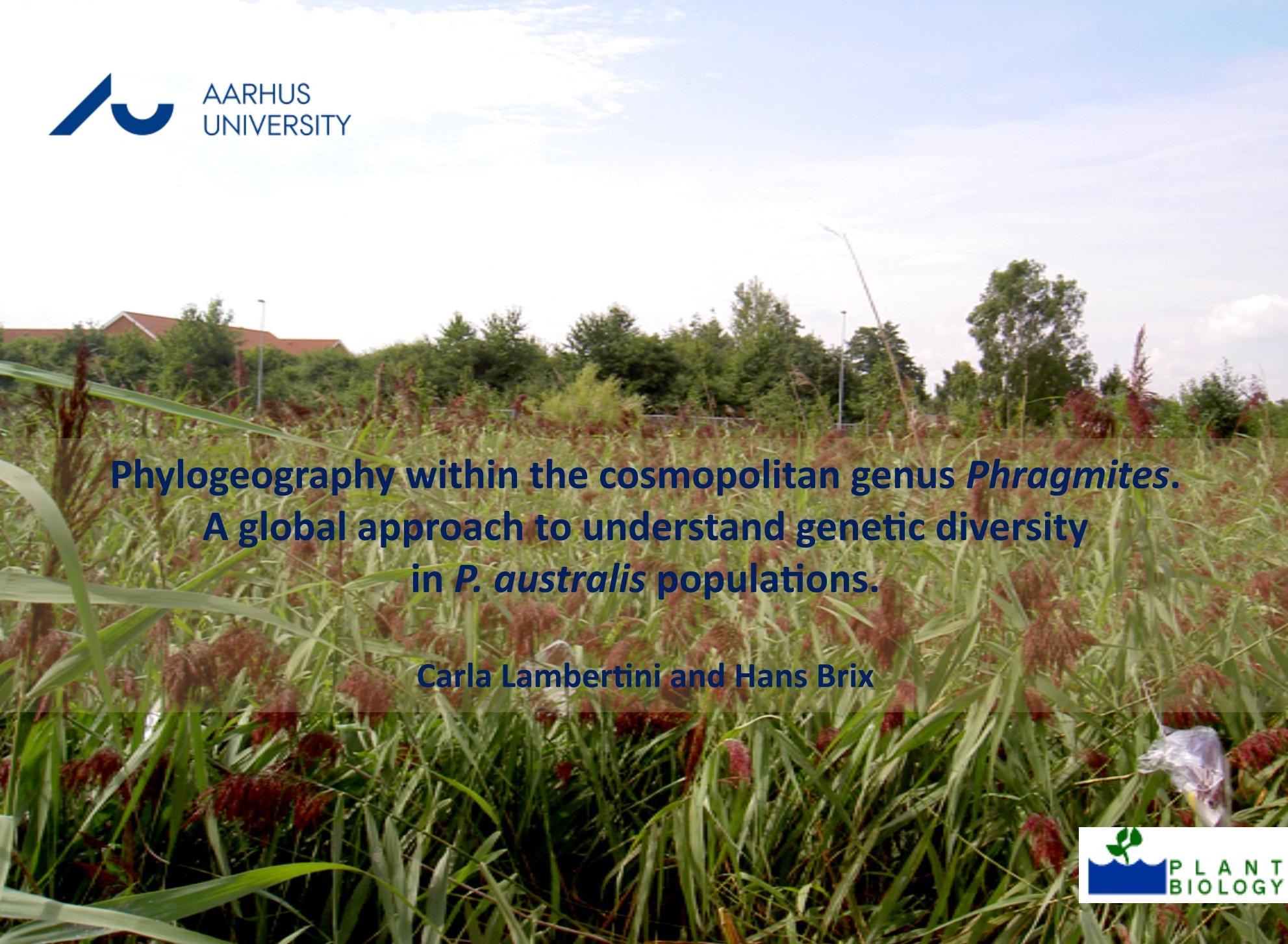




AARHUS
UNIVERSITY



Phylogeography within the cosmopolitan genus *Phragmites*.
A global approach to understand genetic diversity
in *P. australis* populations.

