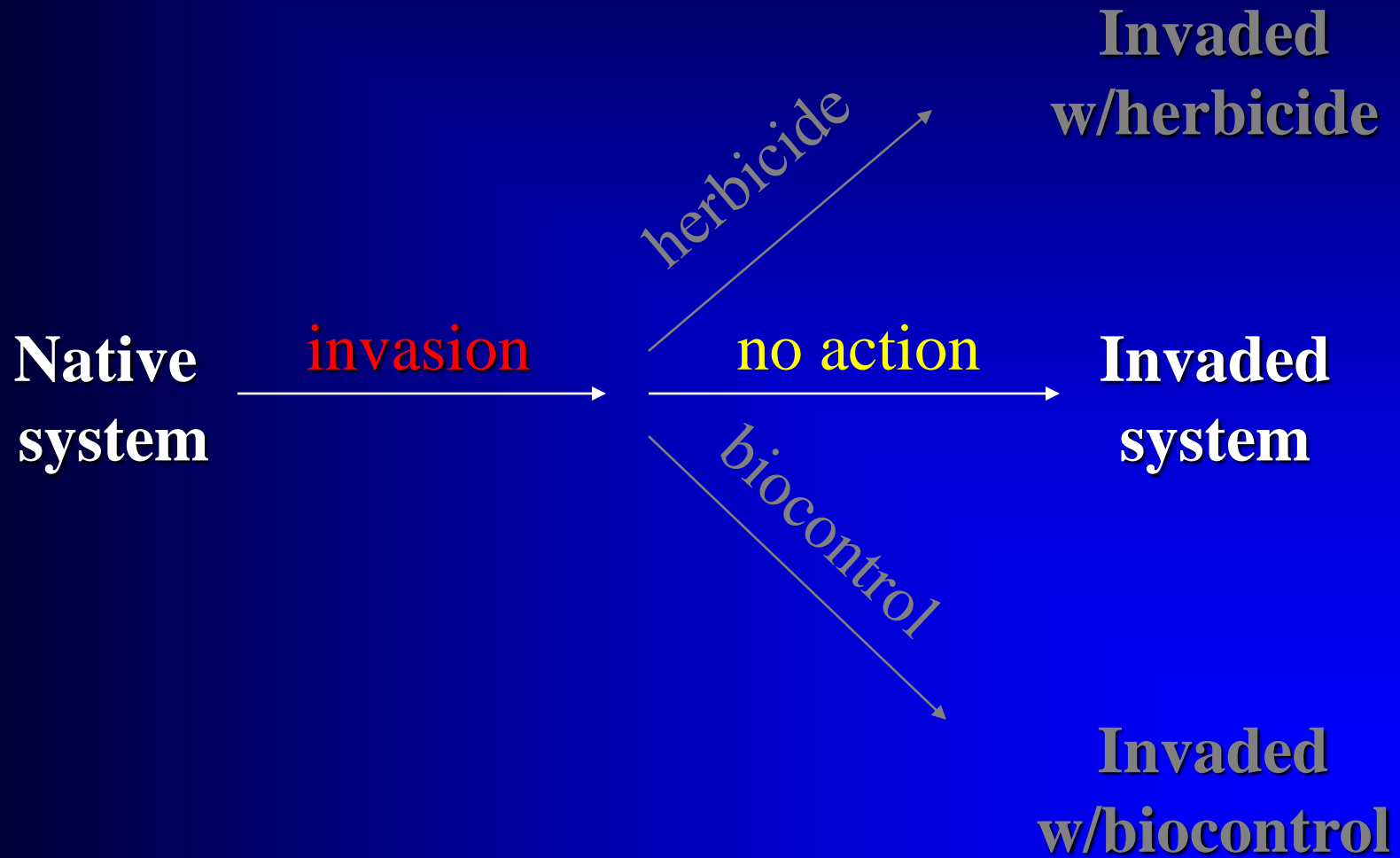
**Invaded  
w/herbicide**

**Invaded  
system**

**Invaded  
w/biocontrol**

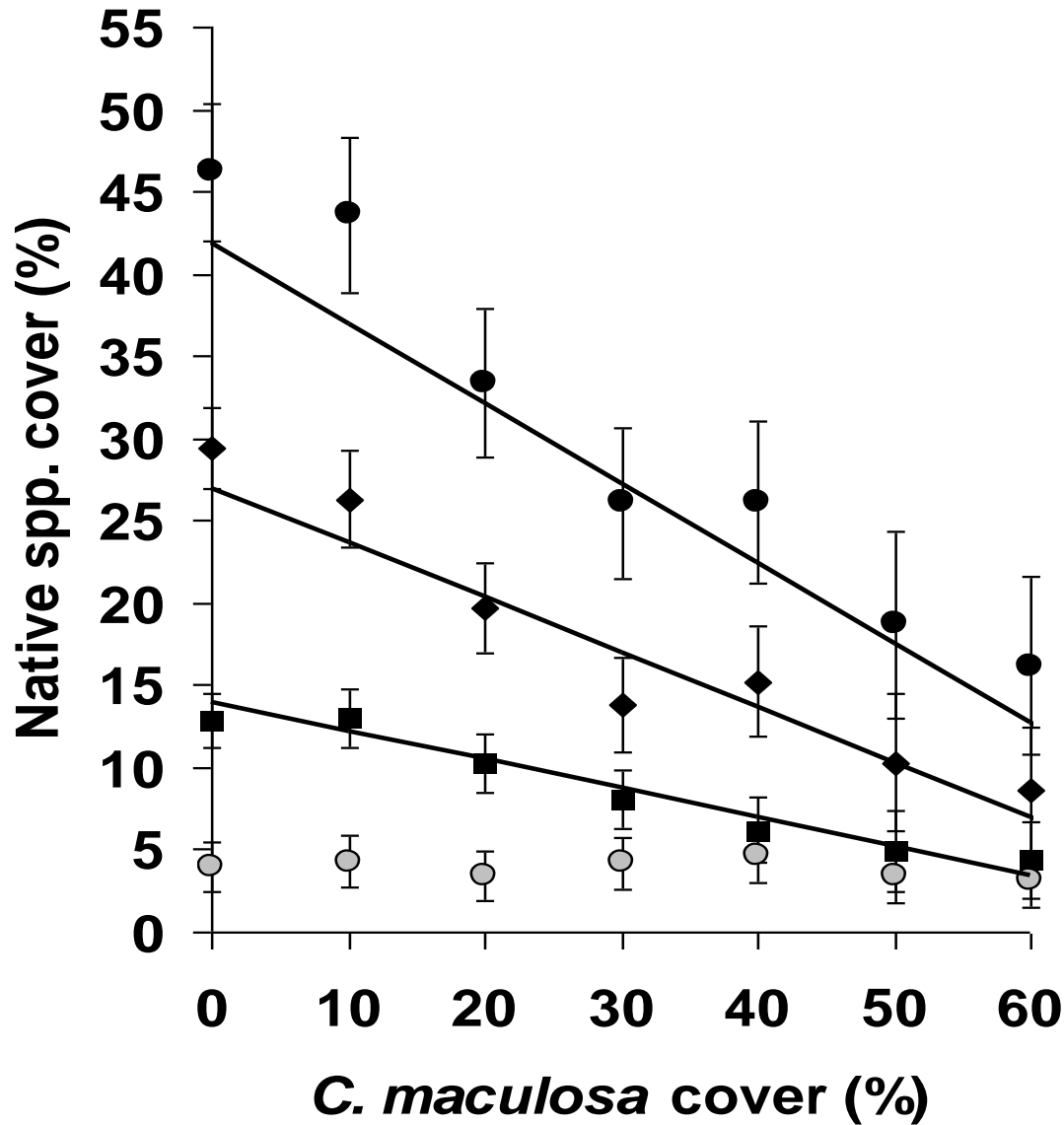












All species  
 Perennial forbs  
 Perennial grasses  
 Annual forbs

# Quantifying and ranking invader impacts on plants

TABLE 1. Components of exotic species invasiveness and impact based on surveys of  $n = 620$  1-m<sup>2</sup> plots in 31 grasslands across west-central Montana, USA.

Species	Type	Invasiveness			Impact			Other invaders			
		<i>R</i>	<i>A</i>	Rank (score)	<i>E</i>	<i>F</i>	<i>P</i>	Rank (score)	Slope	<i>F</i>	<i>P</i>
<i>Bromus tectorum</i>	AG	461	14.9	1 (6861)	-0.39	129.3	<0.001	1 (2676)	-0.50	147.9	<0.001
<i>Centaurea stoebe</i> <sup>†</sup>	PF	233	6.7	2 (1555)	-0.72	30.5	<0.001	2 (1120)	-0.43	252.1	<0.001
<i>Euphorbia esula</i> <sup>†</sup>	PF	87	12.8	3 (1111)	-0.53	37.5	<0.001	3 (589)	-0.43	229.1	<0.001
<i>Potentilla recta</i> <sup>†</sup>	PF	148	6.3	4 (937)	-0.50	19.1	<0.001	4 (468)	-0.43	242.5	<0.001
<i>Veronica verna</i>	AF	180	3.1	6 (564)	-0.57	9.4	0.002	5 (322)	-0.43	244.5	<0.001
<i>Linaria dalmatICA</i> <sup>†</sup>	PF	84	3.8	9 (316)	-0.75	14.4	<0.001	6 (237)	-0.43	250.2	<0.001
<i>Poa pratensis</i>	PG	38	9.4	8 (358)	-0.64	19.3	<0.001	7 (229)	-0.43	244.9	<0.001
<i>Alyssum alyssoides</i>	AF	114	1.7	16 (188)	-1.17	3.9	0.05	8 (220)	-0.44	256.8	<0.001
