Keeping Pesticides Out of Water

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IPM with reduced impacts on water quality	Impact on water quality	Impact on efficacy	x
SOURCE REDUCTION			
Substitute alternatives to pesticides (biological, cultural, physical)	Eliminates risks	Can increase pest suppression by adding or substituting alternative measures	
Minimize amounts applied (e.g. monitoring, thresholds)	Reduces risks	Maximizes efficacy by timing correctly	
RISK MITIGATION			
Use of an alternative, lower risk pesticide to aquatic life (has the potential to eliminate risks)	Reduces risks	Depends upon efficacy and good application practices	
Eliminate off-site pesticide losses (e.g. drift reduction technology, application management, buffers)	**Can reduce leaching, solution and adsorbed run-off, and drift risks**	**Maximizes efficacy by increasing retention at target**	

Paul Jepson, IPPC, OSU

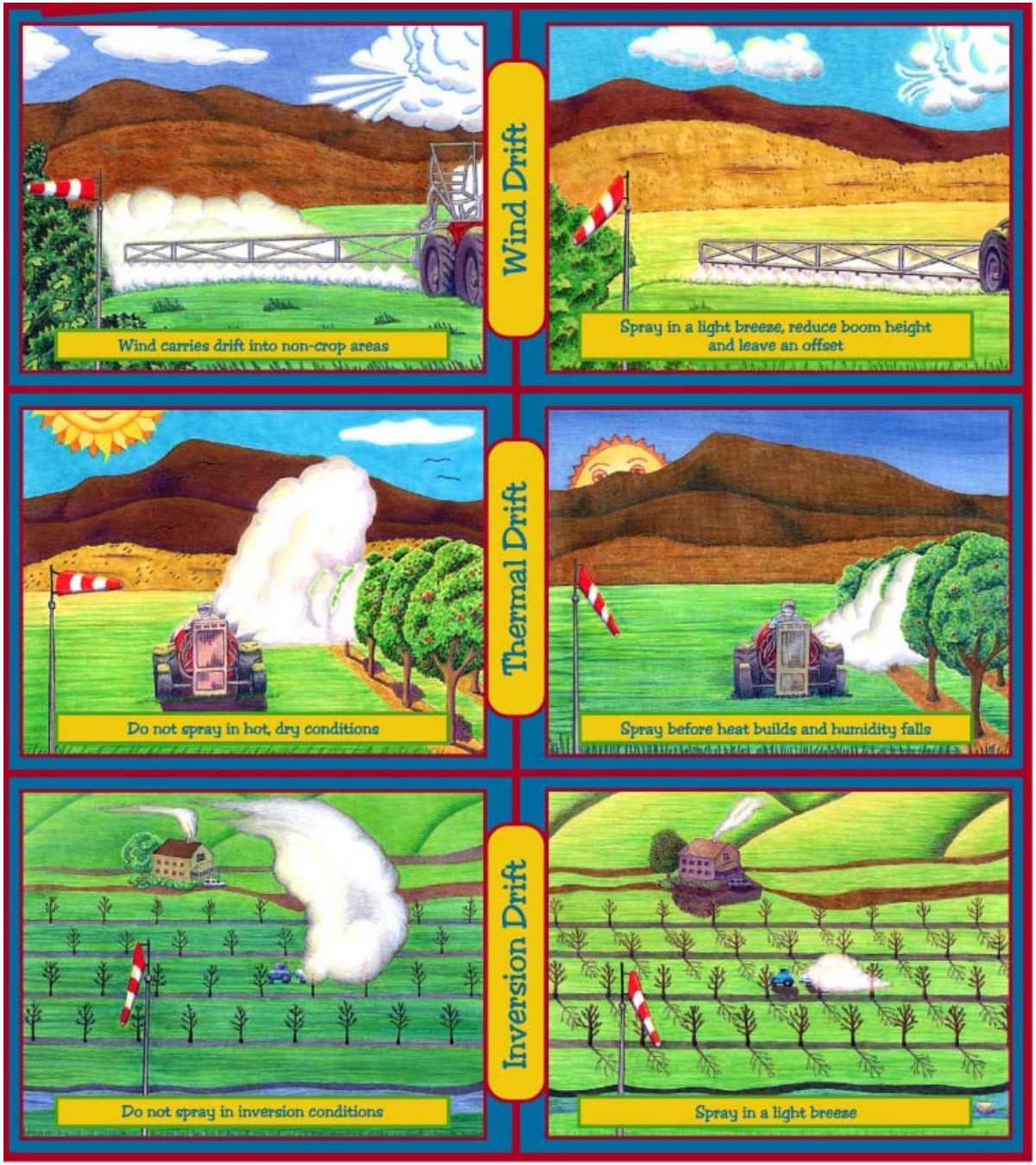
Drift happens: waste, risky losses and reduced efficacy

PRINTABLE FACT SHEET AVAILABLE AT

IPMNET.ORG

ENGLISH AND SPANISH VERSIONS AVAILABLE

PESTICIDE APPLICATION AND WEATHER CONDITIONS



The three kinds of pesticide drift that are caused by the weather

1. **Wind drift**
2. **Thermal drift**
3. **Inversion Drift**

General Drift Management Guidance

Plan ahead (NOW!) to protect sensitive sites

- **Map target areas, including areas to be protected**
- **Consider climate at the different times you spray and plan a response**
- **Apply appropriate application practices to minimize losses, depending upon weather at the time of spraying**
- **Invest in drift reduction technologies (DRT's)**

Seasonal drift risk

There is a high risk of drift occurring when:

1. **Wind drift:** Wind speeds > 9mph
2. **Thermal drift:** Temperatures > 70ºF, RH <40%
3. **Inversion drift:** Stable air, following cool, cloudless nights in spring and fall

THE FOLLOWING TABLES ARE BASED ON LONG-TERM AVERAGES AND ARE FOR GUIDANCE ONLY, TO ASSIST DISCUSSIONS ON HOW YOU SHOULD PLAN YOUR APPLICATION AND DRIFT MANAGEMENT PRACTICES IN THE SEASON AHEAD

Calendar of LOW risk, CAUTION and HAZARD for wind, thermal and inversion drift, Pendleton

	J	F	M	A	M	J	J	A	S	O	N	D
Mean wind speed	8	8	9	10	10	10	9	9	8	8	8	8
Low wind drift risk (% <7 mph)	65	63	56	50	51	52	52	57	60	67	65	68
Caution (7-11 mph)	20	21	24	25	26	27	30	28	26	21	21	19
Hazard (>12 mph)	15	16	20	24	23	21	18	15	15	12	14	13
Mean max temp	40	47	54	61	70	80	88	86	76	64	49	41
RH 10am	78	71	59	51	47	42	34	36	42	55	72	78
RH 4pm	75	65	49	42	37	32	23	26	32	46	69	78
Proportion calm	7	5	3	3	3	3	3	4	4	5	7	7

Calendar of LOW risk, CAUTION and HAZARD for wind, thermal and inversion drift, Portland

	J	F	M	A	M	J	J	A	S	O	N	D
Mean wind speed	10	9	8	8	7	7	7	7	7	7	9	9
Low wind drift risk (%<7 mph)	32	32	38	43	47	46	46	49	53	50	35	34
Caution (7-11 mph)	25	27	30	29	33	35	37	35	27	22	27	25
Hazard (>12 mph)	33	30	22	15	12	12	12	10	10	13	27	30
Mean max temp	45	51	56	61	67	74	80	80	75	64	53	46
RH 10am	82	80	73	69	66	65	62	64	67	78	82	83
RH 4pm	75	67	60	55	53	49	45	45	48	62	74	78
Proportion calm	10	11	11	12	8	7	5	7	11	15	10	11

Calendar of LOW risk, CAUTION and HAZARD for wind, thermal and inversion drift, Salem

	J	F	M	A	M	J	J	A	S	O	N	D
Mean wind speed	8	8	8	8	7	7	7	7	7	7	8	8
Low wind drift risk (% <7 mph)	38	38	39	42	45	45	44	46	46	44	36	39
Caution (7-11 mph)	22	25	27	29	30	31	32	27	24	20	25	24
Hazard (11 mph)	22	21	21	15	10	9	9	8	9	10	22	20
Mean max temp	47	51	56	61	67	73	80	80	75	64	52	46
RH 10am	84	81	75	70	65	62	57	58	64	76	85	85
RH 4pm	75	68	60	57	53	49	40	40	75	59	77	80
Proportion calm	18	16	14	14	14	14	14	18	21	24	17	17

Calendar of LOW risk, CAUTION and HAZARD for wind, thermal and inversion drift, Medford

	J	F	M	A	M	J	J	A	S	O	N	D
Mean wind speed	4	5	5	6	6	6	6	5	5	4	4	4
Low wind drift risk (%<7 mph)	54	56	58	57	56	54	53	55	59	58	55	52
Caution (7-11 mph)	6	9	14	18	20	22	22	19	12	7	7	6
Hazard (>12 mph)	4	5	7	6	6	8	8	7	3	2	2	3
Mean max temp	46	53	59	65	73	82	91	90	83	69	53	44
RH 10am est.	88	83	73	63	56	48	45	47	53	69	87	89
RH 4pm est	71	57	50	45	39	33	26	27	29	43	68	76
Proportion calm	35	27	21	18	17	16	18	20	25	33	35	38

Examples of pesticides detected by ODEQ in 2014,15 & 16 in the Middle Rogue that are used by wine grape producers in S. Oregon

PRODUCT	USES IN S OREGON WINEGRAPE
Glyphosate (Roundup)	GOOD Annual and perennial bread leaves and grasses
Dichlobenil (Casuron)	FAIR Willow weed, wild carrot, fluvellin, cat ear, clover, mallow, Canada thistle, dendelion; GOOD Fine fescue, bindweed
Acetamiprid (Assail)	GOOD Leafhopper, mealybug
Carbaryl (Sevin)	GOOD Cutworm (trunk spray)
Diuron (Direx, Karmex)	GOOD Dandelion
Imidacloprid (Admire, Provado, Gaucho, Marathon)	GOOD Leafhopper, mealybug
Oxyflurofen (Goal)	GOOD Willow weed, wild carrot, cat ear, clover; FAIR Fluvellin, clover, bind weed, Canada thistle, dandelion, fine fescue

IPM activities in S. Oregon wine grapes

~Pest Management Activities~

Activity	J	F	M	A	M	J	J	A	S	O	N	D
Bird netting								X	X		X	
Cultivating										X	X	
Leaf pulling						X	X					
Mowing				X	X	X	X	X				
Pesticide applications (powdery mildew, botrytis, insects)				X	X	X	X	X	X			
Rogueing	X										X	X
Scouting				X	X	X	X	X	X	X		
Suckering					X	X						
Trapping				X	X	X	X	X	X	X		
Virus monitoring								X	X	X		

Wind, thermal and inversion drift all occur during the main period for spraying in Medford

<u>BUT YOU HAVE TO KNOW WHAT CONDITIONS APPLY LOCALLY TO YOU</u>

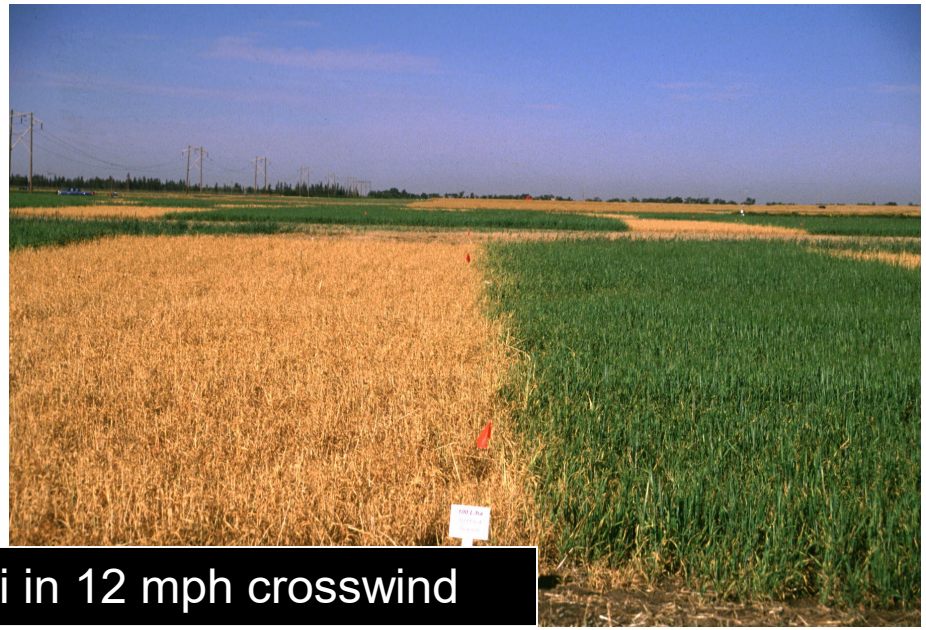
Sprayer adjustments and drift reduction technologies

ATTACHED TO CALIBRATED SPRAYERS

Boom sprayers: nozzle selection

NOZZLE CATEGORIES	COMMENTS	USE GUIDE
CONVENTIONAL FLAT FAN	Fine spray, reliable, but drift prone	20-60psi, >3gpa
PRE-ORIFICE	50% drift reduction, reliable at low volumes	30-60+psi, >5gpa
LOW-PRESSURE AIR INDUCTION	50-70% drift reduction	30-60+psi, >5gpa
HIGH PRESSURE AIR-INDUCTION	70-90% drift reduction	60-80+psi, >7gpa

