South American *Lathyrus*

New collections of sweet peas (Leguminosae) for a taxonomic revision

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Introduction

This report presents the results of a collecting and herbarium-based field research trip to Argentina. The report is presented following the format required by the RHS Bursaries Committee and is intended as an outline of the expedition for all three major funders.
Full expenditure details are included in an appendix at the rear of this document.

Lathyrus
The principal focus of this field research was the genus *Lathyrus* - the sweet peas. Approximately 140 species are found throughout the temperate northern hemisphere. These species fall into two major lineages - the larger is centred on the eastern Mediterranean and a secondary group spans the Bering region and is most diverse in the western USA.
The third lineage in the genus is represented by the Notolathyrus group. This group contains around 20 species endemic to temperate South America and a single species (*Lathyrus pusillus*) that appears in the southwestern USA. The Notolathyrus group is thus of particular interest in the evolutionary history of *Lathyrus* as it represents an antitropical disjunct. The origins of this distribution pattern offer an insight into the processes of movements by this, and other temperate plant groups in response to factors such as climate change and major ocean circulations.

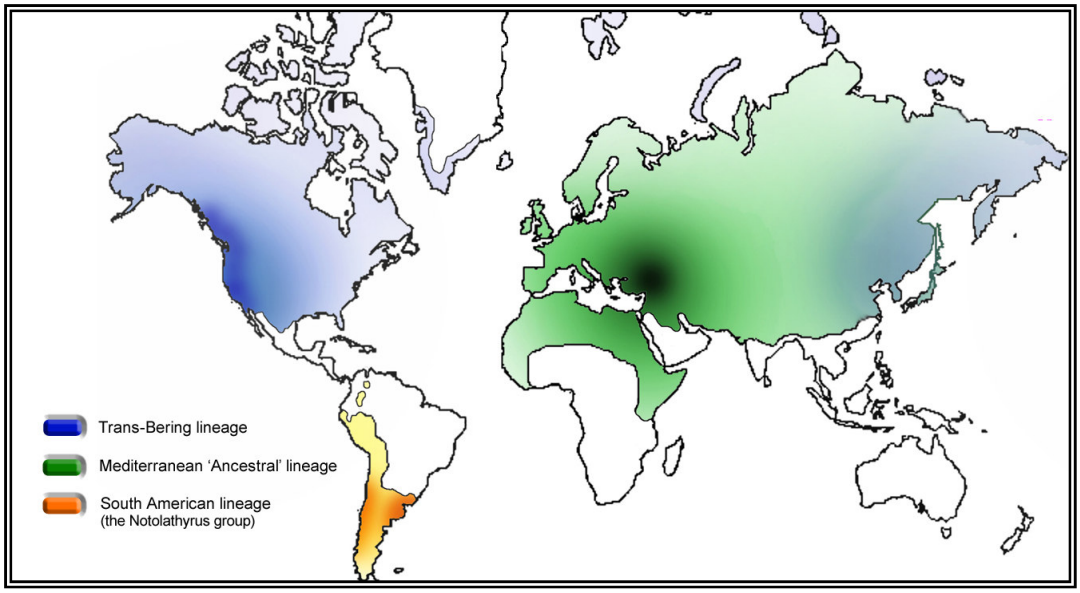

Figure 1. Worldwide distribution of Lathyrus.
The colour density on this map indicates diversity of species in each area. The main centre of diversity in the genus is around the eastern Mediterranean and Pontic region. Within South America, the greatest species diversity is in the north west of Argentina, Uruguay and southern Brasil.

Lathyrus is undoubtedly one of horticulture's major herbaceous genera. Most of the commercially significant sweet peas are derived from European species, particularly *L. odoratus* (the true sweet pea) and its close relatives.
Of the South American species, only *L. nervosus* is regularly available to gardeners in the UK, from a limited number of suppliers. The native range of *L. nervosus* is enormous and covers a huge ecological range from subtropical Brasilian 'jungle' to the beaches of Tierra del Fuego. Consequently, some ecotypes are well suited to outdoor cultivation in the UK. This species is commonly known as Lord Anson's blue pea, a name that is also often (mis)applied to *Lathyrus pubescens* - another widespread and common South American species. The remainder of section Notolathyrus is even less well known to northern hemisphere botany and horticulture. *Lathyrus magellanicus* and its allies, all of which dry black, are particularly taxonomically difficult.

