LIPPIA

by

Alejandro Sosa and Pamela Krug

Cooperators: Mic Julien & Rieks Van Klinken-CSIRO Ecosystem Sciences, Brisbane, Australia

Abstract

The distribution of *Phyla* sp. in Argentina was modelled through known environmental and demographic variables, resulting in a probability distribution map. It was supported by additional records from field collected sites in Chile and from herbarium records. Biology and preliminary host specificity of *Kuschelina* sp. 2 are presented, through the studies of survivorship curves.

Introduction

Phyla canescens (Kunth) Greene, Verbenaceae, is a mat-forming perennial herb that grows on floodplains and in pastures (Kennedy, 1992; Múlgura de Romero et al., 2003). It is native to South America and was commercially introduced to Australia and other countries and has become invasive. In Australia the greatest invasion and impact occur in the Murray Darling Basin costing the grazing industry $38 million per annum and producing an environmental cost of $1.8 billion per annum (Earl, 2003). Biological control was proposed as part of the weed management in reserve areas, woodlands, forests, and along stream banks.

Phyla distribution modelling (in collaboration with Victoria Cardo, Univ. of Buenos Aires)

We used Generalized Linear Models (GLM) to model the distribution of *Phyla* sp., from surveying data (2005-2010) as a function of environmental and demographic variables. Presence/absence of *Phyla* sp. per sampling site (219 presences + 97 absences) was used as the response variable, assuming binomial distribution of errors and logistic as link function. To evaluate the final models classification effectiveness, we applied a 10-fold cross-validation using the Kappa index (K) to assess improvement of classification of the model over chance (Fielding and Bell, 1997). The Kappa index overcomes the problem of unequal number of presences and absences (Titus and Mosher, 1984). We reported as follows: poor $K<0.4$; good $0.4<K<0.75$; excellent $K>0.75$. Finally, as an external validation data set, we used 61 *P. canescens* herbarium records from Instituto de Botanica Darwinion. The potential distribution map was built by applying the final GLM formula pixel to pixel in the GIS. R 2.10.1 (R Development Core Team, 2009) and Arcview GIS 3.2 were used for modelling and mapping, respectively.

Results (Fig.1): The best model described the distribution of the plant as a function of windspeed, precipitation, daylength, temperature, population and bare soil as main terms along with the interaction of the first two variables. ROC cut-off point was estimated at 0.7; this means that a pixel in the map with a probability of occurrence of 0.7 or higher should be considered as species present; while a value lower than 0.7 means that plant presence is unlikely. K value was 0.46, classifying the model as good. Moreover the percentage of correctly classified herbarium records was 72% (44/61) and 82% (50/61) when considering 0.7 and 0.5 as cut-off points, respectively. The map of potential distribution shows a higher occurrence probability along the north-centre of the country (East Salta and Jujuy, Tucumán, West Chaco and Formosa, and

North Santiago del Estero) coinciding with high variation in plant morphology. The probability of occurrence falls toward the west all along the country and in a circumscribed zone in north-eastern Argentina, region known as Mesopotamia (Corrientes and Misiones Provinces). The map shows zones of high probability of presence outside the study area, in Eastern Patagonia particularly along the coast (south of 40^{O}). Although data on neighbouring countries was excluded from the modelling, the best model selected correctly classified records in Chile. Given that the variables used are easily available, this kind of approach might also be extended to other regions and validated with external data sets in order to check for model accuracy.

***Kuschelina* sp. 2**

To establish a laboratory colony surveying efforts were focused in and around sites where *Kuschelina* sp. 2 and its close related *K. bergi* had been previously found: Formosa and Buenos Aires Province near Tres Arroyos, respectively (Fig 1). Verbanaceae in the *Lantana* group were also collected for cultivation in the laboratory. Despite the 25 sites surveyed in four exploratory trips, this insect was scarcely collected only in Laguna Yema in November 2010.

No choice. To estimate its host range the survivorship of this flea beetle was studied on two morphologically different *P. canescens* (one from northern Argentina Phyla458 and the other from Buenos Aires latitudes PhylaH) and other Verbenaceae: *Aloysia citriodora* Palau, *A. polystachya* (Griseb.) Moldenke, *Lippia alba* (Mill.) N. E. Br. var *alba*, *Lippia turbinata* Groseb. F. var. *turbinata* and *Duranta repens*. These species were selected due to its relatedness with the target weed (Marx et al. 2010) and because they also occurred on the same habitat. From about 15 field-collected females eggs were obtained and the ensuing newly emerged larva (n= 207) were randomly assigned to one of the 7 plants in the Verbenaceae. They were followed individually, inspected daily and their survivorship curves compared among plants using Cox proportional hazards model in surviving analysis (Lumley 2009).

