A process-based guide to data collection in plant health

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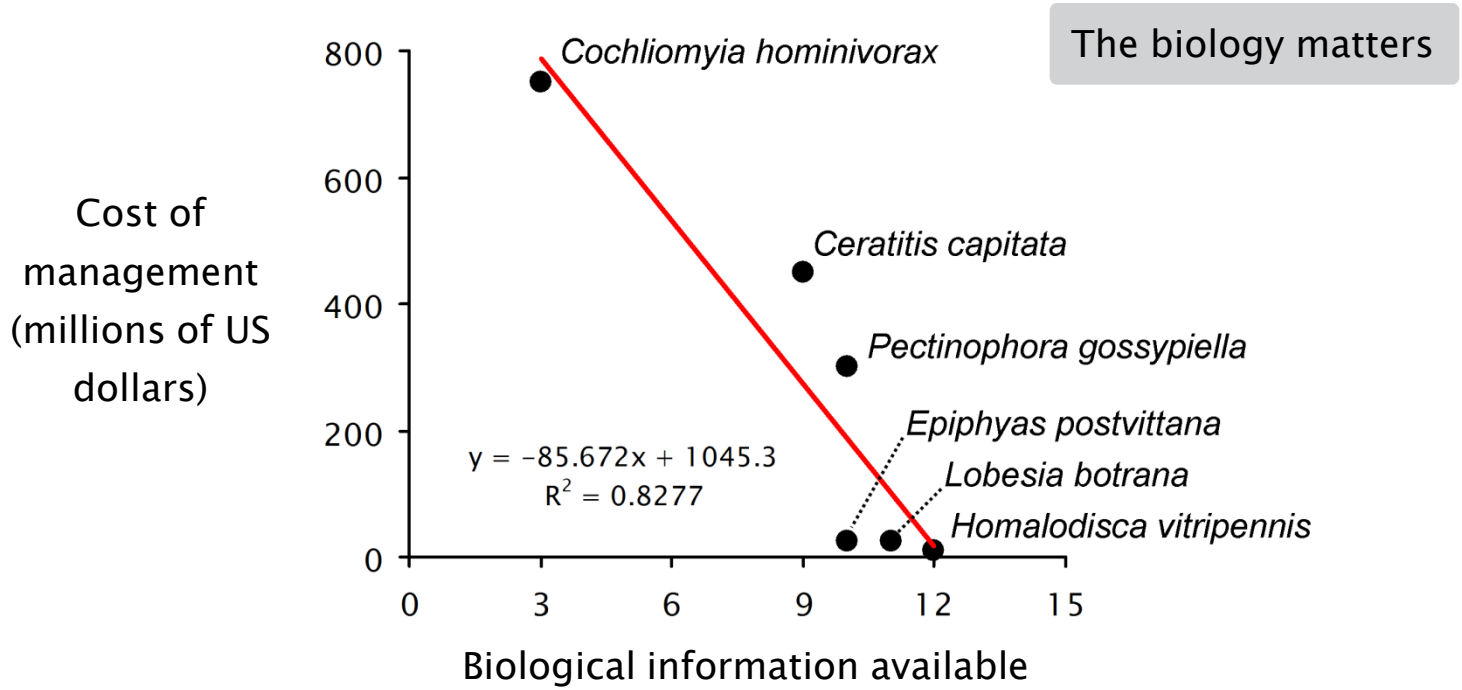
EFSA, Parma
Wed 2 April 2014

A process-based approach is key to managing pests effectively



Gutierrez & Ponti 2013

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Why the biology matters

North American examples

A process-based approach

Physiological analogies

Work in progress

Tuta absoluta

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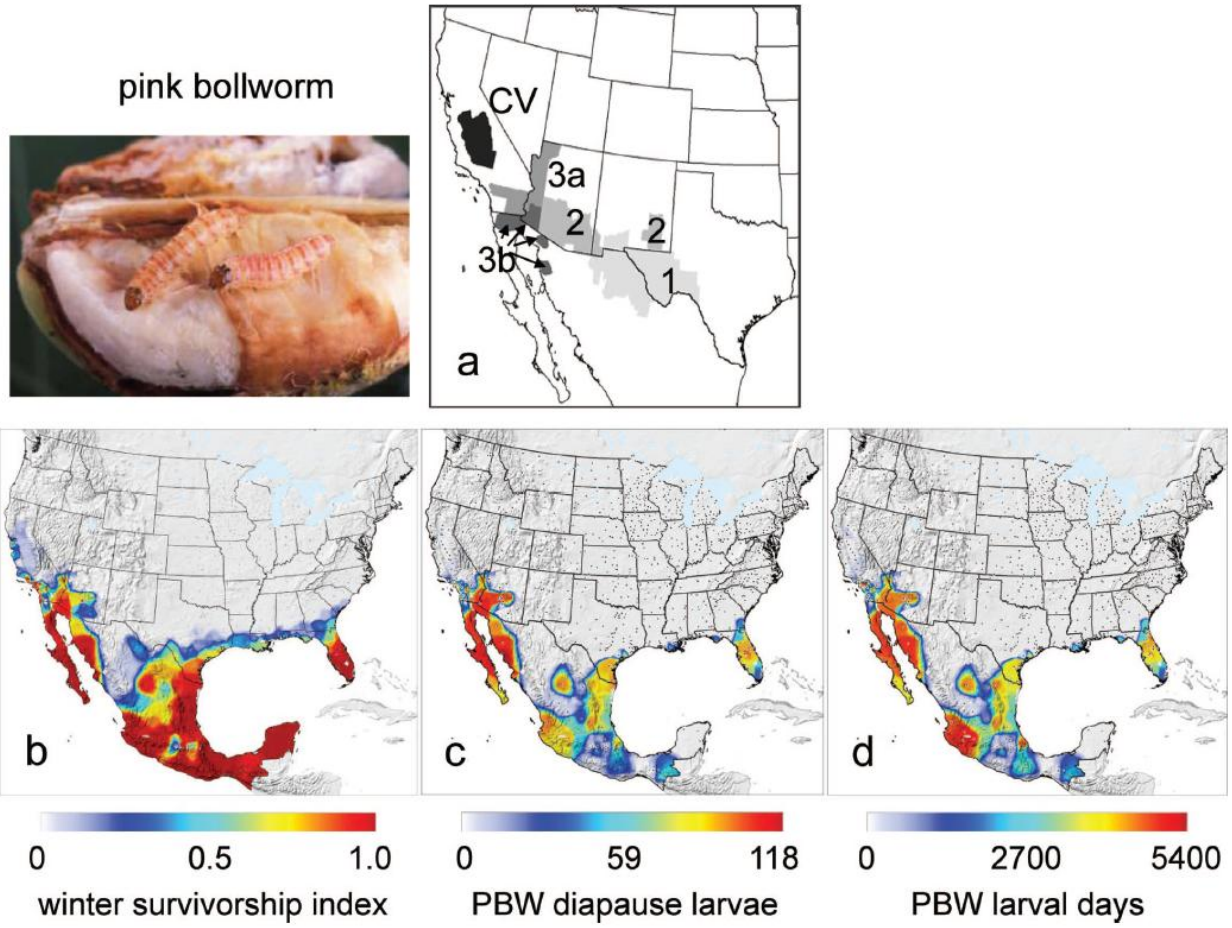
Pink bollworm cost 300 million $, yet in the Central Valley of California weather is the limiting factor