Lathyrus magellanicus, *L. nervosus* and *L. pubescens* are the three most widespread species in South America. Many South American specimens in northern hemisphere herbaria are mislabelled with one of these 'default' names. Furthermore, misidentification hinders the ability for UK horticulture to adopt suitable hardy plants and limits the usefulness of ecological and biodiversity studies in temperate South America.
For these reasons, a complete revision of the South American species of *Lathyrus* is necessary. An English language account will prove of particular value to botanists and horticulturalists in English-speaking countries.

Arturo Burkart's 1935 revision of Argentine *Lathyrus* (in Spanish) and a recent Brasilian revision (in Portuguese) by Neubert and Miotto (2001) provide a good baseline from which to work. Burkart's revision was used throughout this fieldwork to place provisional identifications on specimens we collected.

The Royal Botanic Garden Edinburgh (RBGE) holds particularly good recent collections of *Lathyrus* from Peru, Bolivia, Chile and Argentine Patagonia. The main area where recent collections are lacking is northern Argentina and south Brasil. The collections from Kew, the Natural History Museum, New York Botanical Garden, Chicago Museum of Natural History and The Smithsonian Institute (all currently on loan to RBGE) follow a similar pattern, although typically with better representation from Brasil and poor collections from Chile. Consequently the field research reported here focussed on collections from north-eastern Argentina.

Aims

To make new collections of *Lathyrus* from northern Argentina including:

- Herbarium material (dried and pressed specimens) to be deposited in the Royal Botanic Garden Edinburgh.
- Seed for cultivation at the Royal Botanic Garden Edinburgh and allied collections.
- Field observations, including photographs, habitat and life-cycle notes.

The collections are being used to:

- Produce a complete revision of the South American species of *Lathyrus*.
- Investigate the antitropical distribution pattern and evolutionary history of the genus using DNA sequencing techniques.

The areas visited reflect those in which northern hemisphere herbaria's South American *Lathyrus* collections are weakest.

Achievements

Field research was very successful in terms of both collections and field observations of *Lathyrus*.
More than 5000 miles were covered, during which new collections of six species of *Lathyrus* were made, including multiple accessions of all species.

My colleagues in Argentina were Darien Prado and Luis Oakley, both of the Faculty of Agriculture, The University of Rosario. In preparation for fieldwork, Mr Oakley and myself did extensive herbarium-based research into localities where the plants had been collected in the past.
Figure 2 summarizes the coverage of the field expedition.

Figure 2. Areas visited
The coloured regions highlight the Argentine provinces in which we collected.

Our route essentially followed the perimeter of these provinces, following the courses of the major rivers.

Within the northeast of Argentina, we collected primarily in the Mesopotamia region, between the Uruguay and Parana rivers, across a wide range of habitats.

A four day expedition to Tucuman province, in the west allowed us to collect in higher altitude, typically drier, areas.

Two days were spent in the herbarium of Darwinion, Argentina's main botanical institute in Buenos Aires.

The North east

The initial leg of the expedition began in Rosario city, Santa Fe province and travelled through a wide variety of habitat types:

- *Espinal* dry forest
  The espinal dry forests of Santa Fe and Western Corrientes provinces are amongst the most intensively grazed in Argentina. Consequently the diversity of herbaceous plants is relatively low. Only *L. pusillus* and *L. subulatus* are native to these areas, although neither were available during the period we were there.

- *Wet chaco swamps*
  This habitat surrounds the Paraguay and Parana Rivers (in Corrientes, Chaco and Formosa provinces), where we collected *L. macrostachys* (Fig. 3) and *L. nigrivalvis* (Fig. 4). Neither of these species is present in any of the major UK collections. Both blacken on drying and are evidently close to the traditional view of *Lathyrus magellanicus*. These collections were therefore particularly important for understanding the interrelationships and species delimitation amongst black-drying South American *Lathyrus*. Our collections of *L. nigrivalvis* had robust rootstocks, suggesting that they are perennial plants. This species has previously only been recorded as an annual.

Figure 4 (above). *Lathyrus nigrivalvis*
This species has a relatively small stature and only 2 flowers per inflorescence, allowing it to be readily distinguished from other species in the genus.

Figure 3 (above). *Lathyrus macrostachys*
The black, linear pods shown here are typical of the black-drying *L. magellanicus* group. This is from a large patch of the species found growing on the borders of Chaco and Formosa provinces.

Figure 5. Wet chaco swamp
Typical wet chaco swamp in eastern Chaco province. Such areas are permanently waterlogged and highly biodiverse.

