Biodiversity in the Patent System: Madagascar

A country study of genetic resources and traditional knowledge in the patent system of relevance to Madagascar

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One World Analytics is a trading name of POMC Consulting Ltd. UK.

Introduction

This report presents the results of analysis of patent activity for genetic resources and traditional knowledge from Madagascar. The report is divided into three sections:

Section 1 provides an overview of biodiversity in Madagascar based on information from the Global Biodiversity Information Facility and introduces the patent data.

Section 2 provides a general overview of patent activity for species known to occur in Madagascar in the period 1976-2010. This is followed by detailed analysis of patent documents that make reference to Madagascar and data based on species that are limited to distribution in Madagascar.

Section 3 provides a set of short summaries for species that are a focus of patent activity. This information will also be made available online for further research through the Access and Benefit Sharing Patent Index (ABSPAT).[1]

The report was prepared using large scale text mining of patent data for species names and country names. This data was then combined with taxonomic information from the Global Biodiversity Information Facility. Additional patent research was conducted using the commercial Thomson Innovation database and processed using a variety of software tools.

Patents are an important indicator of investments in research and development directed to the development of commercial products. The aim of the report is to identify potential opportunities for economic development in support of conservation by identifying existing research and development involving species from Madagascar. The research did not investigate the terms and conditions under which patent applicants obtained the genetic resources and traditional knowledge disclosed in the patent document. Therefore the report does not consider the problem of biopiracy or misappropriation of genetic resources and traditional knowledge.

The research was limited to searches of patent data from the United States, the European Patent Office and the international Patent Cooperation Treaty in the period 1976-2010. As such, the research is limited to the major patent offices for this period. We do not consider patent activity prior to 1976 or after 2010 except through patent family information and citation data. As such the report provides a baseline for patent activity involving species from Madagascar as a basis for further research.

Our research focused primarily on documents that make reference to Madagascar and to cases where existing distribution data suggests Madagascar is a likely source for the species. This imposes two limitations on the research. First, we focus on identifying species that are a focus of existing research and development. However, the report does not seek to provide the complete global patent landscape for an individual species. Second, because we focused on identifying species from a country we did not search patent data for references to regions (i.e. Africa) or sub-regions (i.e. Southern Africa) in the patent data. To address this issue we deliberately highlight cases where a species is distributed in more than one African country.

[1] ABSPAT is available at http://www.abspat.net

This report is one in a series of reports on patent activity for species from African countries. The following observations are based on the research for the six African country reports to date and form the main recommendations arising from the research.

Taxonomic Research:

1. There is a need to improve the availability of taxonomic information for each country. In the absence of taxonomic information it is not possible to identify genetic resources that are relevant to a particular country in patent data and any relevant opportunities for economic development. African countries could consider giving greater priority to taxonomic research and making taxonomic information available through GBIF;
2. Georeferencing of the coordinates for the locations of species is an important standard in modern biodiversity research. Georeference data can be used to identify where species have been recorded in a country and also where biodiversity research has been concentrated. In our view georeferencing is an underutilized tool for identifying where species are located as a basis for engaging with indigenous and local communities to consider potential development opportunities. We recommend greater attention to georeferencing and its use for engagement with relevant indigenous and local communities;
3. Taxonomic research does not attract investment because it appears to be remote from economic considerations. In practice taxonomic information is vital to identifying opportunities for development that is supportive of the objectives of the Convention on Biological Diversity and its Nagoya Protocol.
4. Taxonomic information is also important for the capacity of countries to monitor compliance with the Nagoya Protocol by improving baseline data on the species within a country. Advancing knowledge and understanding of biodiversity and the traditional knowledge of indigenous and local communities has an important role to play in long term monitoring under the Nagoya Protocol.

The Patent System:

1. Patent documents are frequently unclear on the precise origin or source of genetic resources and associated traditional knowledge. In addition very limited information is available on the terms and conditions of acquisition of genetic resources and traditional knowledge. This could be improved through enhanced disclosure of origin measures as advanced by the African Group and discussed in greater detail elsewhere;[2]
2. Species are commonly distributed in more than one country. It is important that African countries include requirements in access and benefit sharing agreements to clearly specify the source of genetic resources and associated traditional knowledge in any patent applications that may arise under the terms of an agreement. When combined with the enhanced disclosure measures noted above this would greatly improve capacity to monitor patent activity under the terms of the Nagoya Protocol;
3. One of the major issues that emerged in the research is the problem of *essential incorporation* of species into patent claims. Patent applicants frequently list very large numbers of species, or make reference to genera and families, with the purpose of incorporating all members of a genus or family into the scope of the patent claims. Typically these applications did not involve collection or use of many of the species that are listed. The aim of essential incorporation is to prevent others from using compounds, extracts or ingredients from these species in similar inventions or products. Where granted these patents are likely to have negative consequences for researchers

[2] Oldham, P & Burton G (2010) *Defusing Disclosure in Patent Applications*. UNEP/CBD/COP/10/INF/44

and producers in African countries seeking to develop and export similar products from these species. In our view, patent claims for components of organisms should be limited to the species from which the compound or extract was isolated by the applicants and not extend to members of the genus or entire families. Furthermore, in our view essential incorporation is anticompetitive and action should be considered to stop or severely restrict this practice.