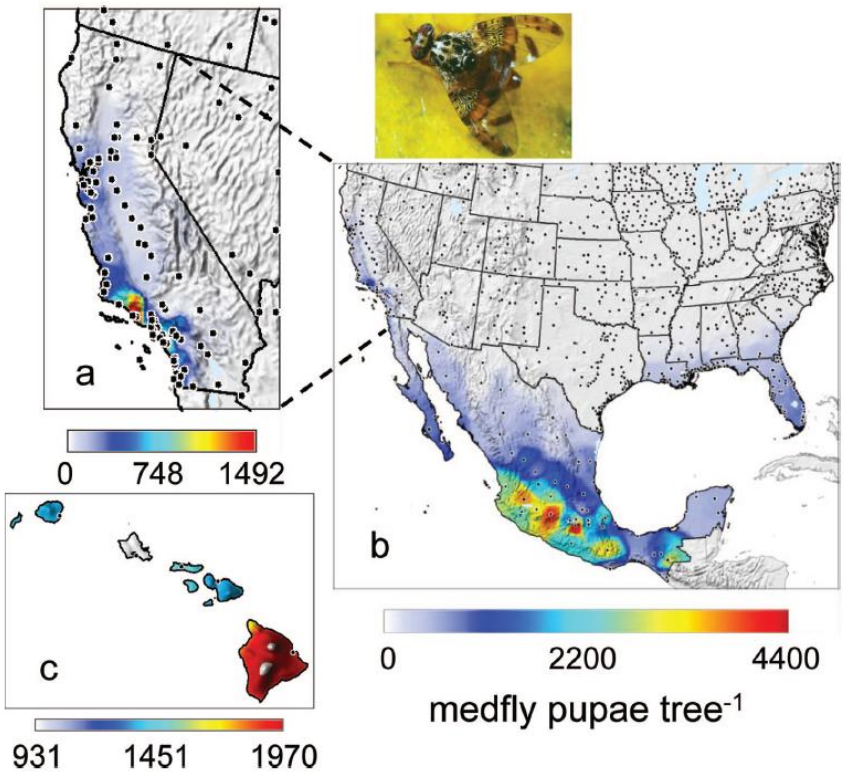
Introduced to California in the late 60s



Gutierrez & Ponti 2013a

Mediterranean fruit fly cost >450 million $ as threat to California agriculture was overestimated

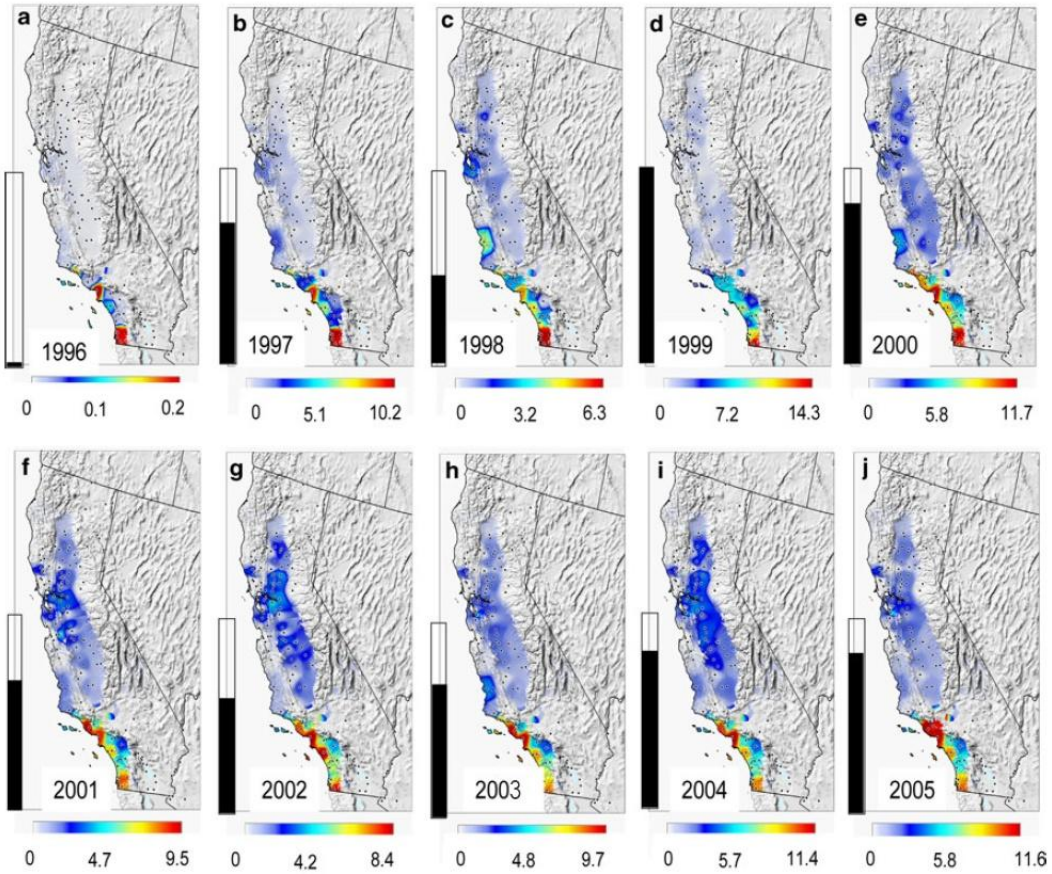
First detected in California in 1975



Gutierrez & Ponti 2013a

Large-scale monitoring and eradication since 1975 with no knowledge of the potential distribution

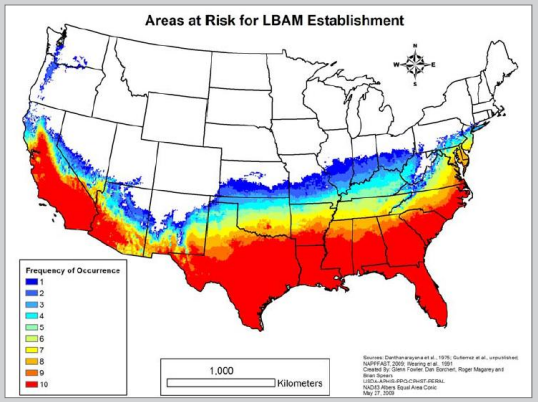
Medfly pupae (10^3)



Gutierrez & Ponti 2011

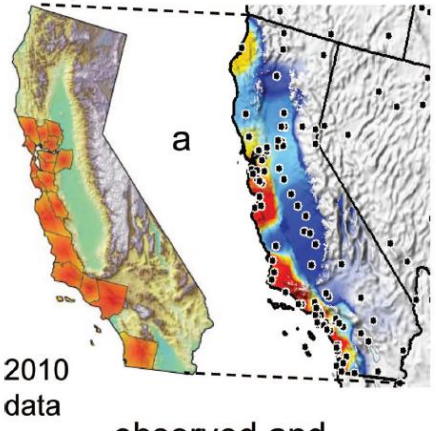
Planned eradication (worth 100 million $) for light brown apple moth was abandoned

