Project Notes

Project Title: Application of muropeptides for the eradication of invasive plant species
Name: Jackson Whitley
Contents:

Knowledge Gaps:

This list provides a brief overview of the major knowledge gaps for this project, how they were resolved and where to find the information.

Knowledge Gap	Resolved By	Information is located	Date resolved
Melanoma structure and treatment techniques	Online sources. Article #1.	https://doi.org/10.1016/s0140-6736(18)31559-9.	Sept.10th 2024
Enviromental Risks, pollution, and effects on ecosystems	Online sources. Articles #2 and #4 and #8	https://www.nature.com/articles/s41467-024-46818-3 https://www.science.org/doi/10.1126/sciadv.abj5471 https://www.pnas.org/doi/10.1073/pnas.1609633114	I resolved this knowledge gap through research on various sources throughout September
Microplastics (where, why, how, when, who)	Online sources. Article #9 and patent #2.	https://patentimages.storage.googleapis.com/b1/5f/0c/11c3c799777321/US8944253.pdf https://www.science.org/doi/10.1126/sciadv.add2348	Oct 7th, 2024
Muropeptides, what they are and what they do.	Online source. Article #5.	https://www.cell.com/immunity/pdf/S1074-7613(23)00163-2.pdf	Partially resolved, Sept 25th
Both general and specific information on Invasive species and how they work/what they do.	Online sources. Articles #3, #4, #6, #7, #8, #10	https://www.nature.com/articles/s41467-024-46818-3 https://www.science.org/doi/10.1126/sciadv.abj5471 https://www.nature.com/articles/s41467-020-19031-1 https://www.science.org/doi/10.1126/sciadv.1603080	Oct 10th, 2024

		https://www.pnas.org/doi/10.1073/pnas.1609633114 https://www.science.org/doi/10.1126/sciadv.abi8943	

Literature Search Parameters:

These searches were performed between (Start Date of reading) and XX/XX/2019.
List of keywords and databases used during this project.

Database/search engine	Keywords	Summary of search
JSTOR	Invasive plant species removal	Multiple articles on invasives came up and how they affect ecosystems.
Science	Invasive species control	Many articles on different invasives like ants or trout. The one about trout was very interesting and may have been one of my favorites.
Nature	Microplastic Marine Pollution	Lots of research on microplastics. Where they are, what they are, how they affect the ocean.
Science	Microplastic Marine Pollution	Lots of research on microplastics. Where they are, what they are, how they affect the ocean.
Science Direct	Melanoma Clinical Treatment	Treatment methods for melanomas in clinics. Research on the betterment of the methods.
PNAS	Invasive plant species removal	Many articles on this topic. I found one specific to New England and thought it would be really interesting. It's article #8.

Tags:

Tag Name	
#InvasiveRisks	#MicroPlastics

#Melanoma	#DamageToEnvironment
#Muropeptides	#InvasiveAlternative

Article #1 Notes: Title

Article notes should be on separate sheets

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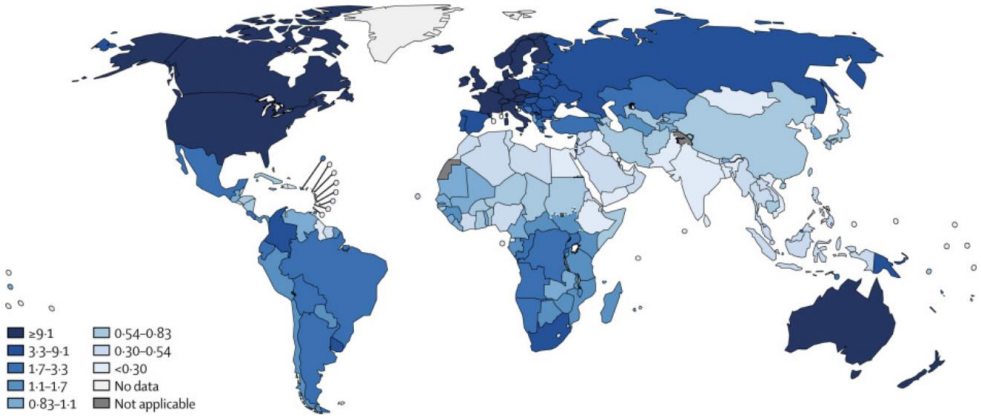
Source Title	
Source citation (APA Format)	
Original URL	
Source type	
Keywords	
#Tags	
Summary of key points + notes (include methodology)	
Research Question/Problem/ Need	
Important Figures	
VOCAB: (w/definition)	
Cited references to follow up on	
Follow up Questions	

Article #1 Notes: Melanoma

Article notes should be on separate sheets

Source Title	Melanoma
Source citation (APA Format)	Schadendorf, Dirk, et al. Melanoma. *The Lancet*, *vol. 392*, no. 10151, Sept. 2018, pp. 971–984, https://doi.org/10.1016/s0140-6736(18)31559-9.
Original URL	https://doi.org/10.1016/s0140-6736(18)31559-9 To get full thing, go to Gordon Library, search "Melanoma", and click 1st one.
Source type	Review article
Keywords	Melanoma, cancer, treatment, detection, care, tumor.
#Tags	#Melanoma
Summary of key points + notes (include methodology)	Cutaneous melanoma is a deadly skin cancer that kills tens of thousands of people every year and is found most commonly in people with freckles and fair hair, eye, and skin colors. Melanomas are classified by their tumor thickness, lymph node action, and existence of metastasis. To treat melanomas, a person must prevent them by reducing UV light exposure, detect them in early stages, and seek clinical care. The treatments used on cutaneous melanoma tumors are proving to be a model for general cancerous tumor treatment and have been successfully increasing survival rates.
Research Question/Problem/ Need	What is cutaneous melanoma and how is it screened for and managed?
Important Figures	 Download: Download high-res image (713KB) Download: Download full-size image Figure 1. Estimated age-standardised worldwide incidence of cutaneous melanoma in both men and women in 2012

VOCAB: (w/definition)	Cutaneous – of or relating to the skin Malignant – infectious, cancerous Endogenous – having an internal cause or origin Exogenous – having an external cause or origin Proliferative – to increase or multiply rapidly
Cited references to follow up on	Boniol M, Autier P, Boyle P, Gandini S. Cutaneous melanoma attributable to sunbed use: systematic review and meta-analysis BMJ 2012; 345 :e4757 doi:10.1136/bmj.e4757
Follow up Questions	How can we use new technology like AI to help detect or treat melanomas? How can we increase the likelihood of melanomas being detected earlier? How can we mitigate the damage to our skin from UV light?

Article #2 Notes: Carbon emissions from the 2023 Canadian wildfires

Article notes should be on separate sheets

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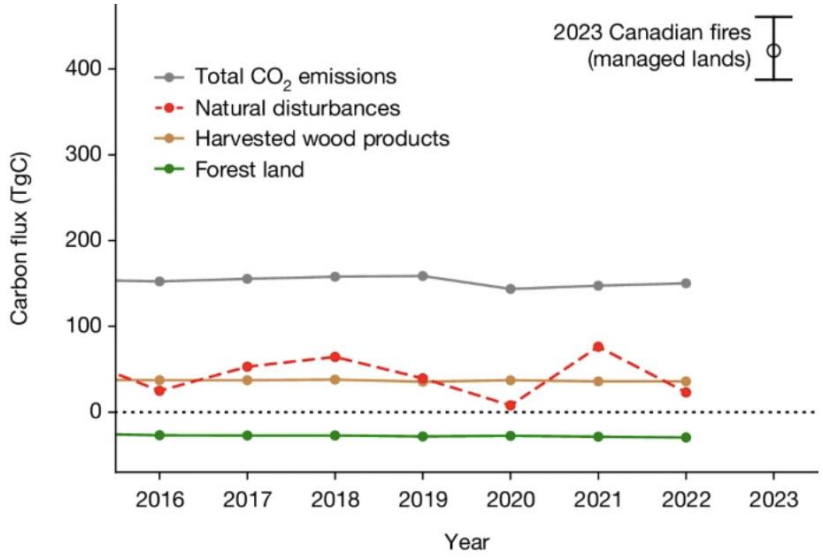
Source Title	Carbon emissions from the 2023 Canadian wildfires
Source citation (APA Format)	Byrne, B., Liu, J., Bowman, K. W., Pascolini-Campbell, M., Chatterjee, A., Pandey, S., Miyazaki, K., van der Werf, G. R., Wunch, D., Wennberg, P. O., Roehl, C. M., & Sinha, S. (2024b). Carbon emissions from the 2023 Canadian wildfires. *Nature*. https://doi.org/10.1038/s41586-024-07878-z
Original URL	https://www.nature.com/articles/s41586-024-07878-z
Source type	Research article
Keywords	Forest fires, carbon emissions, weather, conditions, climate,
#Tags	#DamageToEnviroment
Summary of key points + notes (include methodology)	The Canadian wildfires are extremely harmful to the environment and have only reached further and damaged more forests in the last couple of years. To track and quantify the fires, researchers in this study used satellite images and inverse carbon monoxide modelling to assess the situation and conclude the amount of CO2 released. The increasing temperatures in the coming decades

	are worrying as they will typically be much higher.
Research Question/Problem/ Need	How can we quantify the amount of carbon released from the Canadian wildfires in 2023 and how can we predict future data?
Important Figures	**Fig. 4: Canada's NGHGI CO_2 emissions and removals compared with the 2023 Canadian fires.**  Lines show the annual net emissions or removals from managed forest land (green), harvested wood products (brown), natural disturbances that are not counted towards Canada's emissions (red) and the economy-wide net CO_2 emissions (grey). The top-down estimates of the 2023 CO_2 + CO fires emissions over managed land are shown in black. Total CO_2 emissions, harvested wood products and forest land emissions and removals were obtained from Table A11-1 of the NGHGI[32], whereas natural disturbances were obtained from Table 6-5 of the NGHGI. All quantities presented are in units of teragrams of carbon (1 TgC = 1 MtC = 1,012 gC), which can be converted to units of megatonnes of CO_2 ($MtCO_2$) by multiplying by a factor of 3.664.
VOCAB: (w/definition)	Anomalies- Something that deviates from what is standard, normal, or expected. Assimilation - the process of taking in and fully understanding information or ideas. Deficit - the amount by which something is too small. Concurrent - existing, happening, or done at the same time. Ensemble - a group of items viewed as a whole rather than individually.
Cited references to follow up on	Kitzberger, T., Falk, D. A., Westerling, A. L. & Swetnam, T. W. Direct and indirect climate controls predict heterogeneous early-mid 21st century wildfire burned area across western and boreal North America. PLoS ONE 12, 0188486 (2017).
Follow up Questions	How can we reduce the bare amount of carbon released from the atmosphere? What can we do to stop forest fires? Are there mechanisms in place to detect and put out fires in early stages?