Results. *Kuschelina* sp. seems to be specific to *Phyla*, clearly its survivorship is the highest in both *Phyla* genotypes (Loglik=-316.7; Chisq= 336.24, fd=6; $P<0.05$), followed by *A. citriodora* and the remaining plants.

Fungi (in collaboration with Guadalupe Traversa, Universidad Nacional del Sur, UNS)

Surveys were concentrated in Formosa, Santiago del Estero and Entre Ríos Provinces to search for *Cercospora lippiae* and *Puccinia lantanae* to increase their culture for host specificity testing at the Laboratorio de Fitopatologia (UNS-Bahía Blanca). However, only plants with an unknown causal agent of leaf galls (Fig. 4a) and damaged by saprophagous fungi and possibly a nematode (Fig 4b) were found in Formosa and Tucumán Provinces in January.

Relevant accomplishments

The apparent specificity of *Kuschelina* sp. for *Phyla* in Argentina

Future Plans

Project was cancelled due to re-direction of funds by CSIRO

Travel

-Nov 2010: Buenos Aires province to collect *K. bergi*, and plants (Sosa, Hernández).

-Nov 2010: Santa Fé, Santiago del Estero, Tucumán, Salta, Jujuy, Formosa, Chaco, and Entre Ríos to collect *Longitarsus* sp., *K. bergi*, pathogens and plants (Sosa, González Márquez).
-Jan 2011: Santiago del Estero, Tucumán, Salta, Jujuy, Formosa to collect *Longitarsus* and plants (Sosa and Krug).
-Mar 2011: Buenos Aires province to collect *K. bergi*, and plants (Sosa, Hernández).

References

Earl, J. 2003. The distribution and impact of Lippia (*Phyla canescens*) in the Murray Darling System. Agricultural Information & Monitoring Services, pp. ABN: 73 918 506 894.
Fielding, A.H. & J.F Bell. 1997. A review of the methods for the assessment of prediction errors in conservation presence/absence models. Environmental Conservation 24: 38-49.
Kennedy, K., 1992. A systematic study of the genus *Phyla* Lour. (Verbenaceae: Verbenoideae, Lantanae). The University of Texas at Austin.
Lumley, T. 2009. Survival: Survival analysis, including penalised likelihood. R package version 2.35-4. http://CRAN.R-project.org/package=survival
Marx, H.E., N. O'Leary, Y.-W. Yuan, P. Lu-Irving, D.C. Tank, M.E. Mulgura, R.G. Olmstead. 2010. A molecular phylogeny and classification of Verbenaceae. Am. J. Bot. 97, 1647-1663.
Múlgura de Romero, M.E., A.D. Rotman, S. Atkins. 2003. Verbenacaeae, tribu Lantanae. In: Anton, A.M., Zuloaga, F.O., (Eds.), Flora Fanerogámica Argentina, pp. 1-46.
R Development Core Team. 2009. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.
Titus, K. & J.A. Mosher. 1984. Chance-corrected classification for use in discriminant analysis: ecological applications. The American Midland Naturalist 111: 1-7.

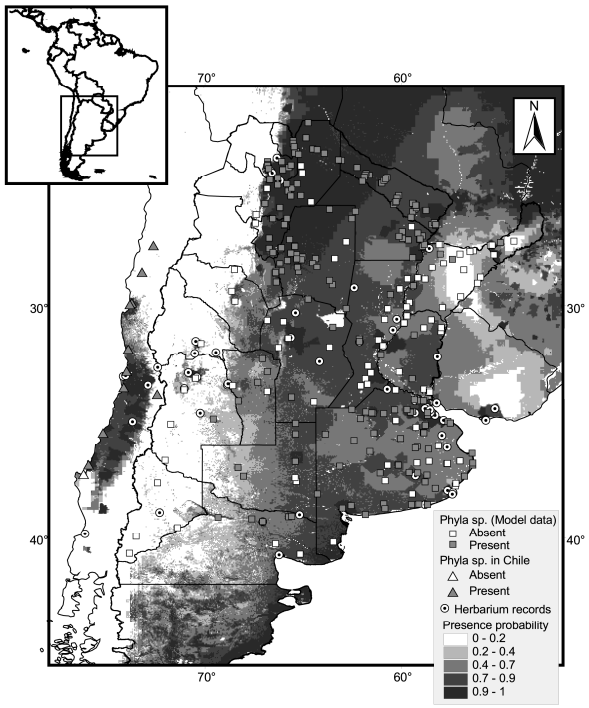

Fig. 1. Potential distribution of *Phyla* sp. in Argentina shown in a grey scale. Presence is predicted in areas with probability higher than 0.7. Sites used for model development are indicated by squares and records in Chile are indicated by triangles (filled for presence and empty for absence of *Phyla* sp.). Validation sites (herbarium records) are plotted as circles.

