B3 Science Solutions for BETTER BORDER BIOSECURITY www.b3nz.org

SCION forests · products · innovation

Phytosanitary measures to reduce borer infestations of wood packaging materials: Effects on infestation rates and future rates of establishment

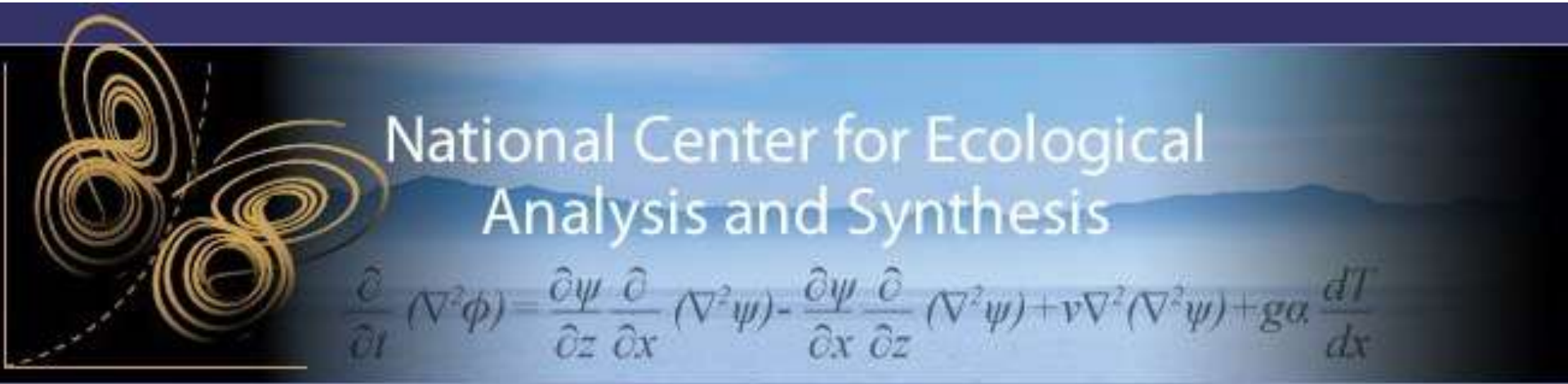
Eckehard Brockerhoff, *A. Liebhold, R. Haack, J. Cavey, M. Kimberley*

IUFRO 7.03.12, Tokyo, 13 June 2012

Outline

- “Borer” invasions and phytosanitary policy
  (ISPM 15 – wood packaging materials)
- Effects of ISPM15 on interception & establishment rates

Part of a project on benefits and costs of phytosanitary policy at ‘NCEAS’ (University of California, Santa Barbara)



1996: *Anoplophora glabripennis* (Cerambycidae)

Establishments of *Anoplophora glabripennis* (ALB)

