Helicoverpa armigera invading the Americas:

It was just a matter of time

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One if by land, two if by sea…

OVERVIEW

- History of Interceptions and Risk Assessment in the USA
- Potential Geographical Range in North America
- Potential economic impact in the US
- Invasion pathways in North America

(Embrapa)

History of Interceptions and Pest Risk Assessment in North America

Pest Risk Assessment

In 2003, “Mini” PRA

Perception of invasion pathway focused on interception data

4,431 intercepts of **Heliothines** at airports between 1985 and 2003 (about 280 p.a.)

No known field establishments

Establishment potential rated as **High**

Large number of high value crop hosts – economic threat rating **High**

Mini Risk Assessment
Old World bollworm, *Helicoverpa armigera* Hübner
[Lepidoptera: Noctuidae]

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Introduction

Helicoverpa armigera is a highly polyphagous pest of many economically significant crops in portions of Africa, Asia, Australia (including Oceania), and Europe (King 1994). The likelihood and consequences of establishment by *H. armigera* have been evaluated in pathway-initiated risk assessments and pest risk assessments. *Helicoverpa armigera* is considered highly likely of becoming established in the US if introduced; the consequences of its establishment for US agricultural and natural ecosystems are consistently rated high (i.e., severe) (Cave and Redlin 1996a, b, c, Lightfield 1997a, b, Ogden and Podleckis 2000, Fowler and Lakin 2001). Because of the number of crops that this pest affects, it has many common names: scarce bordered straw worm, corn earworm, African cotton bollworm, American bollworm, and tomato worm (Zhang 1994, Begemann and Schoeman 1999).

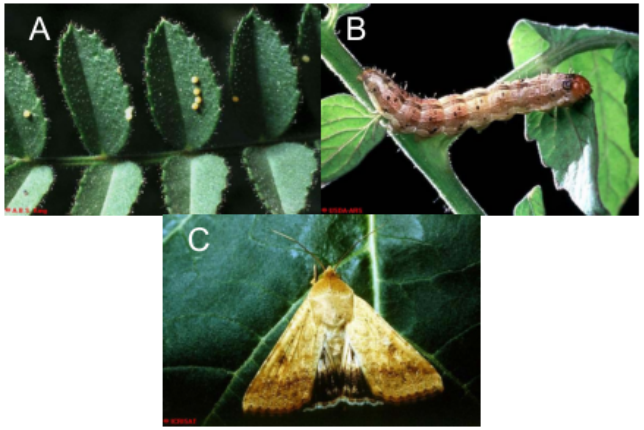
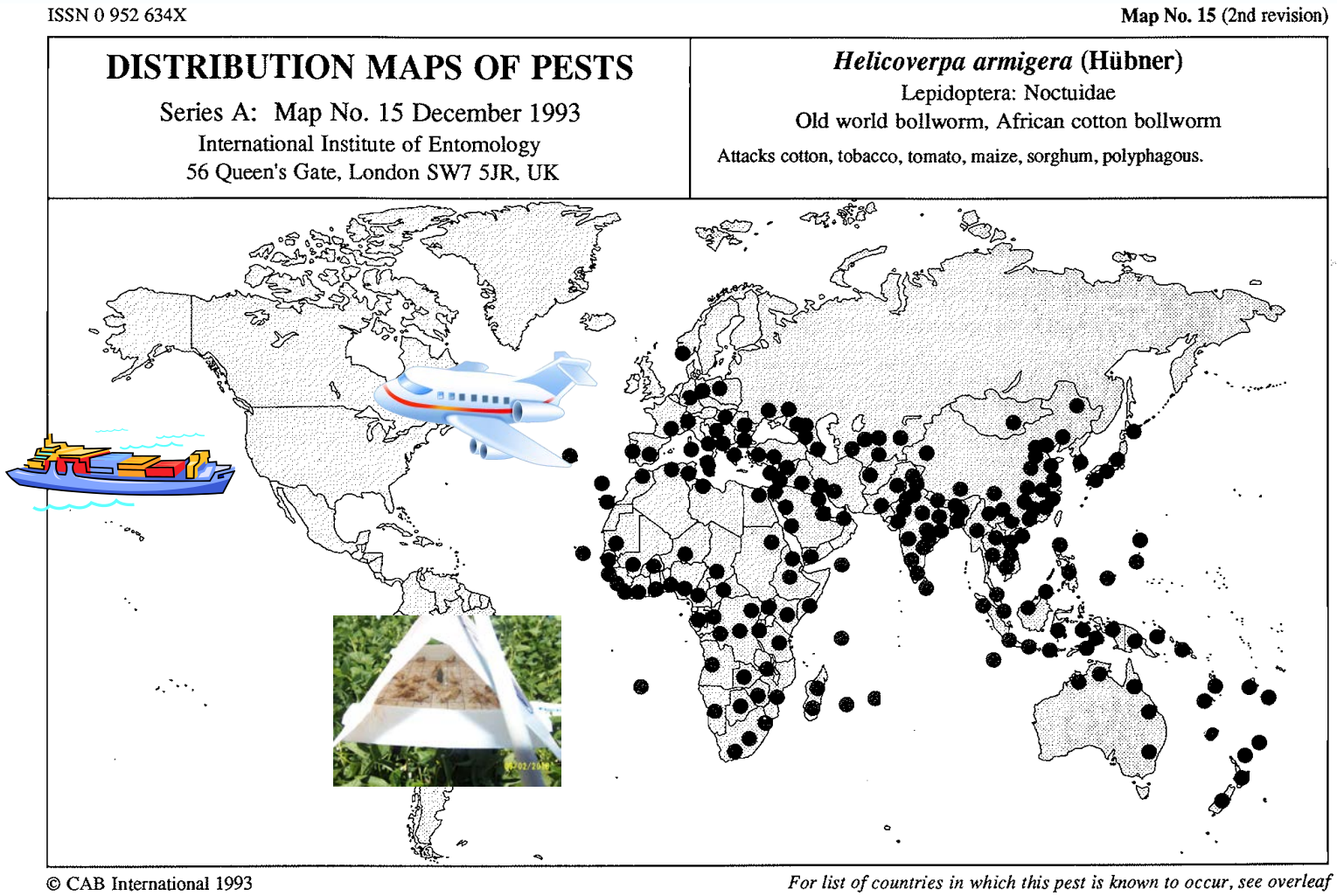


