



# International Oaks

The Journal of the International Oak Society

Proceedings  
8th International Oak Society Conference  
October 18-21, 2015

Issue No. 27/ 2016 / ISSN 1941-2061



# International Oaks

The Journal of the International Oak Society

---

Proceedings  
8th International Oak Society Conference  
October 18-21, 2015

Issue No. 27/ 2016 / ISSN 1941-2061





## International Oak Society Officers and Board of Directors 2015-2018

### Officers

*President* Charles Snyers d'Attenhoven (Belgium)

*Vice-President* Shaun Haddock (France)

*Secretary* Gert Fortgens (The Netherlands)

*Treasurer* James E. Hitz (USA)

### Board of Directors

*Membership Director*

Robert Routon (USA)

*Tour Director*

Shaun Haddock (France)

*International Oaks*

*Editor* Béatrice Chassé

*Co-Editor* Allen Coombes (Mexico)

*Oak News & Notes*

*Editor* Roderick Cameron (Uruguay)

*Co-Editor* Ryan Russell (USA)

*Website Administrator*

Charles Snyers d'Attenhoven

### Editorial Committee

*Chairman*

Béatrice Chassé

*Members*

Roderick Cameron

Allen Coombes

Dirk Giseburt (USA)

Shaun Haddock

Ryan Russell

### For contributions to *International Oaks*

contact

Béatrice Chassé

pouyouleix.arboretum@gmail.com or editor@internationaloaksociety.org

Les Pouyouleix

24800 St.-Jory-de-Chalais

France

Author guidelines for submissions can be found at

<http://www.internationaloaksociety.org/content/author-guidelines-journal-ios>

© 2016 International Oak Society

Copyright of *International Oaks* and to articles in their final form as they appear in the publication belong to the International Oak Society. Copyrights to texts, photographs, illustrations, figures, etc., belong to individual authors and photographers.

**Cover illustration.** Wendy Brockman (*Quercus palustris*).

**Photos.** p. 9: James MacEwen (Michael Heathcoat Amory); p. 10: Guy Sternberg (8<sup>th</sup> International Oak Society Conference participants); p. 11: Charles Snyers d'Attenhoven (*Quercus stellata*); p. 13: Béatrice Chassé (*Q. ×fernowii*).

**[www.internationaloaksociety.org](http://www.internationaloaksociety.org)**

**Join the International Oak Society today!**

# Table of Contents

—/ 11 /—

Foreword

Twenty-one Years After

*Charles Snyers d'Attenhoven*

—/ 13 /—

Preface

From Small Acorns

*Sara Oldfield*

—/ 15 /—

Introduction

Oak Research in 2015: a Snapshot from the IOS Conference

*Andrew L. Hipp*

—/ 23 /—

Systematics and Biogeography of the American Oaks

*Paul S. Manos*

—/ 37 /—

Diversity, Distribution and Ecosystem Services of the North American Oaks

*Jeannine Cavender-Bares*

—/ 49 /—

Drought Tolerance and Climatic Distributions of the American Oaks

*Matthew Kaproth and Jeannine Cavender-Bares*

—/ 61 /—

Phylogeny and Introgression of California Scrub White Oaks (*Quercus* section *Quercus*)

*Victoria L. Sork, Erin Riordan, Paul F. Grugger, Sorell Fitz-Gibbon, Xinzeng Wei, and Joaquín Ortego*

—/ 75 /—

A Tough Little Survivor: The West Texas Oak, *Quercus hinckleyi*

*Janet Rizner Backs*

—/ 83 /—

Landscape and Conservation Genetics of the Island Oak, *Quercus tomentella*

*Mary V. Ashley, Janet R. Backs, and Saji T. Abraham*

—/ 91 /—

Hybridization and Adaptive Divergence in Oaks

*Olivier Gailing and Jennifer Riehl*

—/ 99 /—

Asexual Propagation of Oak Hybrids: Our Progress, and the Challenges of Producing Clonal Plants  
*Nina L. Bassuk, Bryan R. Denig, and Miles Schwartz Sax*

