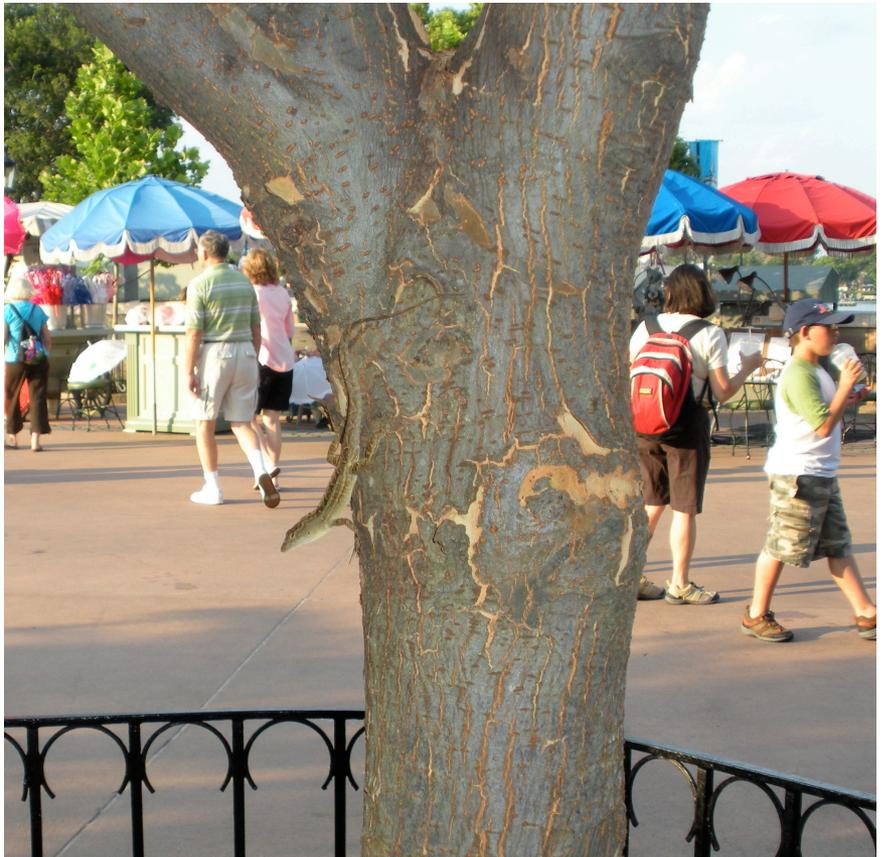


Herpetology 22 November 2022

- "Invasive" species
 - What are they?
 - Examples
 - They are bad
 - They are not so bad
 - Comparing recent and historical invaders



Invasive species

"As per **Executive Order 13112** an 'invasive species' is defined as a species that is:

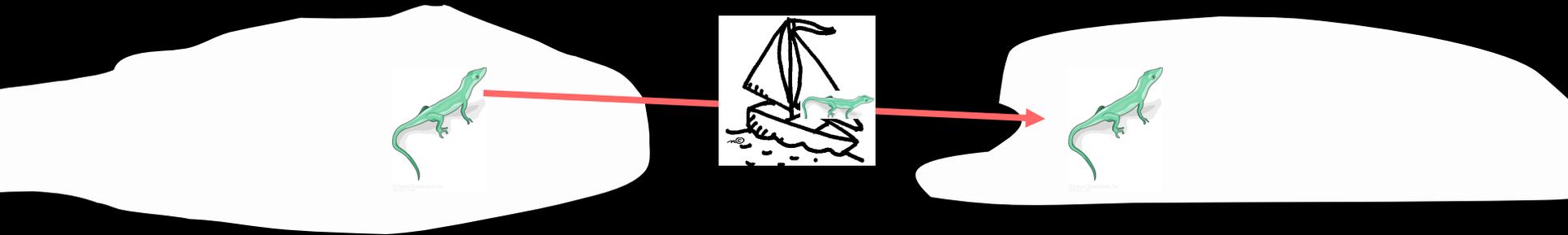
- 1) non-native (or alien) to the ecosystem under consideration and
- 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

Invasive species can be plants, animals, and other organisms (e.g., microbes). Human actions are the primary means of invasive species introductions."

