**Intro**

~~I linked demographic and species distribution models for the invasive plant~~ *~~Frangula alnus~~* ~~throughout its North American range, and compared simulation results to observed patterns of spatial spread to determine the demographic properties and processes most likely responsible for this species’ success~~.

*I removed this from the intro (last paragraph) because I didn’t actually test these two hypotheses directly. Further, the starling hypothesis does not have support, because buckthorn spread west prior to starlings, and the frappier hypothesis is hard to test. Might be useful for the discussion section though.*

“While some authors have proposed that the extended lag phase for *F. alnus* is a result of the time required for European starling to spread through North America (Howell and Blackwell 1977) or the time required for adaptation (Frappier et al. 2003b), these hypotheses have not been examined in detail.”

*Here’s all the lag-phase specific stuff I’ve cut out …*

“One of the remaining gaps in our knowledge is a full understanding of the processes governing population dynamics during invasive species lag phases (Pyšek and Hulme 2005, Blackburn et al. 2011, Gurevitch et al. 2011). The lag phase is the period of time between the establishment of self-sustaining populations and rapid expansion in abundance and area of occupancy characteristic of invasive species (Kowarik 1995, Crooks and Soulé 1999, Sakai et al. 2001, Pyšek and Hulme 2005, Theoharides and Dukes 2007). This lag may simply be the result of the time required for a population to grow large enough that emigration leads to colonization of new populations. However, lags that extend longer than such constraints are commonly reported for invasive plants in varying geographic locations (Kowarik 1995, Crooks and Soulé 1999, Aikio et al. 2010a, Larkin 2011).

Several explanations for why extended lags occur have been proposed. A species might only begin rapidly expanding after it has adapted to the novel range (e.g., evolution via hybridization (Ellstrand and Schierenbeck 2000)). It may expand following landscape disturbance, such as logging or a change in ecosystem conditions (e.g., *F. alnus* and logging (Lee and Thompson 2012)). It may only expand after an invader that facilitates its expansion enters the ecosystem (e.g., *Celastrus orbiculatus* (Oriental bittersweet) and *Sturnus vulgaris* (European starlings) (Merow et al. 2011)).

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**Methods**

Across all six sites, 815 individual plants were measured and tagged with a unique identifier, 182 first tagged in 2010, 567 in 2011, and 65 in 2012.

At four of the six sites, I counted the number of fruit on tagged plants during the month of July of 2012 to estimate differences in timing of fruit set within a season and to estimate annual maximum fruit per plant values.

Another advantage to using the IPM framework is that the regression analyses allowed me to estimate parameter uncertainty bounds to use in a GSA (described below in **Exploring parameter uncertainty space via global sensitivity analysis**).

Other records were reported in the Early Detection and Distribution Mapping System database (EDDMapS n.d.), iMap Invasives – New York (© 2013 The Nature Conservancy) database, and the Great Lakes Indian Fish and Wildlife Commission invasive species survey data (Garske and Falck 2007, Garske 2010).

Approximately 75% of occurrences were collected after the year 2000.

The climate/ weather variables matched a set of widely applied bioclimatic variables (Hijmans et al. 2005), and were calculated as 10-year and 50-year aggregated climate variables. All variables were provided as raster layers (WGS84 projection with a decimal degree coordinate reference system) at a spatial resolution of 5 x 5 arc minutes. The variables were continuous measurements with the exceptions of potential vegetation, pH top, and pH sub. While each predictor variable was chosen based on hypothesized importance in plant performance, some variables were not used in the final SDMs because they were highly correlated with other variables. Eliminations were based both on correlations with other variables and results from preliminary SDMs (see appendix for details).

**Discussion (maybe)**

(THIS PASSAGE COMES FROM MY INTRO, BUT SEEMS MORE LIKE DISCUSSION TO ME NOW?) This is similar to patterns found by Larkin (2011) for this species regionally in Michigan and Wisconsin (i.e., a lag of approximately 30 – 40 years).

I THINK THIS PASSAGE IS REDUNDANT WITH OTHER ASSERTIONS MADE IN THE DISCUSSION

The patterns I found here are indicative of many ornamental plants introduced into North America during the 20th century. In a recent study, Larkin (2011) examined correlations between plant characteristics and the length of lag phases for almost 100 plants in three distinct regions in Michigan and Wisconsin. He did not find any strong predictive relationships between these characteristics and lag phase length, suggesting that dynamics governing lag-phases may be specific to species and circumstance. However, there was evidence that species introduced for ornamental purposes (65% of the species examined, including *F. alnus*), experienced comparatively shorter lag phases than other invaders, providing further support for the importance of human assisted dispersal.