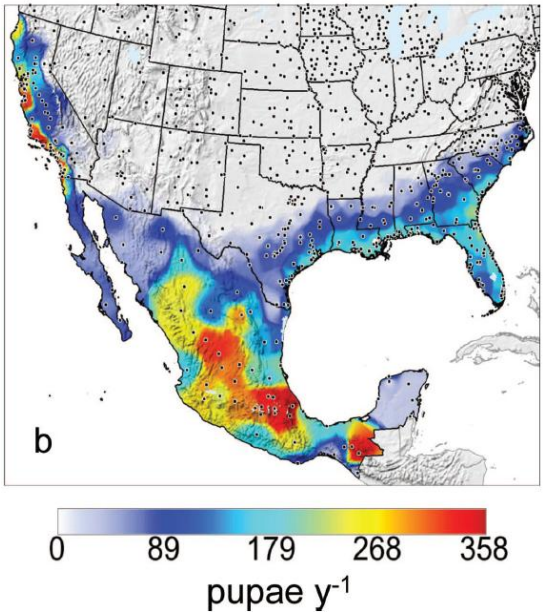
First detected in California in 2007



USDA: risk of establishment (Fowler et al. 2009)

light brown apple moth





Gutierrez & Ponti 2013a

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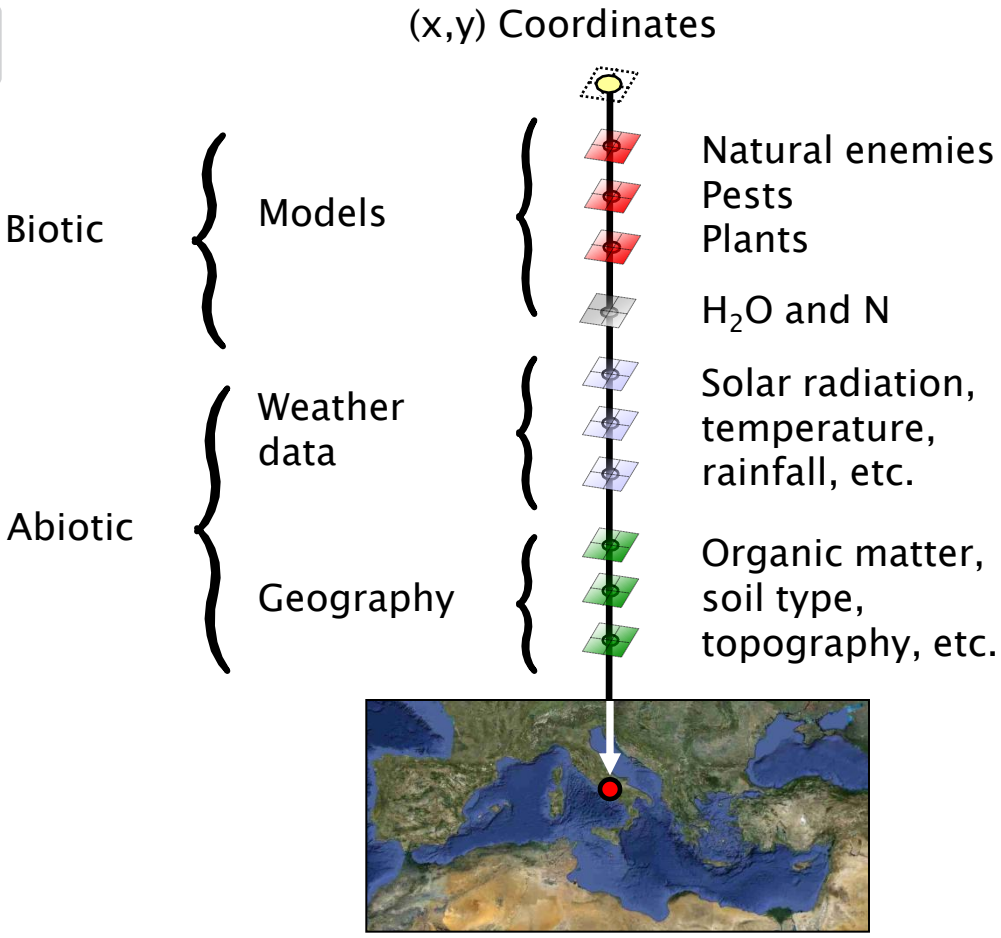
The regional pest status of species is affected by many factors difficult to separate and quantify