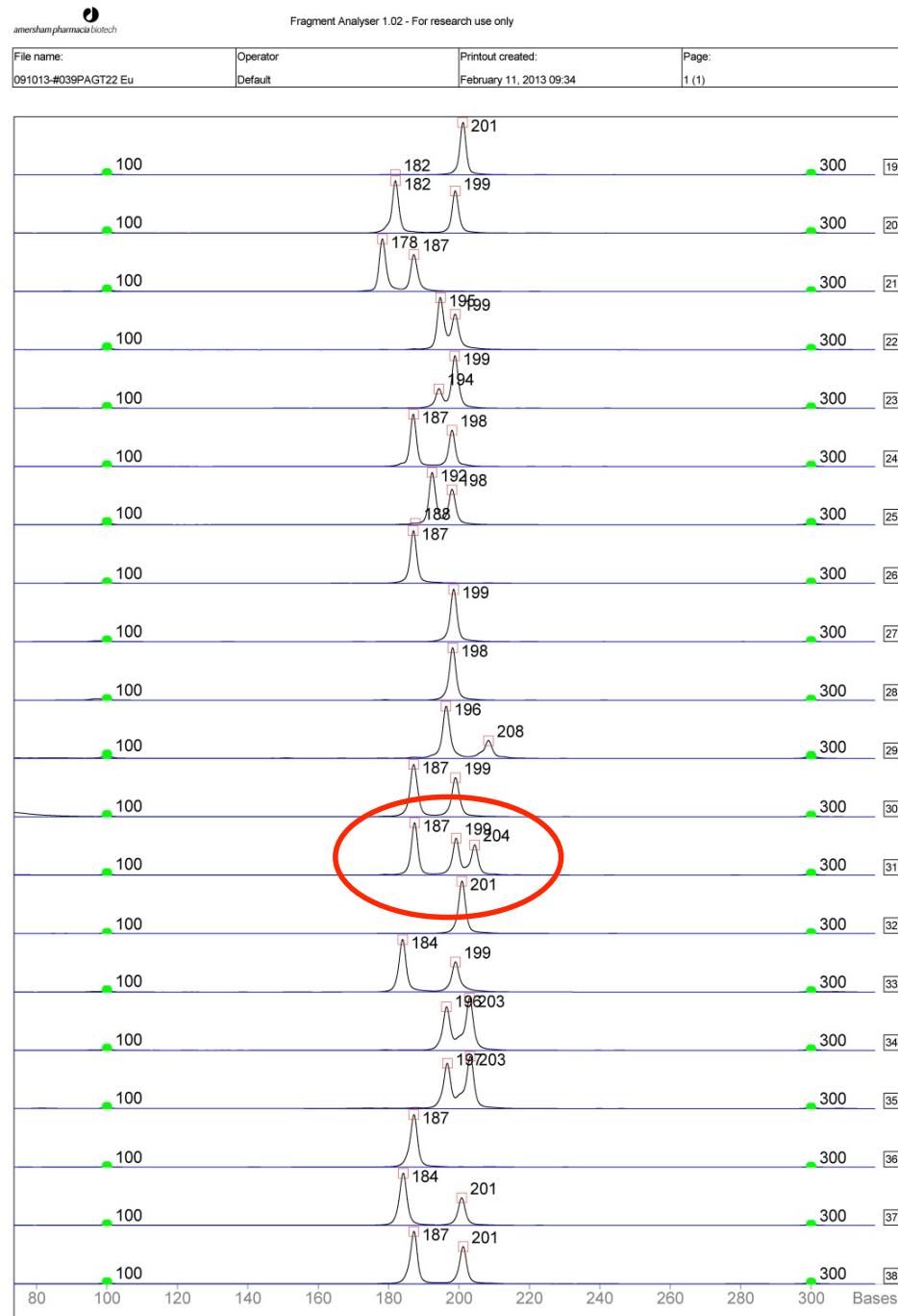
Carla Lambertini and Hans Brix





Does it matter where *Phragmites* comes from?





Genetic diversity in wild populations (in Europe)

- Several different alleles
- Often more than two alleles
- Variation within population

AMOVA:

% of variation	Italy	UK	CZ
Among populations	15	36	6
Within populations	85	64	94
Fixation index Fst	0.15	0.270	0.06
p-value	<0.01	<0.01	<0.01

Italy: Lambertini et al., 2008

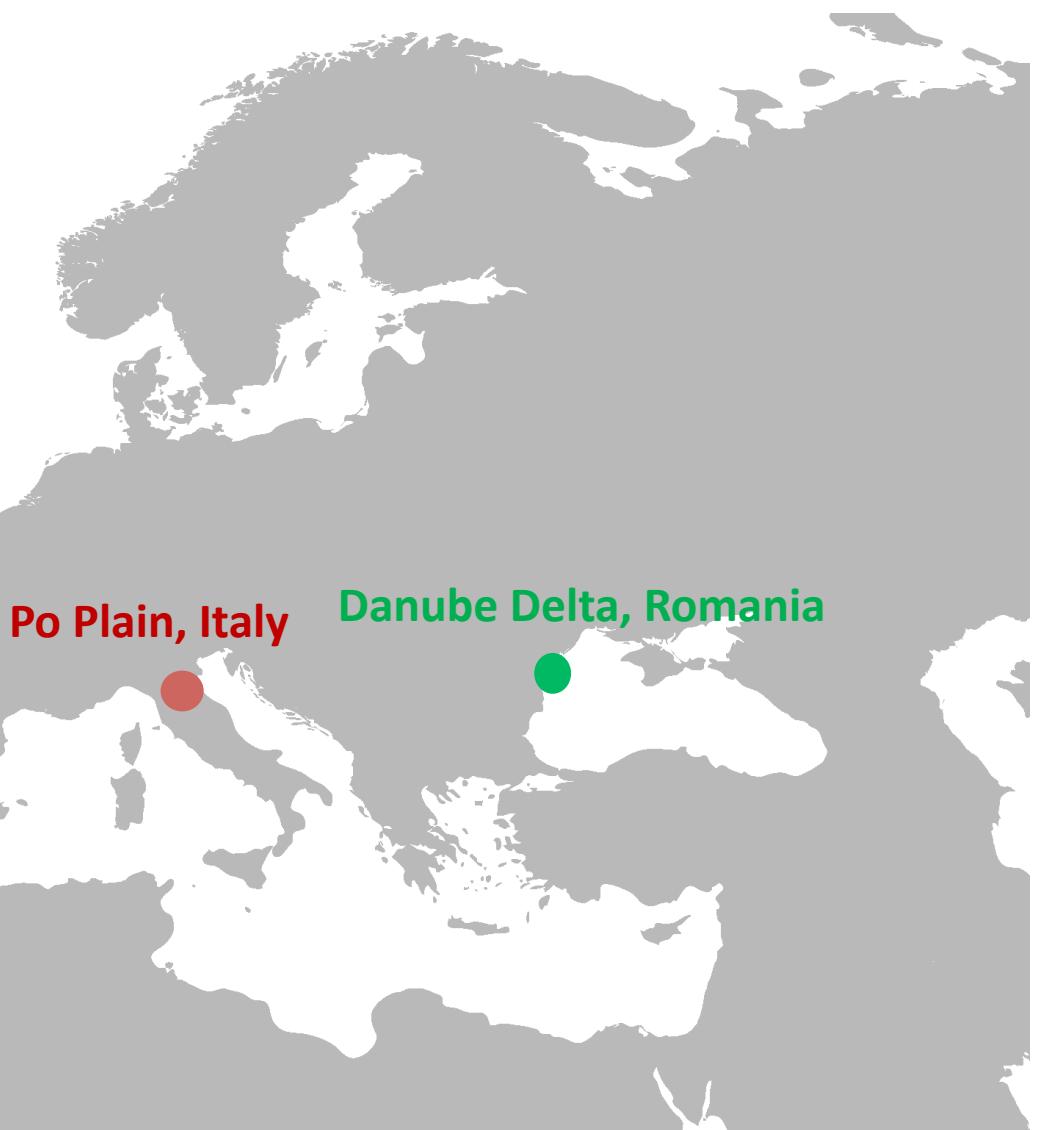
UK: Paul et al., 2011

CZ: Fer and Hroudova, 2009

- Genetic distances do not increase with geographic distances

Comparison among distant wild populations (in Europe)

Source of variation	d.f.	Sum of squares	Variance components	% of variation
1) PO PLAIN POPULATIONS				
Among populations	7	129,736	1,60541 Va	14,67
Within populations	38	354,917	9,33991 Vb	85,33
Total	45	484,652	10,94533	
Fixation index FST =	0,14668			
P (Va and FST)	<0.01			
2) INCLUDING DANUBE DELTA POPULATION (without grouping)				
Among populations	8	162,24	1,69635 Va	14,94
Within populations	48	463,462	9,65546 Vb	85,06
Total	56	625,702	11,35181	
Fixation index FST =	0,14943			
P (Va and FST)	<0.01			
3) 2 GROUPS: PO PLAIN POPULATIONS AND DANUBE DELTA POPULATION				
Among groups	1	32,504	0,41213 Va	3,55
Among populations within group	7	129,736	1,55031 Vb	13,34
Within populations	48	463,462	9,65546 Vc	83,11
Total	56	625,702	11,61791	
Fixation indexes:				
FCT =	0,03547	P (Va and FCT)	>0,05	
FSC =	0,13835	P (Vb and FSC)	< 0,01	
FST =	0,16892	P (Vc and FST)	< 0,01	