2003, Ontario

2008, Mas-sachusetts

1998, Illinois

1996, New York

2011, Ohio

2002, New Jersey

2012, UK

2004, Germany

2003, France

2001, Austria

2007, Italy

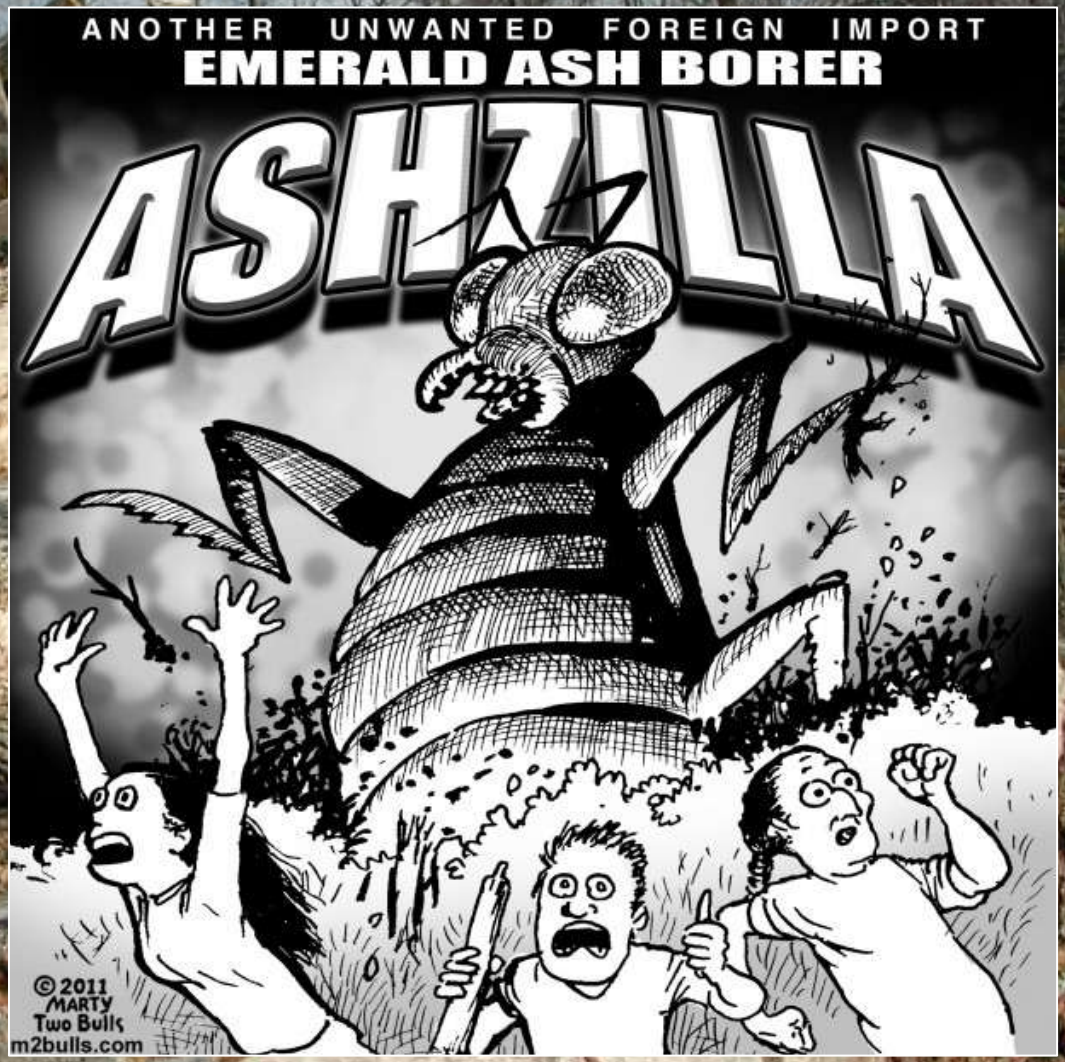
Native region

Interceptions (<u>not</u> establishments!) in ... New Zealand:
1995, 1999, 2000, 2001, 2004, 2006
Australia: interceptions in 2005, 2006, 2007, 2008

Haack et al. 2010, Annu. Rev. Entomol.

Emerald ash borer, *Agrilus planipennis* (Buprestidae), N. Am.

- **As of 2010, > 50 million ash (*Fraxinus*) trees killed**
- **Ash is expected to be "virtually eradicated" in N. Am.**



Wood Packaging Material (WPM)

Pallets

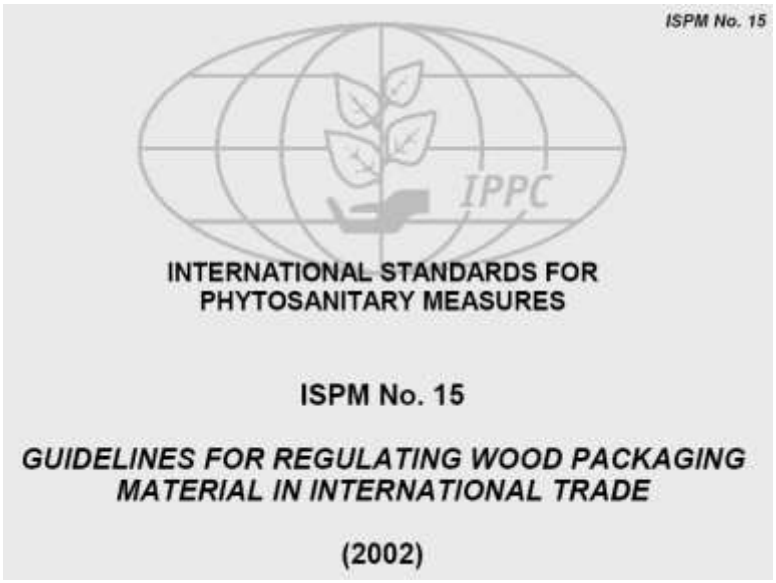
Spools

Dunnage

ISPM 15 - International Standards for Phytosanitary Measures, No. 15: *Guidelines for Regulating Wood Packaging Material in International Trade*

HT: Heat treatment (56°C at the core for 30 min)

MB: Methyl bromide fumigation (Conc. x time)



– First implemented in NZ: 2003

– USA: Sep. 2005 - July 2006

Objectives of NCEAS Working Group

Benefits (and costs) of phytosanitary policy

1. **Effects of ISPM 15** (Scolytinae, Cerambycidae, other borers)
2. **Relationship between <u>arrival rate</u> & <u>establishment</u>**

1. Effects of ISPM 15 - Changes in borer arrival rate?

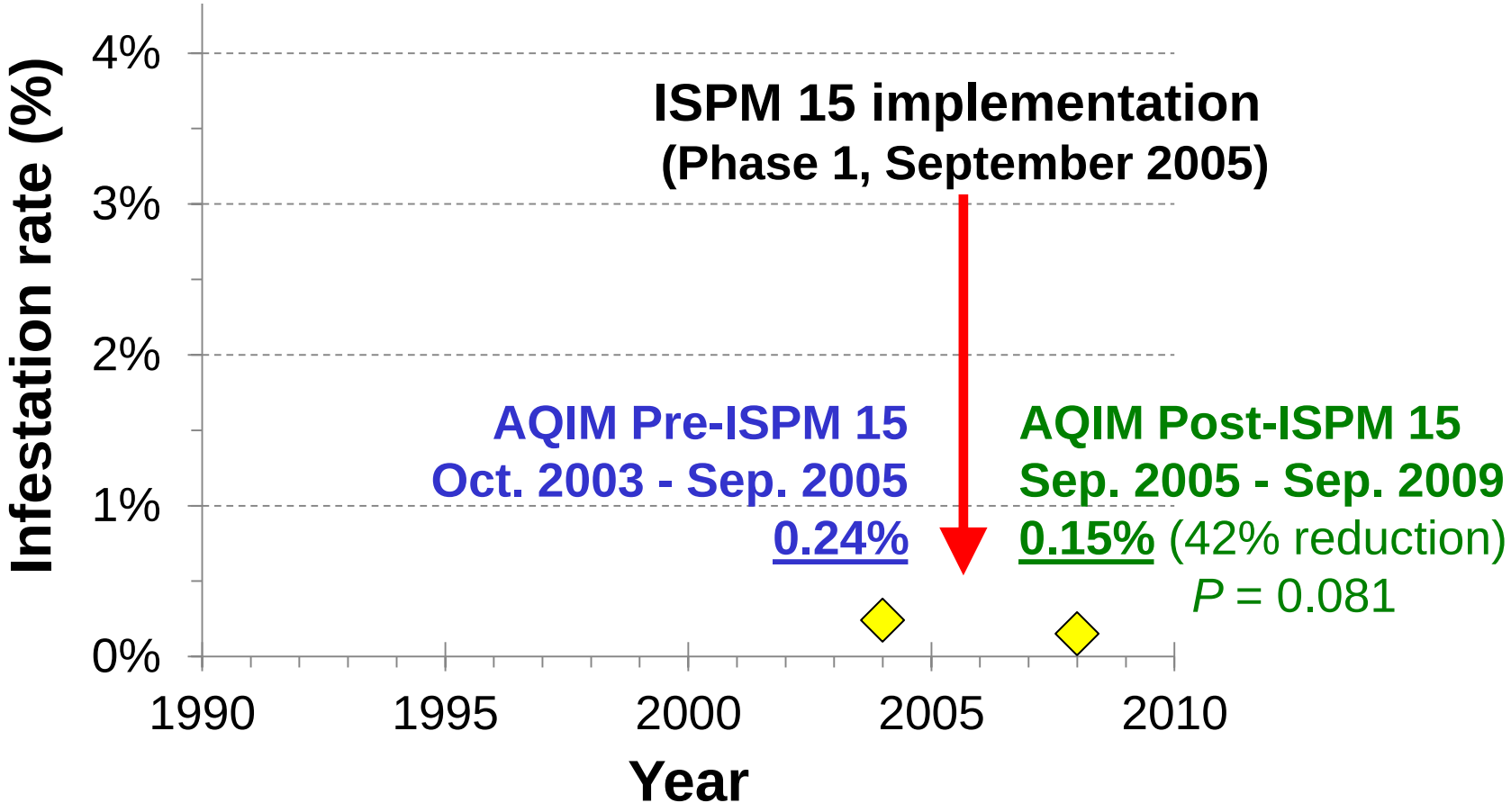
- **Treatments are effective in lab! Effect at the border?**
- **Before–after ISPM 15 comparison of borer <u>interceptions</u> "at the border"**