<i>P. compressa</i>	PG	48	4.8	12 (229)	-0.79	20.1	<0.001	9 (181)	-0.43	242.3	<0.001
<i>Hypericum perforatum</i> <sup>†</sup>	PF	47	7.8	7 (367)	-0.44	8.3	0.004	10 (162)	-0.44	253.3	<0.001
<i>Verbascum blattaria</i>	BF	40	6.7	10 (268)	-0.59	6.4	0.01	11 (158)	-0.43	246.5	<0.001
<i>P. bulbosa</i>	PF	74	7.7	5 (568)	-0.06	0.2	0.68	(0)	-0.45	267.7	<0.001
<i>Arenaria serpyllifolia</i>	AF	114	2.0	11 (232)	-0.16	0.3	0.61	(0)	-0.44	254.2	<0.001
<i>Tragopogon dubius</i>	BF	166	1.4	13 (228)	-0.44	0.9	0.35	(0)	-0.44	256.1	<0.001
<i>Agrostis interrupta</i>	AG	100	2.1	14 (212)	0.14	0.2	0.69	(0)	-0.44	260.1	<0.001
<i>B. japonicus</i>	AG	88	2.3	15 (204)	-0.06	0.1	0.83	(0)	-0.44	258.2	<0.001
<i>Erodium cicutarium</i>	AF	68	2.7	17 (186)	-0.44	1.3	0.26	(0)	-0.44	248.4	<0.001
<i>Sisymbrium altissimum</i>	ABF	69	1.9	18 (132)	-0.74	2.8	0.10	(0)	-0.43	240.7	<0.001
<i>Taraxacum officinale</i>	PF	81	2.3	19 (108)	-0.91	1.3	0.26	(0)	-0.44	252.6	<0.001
<i>Myosotis micrantha</i>	AF	151	0.7	20 (100)	-2.20	2.0	0.16	(0)	-0.43	244.2	<0.001
<i>Holosteum umbellatum</i>	AF	158	0.6	21 (97)	0.69	0.3	0.59	(0)	-0.44	255.1	<0.001
<i>Lactuca serriola</i>	ABF	77	1.0	22 (78)	-1.09	0.9	0.35	(0)	-0.44	248.4	<0.001
<i>Filago arvensis</i>	AF	72	0.5	23 (39)	-1.01	0.1	0.73	(0)	-0.44	255.6	<0.001
<i>S. loeselii</i>	ABF	34	1.0	24 (36)	-1.69	1.2	0.28	(0)	-0.44	249.6	<0.001
<i>Camelina microcarpa</i>	AF	42	0.5	25 (23)	-7.12	2.0	0.16	(0)	-0.43	252.1	<0.001