Figure 1. Life stages of *Helicoverpa armigera*, images not to scale: (A) eggs; (B) larva; and (C) adult. [Photos from (CAB 2003)].

2003 view of the invasion threat



Potential Distribution

Climate Suitability

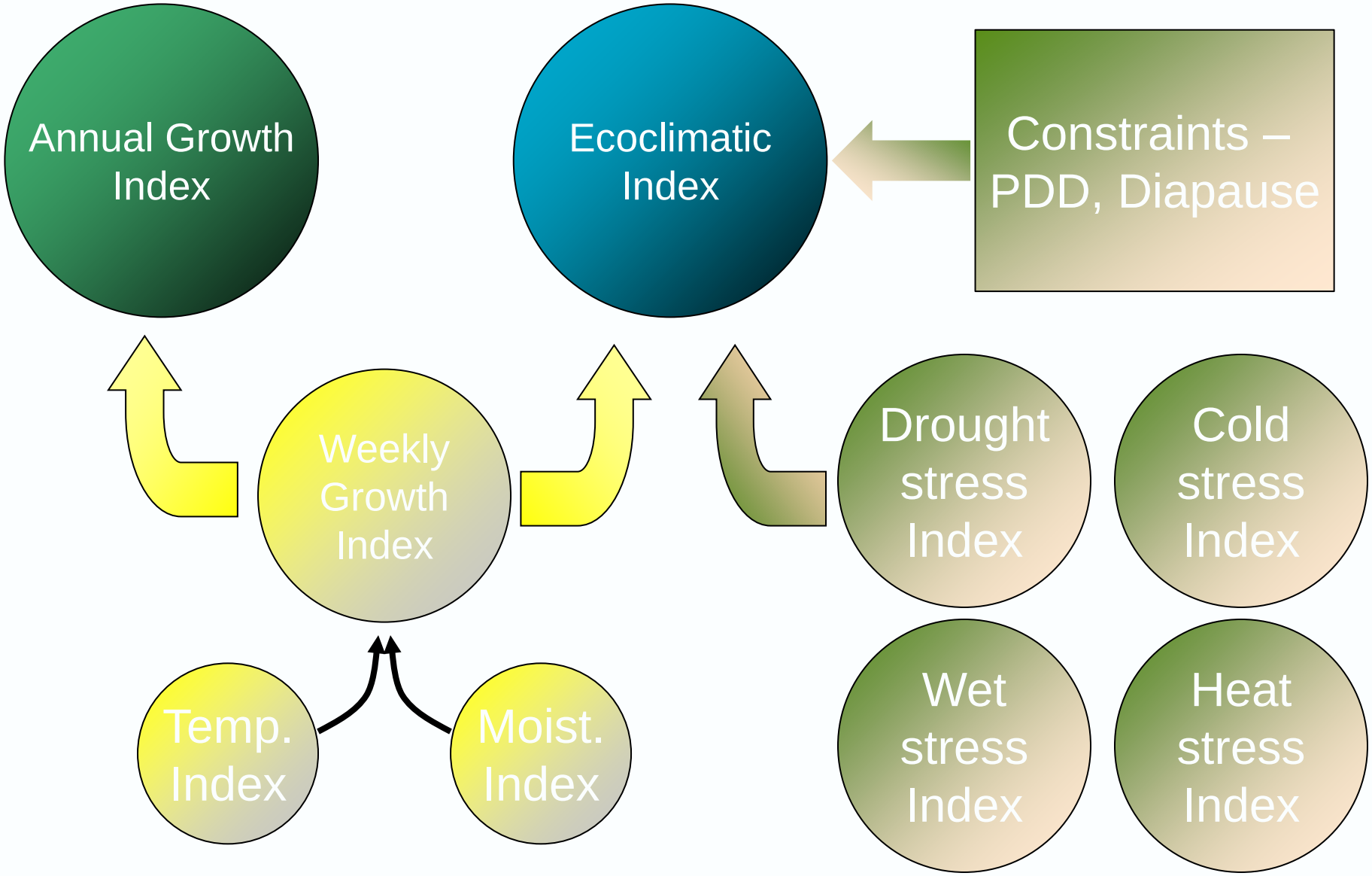
Process-based bioclimatic niche modelling package

