Elaeagnus angustifolia Colonization and Herbaceous Succession in Mid Valley Riparian Areas

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Introduction

In 1893 Darwin described the Río Negro as a wide river surrounded by plains with rich grasses and willow-trees. The only native tree is *Salix humboldtiana* Willd, but many invasive *Salicaceae* have colonized the river banks as well as *Tamarix* species. From circa 1970 the principal invader has been *Elaeagnus angustifolia* (silverberry, Russian olive) (Klich, 2013). A tree invasion implies changes in the floristic composition and influences the understory microclimate, soil and plant community. In this study, the effects of different *E. angustifolia* colonization stages on herbaceous forage resources were evaluated.

Materials and Methods

The study site is the Mid Valley of Río Negro, Argentina (39º 30´ S, 65º 30´ W); a temperate semiarid region with annual precipitation of 303 mm and evapotranspiration over 800 mm. Long droughts are common. The river is characterized by meandering and branching. The natural flow regime depends on snowmelt in the Andes Mountains and hydroelectric dam regulation.

Regional climatic data were provided by INTA (2000) and site data were recorded (Klich, 2000). Soil fertility and salinity were determined in 1998 and 2012. Between 1994 and 2009 the understory vegetation was observed and described but not quantified. In 2010 and 2011 the flora underneath and outside the *E. angustifolia* canopy was described and compared using the Sorensen similarity index (Andrada et al 2011). Plant species, biomass and cover were monitored in the understory zone from 2012 to 2015. At the end of 2015 the revegetation success after mechanical tree suppression at silverberry sites was studied in a 3 ha area.

Results and Discussion

Before the arrival of *E. angustifolia* the herbaceous layer was composed of highly palatable grasses and legumes. Once established it developed into dense populations, and it began to reduce available light to the understory, which decreased in density and volume (Klich, 2013).

During the rainy years of 2000 to 2006 the vegetation underneath the silverberry trees included their own seedlings, plus patches of *Cynodon dactylon* and caltrops (*Xanthium sp*.). In 2002 and 2006 water release from dams caused coastal floods and temporary reactivation of old channels leading to *E. angustifolia* colonization of wet lands.

The floristic inventory (2010-2011) showed 47 species in the understory belonging to 20 families. Poaceae and Asteraceae were the most represented families. The Sorensen index was 0.28, showing differences in floristic composition underneath and outside the canopy. Presence of *E. angustifolia* facilitated an increase in plant diversity. These years were also extremely dry and some edge plants lost their leaves. Leaf abscission decreased by 10 to 30% the rate of light attenuation previously quantified (90%) due to the effect of a dense canopy (Klich, 2000). From 1998 to 2012 a significant increase in the amount of organic matter (from 3 to 6.5-

%) was found, and hence more total nitrogen, was detected in the upper soil layer under the actinorhizal shrub canopy.
Since 2012, the Russian olive sites had been used to feed breeding cows using a schedule of high density grazing (3 to 5 CE/ha) during one month in each plot. As *E. angustifolia* is consumed by bovines, the grazing, trampling and dunging under trees may have affected the understory communities. With some exceptions (e.g. *Cynodon dactylon* and *Sonchus oleraceus*) the herbs are not grazed. According to the literature, there are many species among those that cattle do not eat that are nitrophilous.

After the winter removal of plants near fences, *E. angustifolia* resprouted fast. Herbaceous plant germination and growth was notable in the disturbed areas, especially Poaceae and Fabaceae. By the end of spring (December, 2015) the herbaceous biomass production was 7240 kg DM/ha and exceeded 1.5 m in height at many places.

Table 1. Herbaceous strata under *Elaeagnus angustifolia* (E.a.) shrub canopy: Families, dominant species, % cover, biomass (DM/ha) and the most grazed species in different periods of shrub colonization and under diverse climatic conditions.

Period	Stage/ clima /condition	Main understory Families	Dominant Spp.	Total % herbaceous cover	DM ton/ha	Most grazed spp.
Since 1970	Introduction of the shrub	Poaceae Fabaceae Asteraceae	*Erodium cicutarium Melilotus sp, Lolium sp. Hordeum sp. Bromus sp.*	> 90 %	¿?	*Erodium cicutarium Melilotus sp, Lolium sp. Hordeum sp. Bromus sp.*
2000-2006	Colonization Rain/flood	Poaceae Fabaceae Asteraceae	*Cynodon dactylon* *Xanthium sp* E.a. plantlets	< 20 %	¿?	*Cynodon dactylon*
2010-2011	drought	Poaceae Fabaceae Asteraceae Brassicaceae	*Bromus sp., Lolium sp., Xanthium sp., Melilotus albus, Medicago lupulina*	20-40 %	1.2	*Bromus catharticus, Melilotus albus*
2012-2015	rain	Poaceae Fabaceae Asteraceae Brassicaceae	*Carduus sp., Taraxacum officinalis, Sonchus oleraceus, Hirschfeldia incana, Boopis anthemoides, Geranium sp., Mentha sp., Rumex crispus, Urtica sp.*	20-30 %	0.7	*Cynodon dactylon* *Sonchus oleraceus*
2015-2016	Shrub removed	Poaceae Fabaceae	*Melilotus albus, Xantium sp., Carduus sp., Bromus sp., Hordeum sp.*	100 %	7.2	*Bromus catharticus* *Hordeum sp.* *Melilotus albus*

Conclusions and Implications

Rainy years and wet soils hastened *E. angustifolia* colonization. Once established, the amelioration of soil quality and the attenuation of incident sunlight enhanced herbaceous plant diversity under the shrub canopy during drought years. Subsequent grazing affected understory communities and with non-palatable species benefiting from enhanced soil nitrogen. When silverberry trees were removed, the herbaceous strata provided important forage biomass, although the reinvasion of *E. angustifolia* was rapid and difficult to control. A comparison of the forage resource provided by the *E. angustifolia* trees (paper ID 10729 on this IRC-2016) and the potential herbaceous resource in the invaded area will be completed soon.

References

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