—/ 107 /—

Eating Acorns: What Story do the Distant, Far, and Near Past Tell Us, and Why?  
*Béatrice Chassé*

—/ 137 /—

New and Lesser-Known Cultivars 2013-2015  
*Ryan Russell and Eike Jablonski*

—/ 149 /—

Anther Culture of Turkey Oak (*Quercus cerris*)  
*Joseph Rothleutner*

—/ 155 /—

The Plant Collections Network and the *Quercus* Multisite Collection  
*Greg Paige*

—/ 163 /—

Rescuing Plant Species with Extremely Small Populations in China: the Case of the Xichou oak,  
*Quercus sichourensis*  
*Weibang Sun, Zhekou Zhou, Wenyun Chen, Yuan Zhou, Lei Cai, Murphy Westwood, and Jessica Turner*

—/ 171 /—

Conservation of *Quercus arbutifolia*, a Rare Oak, from Southern China's Montane Cloud Forests  
*Min Deng, Xu Jun, Yi-Gang Song, and Xiao-Long Jiang*

—/ 181 /—

A Genetic Map for the *Lobatae*  
*Arpita Konar, Olivia Choudury, Oliver Gailing, Mark V. Coggeshall, Margaret E. Staton, Scott Emrich, John E. Carlson, and Jeanne Romero-Severson*

—/ 189 /—

Development of New Genomic Resources for Northern Red Oak, *Quercus rubra*  
*Christopher R. Heim, Mark V. Coggeshall, Arpita Konar, and Jeanne Romero-Severson*

—/ 195 /—

Sustaining Oaks in the Chicago Region Landscape: Developing a Plan for Maintaining Oak  
Dominance in an Urban Landscape  
*Lindsay Darling and Robert T. Fahey*

—/ 207 /—

Pathfinder: the Last Prairie Sentinel  
*Guy Sternberg*

—/ 217 /—

Oaks in Puebla: Growing Successes and Failures, and New Research Topics  
*Maricela Rodríguez-Acosta, Allen J. Coombes, Carlos A. Paredes-Contreras, Stephanie Fernández-Velázquez, and Citlali Guevara-González*

—/ 227 /—

Searching for the Hardy Southern Live Oak  
*Anthony Aiello*

—/ 233 /—

The Last Basketmaker: Indiana's Forgotten History of Oak-Rod Baskets  
*Jon Kay*

—/ 245 /—

Are Resource Dynamics a Necessity for Oak Masting?  
*Ian Pearse*

—/ 255 /—

Preserving Oak (*Quercus* sp.) Germplasm to Promote Ex-Situ Conservation  
*Christina Walters, Lisa Hill, Jennifer Crane, Marcin Michalak, Xia Ke, Jeffrey Carstens, Kevin Conrad, Murphy Westwood, Alison Colwell, Joanna Clines, and Pawel Chmielarz*

—/ 267 /—

The Pace of Microevolution of European Oaks During Environmental Changes  
*Antoine Kremer*

—/ 277 /—

Launching the Global Oak Conservation Initiative at The Morton Arboretum  
*Lisa Kenny and Murphy Westwood*

—/ 290 /—

Workshops

—/ 305 /—

Poster Sessions

—/ 343 /—

Pre-Conference Tour  
*Roderick Cameron*

—/ 364 /—

The Morton Arboretum  
*Charles Snyers d'Attenhoven*

—/ 375 /—

Post-Conference Tour  
*James Hitz*

—/ 390 /—

International Oak Society Service Awards

—/ 392 /—

First International Oak Society Silent Auction



*Quercus bicolor* at Starhill Forest Arboretum (Charles Snyers d'Attenhoven).

