Residential landscape ecology: understanding the ecological patterns and processes of the fastest growing land cover in the USA

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Context:

- Residential / exurban landscapes are the most rapidly expanding land cover type in the USA [1]
- These ecosystems effect patterns of biodiversity and ecological processes via:
  - Fragmentation (**Fig. 1**)
  - Construction of engineered / designer ecosystems (**Fig. 2**)
- Research is needed to make the design, construction, and management of residential landscapes more sustainable [2]

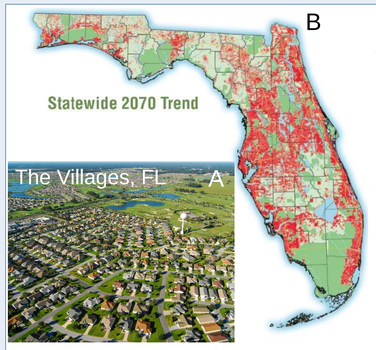

Fig. 1 An example of how predicted expansion of residential landscapes (A) in Florida will lead to fragmentation of remnant natural areas (B)

(1,000 Friends of FL, FDACS, UF GeoPlan Center)

Assumptions:
- Future development densities will be similar to current densities
- Protected natural areas will not be developed

Fig. 2 Two common engineered / designer ecosystems in residential landscapes—stormwater ponds (A) and ornamental gardens (B)

Residential Landscape Ecology Lab

Overarching Goal: Quantify spatial patterns of ecological processes and their drivers within and around residential landscapes in order to meet the following aims

Aims:

1) Mitigate the environmental impacts of expanding residential landscapes

2) Inform the design of future residential landscapes so that they exhibit greater ecological functionality

Literature Cited

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Ongoing Research Projects

1) *Contribution of garden structure, diversity, and landscape context to arthropod pest control*

- **Background:** Plants in urbanizing areas experience increased pressure from herbivorous arthropod pests, limiting the ecosystem services that they provide [3]
- **Objectives:** Determine (1) the effects of alpha and beta diversity, structural complexity, and landscape context of ornamental gardens on the abundance of herbivorous arthropod pests & (2) if these effects occur via top-down or bottom-up regulation

Fig. 3 Methods: Variability in plant diversity and vertical structure (e.g. A-C) and arthropod pests and predators (e.g. D-E) is being sampled across 16 gardens of four different residential communities (F). A nested sampling design will allow us to model pest abundance in relation to garden characteristics and predator abundance using a suite of statistical approaches, including mixed-effects models

2) *Benefits of reducing irrigation & fertilizer usage on wetlands*

- **Background:** Excessive irrigation and fertilizer use in residential landscapes can have negative impacts on nearby aquatic ecosystems, including wetlands
- **Objectives:** Determine (1) how variation in irrigation and fertilizer use in residential landscapes affect the hydrology, nutrient levels, and plant communities of adjacent wetlands & (2) use this information to predict the benefits of alternative landscaping that needs minimal irrigation and fertilizer to maintain

