Hawai‘i Gets Hit by New Birds on the Block

Educator guide

PAPER DETAILS

Original title:

Reference: Vol. 364, pp. 78-82

Authors: Jeferson Vizentin-Bugoni, Corey E. Tarwater, Jeffrey T. Foster, Donald R. Drake, Jason M. Gleditsch, Amy M. Hruska, J. Patrick Kelley, Jinelle H. Sperry

Issue name: Science

Original publication date: 5 April 2019

DOI: 10.1126/science.aau8751

Annotator(s): Briana James

TABLE OF CONTENTS

DISCUSSION QUESTIONS

Question	LEARNING STANDARDS
1. How did the replacement of native birds with invasive bird species affect O'ahu's ecosystem?	LS2.A LS2.D RST.11-12.2 EK4.B.3
2. Why was it important for the researchers to collect seed samples from multiple locations?	Scale, proportion, and quantity RST.11-12.2 NS4
3. What are other examples of invasive species?	RST.11-12.4 SP3 EK4.A.5 NS1
4. What can conservationist do to minimize the effects of the invasive bird species on native plants in O'ahu?	LS2.A Stability and change SP3 RST.11-12.6 VC6

ACTIVITIES FOR INTERACTIVE ENGAGEMENT

	LEARNING STANDARDS
Science in the news Students explore news stories in the Related Resources tab and evaluate the stories for tone, accuracy, missing information, etc. They may then write their own news stories on the article.	**RST.9-10.5** **RST.11-12.5** **RST.9-10.6** **RST.11-12.6** **RST.9-10.8** **RST.11-12.8**
Reaction explanation Describe a scenario in which a human activity introduces an invasive species into a habitat.	**LS2.C** **EK4.B.3** **NS1** **VC6**
Results and conclusions Create a simple interaction matrix (similar to Figure 1) that has low specialization and high connectance.	**SEP4** **RST.11-12.8** **RST.9-10.7** **RST.9-10.9** **SP1**
The next steps Students design a follow-on experiment to this study that either addresses flaws or unanswered questions in the research at hand or builds on it to explore a new question.	**SEP4** **EK4.A.5** **Cause and effect** **SP5**

ARTICLE OVERVIEW

Article summary (recommended for educator use only)

On the Hawaiian island of O'ahu, native plants rely on birds to distribute their seeds throughout the island. These interactions create a seed dispersion network, which can be threatened with the introduction of invasive species. Vizentin-Bugoni *et al.* investigate how invasive bird species affect the seed dispersal network on the island. They find that the invasive birds spread predominately non-native plant seeds. However, the invasive birds' seed dispersal patterns mimic the complexity and stability of the seed dispersal pattens of native birds, even though both species are not closely related. Ultimately the authors conclude that these invasives species successfully integrated into the seed dispersion networks of O'ahu, unfortunately at the expense of its native birds and plants.

Importance of this research

In most Hawai'i forests native birds have been replaced by invasive bird species, resulting in the emergence of novel seed dispersion networks. Previous studies have demonstrated the complexity and stability of native-dominated networks, but little research has investigated the interaction patterns involving introduced species and how these novel networks compare to native networks. Vizentin-Bugoni *et al.* performed this study to address these concerns. Their work also demonstrated the importance of studying ecological networks across multiple spatial scales to more accurately generalize interaction patterns.

Experimental methods

- Seed Dispersal Collection: The authors collected fecal samples from 21 bird species over the span of 3 years to identify the seeds of different plant species being dispersed by the birds.
- Interaction Matrices: The authors created a matrix that depicts each seed dispersion event between a bird and plant species, highlighting the interaction patterns and levels of complexity.
- Interaction Dissimilarity: A measurement that calculates the percentage of interaction patterns two sites do not share.
- Compared the seed dispersal network in O'ahu to other seed dispersal networks around the world.

Conclusions

- The invasive bird species in O'ahu distribute seeds predominantly from invasive plant species instead of native plant species.
- Novel seed dispersion networks composed of invasive bird species maintain the complexity and stability of native-dominated seed dispersion networks.

LEARNING STANDARDS ALIGNMENT

The following tables provide an overview of the learning standards covered by this article, including the A Framework for K-12 Science Education (Framework), Common Core State Standards English Language Arts-Literacy (CCSS ELA), Common Core State Standards Statistics and Probability (CCSS HSS), AP Science Practices, and Vision and Change for Undergraduate Education. Where applicable, activities and information will be marked with specific standards to which they are linked.

A Framework for K-12 Science Education		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and interpreting data (SEP4) Analyze data systematically, either to look for salient patterns or to test whether data are consistent with an initial hypothesis. Use spreadsheets, databases, tables, charts, graphs, statistics, mathematics, and information and computer technology to collate, summarize, and display data and to explore relationships between variables, especially those representing input and output.	**LS2.A Ecosystems: Interactions, Energy, and Dynamics** Plants depend on animals for pollination or to move their seeds around. Although the species involved in these mutually beneficial interactions vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared. **LS2.C Ecosystems Dynamics, Functioning, and Resilience** Anthropogenic changes (induced by human activity) in the environment- including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change- can disrupt an ecosystem and threaten the survival of some species. **LS2.D Social Interactions and Group Behavior** Social Interactions and Group Behavior Groups may form because of genetic relatedness, physical proximity, or other recognition mechanisms (which may be species specific).	**Patterns** Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them. **Scale, proportion, and quantity** In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance. **Stability and change** For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Common Core State Standards English Language Arts-Literacy		
Key Ideas and Details	Craft and Structure	Integration of Knowledge and Ideas
RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. **RST.11-12.2** Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.	**RST.9-10.5** Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy). **RST.9-10.6** Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address. **RST.11-12.4** Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics. **RST.11-12.6** Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.	**RST.9-10.7** Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words. **RST.9-10.8** Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem. **RST.9-10.9** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts. **RST.11-12.8** Evaluate the hypotheses, data, analyses, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.

AP Science Standards	
AP Science Practices	AP Biology Content Standards
Science Practice (SP1) The student can use representations and models to communicate scientific phenomena and solve scientific problems. **Science Practice (SP3)** The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the course.	**Essential knowledge 4.A.5 (EK4.A.5)** Communities are composed of populations of organisms that interact in complex ways. The structure of a community is measured and described in terms of species composition and species diversity. Mathematical or computer models are used to illustrate and investigate population interactions within and environmental impacts on a community. **Essential knowledge 4.B.3 (EK4.B.3)** Interactions between and within populations influence patterns of species distribution and abundance.

Connections to the Nature of Science	
Vision and Change for Undergraduate Biology Education Core Competencies and Disciplinary Practices	A Framework for K-12 Science Education Understandings About the Nature of Science
Ability to apply the process of science (VC1) Observational strategies. Biology is an evidence-based discipline. **Ability to use modeling and simulation (VC3)** Use mathematical modeling and simulation tools to describe living systems. **Ability to understand the relationship between science and society (VC6)** Evaluating the relevance of social contexts to biological problems.	**Scientific investigations use a variety of methods (NS1)** Scientific inquiry is characterized by a common set of values that include: logical thinking, precision, open-mindedness, objectivity, skepticism, replicability of results, and honest and ethical reporting of findings. New technologies advance scientific knowledge. **Science models, laws, mechanisms, and theories explain natural phenomena (NS4)** Science knowledge is based on empirical evidence. Science disciplines share common rules of evidence used to evaluate explanations about natural systems. Science includes the process of coordinating patterns of evidence with current theory. Science arguments are strengthened by multiple lines of evidence supporting a single explanation.