From Pesticide Addiction
To Ecological Integrated Pest Management

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Crop Protection

A Negative spiral

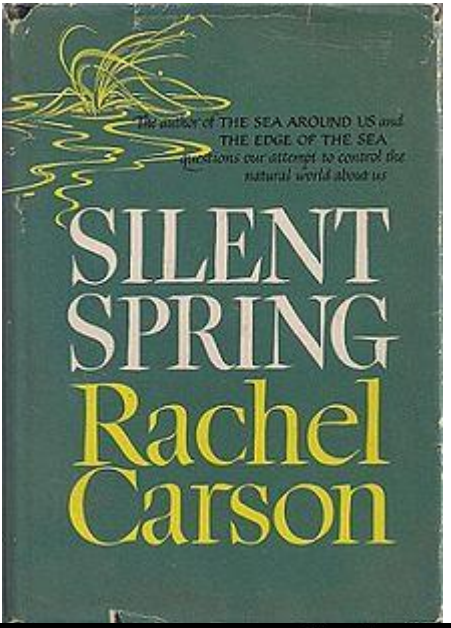
Kills pests
Kills beneficials

More pests

Even
More
Pesticides

Pest resistance

1962 55 years later 2017: Empty Spring



Germany Sees Drastic Decrease in Insects

A 27-year-long study finds insect biomass has declined by about 75 percent.

Oct 18, 2017
ANNA AZVOLINSKY

Insects within alcohol Malaise trap
ENTOMOLOGICAL SOCIETY KREFELD

Sampling from 63 protected nature areas throughout Germany, researchers have found a drop in flying insect mass by about 76 percent over 27 years. The results, published today (October 18) in *PLOS ONE*, are drastic, but are consistent with prior studies of butterflies, wild bees, and other surveys of specific insect species.

"The amount of decline, about 75 percent, is way too much to be attributed to just one or a few species such as bees or butterflies," says plant ecologist and study author Hans de Kroon of Radboud

The New York Times Magazine

FEATURE

The Insect Apocalypse Is Here

What does it mean for the rest of life on Earth?