Lambertini et al., 2008

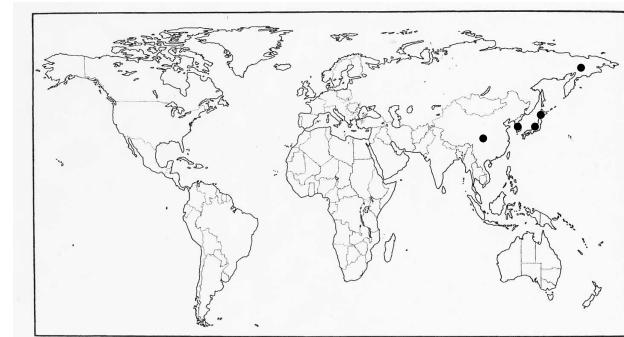
A global approach to understand genetic diversity in wild *Phragmites* populations



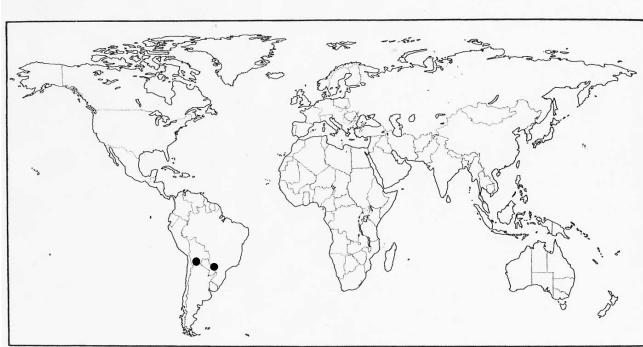


P. frutescens

Phragmites species



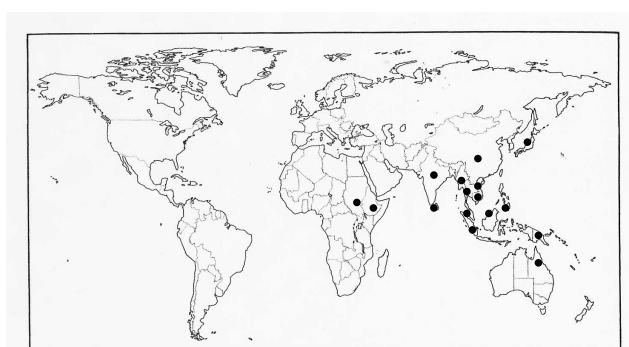
P. japonicus



P. dioicus



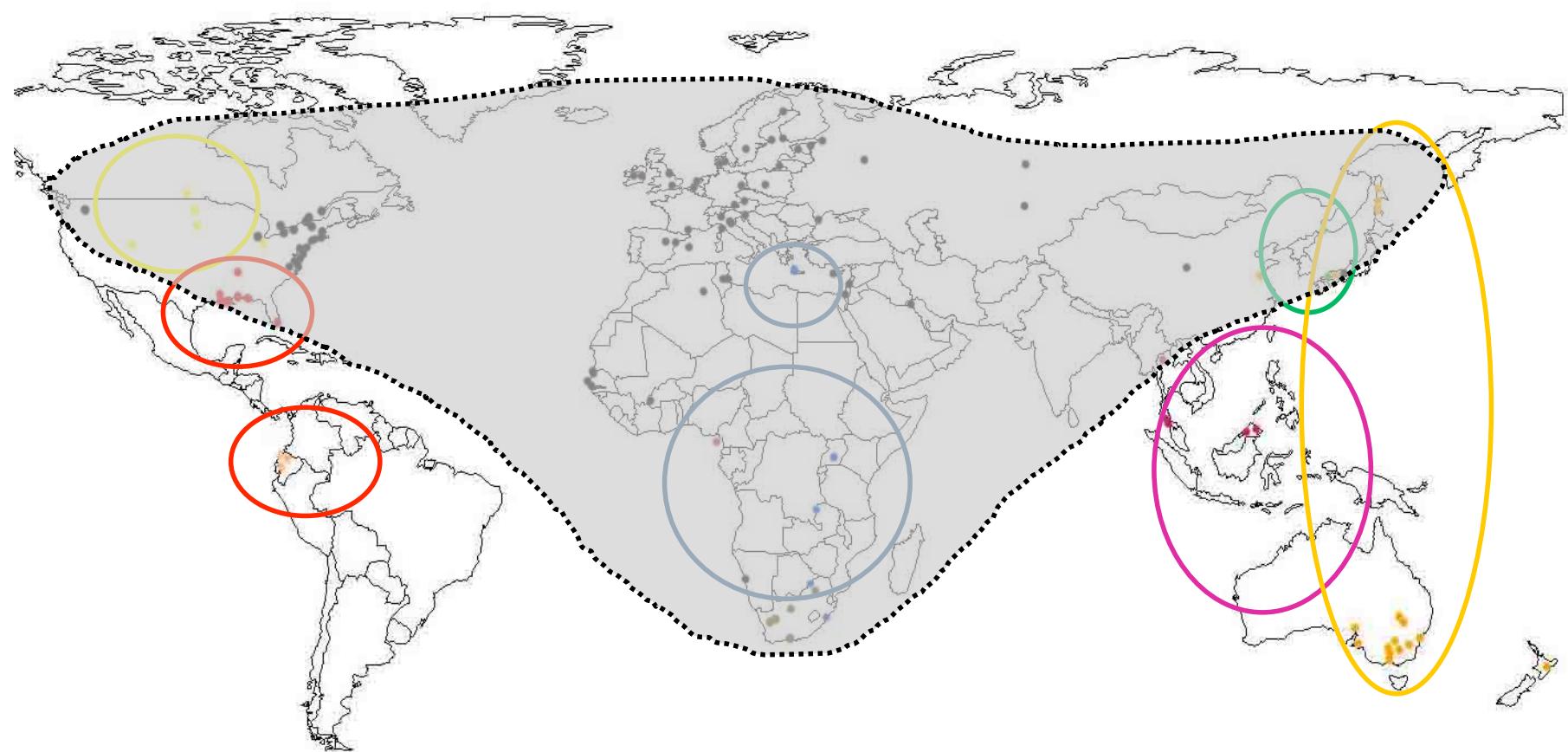
P. mauritianus



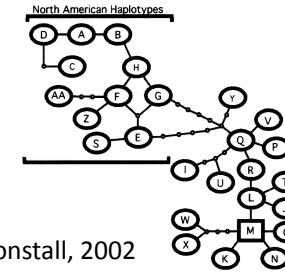
P. karka

Phragmites genetic diversity (AFLPs)