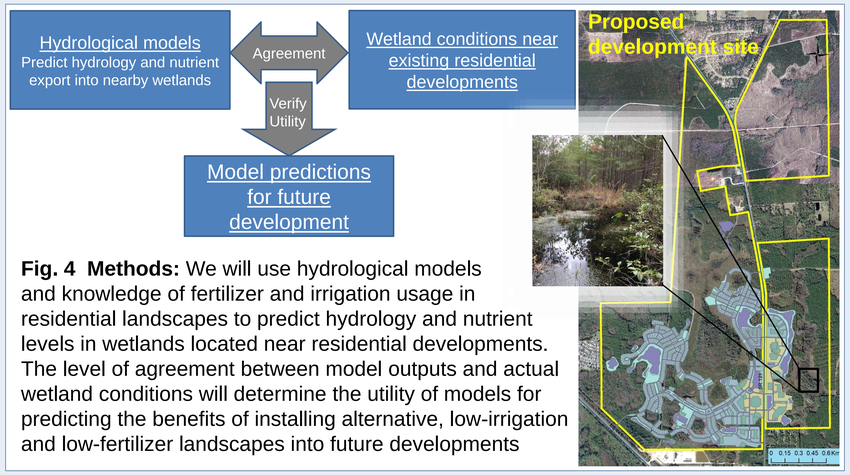


Fig. 4 Methods: We will use hydrological models and knowledge of fertilizer and irrigation usage in residential landscapes to predict hydrology and nutrient levels in wetlands located near residential developments. The level of agreement between model outputs and actual wetland conditions will determine the utility of models for predicting the benefits of installing alternative, low-irrigation and low-fertilizer landscapes into future developments

3) *Stormwater ponds (SWPs) as vectors for invasive plants*

- **Background:** SWPs, being designed to reduce stormwater runoff and pollutant export (e.g. N and P) from developed areas into natural waters [4], can exhibit dynamic hydrology and nutrient-rich conditions well-suited for invasive plants [5-7]
- **Objectives:** Determine (1) if these common engineered ecosystems (**Fig. 5**) act as vectors for invasive plants & (2) the invader traits that most benefit from their presence. Focusing on traits will allow us to make inferences about future invaders and species movement in general

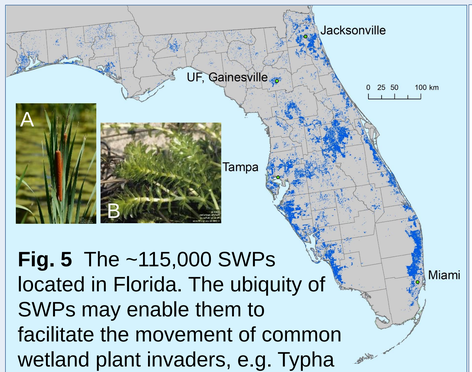


Fig. 5 The ~115,000 SWPs located in Florida. The ubiquity of SWPs may enable them to facilitate the movement of common wetland plant invaders, e.g. Typha (A) and Hydrilla (B)

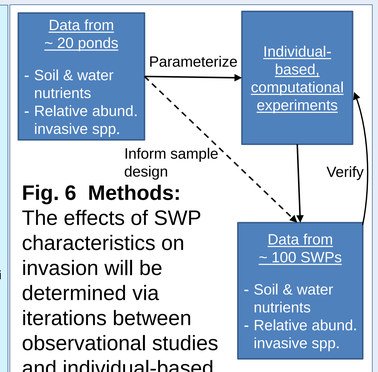
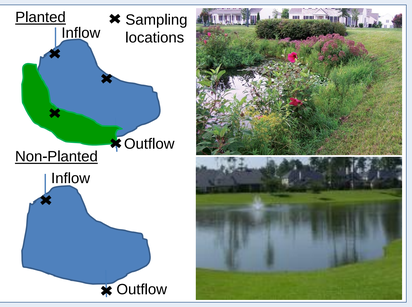


Fig. 6 Methods: The effects of SWP characteristics on invasion will be determined via iterations between observational studies and individual-based models

4) *Enhancing SWP functionality through ornamental plantings*

- **Background:** The assumption that SWPs limit eutrophying nutrients (N and P) from entering natural water bodies is often not supported [8]. Incorporating ornamental plantings into SWPs may help them to achieve this intended function, promote bank stabilization, and provide economic opportunity for horticulture
- **Objectives:** Determine if ornamental plants along the banks and in the littoral zones of SWPs help to improve water quality and bank stabilization

Fig. 7 Methods: Water quality and bank erosion will be quantified in paired planted and non-planted ponds over a 12-month period. Water samples will be collected at SWP inputs and outputs to measure pond level effects and in planted and non-planted areas of planted ponds to quantify within pond effects



Future Directions / Interests

- Identify thresholds and drivers of spatial heterogeneity in ecosystem services important to residential landscapes (e.g. pest control, cooling, soil fertility)
- Determine how the excessive use of limited landscaping plant species affects long-term invasion patterns and changes in plant community composition

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