- **AQIM data** (USDA **A**gricultural **Q**uarantine **I**nspection **M**onitoring)
  - Random, hypergeometric sampling protocol.
  - Statistically robust, negatives recorded.
  - Allows setting detection rate with X% confidence.
  - 29,945 entries / 33 borer type records.
  - **Allow overall arrival rate calculation**.
  - **Pre-** *vs*. **Post-ISPM** (arrivals per shipment).
- **Data from other countries** (e.g., survey results)

Has ISPM 15 made a difference?

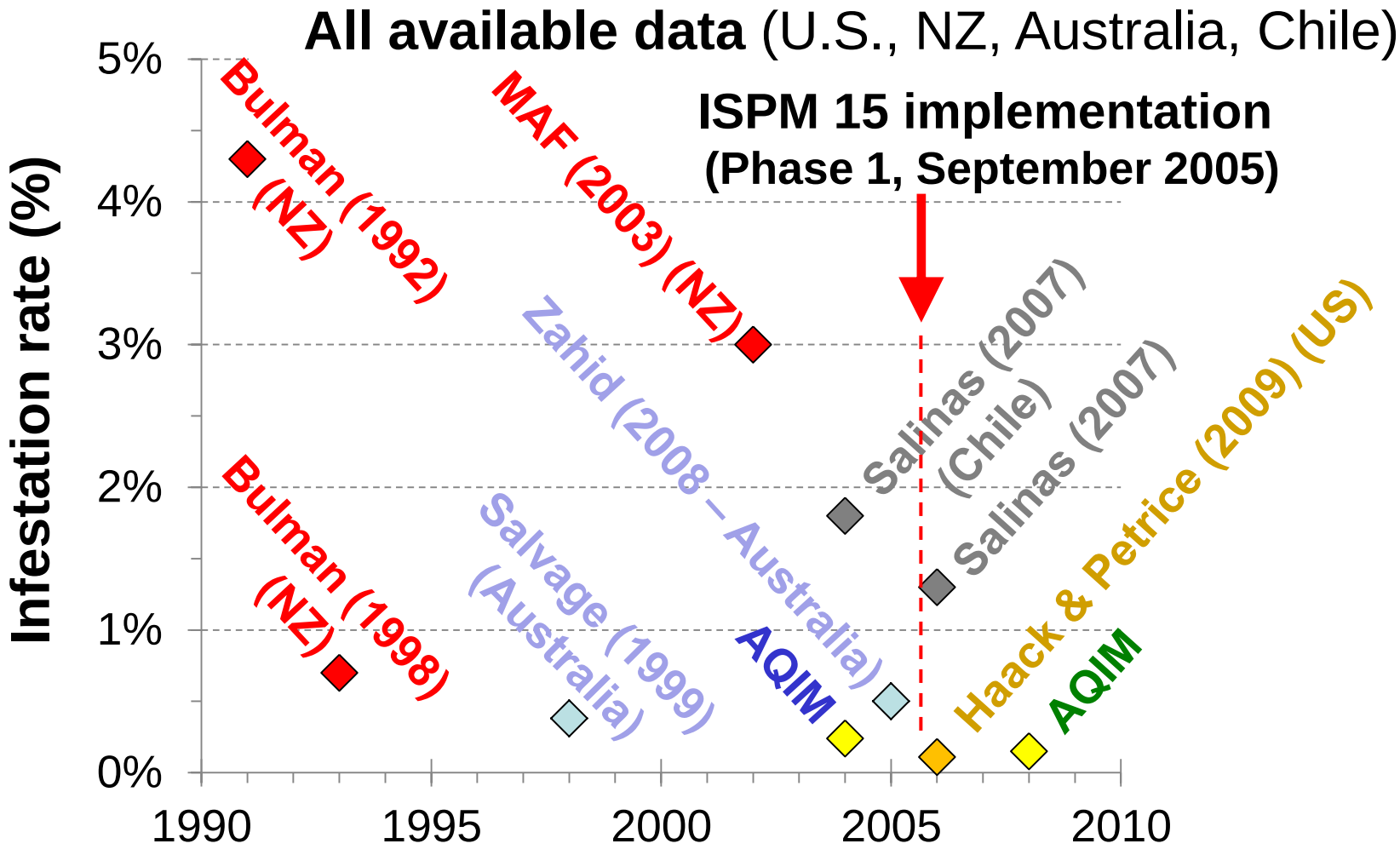
Change in infestation rate by live borers …

… before and after implementation of ISPM 15?