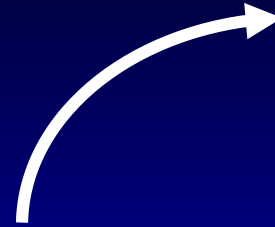
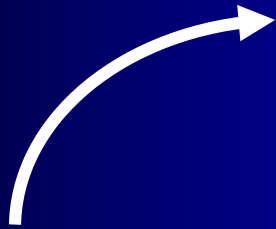


Thompson 2005









- Reduced nest success
- Disruption of singing





Pearson et al. 2012







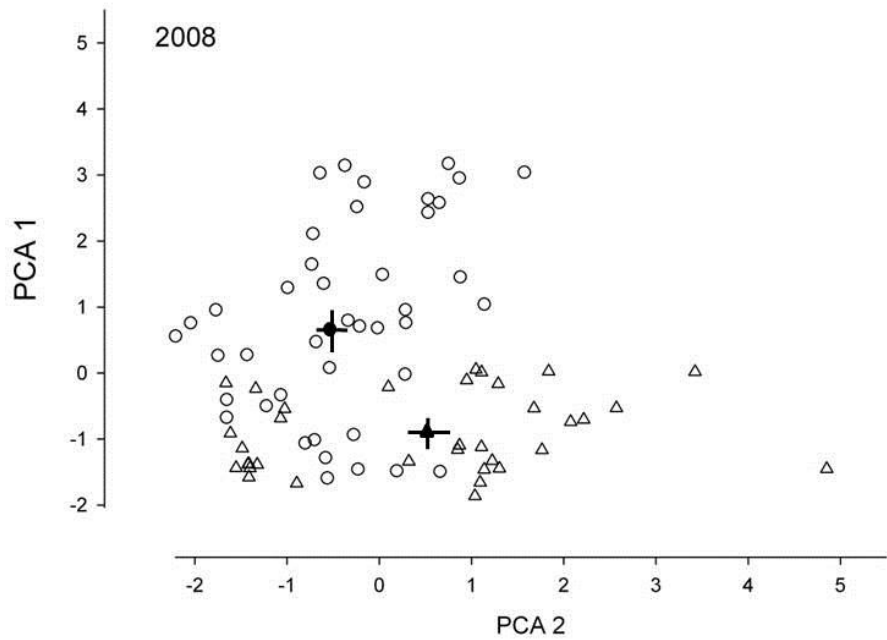
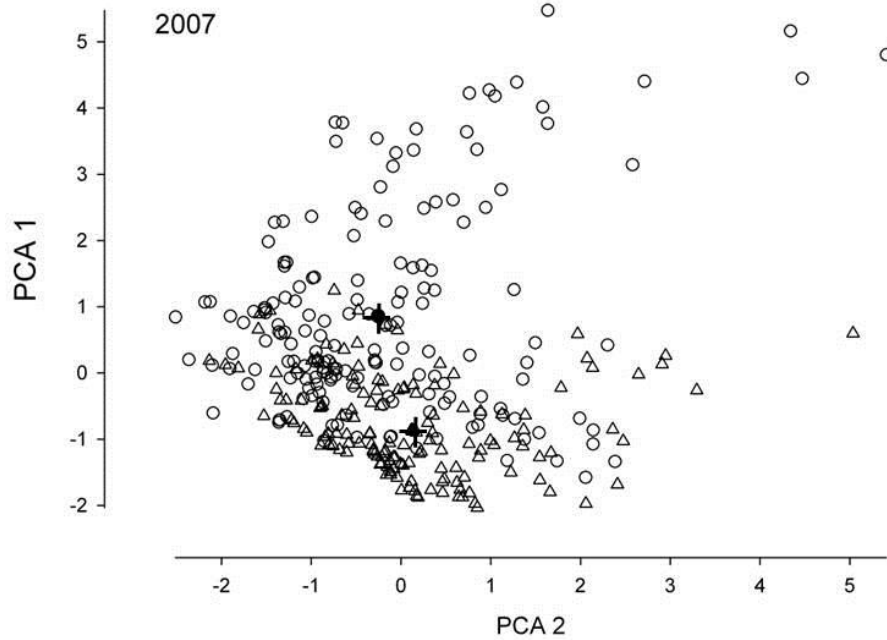