Article #3 Notes: Risks posed by invasive species to the provision of ecosystem services in Europe

Article notes should be on separate sheets

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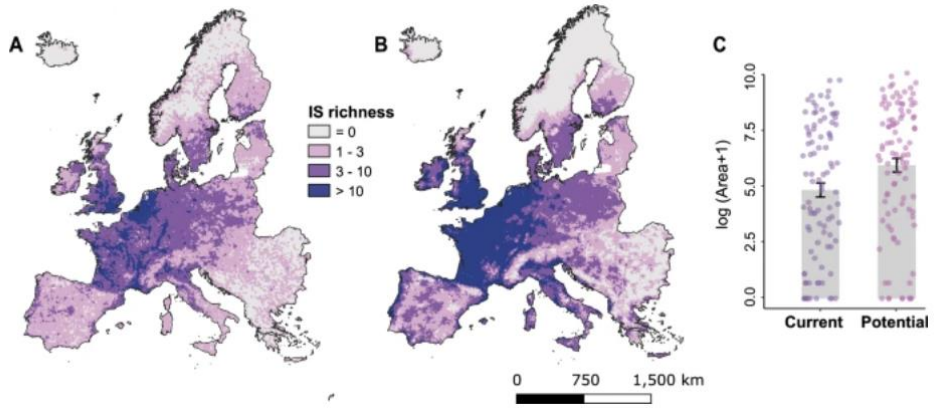
Source Title	Risks posed by invasive species to the provision of ecosystem services in Europe

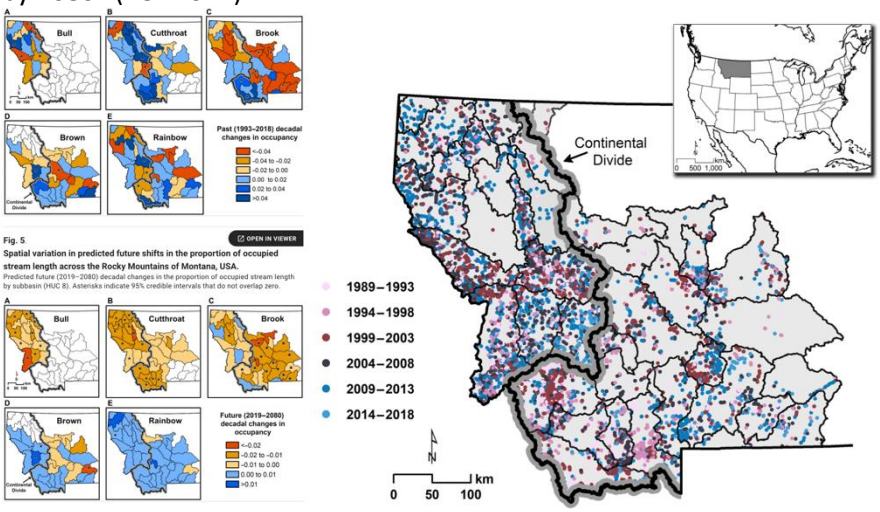
Source citation (APA Format)	Gallardo, B., Bacher, S., Barbosa, A.M. et al. Risks posed by invasive species to the provision of ecosystem services in Europe. Nat Commun *15, 2631* (2024). https://doi.org/10.1038/s41467-024-46818-3
Original URL	https://www.nature.com/articles/s41467-024-46818-3
Source type	Journal
Keywords	Biodiversity- the variety of life in the world or in a particular habitat or ecosystem. Ecosystem- a biological community of interacting organisms and their physical environment. Invasive- tending to spread prolifically and undesirably or harmfully. Native- of indigenous origin or growth. Ecosystem services- benefits that humans receive from healthy ecosystems
#Tags	#InvasivesRisks. #DamageToEnviroment
Summary of key points + notes (include methodology)	It is difficult to understand the large impacts that invasive species have on ecosystems. To discover more, scientists assessed the risks of almost a hundred European invasive species in the future and present. Areas in Europe with considerable ecosystem services were seen to have less invasive species and in contrast, areas with little to no services had many invasive species. The journal, with these findings, concludes that these hotspots of environmental benefits need to be protected from the invasion of non-native species.
Research Question/Problem/ Need	How do invasive species affect ecosystems and ecosystem services in Europe?
Important Figures	**Fig. 2: Current and potential exposure to 94 invasive species regulated in Europe.**  **A** Current exposure is measured based on the real number of invasive species currently present using occurrences. **B** Potential exposure is based on species distribution model predictions of invasive species establishment. **C** Barplot showing the average area (+SD) under current and potential exposure to invasive species of concern in Europe, respectively. Please note that, to facilitate visualization, the area has been log-transformed. Differences between Current and Potential are highly significant according to a paired Student's *t* test ($t = -7.14$, df = 93, $P < 0.001$).

VOCAB: (w/definition)	Niche- a comfortable or suitable position in life or employment. Propagule- a vegetative structure that can become detached from a plant and give rise to a new plant. Terrestrial - of, on, or relating to the earth.
Cited references to follow up on	IPBES. Thematic Assessment Report on Invasive Alien Species and their Control of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. (IPBES Secretariat, 2023).
Follow up Questions	Can we predict and quantify the movement of invasive species to new areas using modern technology like machine learning? How can we stop invasive species from ever leaving their native ecosystem?

Article #4 Notes: Climate change and expanding invasive species drive widespread declines of native trout in the northern Rocky Mountains, USA

Article notes should be on separate sheets

Source Title	Climate change and expanding invasive species drive widespread declines of native trout in the northern Rocky Mountains, USA
Source citation (APA Format)	Donovan A. Bell *et al.*, Climate change and expanding invasive species drive widespread declines of native trout in the northern Rocky Mountains, USA. *Sci. Adv.* **7**,eabj5471(2021).DOI:10.1126/sciadv.abj547
Original URL	https://www.science.org/doi/10.1126/sciadv.abj5471 DOI: 10.1126/sciadv.abj547
Source type	Research Article
Keywords	Biodiversity, Climate change, invasive, Species, native.
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	Climate change and invasive species are both extremely harmful to native species and seriously threaten global biodiversity. This study researched the combined effects of climate change and invasive species on trout populations

	in the Rocky Mountains of the Western United States. To track and analyze five species of invasive and native trout, the study used over twenty thousand surveys from the last couple of decades. It was determined that from 1993-2018, the two native trout populations, bull trout and cutthroat trout, had declined by 18% and 6% correspondingly with much more reduction predicted in future years. Although the paper also discovered that the bull trout's decline was greatly due to the increasing temperature and warming climate, while the cutthroat trout's decline was conflictingly most likely due to the invasive species of that region. This finding indicates the importance and need of individual, specialized treatment for each independent species threatened by the dangers of the 21st century.
Research Question/Problem/ Need	How does climate change and invasive species affect the native trout populations of the Rocky Mountains both in the present and future?
Important Figures	"We found that the occupancy of native bull trout and cutthroat trout declined by 18 and 6%, respectively (1993–2018)" (Bell 2021) "[Trout populations are] predicted to decrease by an additional 39 and 16% by 2080" (Bell 2021) 
VOCAB: (w/definition)	Biota- the animal and plant life of a particular region, habitat, or geological period. Regimes- a system or planned way of doing things. Portend - be a sign or warning that something dramatic is likely to happen.
Cited references to follow up on	https://onlinelibrary.wiley.com/doi/10.1111/fwb.12081 Climate-induced changes in the distribution of freshwater fish: Observed and predicted trends
Follow up Questions	How can we decipher the root of a species' decline in population? How can we determine the species-specific treatment for populations?

Article #5 Notes: Methotrexate suppresses psoriatic skin inflammation by inhibiting muropeptide transporter SLC46A2 activity