(USDA website)

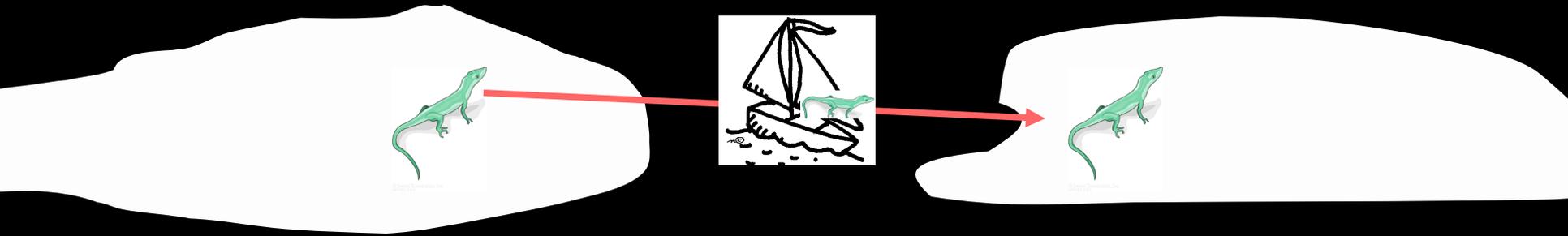
Stages of "invasion"

1. Introduction/transport
Exotic/alien/nonnative

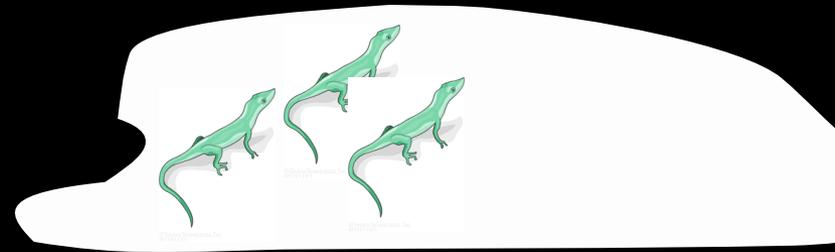


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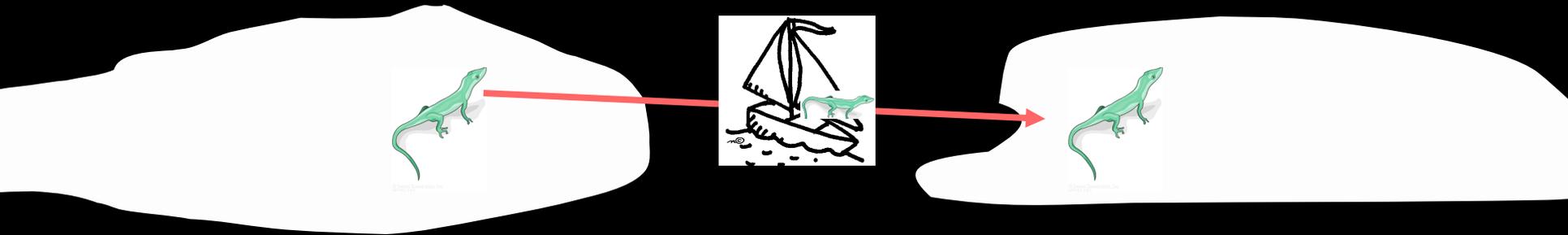


2. Colonization/establishment/naturalization

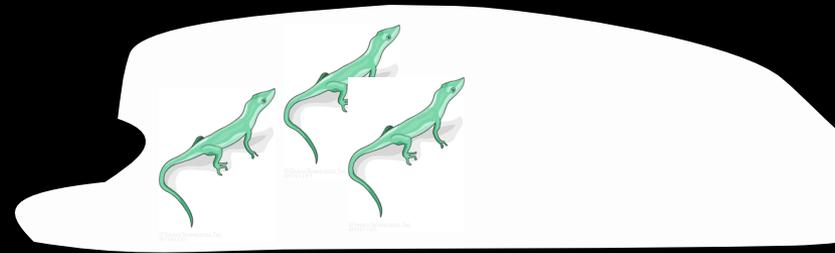


Stages of "invasion"