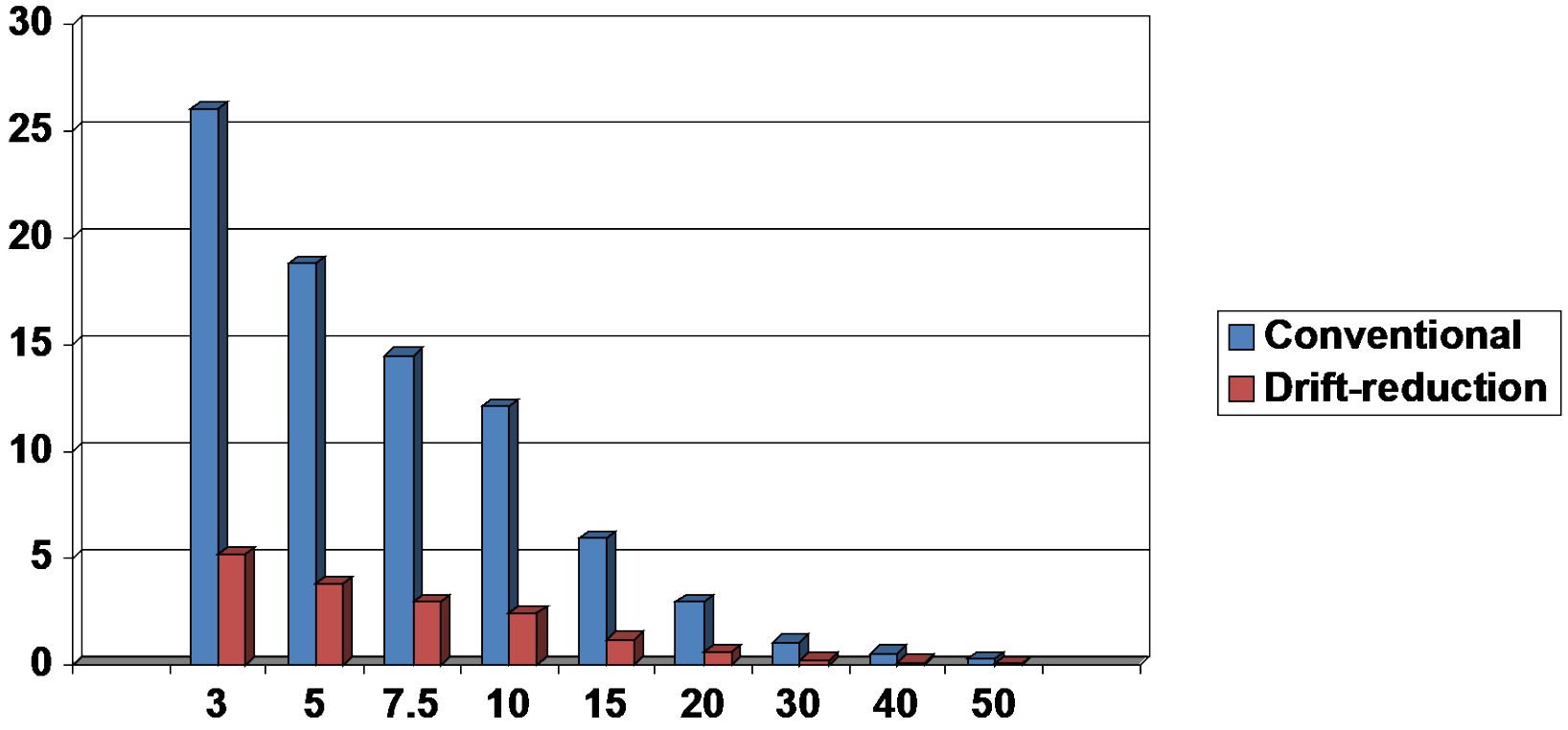
TeeJet XR 8004 @ 40 psi in 12 mph crosswind



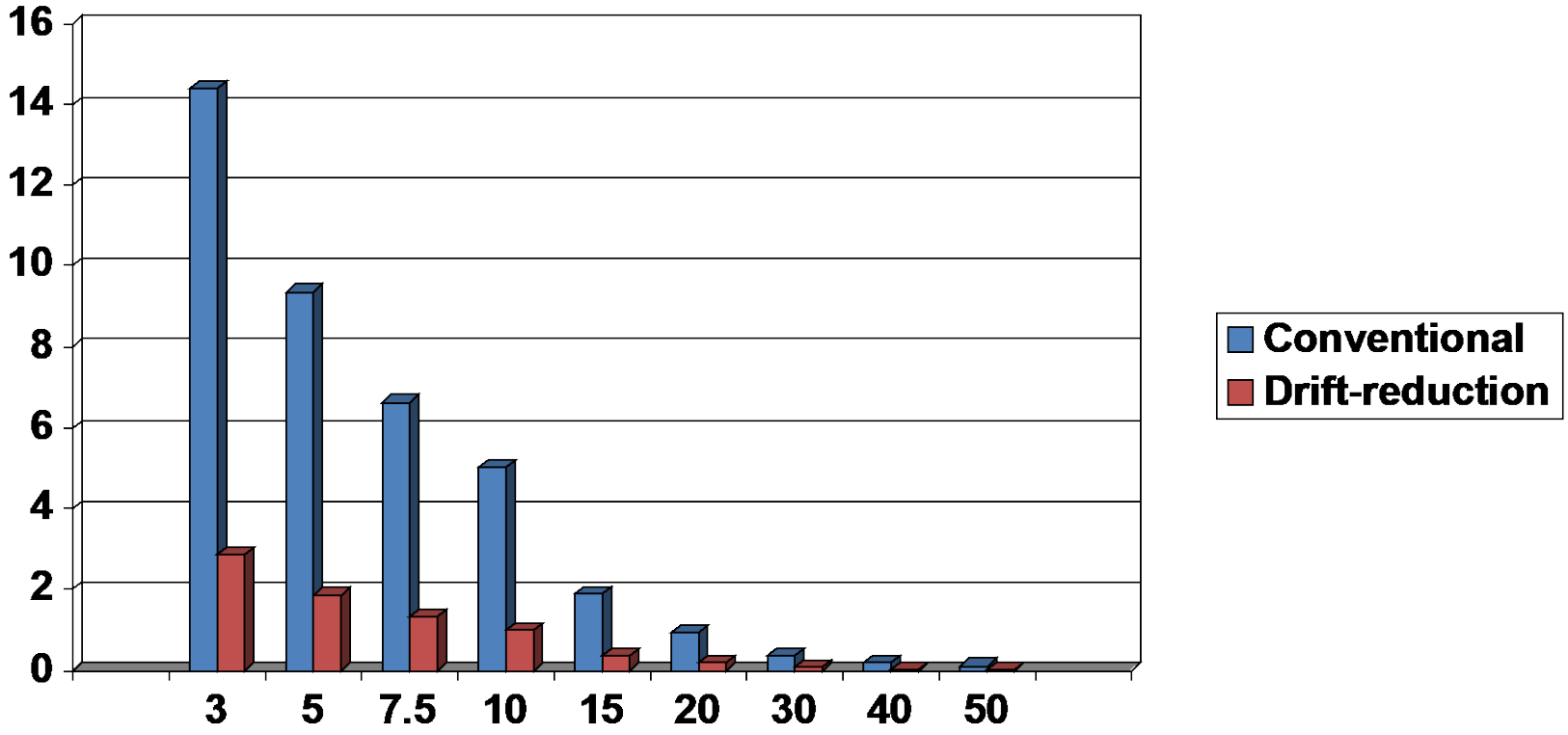
Turbo Drop 11003@ 70 psi in 12 mph crosswind

Air-blast sprayer with air induction nozzles

Drift (as % of applied spray distance (m)) for conventional and drift-reducing nozzle systems, in orchard crops (German regulatory data: early season)



Drift (as % of applied spray distance (m)) for conventional and drift-reducing nozzle systems, in orchard crops (German regulatory data: late season)

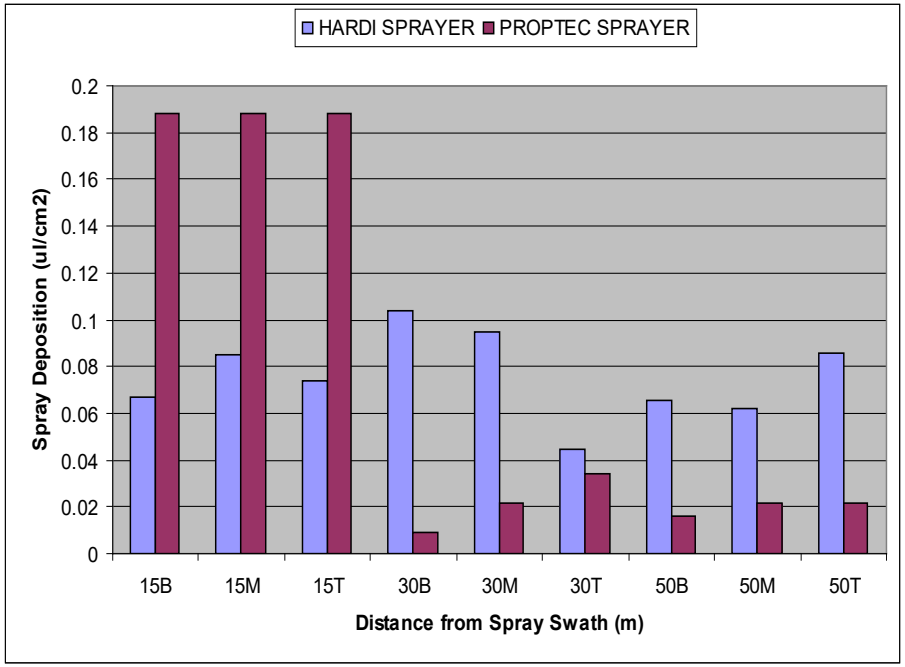


Proptec tower sprayer, Blue-Line

Mono-sized droplets; limited downwind airflow

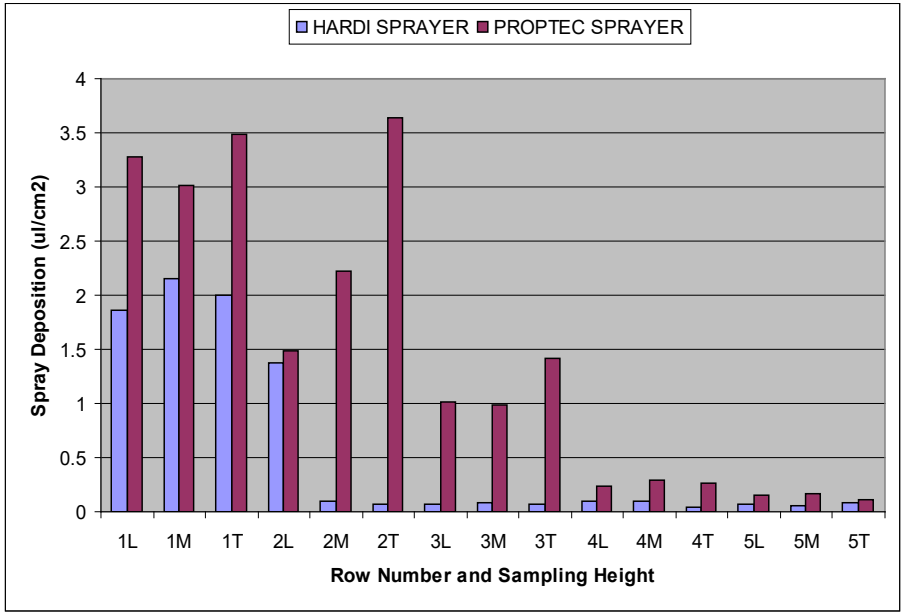
Hardi-arrow, tower sprayer

Lower velocity, high air volume limits drift



Drift potential - tower sprayers.

Uniformly sized droplets from the Proptec sprayer deposit out at a similar distance



Spray coverage - tower sprayers.

Within the canopy, the drop size range and fan projection from the Proptec achieved better coverage in this example

Farmers have a history in Oregon of responding to pesticide risks

IPM and pesticide stewardship partnerships to limit pesticides in Oregon surface waters

- *participatory education, not technology transfer*

Paul Jepson, Mary Halbleib,

Oregon State University

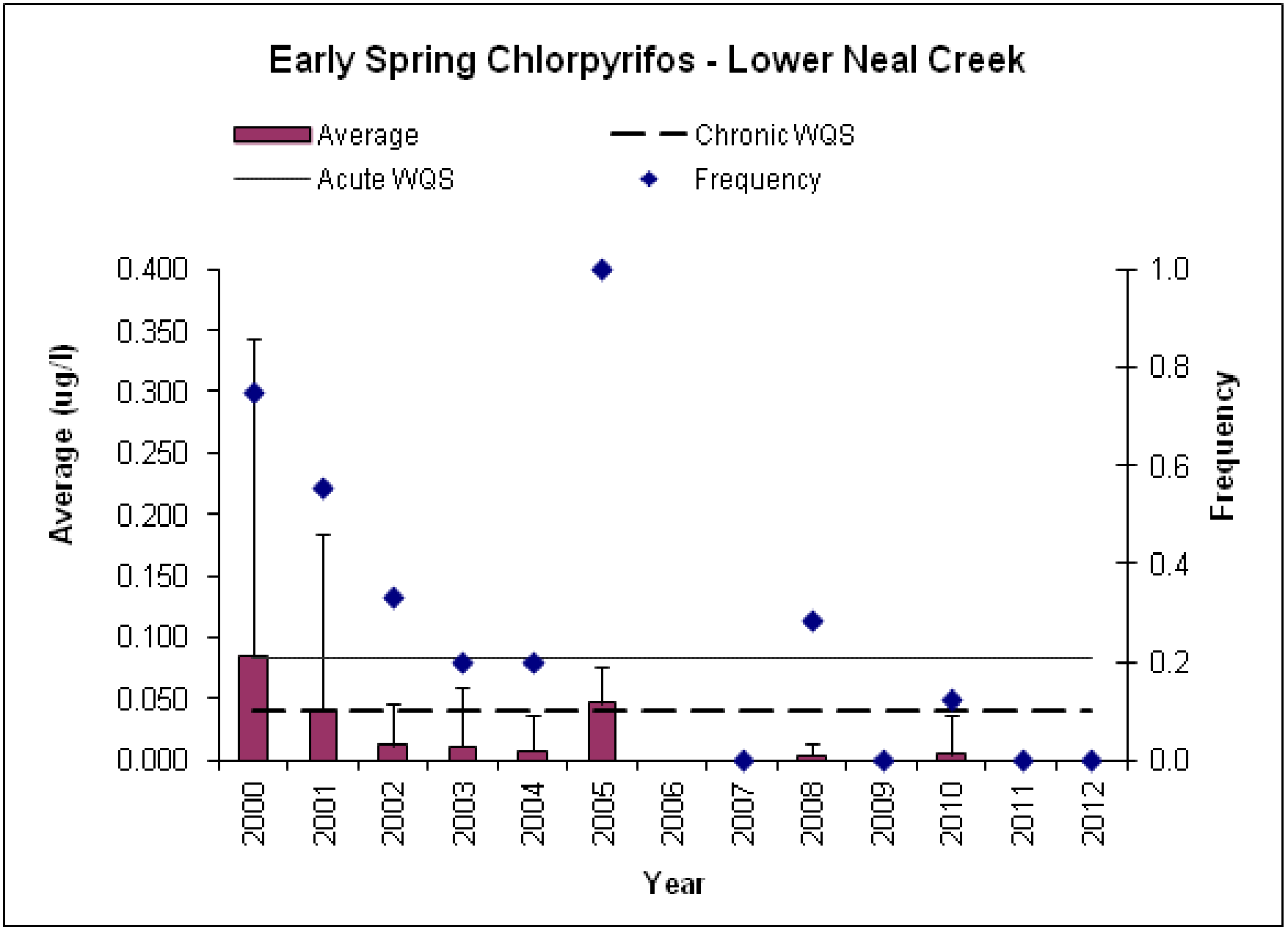
Kevin Masterson,
Oregon Department of Environmental Quality

+ about 4,000 farmers

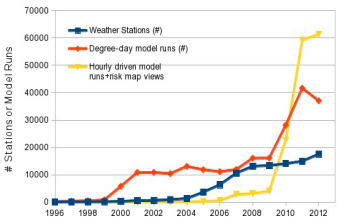
OSU

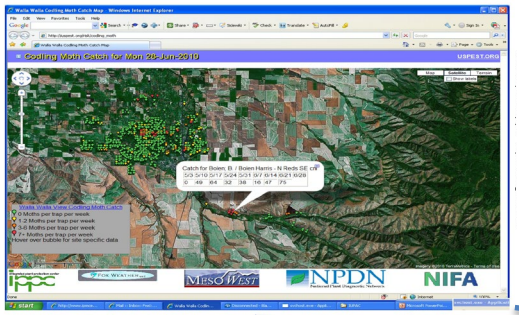
jepsonp@science.oregonstate.edu

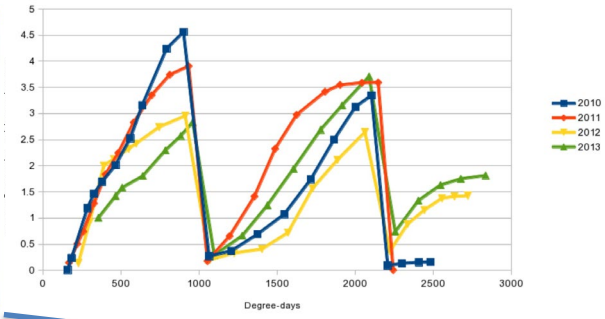
Pesticide Stewardship Partnership Results Hood River, Oregon