Well-suited to biosecurity applications extrapolating from present distribution to potential distributions in novel climate conditions

Can use geographical, phenological and experimental data

Climatic database and modelling framework to estimate seasonal and geographical climate suitability patterns

CLIMEX indices

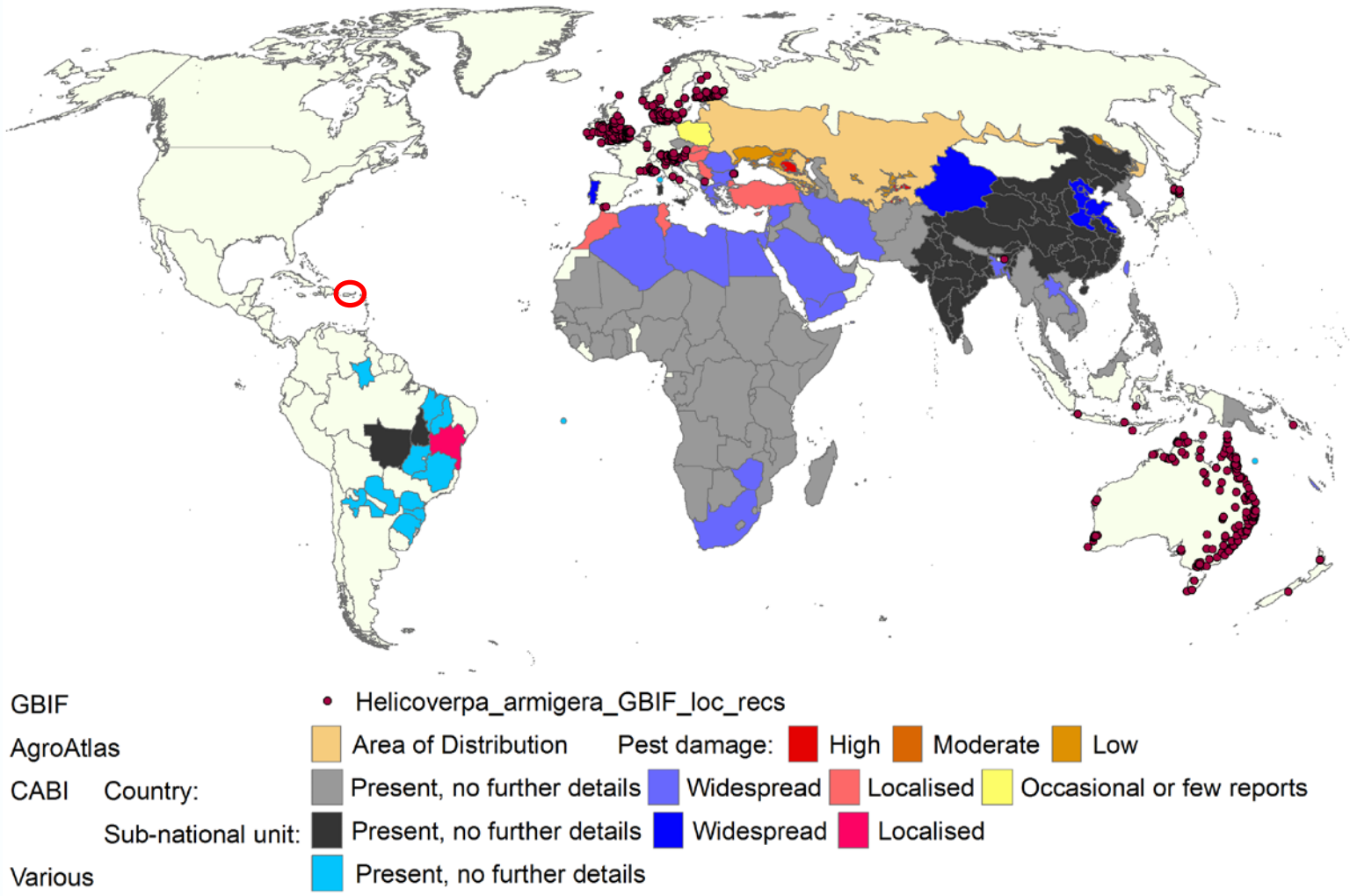


CLIMEX modelling

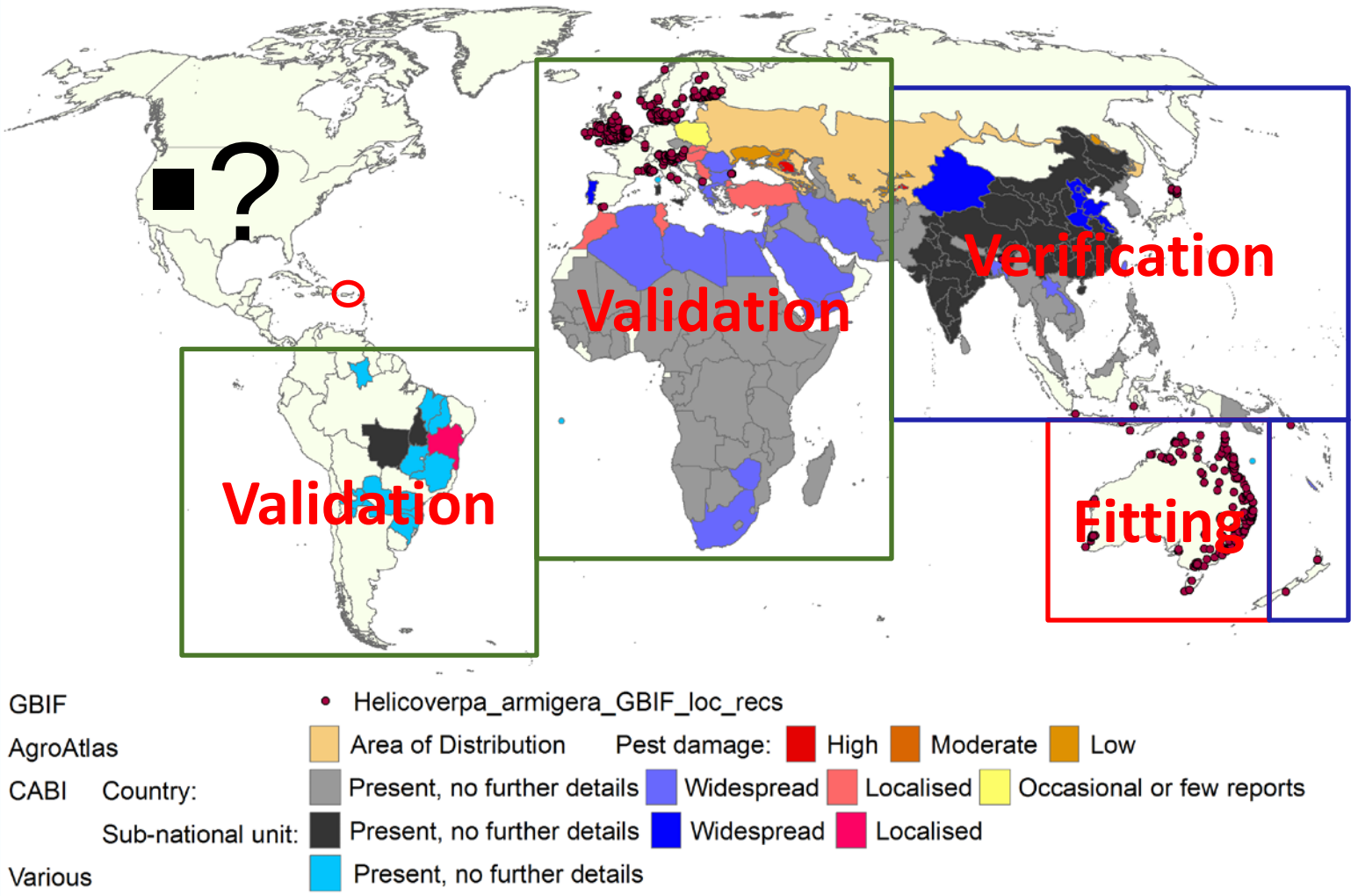
- Adapted model from Zalucki & Furlong (2005) *Insect Science*. **12**: 45-56
- Included effects of irrigation, applying irrigation scenario at locations where irrigation practiced

  Portmann *et al.* (2010)
- Growth functions fitted to experimental and theoretical data
- Stresses and diapause ***fitted*** to Australian distribution data
- ***Verified*** with Australian phenological data and Asian distribution data
- ***Validated*** with data elsewhere

