Double Trouble: The intersection of invasive species and climate change

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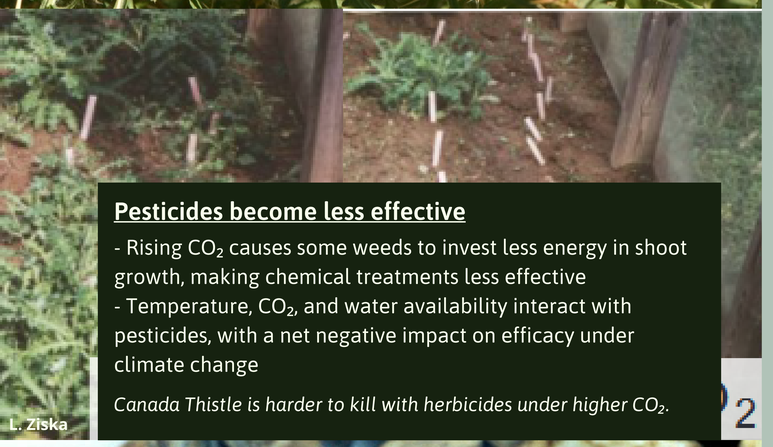
Invasives shift their ranges into new ecosystems

- Invasive plants and aquatics are often native to warmer regions, making them preadapted to climate warming in new regions
- New animal pests, pathogens, and 86 invasive plants are expected to shift into the North Central region (2040-2060)

Purple starthistles and Japanese beetles are moving northward.

liesvanrompaey, Flickr

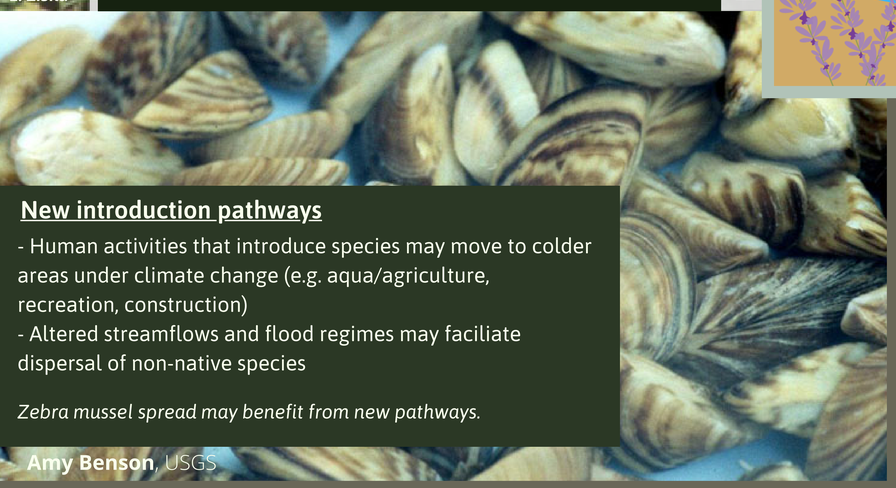


Pesticides become less effective

- Rising CO_2 causes some weeds to invest less energy in shoot growth, making chemical treatments less effective
- Temperature, CO_2, and water availability interact with pesticides, with a net negative impact on efficacy under climate change

Canada Thistle is harder to kill with herbicides under higher CO_2.