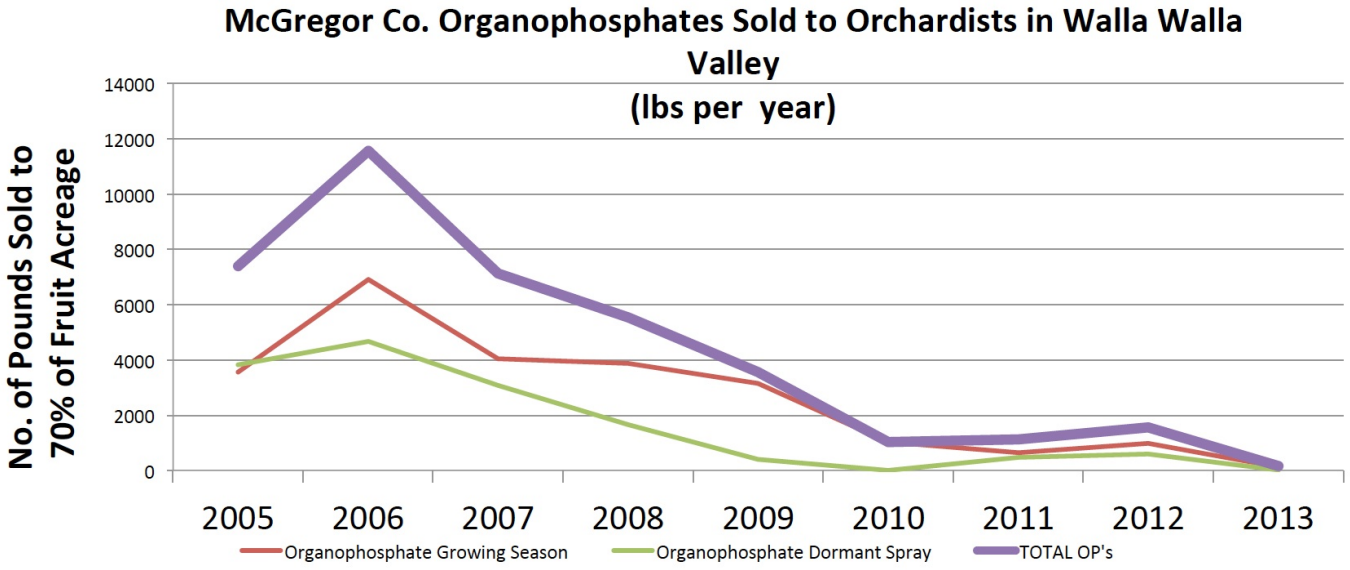
It takes small contributions from many applicators







05	06	07	08	09	10	11	12	13



PSP monitoring data, backed up by pesticide sales data, codling moth trap counts (all three show declines since 2010)

Clive Kaiser, IPPC, DEQ

Specialized website online from IPPC Sept 2006 http://uspest.org/MF/

117 house visits 2007-9 to demo IPPC web tools

Trap # 612-1250 (2006-2013)

On-line trap mapping available since April 2009 from IPPC

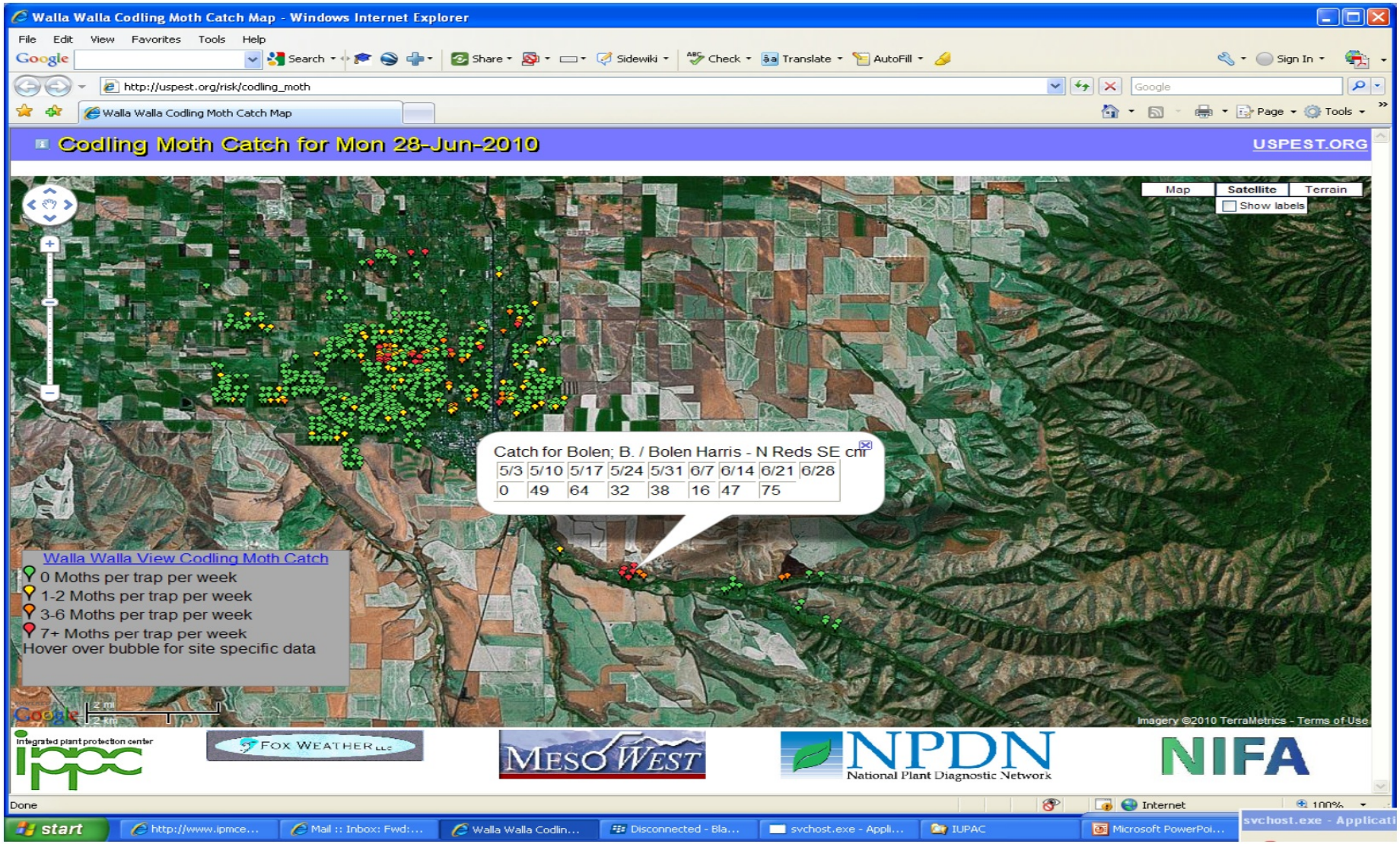
ipmPRiME analysis of 50% of acreage, 2012

Garden tree fruit pest management since 2006 (Don't Bug Us, Tree for Tree)

Sleuthing for o/w sources 2008 onwards

Annual DEQ report from Kevin Masterson

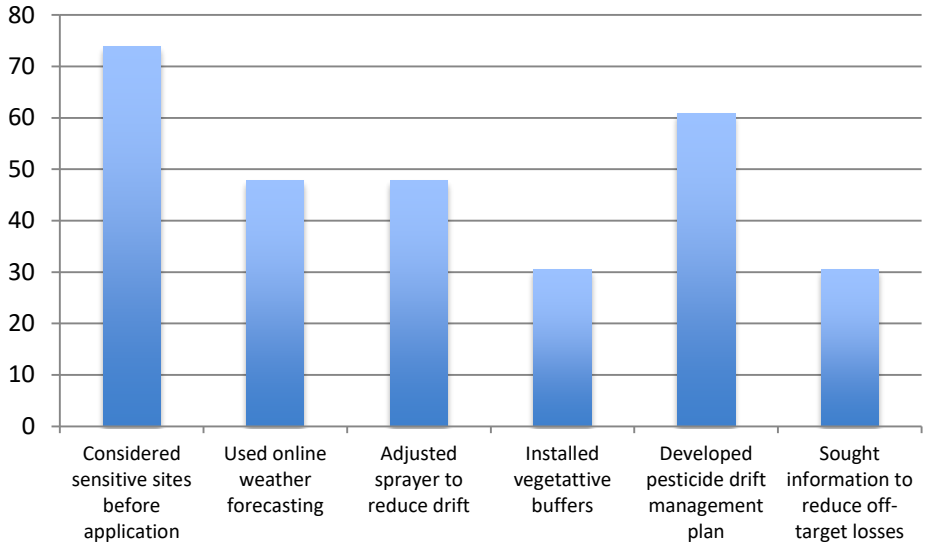
Mapping of pest trapping records to target sprays where they are needed



Knowledge or skill area	Before	After	Change
Ability to include water quality considerations in your pesticide selection decisions (n = 25)	4.4	5.7	1.3*
Access local online weather and climate information (n = 24)	3.8	6.0	2.2*
Incorporate local climate and weather data into pesticide application management (n = 25)	4.2	5.8	1.6*
Develop a pesticide application and drift management plan for your farm (n = 23)	4.0	5.7	1.8*
Determine if vegetative buffers would benefit water quality on for your farm (n = 24)	3.5	5.0	1.5*

Mean scores of retrospective pretests before and after education interventions (scale 1 = no ability, and 7 = very able)

% Farmers making changes following intervention (La Grande, 2006; N=23)



Halbleib & Jepson (2014) The Journal of Agricultural Education and Extension. http://dx.doi.org/10.1080/1389224X.2014.927377

Education Program Design
Jointly Envision Intended Outcomes

Education Program Design
Generate Learning Guides

COURSE DESIGNED BACKWARDS FROM MORE NARROWLY DEFINED OUTCOMES

Concepts

Pest epidemiology

Pest symptomology and early recognition

Monitoring principles and practices

Skills

Recognize early signs and symptoms of pests in different tree species

Design a manageable monitoring plan by management unit

Task

Interpreting monitoring data to guide long and short-term IPM decision-making

Example for one outcome

Intended outcome

Develop guidance for effective monitoring and recording keeping skills and methods that supports IPM decisions

COURSE TAUGHT FORWARDS

Education Program Design
Support Powerful Learning

IPM PROGRAM EDUCATION BASED UPON CONSULTATION AND PLANNING WITH THE CHRISTMAS TREE AND NURSERY INDUSTRIES

Education events, participation (N), & skills taught in pesticide use reduction, or in pesticide risk mitigation

Crop	Abbreviated title	N	Use reduction	Risk mitigation
Nursery 2/20/14	**Maximize pesticide use efficiency**	49		5
Christmas tree 6/11/14	**Identification and use of beneficial insects**	34	3	2
Nursery 10/13/14	**Sprayer calibration and application assessment**	31		3
Nursery 2/3/15	**Combining IPM and pesticide risk management**	34	5	6
Christmas tree 2/11/15	**Beneficial insects moving ahead**	27	5	1
Christmas tree 6/17/15	**Farmscaping for predation and parasitism**	12	7	

FARMER AND NURSERY MANAGER INTENTIONS TO USE PESTICIDE MANAGEMENT SKILLS AFTER WORKSHOPS

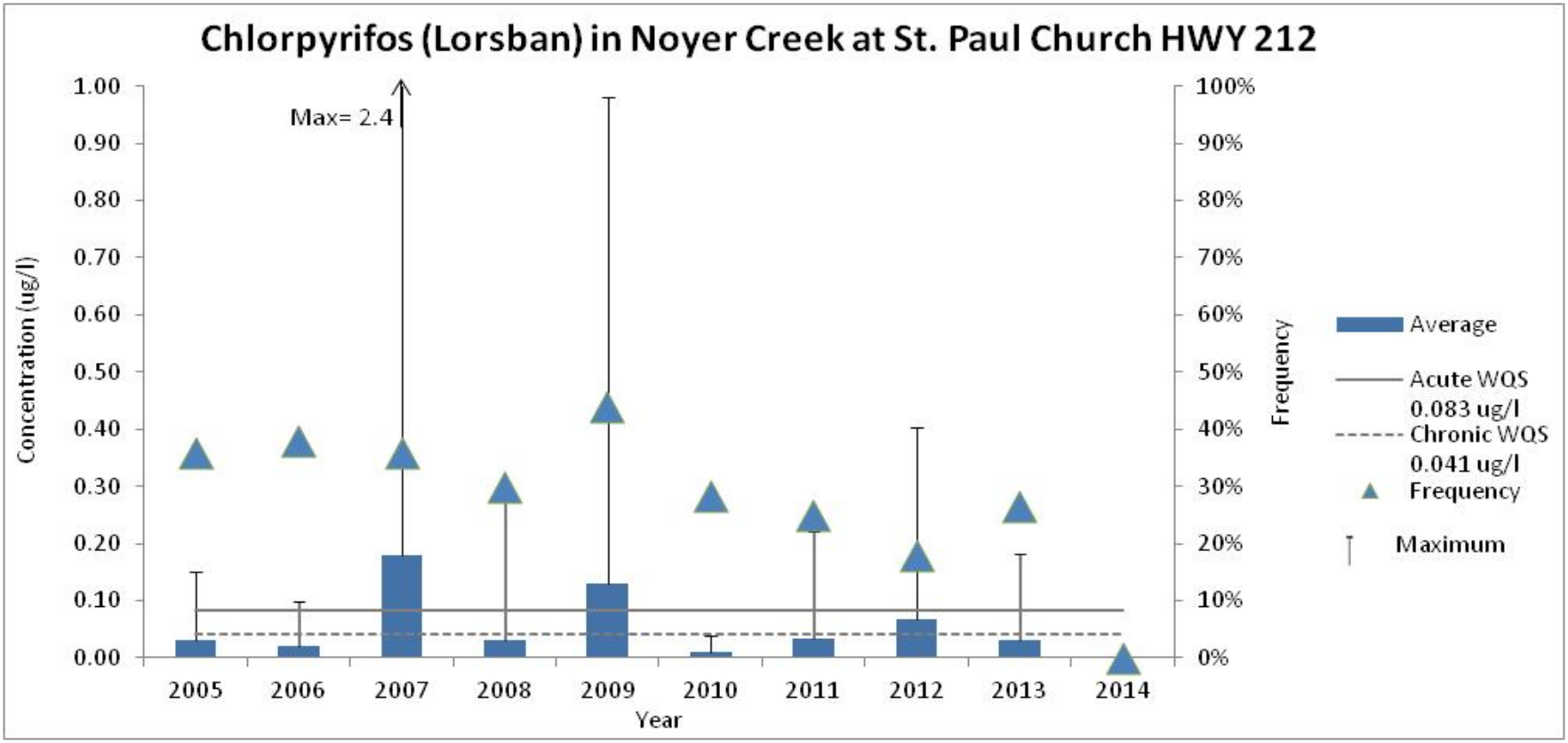
Intentions to mitigate risks (green), or limit use (blue) (%)	June 2014 (N=12)	Aug 2014 (N=23)	Feb 2015 (N=19)
Calibrate sprayer	N/A	87	N/A
Replace nozzles	N/A	74	N/A
Adjust spray timing	64	N/A	100
Use low risk pesticide	50	N/A	100
Reduce spray frequency	58	N/A	100