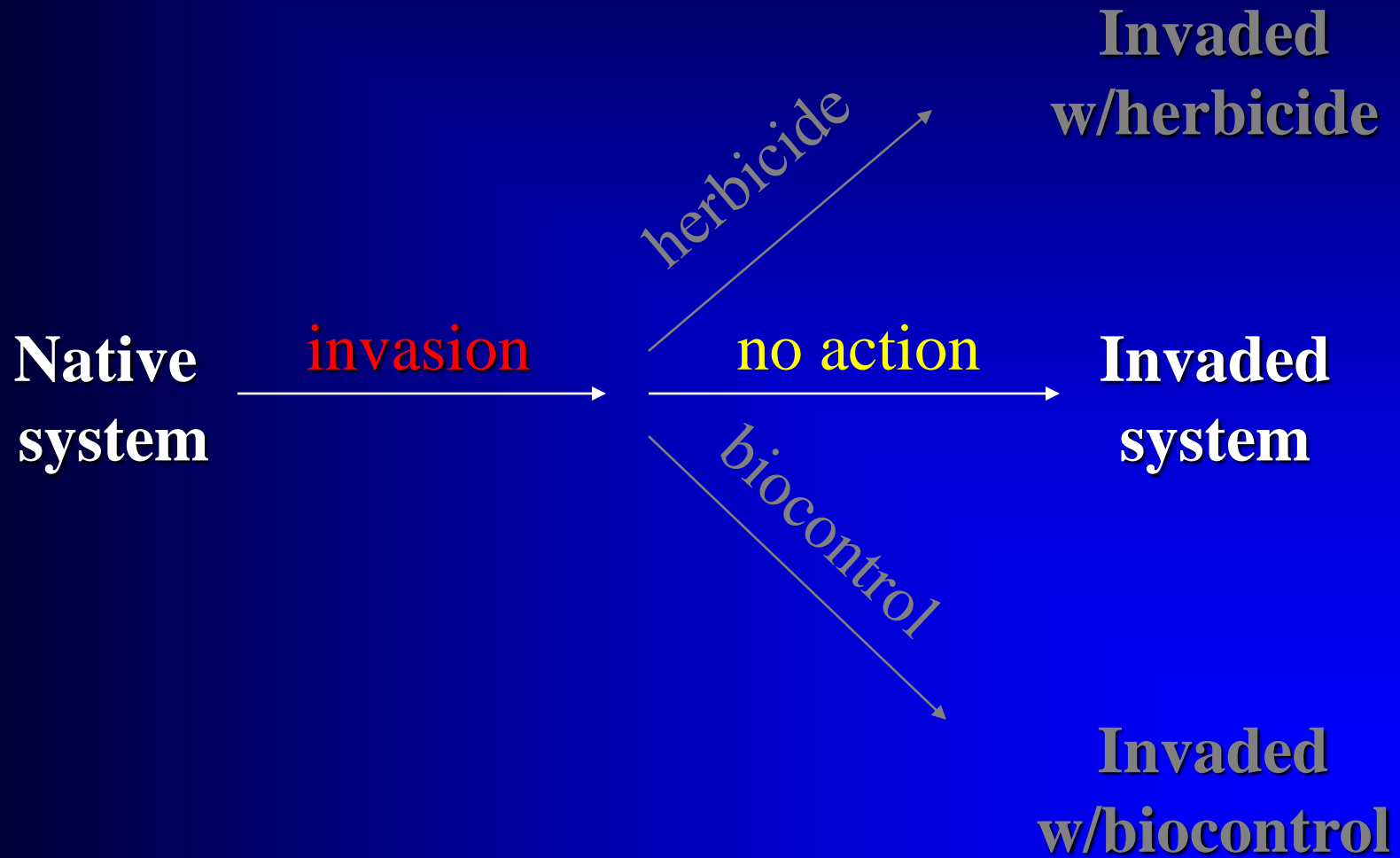
Pearson 2010



Pearson 2009







**Native  
system**

**invasion**

**herbicide**

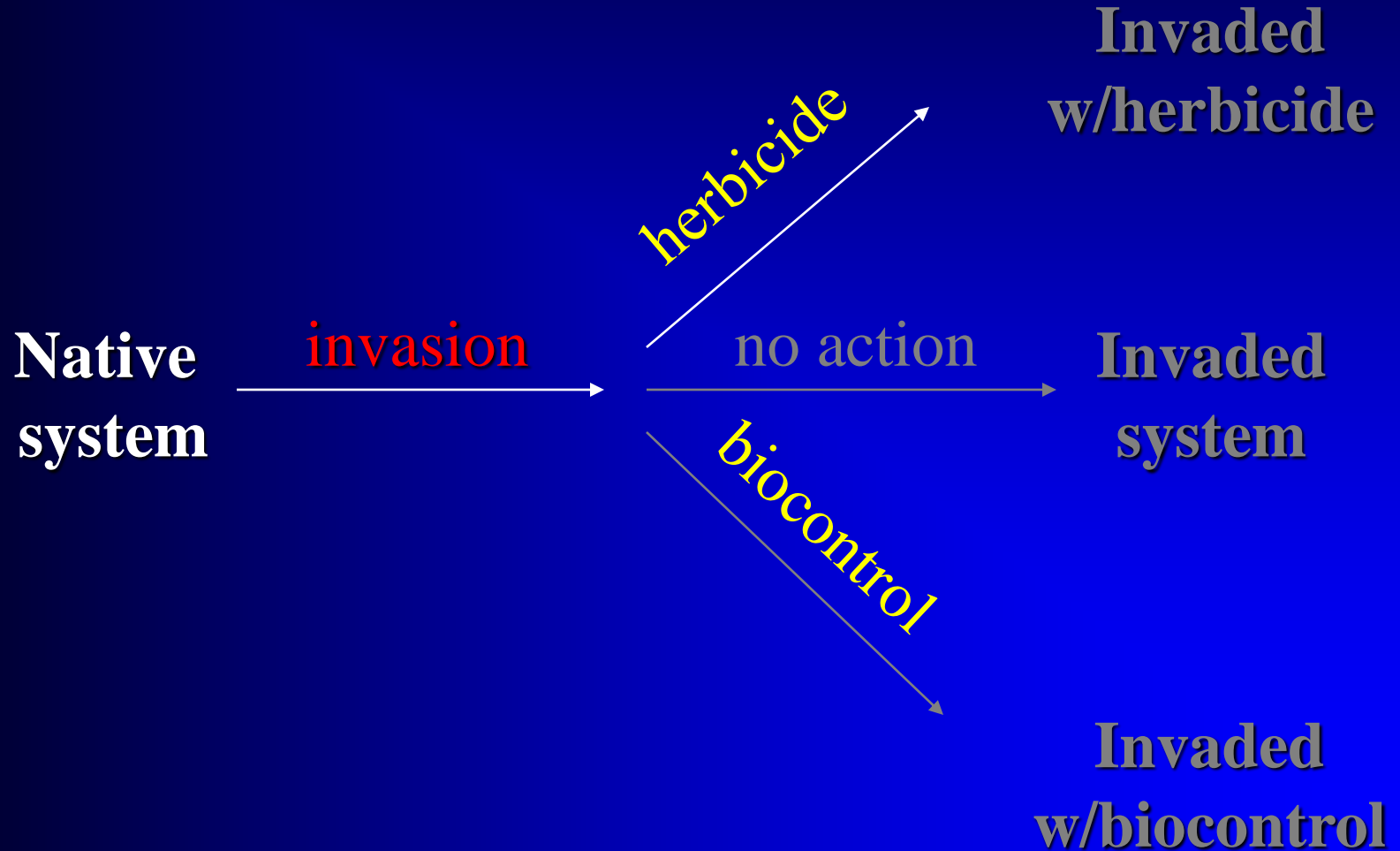
**no action**

**biocontrol**

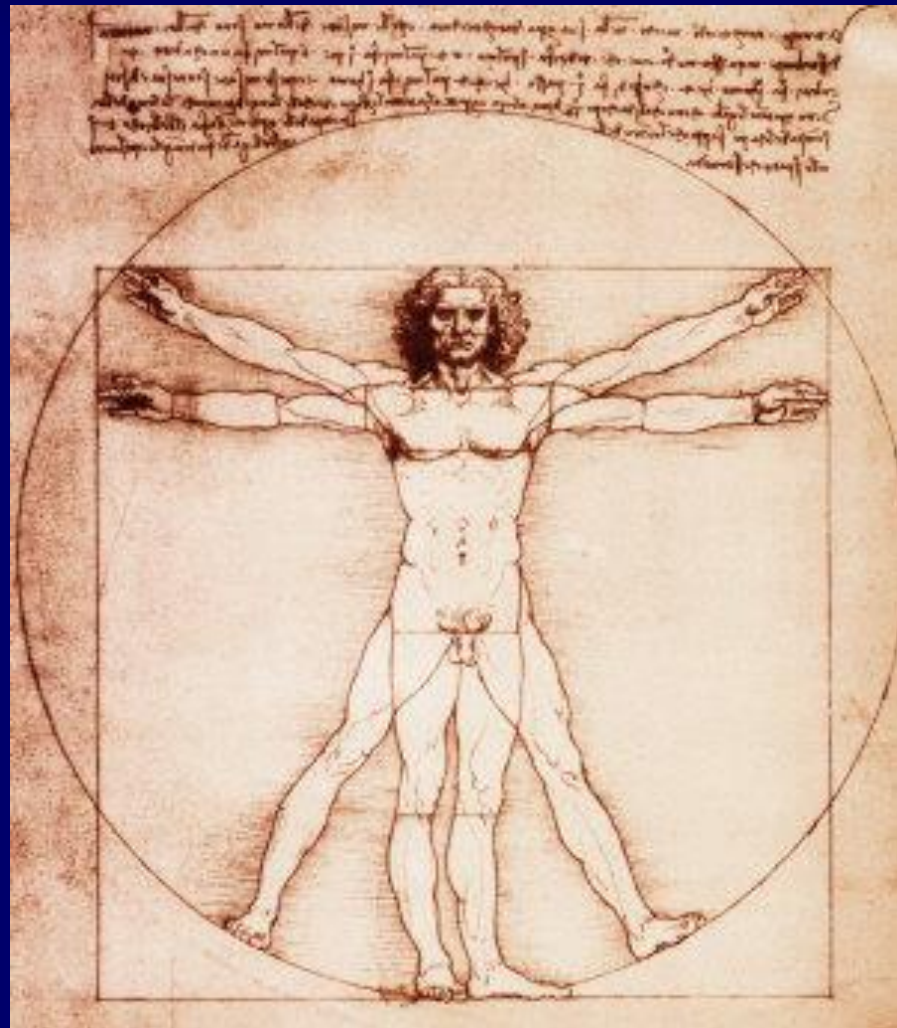
**Invaded  
w/herbicide**