Geographic scale

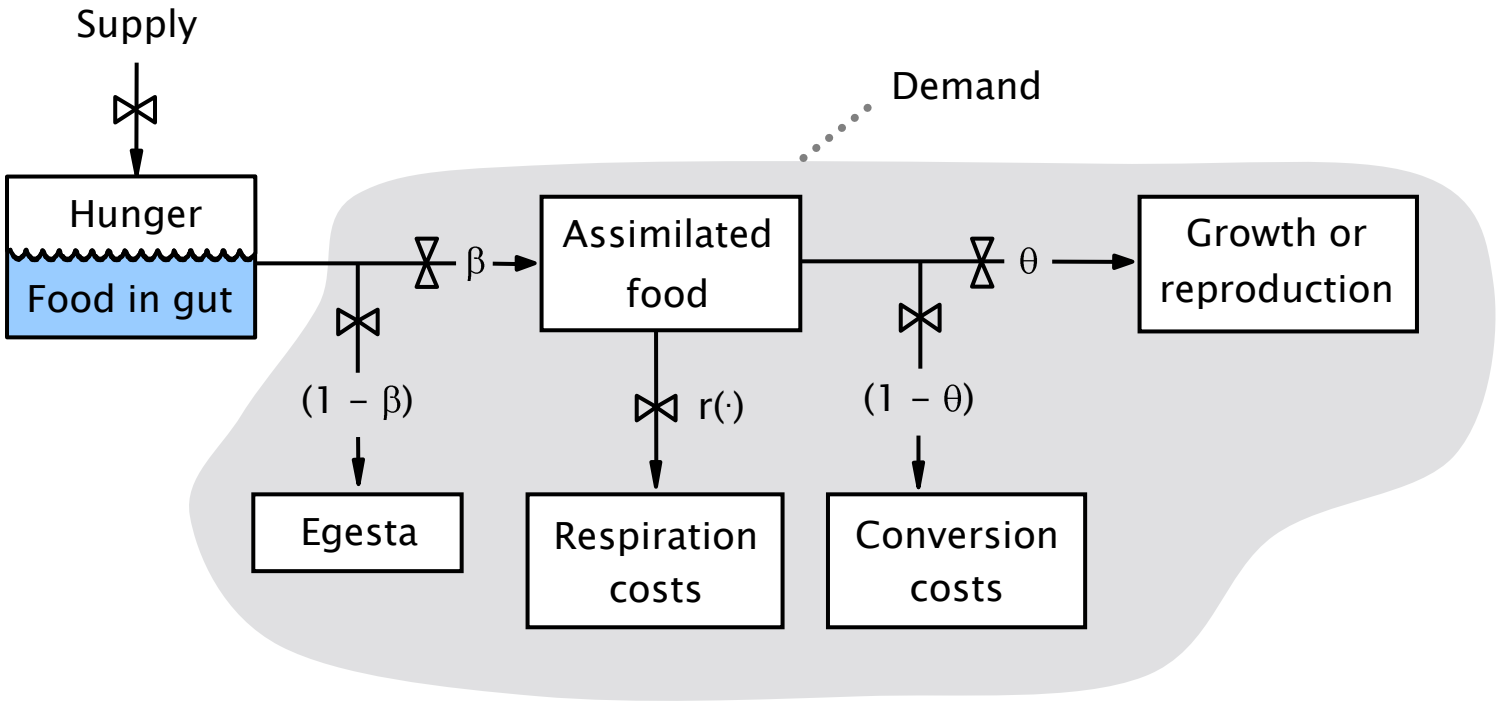


Physiological analogy among trophic levels is a powerful conceptual tool

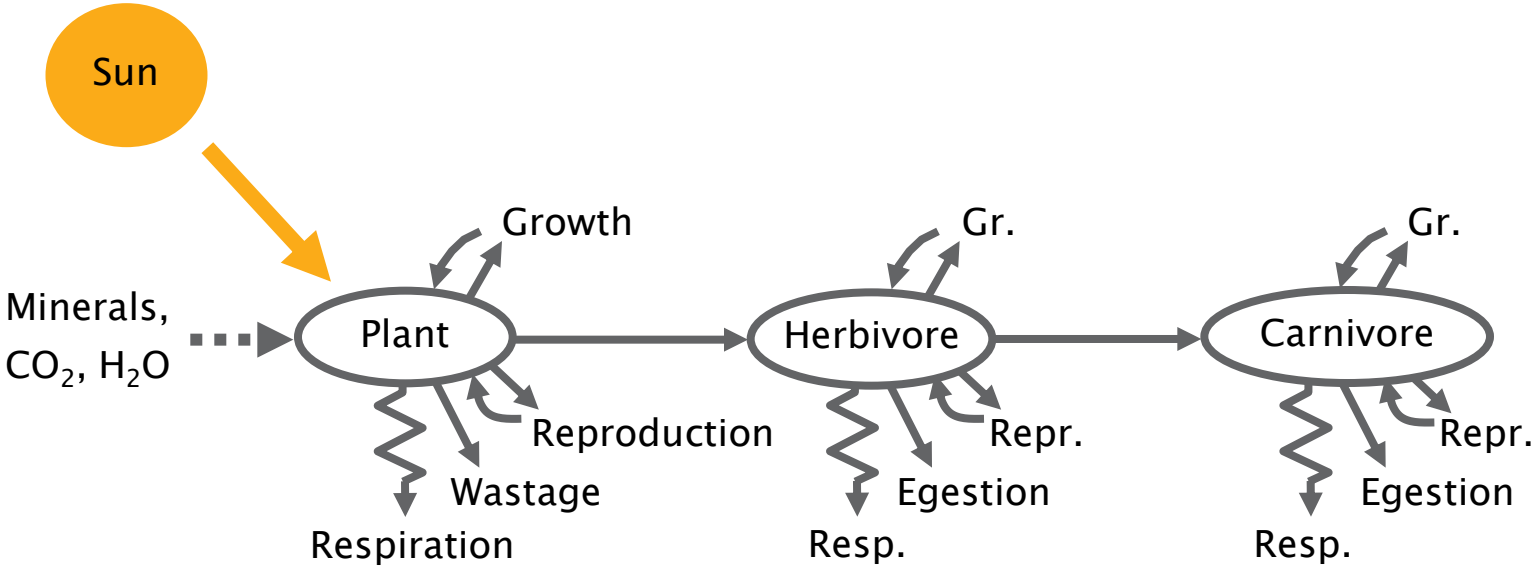
Processes like predation play
by similar rules in all ecosystems

Purves et al. 2013

All organisms are consumers with common pattern of resource acquisition and allocation



Same model can be used in all trophic levels, each level supplies resource to the next



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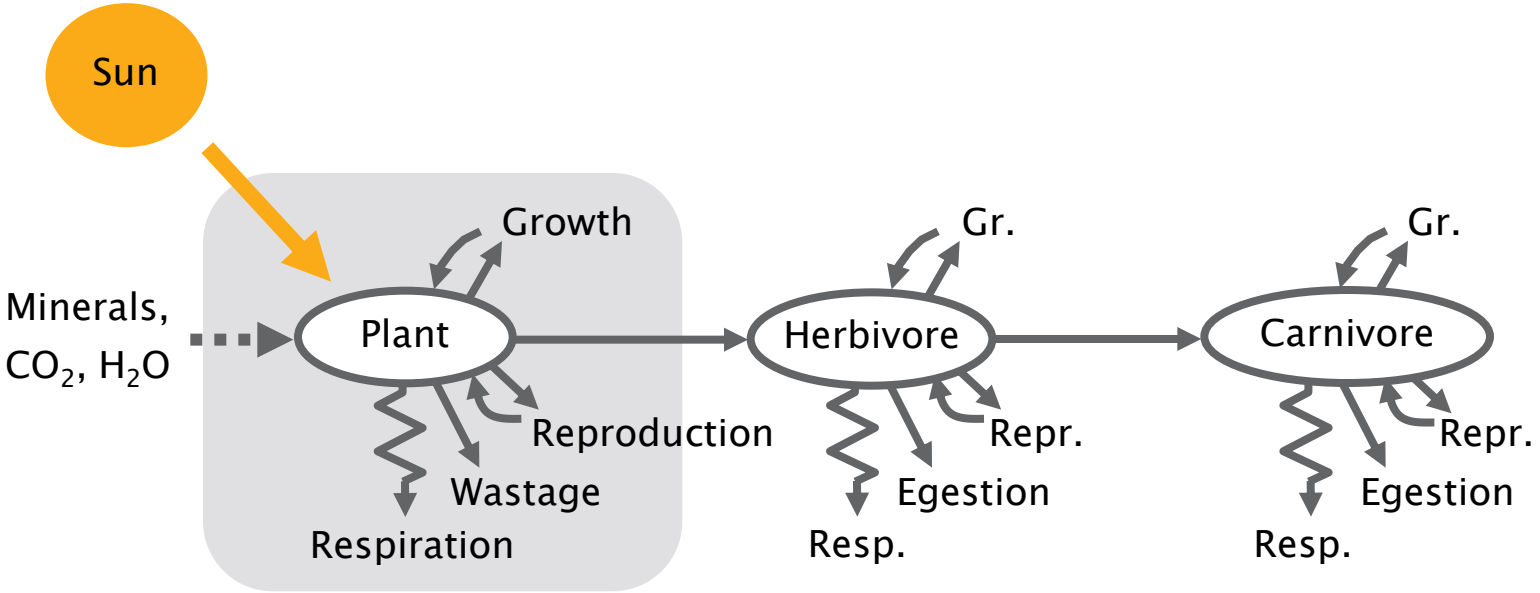