Education Program Design
Evaluate and Inform

IPM AND PESTICIDE MANAGEMENT METHODS USED BY FARMERS AND NURSERY MANAGERS

Grower actions 12 months after education events (%)	Christmas tree (n=23)	Nursery (n=20)
Used on-line weather forecasting	50	90
Adjusted application based on weather	79	95
Adjusted application to protect sensitive site	55	90
Used less chlorpyrifos	30	58

PSP Monitoring Data
2015 marketplace complication



Formation
IEC communication
Réglementation
Alternatives
Promouvoir des alternatives aux produits chimiques

The first comprehensive, science-based risk portrayal, based upon West African pesticide risks

Les Risques des Pesticides

IPPC integrated plant protection center

CONSORTIUM AGRI

OSU Oregon State University

Délai de réentrée (jours)

NOM									
Abamec	100		>21	>21	>21				
Acarex	4		>21	>21	>21				
Acarius	100		>21	>21	>21				
Acaron	118		20	17	18				
Armada 40EC	53		>21	>21	>21				
Attakan	0.2		1	1	1				
Basudine	133		>21	>21	>21				
Biobit	~0		1	1	1				

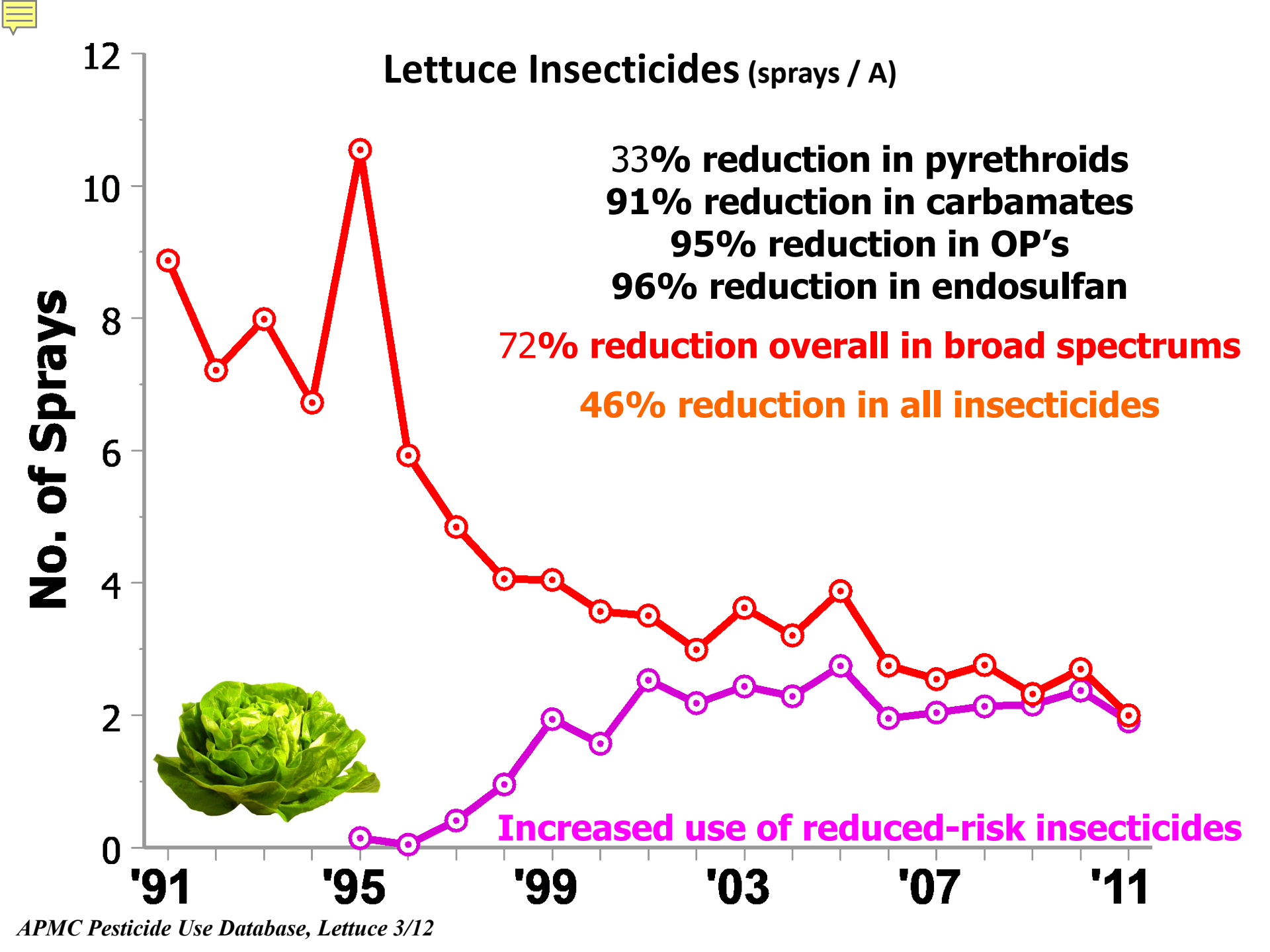
A complete agro-ecosystem where risks have been reduced Arizona Lettuce:

Paul Jepson, Michael Guzy, Peter Ellsworth, Al Fournier, Wayne Dixon, John Palumbo

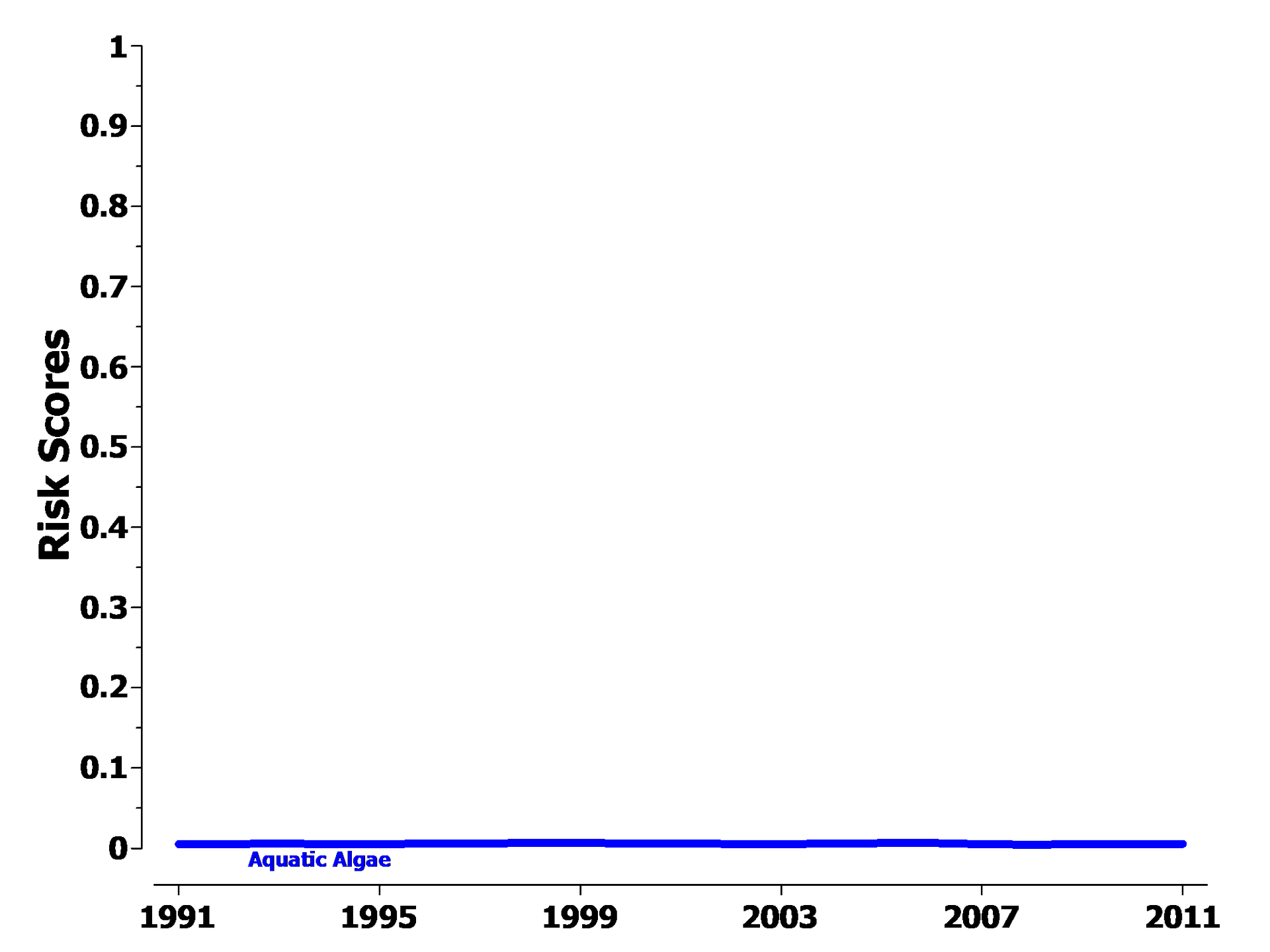
IPPC integrated plant protection center

Value of Arizona Lettuce Industry

- $828,690,000 = value of production (2011)
- Over 70,000 acres planted annually
- >95% of U.S. winter supply of lettuce (Nov–Mar)