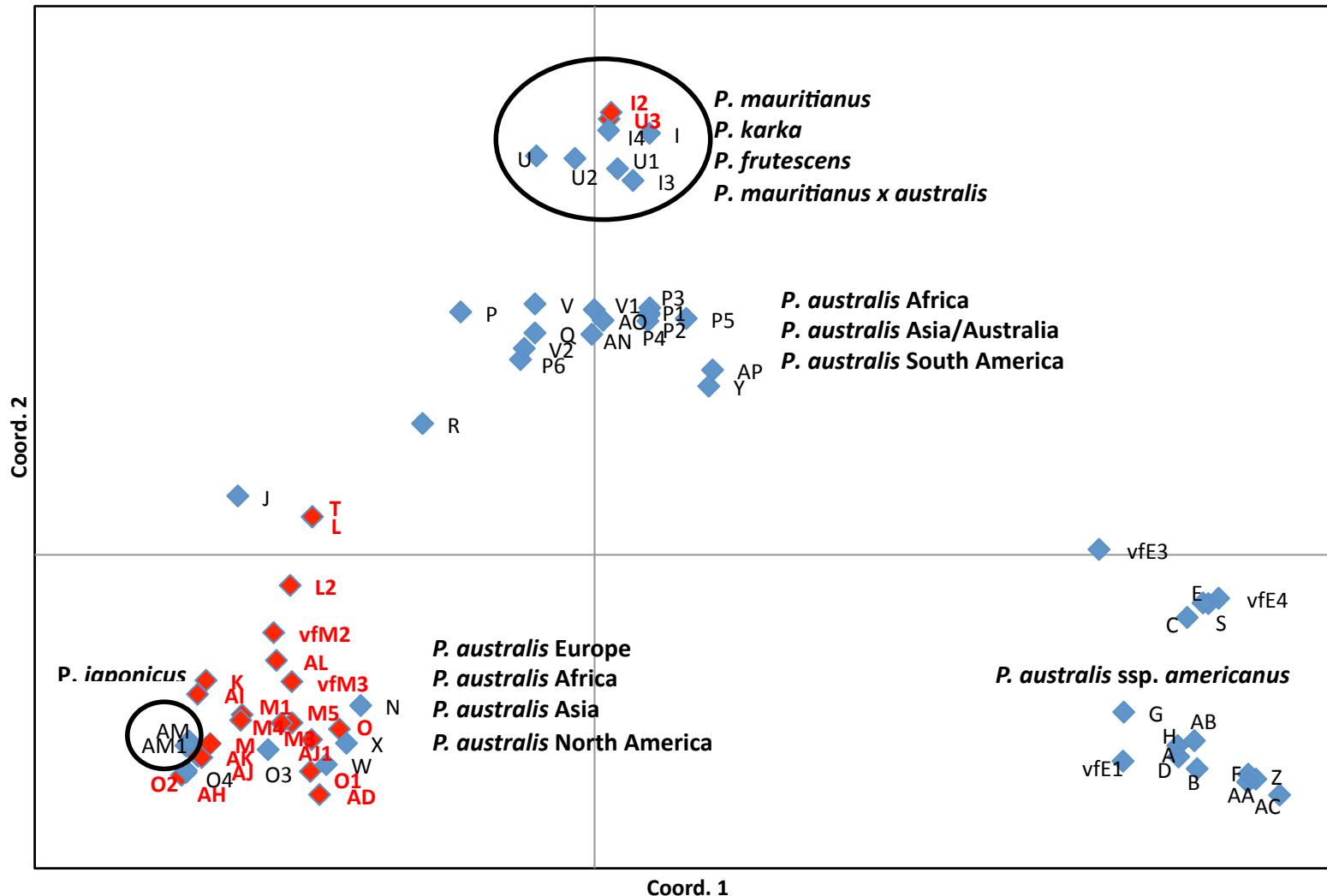
P. mauritianus (*P. frutescens*)
P. karka
P. japonicus
P. australis Asia/AU
P. australis ssp. *americanus*
P. australis var. *berlandieri*
P. australis South America
P. australis Europe



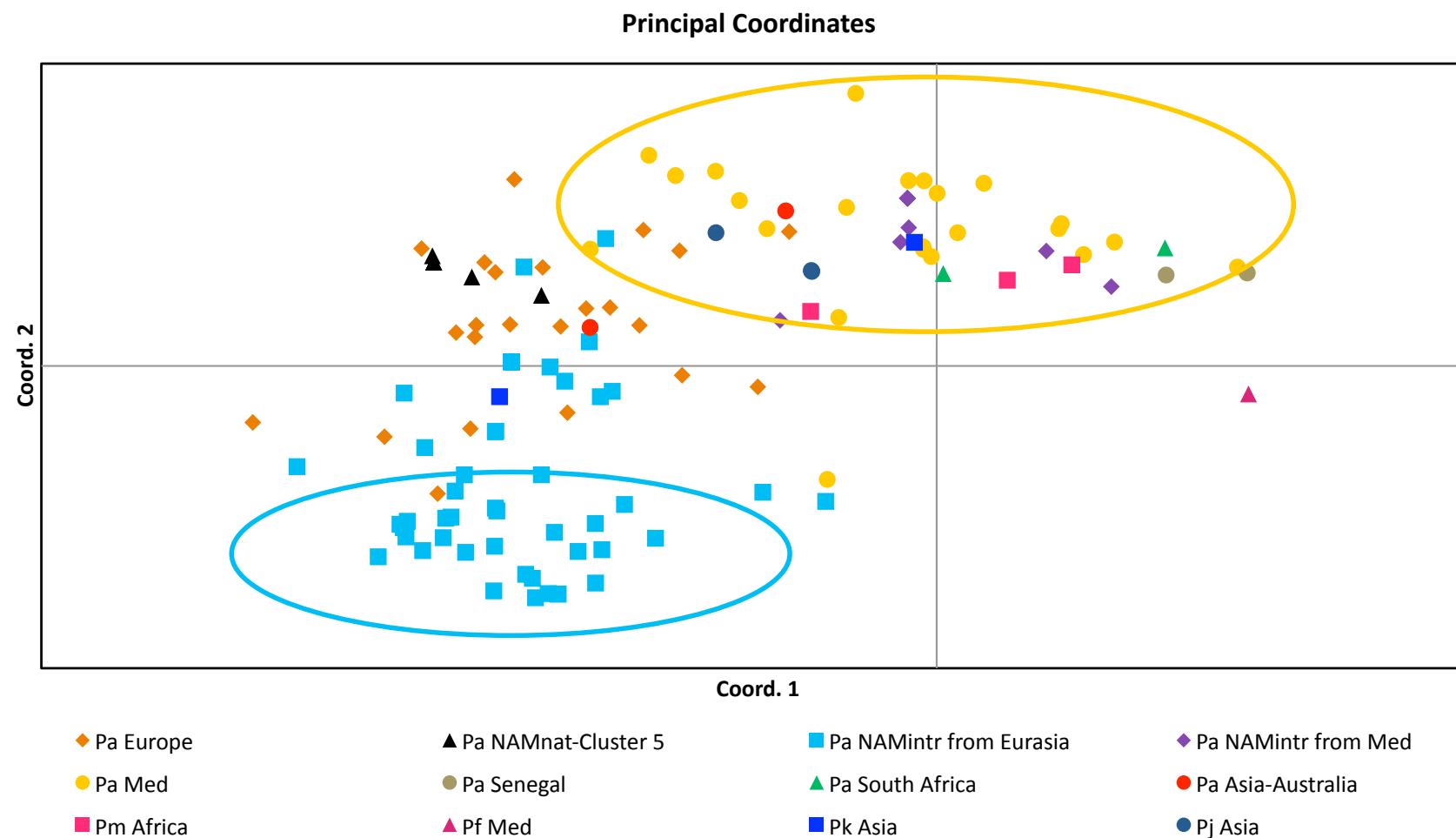
Phragmites cp-DNA lineages (*trnT-trnL* + *rbcL-psal*)