4. In some cases patent activity may involve species that are vulnerable, endangered or CITES listed. In considering the possibilities for economic development identified in patent data it is also important to identify and assess the conservation status of the species concerned in order to support the objectives of the Convention on Biological Diversity.

Patents have frequently been viewed with suspicion within the biodiversity policy community as examples of the inequitable exploitation of resources from biodiversity rich developing countries. Our research demonstrates that patent data can also be turned to positive purposes to identify potential opportunities for economic development in Africa. We hope that this information will prove to be useful to African countries.

Madagascar

Area:
587,041 sq. km
Coastline:
4,828km
Climate:
Tropical along coast, temperate inland, arid in south
Environment:
Narrow coastal plain, high plateau and mountains in centre. Madagascar was once covered almost completely by forests, but slash and burn denuded most of the landscape, especially in the central highlands. Secondary growth has replaced the original forest along the east coast and in the north. The vegetation of the central highlands and the west coast is for the most part savanna.

Biodiversity in Madagascar and Patent Activity:

Data for biological diversity was obtained from the Global Biodiversity Information Facility (GBIF). GBIF is an international government-initiated resource that provides open access to the most comprehensive quantitative data of species across time and space presently available. All data is submitted by participants who share biodiversity information.

Using this resource we have obtained biodiversity records for species which occur in Madagascar. It should be noted that the usefulness of this data in determining the actual distribution of a given species is conditional to the comprehensiveness of the data submitted by GBIF participants. Therefore we would stress that the absence of records should not be interpreted as indicating an absence of a given species, and similarly that a recorded species that only appears from one country should not be regarded as evidence of endemism. All reasonable efforts in identifying endemic species were made from alternative sources during the compilation of this report.

GBIF presently records 23,220 species for Madagascar and 591,877 georeferenced records of the locations where these species occur in Madagascar.

We identified a total of 134,230 documents containing species known to be distributed in Madagascar. Of these 512 made some form of reference to Madagascar. These documents were manually reviewed in MaxQDA software to identify documents specifying a source or origin in Madagascar.

The 512 documents that made a specific reference to Madagascar contained 2,706 species. These documents were manually reviewed in MaxQDA data analysis software and through this process we were able to identify species where it was definitively stated that they had been collected, sampled or otherwise obtained from Madagascar.

In addition, using GBIF distribution data we identified 224 species where GBIF presently records distribution only in Madagascar. These species appeared in 830 patent documents where Madagascar was not explicitly mentioned. The idea behind this was to identify cases where a species (based on available distribution data) was likely to have come from Madagascar and thus be regarded as a species of likely or potential significance for

Madagascar. For the sake of simplicity we call data where Madagascar was specifically mentioned along with a species "Origin" data. We call data identified based only on distribution information "Distribution." Based on further research we sought to establish whether an identified species was endemic to Madagascar or known to be distributed in multiple countries (Cosmopolitan).

Biodiversity and Distribution

Much of the data submitted to GBIF includes geographical coordinates indicating where the recorded species was located. Using this data we are able to show the physical distribution across Madagascar of all GBIF recorded species. Plate 1 shows two maps: The left map shows plotted points, each indicating a GBIF record. The points are coloured to indicate the taxonomic kingdom of the species to which the record refers. It should be noted that this geographical information is raw data as submitted to GBIF by participating recorders. It has not been cleaned to remove any human errors when inputting to the GBIF database (an example of such an error might be where a longitudinal coordinate has been recorded as a + rather than a -). The map to the right shows major settlements and roads, it also includes the location of some statutory conservation sites such as national parks and nature reserves - places expected to be of significance for biodiversity. A larger version of the distribution map can be found in the appendix of this country summary.