Article notes should be on separate sheets

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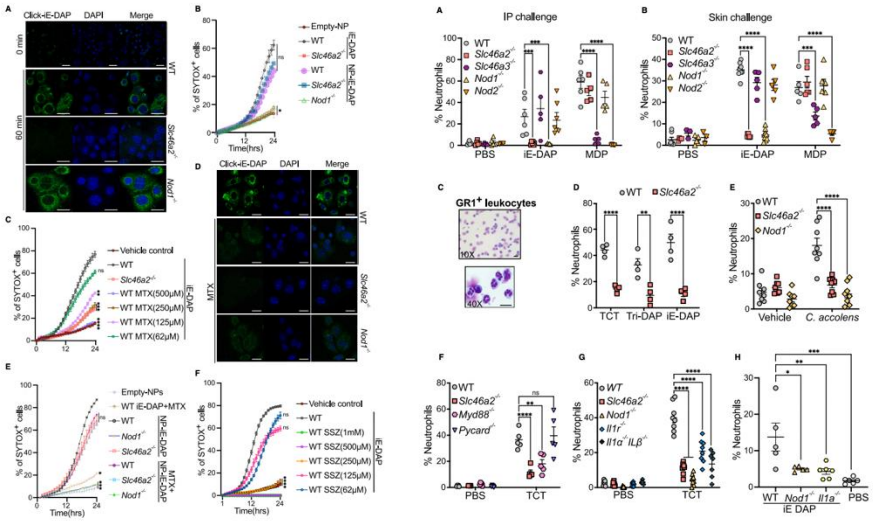
Source Title	Methotrexate suppresses psoriatic skin inflammation by inhibiting muropeptide transporter SLC46A2 activity
Source citation (APA Format)	Bharadwaj R, Lusi CF, Mashayekh S, Nagar A, Subbarao M, Kane GI, Wodzanowski KA, Brown AR, Okuda K, Monahan A, Paik D, Nandy A, Anonick MV, Goldman WE, Kanneganti TD, Orzalli MH, Grimes CL, Atukorale PU, Silverman N. Methotrexate suppresses psoriatic skin inflammation by inhibiting muropeptide transporter SLC46A2 activity. Immunity. 2023 May 9;56(5):998-1012.e8. doi: 10.1016/j.immuni.2023.04.001. Epub 2023 Apr 27. PMID: 37116499; PMCID: PMC10195032.
Original URL	https://www.cell.com/immunity/pdf/S1074-7613(23)00163-2.pdf DOI: 10.1016/j.immuni.2023.04.001
Source type	Research Article
Keywords	Muropeptides, cells, immune/ity, transport/ers, inflammatory, barrier, NOD1, NOD2, Slc46a2
#Tags	#Muropeptides
Summary of key points + notes (include methodology)	NOD1 and NOD2, protein receptors in humans, are crucial in sensing danger molecules, muropeptides (also known as small peptidoglycan fragments), which are in the cell walls of bacteria. In the research paper, the authors look

	to identify how muropeptides enter the cells to be sensed by NOD1 and NOD2. The article determines Slc46a2 to be the transporter of DAP, diaminopimelic acid muropeptides. Slc46a2 was established to be an important part of the body's immune response to inflammation.
Research Question/Problem/ Need	How do the danger molecules, muropeptides, get into the cells to be sensed by cytosolic innate immune sensors?
Important Figures	
VOCAB: (w/definition)	Methotrexate- a type of drug called an antimetabolite Psoriatic- relating to, affected by, or accompanied by psoriasis (skin condition) Muropeptide- bacterial-derived cell wall components Cytosolic- the fluid portion of the cytoplasm Peptidoglycan- a large macromolecule that's a vital component of bacterial cell walls Epithelial- the cells that line the internal and external surfaces of the body Keratinocytes- a cell of the epidermis that produces keratin
Cited references to follow up on	Irazoki, O., Hernandez, S.B., and Cava, F. (2019). Peptidoglycan muropeptides: release, perception, and functions as signaling molecules. Front. Microbiol. 10, 500. https://doi.org/10.3389/fmicb.2019.00500.
Follow up Questions	Now that we understand what NOD1 is and its importance in anti-inflammation can we suppress it and kill cells? If so, how could I use something like this to harm invasive plants? And will it be completely environmentally safe unlike some other alternatives like pesticides?

Article #6 Notes: Smaller climatic niche shifts in invasive than non-invasive alien ant species

Article notes should be on separate sheets

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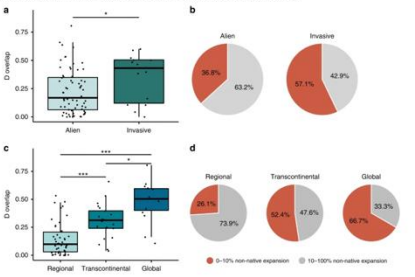
Source Title	Smaller climatic niche shifts in invasive than non-invasive alien ant species
Source citation (APA Format)	Bates, O.K., Ollier, S. & Bertelsmeier, C. Smaller climatic niche shifts in invasive than non-invasive alien ant species. *Nat Commun* **11**, 5213 (2020). https://doi.org/10.1038/s41467-020-19031-1
Original URL	https://www.nature.com/articles/s41467-020-19031-1
Source type	Research article
Keywords	Dispersal, alien, biodiversity, climates, native, niche, range,
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	Humans have spread thousands of invasive species across the world and displaced many natural ecosystems. This article seeked to determine whether invasive ant species spread more than native ones. The article concludes that surprisingly, non-invasive alien ant species do in fact expand their habitats much more than invasives. The article performed tests and calculations to discover that all but two of the many species had significant differences in niches between non-invasive and invasive plants.
Research Question/Problem/ Need	Do invasive species expand more into novel climates than non-invasive alien species and if so, how?
Important Figures	Median number of occurrence points per species: 209, range: 27–3531. (Bates 2020)

	Fig. 2: Comparison of niche similarity between the native and non-native ranges of different ant species using different definitions of invasiveness.  **a** Compared to non-invasive alien species ($n = 68$ species), IUCN-classified invasive species ($n = 14$ species) have a larger D-overlap (Kruskal–Wallis sum rank test, $p = 0.04$) and (**b**) the similar percentages of species that have expanded above 10% (Pearson's chi-squared test). **c** Between species distributed at regional ($n = 46$ species), transcontinental ($n = 21$ species), and global ($n = 15$ species) levels, with increasing levels of global dispersion quantifying higher invasiveness, there are increasing amounts of D-overlap (Post-hoc Dunn test with Benjamini-Hochberg correction, regional-transcontinental, $p < 0.001$; transcontinental-global, $p = 0.02$; regional-transcontinental, $p < 0.001$), and (**d**) decreasing percentage of species with expansion above 10%, as levels of geographical dispersion increase (regional to transcontinental to global, Pearson's chi-squared test). Boxplots elements show; center line, median; box limits, upper and lower quartiles; whiskers, 1.5× interquartile range.
VOCAB: (w/definition)	Niche - a position or role taken by a particular kind of organism within its community. Divergent - tending to be different or develop in different directions. Propensity - an inclination or natural tendency to behave in a particular way. Plasticity - the quality of being easily shaped or molded.
Cited references to follow up on	Van Kleunen, M., Dawson, W., Schlaepfer, D., Jeschke, J. M. & Fischer, M. Are invaders different? A conceptual framework of comparative approaches for assessing determinants of invasiveness. Ecol. Lett. 13, 947–958 (2010).
Follow up Questions	How do we determine whether a non-native species is invasive or not? Are there better ways to limit the dispersal of species and ecosystems due to human globalization?

Article #7 Notes: Globally threatened vertebrates on islands with invasive species

Article notes should be on separate sheets

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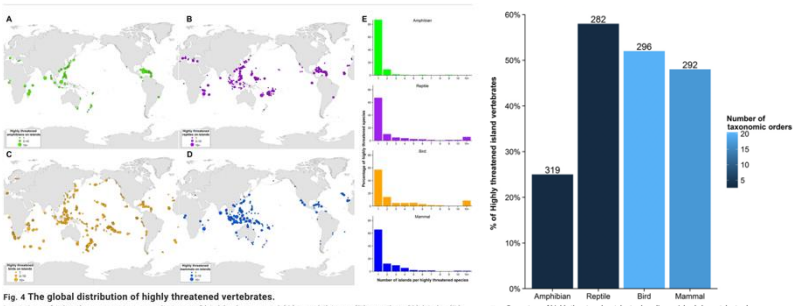
Source Title	Globally threatened vertebrates on islands with invasive species
Source citation (APA Format)	Spatz, D. R., Zilliacus, K. M., Holmes, N. D., Butchart, S. H., Genovesi, P., Ceballos, G., Tershy, B. R., & Croll, D. A. (2017). Globally threatened vertebrates on islands with invasive species. *Science Advances*, *3*(10). https://doi.org/10.1126/sciadv.1603080
Original URL	https://www.science.org/doi/10.1126/sciadv.1603080
Source type	Research Article
Keywords	Biodiversity, terrestrial, vertebrates, island, extinctions, species.
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	On islands, biodiversity is lost much quicker than in mainland ecosystems and invasive plants and animals are driving some species into extinction. To combat this danger, this study researched the distribution and biogeographic patterns of threatened vertebrate and invasive vertebrates in almost five hundred thousand islands across the globe. Five percent of the entire world's vertebrates and forty one percent of the entire world endangered vertebrates live on these islands. This research can provide a framework for further invasive species management in island ecosystems.
Research Question/Problem/ Need	What are the distribution and biogeographic patterns of highly threatened terrestrial vertebrates and invasive vertebrates on islands worldwide?
Important Figures	1189 highly threatened vertebrate species (319 amphibians, 282 reptiles, 296 birds, and 292 mammals) breed on 1288 islands. (Spatz 2017) Invasive vertebrates were absent from 24% of these islands, where biosecurity to prevent invasions is a critical management tool. On the 76% of islands where invasive vertebrates were present, management could benefit 39% of Earth's highly threatened vertebrates. (Spatz 2017)

	 **Fig. 4 The global distribution of highly threatened vertebrates.** Location of islands supporting populations of highly threatened (**A**) amphibians, (**B**) reptiles, (**C**) birds, (**D**) mammals, and the number of islands with breeding populations per highly threatened species (**E**). **Fig. 1 Percentage of highly threatened vertebrates breeding on islands by vertebrate class.** Numbers above the bar give the total number of highly threatened species that breed on islands. Color shading indicates the number of taxonomic orders within each island vertebrate class.
VOCAB: (w/definition)	Terrestrial - of, on, or relating to the earth Germination - the process by which a plant grows from a seed into a seedling Endemics - species or diseases that are specific to a certain area or population Elucidated - make (something) clear; explain
Cited references to follow up on	D. Dudgeon, A. H. Arthington, M. O. Gessner, Z.-I. Kawabata, D. J. Knowler, C. Lévêque, R. J. Naiman, A.-H. Prieur-Richard, D. Soto, M. L. J. Stiassny, C. A. Sullivan, Freshwater biodiversity: Importance, threats, status and conservation challenges. Biol. Rev. Camb. Philos. Soc. 81, 163–182 (2006).
Follow up Questions	How can we protect island vertebrates from invasive and exotic species? How are invasive species different in island ecosystems than on mainland ones? Are islands relatively easier to protect from invasive species than the mainland because of their isolation?