Principal Coordinates



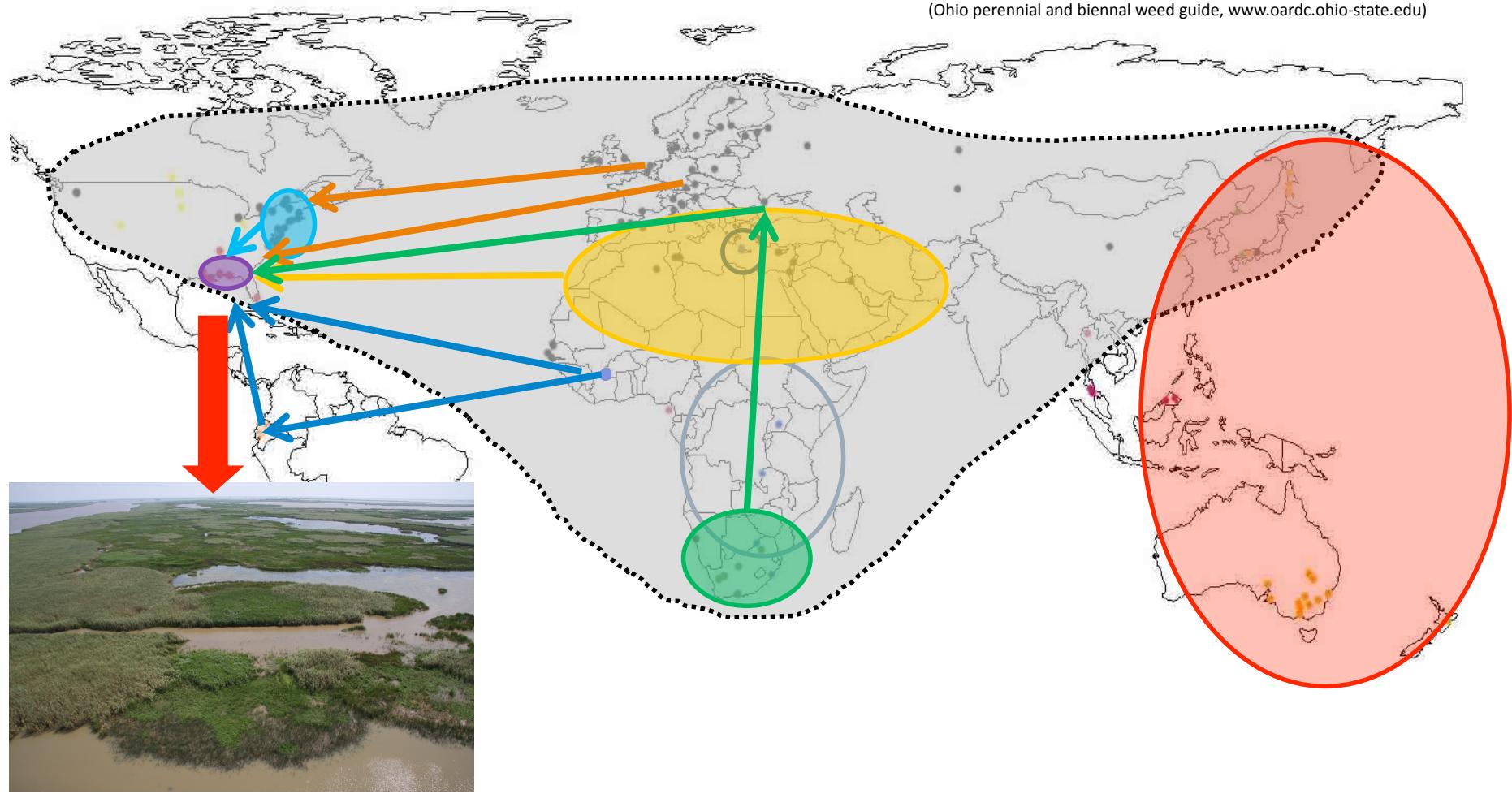
SSRs identify two groups within European *Phragmites*