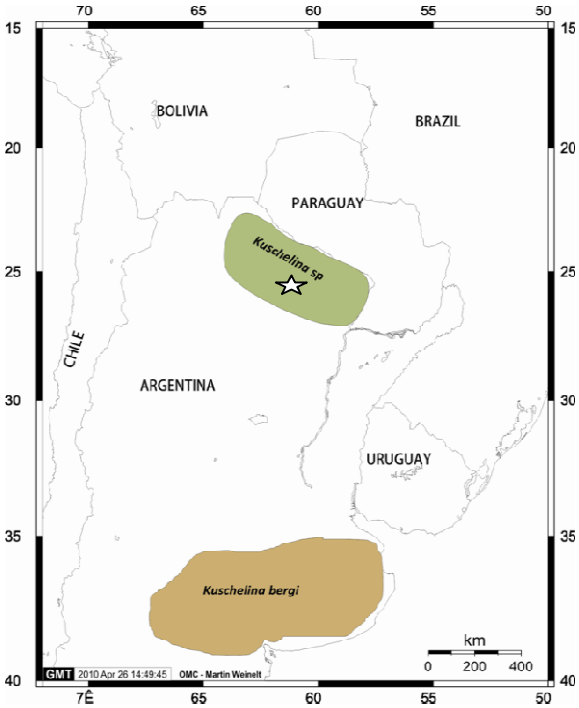

Fig. 2. Natural distribution of *Kuschelina*. Star indicates sites where *Kuschelina* sp. was collected, Laguna Yema (Formosa)

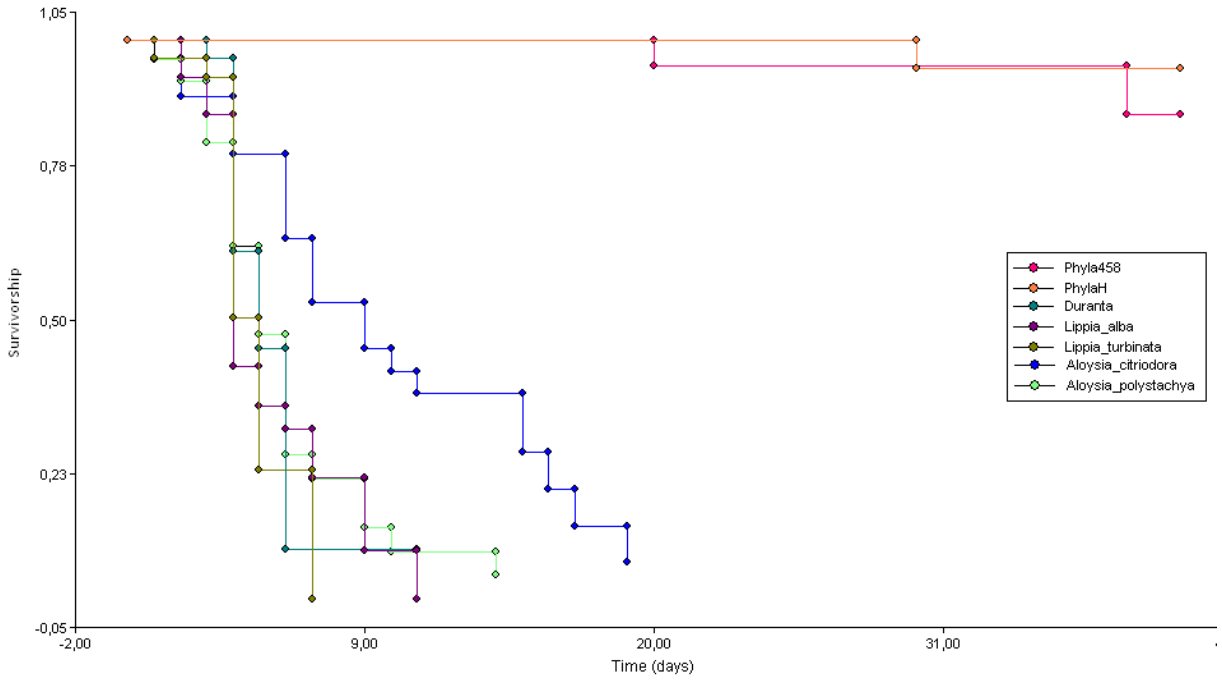

Fig. 3 Kaplan-Meier survival curves for *Kuschelina* sp. fed with two genotypes of *Phyla canescens* and Verbenaceae test plants.

Fig. 4. Leaf and stem galls found on *Phyla* in north-western Argentina. a- leaf and stem galls found in Formosa, the causal agent is unknown, b- stem lesions produced probably by a secondary invader fungi and or nematode.