# Best Under Stress: Does An Episodic Hybrid Advantage Suppress Reproductive Barriers in Oaks?

Warren B. Chatwin<sup>1</sup>, Chris R. Heim<sup>2</sup>, Mark V. Coggeshall<sup>2</sup>, and Jeanne Romero-Severson<sup>1</sup>

1. Department of Biological Sciences  
University of Notre Dame  
Notre Dame, IA 46556, USA

2. School of Natural Resources  
University of Missouri  
Columbia, MO 65211, USA

The effects of hybridization in oaks (*Quercus*) are poorly understood. Even among allopatric species, intrinsic reproductive barriers appear weak. Why have these barriers not arisen despite millions of years of separation? We hypothesize that, under episodic climate stress, hybrids have a periodic advantage that suppresses the development of intrinsic reproductive barriers, resulting in a highly conserved genomic architecture among interacting species. This conservation preserves a general oak “lineage pool” which allows species to emerge, split, and fuse according to changes in long-term climate trends.

Given that selection is most intense in seedlings, we will determine the relative fitness of hybrid and parental seedlings under drought, flooding, and permissive conditions. We will also use genetic mapping with ddRADtags to infer their genomic architecture. We have used 18 EST-SSR markers (mapped in *Q. robur* L.) to identify the parentage of the progeny of two F<sub>1</sub> hybrids. We have genotyped 256 germinated progeny, 70 progeny that failed to germinate, and all potential pollen parents within 500 m (including *Q. ×warei* Green & Hess, *Q. ×schuettei* Trel., *Q. robur*, *Q. bicolor* Willd., and five other species). We inferred parentage using CERVUS. Parentage assignment was successful with positive LOD scores for 167 progeny. Our analysis indicates that most progeny are backcrosses to *Q. robur*. Starting fresh in Fall 2015, we have collected thousands of acorns to be used in a four-year study to test our hypothesis of a periodic hybrid advantage under climate stress. We expect these data to help us understand why oaks, and other forest trees, have not developed strong reproductive barriers over millions of years of ecological speciation.



# Best Under Stress: Does An Episodic Hybrid Advantage Suppress Reproductive Barriers in Oaks?

WARREN B. CHATWIN<sup>1</sup>, CHRIS R. HEIM<sup>2</sup>, MARK V. COGGESHALL<sup>2</sup>, JEANNE ROMERO-SEVERSON<sup>1</sup>



<sup>1</sup> DEPARTMENT OF BIOLOGICAL SCIENCES, UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA 46556 USA

<sup>2</sup> SCHOOL OF NATURAL RESOURCES, UNIVERSITY OF MISSOURI, COLUMBIA, MISSOURI 65211 USA

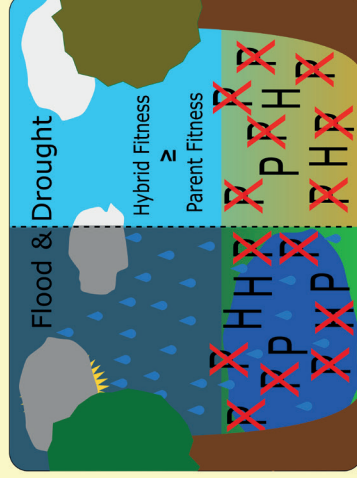
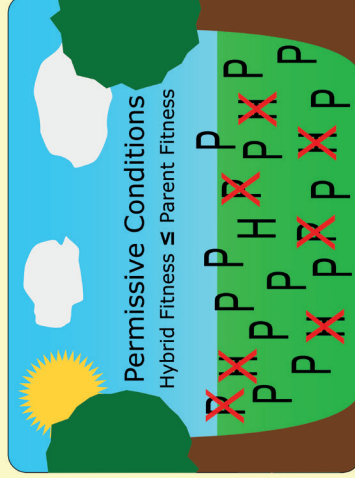


University of Missouri

## Introduction:

The effects of hybridization in oaks (*Quercus*) are poorly understood. Even among geographically separated species, intrinsic reproductive barriers appear weak. Why have these barriers not arisen despite millions of years of separation? We hypothesize that, under episodic climate stress, hybrids have a periodic advantage which suppresses the development of intrinsic reproductive barriers, resulting in a highly conserved genomic architecture among interacting species. This conservation preserves a general oak "lineage pool" which allows species to emerge, split, and fuse according to changes in long term climate trends.