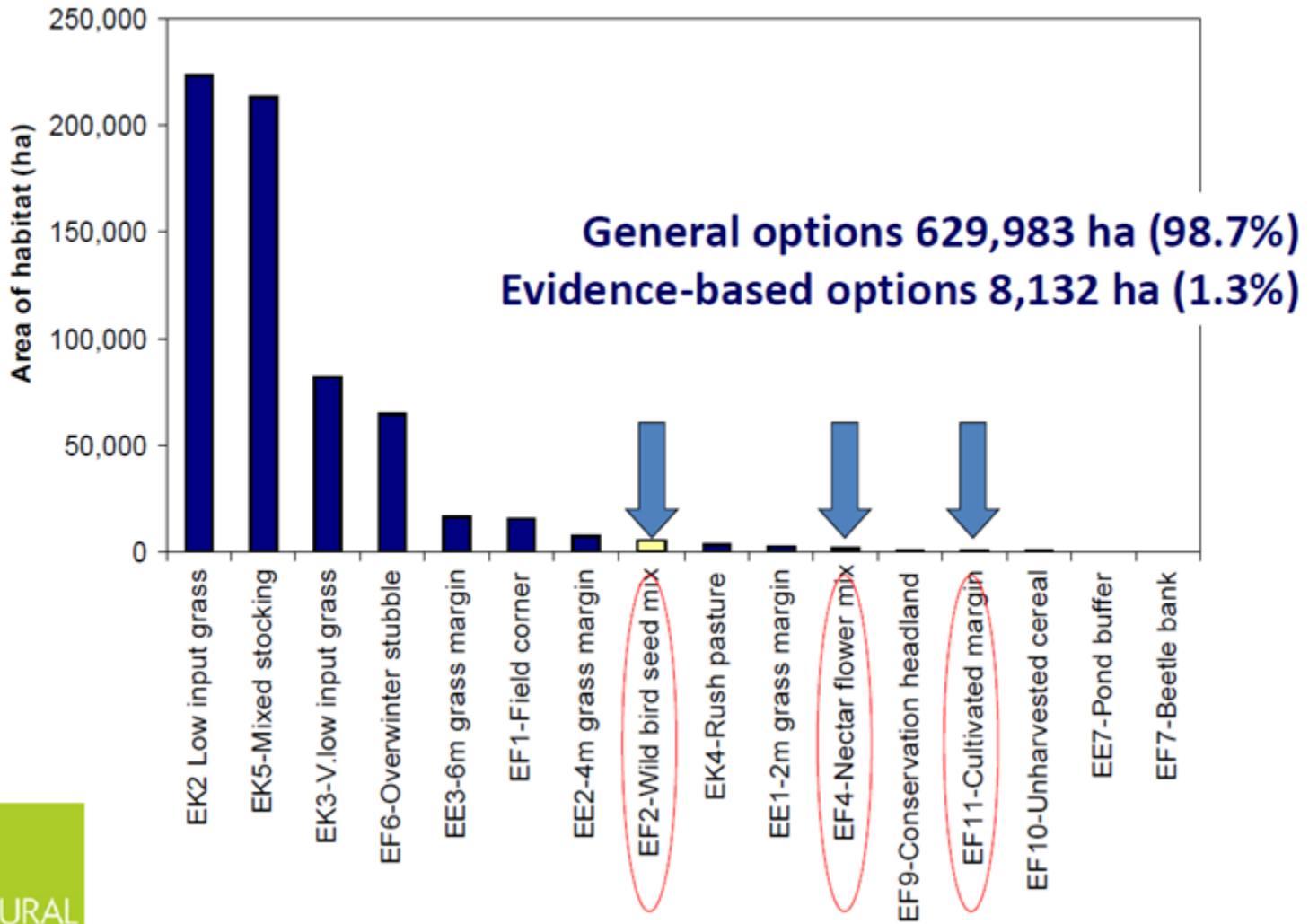
Agri Environment Schemes

Agriculture → **Environment**

Focus on conservation


Perceived Conflict
Yield or environment?