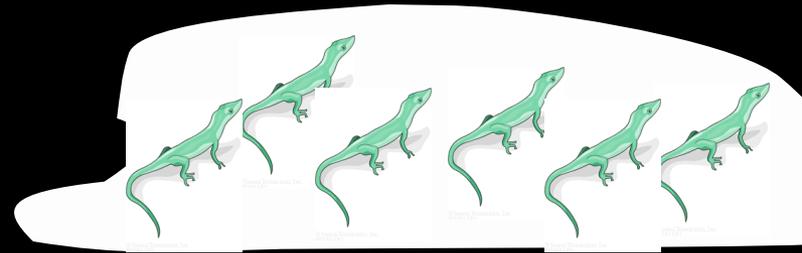
1. Introduction/transport
Exotic/alien/nonnative



2. Colonization/establishment/naturalization



3. Invasion/spread



Boiga irregularis



#105747146

Python bivittatus

TIME

Rhinella marina



1940



1980

Rhinella marina

Cane Toads: An Unnatural History 1988

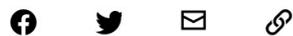
Eleutherodactylus coqui



Tropical Frog's Shrill Mating Song Keeps Southern California Residents Up at Night

The calls are so shrill that they've been mistaken for house alarms.

By JULIA JACOBO
March 18, 2016, 5:23 PM



PEST ALERT!
Stop the Spread of Coqui in Hawaii



Eleutherodactylus coqui



Chamaeleo

Please do not release Jackson's chameleons!

It is illegal, and Jackson's chameleons cause environmental damage by eating native Hawaiian species.

If you have a pet chameleon and no longer wish to keep it, please either euthanize it in a humane fashion (you can put it in the freezer) and dispose of it, or deliver to us live at the University of Hawaii (337 Henke Hall), or a State of Hawaii Department of Agriculture or Department Land and Natural Resources office.

For more information contact:

Dr. Brenden Holland
(808) 956-6176
bholland@hawaii.edu



UNIVERSITY
of HAWAII
MĀNOA



Nonnative species are bad

Nonnative species are bad

- "...when a species is introduced—accidentally or intentionally—into a new landscape that is not used to its presence, the consequences can be **devastating**. ... They push out native species and cause **ecological chaos**."

(Nature Conservancy website)

Nonnative species are bad

- "...when a species is introduced—accidentally or intentionally—into a new landscape that is not used to its presence, the consequences can be **devastating**. ... They push out native species and cause **ecological chaos**."

(Nature Conservancy website)

- "The indirect **threats** of invasive species:
 - **Changing food webs**: Invasive species can **change the food web** in an ecosystem by destroying or replacing native food sources.
 - **Decreasing biodiversity**: Invasive species can **alter the abundance or diversity of species** that are important habitat for native wildlife.
 - **Altering ecosystem conditions**: Some invasive species are capable of **changing the conditions in an ecosystem**, such as changing soil chemistry or the intensity of wildfires."

(National Wildlife Federation website)

Nonnative species are bad

- Cost billions of dollars per year

Nonnative species are bad

- Cost billions of dollars per year
 - But...
 - evidence for cost is lacking (Sagoff 2019)
 - does not account for economic *gains*
 - native species cost millions too
 - much of this is eradication costs

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Guiasu (2016) showed that in Canada the only cost associated with purple loosestrife (*Lythrum salicaria*), a notorious invader, is the expense of the programs initiated to control it. “If there are no more control programs against purple loosestrife, then, this plant would no longer cost us anything, so the ‘problem’ of our own making would be solved” (p. 207).