L. Ziska

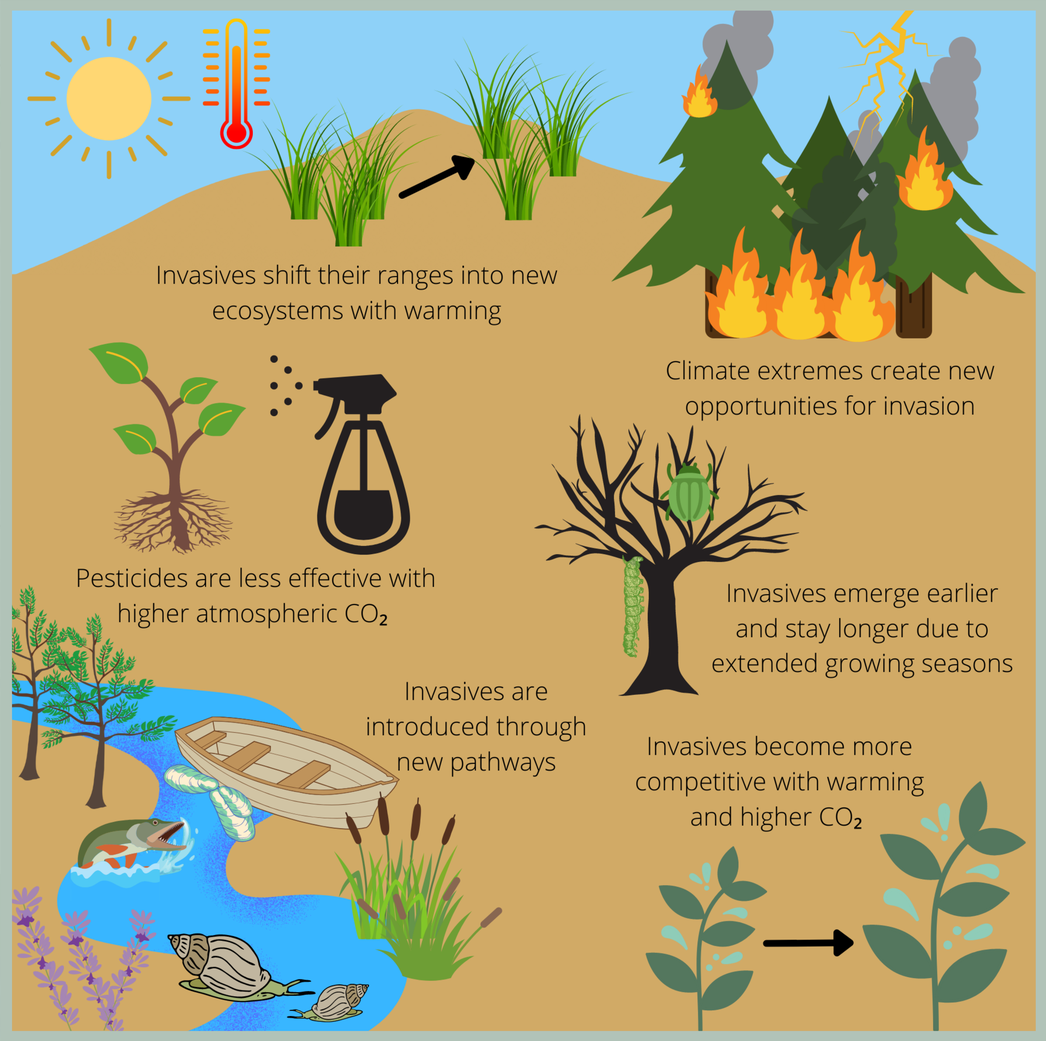


New introduction pathways

- Human activities that introduce species may move to colder areas under climate change (e.g. aqua/agriculture, recreation, construction)
- Altered streamflows and flood regimes may faciliate dispersal of non-native species

Zebra mussel spread may benefit from new pathways.

Amy Benson, USGS

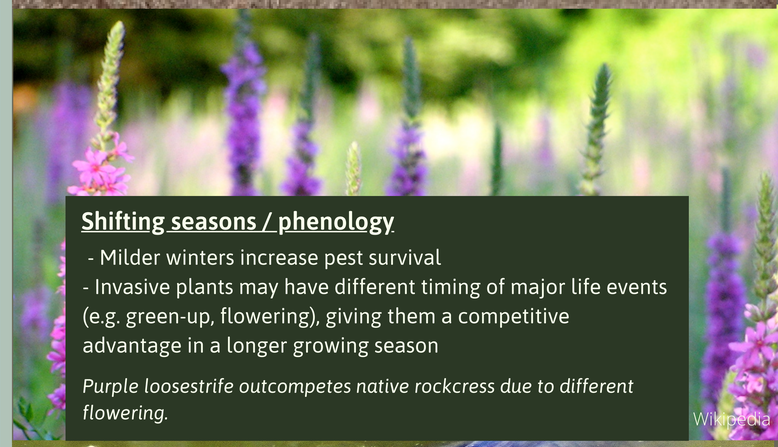


Climate extremes create opportunities for invasion

- Extreme droughts, fires, and floods create novel disturbances and opportunities for invasion
- Drought stress increases tree vulnerability to invasive pests

Cheatgrass benefits from new opportunities post-fire.

US FWS



Shifting seasons / phenology

- Milder winters increase pest survival
- Invasive plants may have different timing of major life events (e.g. green-up, flowering), giving them a competitive advantage in a longer growing season

Purple loosestrife outcompetes native rockcress due to different flowering.

Wikipedia

Invasives become more competitive

- Warming and elevated CO_2 causes invasive plants to grow faster and produce more biomass than native plants
-Invasive species often have traits that help them adapt to new and changing environments (e.g. broad environmental tolerances, dispersal)

Common carp spawn after disturbances before other species arrive.

P. J. Connor, Wikimedia

The North Central Regional Invasive Species and Climate Change (NC RISCC) Network, founded by this team, connects managers and researchers to integrate climate adaptation science and management for invasive species.

Learn more at
https://www.risccnetwork.org/north-central

North Central Climate Adaptation Science Center

Earth Lab

CIRES

North Central RISCC

Citations: Allen & Bradley 2016 Biol. Conserv.; Bajer & Sorensen Biol. Invasions 2010; Bradley et al. 2010 Biol. Invasions; Bradley et al. 2015 Frontiers Ecol. Evol; Calinger et al 2013 Eco Letters; Colautti et al 2017 Bio. Sci.; DeKeyser et al 2013 Nat Areas; Dukes et al. 2009 Can J. For. Res.; EDDMaps https://www.eddmaps.org/; Finch et al 2021 IS in For Range of US; Hand et al 2018 USDA FS; Kistner-Thomas 2019 J. Ins. Sci; Kolb et al. 2016 For. Ecol. Mgmt.; Korres et al. 2016 Agronomy for Sust. Dev.; Liu et al. 2017 Global Change Biol.; Matzrafi 2018 Pest Man Sci; Pyke et al. 2008 Cons. Biol.; Rahel & Olden 2008 Cons. Biol; Varanasi et al 2016 Adv in Ag; Ziska et al. 2004 Weed Science