Farmers chose ecologically least valuable options



NATURAL ENGLAND

Agri Environment Schemes

Agriculture → **Environment**

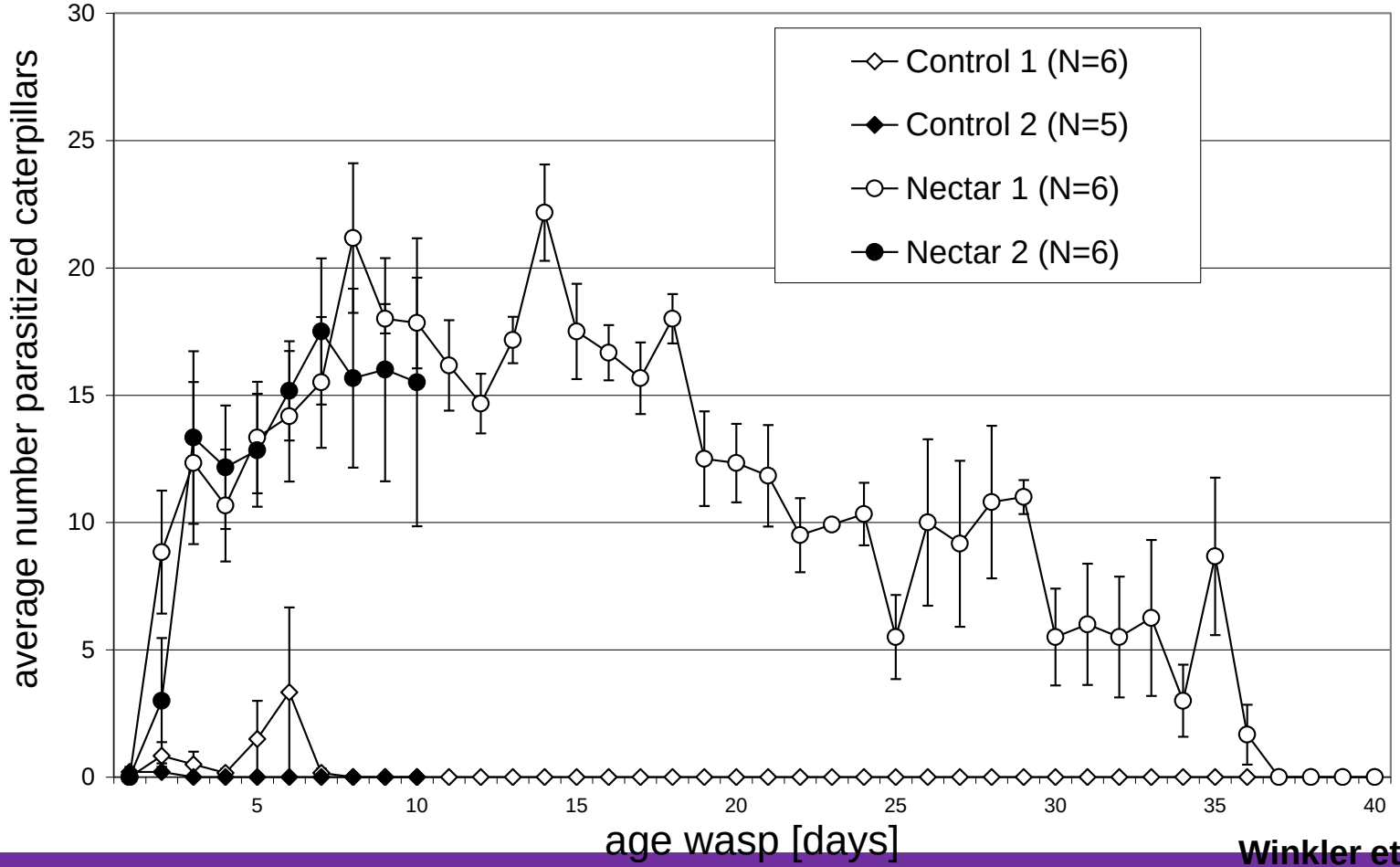
€320 billion/year

Focus on ecosystem services

€90 billion/year
(*Constanza 1997*)

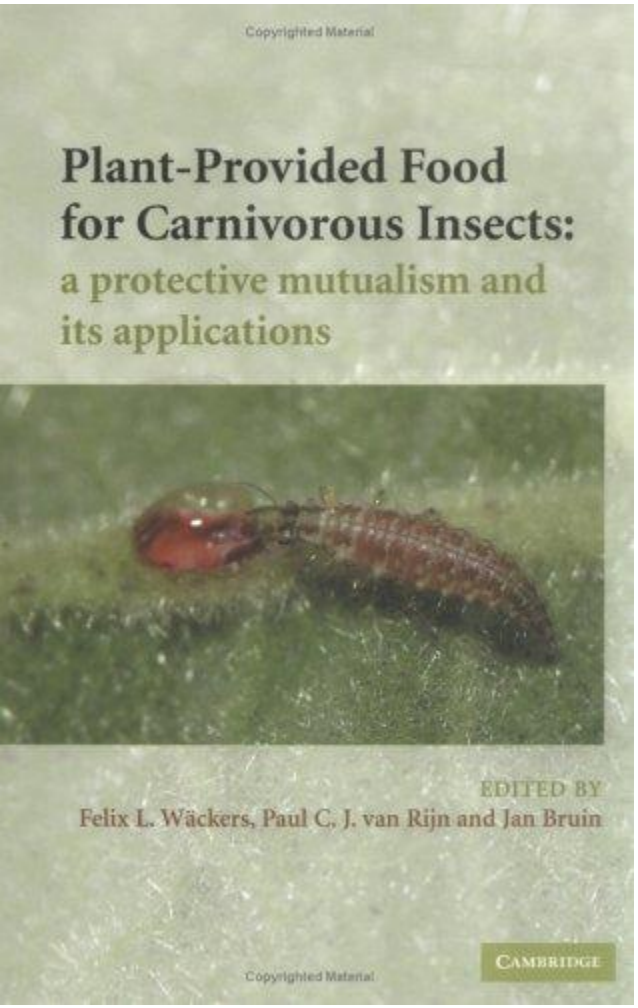
“Clean Fields”

The impact of flowers on biocontrol efficacy



Winkler et al., (2006)