OPEN

Global economic costs of herpetofauna invasions

Ismael Soto¹, Ross N. Cuthbert², Antonín Kouba¹, César Capinha^{3,4}, Anna Turbelin⁵,
Emma J. Hudgins⁶, Christophe Diagne⁵, Franck Courchamp⁵ & Phillip J. Haubrock^{1,7}✉

"The cost of invasive herpetofauna totaled at 17.0 billion US\$ between 1986 and 2020...

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...Also, costs were positively correlated with research effort, suggesting research biases towards well-known taxa. So far, **costs have been dominated by predictions and extrapolations (79%)**, and thus empirical observations for impact were relatively scarce."

Nonnative species are bad

- Cost billions of dollars per year
 - But...
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 - does not account for economic *gains*
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 - much of this is eradication costs
- "Damage" ecosystems

Nonnative species are bad

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 - But...
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 - native species cost millions too
 - much of this is eradication costs
- "Damage" ecosystems
 - But...
 - How can an ecosystem be harmed?
 - What the f is "ecological chaos"?

They push out native species and cause **ecological chaos.**"
(Nature Conservancy website)

Nonnative species are bad

- Undeniably, nonnative species change ecosystems

Nonnative species are bad

- Undeniably, nonnative species change ecosystems
 - But...

Change \neq damage, harm, injure,
bad, dysfunction, corruption,
immoral, unethical

Complicating factor: Minimal impact

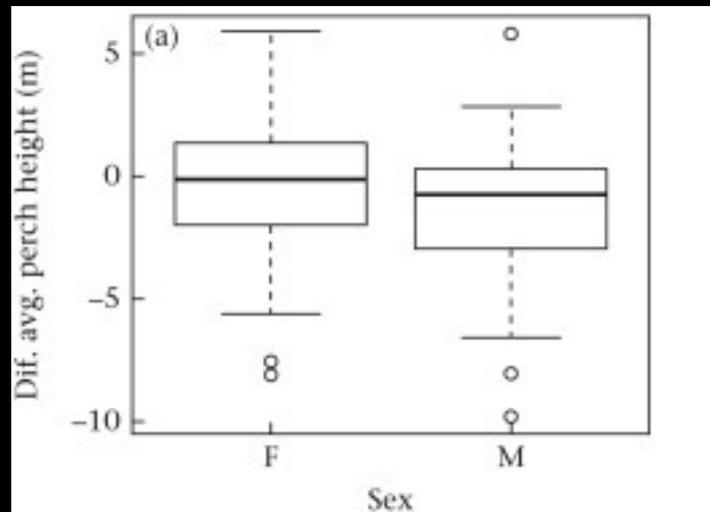
 **Animal Behaviour**
Available online 13 November 2021
In Press, Corrected Proof 



Impacts of an invasive species
(*Anolis sagrei*) on social and spatial
behaviours of a native congener
(*Anolis carolinensis*)

Jordan M. Bush , Michael Ellison, Daniel Simberloff

Where it is invasive, negative effects of *A. sagrei* on native fauna are numerous and include (Losos, et al., 1993), **competition-induced habitat shifts** decreases in population density (Campbell, 1999; Echternacht, 1999), and intraguild predation (Gerber and Echternacht, 2000).
(US EPA)



Complicating factor:
Nonnative species are bad, but...
um...some also need protection



Complicating factor: The Biodiversity issue



“Florida is the cesspool of the world when it comes to introduced species”

Kenneth Krysko, University of Florida

Biodiversity is good

1. Wildlife support healthy ecosystems that we rely on.
2. Keeping biodiverse ecosystems intact helps humans stay healthy.
3. Biodiversity is an essential part of the solution to climate change.
4. Biodiversity is good for the economy.
5. Biodiversity is an integral part of culture and identity.

[conservation.org](https://www.conservation.org)

Biodiversity is good [right? RIGHT?]

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[conservation.org](https://www.conservaion.org)

Florida native vertebrates: **700** species

Florida native + nonnative vertebrates: **1183** species

Nonnative species are OK

- "Nativeness is not a sign of...a species having positive effects."