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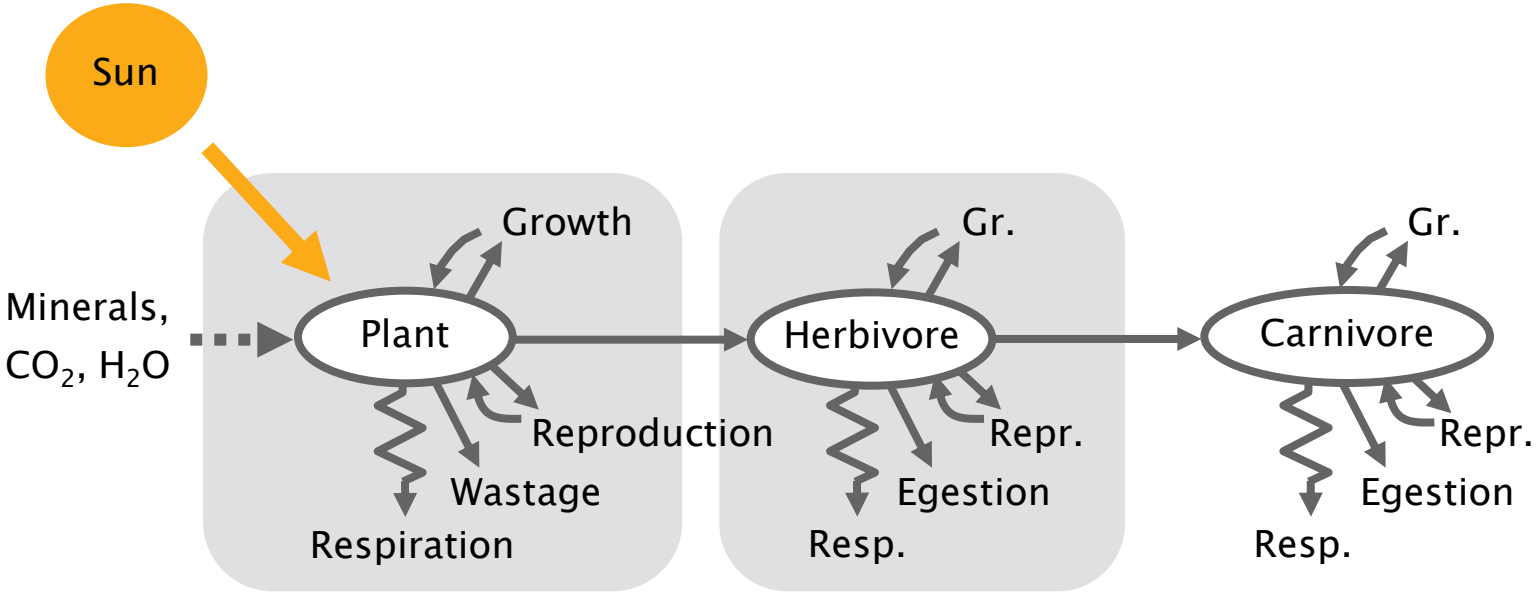

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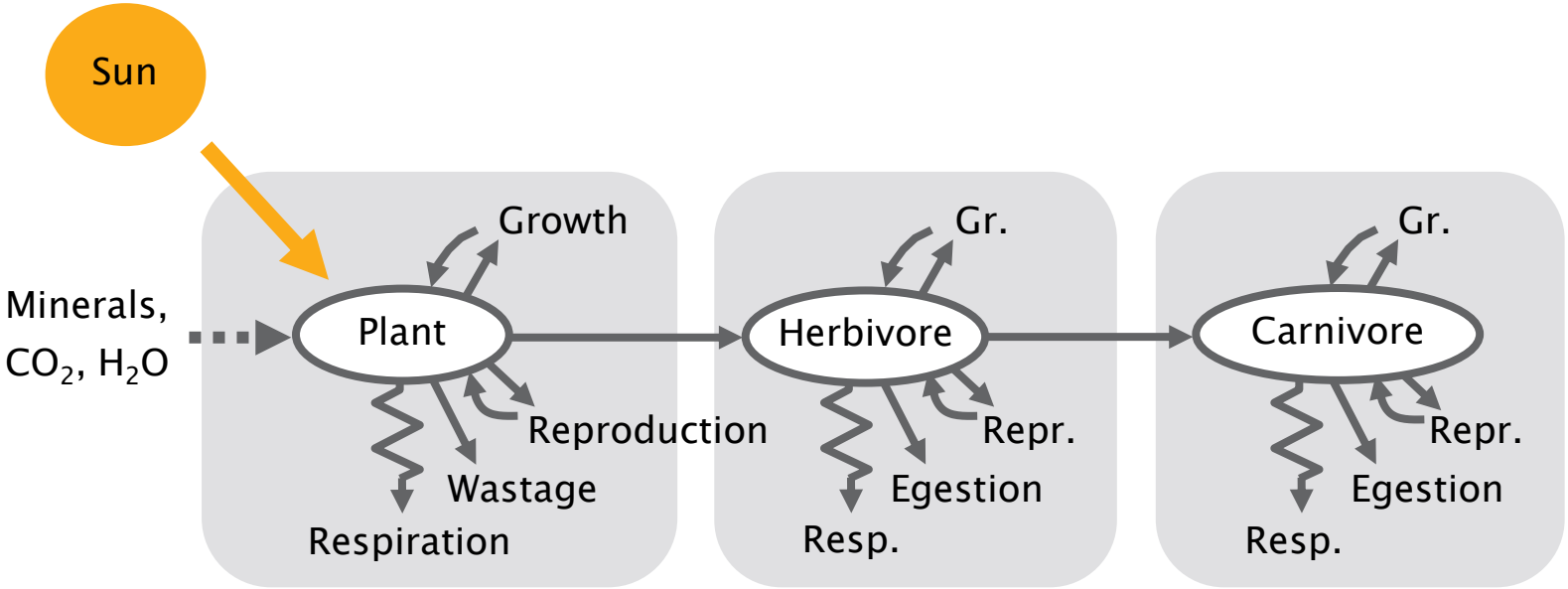
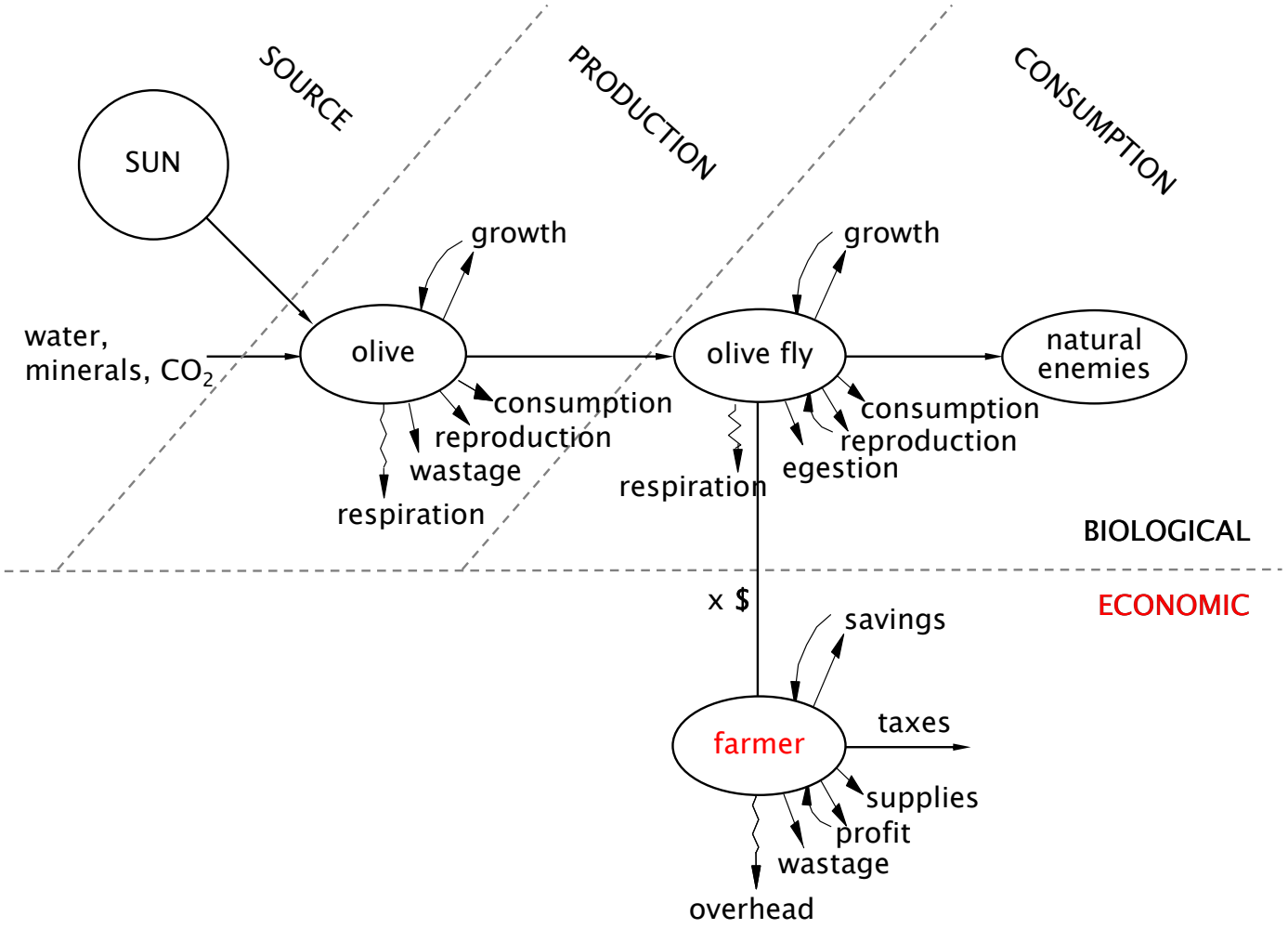