**Invaded  
system**

**Invaded  
w/biocontrol**



# Human medicine analogy





# Side effects

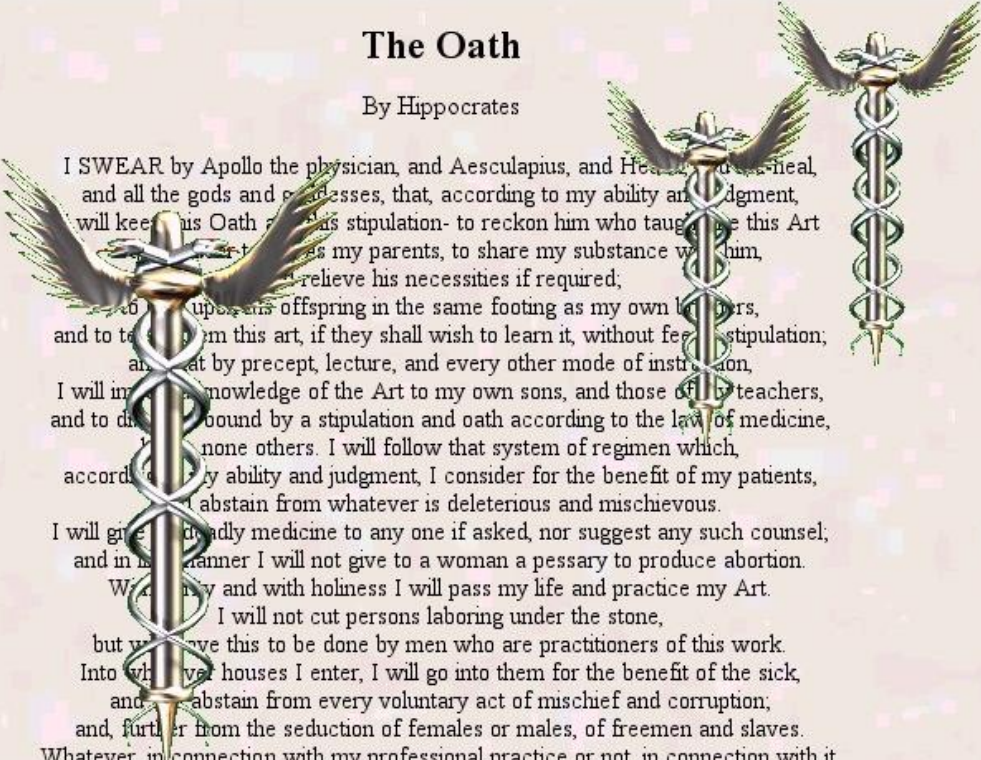
- Nausea
- Insomnia
- Diarrhea
- Chest palpitations
- Dry mouth
- Fatigue
- Drowsiness
- Hallucinations
- Suicidal thoughts or behavior