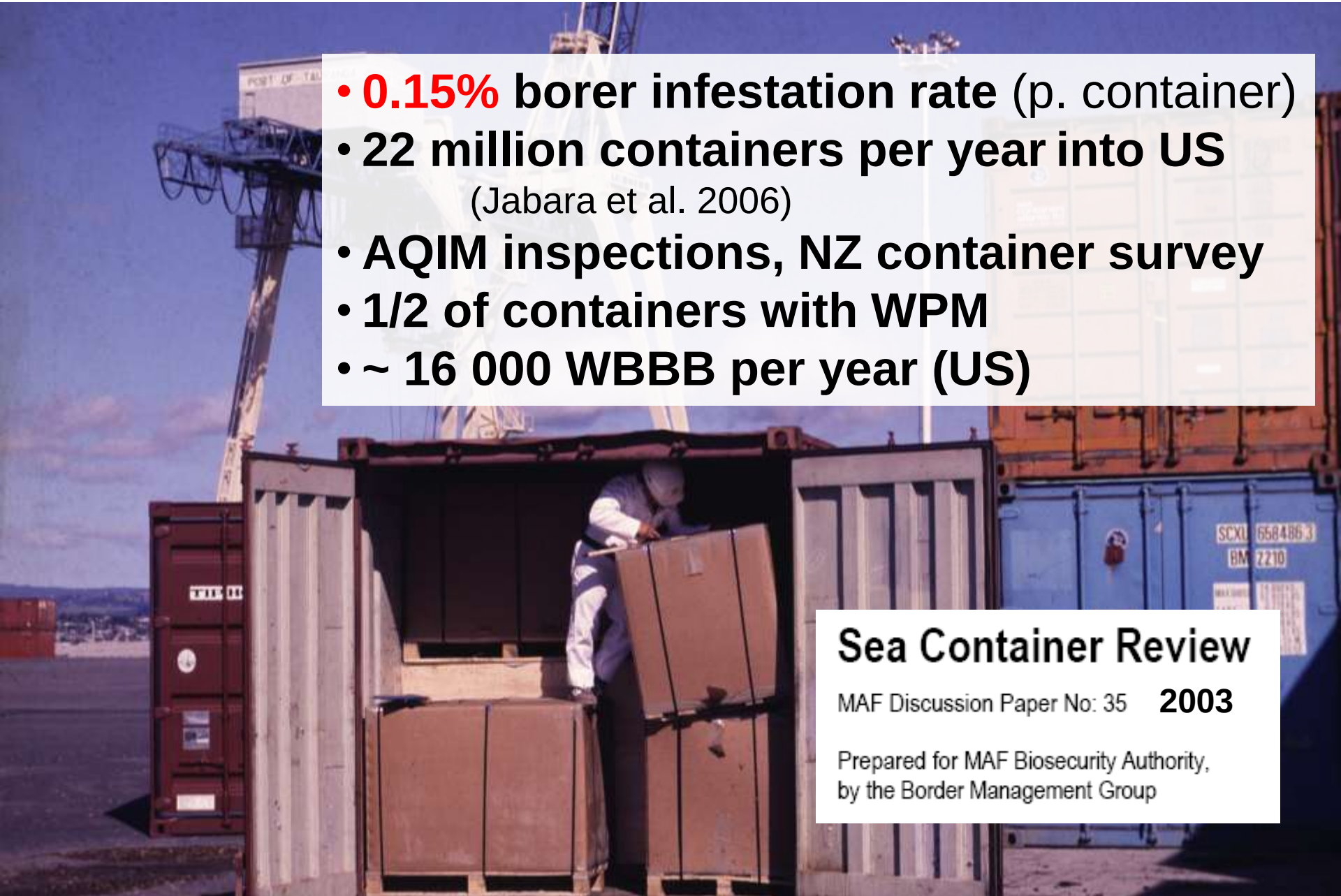
NCEAS Group manuscript in prep.

…. Has ISPM 15 made a difference?



Issues around comparability: Data on - *per consignment* basis
- *per WPM item* basis

WPM and borer arrivals – still a problem?



- **0.15% borer infestation rate** (p. container)
- **22 million containers per year into US**
  (Jabara et al. 2006)
- **AQIM inspections, NZ container survey**
- **1/2 of containers with WPM**
- **~ 16 000 WBBB per year (US)**

