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KeyBase (<http://keybase.rbg.vic.gov.au>) provides an environment and tool for managing and disseminating pathway keys on the web. KeyBase keys can be displayed as traditional bracketed or indented keys, but also come as an interactive key. KeyBase also adds additional functionality, such as the ability to filter keys on a subset of taxa. And KeyBase is highly scalable, even for big projects.

KeyBase has been adopted as an Atlas of Living Australia (ALA) project and will be further developed as a set of web services and JQuery plugins, so keys can be easily and seamlessly included in online floras and other species information systems.

Identification keys traditionally come in two flavours, matrix keys (also called multi-access keys), and pathway keys (traditionally called dichotomous keys). The former have usually been digital products, while the latter are usually printed, either on paper or on screen with limited interactivity. Pathway keys have certain advantages over matrix keys: they provide insights into the knowledge of the taxonomists who build them; users tend to learn more from using them than from matrix keys; and there are many more of them, partly because they have been made for much longer and partly because they are easier to make. Pathway keys are still routinely written for conventional taxonomic treatments, while matrix keys are generally created as separate projects with special-purpose funding. However, pathway keys are not known to work very well on the web.

KeyBase was conceived and created by active plant systematists who deal with floras with large numbers of dichotomous keys. One aim of KeyBase is to manage pathway keys for the web. Available software for dealing with matrix keys (e.g. IntKey and Lucid) and pathway key systems (e.g. Lucid Phoenix) were designed as desktop applications and deal with single keys. KeyBase, by contrast, was designed for the web. It manages multiple users, multiple projects and multiple keys, and links them together in a dynamic and flexible way.

### KeyBase keys

KeyBase currently contains over 5000 keys to over 30,000 taxa.

Keybase keys can be disseminated as interactive keys, but also in the traditional bracketed and indented formats. The interactive keys are driven by Javascript, so no browser plugin is required to run them.

Keys can be uploaded to KeyBase in Lucid Phoenix Key format (LPXK; an XML format) or in KeyBase's own three-column (from-node | lead text | to-node) delimited text format.

KeyBase keys are currently stored in a MySQL database in three tables: a key metadata table; an item (taxa) names and metadata table; and a leads table. The leads

Flora of New South Wales (2 contributors, 1308 keys to 8742 taxa)

Flora of Victoria (7 contributors, 962 keys to 5983 taxa)

Vascular plants of California (2 contributors, 941 keys to 8926 taxa)

Flowering plants of Tasmania (2 contributors, 165 keys to 814 taxa)

Flowering plants of Queensland (4 contributors, 134 keys to 1322 taxa)

Flowering plants of Western Australia (4 contributors, 131 keys to 843 taxa)

California Moss eFlora (2 contributors, 87 keys to 808 taxa)

Flowering plants of Sri Lanka (2 contributors, 84 keys to 348 taxa)

Ferns and fern allies of Australia (1 contributor, 22 keys to 138 taxa)

Flowering plants of Australia (8 contributors, 1448 keys to 16070 taxa)

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Keys in KeyBase are organised in projects. KeyBase projects currently comprise between 2 and 1448 keys.

Flowering plants of Australia: Genera of Proteaceae  
 From: Weston, P.H. (1995). Proteaceae. In: Flora of Australia 16. Australian Biological Resources Study, Canberra.

Interactive Bracketed Indented About

Current node  
 Perianth zygomorphic  
 Perianth actinomorphic

Remaining taxa (39)  
 Acridonia microcarpa  
 Adenanthos  
 Agastachys odorata  
 Alloxyylon  
 Athertonia diversifolia  
 Austroruellera  
 Banksia  
 Bellenden montana  
 Buckinghamia  
 Cardwellia sublimis  
 Catalepidia heyana  
 Cenarrhenes nitida  
 Conospermum  
 Darlingia  
 Dryandra  
 Floydia praealta  
 Gevuina bleasdalei  
 Grevillea

Steps  
 1. Leaves alternate  
 2. Leaves simple or pinnately or bipinnately or (pseudo-)dichotomously compound  
 3. Leaves either entire or with dentate margins or pinnately compound or divided  
 4. Pending question

Discarded taxa (7)  
 Carnarvonia aralifolia  
 Eidothea  
 Franklandia  
 Lambertia  
 Macadamia  
 Stirlingia  
 Xylomelum

KeyBase turns pathway keys into truly interactive keys. The interactive keys are completely driven by Javascript, so do not require a Java browser plugin.