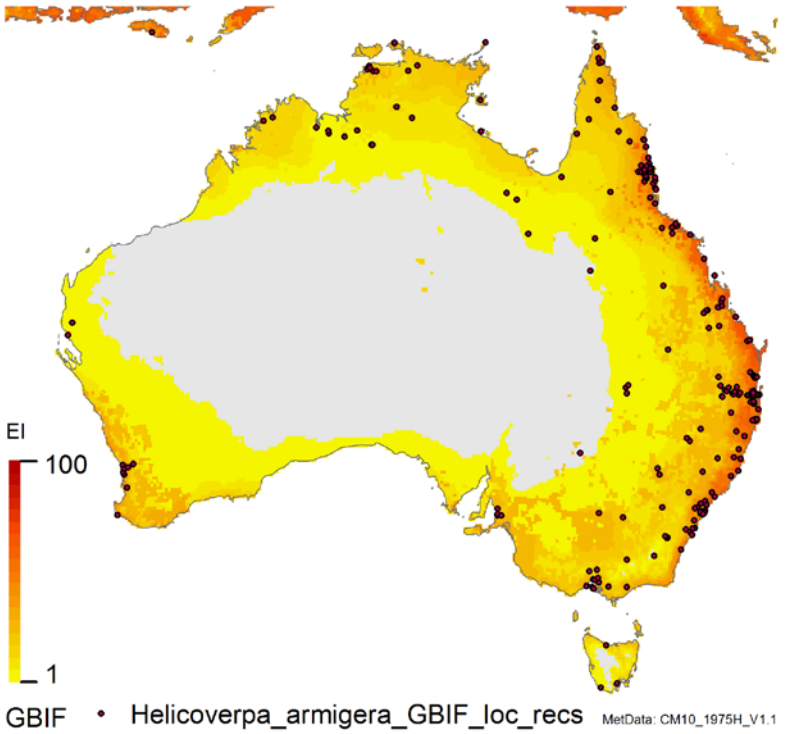
Current distribution 2014



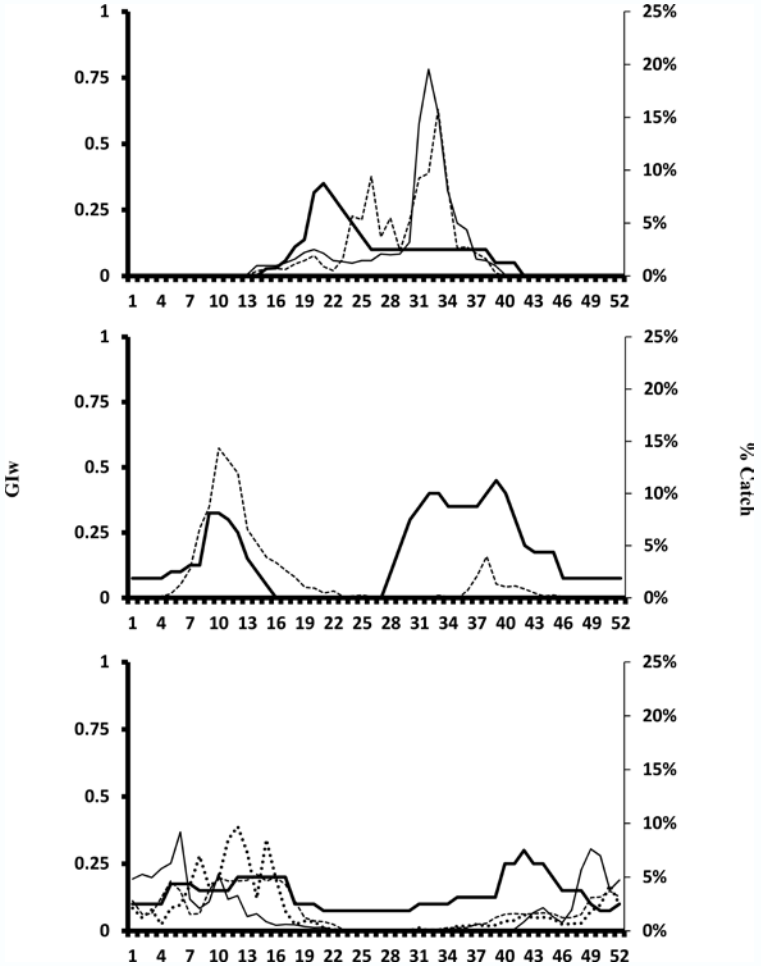
Model-fitting procedure - Stresses



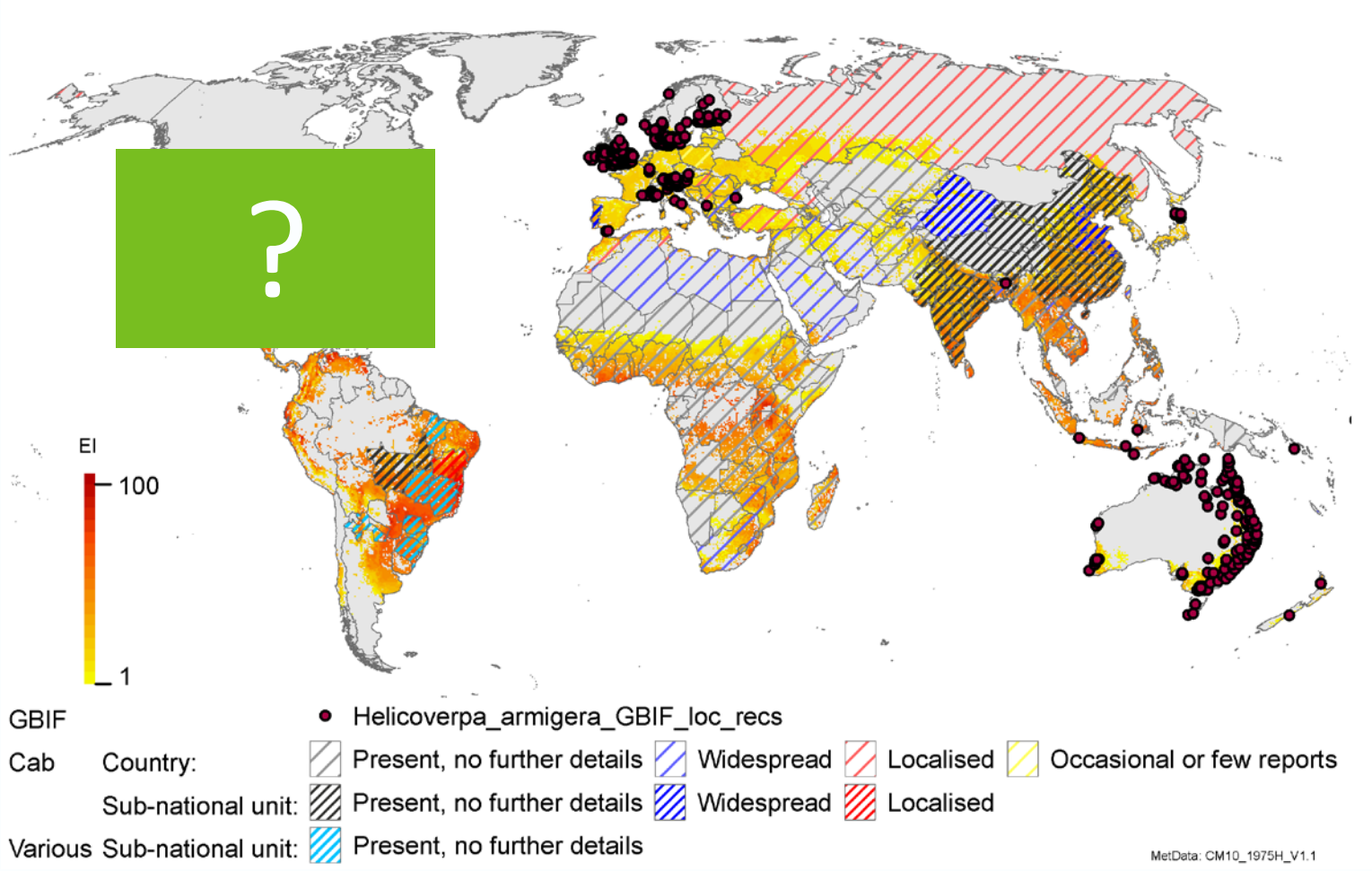
Model fit in Australia



Model-fitting – Verifying phenology