Article #8 Notes: Climate change both facilitates and inhibits invasive plant ranges in New England

Article notes should be on separate sheets

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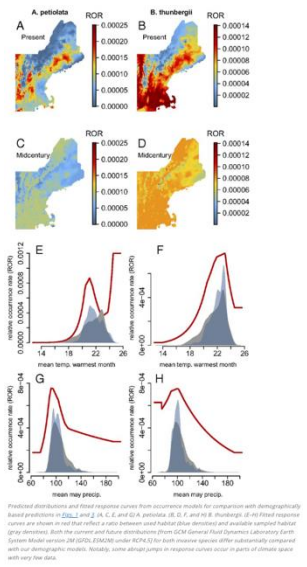
Source Title	Climate change both facilitates and inhibits invasive plant ranges in New England
Source citation (APA Format)	Merow, C., Bois, S. T., Allen, J. M., Xie, Y., & Silander, J. A. (2017). Climate change both facilitates and inhibits invasive plant ranges in New England. *Proceedings of the National Academy of Sciences*, *114*(16). https://doi.org/10.1073/pnas.1609633114
Original URL	https://www.pnas.org/doi/10.1073/pnas.1609633114
Source type	Research article
Keywords	Invasive, conditions, climate, environments, native, habitat, community,
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	The article used experimental biogeography to predict the distribution of invasive species in the future climates of New England, United States and connect populations to their environments. The article studies how invasive plant species, one in which I spent my summer removing from my hometown of Harvard, Japanese Barberry were distributed across NE. The study predicted the future decrease in the second invasive species that was studied, A. petiolata, due to climate change.
Research Question/Problem/ Need	How can we predict the ecological responses to climate change, invasion, and their interaction?

Important Figures	
VOCAB: (w/definition)	Extrapolation - the action of estimating or concluding something by assuming that existing trends will continue, or a current method will remain applicable. Demography - the study of statistics which illustrate the changing structure of populations. Biogeography - the branch of biology that deals with the geographical distribution of plants and animals.
Cited references to follow up on	JM Allen, BA Bradley, Out of the weeds? Reduced plant invasion risk with climate change in the continental United States. Biol Conserv 203, 306–312 (2016).
Follow up Questions	Can we create a machine learning model that can predict the future invasion of exotic and invasive species? Could this model find the weak spots and strong points of ecosystems? Can it possibly adapt to do diverse ecosysstems across the world?

Patent #1 Notes: SYSTEM AND METHODS FOR IMPLEMENTING AN UNMANNED AIRCRAFT TRACKING SYSTEM

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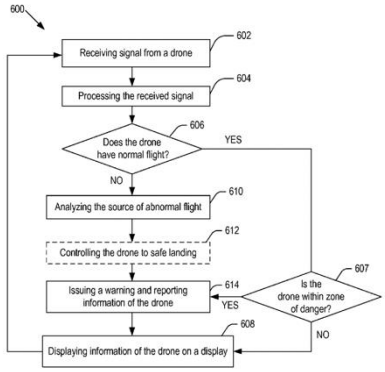
Source Title	SYSTEM AND METHODS FOR IMPLEMENTING AN UNMANNED AIRCRAFT TRACKING SYSTEM
Source citation (APA Format)	Sung Ho Rhee. (2017). SYSTEM AND METHODS FOR IMPLEMENTING AN UNMANNED AIRCRAFT TRACKING SYSTEM (Patent No. US20170004714A1). DREAMSPACEWORLD CO. LTD. https://patentimages.storage.googleapis.com/dd/45/36/8ef7d72ab14047/US20170004714A1.pdf
Original URL	https://patentimages.storage.googleapis.com/dd/45/36/8ef7d72ab14047/US20170004714A1.pdf
Source type	Patent
Keywords	Drone, monitor, information, device, display, danger.
#Tags	
Summary of key points + notes (include methodology)	Drones in the future will get more agile, cheaper, and possibly even lethal due to military use. This patent created a computer readable medium that can receive information from a drone via a communication unit, display that information from the drone on a display of a device; and respond to detection of a danger posed by the drone, issuing a warning of the danger.
Research Question/Problem/ Need	How can we make drones safer with the inevitable technological advancement that can possibly increase their lethal capabilities?

Important Figures	 FIG. 6 Here is a diagram of how the invention works. It starts at 602 and goes to 608 then repeats.
VOCAB: (w/definition)	Transitory - not permanent Tangible - perceptible by touch Aggregate - form or group into a class or cluster
Cited references to follow up on	Anderton, Donald C., "Synchronized Line-Scan LIDAR/EO Imager for Creating 3D Images of Dynamic Scenes: Prototype II," Utah State University, All Graduate Plan B and Other Reports, 2005, 148 pages.
Follow up Questions	How can we use drones to track invasive species? Can a program be created to identify invasive plants from satellite or at least just bird's eye view images? Can AI be used to identify and distinguish invasive and native species to assess the damage of exotic species in certain areas and prepare them for removal?

Patent #2 Notes: Marine microplastic removal tool

Article notes should be on separate sheets

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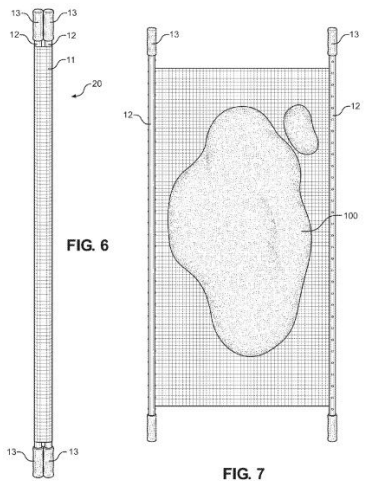
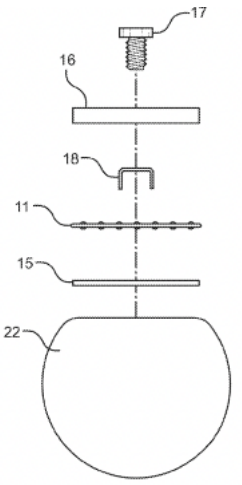
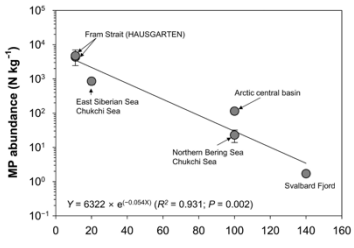
Source Title	Marine microplastic removal tool
Source citation (APA Format)	Marc Ward. (2015). Marine Microplastic Removal Tool. (Patent No. US8944253B2). https://patentimages.storage.googleapis.com/b1/5f/0c/11c3c799777321/US8944253.pdf
Original URL	https://patentimages.storage.googleapis.com/b1/5f/0c/11c3c799777321/US8944253.pdf
Source type	Patent
Keywords	Microplastic, particles, removal, tools.
#Tags	#MicroPlastics
Summary of key points + notes (include methodology)	The invention is a hand tool that can be used to sift sand on beaches and shorelines. It specifically targets the microplastic particles in the sand and seeks to remove them. The invention provides a new tool that can be used to provide convenience for beachfront owners and cleanup crews who remove microplastic particles that have been deposited in the beach sand.
Research Question/Problem / Need	How can the deposited marine microplastic particles be removed from along beaches and shorelines?

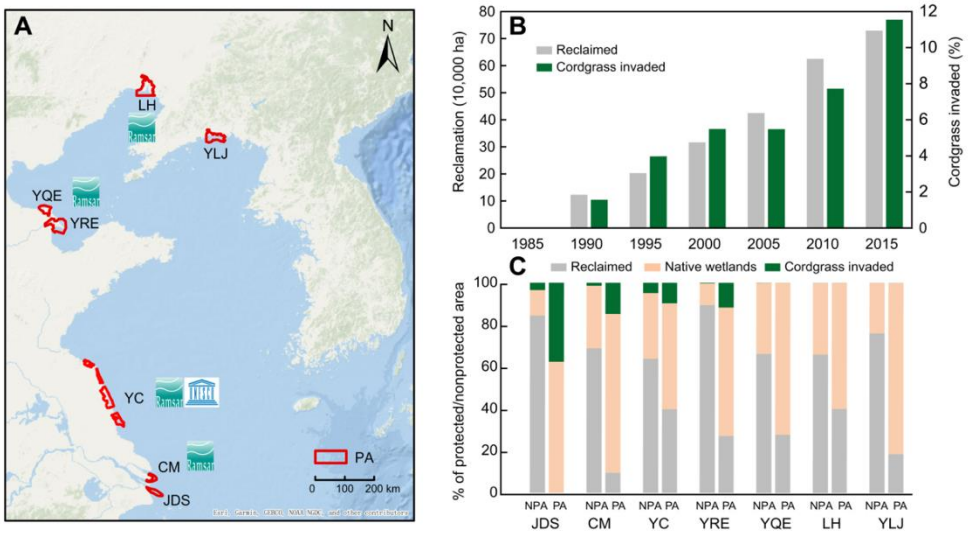
Important Figures	 FIG. 6 FIG. 7 
VOCAB: (w/definition)	Substrate - an underlying substance or layer. Apertures- an opening, hole, or gap. Conjunction - the action or an instance of two or more events or things occurring at the same point in time or space
Cited references to follow up on	Westgard, C. (2014, April 1). Sifting implement and methods of using the same.
Follow up Questions	How can this sieve be used in the ocean? Can it work underwater? Attached to a boat? How can this be used on a larger scale?