APMC Pesticide Use Database, Lettuce 3/12


Risk Scores
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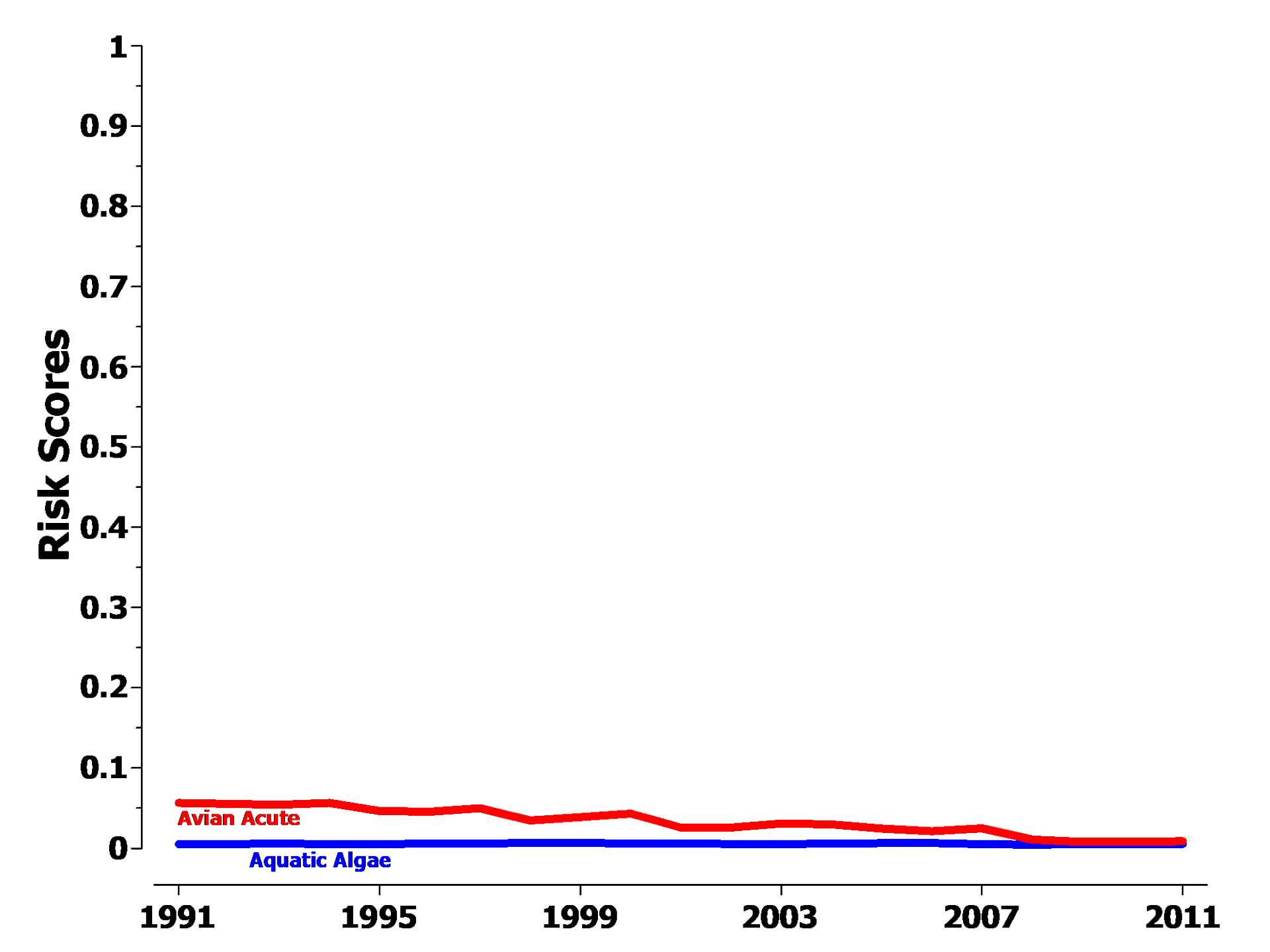
Aquatic Algae
1991
1995
1999
2003
2007
2011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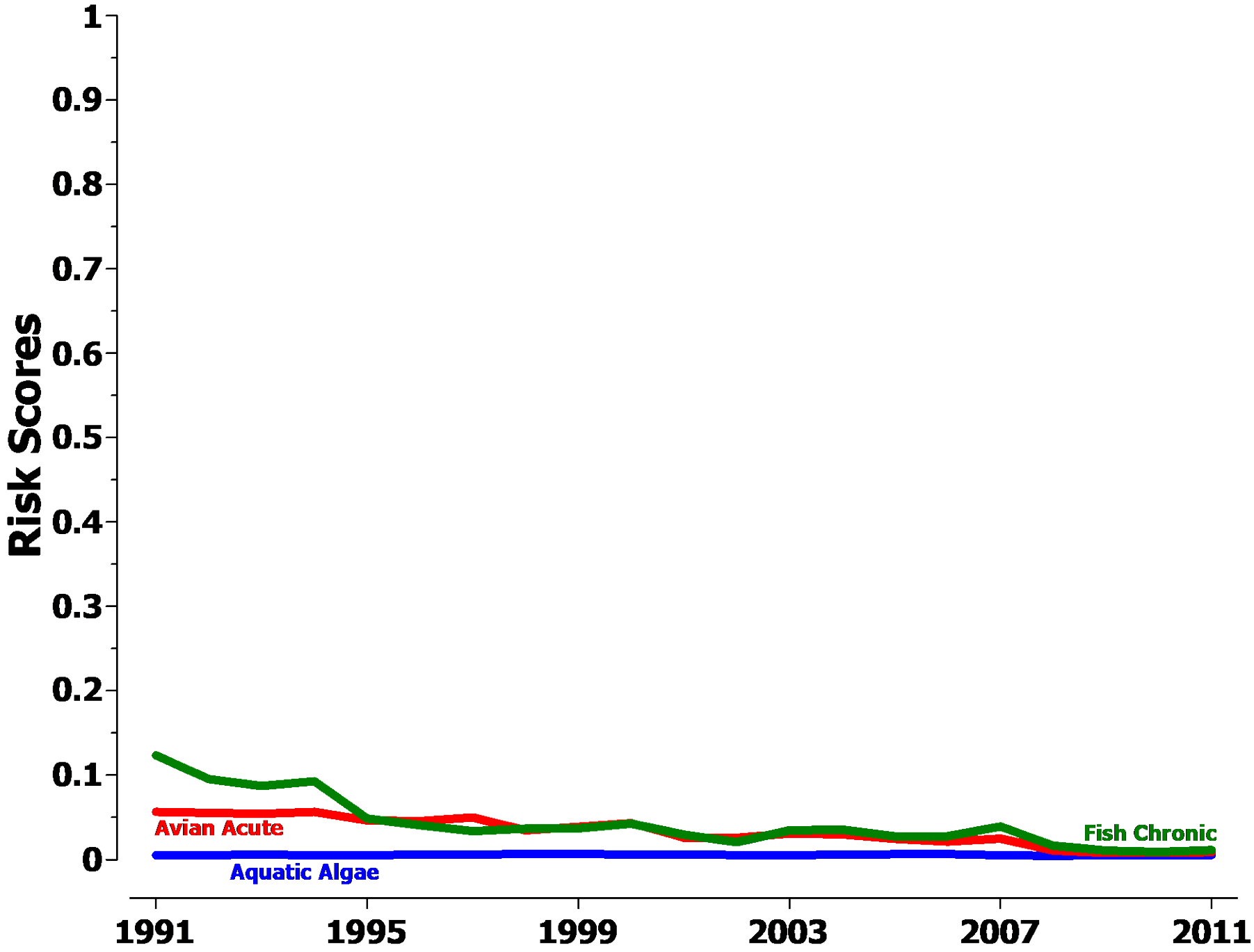
Risk Scores
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Avian Acute
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Fish Chronic
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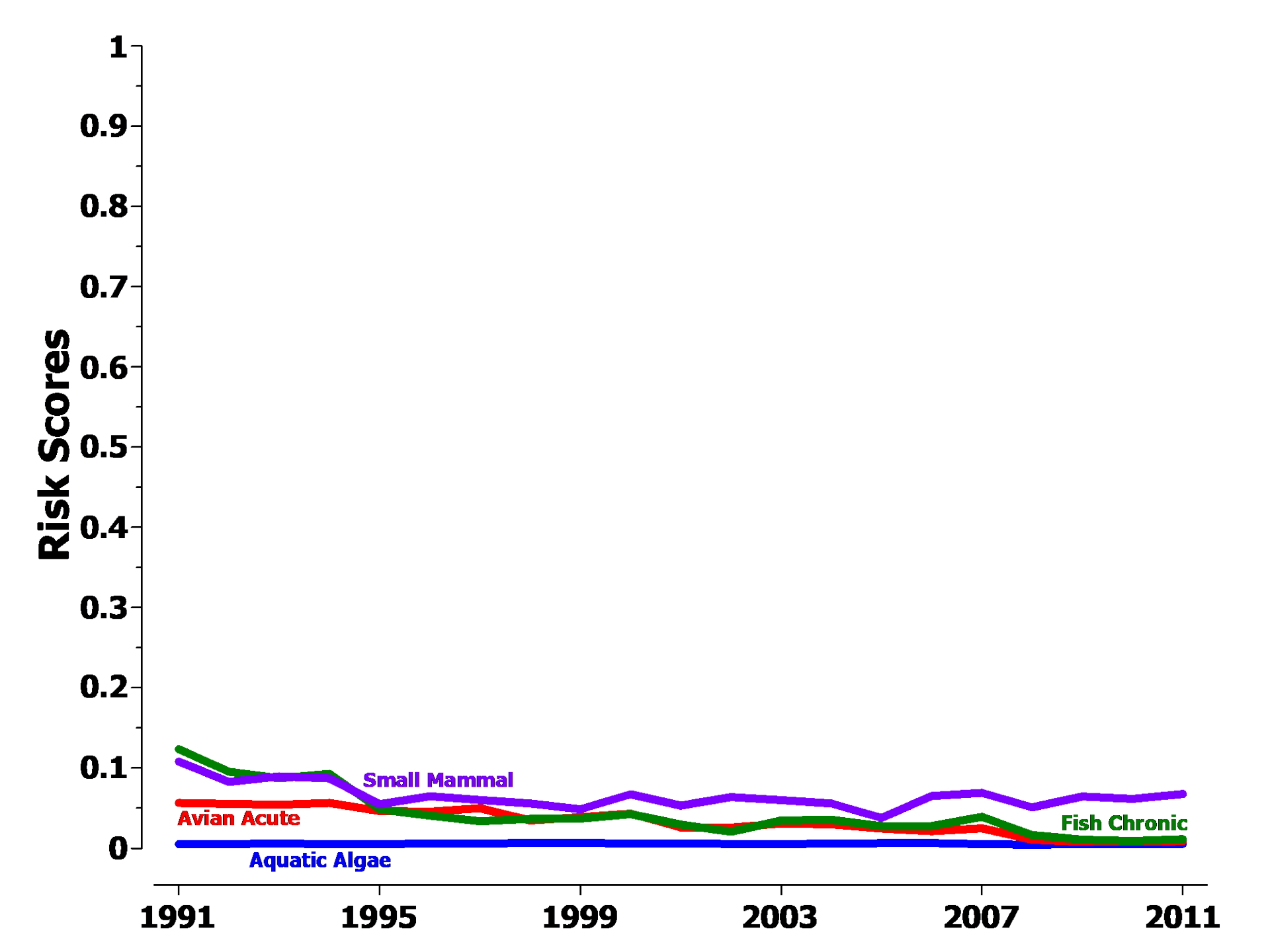
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Small Mammal
Avian Acute
Fish Chronic
Aquatic Algae
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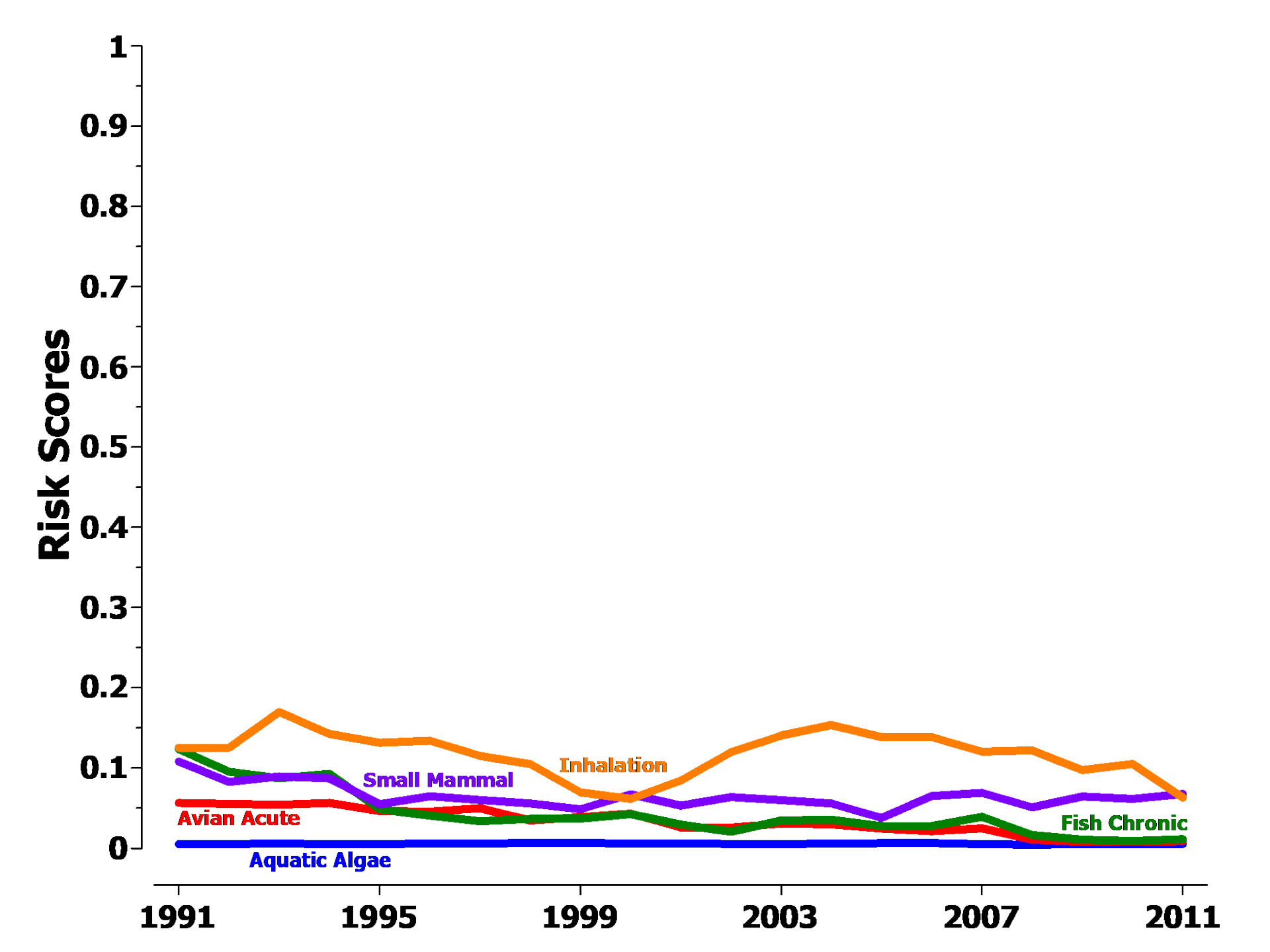
Risk Scores
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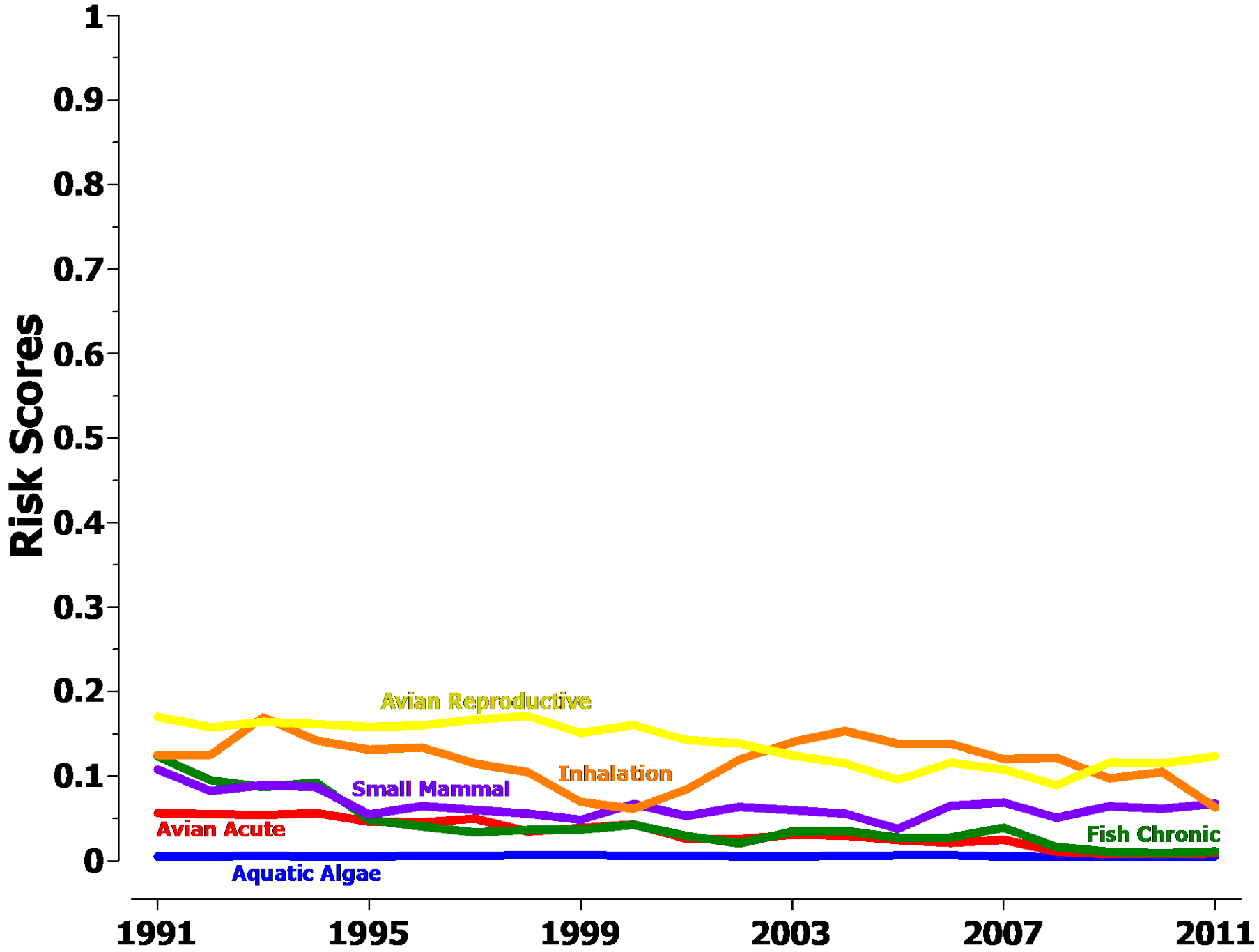
Avian Acute
Fish Chronic
Aquatic Algae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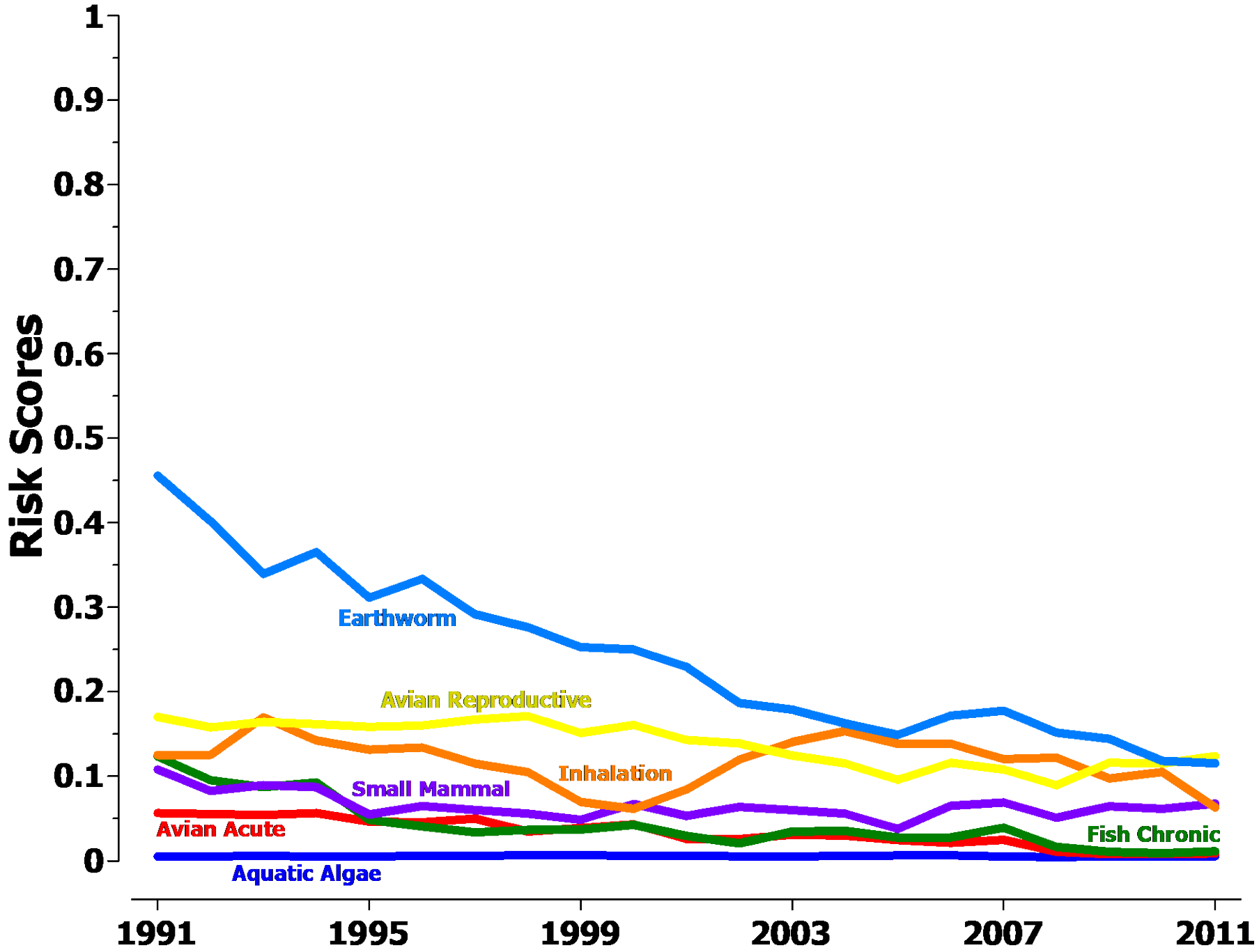
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2007
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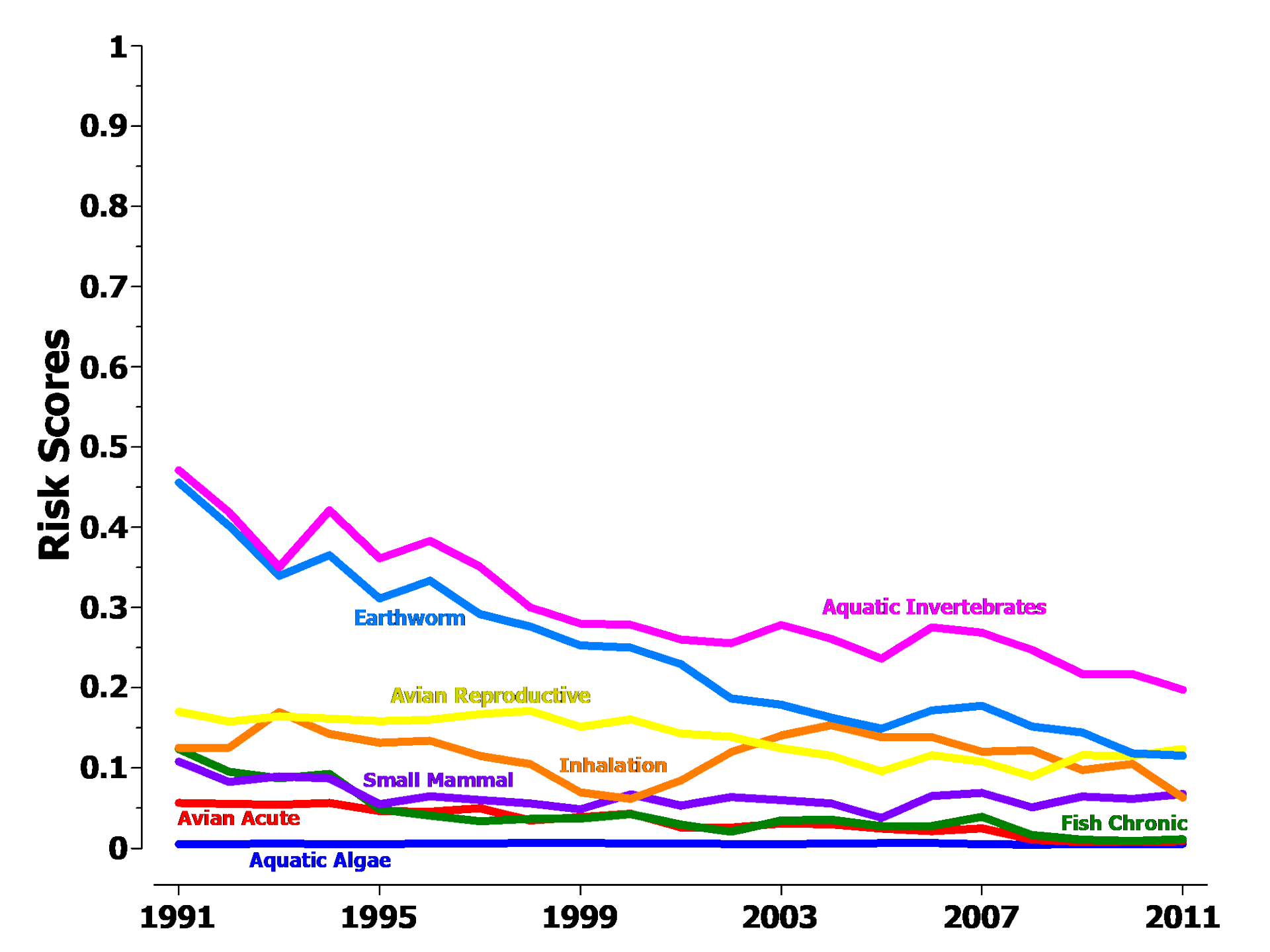
Earthworm
Avian Reproductive
Inhalation
Small Mammal
Avian Acute
Fish Chronic
Aquatic Algae