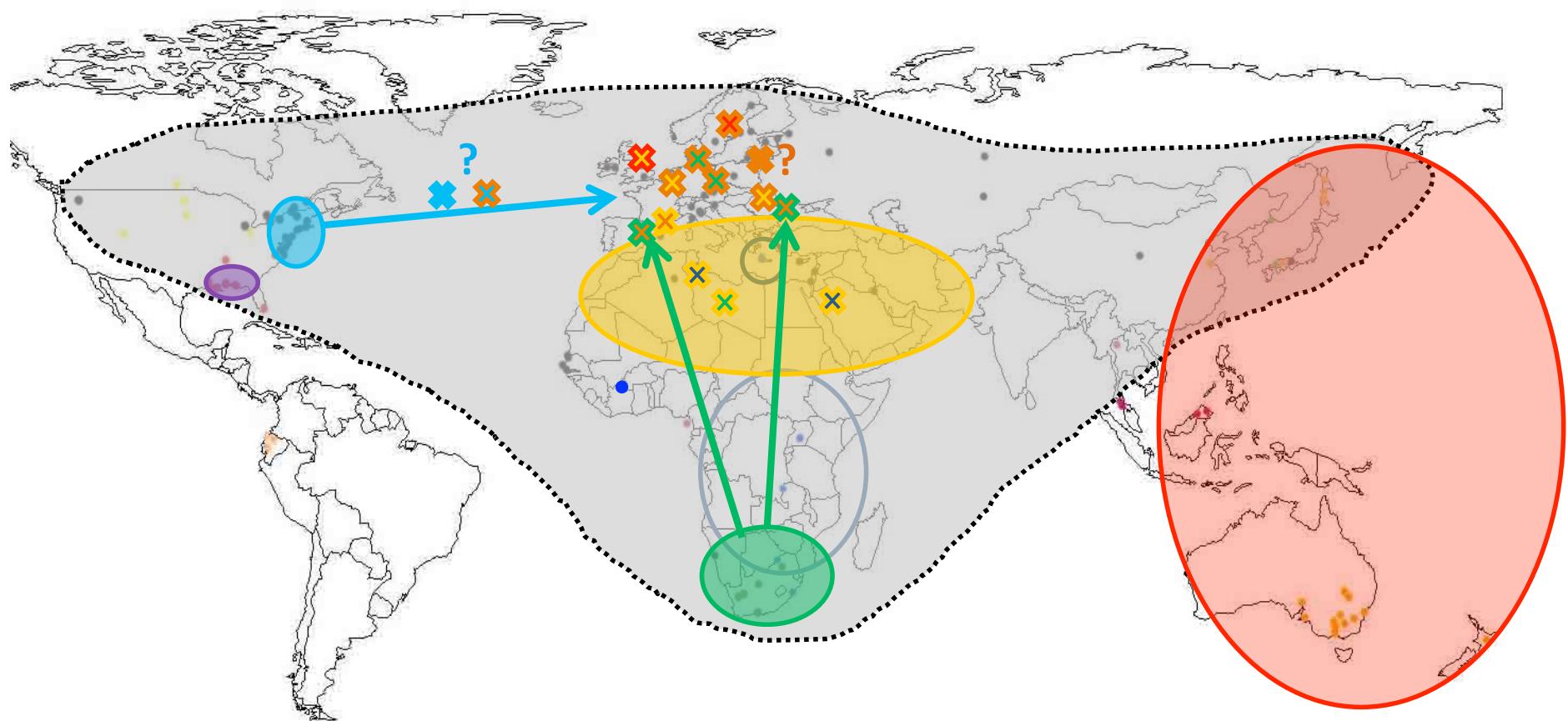
Structure within European *Phragmites*



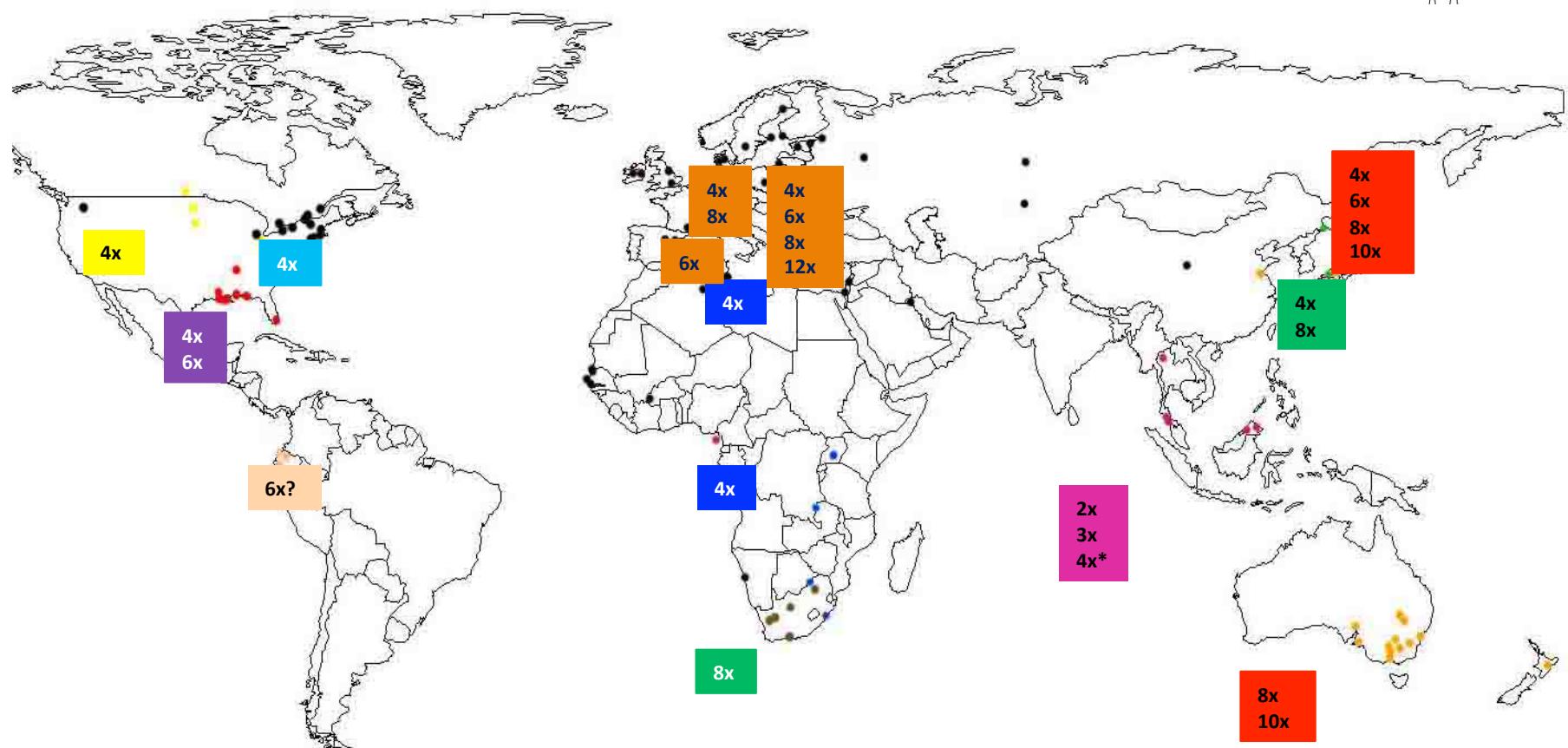
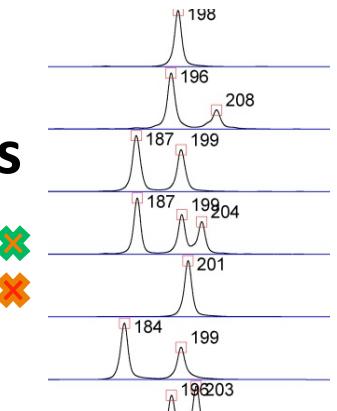
(Ohio perennial and biennial weed guide, www.oardc.ohio-state.edu)