Davis et al. (2011)

 CellPress

Trends in
Ecology & Evolution

Opinion

Valuing the contributions of non-native species to people and nature

Dov F. Sax,^{1,4,*} Martin A. Schlaepfer ,^{2,5,@} and Julian D. Olden ^{3,6,@}

Potentially positive aspects of nonnative species

- Science

scientific reports

 Check for updates

OPEN Shifts in the foraging tactics of crocodiles following invasion by toxic prey

Abhilasha Aiyer¹, Richard Shine², Ruchira Somaweera³, Tina Bell¹ & Georgia Ward-Fear²✉

JOURNAL ARTICLE

The country toad and the city toad: comparing morphology of invasive cane toads (*Rhinella marina*) from rural and urban environments

Hirotaaka Komine ✉, Kiyomi Yasumiba, Lin Schwarzkopf

Biological Journal of the Linnean Society, Volume 137, Issue 3, November 2022, Pages 450–464,
<https://doi.org/10.1093/biolinnean/blac100>

Published: 02 September 2022 **Article history** ▾

DOI: 10.1111/mec.16347

ORIGINAL ARTICLE

MOLECULAR ECOLOGY WILEY

Brain transcriptome analysis reveals gene expression differences associated with dispersal behaviour between range-front and range-core populations of invasive cane toads in Australia

Boris Yagound¹  | Andrea J. West²  | Mark F. Richardson^{2,3}  | Daniel Selechnik²  | Richard Shine⁴  | Lee A. Rollins^{1,2} 

Potentially positive aspects of nonnative species

- Science
- Ecosystem "health"
- Conservation



Potentially positive aspects of nonnative species

- Science
- Ecosystem "health"
- Conservation
- Aesthetic



Potentially positive aspects of nonnative species

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Potentially positive aspects of nonnative species

- Science
- Ecosystem "health"
- Conservation
- Aesthetic
- Economic
- Biodiversity

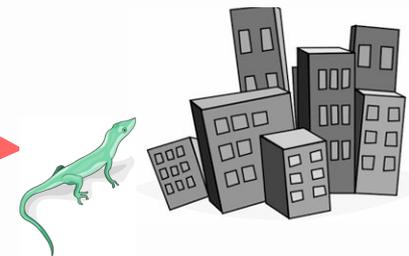
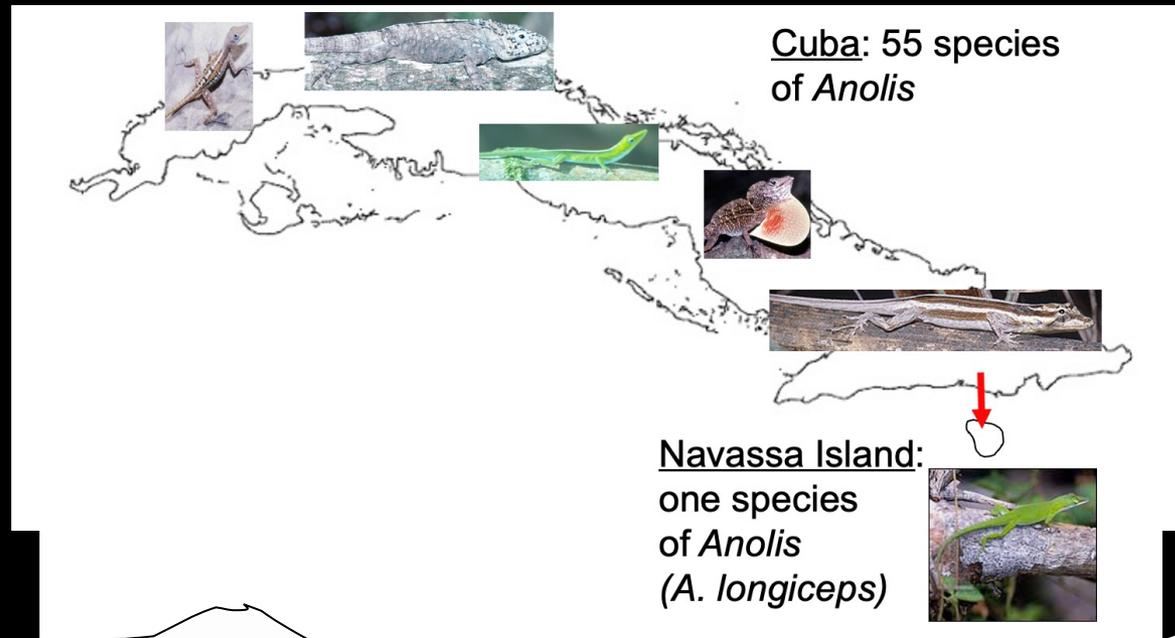