Sea Container Review

MAF Discussion Paper No: 35 **2003**

Prepared for MAF Biosecurity Authority,
by the Border Management Group

2. Relationship between arrival rate & establishment

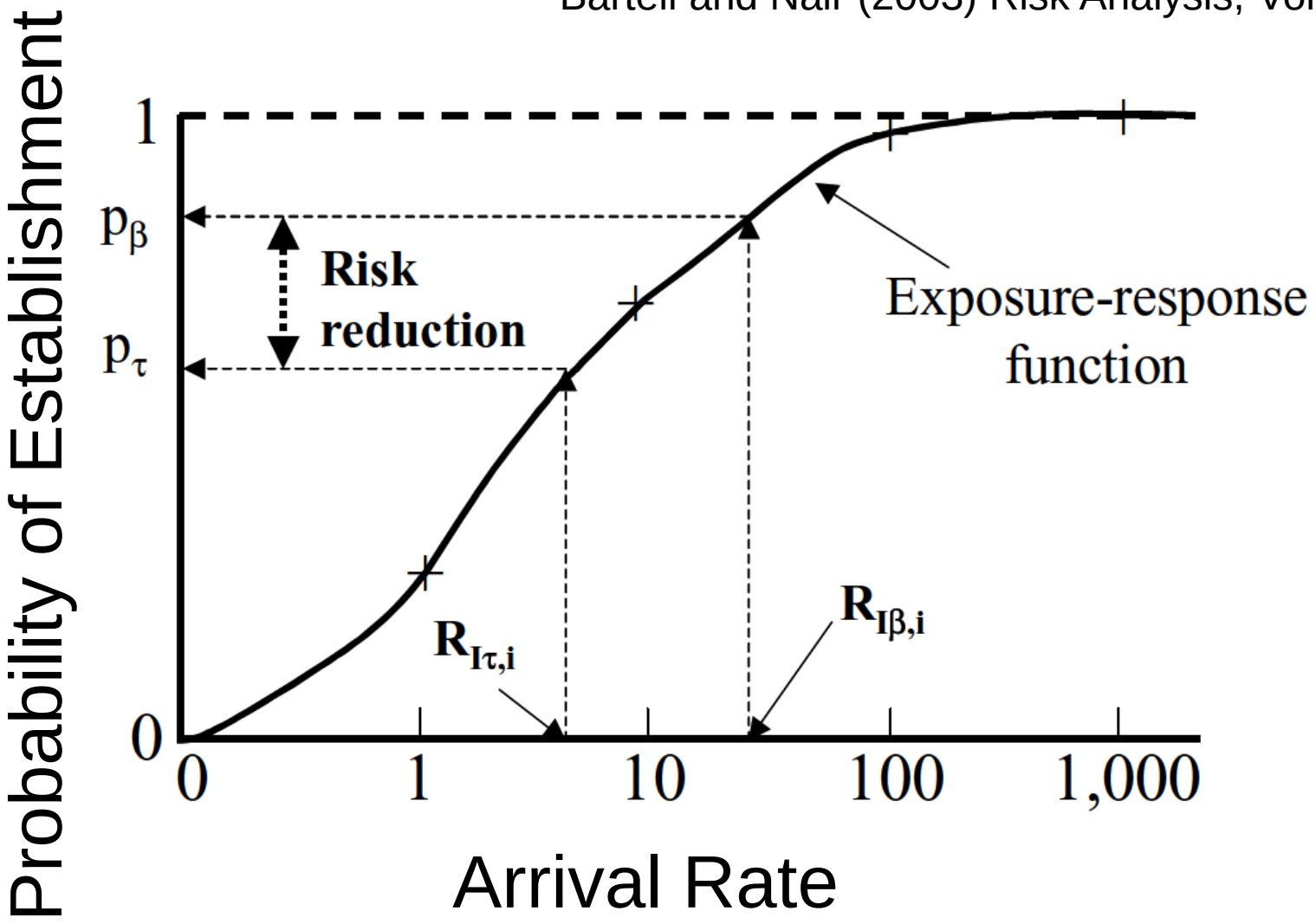
Problem:

– Actual arrival rates (of individual borer species) unknown

– Border "interception" records - a proxy for arrival rate?

Arrival rate & establishment relationship – theoretical for *Anoplophora glabripennis*

Bartell and Nair (2003) Risk Analysis, Vol. 24



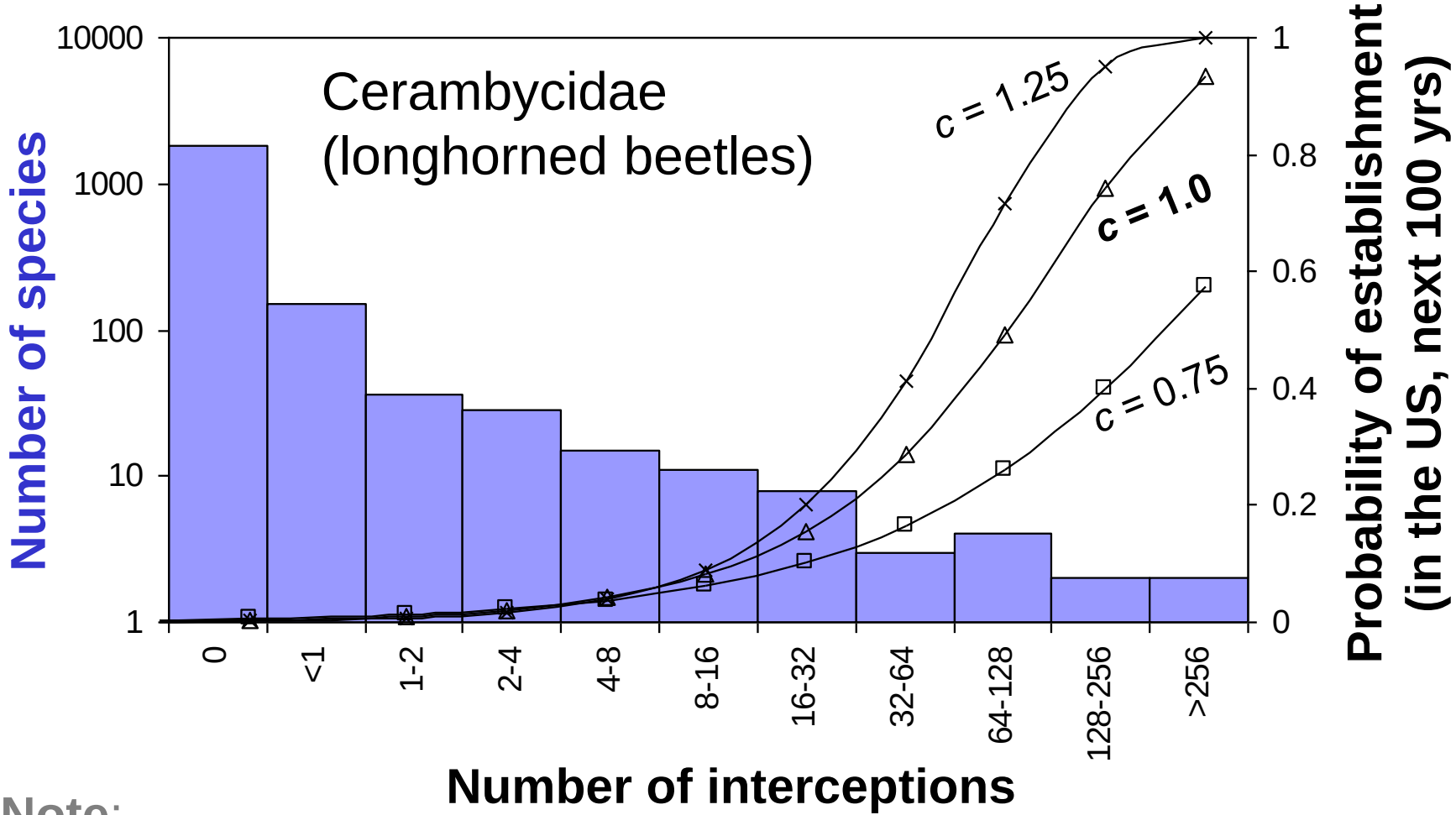
Interception – establishment relationship model ("dose-response" model)