Long distance dispersal and interbreeding

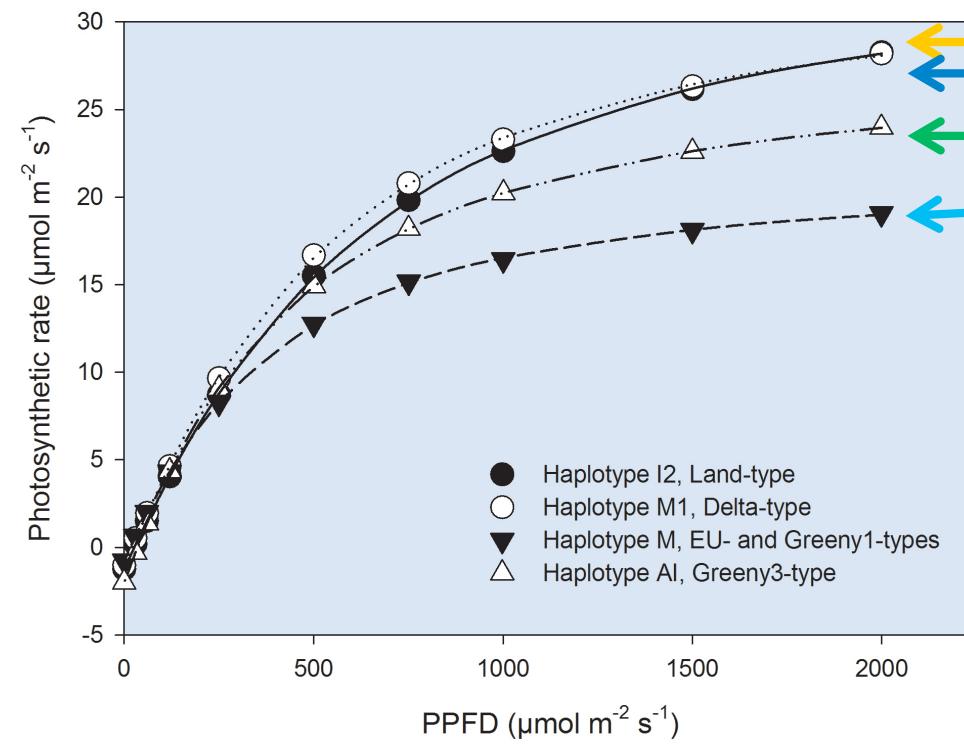
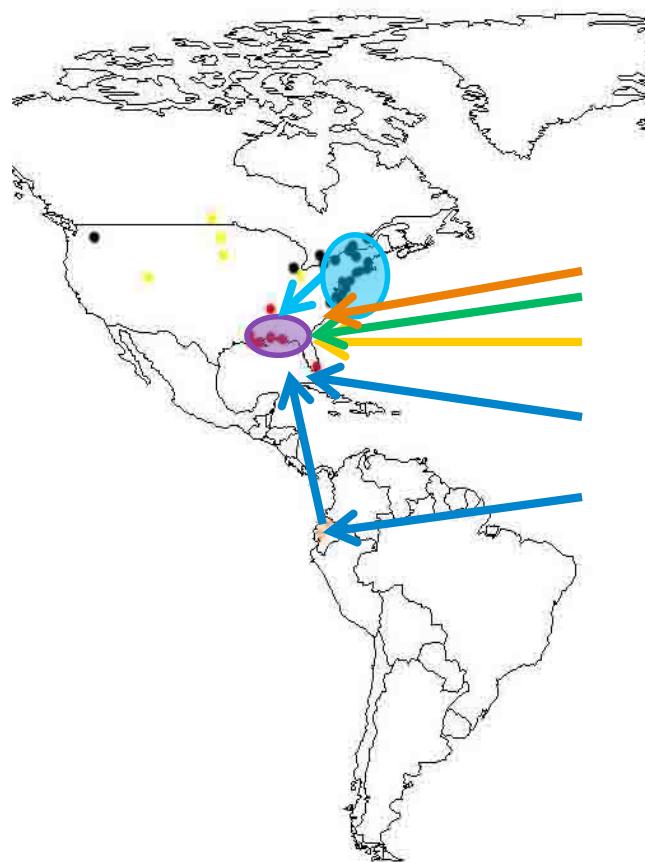


Cytological variation is within phylogeographic groups (based on Clevering and Lissner, 1999)



P. mauritianus (*P. frutescens*) *P. karka* *P. japonicus* *P. australis* Asia/AU
P. australis ssp. *americanus* *P. australis* var. *berlandieri* *P. australis* South America *P. australis* Europe

How does genetic diversity affect ecophysiology?



Can the different types be recognized morphologically?

Mediterranean *P. australis* ? Southafrican *P. australis* ?
(Greeny)