Questions

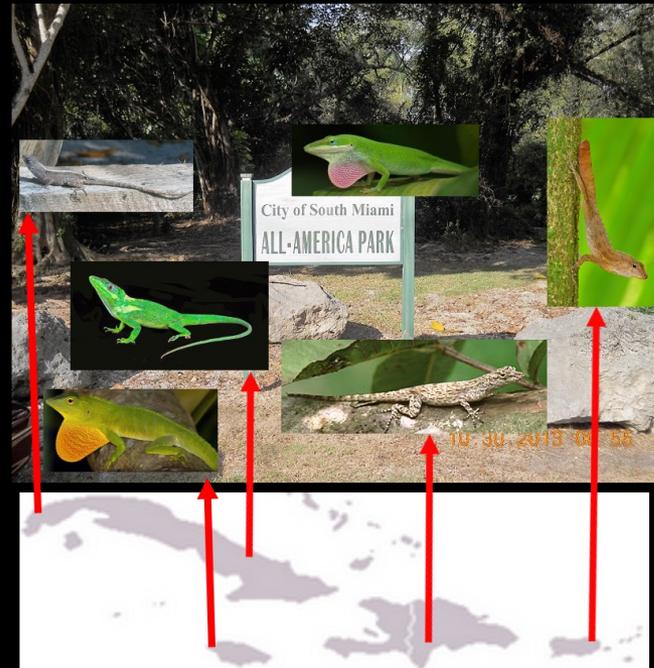
Are ancient colonizers similar to recent invaders?

- Can ancient colonization predict recent naturalization?



Questions

Are recent assemblages structured like ancient assemblages?



Are ancient colonizers similar to recent invaders?

Are recent assemblages structured like ancient assemblages?

If **No**: human interactions are paramount in species invasions

If **Yes**: although humans clearly play a role in recent invasions, they may simply accelerate rather than fundamentally alter omnipresent natural processes