Risk Scores
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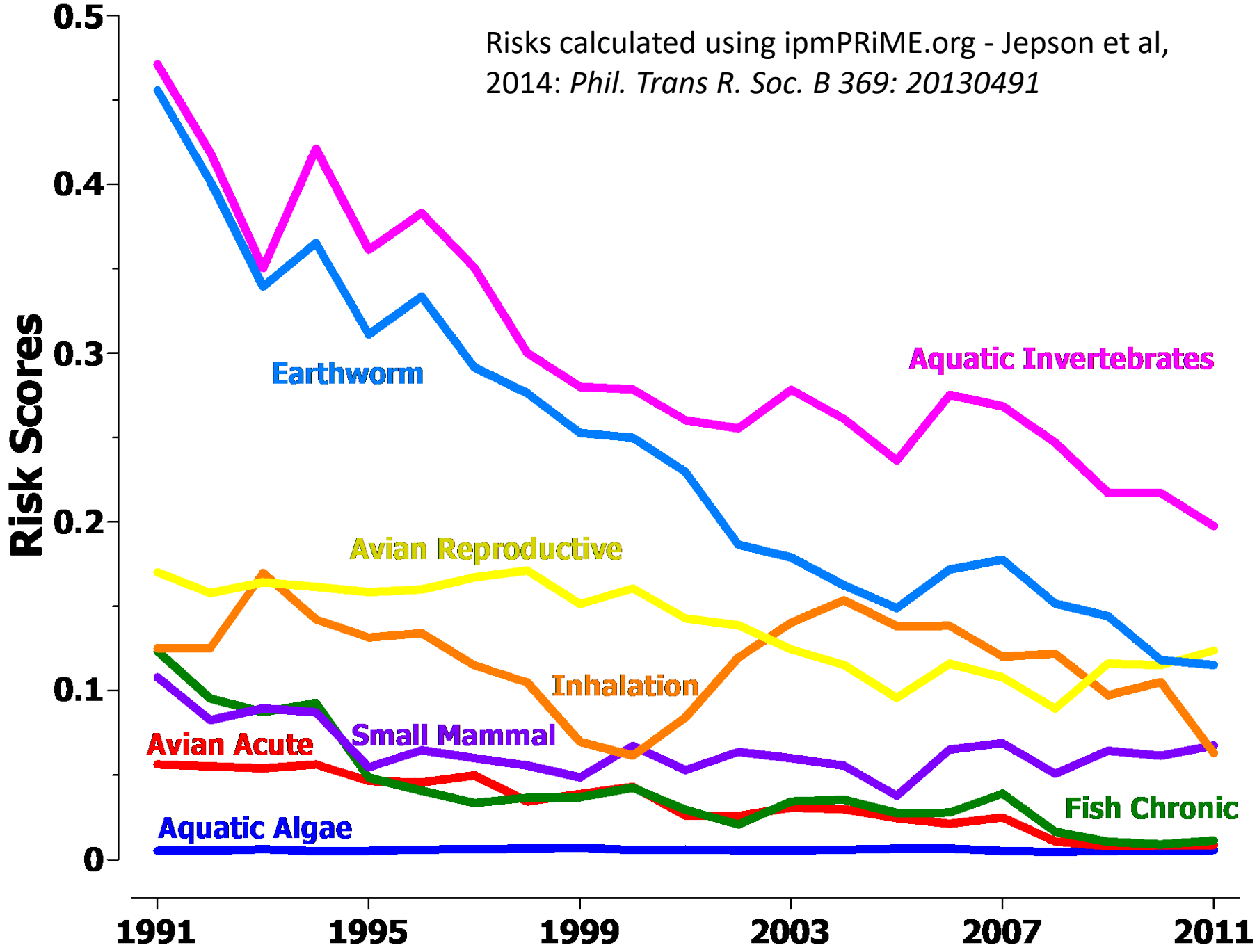
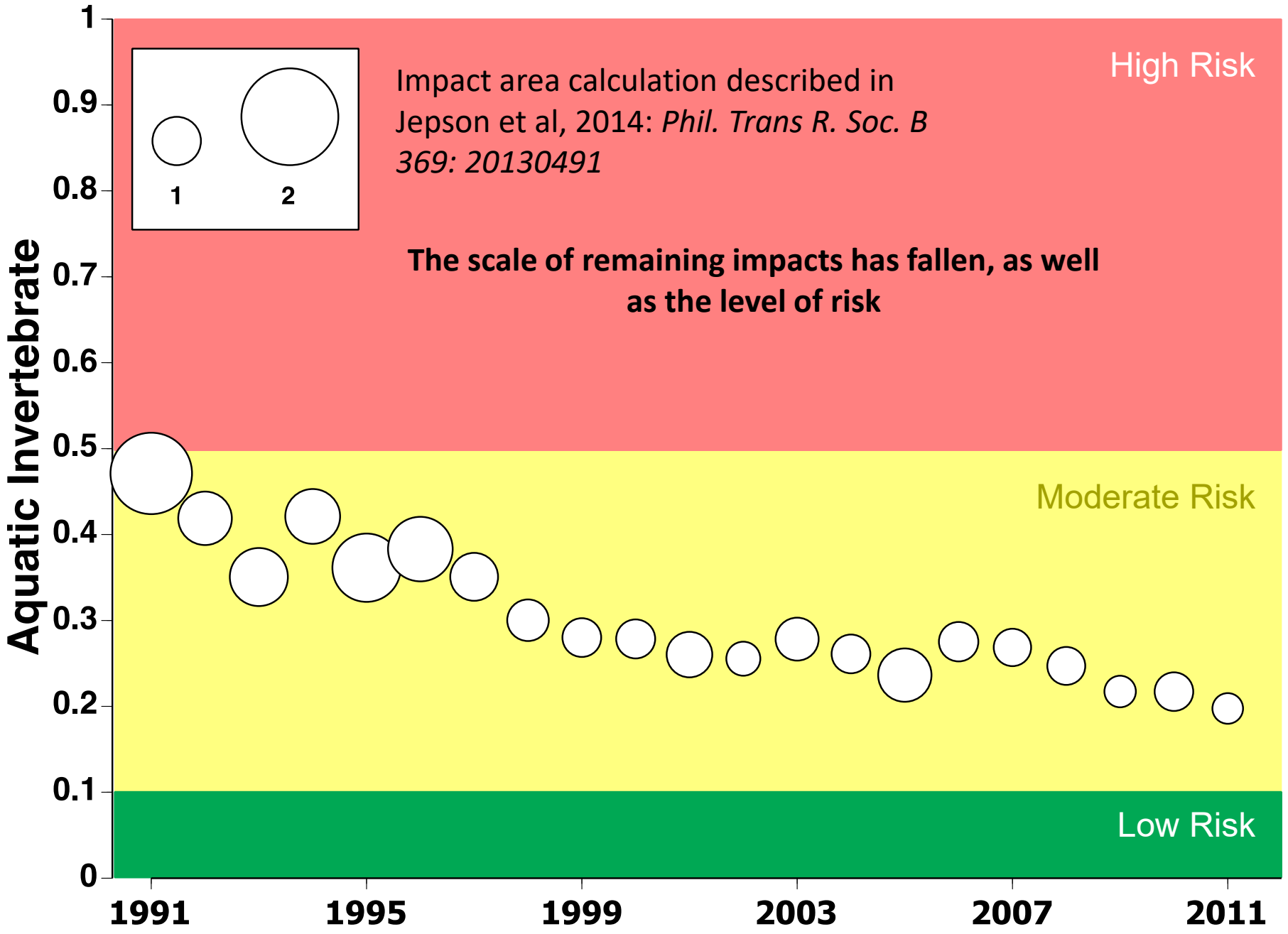
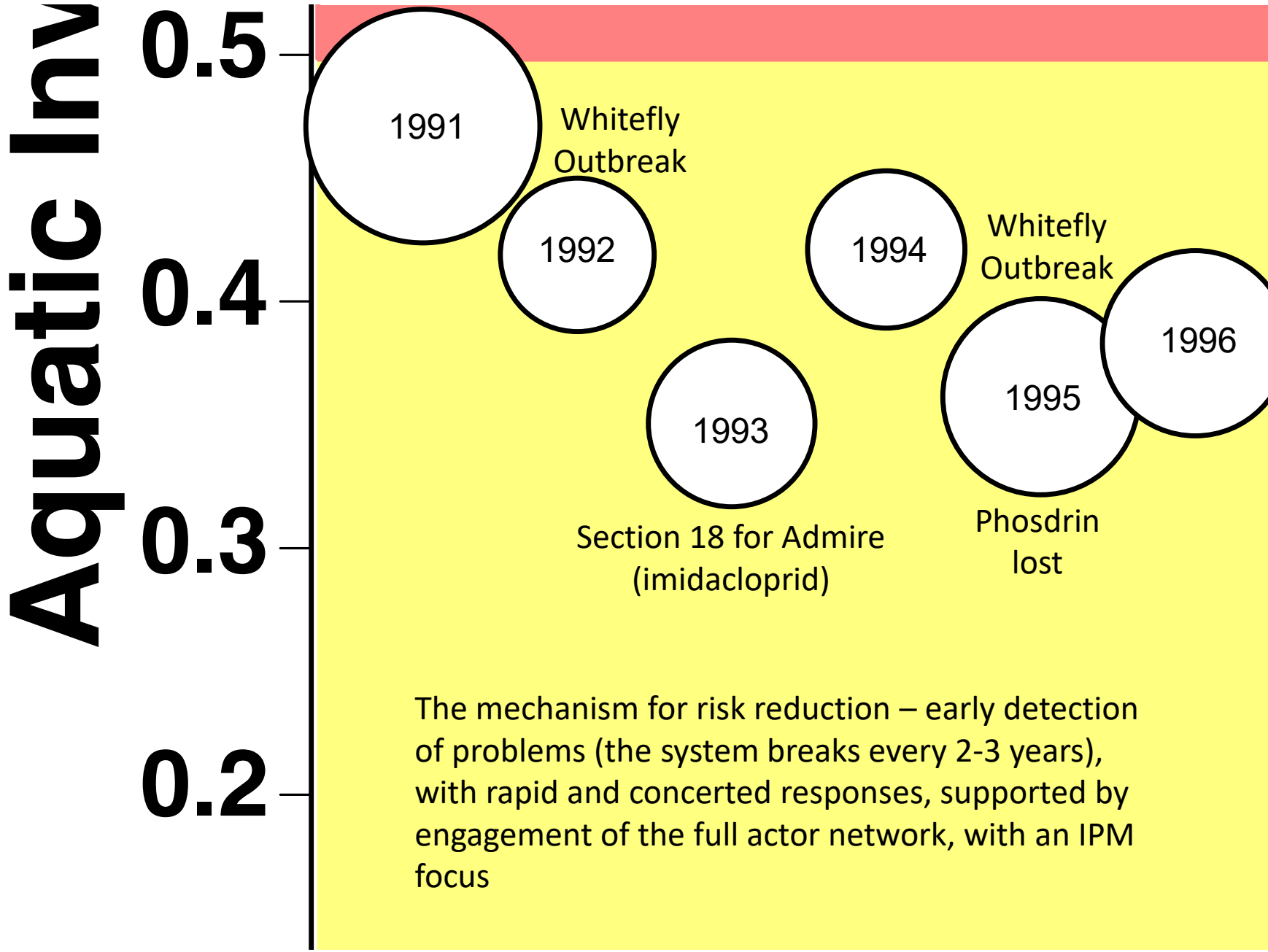
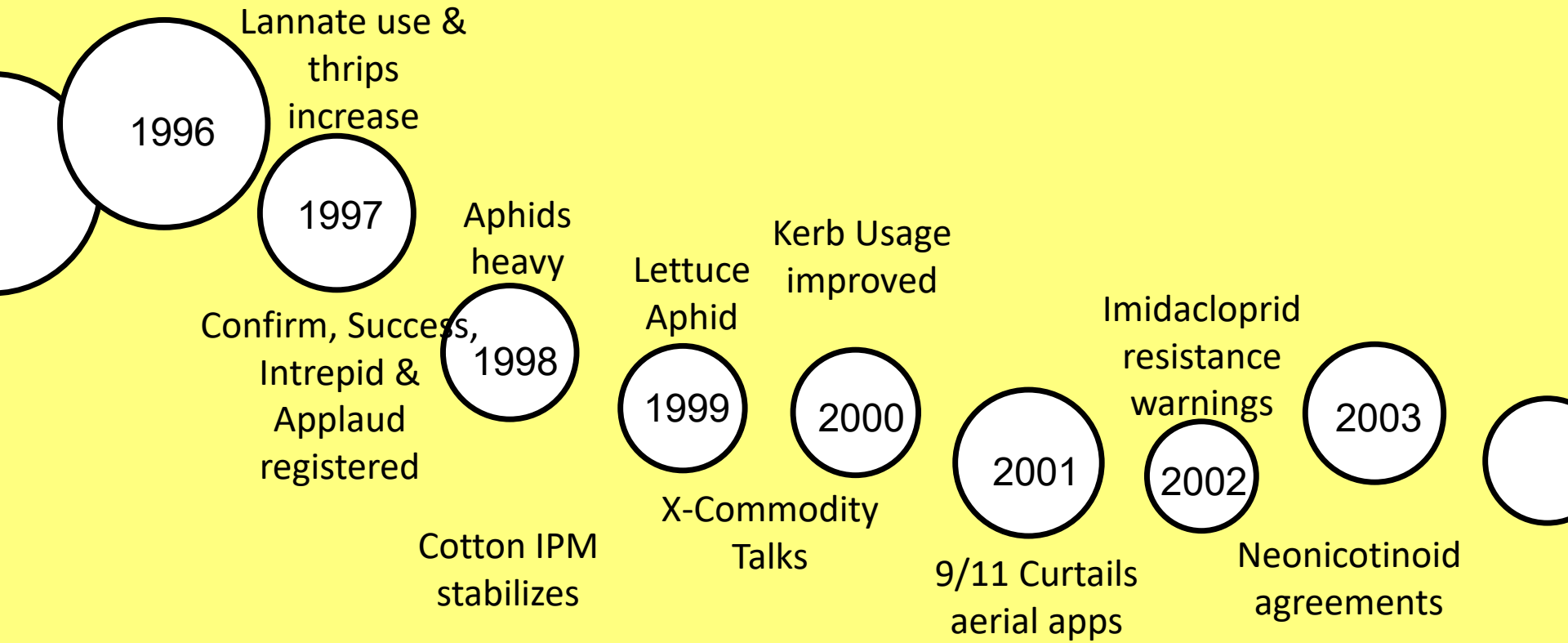
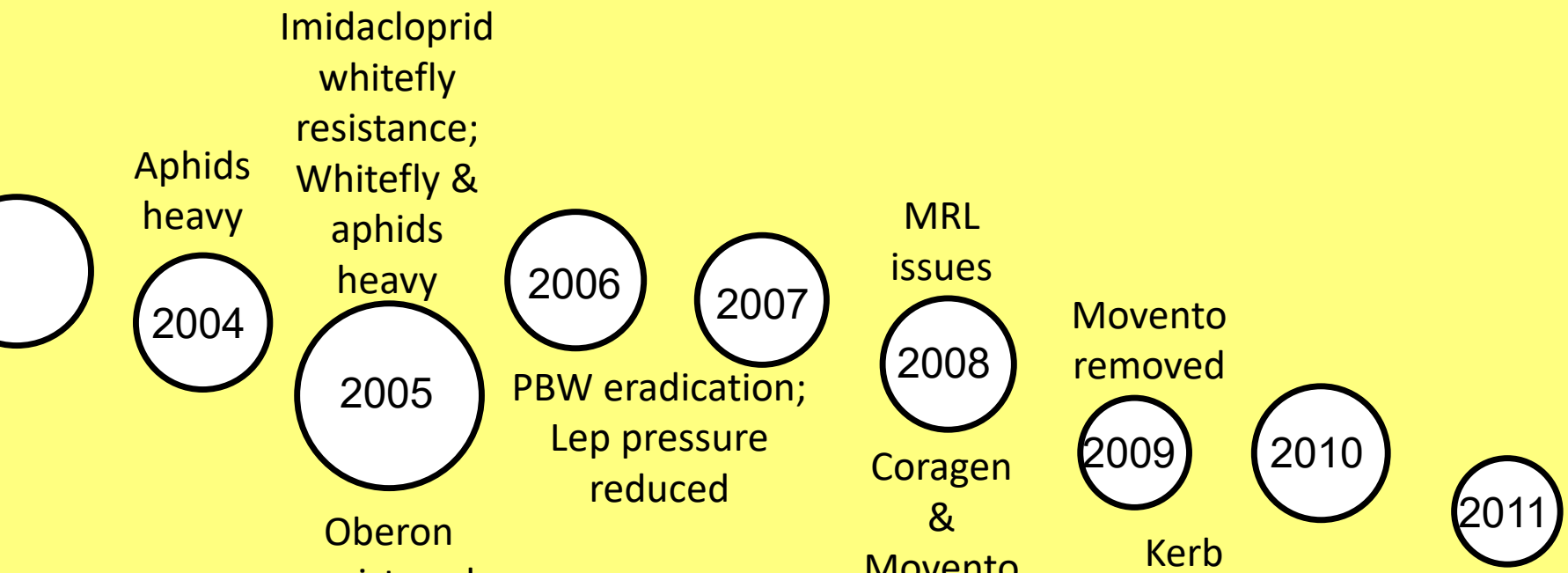
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1991
1995
1999
2003
2007
2011
Earthworm
Aquatic Invertebrates
Avian Reproductive
Inhalation
Small Mammal
Avian Acute
Fish Chronic
Aquatic Algae