The wet chaco habitat (Fig. 5) represents a uniquely South American ecosystem, *Lathyrus palustris* is the sole true wetland species in the northern hemisphere. This is one of the habitats that we visited in which human influence is relatively limited. This is mainly due to its relative isolation from large centres of population and because the land is unsuited to grazing. Consequently species diversity is particularly high here.

- *Subtropical rainforests*
  In subtropical Misiones province we collected the first specimens of *L. hasslerianus* known in the UK. This species is poorly known throughout its range (southern Brazil and north Argentina), with few collections ever having been made.
  The habitat in which it was found was relatively shaded areas at the margins of dense subtropical forests - by roadsides or at the edges of shaded creeks. The inflorescence on this species is a dense cluster of 20 or more relatively small, waxy yellow flowers. This inflorescence type is unique among South American species - all others have relatively large purple or blue flowers. However, as the flowers on most species dry to yellow in the herbarium, this unique feature of *L. hasslerianus* had not been recorded.
  This inflorescence type is extremely similar to that found in disparate members of *Lathyrus* from Europe and North America and also another genus, *Vicia* (Fig. 6). This implies that these relatively unrelated species are all attracting pollinators using a similar display. *Bombus* species (bumblebees) were observed visiting the flowers of *L. hasslerianus*, but are also the main pollinators of the blue-flowered species. It may be that

the yellow, waxy flowers are merely a different means to attract the same pollinator, or perhaps they exploit other pollinators that have not been observed yet on the flowers.

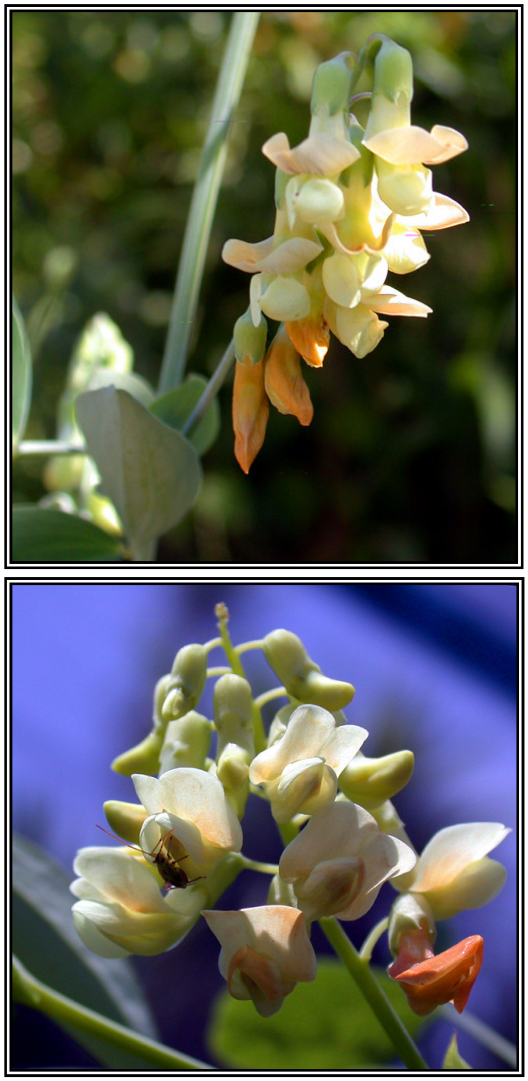

Figure 6. Spot the difference
The inflorescences of *L. hasslerianus* (left), *L. davidii* (below, left) and *Vicia pisiformis* (below) are strikingly similar.

Whilst it is certainly an attractive species, *Lathyrus hasslerianus* could only be cultivated under glass in the UK and other yellow- flowered species such as *L. davidii*, from China, Korea and Japan would be more tolerant of conditions in the UK. Indeed, *L. aureus*, from the Caucasus is hardy in the UK and available from commercial breeders, but has a less vine- like habit than these other species.

The weedy annual *L. pusillus* was also collected in Misiones Province, in open ruderal habitats near to the roadside. All individuals we came across had set seed and 'gone over', so neither seed nor good quality tissue for DNA was available. However, habitat and life-cycle observations were made.

- Returning south through Corrientes province, we collected the attractive, blue-flowered *L. pubescens* close to the river Uruguay. Most of the individuals from this population had begun to set seed, so good seed collections were made. Individuals from this area were typically less pubescent than those taken from higher altitudes in Tucuman province.