Article #9 Notes: Arctic Ocean sediments as important current and future sinks for marine microplastics missing in the global microplastic budget

Source Title	Arctic Ocean sediments as important current and future sinks for marine microplastics missing in the global microplastic budget
Source citation (APA Format)	Seung-Kyu Kim et al. ,Arctic Ocean sediments as important current and future sinks for marine microplastics missing in the global microplastic budget.Sci. Adv.9,eadd2348(2023).DOI:10.1126/sciadv.add2348
Original URL	https://www.science.org/doi/10.1126/sciadv.add2348
Source type	Research article
Keywords	Plastic, ocean, sinks, sediments, abundances, sea, ice
#Tags	#MicroPlastic
Summary of key points + notes (include methodology)	The earth's surface has had unexpectedly low outputs of plastic compared to the input amounts. So where does this plastic go? The western Arctic Ocean was found to have large deposits of microplastics as the accumulation was increased by the climate and more specifically ice barriers. The buried microplastic from the past 90 years in the Artic has now exceeded the global average of the microplastic loads.
Research Question/Problem/ Need	Where are the unidentified microplastic sinks of marine microplastics and how do they work?
Important Figures	 Fig. 5. Dependence of microplastic (MP) abundance in Arctic surface sediment on measured MP detection cutoff size.
VOCAB: (w/definition)	Sequestered - (of a place) isolated and hidden away. Coagulation- the action or process of a liquid, especially blood, changing to a solid or semi-solid state. Flocculation - the process of small particles in a liquid or solution clumping together to form larger clusters

Cited references to follow up on	L. C. Woodall, A. Sanchez-Vidal, M. Canals, G. L. Paterson, R. Coppock, V. Sleight, A. Calafat, A. D. Rogers, B. E. Narayanaswamy, R. C. Thompson, The deep sea is a major sink for microplastic debris. R. Soc. Open Sci. 1, 140317 (2014).
Follow up Questions	How can we remove microplastics from the sinks and is that a good idea? How can we prevent microplastics from entering the sinks? How do microplastic sinks affect surrounding ecosystems?

Article #10 Notes: An invasive species erodes the performance of coastal wetland protected areas

Source Title	An invasive species erodes the performance of coastal wetland protected areas
Source citation (APA Format)	Junlin Ren *et al.*, An invasive species erodes the performance of coastal wetland protected areas. *Sci. Adv.* 7, eabi8943(2021). DOI:10.1126/sciadv.abi8943
Original URL	https://www.science.org/doi/10.1126/sciadv.abi8943
Source type	Research Article
Keywords	Protected areas, ecosystems, bio invasion, wetlands, plant, Cordgrass, native, invasive
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	Protected areas shield land from human activity, keeping it natural and untouched by industry, pollution, and destruction. Despite being protected from humans, protected areas are still in great danger to exotic and invasive plant and animal species. The study was conducted in the Yellow Sea wetland of China and used satellite imaging from the last three decades to determine the severity of invasion. It was determined that plant invasions were much more extensive in the protected areas rather than the non-protected areas and that the invasions undermined the performance and hurt the ecosystems of the protected areas.
Research Question/Problem/ Need	How will invasive species affect protected areas and their valuable ecosystems?
Important Figures	 A - Locations of seven of the largest wetland PAs along the Yellow Sea

	coastline B - Increases in wetland reclamation and cordgrass invasion across China's Yellow Sea coastline C - Proportions of reclaimed, cordgrass-invaded, and remaining native wetlands in PAs and non-PA controls
VOCAB: (w/definition)	Spatiotemporal - belonging to both space and time or to space-time. Remediate - provide a remedy for; redress or make right. Geomorphology - the study of the physical features of the surface of the earth and their relation to its geological structures. Diking - provide (land) with a wall or embankment to prevent flooding.
Cited references to follow up on	D. D. Burfeind, K. A. Pitt, R. M. Connolly, J. E. Byers, Performance of non-native species within marine reserves. Biol. Invasions 15, 17–28 (2013).
Follow up Questions	How can we prevent protected area bio invasions without damaging the ecosystem? Can we analyze other invasive plants using satellite imaging?

Article #11 Notes: Native diversity buffers against severity of non-native tree invasions

Article notes should be on separate sheets

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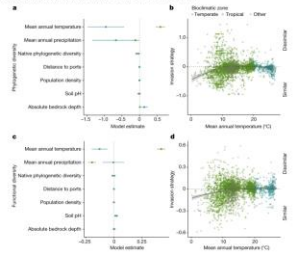
Source Title	Native diversity buffers against severity of non-native tree invasions
Source citation (APA Format)	Delavaux, C. S., Crowther, T. W., Zohner, C. M., Niamh Robmann, T. Bruce Lauber, van, Kuebbing, S. E., Liang, J., de-Miguel, S., Gert-Jan Nabuurs, Reich, P. B., Abegg, M., Yao, A., Alberti, G., Almeyda, A. M., Braulio Vilchez Alvarado, Álvarez-Dávila, E., Alvarez-Loayza, P., Alves, L. F., & Ammer, C. (2023). Native diversity buffers against severity of non-native tree invasions. *Nature*. https://doi.org/10.1038/s41586-023-06440-7 *No volume and issue number
Original URL	https://www.nature.com/articles/s41586-023-06440-7
Source type	Research article
Keywords	Invasive, tree, ecosystem, biodiversity, influence, severity, environment, human, risk.
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	Invasive tree species have great potential to harm valuable ecosystems and reduce biodiversity. To determine the severity and influence that non-native tree species have on ecosystems this article focused on the environment, human pressure, and functional diversity of native tree communities. The environmental change caused by humans is key to the determination of which locations will be invaded by non-native tree species. High environmental diversity decreases invasive risk. Climate and environmental conditions play a large role in whether a species successfully invades has they tend to succeed more when in extremely dry or cold climates. Human activity also directly affects the presence of invasive trees.
Research Question/Problem/ Need	How can we manage invasive tree species, limit their spread, and determine what causes their expansion?

Important Figures	 **Fig. 4: Environmental filtering at temperature extremes.** **a**,**c**, Estimates of overlapping variables included in temperate and tropical GLM models (forest plot) for phylogenetic (**a**) and functional (**c**) diversity models (phylogenetic diversity, $n = 3,498$; functional diversity, $n = 3,368$). Values to the left of the zero line indicate negative model estimates, and those to the right indicate positive estimates. **b**,**d**, Relationship between mean annual temperature and invasion strategy for phylogenetic (**b**) and functional (**d**) diversity models, showing that at extreme temperatures invasion occurs through similarity (Supplementary Table 7; phylogenetic diversity: $P_{(1)} = 9.69 \times 10^{-18}$, $P_{(2)} = 2.13 \times 10^{-5}$; functional diversity: $P_{(1)} < 2 \times 10^{-16}$, $P_{(2)} = 1.07 \times 10^{-4}$, where $P_{(1)}$ and $P_{(2)}$ represent each temperature and temperature squared P values, respectively). Note for functional diversity, this pattern only holds at low temperatures. Error bars and bands represent standard error.
VOCAB: (w/definition)	Anthropogenic - environmental change caused or influenced by people, either directly or indirectly Phylogenetic - relating to the evolutionary development and diversification of a species or group of organisms Multifaceted – having many factors
Cited references to follow up on	Mack, R. N. et al. Biotic invasions: causes, epidemiology, global consequences, and control. Ecol. Appl. 10, 689–710 (2000).
Follow up Questions	Can we apply a chemical solution to invasive plants to harm them and prevent their spread? Are there any solutions that can eat away at certain plants just from being sprayed onto them? Or do solutions need to be applied to wounds in the plants skin?

Article #12 Notes: The emerging invasive species and climate-change lexicon

Article notes should be on separate sheets

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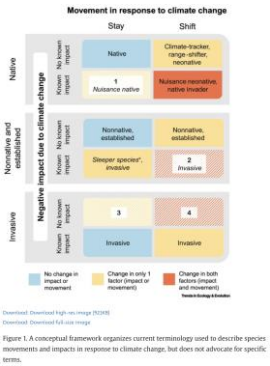
Source Title	The emerging invasive species and climate-change lexicon
Source citation (APA Format)	Fusco, E. J., Falk, B. G., Heimowitz, P. J., Lieurance, D., Parsons, E. W., Rottler, C. M., Thurman, L. L., & Evans, A. E. (2024). The emerging invasive species and climate-change lexicon. *Trends in Ecology & Evolution*. https://doi.org/10.1016/j.tree.2024.08.005
Original URL	https://www.sciencedirect.com/science/article/pii/S0169534724001988
Source type	Research article
Keywords	anthropogenic climate change, invasive species management, range-shift, terminology
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	Invasive species require high amounts of time, effort, and funding to combat each year as they reduce biodiversity and harm ecosystem services. Climate change has also been fueling the fire and has changed the range of these species, making them harder to predict and control. This article proposed the usage of a new lexicon for the terminology of invasive species as it will assist decision making and improve communication between researchers. The new system will reflect a greater range of viewpoints. The study also illustrates how current ambiguities in the field have impacted the research.
Research Question/Problem/ Need	How can communication surrounding invasive species and the management of them be improved?

Important Figures	 Figure 1. A conceptual framework organizes current terminology used to describe species movements and impacts in response to climate change, but does not advocate for specific terms.
VOCAB: (w/definition)	Lexicon - the vocabulary of a person, language, or branch of knowledge. Archetypes - a very typical example of a certain person or thing. Parse - analyze (a sentence) into its parts and describe their syntactic roles.
Cited references to follow up on	https://www.sciencedirect.com/science/article/pii/S0169534716302129
Follow up Questions	How does the usage of certain terms or certain syntaxes impact management efficiency? How can we determine what words and terms are the most effective? How can one lexicon and system of terminology be compared to another?

