

**Strategic International Partnership Initiative: Chile**  
**Chile Initiative RFP 2015**

**1) Type of project:** Research Planning / Scientific Exchange

**2) Title:** Vulnerabilities to climate change of forest plantation species and their bi-continental competing vegetation: Research Planning Phase

**3) Team Members and Affiliations:**

**Carlos González-Benecke** (Assistant Professor, FERM) and **Barbara Lachenbruch** (Professor, FES), OSU; and

**M. Paulina Fernández** (Associate Professor) and **Alonso Pérez** (Associate Professor), Faculty of Agronomy and Forest Engineering, Pontificia Universidad Católica de Chile (UC), Santiago

Dr. González-Benecke is the director of the Vegetation Management Research Cooperative (VMRC); he has expertise on fast-growing plantation management in Chile and United States, as well as forest ecophysiology and modeling. Dr. Lachenbruch has expertise on plant ecophysiology with focuses in plant structure and performance during drought, wind, and pathogen attack; she has worked in both Douglas-fir and radiata pine. Dr. Fernández has experience in ecophysiology and silvicultural management of fast growing species in Chile, and in modeling and growth and relationships between wood structure and crown architecture. Dr. Pérez' research centers on plant physiology and hydraulics, with focus on drought stress tolerance. This complementary team of researches gives this project a unique strength of bringing experts from both countries together to work synergistically on common research questions related to climate change impact on forest management.

**4) Rationale:** The efficient management of competing vegetation management is a vital silvicultural activity for establishing healthy and productive plantations. Without proper control, tree seedlings will have large reductions in growth and survivorship through loss of site resources (nutrients, water, light, space) to the strong weedy competitors (Rose and Ketchum 2003; Albaugh et al. 2004).

We know that the current range limits of species results from complex interactions among physiology and key biotic and abiotic factors (Gould et al. 2012). We also know that a tree's physiological potential varies greatly throughout the year (Cuny et al. 2008). Thus the tree species' vulnerabilities to environmental perturbations will also vary markedly through the year. For example, in the Douglas-fir, among the many activities in the dormant season are root growth, re-mobilization of nutrients, and development of tissues within buds. During the growing season, the plant transforms from one that is 'clad' in last year's needles and the latewood, to one that is clad in this year's needles and at first the earlywood, and then the latewood of this year's xylem—meaning that much of the physiology occurs through cohorts that are changing in size and function over time. In reality, we have only a modest understanding of

these seasonal activities for most species, and so we are not well-equipped to predict the vulnerabilities of trees to altered climate regimes (St. Clair and Howe 2007). What happens if spring conditions arrive early, fall conditions are delayed, or there is a summer-like temperature or moisture events in the winter? What happens if cues that would typically tell the tree to go dormant are not present in a given year?

The need to understand these issues and questions is equally compelling for the competing vegetation. This project aims to secure funding to study forest/weed physio-phenology in Oregon and Chile, taking advantage of two replicates of the forest/weed interactions that have only rather subtle differences in climate and environment. Under the current climate Scotch broom (*Cytisus scoparius*), blackberry (*Rubus ursinus*), bull thistle (*Cirsium vulgare*), gorse (*Ulex europaeus*) and *Senecio* spp. are capable of engaging in strong competition within our plantations in both hemispheres, Douglas-fir in the PNW and radiata pine/*Eucalyptus globulus* in Chile (Burrill et al. 2006; Fuentes et al. 2014). With altered climate regimes, how will competing vegetation fare? Which conditions will be more damaging to weed species than to the target tree species? Likewise, what are the climatic regimes in which the weed species will become even more aggressive?

The future climate of the PNW and the central south of Chile are predicted to be warmer, drier and more variable in rainfall, which may increase drought frequency and intensity. On the other hand, the potential impact of future climate change on productivity of main tree species and the competing vegetation is not well understood (Chmura et al. 2011). Ecophysiological techniques, including whole-plant assessments of hydraulic architecture, are contributing much information to our understanding of the impacts of drought on plant growth and survival (e.g., McDowell et al. 2008) and to the debates on the fate of future forests (McDowell et al. 2015). Such research has also shown that seedling traits are indicative of drought tolerance of adults, at least in tropic tree species (Poorter and Markesteijn 2008). This ecophysiological information (focusing particularly on drought and water relations), together with soil and weather data from sites where samples were collected, will allow us to better understand the effect of seasonal and aseasonal climate extremes on trees and competing vegetation.

This research bears on both applied and theoretical ecology. The application is to predict weed success in future climates such that we can put resources into understanding their control, and let research and even management of other weedy species drop. The theoretical direction (also of appeal to NSF) is to contribute to our understanding of the determinants of species range means.

## **5) Project Objective:**

The main objective is to develop a funded research project, to be carried out in both Chile and Oregon, with collaboration among four professors and the students who would be involved. The specific goals are the following.

- 1) Engage in reciprocal visits with both of the PIs visiting the Chile and both of the collaborators visiting Oregon;
- 2) Research the government programs and talk to program offices to target programs (much likely NSF-DEB and CONICYT) for the proposals;

- 3) Research the best way to have a strong cultural exchange among Chilean and US graduate students and possibly undergraduates; and
- 4) Write and submit the proposals for the joint research and cultural exchanges.