Tucuman province
The second leg of the expedition was to the dry chaco, cloud forest and arid upland areas of Tucuman province. Here, we secured further accessions of *L. pubescens* in *Alnus*-dominated cloud forests (Fig. 7a). Were greatly aided by the local knowledge of schoolchildren who were apparently on holiday at the time.

The *L. pubescens* at this altitude (circa 1500m) was typically more pubescent than that of the collection made at lower altitude in Corrientes province (circa 40m).

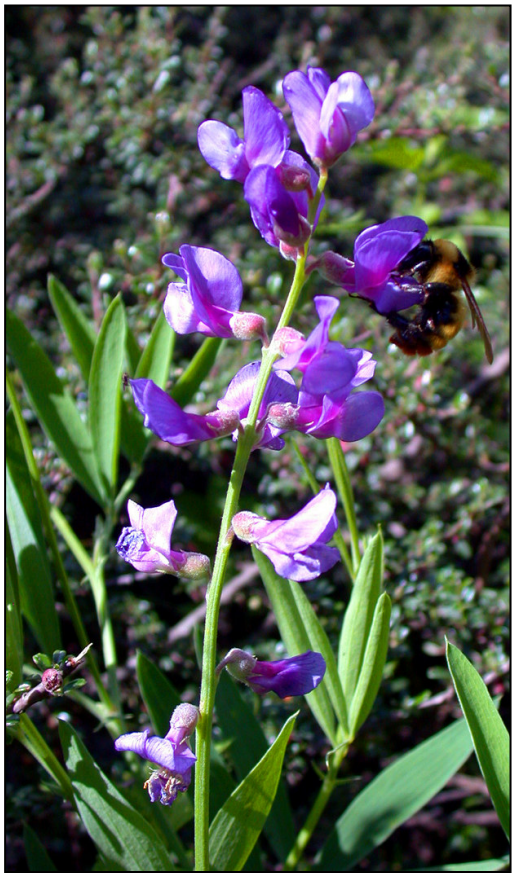

Figure 7
a) The dense raceme of *L. pubescens* (above) has relatively pale purple-blue flowers.

b) Compare this with the longer spikes of purple flowers on *L. macropus* (right).

The subalpine meadows near Tafi del Valee contained scattered patches of *Agua de nieve* (*L. macropus*) - a species that offers great potential as an ornamental in the UK (Fig. 6b). This is the only native species in South America with more than one pair of leaflets and possesses handsome spikes of purple flowers. *Lathyrus macropus* has been brought into cultivation in the in the past, but is very difficult

to obtain or unavailable today. Its tolerance for the climate of the Argentine sub-Andean uplands would make it ideal as an ornamental in the UK.

Our finds of this species highlighted the influence of grazing on the distribution of *Lathyrus* as it only grew on rock faces inaccessible to cattle and horses. The surrounding vegetation was exclusively close-cropped grassland, with scant *Alnus* forest in gulleys (Fig. 8). Further south in Mendoza province, *L. macropus* is said to be particularly abundant and forms extensive swathes of purple flowers.

Figure 8. *Lathyrus macropus* habitat.
In the Andean foothills of Tafi del Valee. (Inset) one of the many horses that graze the area.

Buenos Aires
From Buenos Aires it was possible to access the marshlands of the Rio Parana delta in search of *L. paranensis* and *L. parodii*. However, there are few recent collections of these species from around the delta region and we were unable to find either over three days of searching. Human interference in these delicate wetland habitats was thought to have influenced the distribution of these species. Most of the accessible delta region has been converted into luxury housing areas for people wishing to escape Buenos Aries. The accompanying riverbank stabilisation programmes excludes the marsh-loving species of *Lathyrus*.

Herbarium work
Whilst in Buenos Aires, I was also able to visit Darwinion, Argentina's largest herbarium, to observe and photograph all of the country's available type specimens of *Lathyrus*. This is a fundamental requirement for a revision of the South American taxa. It is hoped that these specimens will be sent on loan to The Royal Botanic Garden Edinburgh.

Collection types
Collections included herbarium specimens of entire plants including roots and mature flowers. These have been dried and submitted to the RBGE herbarium. Duplicates will be sent to Kew and the herbarium of the University of Rosario, Argentina in due course.
More than 35 accessions of Lathyrus (80 sheets) were collected. Due to the relatively small population sizes encountered, we were particularly scrupulous in avoiding over-collection.

The multiple collections made of species allow opportunities for comparison within a species. The most disparate collections were those of *L. pubescens* from the banks of the River Uruguay and montane collections of the same species from the cloud forest of Tucuman province.