Flower feeding by biocontrol organisms

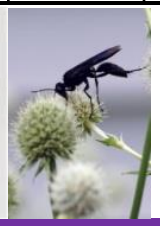


Type	Plant-feeding stage	Arthropod examples can be found within:		Type of plant food utilised
Life-history omnivory	adult	Neuroptera:	Chrysopidae (green lacewings)	nectar, pollen
		Diptera:	Syrphidae (hoverflies)	nectar, pollen
			Cecidomyiidae (gall midges)	nectar
			Tachinidea (parasitoid flies)	nectar
		Hymenoptera:	Ichneumonidae, Braconidae, a.o. (parasitoid wasps)	nectar
			Vespidae (social wasps)	nectar, fruit
			Formicidae (ants)	nectar
		Coleoptera:	Meloidae (blister beetles)	nectar, pollen
	juvenile	Heteroptera:	Pentatomidae (stink bugs)	plant-juice
Temporal omnivory	adult	Hymenoptera:	Ichneumonidae, Braconidae, a.o. (host feeding parasitoids)	nectar
		Coleoptera:	Cicindelidae (tiger beetles)	seeds
	juvenile	Araneae:	Araneidae (orb web spiders)	pollen
Permanent omnivory	adult & juvenile	Acari:Mesostigmat	Phytoseiidae (predatory mites)	nectar, pollen
		Heteroptera:	Pentatomidae (stink bugs)	plant juice
			Miridae (mirid bugs)	plant juice
			Geocorinae (big-eyed bugs)	plant juice
			Anthocoridae (flower bugs)	pollen
		Neuroptera:	*Chrysopa*, Hemerobiidae (brown lacewings)	nectar, pollen
		Thysanoptera:	Aeolothripidae, Phlaeothripidae	leaves, pollen
			Coccinellidae (ladybirds)	nectar
		Coleoptera:	Carabidae (ground beetles)	pollen, seeds

Targeted Flower Margins (Wäckers and van Rijn, 2012)

Select plants that optimize biological pest control

family	species	Floral Nectar depth	Longevity (AFLI) Hoverfly *E. balteatus*	Longevity (AFLI) Lacewing *C. carnea*	Longevity (AFLI) Parasitoids	References parasitoids (species)
Apiaceae	*Ammi majus*	0	+	+	-	Geneau et al., unpubl. (*Microplitis mediator*)
Apiaceae	*Coriandrum sativum*	0	+		+/-	Vattala et al., 2006 (*Microtonus hyperodae*)
Apiaceae	*Daucus carota*	0	+	++	+	Winkler et al., 2009 (*Cotesia glomerata*)
Apiaceae	*Foeniculum vulgare*	0	+		+	Winkler et al., 2009 (*Cotesia glomerata*)
Apiaceae	*Heracleum spondylium*	0	+		+/-	Winkler et al., 2009 (*Cotesia glomerata*)
Apiaceae	*Pastinaca sativa*	0	+	++	+/-	Foster & Ruessink, 1984 (*Meteorus rubens*)
Polygonaceae	*Fagopyrum esculentum*	0	+	+	+	Winkler et al., 2009 (*Cotesia glomerata*)
Boraginaceae	*Borago officinalis*	0	+	++	-	Nilsson et al., unpubl. (*Trybliographa rapae*)
Ranunculaceae	*Ranunculus acris*	0	+		-	Kehrli & Bacher, 2008 (*Minotetrastichus frontalis*)
Caryophyllaceae	*Gypsophila elegans*	1	+	++		
Asteraceae	*Matricaria chamomilla*	1	+	+	-	Nilsson et al., unpubl. (*Trybliographa rapae*)
Asteraceae	*Achillea millefolium*	1	+	+/-	-	Wäckers 2004 (*Cotesia glomerata*)
Asteraceae L	*Cichorium intybus*	1	-	+		
Asteraceae	*Chrysanthemum segetum*	2	+	+		
Asteraceae	*Anthemis tinctoria*	2	+/-	+/-		
Asteraceae	*Leucanthemum vulgare*	2	+/-	+	-	Wäckers 2004 (*Cotesia glomerata*)
Asteraceae	*Tanacetum vulgare*	2	-	+/-		
Asteraceae	*Calendula officinalis*	3	-		-	Rahat et al., 2005 (*Trissolcus basalis*)
Asteraceae	*Centaurea cyanus* (+EFN)	3	+	++	+/-	Winkler et al., 2009 (*Cotesia glomerata*)
Asteraceae	*Helianthus annuus* (+EFN)	3	+	+		
Asteraceae	*Cosmos bipinnatus*	4	-	+/-	+	Rahat et al., 2005 (*Trissolcus basalis*)
Malvaceae	*Malva sylvestris*	4	-		-	
Boraginaceae	*Phacelia tanacetifolia*	4	+/-	+/-	-	Irvin et al., 2007 (*Gonatocerus* spp.)
Fabaceae	*Medicago sativa*	4	-		-	Kehrli & Bacher, 2008 (*Minotetrastichus frontalis*)
Fabaceae	*Vicia sativa* (+EFN)	4	+		++	Geneau et al., unpubl. (*Microplitis mediator*)
Fabaceae	*Lotus corniculatus*	4	-	-		