Same model describes species biology across trophic levels including the economy of humans

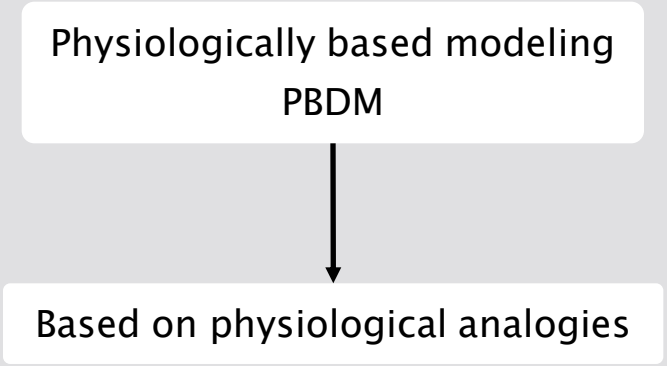


Ponti et al. 2014

Sub-models of biological process are the same for all trophic levels

Physiologically based modeling
PBDM

Sub-models of biological process are the same for all trophic levels



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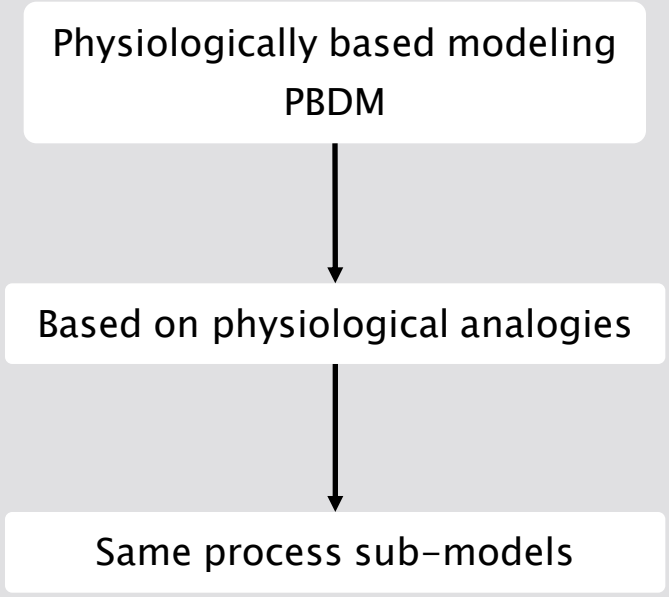
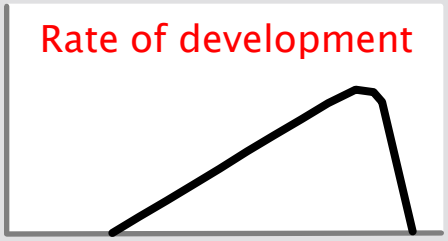
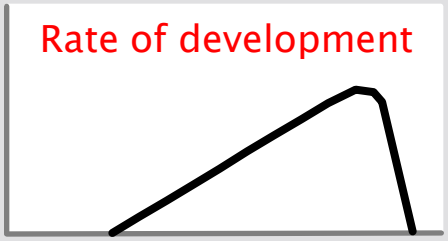


1 / days



Temperature

1 / days

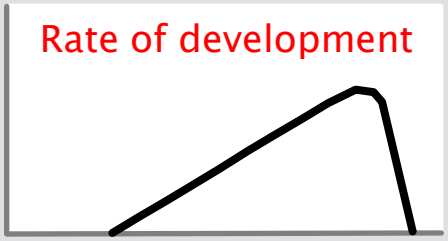


Temperature

Scalar for developmental time

Nutrition

1 / days

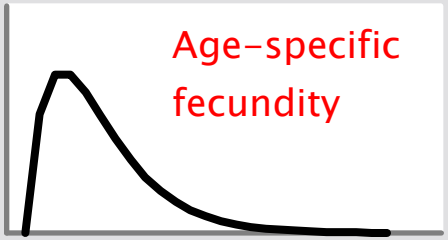


Temperature

Scalar for developmental time

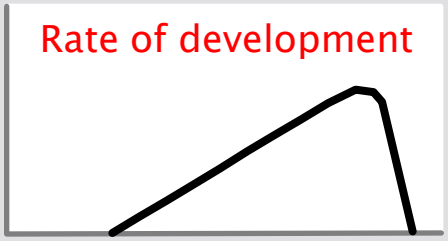
Nutrition

Eggs per female per day



Age

1 / days



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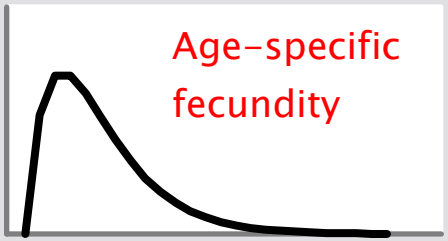
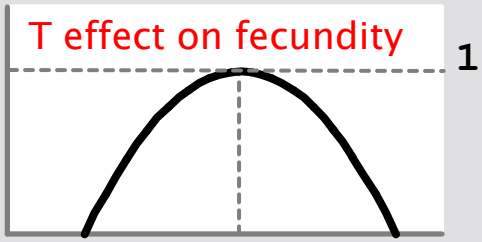