Silica-gel dried leaf material was also taken for DNA sequencing work.

The timing of the field research was ideal as we were able to collect mature seed for all species except *L. pusillus*. In addition, the opportunity to observe and photograph plants in vivo and their typical habitats was invaluable.

Additional collections of diverse temperate and subtropical Angiosperm species were also made. These other collections included herbarium specimens of 30 further species, as well as seed from one Lily and one *Iris* species.

Problems

Within the regions visited, the following species were recorded as being available but we did not encounter them:

- *Lathyrus linearifolius*
- *Lathyrus nervosus*
- *Lathyrus paraguariensis*
- *Lathyrus paranensis*
- *Lathyrus parodii*
- *Lathyrus subulatus*

With the exception of *L. parodii*, these are perennial species and all would potentially have been flowering in December. Although we visited many localities that had been recorded for *L. subulatus* and *L. linearifolius*, neither of these species were found.

Where we did find populations of any species, they were typically small and scattered. This seems to be a characteristic of South American *Lathyrus* species that contrasts strongly with the dense and relatively common populations of many Eurasian and North American species.

The huge numbers of cattle and horses, particularly in Santa Fe and Corrientes provinces, means that north Argentine *Lathyrus*, and indeed all native herb species, are subject to intensive grazing pressures. However, this may not be the sole factor in the relative rarity of *Lathyrus* in northwestern Argentina. It may simply be that the ecologies of these species - as opportunists in a highly competitive, species-rich environment - mean that populations are generally small. Certainly in more species poor areas in the south of Argentina and coastal and montane regions of Chile, *Lathyrus* populations (of species such as *L. magellanicus* and *L. multiceps*) are reported to be extensive and a breathtaking sight when in full flower.

Conservation status of *Lathyrus* species is not recorded in Argentina, implying the distribution and size of populations is not fully known. However, for species such as *L. hasslerianus* and *L. cabrerianus* (from Patagonia), where only few collections have been made, particular attention should be made to assessing their status in the wild in future.

Recommendations for further work

Further collections and field observations from northern Argentina and neighbouring Paraguay, Uruguay and Brasil are necessary to gain a complete picture of the diversity and ecology of *Lathyrus* species in the region. Exploration of Cordoba, Mendoza, Salta and Jujuy provinces would complete the picture for northern Argentina.

Collection at different times of the year and intensive resurveying of further areas for the remaining species would be invaluable. Given that travel is easy, the people are welcoming and restrictions on collection are less stringent in Argentina than in its neighbours, it is a very convenient place in which to do fieldwork. The support, advice and botanical and floristic knowledge provided by Mr Oakley and Dr Prado were superb and would certainly be available to any other researchers in future ventures to the region.

On a broader basis, widespread collections of other taxa exhibiting a similar antitropical distribution are essential if we are to understand the formation of such biogeographical patterns across the entire plant kingdom. Other groups with a disjunct northern hemisphere - South American distribution include *Empetrum* (Ericaceae), *Berberis* (Berberidaceae) and Chrysosplenium (Saxifragaceae).

Conclusions and outcomes

The collections made in North Argentina are valuable additions to the herbarium at RBGE, including three species that are not otherwise known in UK collections. These combined collections, along with those already obtained on loan from other botanical institutions will allow production of a complete revision of South American *Lathyrus* and an extremely useful key for botanical and ecological field workers, horticulturalists and herbarium curators.

Colleagues from RBGE and Oxford University collecting in Brasil and Chile at the same time managed to secure an excellent representative group of the remaining species from South America. In particular, Dr Colin Hughes of Oxford and Brasilian collaborator Sylvia Miotto collected *L. paraguariensis*, *L. linearifolius* and *L. subulatus*. I am now in an excellent position to provide a complete estimate of phylogeny for the South American species of Lathyrus, clarifying their relationships to northern hemisphere species and to one another.

Acknowledgements

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The personal time given by Darien Prado to fieldwork, as well as his patience and stamina in driving are greatly appreciated.

References and further reading

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- Norton S. (1996) *Lathyrus* cousins of the sweet pea. National Council for the Conservation of Plants and Gardens. Woking, Surrey. (in Spanish)

Appendix 1 (following page)

Full expenditure for the expedition is presented in tabular form on the following pages, based on receipts approved by the RBGE accounts department.

Funding was from:

- The Coke Trust (RHS) £ 100
- The Davis Expedition Fund (University of Edinburgh) £ 1759
- The E.A. Bowles of Myddleton House Society: £ 500