# Hippocratic Oath

## The Oath

By Hippocrates



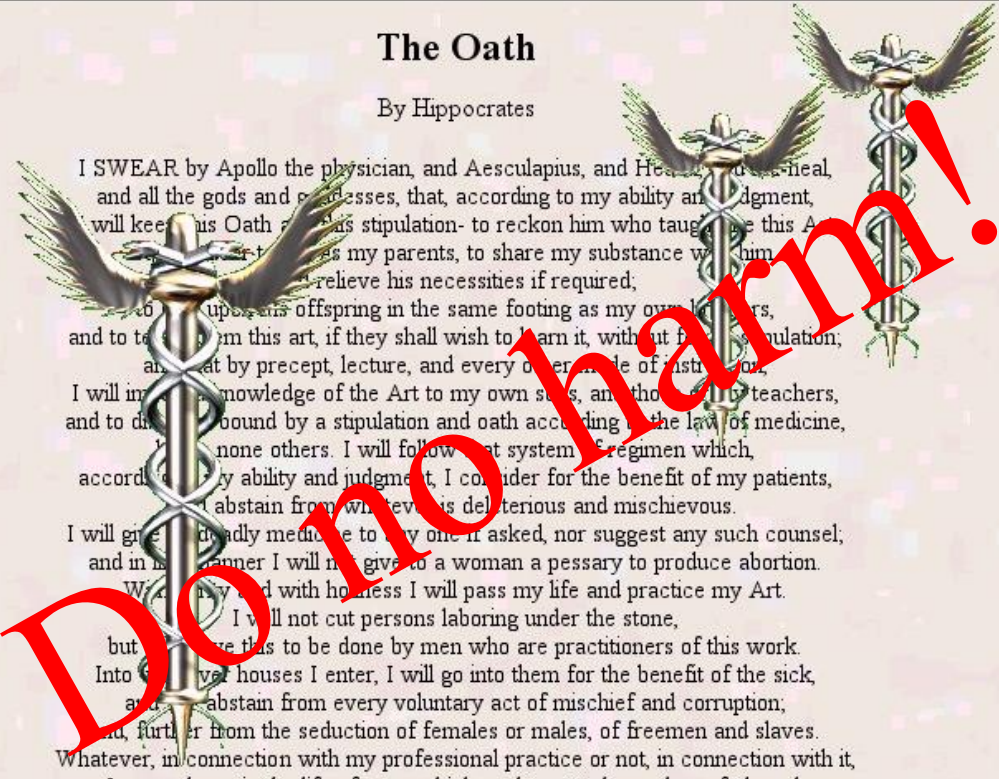
I SWEAR by Apollo the physician, and Aesculapius, and Health, and Quirinus, and all the gods and goddesses, that, according to my ability and judgment, I will keep this Oath and this stipulation- to reckon him who taught me this Art as my father and my teacher, whom I will regard as such, and will treat as such, and will share my substance with him, and will relieve his necessities if required; to help the poor, to give to the suppliant his offspring in the same footing as my own brothers, and to teach them this art, if they shall wish to learn it, without fee or stipulation; and that I will abstain from precept, lecture, and every other mode of instruction, I will impart my knowledge of the Art to my own sons, and those of my teachers, and to those bound by a stipulation and oath according to the law of medicine, but to none others. I will follow that system of regimen which, according to my ability and judgment, I consider for the benefit of my patients, I will abstain from whatever is deleterious and mischievous. I will give no deadly medicine to any one if asked, nor suggest any such counsel; and in like manner I will not give to a woman a pessary to produce abortion. With purity and with holiness I will pass my life and practice my Art. I will not cut persons laboring under the stone, but will leave this to be done by men who are practitioners of this work. Into whatever houses I enter, I will go into them for the benefit of the sick, and I will abstain from every voluntary act of mischief and corruption; and, further from the seduction of females or males, of freemen and slaves. Whatever, in connection with my professional practice or not, in connection with it, I see or hear, in the life of men, which ought not to be spoken of abroad, I will not divulge, as reckoning that all such should be kept secret. While I continue to keep this Oath unviolated, may it be granted to me to enjoy life and the practice of the art, respected by all men, in all times! But should I trespass and violate this Oath, may the reverse be my lot!



# Hippocratic Oath

## The Oath

By Hippocrates



I SWEAR by Apollo the physician, and Aesculapius, and Health, and Quirinus, and all the gods and goddesses, that, according to my ability and judgment, I will keep this Oath and this stipulation- to reckon him who taught me this Art as my father and my teacher, whom I will regard as such, and will relieve his necessities if required; to treat his offspring in the same footing as my own brothers, and to teach them this art, if they shall wish to learn it, without fee or stipulation; and that by precept, lecture, and every other mode of instruction. I will impart my knowledge of the Art to my own sons, and those of my teachers, and to those bound by a stipulation and oath according to the law of medicine, but to none others. I will follow that system of regimen which, according to my ability and judgment, I consider for the benefit of my patients, I will abstain from whatever is deleterious and mischievous. I will give no deadly medicine to any one if asked, nor suggest any such counsel; and in like manner I will not give to a woman a pessary to produce abortion. With purity and with holiness I will pass my life and practice my Art. I will not cut persons laboring under the stone, but I will leave this to be done by men who are practitioners of this work. Into whatever houses I enter, I will go into them for the benefit of the sick, and I will abstain from every voluntary act of mischief and corruption; and, further, from the seduction of females or males, of freemen and slaves. Whatever, in connection with my professional practice or not, in connection with it, I see or hear, in the life of men, which ought not to be spoken of abroad, I will not divulge, as reckoning that all such should be kept secret. While I continue to keep this Oath unviolated, may it be granted to me to enjoy life and the practice of the art, respected by all men, in all times! But should I trespass and violate this Oath, may the reverse be my lot!