P. mauritanus (Africa)?



Phenology can help identify “foreign” genotypes



	inflorescence setting (2005)	stigma/anthers visible (2005)	seed setting (2005)	seed release (2006)
Sample	Locality	Phenological registrations		
Europe				
Pa	101SE Sweden - Luleå	12 jul 05	14 jul 05	>>
Ps	637SE Sweden - Gammelstaden	12 jul 05	28 jul 05	>>
Pa	13SE Sweden - Helsingland	12 jul 05	28 jul 05	>>
Pa	613SE Sweden-Takern	12 jul 05	28 jul 05	>>
Pa	160FI Finland - Åland	12 jul 05	28 jul 05	>>
Pa	34FI Finland - Åland	12 jul 05	28 jul 05	>>
Pa	21FI Finland - Turku	12 jul 05	28 jul 05	>>
Pa	169RU Russia - St. Petersburg	12 jul 05	28 jul 05	>>
Pa	107RU Russia - Moscow	12 jul 05	28 jul 05	>>
Pa	138RU Russia - Omsk	12 jul 05	28 jul 05	>>
Pa	83EE Estonia - Lake Võrtsjärv	12 jul 05	28 jul 05	>>
Pa	159EE Estonia - Lake Peipsi	12 jul 05	28 jul 05	>>
Pa	80DK Denmark - Vejleå	12 jul 05	28 jul 05	>>
Pa	31DK Denmark - Knæbel Vig	12 jul 05	28 jul 05	>>
Pa	45DK Denmark - Nørresønde Fjord	12 jul 05	28 jul 05	>>
Pa	85LU Lithuania-Silute	12 jul 05	28 jul 05	>>
Pa	81GB Great Britain - Tay Estuary, Scotland	12 jul 05	28 jul 05	>>
Pa	53GB Great Britain - River Humber	12 jul 05	28 jul 05	>>
Pa	205GB Great Britain - River Severn	12 jul 05	28 jul 05	>>
Pa	205GB Great Britain - Thames Mead	12 jul 05	28 jul 05	>>
Pa	682GB Great Britain	12 jul 05	28 jul 05	>>
Pa	39IR Ireland - Kilcock	12 jul 05	28 jul 05	>>
Pa	165IR Ireland - Lovetown	12 jul 05	28 jul 05	>>
Pa	164IR Ireland - Lake Kee	12 jul 05	28 jul 05	>>
Pa	163IR Ireland - Hazelhatch	12 jul 05	28 jul 05	>>
Pa	163NL Holland - Verdronken Land van Saetflinghe	12 jul 05	28 jul 05	>>
Pa	80ZNL Holland - Slotmeer	12 jul 05	28 jul 05	>>
Pa	146BE Belgium - Scheldt, Berlare	12 jul 05	28 jul 05	>>
Pa	67BE Belgium - Scheldt Estuarine, Bucht	12 jul 05	28 jul 05	>>
Pa	63DE Germany - Lusatia mining area	12 jul 05	28 jul 05	>>
Pa	64DE Germany - Lusatia mining area	12 jul 05	28 jul 05	>>
Pa	65DE Germany - Lusatia mining area	12 jul 05	28 jul 05	>>
Pa	66DE Germany	12 jul 05	28 jul 05	>>
Pa	18PL Poland - Krakow	12 jul 05	28 jul 05	>>
Pa	80CZ Czech Rep. - Rokznberk	12 jul 05	28 jul 05	>>
Pa	86CZ Czech Rep.	12 jul 05	28 jul 05	>>
Pa	87CZ Czech Rep.	12 jul 05	28 jul 05	>>
Pa	88HU Hungary - Lake Ferto	12 jul 05	28 jul 05	>>
Pa	89HU Hungary - Lake Ferto	12 jul 05	28 jul 05	>>
Pa	84RO Romania - Lake Obretnu-Mare	12 jul 05	28 jul 05	>>
Pa	629RO Romania - Lake Obretnu-Mare	12 jul 05	28 jul 05	>>
Pa	624RO Romania - Lake Obretnu-Mare	12 jul 05	28 jul 05	>>
Pa	634RO Romania - Lake Razin	12 jul 05	28 jul 05	>>
Pa	635RO Romania - Lake Razin	12 jul 05	28 jul 05	>>
Pa	638RO Romania - Lake Razin	12 jul 05	28 jul 05	>>
Pa	639RO Romania - Lake Razin	12 jul 05	28 jul 05	>>
Pa	642RO Romania - Lake Razin	12 jul 05	28 jul 05	>>
Pa	643RO Romania - Lake Razin	12 jul 05	28 jul 05	>>
Pa	644RO Romania - Lake Razin	12 jul 05	28 jul 05	>>
Pa	645RO Romania - Lake Razin	12 jul 05	28 jul 05	>>
Pa	646RO Romania - Lake Razin	12 jul 05	28 jul 05	>>
Pa	648RO Romania	12 jul 05	28 jul 05	>>
Pa	656RO Romania	12 jul 05	28 jul 05	>>
Pa	662RO Romania	12 jul 05	28 jul 05	>>
Pa	663RO Romania	12 jul 05	28 jul 05	>>
Pa	664RO Romania	12 jul 05	28 jul 05	>>
Pa	665RO Romania	12 jul 05	28 jul 05	>>
Pa	667RO Romania	12 jul 05	28 jul 05	>>
Pa	668RO Romania	12 jul 05	28 jul 05	>>
Pa	669RO Romania	12 jul 05	28 jul 05	>>
Pa	670RO Romania	12 jul 05	28 jul 05	>>
Pa	671RO Romania - Lake Razin Lake Razin	12 jul 05	28 jul 05	>>
Pa	17SL Slovenia - Cemisko Lake	12 jul 05	28 jul 05	>>
Pa	171SL Slovenia - Lubiana	12 jul 05	28 jul 05	>>
Pa	172SL Slovenia - Lubiana	12 jul 05	28 jul 05	>>
Pa	70FR France - Campagnol, Narbonne	12 jul 05	28 jul 05	>>
Pa	201IT Italy - Bergamo	12 jul 05	28 jul 05	>>
Pa	731I Italy - Gorgona Island	12 jul 05	28 jul 05	>>
Pa	17ES Spain - Encanyissa (Ebro)	12 jul 05	28 jul 05	>>
Pa	30ES Spain - Mallorca Island	12 jul 05	28 jul 05	>>
Pa	89TK Turkey - Akseler	12 jul 05	28 jul 05	>>
Mediterranean				
Pa	172ES Spain - Gallicantu	12 jul 05	28 jul 05	>>
Pa	173ES Spain - Huesa Massaoud	12 jul 05	28 jul 05	>>
Pa	371T Tunisia - Ras Teguermes, Djerba	12 jul 05	28 jul 05	>>
Pa	372T Tunisia - Ras Teguermes, Djerba	12 jul 05	28 jul 05	>>
Pa	74T Tunisia - Chemin (Gabes)	12 jul 05	28 jul 05	>>
Pa	17Greece Greece - Georgioupolis, Crete	12 jul 05	28 jul 05	>>
Pa	18Greece Greece - Georgioupolis, Crete	12 jul 05	28 jul 05	>>
Pa	17GR Greece - Drama, Crete	12 jul 05	28 jul 05	>>
Pa	17CY Cyprus - Coral Beach, Pafos	12 jul 05	28 jul 05	>>
Pa	17CY Cyprus - Afrodites, Cad. Polis	12 jul 05	28 jul 05	>>
Pa	90IL Israel - Yerokhan, Negev Highlands	12 jul 05	28 jul 05	>>
Pa	37IL Israel - Dead Sea, SW coast	12 jul 05	28 jul 05	>>
Tropics				
Pa	102SN Senegal - Potte d'Oie, Dakar	12 jul 05	28 jul 05	>>
Pm	73UG Uganda - Entebbe	12 jul 05	28 jul 05	>>
Pm	93UG Uganda - Kampala, Kinawataka wetland	12 jul 05	28 jul 05	>>
South Africa				
Pa	115ZA South Africa - Keurbooms Estuary	12 jul 05	28 jul 05	>>
Pa	188ZA South Africa - Leonesfontein	12 jul 05	28 jul 05	>>
Pa	195ZA South Africa - Branderlei	12 jul 05	28 jul 05	>>
Pa	311ZA South Africa - Kalkaat	12 jul 05	28 jul 05	>>
Pa	106ZA South Africa - Reunion, Durban	12 jul 05	28 jul 05	>>
Pa	301NA Namibia - Swakop River	12 jul 05	28 jul 05	>>

An aerial photograph of a vast wetland area. The landscape is dominated by green Phragmites reeds growing in numerous small, winding water channels. In the background, a larger, more permanent body of water or a river is visible under a clear blue sky.

Does it matter where *Phragmites* comes from?

Yes!

Acknowledgements

Colleagues, friends, relatives who collected reeds all over the world and contributed to the creation of the sampleset.

***Phragmites* PhD students** at Aarhus University (DK): **Franziska Eller, Xuan Loc Nguyen , Wenyong Guo, Luciana Achenbach** for studying *Phragmites* ecophysiology

All gardeners in Påskehøjgård (DK) for keeping the *Phragmites* collection alive.

Camilla Håkansson for the DNA-lab work.

Danish Council for independent research, Natural Sciences, for funding.

