PROFILING NATIVE AND INTRODUCED PERENNIAL GARDEN PLANTS IN PUERTO RICAN URBAN RESIDENTIAL YARDS

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Simposio de Manejo de Cuencas Hidrográficas

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Biodiversity conservation and role of urban areas – CoP.

- COP 09 – CBD; Bonn, Germany: Today’s emphasis is on inclusion of urban areas in conservation planning.
- We are running out of space
- Emphasizes the role of the urban matrix to the connectivity of protected areas
- Recognizes a hierarchy in the management of biodiversity and that there is responsibility at all levels.
- Advocates integration of urban planning and design, with conservation goals.
Biodiversity in Cities

- Biological invasions are considered one of the most important global biodiversity threats

- Cities are dominated by non-natives (Pyšek and Richardson 2010; Rojas-Sandoval et al. 2016; Vilà and Hulme 2017).

- Some non-native species may provide important ecosystem services that may create management conflicts (Lugo 2004; Dickie et al. 2014, Novoa et al. 2018).
San Juan ULTRA Network (Sanjuanultra.org)

- Started as an NSF-funded Exploratory Project with long-term expectations

- Interdisciplinary evaluation of the San Juan Urban Socio-Ecological System

- Lifts baseline socio-ecological knowledge to reduce urban vulnerabilities or enhance adaptive capacity to local and global environmental changes.

- Uses the Rio Piedras Watershed (RPWS) as the unit of study

*From Lugo et al. 2011*
Household-level approach
Social and vegetation surveys; N = 432
10 species are invasives of mature forests

| Shrub/Vine                      | Tree                                           |
|---------------------------------|------------------------------------------------|
| *Jasminum fluminense*           | *Schinus terebinthifolius*                     |
| *Jatropha curcas*               | *Spathodea campanulata*                        |
| *Syngonium podophyllum*         | *Syzygium jambos*                              |
| *Ricinus communis*              | *Schefflera actinophylla*                      |
| *Triphasia trifolia*            | *Mangifera indica*                             |
Meléndez-Ackerman and Rojas Sandoval, Journal of Urban Ecology  *In Press*

What is the profile of native and non-native species occurring in residential yards of the Rio Piedras Watershed?

**Objectives:**

1) Evaluate functional traits of residential vegetation that may facilitate invasion.

2) Use results from this and other studies to develop species list of high risk or low risk of invasion.
**Table 1.** Description of the parameters assessed for each plant species growing in 400 patios in San Juan, Puerto Rico. Information was obtained from: Acevedo-Rodríguez (2005), Acevedo-Rodríguez and Strong (2005, 2012); Liogier (1985-1997), Rojas-Sandoval and Acevedo, 2015; The Plant List, USDA-PLANTS and USDA-GRIN

| Parameters               | Description                                                                                                                                                                                                 |
|--------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Native range             | Geographic distribution where native. Modified from Weber (2003) as: Africa, Asia, Europe, Australia-Pacific, continental America, West Indies                                                        |
| Life-form                | Herb, shrub, tree, vine                                                                                                                                                                                     |
| Life-span                | Annual, biennial, perennial                                                                                                                                                                                 |
| Reproduction type        | Hermaphrodite, monococious, dioecious, gynomonoecious, andromonoecious, polygamous                                                                                                                                 |
| Breeding system          | Selfing (species rely almost exclusively on apomixis or autonomous self-pollination) outercrossing (species rely almost exclusively on cross-pollination) mixed (selfing + outercrossing)                           |
| Pollination type         | Animal, wind, water, unspecialized                                                                                                                                                                           |
| Fruit type               | Achene, berry, capsule, caryopsis, cone, drupe, follicle, legume, nutlet, samara, syncarp, utricle                                                                                                                                 |
| Seed size                | Five size categories: 1 = seeds < 1 mm, 2 = 1–2 mm, 3 = 2–5 mm, 4 = 5–10 mm, 5 = seeds > 10 mm                                                                                                                                 |
| Dispersal mode           | Animal, wind, water, unspecialized                                                                                                                                                                           |
| Vegetative propagation   | Yes/No                                                                                                                                                                                                     |
259 introduced species (72%)
Parameters included in the best-fit model explaining the probability that non-native ornamental plants growing in urban residential yards may become invasive.