Don't harm!

**Native  
system**

**invasion**

**herbicide**

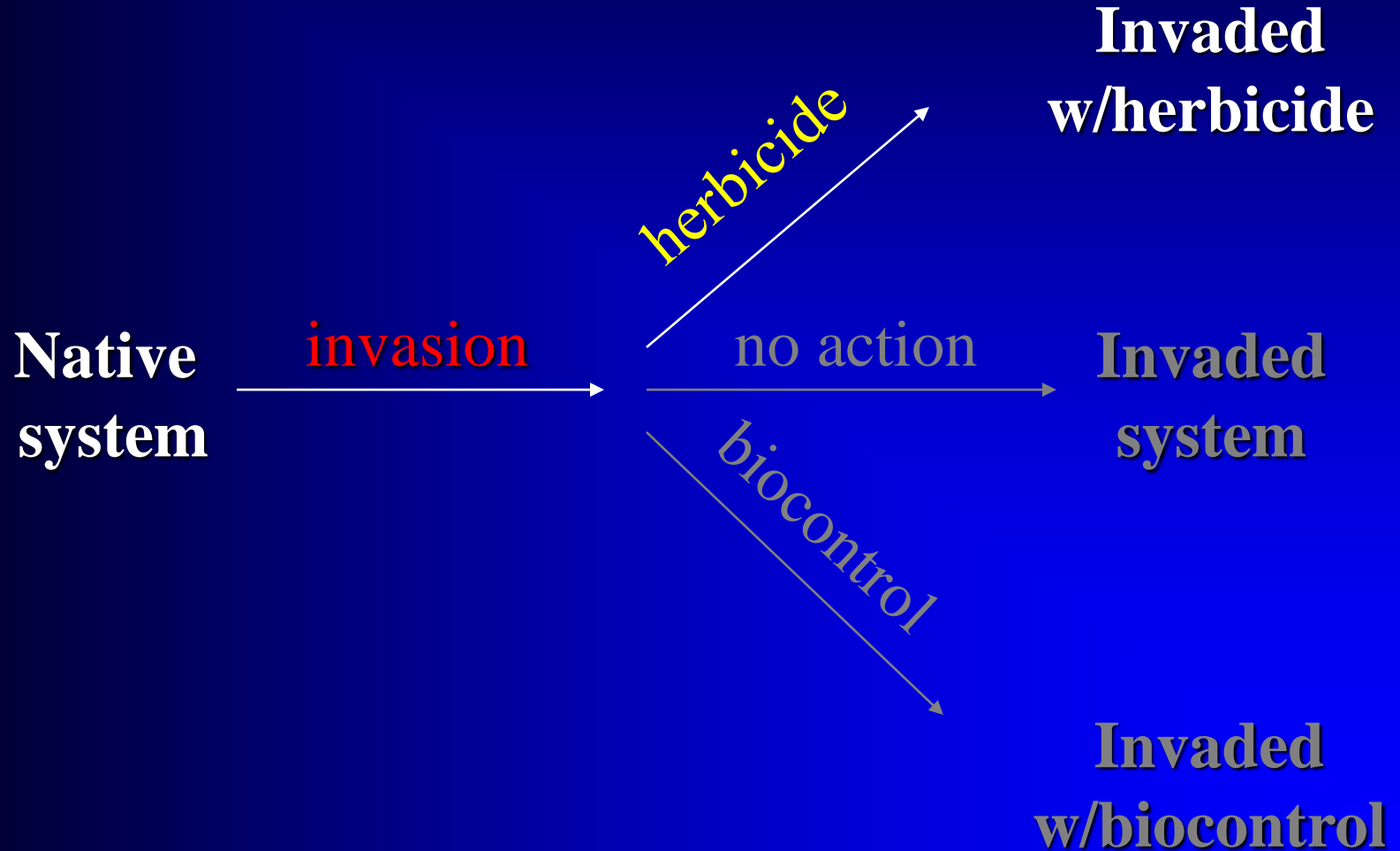
**no action**

**biocontrol**

**Invaded  
w/herbicide**

**Invaded  
system**

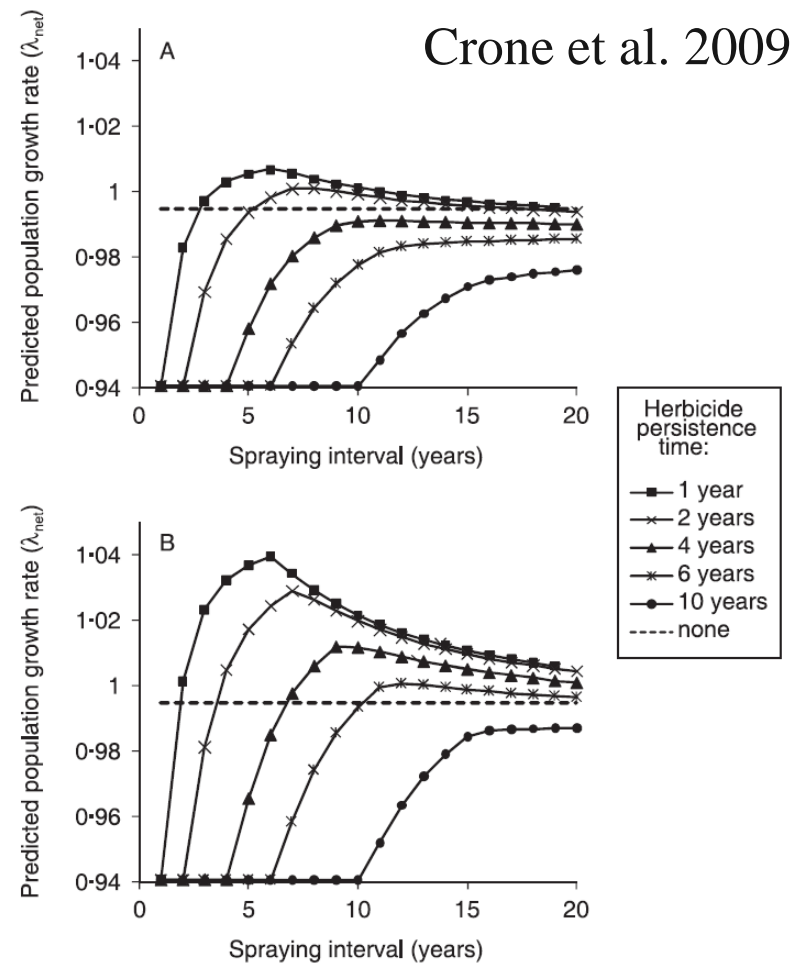
**Invaded  
w/biocontrol**











**Fig. 3.** Predicted population growth rate vs. spraying return interval and persistence time in soil. 'None' refers to no herbicide use. (A) 65% increase in fecundity during the release period; (B) 5% increase in survival and 65% increase in fecundity during the release period.





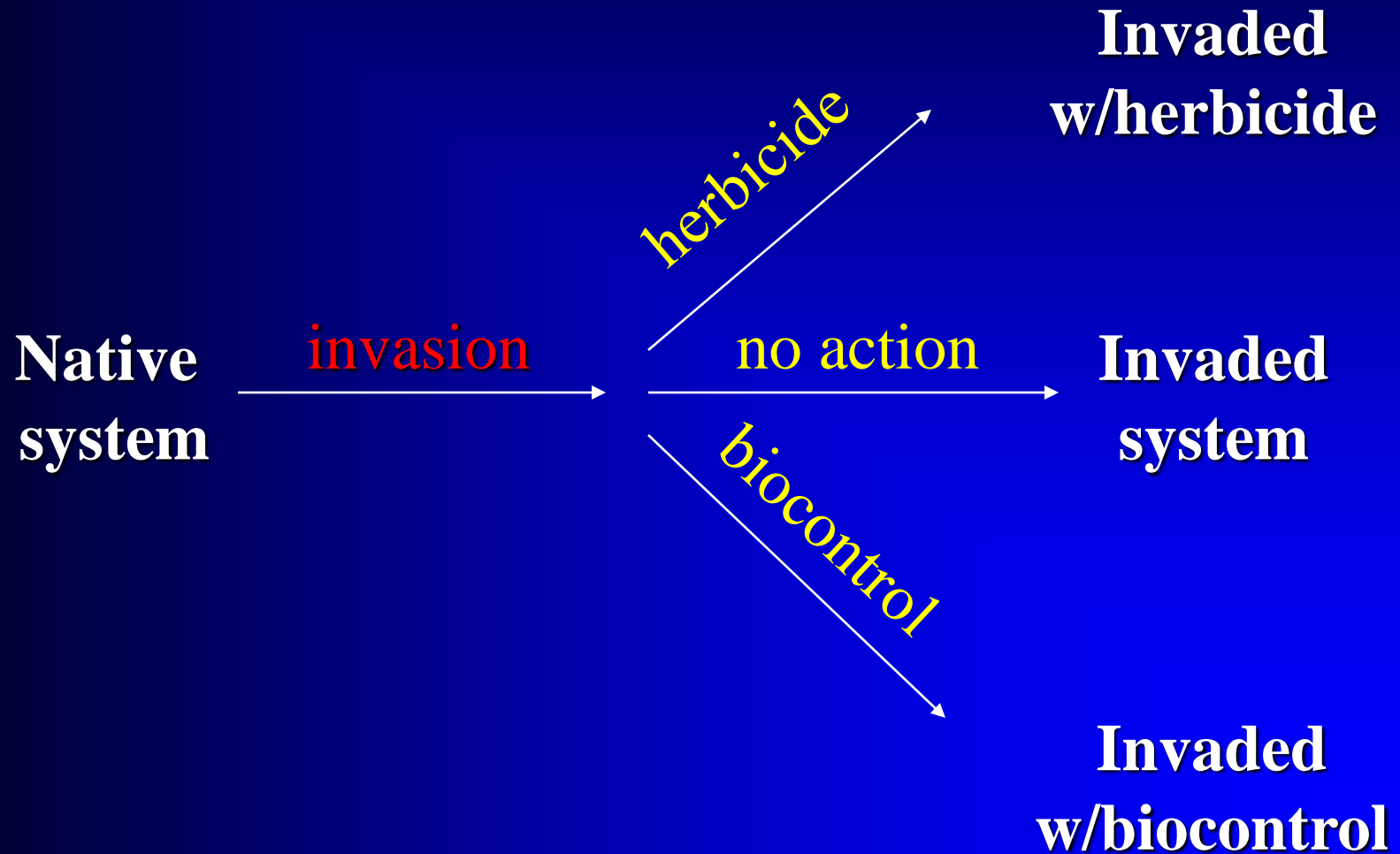


# Secondary invasion the bane of weed management

- Of 168 studies, 38 quantified system response
- Most studies suppressed target (96% )
- Primary response to control is secondary invasion
- 89% of secondary invaders noxious/invasive
- **Secondary invasion correlated with invader control**



# Ecology & Management of Invasive Weeds



# Conclusions

- Invasive plant management is more complicated than killing weeds!
- Exotics create invasion traps – we are not in Kansas any more
- Management is not ruby slippers – they all have side effects and rarely get us back to Kansas
- Effective management requires understanding the system and management tools to maximize intended outcomes and minimize side effects

**We need better restoration tools!**

# For references

- Google scholar Dean Pearson
- [dpearson@fs.fed.us](mailto:dpearson@fs.fed.us)