- **Interception data:**
  List of intercepted plant pests, Pest ID database, NZ Interception data, > 37 500 interception records
- **Establishment data:**
  49 Cerambycidae spp., 36 Scolytinae spp. (true bark beetles) (world-wide and US only)
- **Weibull function** (see Leung et al. (2004) Ecology)

$$E = 1 - q^{n^c}$$

  - ***E*, probability of establishment**
  - **n_i, interception frequency**
  - *q*, calibration parameter
  - *c*, shape parameter

Considering the species 'pool'

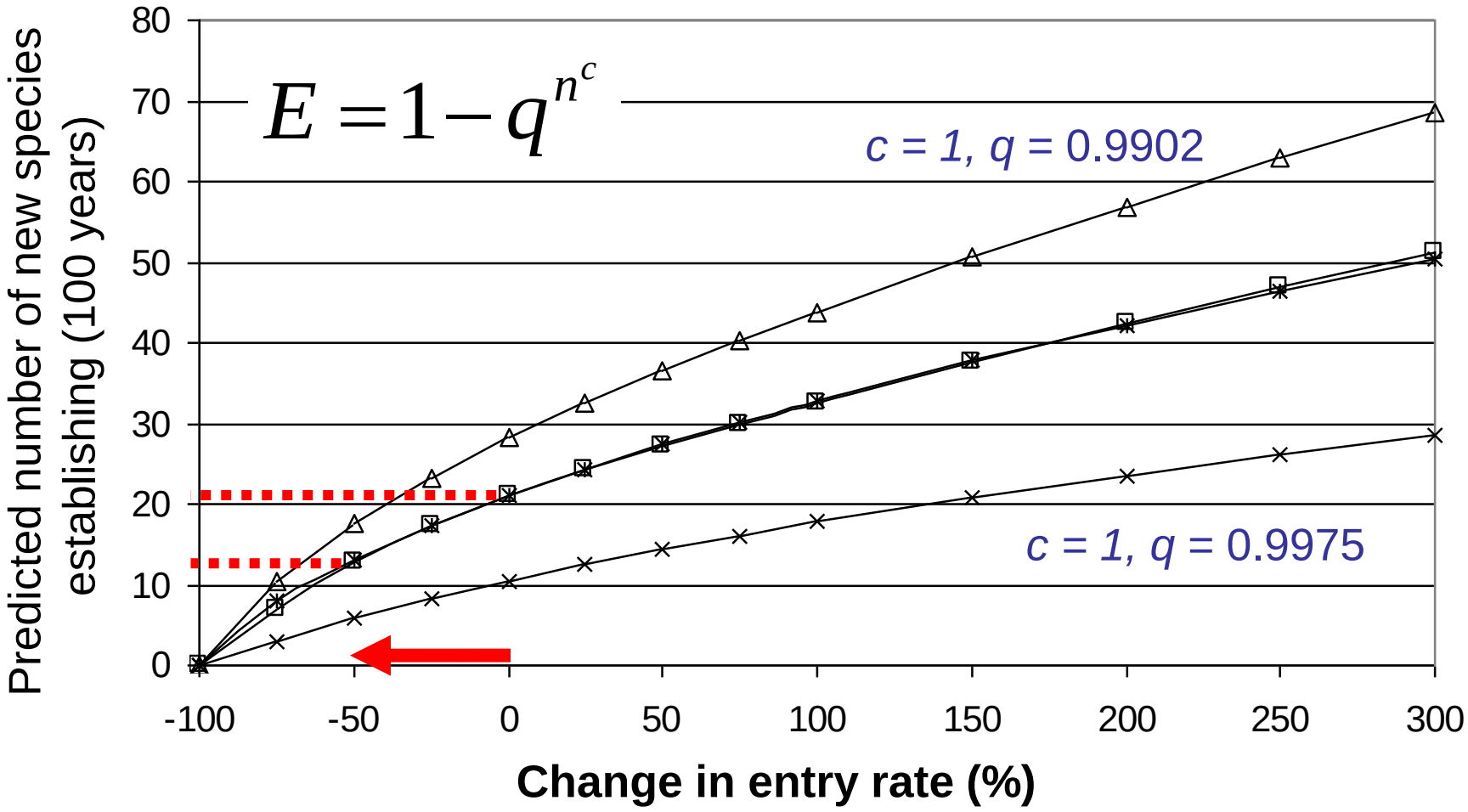


Note:

Frequency distribution assumes 1800 non-intercepted species,
Excludes US native species, species established in the US < 1900

Brockerhoff et al. (ms in prep.)