| Parameters               | Estimates | SE    | P      | Odds ratios |
|--------------------------|-----------|-------|--------|-------------|
| Intercept                | 5.246     | 2.648 | 0.002  |             |
| Vegetative propagation   | 1.481     | 0.393 | <0.001 | 4.397       |
| Unspecialized dispersion | 0.495     | 0.618 | 0.003  | 1.641       |
| Mixed breeding system    | 0.685     | 0.302 | 0.023  | 1.985       |
## A. Reproductive traits only

| Species                      | Family   | Yard | Life Form | Breeding | Pollination | Fruits | Dispersion | Vegetative growth | Notes               |
|------------------------------|----------|------|-----------|----------|-------------|--------|------------|-------------------|---------------------|
| *Plectranthus amboinicus*    | Lamiaceae| 14   | shrub     | mixed    | animal      | nutlet | unspecialized| YES               | Weedy               |
| *Euphorbia nitida*           | Euphorbiaceae| 10  | herb      | mixed    | unspecialized| capsule| NO         | YES               | Bacteria carrier    |
| *Manihot esculenta*          | Euphorbiaceae| 8   | shrub     | mixed    | animal      | capsule| animal     | YES               | Major pest carrier!|
| *Ravenala madagascariensis*  | Strelitziaceae| 8   | tree      | mixed    | animal      | capsule| animal     | YES               | Palm mite host      |
| *Aphel andra squarrosa*      | Acanthaceae| 3   | herb      | mixed    | animal      | capsule| unspecialized| YES               | Virus carrier       |

## B. High C-scores and reproductive traits

| Species                      | Family   | Yard | Life Form | Breeding | Pollination | Fruits | Dispersion | Vegetative growth | Scores (%) |
|------------------------------|----------|------|-----------|----------|-------------|--------|------------|-------------------|------------|
| *Cananga odorata*            | Annonaceae| 9    | tree      | outcross. | animal      | fleshy | animal     | YES               | 82.4 1.7 | 15.9 | C/CR |
| *Gliricidia sepium*          | Fabaceae | 3    | tree      | outcross. | animal      | legume | unspecialized| YES               | 81.8 12.6 | 5.6  | C    |
| *Azadirachta indica*         | Meliaceae| 2    | tree      | outcross. | animal      | drape  | animal     | YES               | 78.9 15.9 | 5.1  | C/CS |
| *Annona muricata*            | Annonaceae| 71   | tree      | outcross. | animal      | fleshy | animal     | YES               | 50.8 31.4 | 17.8 | C/CSR|

## C. High R-scores and reproductive traits

| Species                      | Family   | Yard | Life Form | Breeding | Pollination | Fruits | Dispersion | Vegetative growth | Scores (%) |
|------------------------------|----------|------|-----------|----------|-------------|--------|------------|-------------------|------------|
| *Mentha pulegium*            | Lamiaceae| 1    | herb      | mixed    | animal      | nutlet | unspecialized| YES               | 11.5 12.4 | 76.1 | R/SR |
| *Bougainvillea glabra*       | Nyctaginaceae| 60  | vine      | outcross. | animal      | dry    | wind       | YES               | 33.6 36.2 | 30.2 | CSR |
| *Origanum vulgare*           | Lamiaceae| 1    | herb      | mixed    | animal      | nutlet | unspecialized| YES               | 5.1 70.0 | 24.9 | S/SR |
| *Annona muricata*            | Annonaceae| 71   | tree      | outcross. | animal      | fleshy | animal     | YES               | 50.8 31.4 | 17.8 | C/CSR|
| *Cananga odorata*            | Annonaceae| 9    | tree      | outcross. | animal      | fleshy | animal     | YES               | 82.4 1.7 | 15.9 | C/CR |

## D. Yard Frequencies

| Species                      | Family   | Yard | Life Form | Breeding | Pollination | Fruits | Dispersion | Vegetative growth | Scores (%) |
|------------------------------|----------|------|-----------|----------|-------------|--------|------------|-------------------|------------|
| *Isora coccinea*             | Rubiaceae| 173  | shrub     | outcross. | animal      | fleshy | animal     | YES               | 35.5 62.9 | 1.6  | S/CS |
| *Hibiscus rosa-sinensis*     | Malvaceae| 76   | shrub     | mixed    | animal      | capsule| unspecialized| NO                | 44.4 38.1 | 17.5 | CS/CSR|
Theoharides, K. A. and Dukes, J. S. (2007),
Household

Age, Ownership, Others?

Top-Down Factors
Historical – e.g. Developer Landscaping Nursery Trade

Torres-Camacho et al 2016

Gift Exchange Network

Plant Dispersal Network

Historical – e.g. Prior Owner Landscaping

Bottom-up Factors
How to lower the potential of invasions

• Using a functional approach to management is recommended (i.e replace what may become invasive based on functional traits and services).

• Rojas Sandoval and Acevedo, 2016 – show that there are certain traits are associated with exotics that have become invasive in the Caribbean (introduced for horticultural purposes, mixed reproductive systems, weedy behavior, small seeds, clonal growth, long residence times).

• The majority of species in RPWS yards are introduced but only a fraction is currently invasive (18.6%)
  
  • Focus on species with “invasive” traits
  
  • Increase opportunity for native plants in the nursery market
Yard plant management also requires an ecosystem service approach.
Questions