Article #12 Notes: Characterization and pilot-scale downdraft gasification of invasive forestry species biomass in the Dominican Republic

Article notes should be on separate sheets

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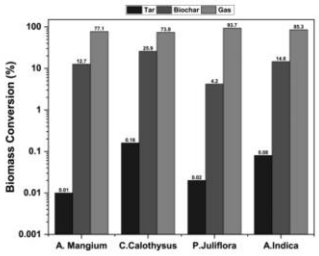
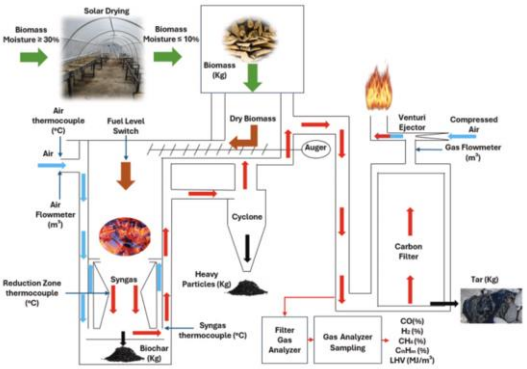
Source Title	Characterization and pilot-scale downdraft gasification of invasive forestry species biomass in the Dominican Republic
Source citation (APA Format)	Vásquez-Martínez, R., Cuervo, J., Ramos, P. A., & Castro, Y. A. (2024). Characterization and pilot-scale downdraft gasification of invasive forestry species biomass in the Dominican Republic. *Biomass and Bioenergy*, *191*. https://doi.org/10.1016/j.biombioe.2024.107476 (No issue # available)
Original URL	https://www.sciencedirect.com/science/article/pii/S096195342400429X
Source type	Research Article
Keywords	Syngas, Acacia, Mesquite, Neem, Calliandra, Prosopis juliflora
#Tags	#InvasiveAlternative
Summary of key points + notes (include methodology)	Nations are extremely dependent on their availability of electricity as it powers cities, homes, food production, transportation, and more. Many countries still use great amounts of fossil fuels as their energy resource which has negative effects on the environment, fuels climate change, and is very unstable depending on the scarcity of the natural resource. Huge amounts of carbon dioxide are released from fossil fuels and alternative energy sources should be a high priority for countries. This article proposes an alternative to the current energy resource in the Dominican Republic which, last year, received 85% of its electricity from burning fossil fuels. This method will hopefully help the Dominican Republic reduce its carbon emissions, harvest its renewable energy from natural sources, and, in addition, remove invasive tree species. This study plans to use a renewable energy technique called biomass, which involves harvesting a living organism or organic material and using it as a fuel source of electricity or heat energy. This article seeked to test various invasive species for

	biomass energy production to determine which would be the best depending on the amount of pollution from burning the tree, its ash content, moisture level, and more. The study reveals the promising potential of P. juliflora as a potential feedstock for gasification-based bioenergy production through biomass.
Research Question/Problem/ Need	How can countries shift away from reliance on fossil fuel as an energy source and use more renewable and sustainable energy while also removing invasive species?
Important Figures	 Download: Download high-res image (159KB) Download: Download full-size image Fig. 3. *Biomass conversion into tar, char and gas for A. mangium* and *C. calothyrsus* in humid forest, as well as *P. juliflora* and *A. indica* in dry forest. 
VOCAB: (w/definition)	Downdraft - a downward current of air. Syngas - a mixture of gases that is a key component in many industrial processes, including energy production and the chemical industry Enthalpy - the measurement of energy in a thermodynamic system.
Cited references to follow up on	https://pubmed.ncbi.nlm.nih.gov/32040738/
Follow up Questions	Can plants like bittersweet, buck thorn, or burning bush be potential feedstock for biomass energy production? How is the viability of an organism measured as a feedstock for biomass energy production? How can invasive plants be harvested for feedstock?

Article #13 Notes: Interference competition with an invasive species as potential driver of rapid extinction in an island-endemic lizard

Article notes should be on separate sheets

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Source Title	Interference competition with an invasive species as potential driver of rapid extinction in an island-endemic lizard
Source citation (APA Format)	Ficetola, G. F., Melotto, A., Scali, S., Sacchi, R., & Salvi, D. (2024). Interference competition with an invasive species as potential driver of rapid extinction in an island-endemic lizard. *Global Ecology and Conservation*, *55*. https://doi.org/10.1016/j.gecco.2024.e03251 (no issue # available)
Original URL	https://www.sciencedirect.com/science/article/pii/S2351989424004554
Source type	Research article
Keywords	Podarcis raffonei, Podarcis siculus, Wall lizards, Interspecific competition, Reproductive interference, Interference competition, Aggressive behavior, Invasive alien species, RAD-seq
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	Many invasive organisms outcompete native species, leading to a loss of biodiversity. Although, this concept is lacking convincing evidence. This

	research focuses on a species of Aeolian lizards in an island ecosystem and collects data to support how various Italian lizards have outcompete the Aeolian species and led to a dramatic decline in its population. The data collected focused on behavioral encounters and morphological data. The behavioral tendencies that were tested were bite tendency and retreat frequency. The testing was done only on males. The males of the invasive Italian species were proven to show a strong competitive advantage in monopolizing territories which, in turn, inhibited reproduction between native male and female Aeolian lizards and rapidly declined their population. To avoid the extinction of the Aeolian lizards, this article introduces the strategy of safeguarding areas where there are no invasive species and making sure that they can't enter these ecosystems.
Research Question/Problem/ Need	How did the decline in the population of Aeolian lizards occur?
Important Figures	Table 1. Results of generalized linear mixed models testing the factors affecting the number of attacks and of escapes of test lizards in agonistic interactions. R^2_M: marginal R^2.

Independent	Dependent	z	P	R^2_M
***N* attacks**	Species of focal individual	0.538	0.591	0.36
	Species of the opponent	4.268	<0.0001	
	Role (resident / intruder)	2.446	0.015	
	Species of focal × opponent	2.408	0.016	
***N* escapes**	Species of focal individual	5.112	<0.0001	0.43
	Species of the opponent	0.571	0.568	
	Role (resident / intruder)	0.763	0.446	
	Species of focal × opponent	2.739	0.006	

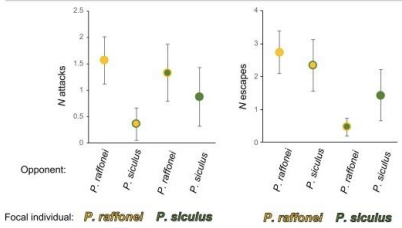

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Fig. 4. Average number of attacks and escapes by endemic (*P. raffonei*) and invasive (*P. siculus*) lizards during behavioral encounters, when facing conspecifics or heterospecifics. Error bars are 2 standard errors of the mean.

VOCAB: (w/definition)	Endemic - (of a plant or animal) native and restricted to a certain place. Agnostic - combative; polemical. Interspecific - existing or occurring between different species.
Cited references to follow up on	https://www.nature.com/articles/s41559-017-0365-6
Follow up Questions	How can the invasion of species be modelled or approximated? Is the speed of invasion and scope of invasion of exotic species dependent on the species and if so, what factors contribute to this and are they quantifiable? How can ecosystems devoid of invasive species be safeguarded from them?

Article #14 Notes: Charting the Course of Invasion: Ensemble Species Distribution Models Predict the Range Expansion of a Newly Invasive Aphid Pest Metopolophium festucae cerealium in North America

Article notes should be on separate sheets

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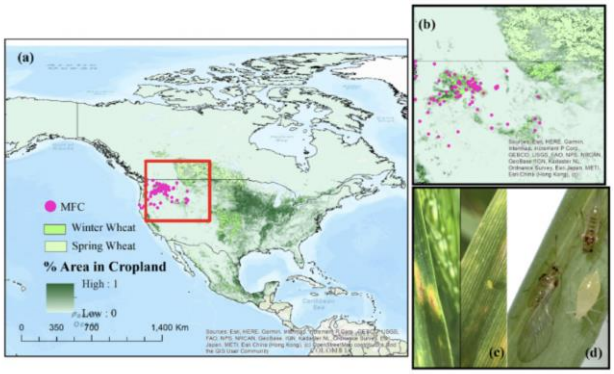
Source Title	Charting the Course of Invasion: Ensemble Species Distribution Models Predict the Range Expansion of a Newly Invasive Aphid Pest Metopolophium festucae cerealium in North America
Source citation (APA Format)	Adhikari, S., Srivastava, V., Wist, T., & Eigenbrode, S. D. (2024). Charting the Course of Invasion: Ensemble Species Distribution Models Predict the Range Expansion of a Newly Invasive Aphid Pest Metopolophium festucae cerealium in North America. *Crop Protection*. https://doi.org/10.1016/j.cropro.2024.107042 (Missing issue # and volume because it's an in-press journal pre-proof)
Original URL	https://www.sciencedirect.com/science/article/pii/S0261219424004708
Source type	Research article
Keywords	Cereal grass aphid, future climate change scenarios, habitat suitability, invasive species, niche modeling, pest management.
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	The harm posed by invasive species, especially insect pests, is growing and climate change has the possibility to make it worse. The subject of this study is an invasive aphid, Metopolophium festucae cerealium, along with its possible spread into North American wheat-growing regions. To determine the aphid's habitat suitability in a range of climates and scenarios, the researchers employed an ensemble modeling approach and examined about 450 sites in the Pacific Northwest. The results demonstrate the likelihood that the aphid will spread eastward and southward in wheat-producing regions and will

	endanger crop yields. Temperature, precipitation, and the percentage of agriculture are some of the environmental elements causing this spread. This study emphasizes the need for pest management plans that consider agricultural practices, such as the availability of host plants, and climate change.
Research Question/Problem/ Need	How can we determine suitable habitats for invasive insects and pests?
Important Figures	 Download: Download high-res image (1MB) Download: Download full-size image Figure 1. (a) *M. f. cerealium* occurrences collected from field surveys from 2011 to 2022. Primary host crop and % area in cropland have been shown here to facilitate visualization of potential range. (b) Zoomed version showing the presence of *M. f. cerealium* in the PNW region. (c) (Left) Red-yellow pigmented spots (or lesions) on wheat leaf due to feeding damage caused by *M. f. cerealium* in field conditions. (Right) A wingless adult sitting over a large fused necrotic lesion on a wheat leaf in Idaho (d) One mature wingless individual and two winged females (Aphid photos from Adhikari et al. 2022b).
VOCAB: (w/definition)	Aphid – a small bug Phytotoxic - poisonous to plants. Blotching – cover with spots or marks. Necrosis – death of body tissue.
Cited references to follow up on	https://academic.oup.com/jee/article/115/5/1320/6568134
Follow up Questions	How can AI or supercomputers be used to model and predict the suitability of different environments for invasive insects? Are invasive pests suitable for any ecosystem other than their own?