Predicted number of establishments in the US, longhorned & true bark beetles, next 100 yrs



No change: **21 spp. establish** (confidence range 10 to 28)

50% reduction in entry rate: **-8 spp**. 75% reduction: **-13.4 spp.**

Brockerhoff et al. (ms in prep.)

Conclusions

- ISPM 15 has reduced borer arrivals
- Actual arrival rates by species are unknown
- Interceptions: useful proxy for arrival rate
- Relationship between arrival rate & establishment is **not linear**
- Modelling interception – establishment relationship ...research tool on key aspect of biological invasions
- …useful for assessing policy effects
- Caveat: other pathways exist (timber, live plants, etc.) but wood packaging is probably the most important
- Recording of **quality** interception records important !!!

Acknowledgements

- NCEAS, UC-Santa Barbara (Amelia Nuding)
- The Nature Conservancy
- New Zealand Foundation for Research, Science and Technology (FRST)
- US Forest Service
- USDA-APHIS
- **MAF** (New Zealand Ministry of Agriculture and Forestry) Carolyn Whyte, Victoria Allison, Debbie Beer, Anthea Craighead, Shane Olsen, Chris Denny)

NCEAS

The Nature Conservancy

Protecting nature. Preserving life.™

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

USDA

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

APHIS

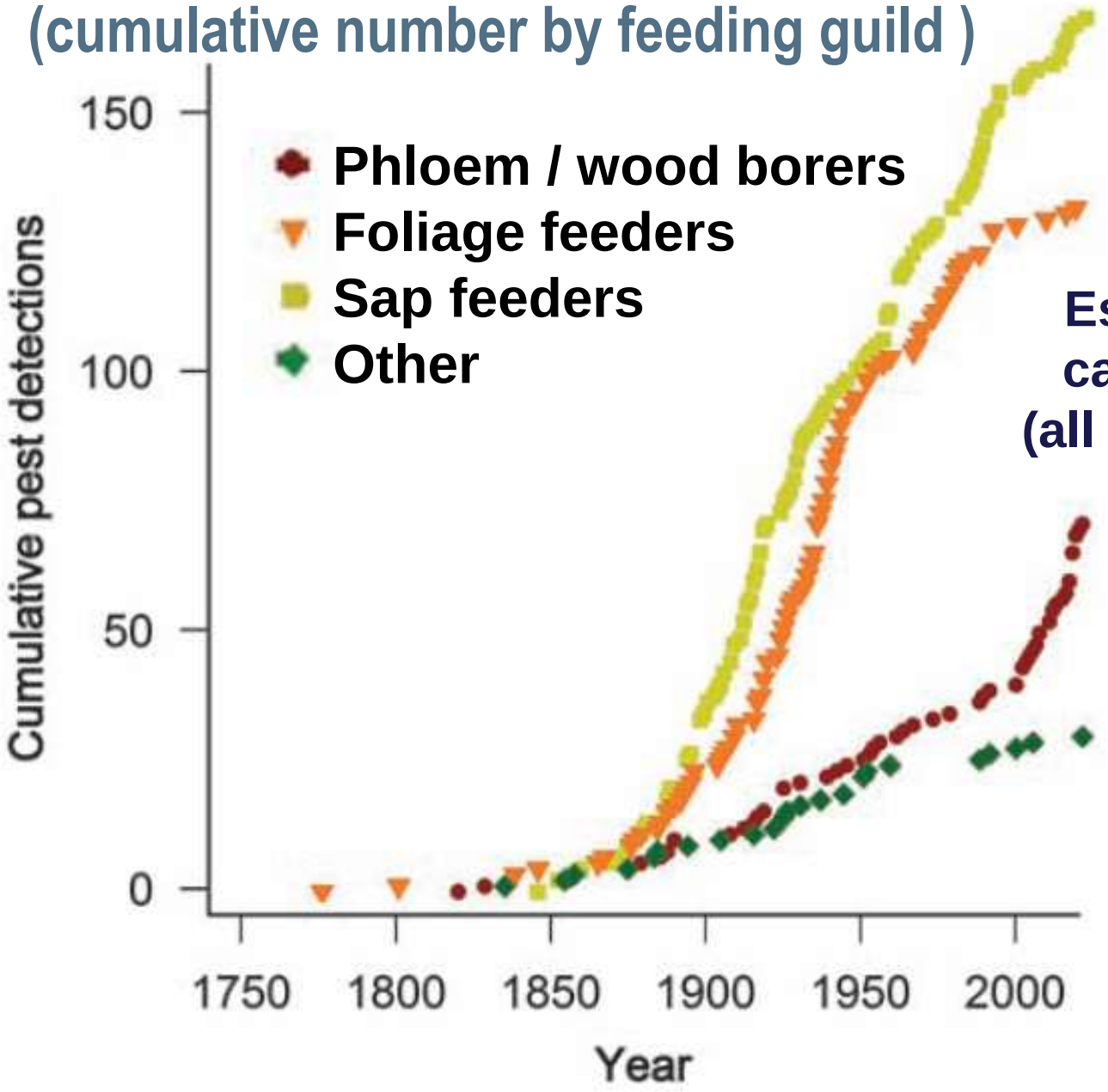
SCION

Next generation biomaterials

& several U.S. universities

New forest insect records, USA, ca. 1750 – 2006

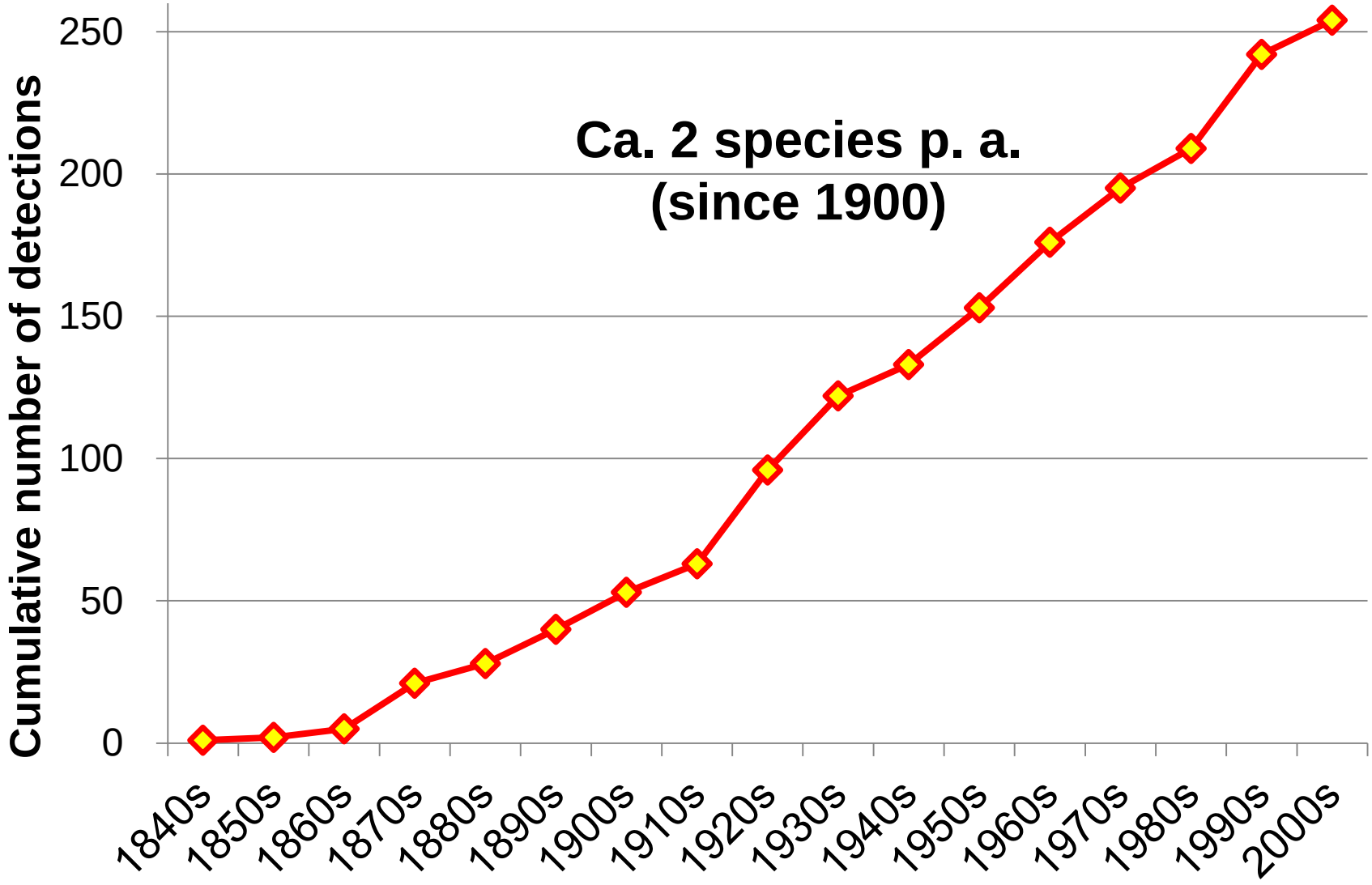
(cumulative number by feeding guild)