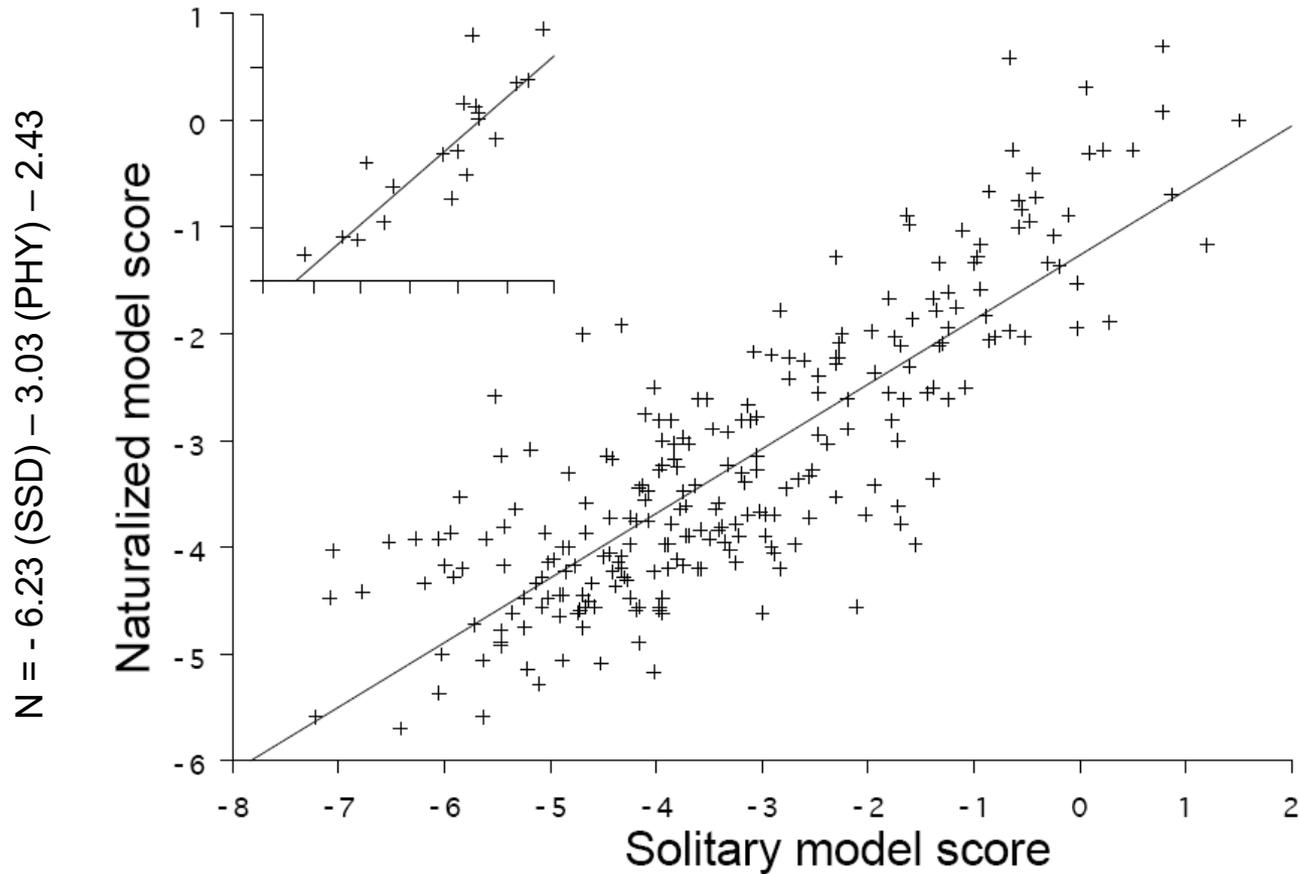
"Can ecologists tell which is which [native vs. nonnative] simply by examining the two systems and their species without knowledge of their history? Is there any biological, as distinct from historical, fact that would tip off the ecologist that he or she is studying a colonized and, in that way, corrupted or disrupted system?"

Mark Sagoff (2002)