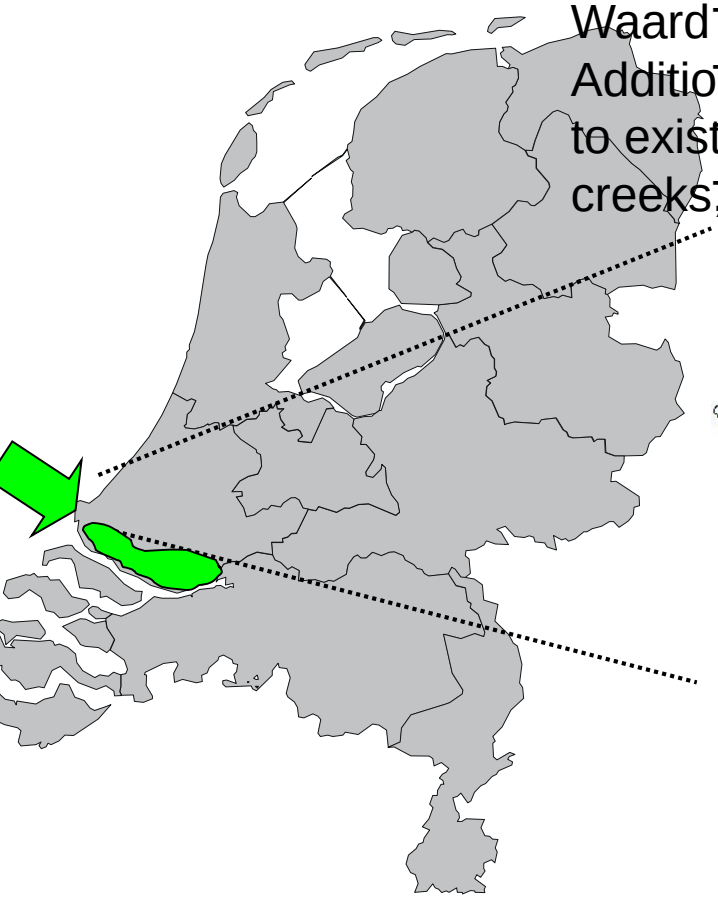


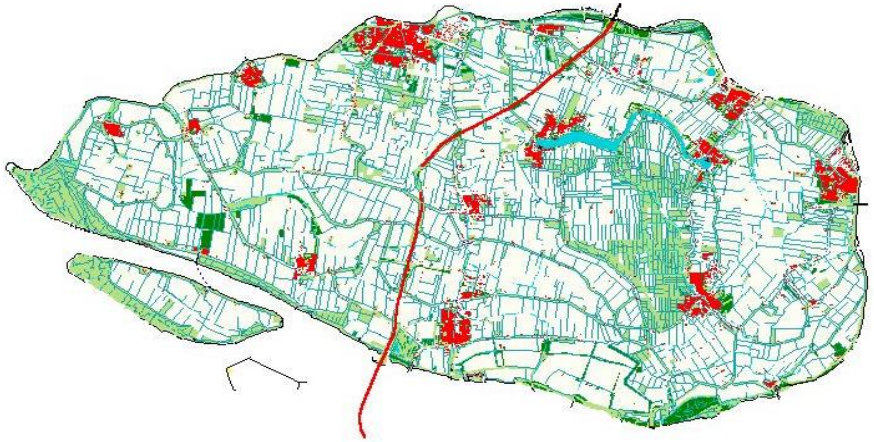
Taking it to the Farmer

FAB (Functional Agrobiodiversity)

Large scale biodiversity project in the Hoekse Waard working with conventional growers.
Addition of annual and perennial field margins to existing landscape features (polders, dikes, creeks, canal borders).