Article #15 Notes: Predicting the potential habitat suitability of two invasive ascidian species in Korean waters under present and future climate conditions

Article notes should be on separate sheets

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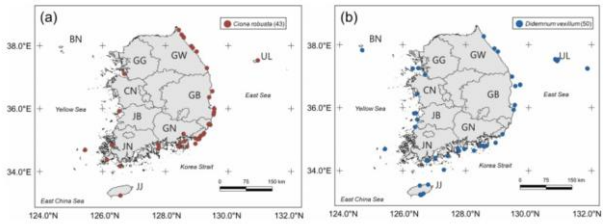
Source Title	Predicting the potential habitat suitability of two invasive ascidian species in Korean waters under present and future climate conditions
Source citation (APA Format)	Bae, S., & Choi, K.-H. (2024). Predicting the potential habitat suitability of two invasive ascidian species in Korean waters under present and future climate conditions. *Regional Studies in Marine Science*, *81*. https://doi.org/10.1016/j.rsma.2024.103967 *Issue number is missing from database
Original URL	https://www.sciencedirect.com/science/article/pii/S2352485524006005
Source type	Research Article
Keywords	Invasive species, Climate change, Ecological niche modeling, Ciona robusta, Didemnum vexillum.
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	Ascidians can be extremely harmful to marine biodiversity as they are an aquatic invasive species. In order to predict habitat suitability for two different invasive ascidians, Ciona robusta and Didemnum vexillum, this study used maximum entropy to create two different models in Korean waters in both the present and future. The models incorporated environmental variables like sea surface temperature, salinity, and chlorophyll-a, along with climate change scenarios. The results of the research gives evidence that chlorophyll-a in May was the primary environmental variable influencing both of the ascidian species. For C. robusta the suitability remained fairly consistent across the

	Korean coast while D. vexilllum varied greatly in different regions of the Korean coast. This study emphasizes the impact of climate change on the distribution of invasive ascidians and reinforces the need for future research with more data.
Research Question/Problem/ Need	How can the suitability of invasive ascidians in different regions be determined in Korea?
Important Figures	 Download: Download high-res image (274KB) Download: Download full-size image Fig. 1. Distribution data for (a) *Ciona robusta* and (b) *Didemnum vexillum* obtained through field surveys, specimen information, research project reports, and online repositories. Each abbreviation corresponds to an administrative region (seven coastal regions and three islands).
VOCAB: (w/definition)	Entropy - lack of order or predictability; gradual decline into disorder. Ascidians – marine invertebrate filter feeders Anthropogenic - environmental change caused or influenced by people.
Cited references to follow up on	https://www.nature.com/articles/s41598-021-03996-0
Follow up Questions	How does the suitability of ascidians differ from their native ecosystem to other coastlines and marine habitats worldwide? How might the introduction of additional environmental variables influence the predicted habitat suitability of ascidians?

Article #16 Notes: Invasive species management: The case of pink salmon in Iceland

Article notes should be on separate sheets

KEEP THIS BLANK AND USE AS A TEMPLATE

Source Title	Invasive species management: The case of pink salmon in Iceland
Source citation (APA Format)	Finnsson, H., Chambers, C., & Guðbergsson, G. (2025). Invasive species management: The case of pink salmon in Iceland. *Marine Policy*, *173*, 106539. https://doi.org/10.1016/j.marpol.2024.106539 *Missing issue number
Original URL	https://www.sciencedirect.com/science/article/pii/S0308597X24005396
Source type	Research article
Keywords	Fisheries management, Biodiversity, CBD, Stakeholder interviews, Risk assessment, River angling, IAS
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	The arctic, with warming waters and increased temperatures, is proving to be a habitable environment for a lot of invasive species previously unable to survive the cold climate and harsh weather. These invasive species have negatively impacted biodiversity and the communities that rely on these ecosystems. One of the invasive species that is now becoming more prevalent in the arctic and particulary Iceland is *Oncorhynchus gorbuscha*, or more commonly known as the pink salmon. This research looked at how communities are responding to the increasing number of pink salmon present in the North Atlantic Ocean and Norwegian Sea. The research conducted identified knowledge gaps in the field such as how there is little understanding of the basic ecology and potential impacts of the pink salmon. In addition to this, there are no organizations or movements to manage the invasive species. The research gives recommendation for the management of the invasive pink salmon and assesses the risks of the species increasing presence. It will hopefully lead to improve invasive species management in Iceland.
Research Question/Problem/ Need	How have institutions in Iceland responded to the arrival of pink salmon and what opportunities exist for improving invasive species management in Iceland?

Important Figures	 Download: Download high-res image (209KB) Download: Download full-size image Fig. 1. Timeline of pink salmon invasion in Icelandic waters. [1][36] [2] [21] [3] [50] [4][51] [5][52] [6][47] [7][53][8][29]
VOCAB: (w/definition)	Novel - new or unusual in an interesting way. Riparian - relating to wetlands adjacent to rivers and streams. Salmonids - a fish of the salmon family.
Cited references to follow up on	https://eprints.bournemouth.ac.uk/9721/
Follow up Questions	How does the introduction of pink salmon threaten biodiversity and local industries in Icelandic aquatic ecosystems? How do Iceland's current responses to pink salmon compare to those of other countries?

Article #17 Notes: Anticipatory stakeholder engagement provides insights for gene drive in invasive species through the case of gene drive grey squirrels

Article notes should be on separate sheets

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Source Title	Anticipatory stakeholder engagement provides insights for gene drive in invasive species through the case of gene drive grey squirrels
Source citation (APA Format)	Hartley, S., & Smith, R. D. J. (2024). Anticipatory stakeholder engagement provides insights for gene drive in invasive species through the case of gene drive grey squirrels. *Environmental Science & Policy*, *162*, 103939. https://doi.org/10.1016/j.envsci.2024.103939 *Missing Issue Number
Original URL	https://www.sciencedirect.com/science/article/pii/S1462901124002739
Source type	Research Article
Keywords	Anticipatory stakeholder engagement, Gene drive, Grey squirrels, Invasive species management, Responsible innovation.
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	The growing severity of invasive and exotic species has required the use of more ambitious removal techniques, various steps higher in extremity from previous methods. A growing field in invasive species management is biological removal involving techniques such as gene drives. This technology in theory has the ability to completely wipe out entire species from large ecosystems but in practice has not been properly proven to succeed. This research focuses on the areas of improvement for gene driving technology by meeting with expert possible investors who are very knowledgeable on the topic. Through the identification of prominent matters of concern, development and funding for gene drives can be improved. The research used employed anticipatory focus groups with knowledgeable practitioners to determine the possible concerns in gene drives in a number of interviews.
Research Question/Problem/ Need	What are the concerns and perspectives of expert stakeholders regarding the use of gene drive technology for the management of invasive species?

Important Figures	Table 1. Five design criteria for anticipatory focus groups (adapted from Macnaghten, 2021). **Design criterion** / **Description** **1. Context** — Focus groups should situate an emerging technology in particular domains of practice because stakeholders will make sense of gene drive from their social contexts. **2. Framing** — The framing of technology matters because it can encourage recipients of information to take a particular position over their own or an alternative. Any information provided should encourage participants to question frames and bring their own interpretations to the focus group. **3. Moderation** — The moderator's role is to keep participants on topic, ensure a diversity of voices, and empathetically probe differences and convergences between participants. It is critical that the moderator empowers participants to articulate issues on their own terms. **4. Sampling** — Focus group participants should be selected based on a balance of shared experience and diversity to allow for divergent views to enrich and revitalise the discussion. Participants must feel comfortable speaking, empowered to articulate their views while also challenged by different perspectives. **5. Analysis** — Focus group analysis is concerned with *what* people say. The researchers' task is to interpret what participants say, uncovering how different domains of practice shape the articulation of certain perspectives. This is the design criteria made by the researchers for anticipatory focus groups.
VOCAB: (w/definition)	Heuristic - enabling someone to discover or learn something for themselves. Anticipatory - happening, performed, or felt in anticipation of something.
Cited references to follow up on	https://journals.sagepub.com/doi/full/10.1177/2514848617747831?casa_token=9MT-jo6fvBUAAAAA%3AKYw1WEAwzgVzY71IYQee67n-Lx1VeEp6AV1r3JIJ5Lvk3PVTDutiyJdFn5zOFDYrn-572cBQ_V06ag
Follow up Questions	How can findings from this UK-based study apply to potential gene drive applications in other regions or for different species? How can the effectiveness of gene drive technology be compared to that of various other existing invasive species management techniques?

Article #18 Notes: Freshwater mollusc community screening - Classical and eDNA monitoring methods to detect rare, indicator and invasive species

Article notes should be on separate sheets

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Source Title	Freshwater mollusc community screening - Classical and eDNA monitoring methods to detect rare, indicator and invasive species
Source citation (APA Format)	Leidenberger, S., Wiese, V., Schaumann, F., Pleiss, F., Langen, K., & Bourlat, S. J. (2024). Freshwater mollusc community screening - Classical and eDNA monitoring methods to detect rare, indicator and invasive species. *Science of the Total Environment*, *958*, 177763. https://doi.org/10.1016/j.scitotenv.2024.177763 *Missing issue number
Original URL	https://www.sciencedirect.com/science/article/pii/S0048969724079208
Source type	Research article
Keywords	Freshwater monitoring, Pea clams, Indicator species, Benthic macroinvertebrates, eDNA metabarcoding, European Water Framework Directive
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	Freshwater is extremely important for humans as we require great amounts of clean drinking water from lakes and ponds. Accurate and precise freshwater quality assessment is also very important as contaminated water, if consumed, can give people many dangerous sicknesses and infections. This study tests whether or not an invasive and exotic species, pea clams, among others can be detected through eDNA metabarcoding methods. The article evaluated the precision of the M42 sediment sampling method and also demonstrates the changing accuracy of various techniques depending on the season of the year and the current outside temperature and climate. The use of barcoding and metabarcoding methods is recommended and evaluated by this article.
Research Question/Problem/ Need	How can barcoding and metabarcoding methods be utilized to better assess benthic macroinvertebrates and indicator species in freshwater samples?