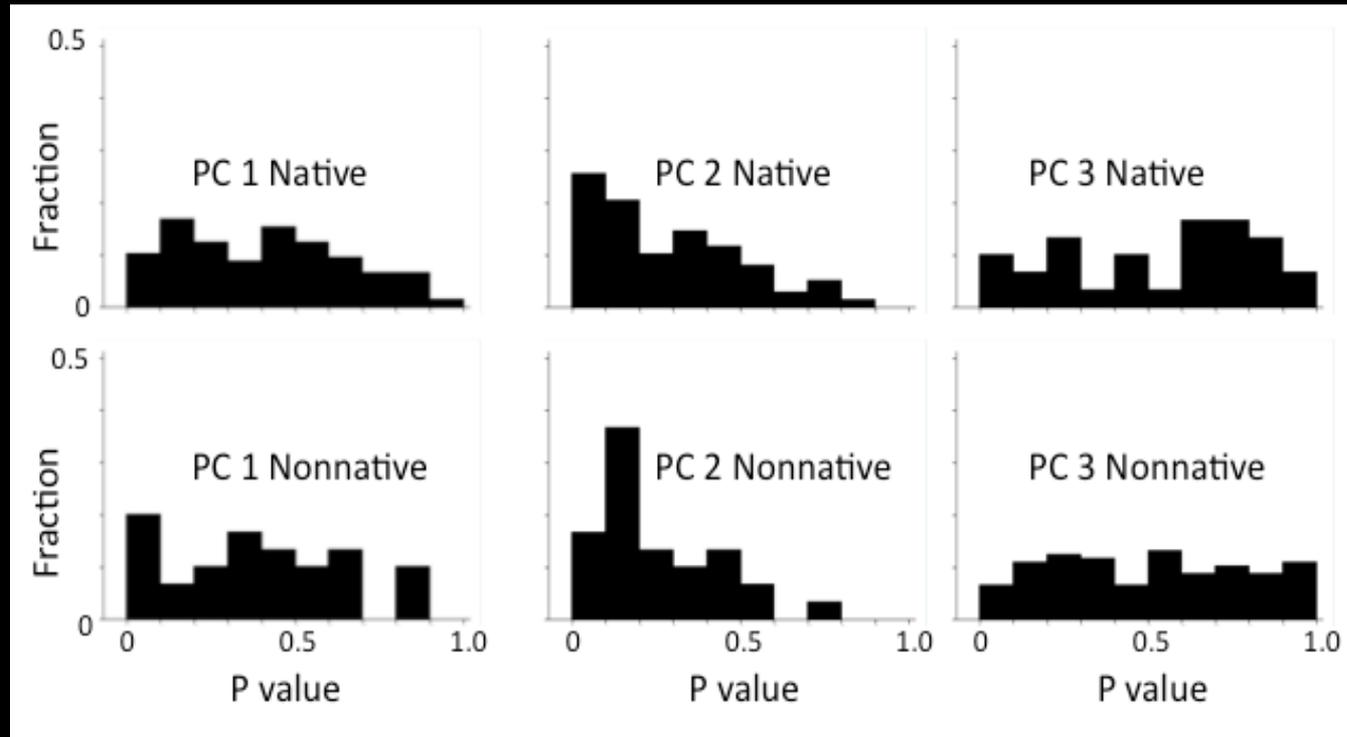
Solitary (evolutionary) colonizers are similar to naturalized species

Comparison of logistic models



$$S = -4.07 (\text{SSD}) + 5.77 (\text{FL}) + 5.72 (\text{LM}) - 4.01 (\text{PHY}) - 1.65$$

Natural and nonnative assemblages are similar in morphological dispersion (both are clustered)





- Invasive species are not necessarily bad
 - Davis et al.

- Invasive species are bad
 - Simberloff et al.

- The evidence for "bad" is not compelling
 - Sagoff
- Value of nonnative species
 - Sax et al.

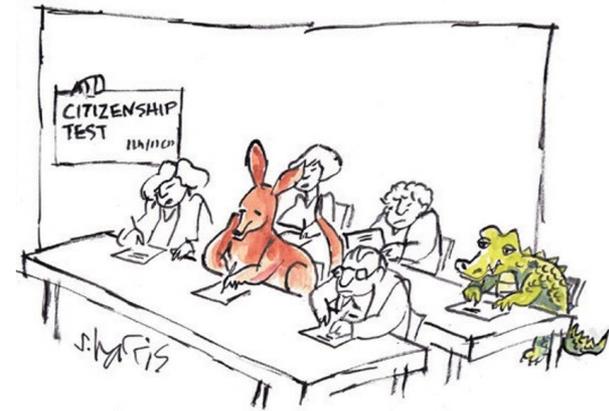
Don't judge species on their origins

Conservationists should assess organisms on environmental impact rather than on whether they are natives, argue **Mark Davis** and 18 other ecologists.

Non-natives: 141 scientists object

We the undersigned feel that in advocating a change in the environmental management of introduced species (*Nature* 474, 153–154; 2011), Mark Davis and colleagues assail two straw men.

First, most conservation biologists and ecologists do not oppose non-native species per se—only those targeted by the Convention on Biological Diversity as threatening “ecosystems,



Conservation Biology

Essay

Fact and value in invasion biology

Mark Sagoff 

Institute
email m

 CellPress

Trends in
Ecology & Evolution

A 22030, U.S.A.,

Opinion

Valuing the contributions of non-native species to people and nature

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