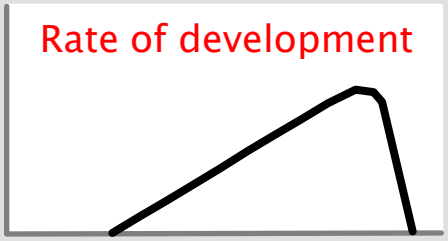
Age

Scalar for eggs per female



Temperature

1 / days



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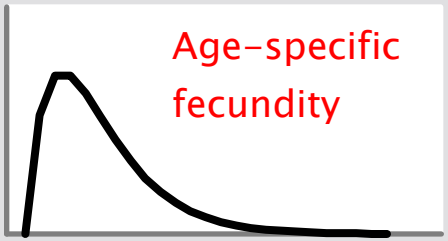
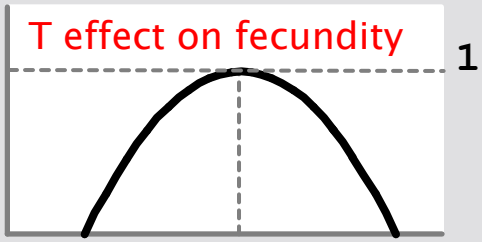
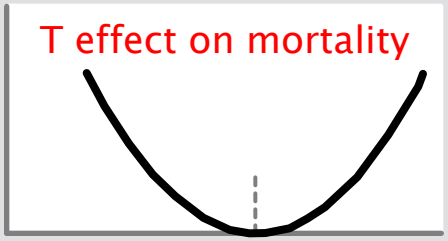


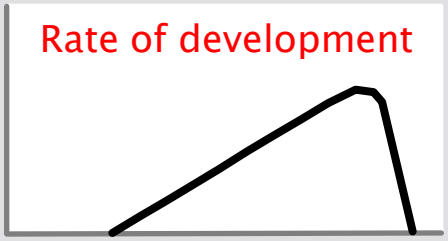
Scalar for eggs per female



Proportion dying per day



1 / days



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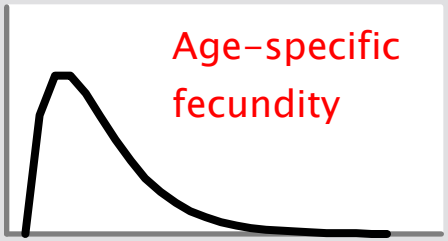
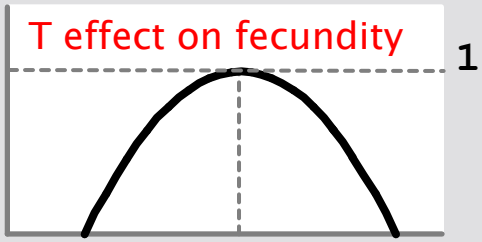


Scalar for eggs per female



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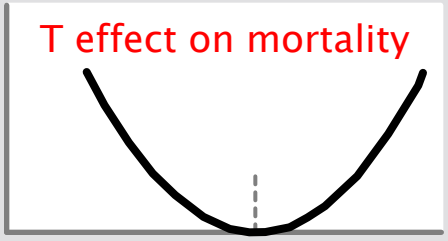
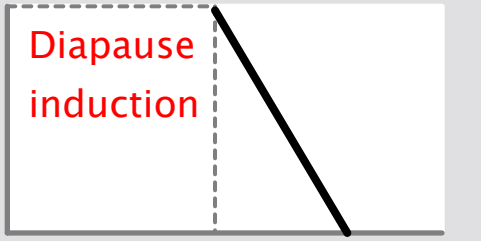
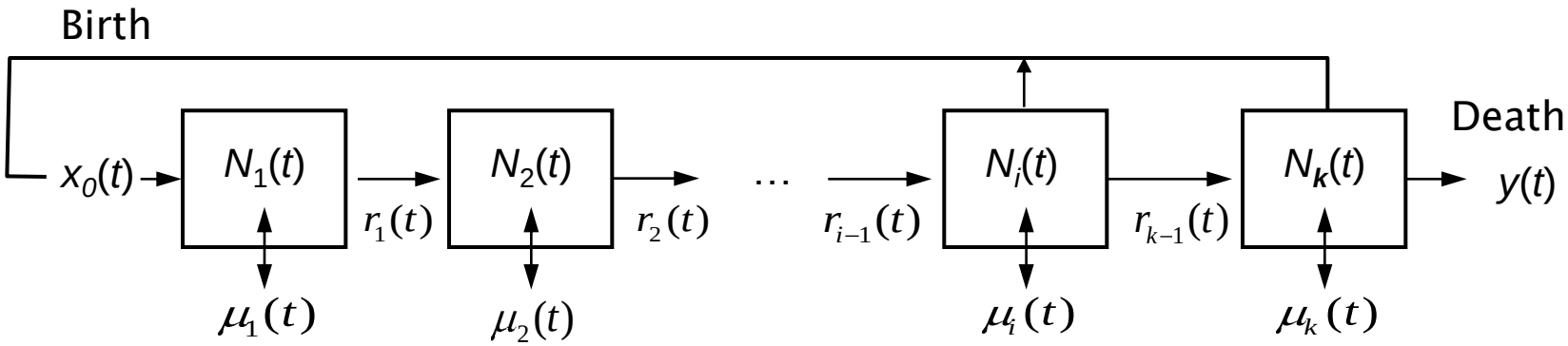
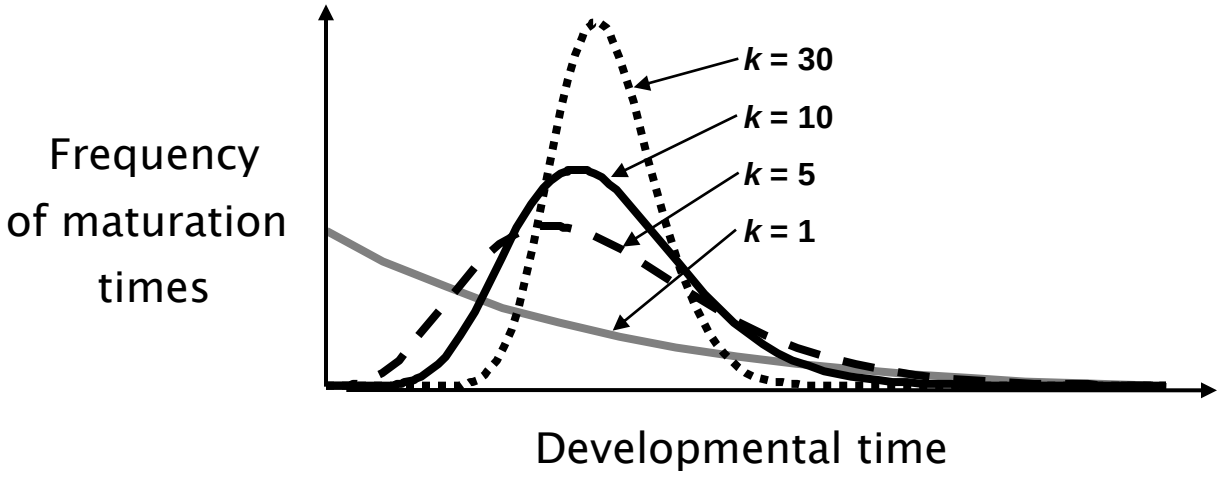