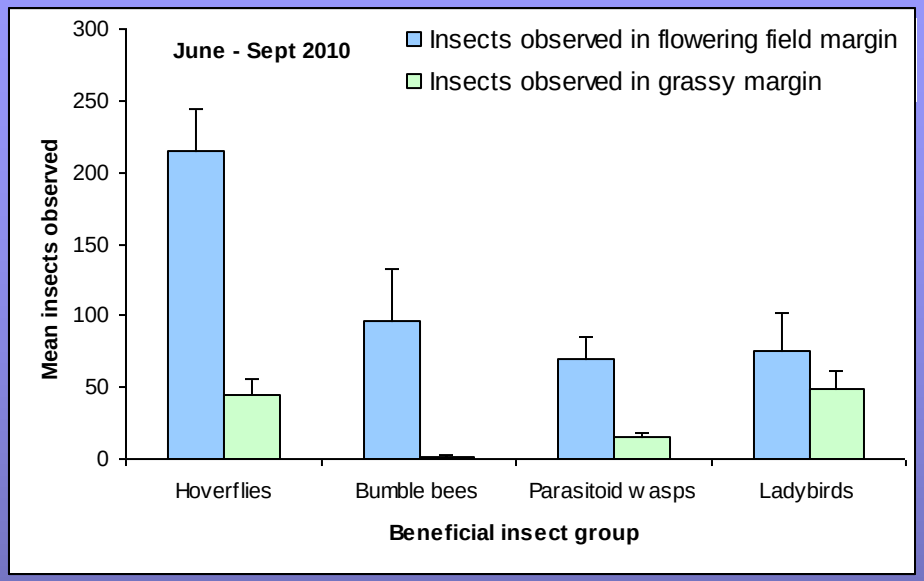
- 15 years running
- Organized by Farmers
- 500 km of targeted flower margins
- 90% reduction in insecticides used