Our study focuses on examining the progeny of two  $F_1$  hybrid crosses,  $Q. \times warei$  ( $Q. bicolor \times Q. macrocarpa$ ) located on the University of Missouri campus. We will evaluate the relative fitness of hybrid and parental seedlings under drought, flooding, and permissive conditions. Many of the  $F_1$  hybrids are more stress tolerant than either parent species. We will also analyze their genetic architecture and search for novel gene combinations. We expect these data to help us understand why oaks



## Results & Conclusions:

- One *Q. robur* is the predominant pollinator for the *Q. \times warei* with the highest seed set
- These backcrossed progeny enable us to leverage the *Q. robur* genome sequence and will generate enough progeny for phenotypic testing
- The other *Q. \times warei* has a variety of pollinators, but a low seed set (likely due to its geographic placement between two tall buildings)
- There does not appear to be any difference in pollinator for acorns that germinate and acorns that fail to germinate
- Our parentage analysis shows that we have enough statistical power to study the mechanisms that sustain weak species boundaries in oaks.



and many other forest tree taxa have not developed strong reproductive barriers over millions of years of ecological speciation.

## Hypotheses:

1.  $F_1$  hybrid seedlings will survive severe abiotic stress better than parental species.
2. Under permissive conditions hybrid seedlings will have little or no survival advantage.
3. Genomic architecture will be highly conserved across sympatric species pools.
4. Conserved genomic architecture will persist even under allopatric speciation.



P = Parent Species Seedlings  
H = Hybrid Seedlings  
**X** = Deceased

## Materials and Methods:

Collect Acorns from Hybrid Trees

Detect the pollen parent using  
18 EST-SSR markers from *Q. robur*

Subject groups of hybrid and parent species  
seedlings to stress tests (drought, flooding)

Collect Phenotypic data  
(Survival, growth metrics)

Use high throughput sequencing of genetic markers  
(ddRADtags) for parents and progeny

Construct genetic maps

Assess genomic architecture in both  
hybrid and parent species

Locate novel combinations of stress  
resistant/tolerant genes using  
QTL analysis and the *Q. robur* genome

## Acknowledgements:

The authors would like to thank Arpita Konar, Aral Noakes, and Lauren Fiedler for their sacrifices of time and supplies to support this project. WC acknowledges support from the National Science Foundation through a Graduate Research Fellowship (DGE-1313583). WC thanks his advisor JRS for her time and constant mentoring to help him become a better scientist and human citizen. He also thanks his wife for her patience with not seeing him much recently, as well as his mother for instilling in him a love for the outdoors and encouraging him to reach his lofty goals.



**Table 1: Pollen Parentage Assignment**  
The distribution of pollen parents for two different *Q. × warei* for acorns that either germinated or failed to germinate in 2014.

<i>Q. × warei</i> #3	Pollen Parent	Number Pollinated	Putative Species
TOTAL	22082	132	<i>Q. robur fastigiata</i>
	22080	15	<i>Q. robur fastigiata</i>
	22133	1	<i>Q. × warei</i>
	22091	1	<i>Q. bicolor</i>
GERMINATED	22082	86	<i>Q. robur fastigiata</i>
	22080	10	<i>Q. robur fastigiata</i>
	22133	1	<i>Q. × warei</i>
FAILED TO GERMINATE	22082	46	<i>Q. robur fastigiata</i>
	22080	5	<i>Q. robur fastigiata</i>
	22091	1	<i>Q. bicolor</i>

<i>Q. × warei</i> #2	Pollen Parent	Number Pollinated	Putative Species
GERMINATED	22133	7	<i>Q. × warei</i>
	22127	3	<i>Q. lyrata</i>
	22112	3	<i>Q. robur</i>
	22098	2	<i>Q. bicolor</i>
	22100	1	<i>Q. × jackiana</i>
	22104	1	<i>Q. bicolor</i>
	22122	1	<i>Q. macrocarpa</i>