Risks calculated using ipmPRiME.org - Jepson et al, 2014: *Phil. Trans R. Soc. B 369: 20130491*
Risk Scores
0.5
0.4
0.3
0.2
0.1
0
1991
1995
1999
2003
2007
2011
Earthworm
Aquatic Invertebrates
Avian Reproductive
Inhalation
Small Mammal
Avian Acute
Fish Chronic
Aquatic Algae

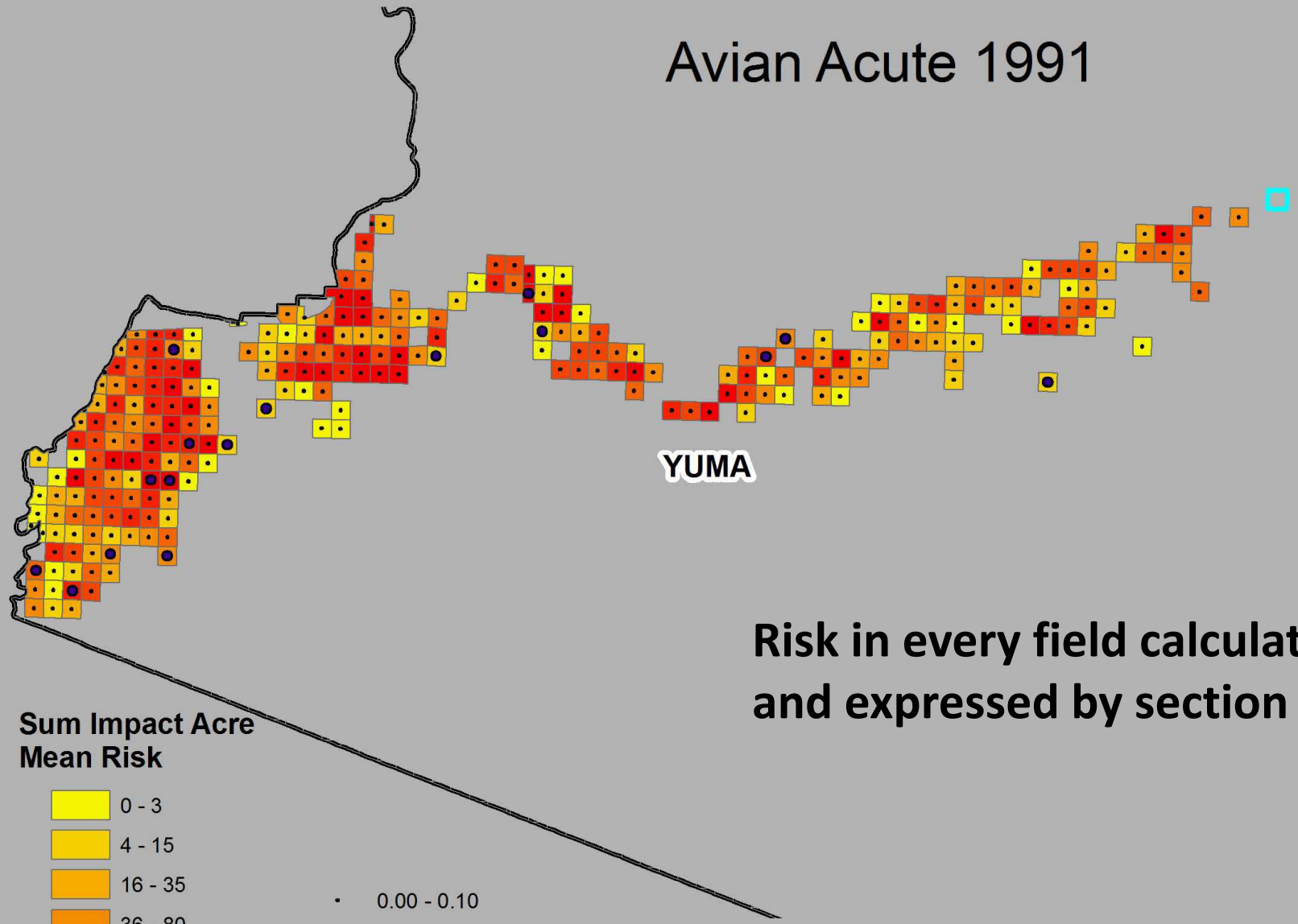

Aquatic Invertebrate
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1991
1995
1999
2003
2007
2011
1
2
Impact area calculation described in Jepson et al, 2014: *Phil. Trans R. Soc. B 369: 20130491*
The scale of remaining impacts has fallen, as well as the level of risk
High Risk
Moderate Risk
Low Risk


Aquatic Inv
0.5
0.4
0.3
0.2
1991
Whitefly Outbreak
1992
1994
Whitefly Outbreak
1996
1995
1993
Section 18 for Admire (imidacloprid)
Phosdrin lost
The mechanism for risk reduction – early detection of problems (the system breaks every 2-3 years), with rapid and concerted responses, supported by engagement of the full actor network, with an IPM focus


1996
Lannate use & thrips increase
1997
Confirm, Success, Intrepid & Applaud registered
Aphids heavy
1998
Cotton IPM stabilizes
Lettuce Aphid
1999
X-Commodity Talks
Kerb Usage improved
2000
2001
9/11 Curtails aerial apps
Imidacloprid resistance warnings
2002
2003
Neonicotinoid agreements