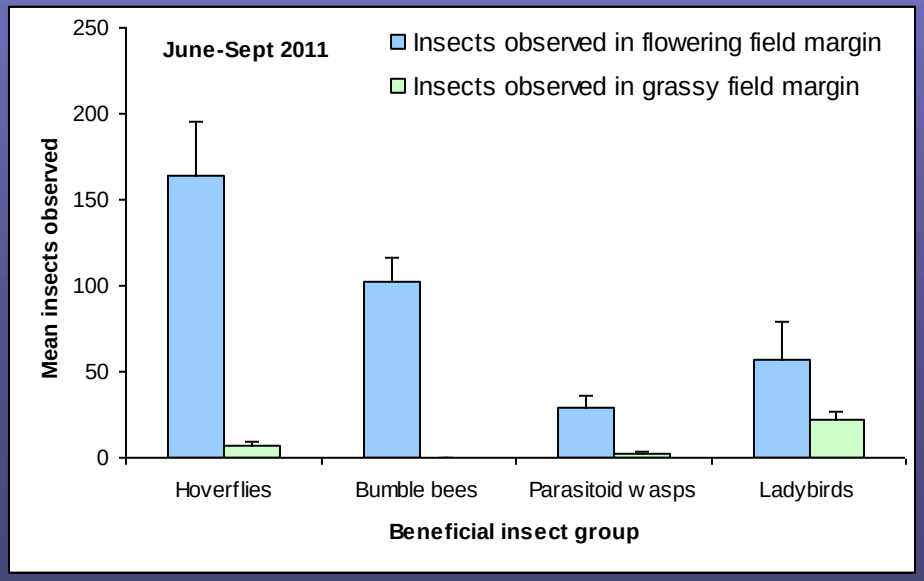




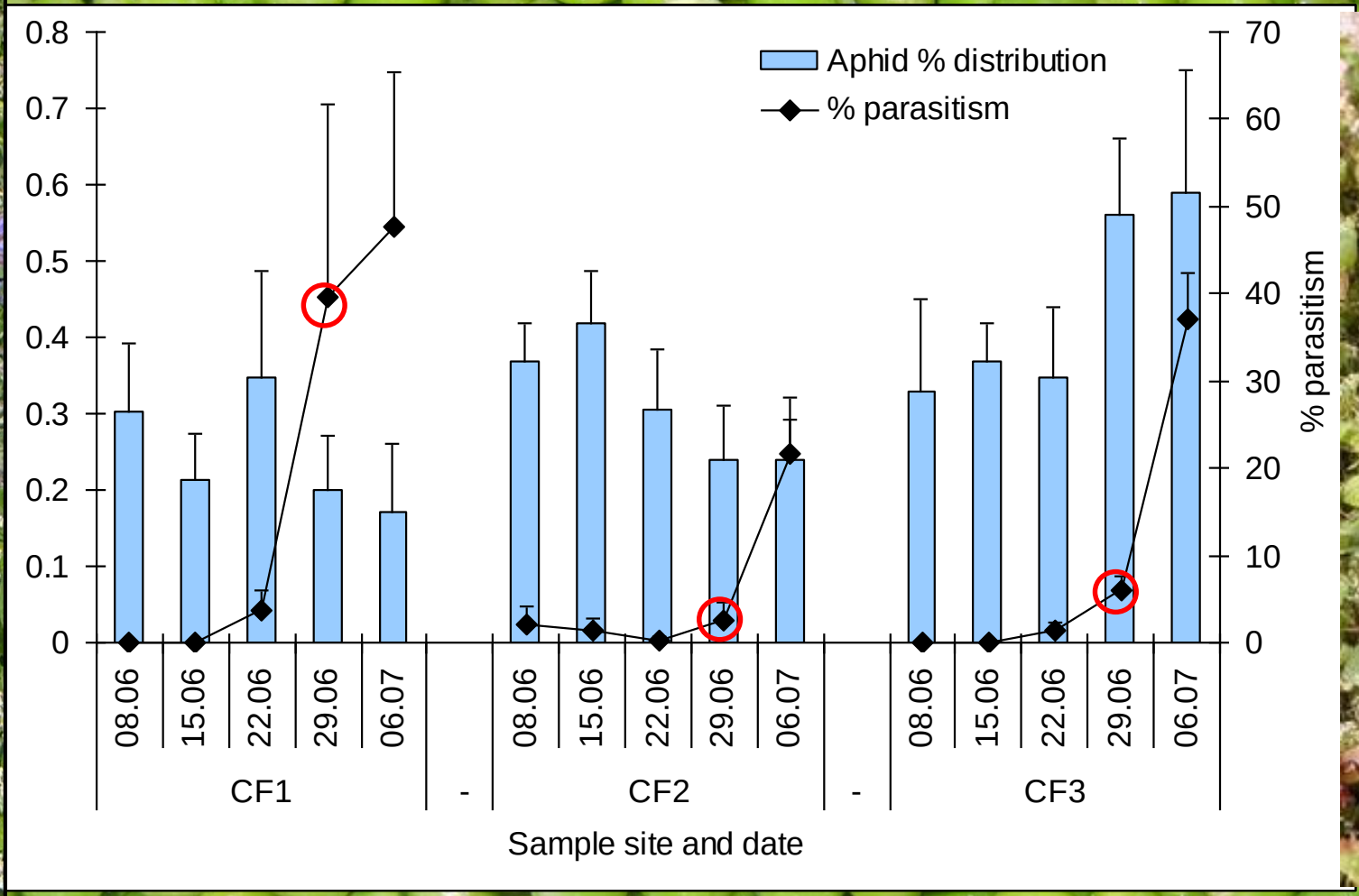
Optimizing Ecosystem Services in Terms of Agronomy and Conservation (ECOSTAC.CO.UK)