Goodness of fit – Ecoclimatic Index



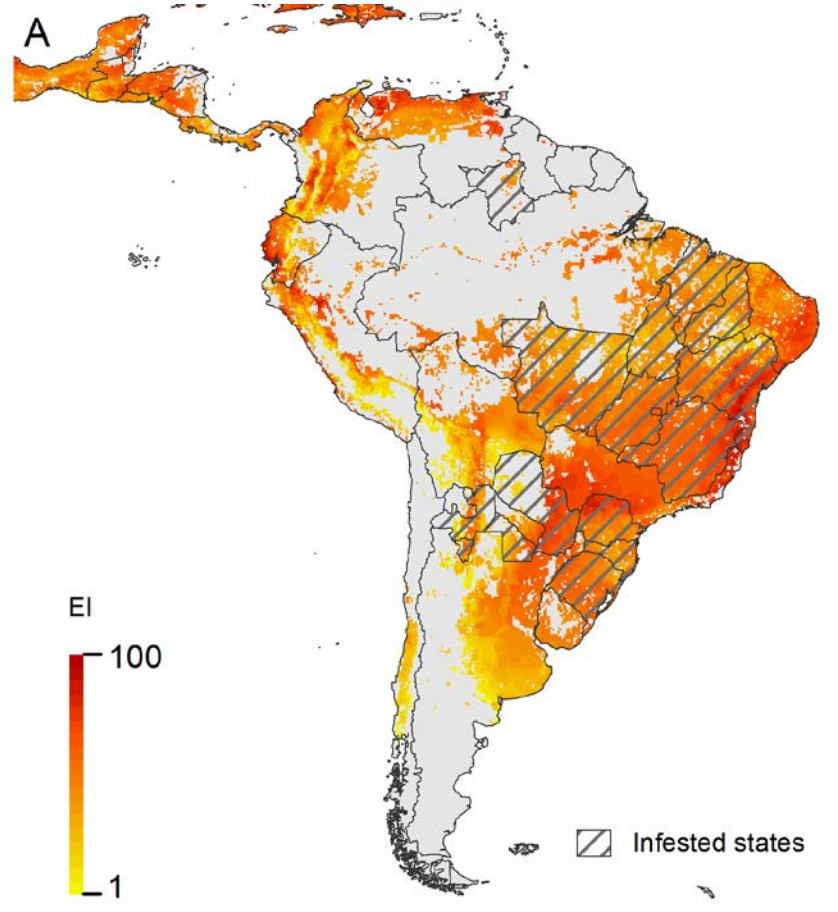
Climate Suitability for South America

Ecoclimatic Index (EI)

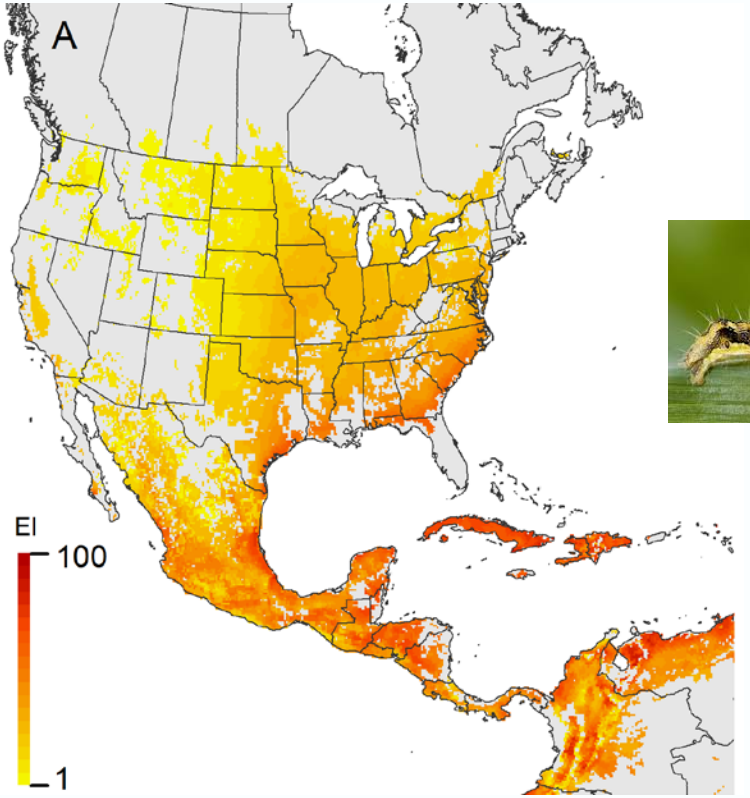
EI >1, climate allows for population establishment & persistence