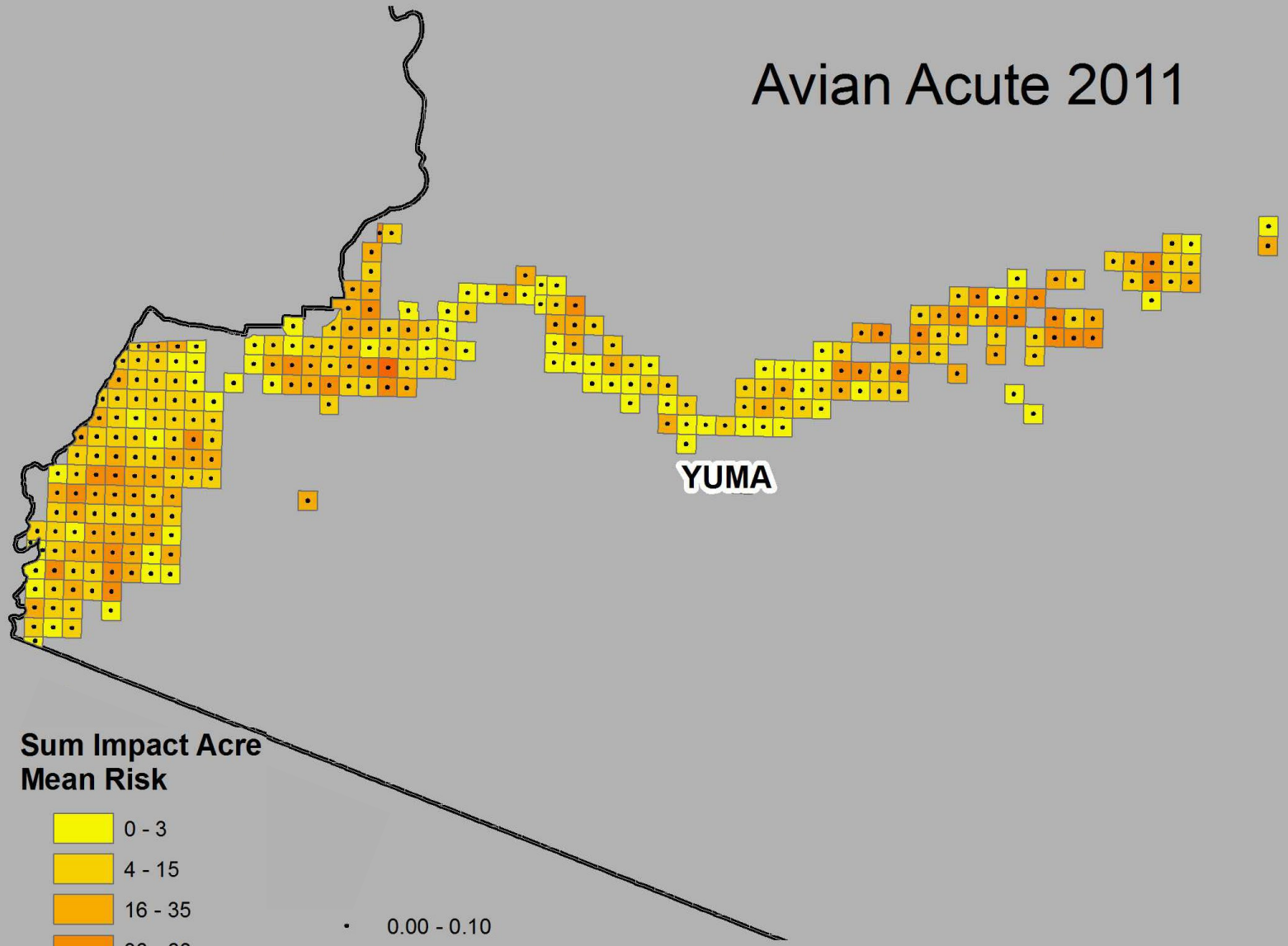

Aphids heavy
2004
Imidacloprid whitefly resistance; Whitefly & aphids heavy
2005
Oberon registered
2006
PBW eradication; Lep pressure reduced
2007
MRL issues
2008
Coragen & Movento registered
Movento removed
2009
Kerb lost
2010
2011

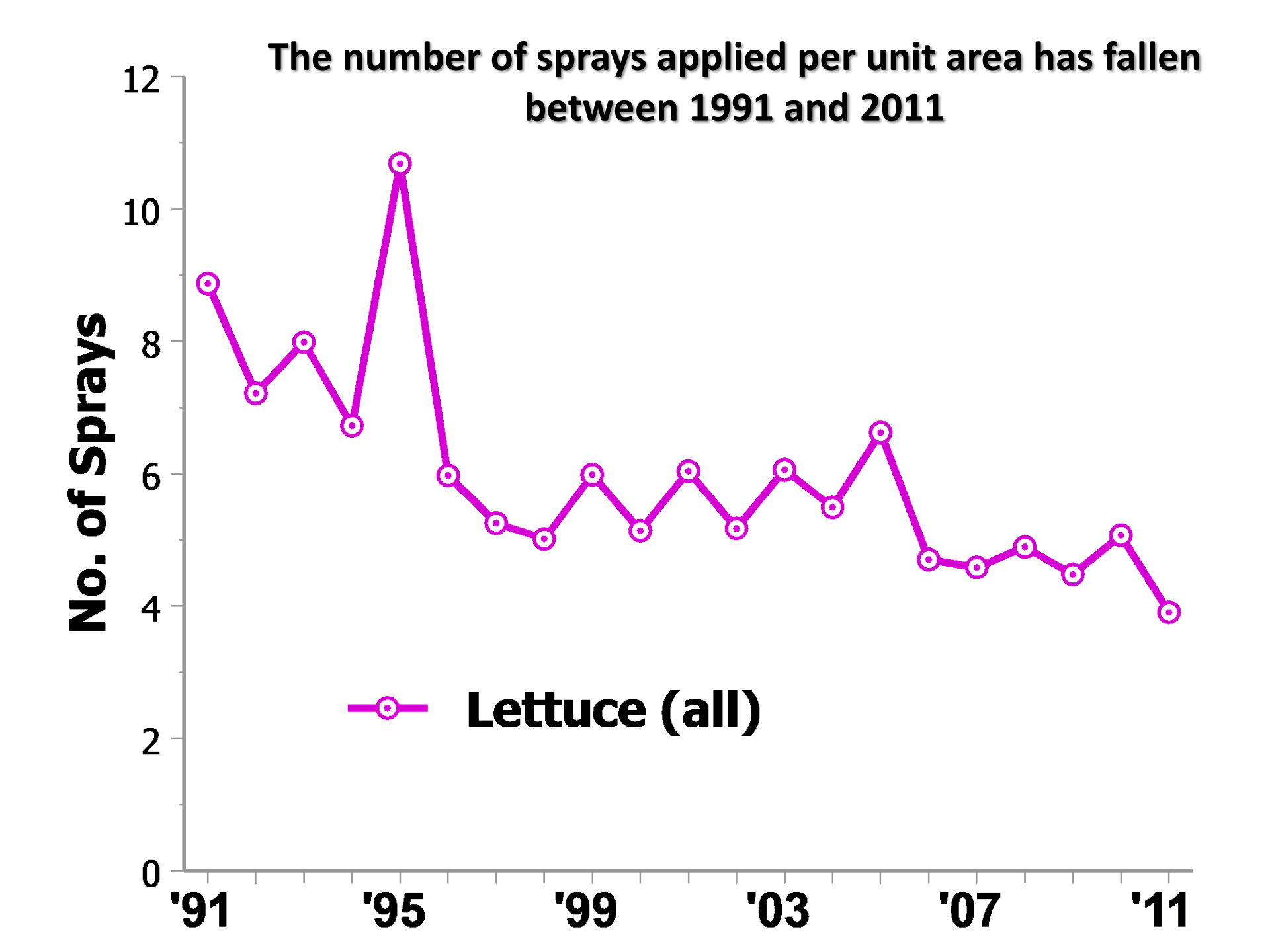
Avian Acute 1991

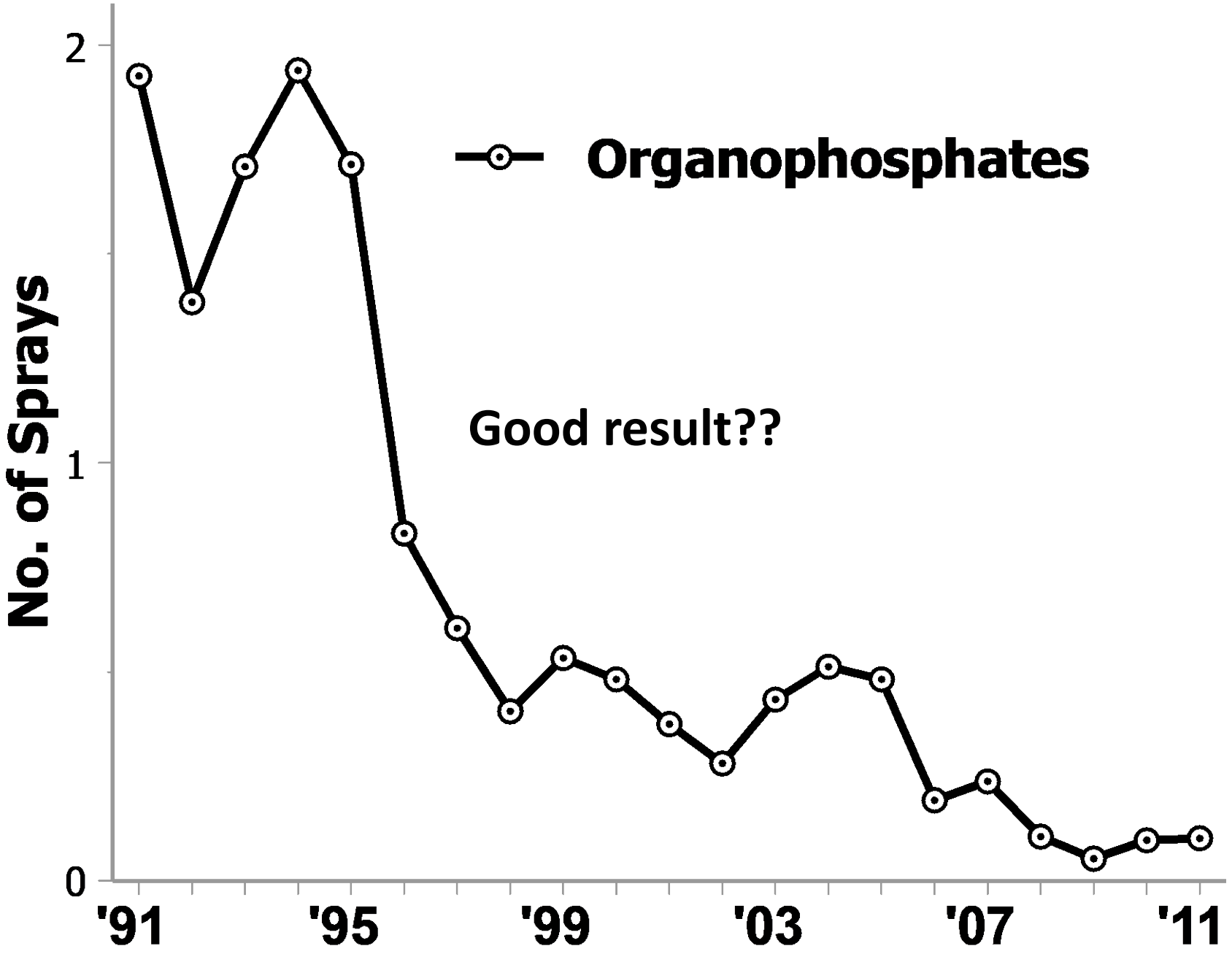


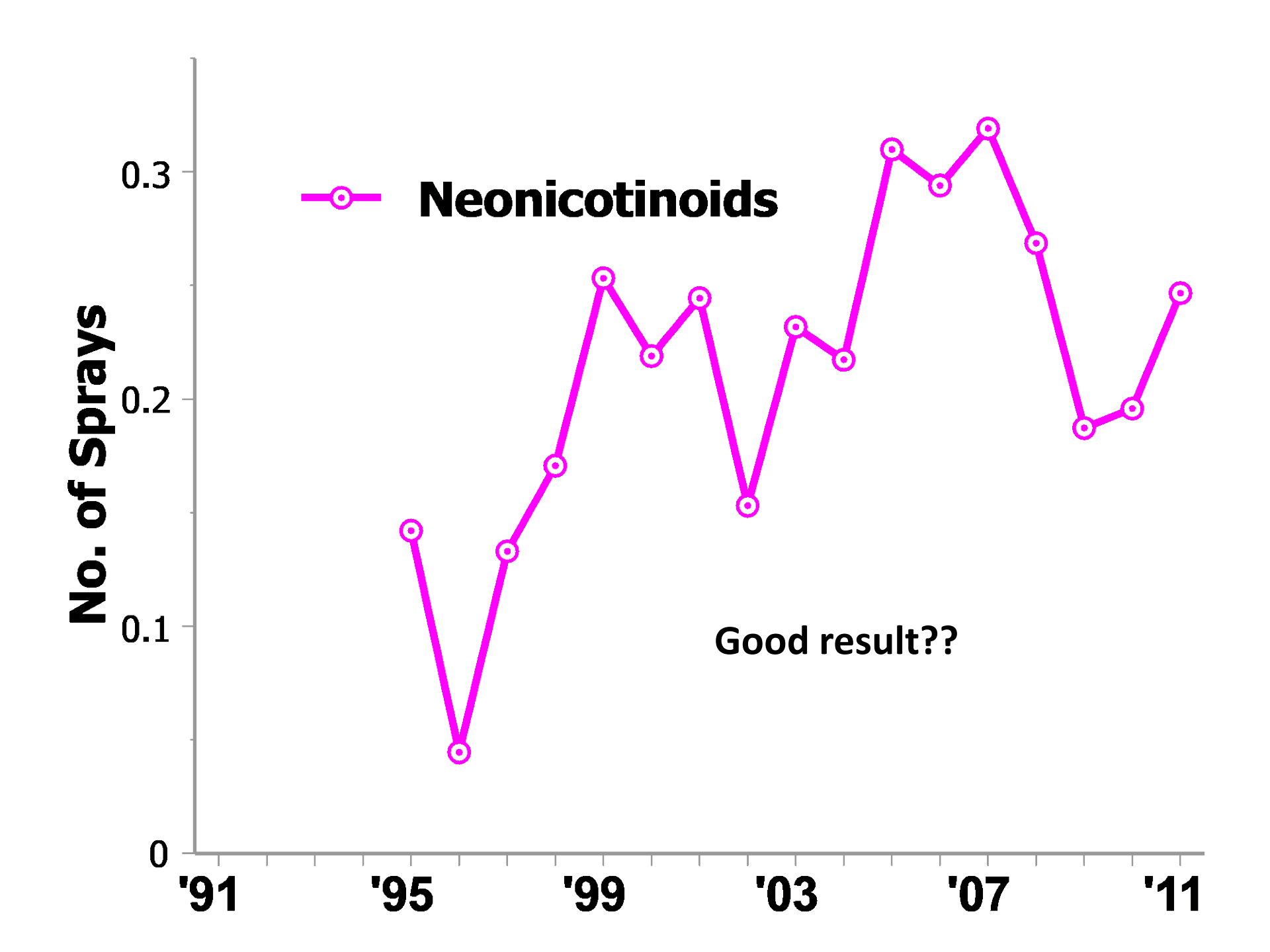
Risk in every field calculated and expressed by section

Avian Acute 2011




The number of sprays applied per unit area has fallen between 1991 and 2011
No. of Sprays
12
10
8
6
4
2
0
'91
'95
'99
'03
'07
'11
Lettuce (all)


Organophosphates
Good result??
No. of Sprays
2
1
0
'91
'95
'99
'03
'07
'11


Neonicotinoids
No. of Sprays
0.3
0.2
0.1
0
'91
'95
'99
'03
'07
'11
Good result??

IPM with reduced impacts on water quality	Impact on water quality	Impact on efficacy	x
SOURCE REDUCTION			
Substitute alternatives to pesticides (biological, cultural, physical)	Eliminates risks	Can increase pest suppression by adding or substituting alternative measures	
Minimize amounts applied (e.g. monitoring, thresholds)	Reduces risks	Maximizes efficacy by timing correctly	
RISK MITIGATION			
Use of an alternative, lower risk pesticide to aquatic life (has the potential to eliminate risks)	Reduces risks	Depends upon efficacy and good application practices	
Eliminate off-site pesticide losses (e.g. drift reduction technology, application management, buffers)	Can reduce leaching, solution and adsorbed run-off, and drift risks	Maximizes efficacy by increasing retention at target	

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