Establishment rate ca. 2.5 species p.a. (all guilds, since 1900)

Source:
Aukema et al. 2010, BioScience 60

New forest insect records, New Zealand, 1840 – 2010



Source: Scion (compiled by John Bain & Lindsay Bulman)

Amenity value: before/after removal of *A. glabrip.*-infested trees

Invasion statistics & case studies

Recent interceptions of borers in New Zealand

2000 – 2010 MAF interception data (Anthea Craighead, MAF)

435 interceptions on *wood packaging*;

1186 on *timber*; 87 on *furniture*; 26 on *willow* (baskets, etc.)

372 on *other wooden items*

Organisms: many "borers", mostly "hitchhikers"

200 Bostrichidae

6 Buprestidae

109 Cerambycidae (*Anoplophora*, *Hylotrupes bajulus*, *Monochamus*)

30 Curculionidae incl. Scolytinae (e.g, *Ips grandicollis*)

12 Siricidae

36 termites (Kalotermitidae, Rhinotermitidae, others)

IHS effect? 43 borers 2000 - Jan. 2004; 61 after Jan. 2004

"**Hitchhikers**" (e.g., 140 ants, incl. Argentine, electric ants)

(further analyses in progress)

Interception – establishment relationship

- **Inspections of cargo at 'borders' (ports, etc.)**

Pest ID (very large US interception database, 1984-2008)

- **13 772 interceptions (Cerambycidae, Scolytinae part)**

List of intercepted plant pests, USDA (1950-1984)

- **19 972 interceptions from published records**

New Zealand interception data (NZFRI) (1950-2000)

- **3 765 interceptions (Brockerhoff et al. (2006) Canadian J.For.Res.)**

Caveats

- **Not random, no negatives recorded**
- **Confounding variables**
- **But: large number of observations**
- **Long time series levels biases (1950-2008)**