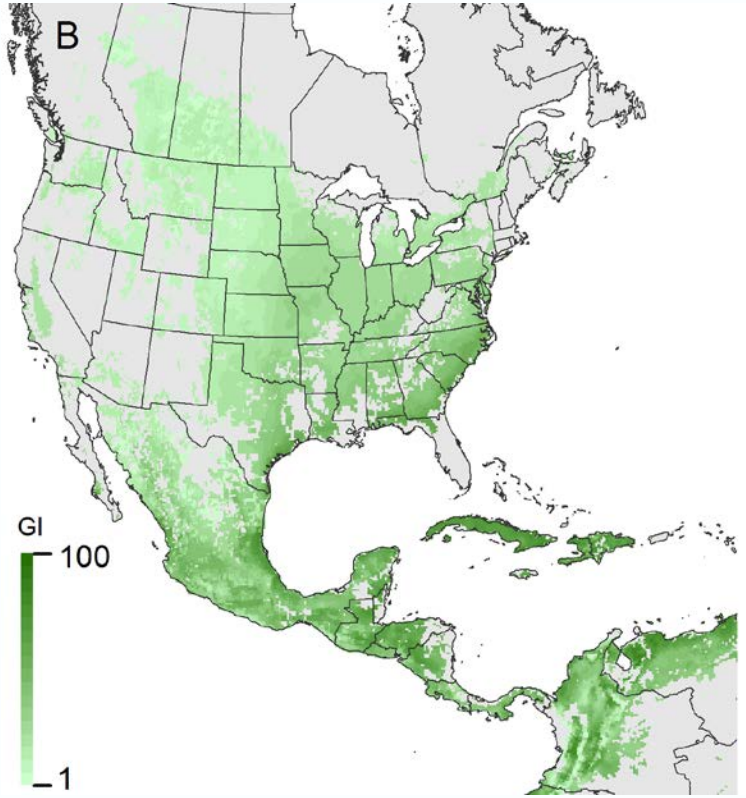
EI suggests High potential for establishment of *H. armigera* in most of S. Am. growing regions

Brazil suitability modelled in 2005



Climate Suitability in North America





- EI (with diapause)

- GI_A Positive

Value of Production at Risk

Host range

Extremely wide!

HarvestChoice have produced maps representing crop and pest geographies (www.mapspam.org)

Major host crops into one map (corn, cotton, soybean, sorghum…)

Spatially intersect crop value of production with the area climatically suited for:

1. Establishment
2. Growth (seasonal invasion)

Value of Agricultural production in the USA

Value of Production (Million US$, 2005)							
Crop	Total U.S. Value of Crop	A Establishment + seasonal presence EI > 0 and GI_A > 0	B Establishment EI > 0	C Establishment and pest impacts EI > 10	D Optimal climate EI > 50	E Seasonal presence EI = 0 AND GI_A > 0	F Seasonal population growth EI = 0 AND GI_A > 10
Cotton	4,078	4,078	4,078	3,968	292	-	-
Maize	40,121	40,121	40,105	38,208	207	16	14
Sorghum	1,463	1,463	1,463	1,305	115	8	-
Soybeans	23,362	23,362	23,356	22,922	131	7	5
Tobacco	543	543	543	543	66	-	-
Wheat	8,686	8,686	8,477	4,808	31	205	93
Total	78,254	78,254	78,022	71,755	843	228	112

Interpreting the VOP at Risk

No cohesive pest impact function relating climate suitability to production losses and reduced profitability