## **6) Methods:**

1) Reciprocal five-day-in-country visits will occur in August and November, with both PIs from each country traveling to the other. The first visit is very important to start framing the proposal. On both visits we will share ideas, visit potential research sites (e.g., in Chile, visit with Forestal Arauco in Concepción, give research seminars in Santiago, and visit sites in the Concepción/Los Angeles/Santiago region; in the US, use VMRC plots and others as needed), and visit with university administrators to discuss project goals. We will also outline and fill out the proposals.

2) and 3) González-Benecke and Lachenbruch will talk with program officers in NSF Division of Environmental Biology (DEB), Mathematical Biology, and International Division about the proposed project. We will also talk with the funding agencies, CoF and OSU about the best way to foster student cultural exchange. Similarly, Fernández and Pérez will talk with CONICYT and others to learn the most streamlined way to find funds, as well as to learn the types of student exchanges (e.g., shared graduate students, grad students sent to get a degree abroad, or undergraduate exchanges) that are most likely to be supported by their funding sources and institutions.

4) We will Skype with periodic scheduled calls to keep the planning and proposal-writing moving along. We expect to submit the required pre-proposal to NSF-DEB by Jan. 26, 2016, and then to continue working on the project in our respective countries until May 2016 when we will learn if our pre-proposal is invited for a full proposal. In the meantime we will be targeting other programs if appropriate, and working toward any other deadlines. We truly hope to do begin this collaboration and do this research even if our first round of funding is unsuccessful.

**7) Contribution to College internationalization goals:** Collaborating partners travelling to the counterpart's country will meet other researchers, explore new possibilities of collaboration, and give research seminars showing examples of current research.

This international project provides a unique opportunity for graduate students to develop their research and work with counterparts. Currently, we are imaging two PhD students on the final project, one from UC/Chile and one from OSU/USA. During the third year of their study program, the students will travel to the partner country, collecting complementary data during the summer and continuing taking classes during the incoming term at the partner country. We may also be able to involve undergraduates from each institution who would help in the home country but then gain exposure by traveling and helping in the foreign country as well.

**8) Project Deliverables:** Proposal to be submitted at NSF or CONICYT; research seminars by international partners; strengthened connections with partners in Chile.

**9) Role of Partner(s):** Co-write the project proposal; give research seminars at CoF; supervise research; advise PhD student in Chile and co-advise PhD student from OSU that will travel to Chile.

**10) Sources of external support (including from Chilean partners) and potential for leveraged funding:** We will leverage Pontificia Universidad Católica (Chile) through utilization of laboratory space and equipment and in-kind contributions. The final project will also leverage VMRC (USA) and Forestal Arauco (Chile) through utilization of study sites for field work. Chilean partners will provide lodging for Dr. Lachenbruch and Gonzalez-Benecke during their trip to Chile.

**11) Anticipated outcomes:** i) Proposal to be submitted at NSF and CONICYT; ii) Research seminars by Dr. Fernández and Dr. Pérez in Corvallis; iii) Research seminars by Dr. Lachenbruch and Dr. González-Benecke in Santiago.

## References

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**Carlos A. Gonzalez-Benecke / Barbara Lachenbruch**

<b>Budget</b>		OSU		PUC		
<b>Travel Corvallis - Santiago - Corvallis</b>	\$/u	U	\$			
<b>(Dr. Lachenbruch and Dr. Gonzalez-Benecke)</b>						
Ground travel Corvallis - Portland - Corvallis	100	2	\$ 200	0	0	\$ -
Air travel Portland - Santiago - Portland	2000	2	\$ 4,000	0	0	\$ -
Trip to Concepción	400	1	\$ 400	0	0	\$ -
Lodging in Concepcion (1 night)	0	0	\$ -	150	4	\$ 600
Meals in Concepción (Chilean staff)	0	0	\$ -	100	2	\$ 200
Lodging in Santiago (3 nights)	0	0	\$ -	150	3	\$ 450
Meals (5 days x 100\$/day)	100	10	\$ 1,000	0	0	\$ -
<b>Travel Santiago - Corvallis - Santiago</b>						
<b>(Dr. Fernández and Dr. Pérez)</b>						
Air travel Portland - Santiago - Portland	2000	2	\$ 4,000	0	0	\$ -
Ground travel Portland - Corvallis - Portland	100	2	\$ 200	0	0	\$ -
Lodging in Corvallis (4 nights)	150	8	\$ 1,200	0	0	\$ -
Meals (5 days x 100\$/day)	100	10	\$ 1,000	0	0	\$ -
<b>Miscellaneous</b>	500	1	\$ 500	0	0	\$ -
<b>Total</b>			<b>\$ 12,000</b>			<b>\$ 1,250</b>

Notes: by car, four people, including car rental, gasoline and tolls

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**Carlos A. Gonzalez-Benecke / Barbara Lachenbruch**

**Timeline**

<b>Year</b>	<b>Month</b>	<b>Activity</b>
2015	August	<b>Travel to USA (Dr. Fernandez and Dr. Perez)</b>
	September	Contact program officers at NSF / CONICYT
	October	Contact funding officers at OSU / UC
	November	Skype meeting
	December	<b>Travel to Chile (Dr. Gonzalez-Benecke and Dr. Lachenbruch)</b>
2016	January	Skype meeting
	February	<b>Submit Pre-Proposal to NSF</b>
	March	
	April	
	May	<b>NSF notice of acceptance / Skype meeting</b>
	June	
	July	Skype meeting *
	August	<b>Submit Full-Proposal to NSF *</b>

\* : Assume proposal accepted at NSF