Player Bracketed key Indented key About

1. Flower 1 per bract; fruit indolent, either an achene, a small nut or a drupe  
 2. Flower 2 per bract; fruit a leathery or woody 2-seeded follicle opening in 2 valves  
 3. Fruit an achene or small nut; ovary sessile, ovule 1, flowers sessile  
 4. Fruit a stalked drupe to c. 1 cm long or more; ovary stipitate, ovules usually 2; flowers pedicellate  
 5. Flowers densely aggregated into cones or in loose corymbs; leaves simple or 2-3 times pinnately with flattened segments  
 6. Inflorescence 1 flowered, subsessile, solitary or up to 3 clustered at branch tips and closely surrounded by leaves; leaves deeply dissected with terete segments; mallee areas of northwest  
 7. Flowers white or bluish, arranged in loose corymbs; perianth more or less bilabiate; style not exerted; glabrous; leaves simple; fruit a small hairy achene  
 8. Flowers yellow, arranged in cones; perianth regular; style exerted, with brushlike hairs; leaves pinnatisect; fruit a plose nut subtended by caducous woody bracts combined into a fragile cone  
 9. Inflorescence 1 flowered, subsessile, solitary or up to 3 clustered at branch tips and closely surrounded by leaves; leaves deeply dissected with terete segments; mallee areas of northwest  
 10. Fruit a stalked drupe to c. 1 cm long or more; ovary stipitate, ovules usually 2; flowers pedicellate  
 11. Flowers 2 per bract; fruit a leathery or woody 2-seeded follicle opening in 2 valves  
 12. Flowers not as above; fruiting follicles stalked or sessile, but not embedded in fruiting axis; seeds 2 or more per follicle  
 13. Flowers arranged in very dense spikes; fruit 2-valved; mature follicles persistent on and partially embedded in an erect woody axis; seeds 2 per follicle  
 14. Flowers not or rarely in terminal spikes (if inflorescence terminal then plants not alpine); perianth irregular; tepals at least partially joined; anthers sessile  
 15. Flowers in terminal and upper axils; perianth regular; tepals free or almost so; anthers on short filaments; shrub of alpine areas  
 16. Seeds 2 per follicle, collateral  
 17. Seeds usually more than 2 per follicle, in 2 imbricate rows  
 18. Follicle leathery; seeds commonly winged all round (or if wing at 1 end only, then wing shorter than seed)  
 19. Follicle woody, opening into 2 thick valves; seeds with a large dark terminal wing longer than body of seed  
 20. Flowers white, cream or yellowish; inflorescence raceme-like or paniculate, sessile or terminal; bracts small and caducous  
 21. Flowers red; inflorescence a large, hemispherical to globose head surrounded by an involucre of enlarged red bracts; East Gippsland only  
 22. Flowers in terminal and upper axils; perianth regular; tepals free or almost so; anthers on short filaments; shrub of alpine areas  
 23. Flowers arranged in very dense spikes; fruit 2-valved; mature follicles persistent on and partially embedded in an erect woody axis; seeds 2 per follicle

KeyBase can also produce traditional bracketed and indented keys. The design of these keys can be fully controlled by CSS and Javascript, so can fit any web design.

table stores a hierarchy with the lead ID roughly corresponding to the to-node and the parent-id roughly corresponding to the from-node.

Keys can be exported in LPXK (enabling editing in Lucid Phoenix), Structured Descriptive Data (SDD; the TDWG standard) or delimited text (enabling editing in standard text or spreadsheet editors). Currently editing of keys is done by exporting the key, editing it outside KeyBase and re-uploading the file.

The KeyBase web application itself uses JSON, currently in production only for the interactive keys, but in development for all display modes.

### KeyBase projects

Keys in KeyBase are managed in projects. Projects can range from individuals uploading a few keys to see what KeyBase does, through projects with many keys from a single institution, to truly collaborative projects between many people from many institutions. KeyBase projects currently comprise between 2 and 1448 keys.

Registered KeyBase users can have two roles in projects, as Contributors and Managers. Contributors can add new keys, and edit and delete keys they've contributed themselves. Managers can edit and delete all keys in the project and can add new users to the project.

### Search and filters

A Search function enables KeyBase users to search for keys to a taxon across all projects.

Filters are used to dynamically downsize keys to a subset of taxa. There are two types of filters. Local filters are used to include or exclude taxa within a single key. Global filters apply to one or more projects, take an uploaded list of taxon names as input, and apply local filters (based on the listed taxa) to all keys (returning only those filtered keys that include the listed taxa and the keys that lead to them).

Filters can be used to create keys or sets of keys to: taxa occurring in a geographic subregion; taxa that share a morphological feature (such as trees, or blue flowers); or taxa that belong to a newly recognised higher taxon. Filters thus provide substantial novel flexibility over traditional pathway keys. They potentially allow switching between matrix and pathway keys, and the dynamic creation of new keys when taxonomic classifications change.

### Future directions

KeyBase has been adopted as an Atlas of Living Australia (ALA) project. Within the ALA infrastructure, KeyBase will become a set of web services and JQuery plugins. This will enable keys to be seamlessly included in other projects, both within and outside ALA. Once the current functionality of KeyBase has been re-created inside the ALA infrastructure, future directions are expected to include:

- Inclusion of media in keys
- Inline editing of keys
- Enhanced management of filters
- Ability to disseminate matrix keys.

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