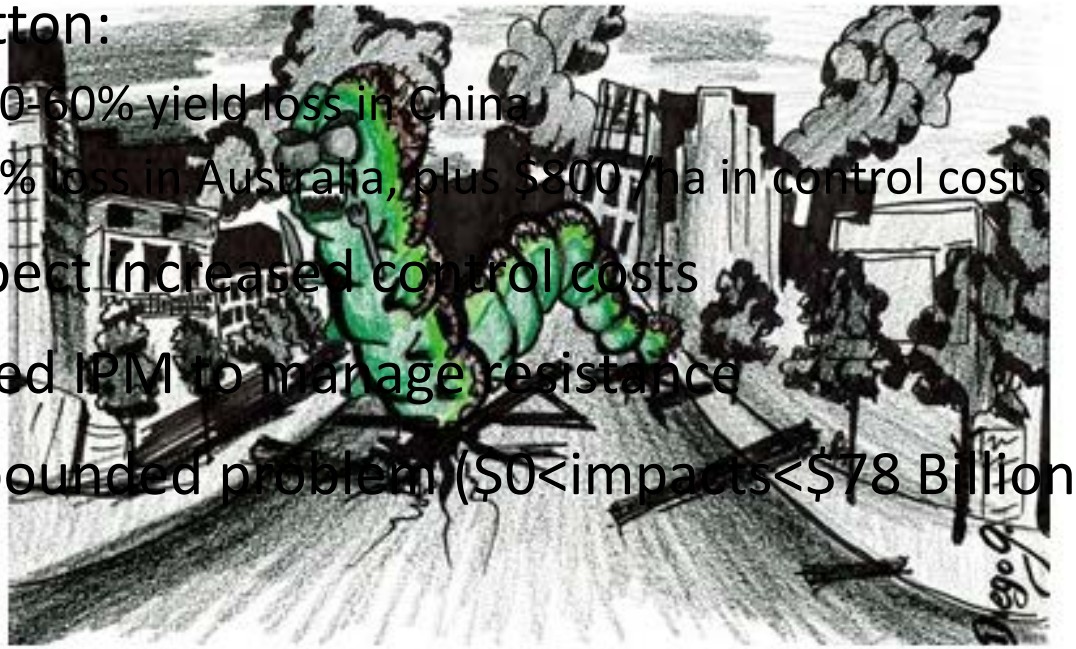
Cotton:

- 50-60% yield loss in China
- 7% loss in Australia, plus $800 /ha in control costs

Expect increased control costs

Need IPM to manage resistance

A bounded problem ($0<impacts<$78 Billion)



(*) por André Luis F. Lourenção

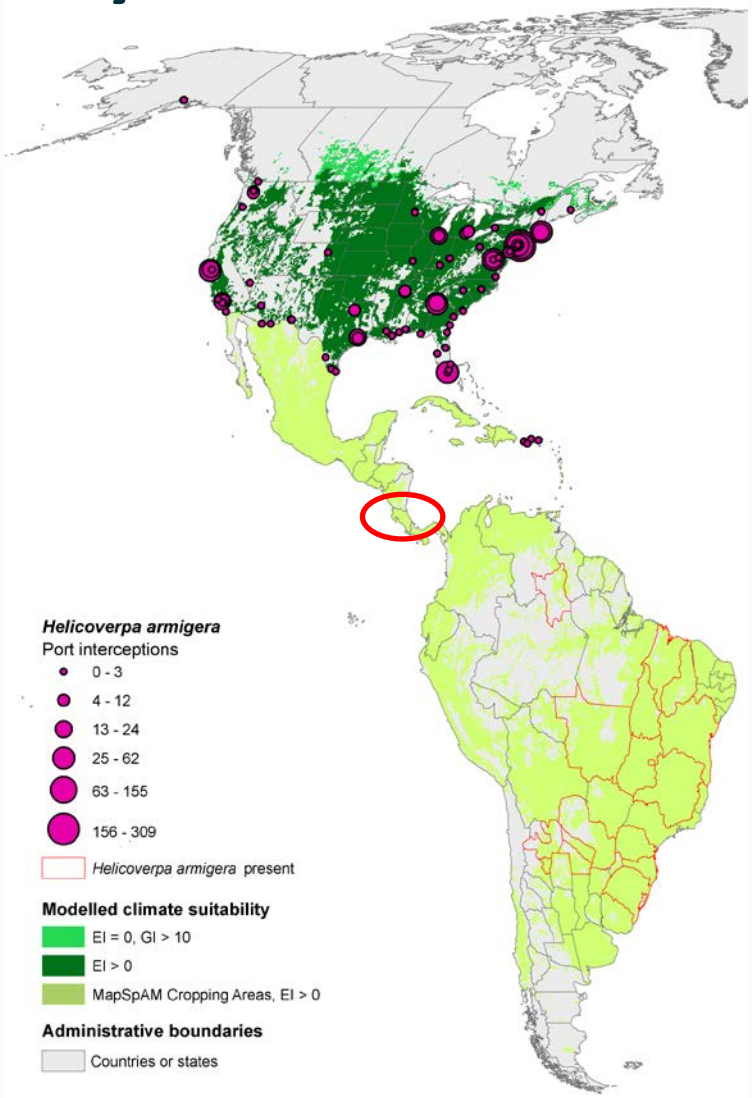
Invasion Pathways

Invasion threats and pathways

Invasion of South America changed the pathway threat qualitatively

Land bridge or island-hopping?

“One if by land, two if by sea…”



What to do?

Slow the spread

- Assist Central American countries to eradicate outlying populations and manage resistance
- Track resistance status of invading populations

Partner with agencies with experience in managing *H. armigera*

Develop economic impact functions

Surveillance

Targeted education of producers

- Forewarned is forearmed

Identify resistant plant materials

Take a lemon and make lemonade

Helicoverpa is likely to invade the USA via natural dispersal

Contorl options could be limited because of the overlapping niche of H. zea (a native pest)

H. Armigera has a tendency to develop resistance

So, what can the Government do?

Natural dispersal pathway undermines the value of an eradication attempt.

Opportunity to engage agricultural sector in a mature discussion about the situation:

Explain why an eradication of an incursion may be of questionable value

Discuss the need for Government intervention – what are the gaps?

So, what happened next????

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Thank you

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