Important Figures	Fig. 4. Number of species detected per site and season using three different sampling methods (plankton, kick-net and M42). Table 2. List of species identified with metabarcoding per sample site. The alpha diversity is given for each site.

Locality	Skaraborg (middle)				Bohuslän (west coast)							Norrbotten (north)			Total	
Species	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**S11**	**S12**	**S13**	**S14**	**S15**	**eDNA**	Morph
*Margaritifera margaritifera^*												x				1	2
Anodonta anatina							x		x	x		x				4	1
Anodonta cygnea				x			x									2	1
Conventus conventus																0	1
Euglesa casertana	x		x	x		x		x	x	x		x		x		9	5
Euglesa globularis	x		x							x		x		x		5	2
Euglesa henslowana	x					x	x		x	x	x			x	x	8	2
*Euglesa hinzi**																-	2
Euglesa liljeborgii		x		x	x										x	4	6
Euglesa milium	x					x	x				x	x			x	6	6
Euglesa nitida	x	x	x	x	x	x	x	x	x	x		x		x	x	13	10
Euglesa obtusalis		x	x	x		x	x			x					x	7	8
Euglesa parvula				x	x	x			x	x		x	x		x	8	10
*Euglesa pseudosphaerium**																-	2
Euglesa subtruncata	x	x		x						x			x		x	6	5
Euglesa supina			x	x	x	x	x		x	x		x	x	x	x	11	2
*Euglesa waldeni**																-	1
Odhneripisidium moitessierianum	x					x	x			x	x					5	1
*Odhneripisidium tenuilineatum**																-	1
Pisidium amnicum	x	x	x	x		x	x		x	x	x	x	x	x	x	13	2
*Pisidium crassum**																-	1
Pseudanodonta complanata																-	1
Sphaerium corneum	x		x	x	x	x	x		x	x		x	x			10	10
Unio tumidus	x									x		x	x			4	1
Sphaeriinae spp.																0	5
Total number of species (α diversity)	**10**	**5**	**7**	**10**	**5**	**10**	**10**	**2**	**8**	**13**	**4**	**11**	**6**	**6**	**9**		
Results Morphology	10	4	5	9	4	3	4	3	5	10	3	8	9	1	10		

^= endangered species (red list 2020, Sweden).

Marked in red=data deficient (red list 2020, Sweden); *=species not detectable as no barcode available.

VOCAB: (w/definition)	Hydromorphological - physical characteristics of bodies of water Taxa - the names given to taxonomic groups in an academic system of nomenclature. Calcareous - containing calcium carbonate; chalky. Morphological - relating to the form or structure of things.
Cited references to follow up on	https://link.springer.com/article/10.1007/s11033-022-08015-7
Follow up Questions	Can an automated system of occasional eDNA monitoring be implemented to assist in invasive species detection? How do eDNA metabarcoding methods compare in terms of sensitivity and accuracy for detecting benthic macroinvertebrates compared to traditional monitoring techniques?

Article #19 Notes: Opportunities for regional collaboration and prevention: Assessing the risk of the live bait trade as a pathway of invasive species

Article notes should be on separate sheets

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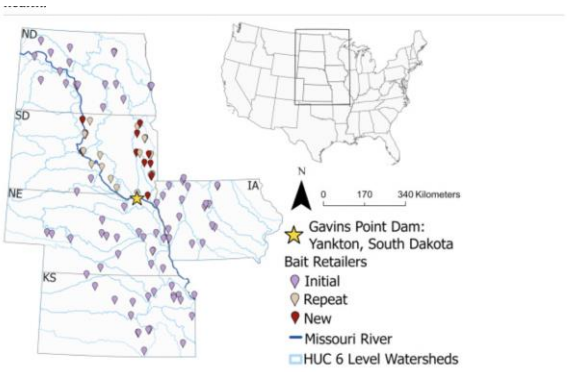
Source Title	Opportunities for regional collaboration and prevention: Assessing the risk of the live bait trade as a pathway of invasive species
Source citation (APA Format)	Mulligan, H., Schall, B. J., Davis, T., & Coulter, A. A. (2023). Opportunities for regional collaboration and prevention: Assessing the risk of the live bait trade as a pathway of invasive species. *Biological Conservation*, *287*, 110342. https://doi.org/10.1016/j.biocon.2023.110342 *Missing Issue Number on site
Original URL	https://www.sciencedirect.com/science/article/pii/S0006320723004433
Source type	Research Article
Keywords	Pathways, Environmental DNA, Education, Outreach, Invasive carp, Aquatic invasive species
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	Invasive species have greatly reduced biodiversity among many ecosystems worldwide. Humans are a large part of the problem because invasive species are often transported to different ecosystems as a result of human activity. The live bait trade is such an activity. Bait fish are transported across the world to new ecosystems every day. This research collected a sample of 259 environmental DNA readings and 112 live bait retailers across Central America. Two high priority invasive species were detected which are from the Great Plains region, a region of great importance within the continent. Educational outreach and broad scale approaches are recommended as risk mitigation strategies for the invasive species that are transported through activities such as bait fish trade.
Research Question/Problem/ Need	How do risk factors influence the detection of high-priority aquatic invasive species in live bait retailers across the central United States?

Important Figures	 Download: Download high-res image (550KB) Download: Download full-size image Fig. 1. Locations of the 112 bait retailers selected for environmental DNA surveillance in North Dakota (ND), South Dakota (SD), Iowa (IA), Nebraska (NE), and Kansas (KS) by Hydrologic Unit Code 6 (HUC 6). Initial widespread regional surveillance occurred from June – July 2022 (N=100). Repeated bait retailers were visited in both the initial and secondary sampling during June – July and September – October (N=18). New bait retailers were visited only during the secondary sampling that occurred from September – October 2022 (N=12). Bait retailers included bait shops, convenience stores, and department stores.
VOCAB: (w/definition)	Anthropogenic - environmental change caused or influenced by people, either directly or indirectly. Ballast - heavy material, such as gravel, sand, iron, or lead, placed low in a vessel to improve its stability. Tributaries - a river or stream flowing into a larger river or lake.
Cited references to follow up on	https://link.springer.com/article/10.1007/s10530-019-02124-4
Follow up Questions	What specific preventive actions or regulations have been shown to be most effective in reducing the introduction of aquatic invasive species via the live bait trade? How effective was the eDNA sampling method in detecting invasive species compared to other detection methods?

Article #20 Notes: Invasive amphibians alter host-pathogen interactions with primarily negative outcomes for native species

Article notes should be on separate sheets

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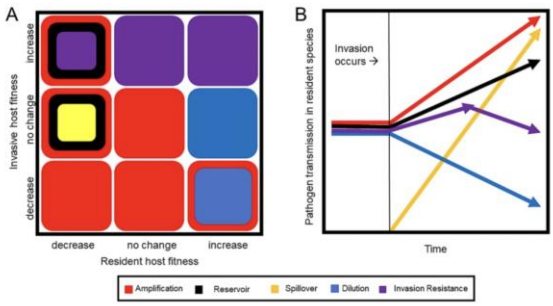
Source Title	Invasive amphibians alter host-pathogen interactions with primarily negative outcomes for native species
Source citation (APA Format)	Atkinson, M. S., & Savage, A. E. (2023). Invasive amphibians alter host-pathogen interactions with primarily negative outcomes for native species. *Biological Conservation*, *286*, 110310. https://doi.org/10.1016/j.biocon.2023.110310 *Doesn't have issue #
Original URL	https://www.sciencedirect.com/science/article/pii/S0006320723004111#bi0005
Source type	Research Article
Keywords	American bullfrog (Aquarana catesbieana), Amplification, Dilution, Invasion resistance, Reservoir host, Spillover
#Tags	#InvasiveRisks
Summary of key points + notes (include methodology)	Invasive species, specifically amphibians, alter the dynamic between hosts and pathogens through various methods, posing risk to native species and possibly reducing biodiversity. When transported to new environments, amphibians have negative impacts on the native ecosystems by the alteration of disease dynamics. 110 documented invasion-facilitated disease amplification amphibian invasions were analyzed to determine pathogen dynamics. Native amphibians are vulnerable to the pathogens transmitted by the invasive ones and in order to protect them, it is necessary to understand how invasive amphibians interact with pathogens. The conduction of research can reduce the responses to amphibian invasions and protect the biodiversity of amphibian species.
Research Question/Problem/ Need	How do invasive amphibian species influence disease dynamics within amphibian communities?

Important Figures	 Download: Download high-res image (298KB) Download: Download full-size image Fig. 1. (A) Potential fitness consequences of pathogens for invasive species (x-axis) compared to resident species (y-axis) across mechanisms of invasive host-pathogen interactions. (B) Hypothesized pathogen transmission rate within the resident amphibian community across mechanisms of invasive host-pathogen interactions. For both plots, each mechanism is represented using specific colors of red (amplification), black (reservoir host), yellow (spillover), blue (dilution), and purple (host-facilitated invasion resistance). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
VOCAB: (w/definition)	Exacerbating - make (a problem, bad situation, or negative feeling) worse. Ameliorating - make (something bad or unsatisfactory) better. Virulence - the severity or harmfulness of a disease or poison.
Cited references to follow up on	https://meridian.allenpress.com/journal-of-parasitology/article-abstract/101/3/275/6549/Elucidating-the-Life-History-and-Ecological
Follow up Questions	What specific mechanisms do invasive amphibians use to amplify or reduce pathogen prevalence, intensity, or diversity in native amphibian populations? Are there certain invasive amphibian species that are more likely to cause disease amplification or disease reduction? How can the negative impacts of invasive amphibian species be mitigated?