Proportion diapause per day

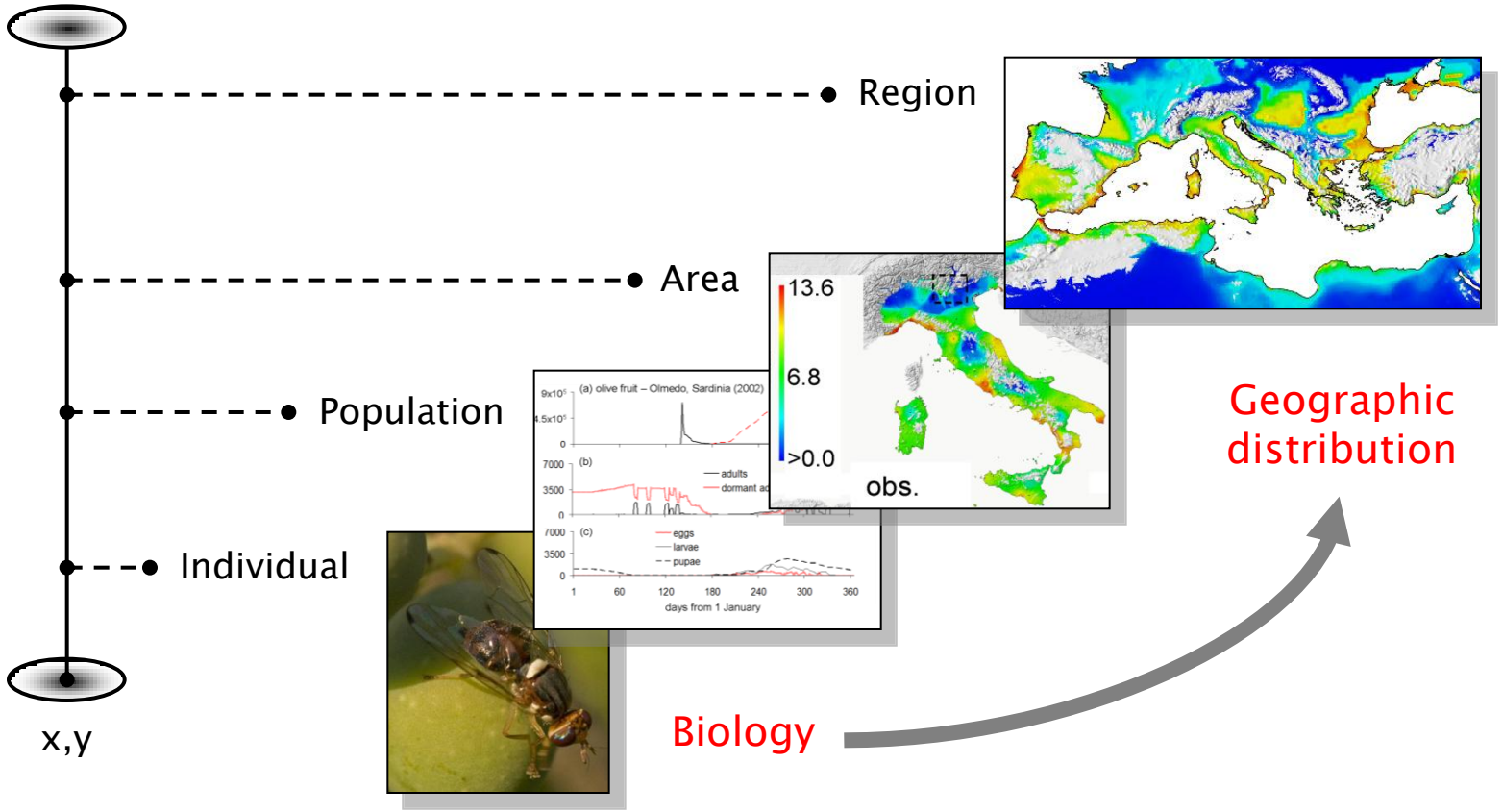


Population dynamics adds more realism (and density) via age structure, distributed delay, and attrition





GIS integration occurs at the population level, factors are modeled on a per-capita basis



Gutierrez, Ponti & Gilioli 2010

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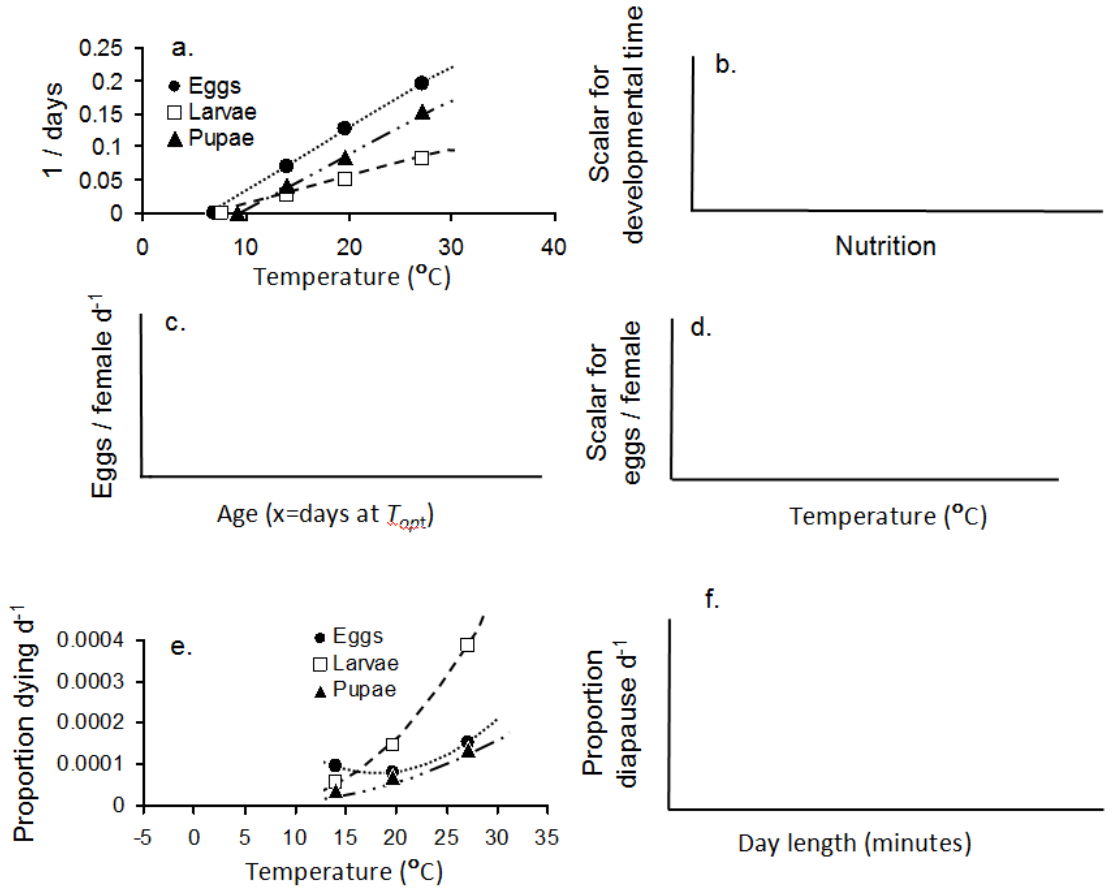
PBDM clearly identifies data gaps in the biology of *T. absoluta* and guides data collection

As of Nov 2013



Ponti et al. submitted

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Joint EFSA-EPPO Workshop "Data collection and information sharing in plant health", EFSA premises, Parma, 1-2-3 April 2014