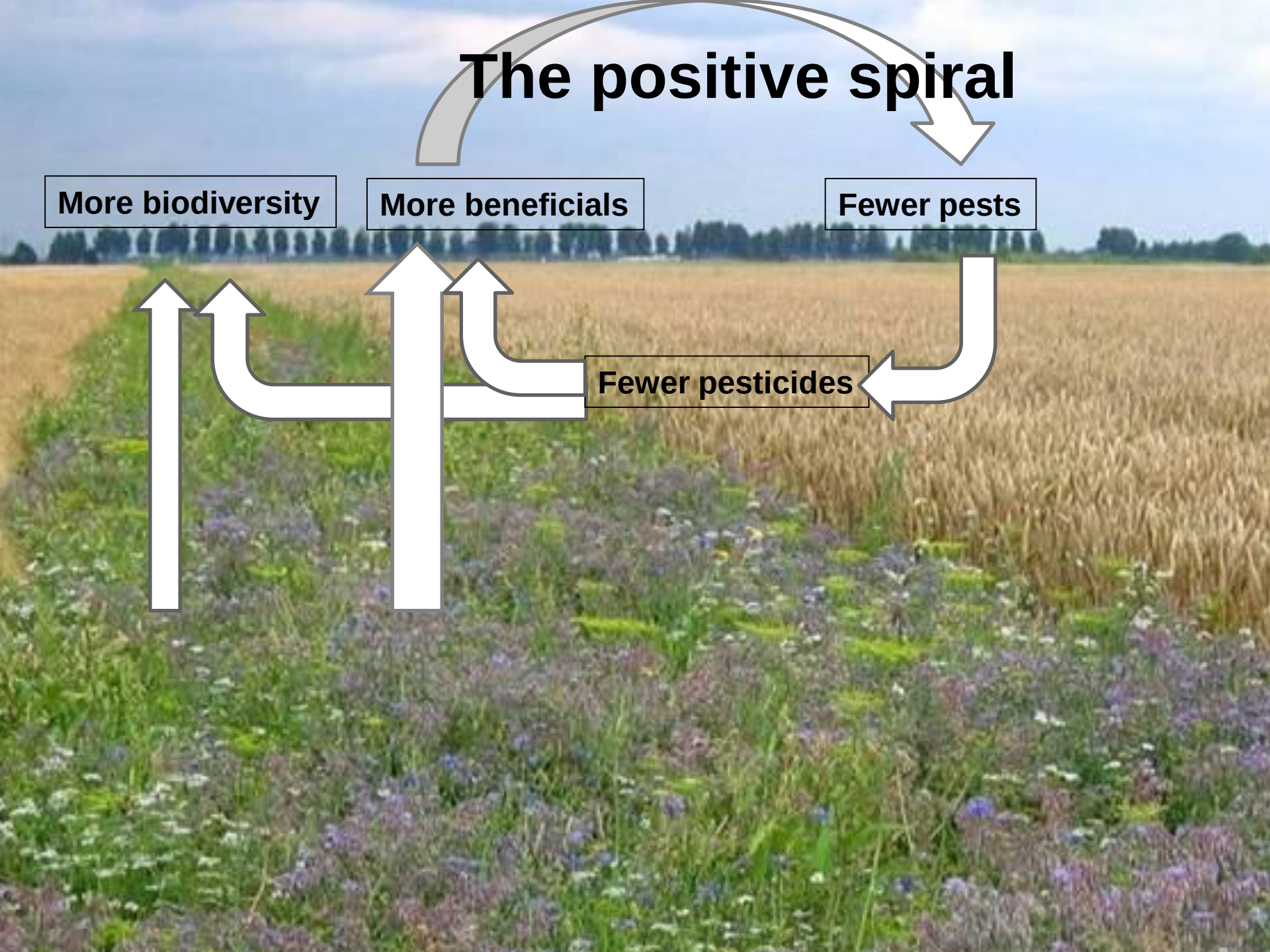
Beneficial insects in field margins





Aphids in peas




The positive spiral
More biodiversity
More beneficials
Fewer pests
Fewer pesticides


Yield impact?

wheat (yield in tonnes/ha)

peas (yield in tonnes/ha)

Biocontrol in Greenhouses: a success story

Biodiversity and Profitability

There is no conflict between
- Biodiversity and Food Production;
- Yield and Environment;
- Yield and Consumer Health

They can go Hand in Hand

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Thanks