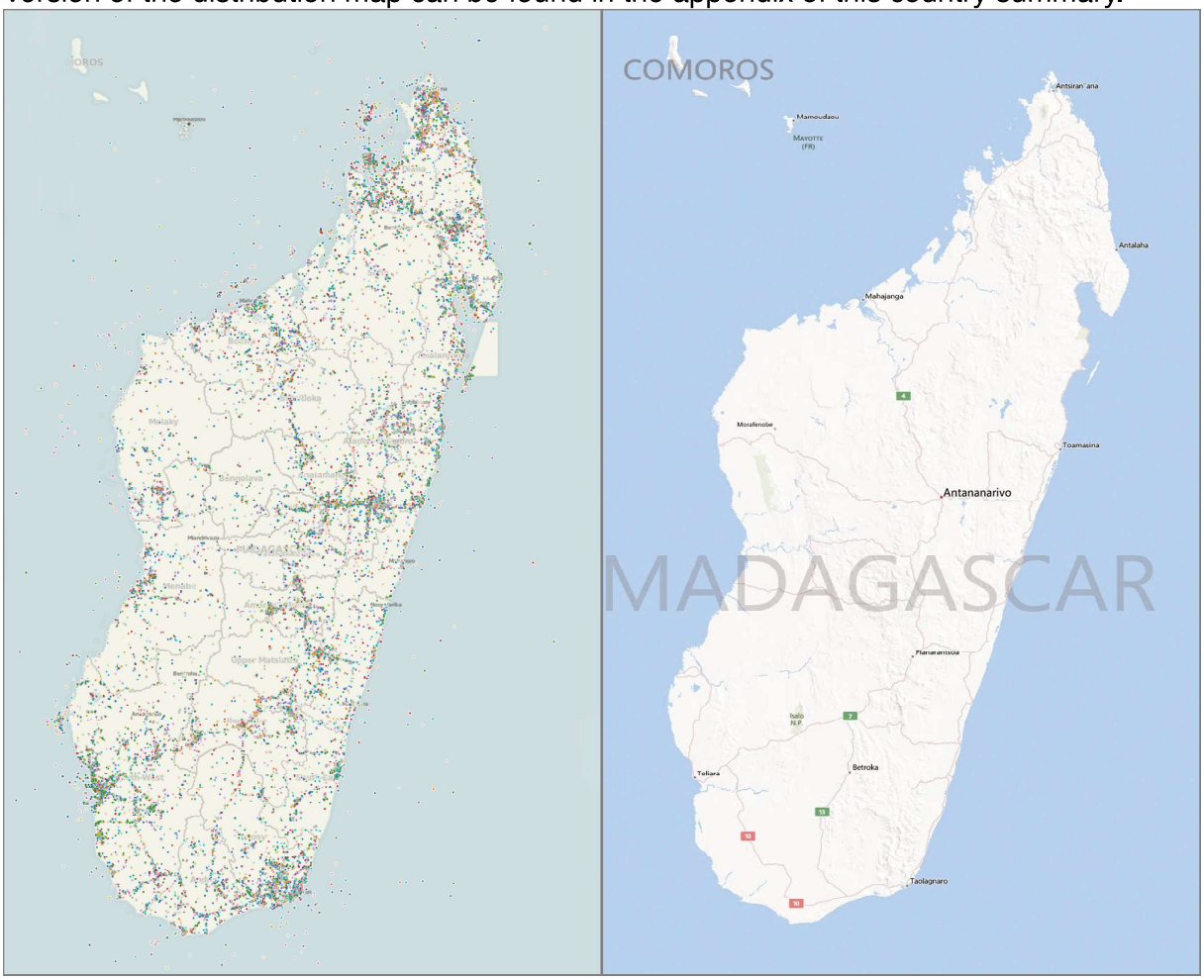


Plate 1. Distribution of GBIF records from Madagascar (1eft) and major settlements and roads (right) (map courtesy of Bing Maps). Each colour point represents a species record coloured by taxonomic kingdom.

It is very interesting to compare the two maps. The distribution map shows that records are not uniformly dispersed across the country. A feature of these mapped distribution records are the strings of data points which cross the country. When compared with the right-hand map it can be seen that the strings of data points closely follow the routes of major roads across the central highland regions and along the coastal plains. The density of records also increases around the locations of major settlements and at the junctions of roads, all places where human access for biological collection is likely to be greater. This pattern of record locations suggest that there are practical restrictions which have prevented collection of data across a broader geographical range. There are three statutory conservation sites visible on these maps: The Tsingy de Bemaraha Strict Nature Reserve in the west of the country, The Mananara Terrestrial National Park on the east coast and The Isalo National Park in the south. In all of these locations of biodiversity interest there is a marked clustering of GBIF records. Madagascar is renowned for possessing a flora and fauna with many species unique to the island. Over 600 new species have been discovered in the past decade. This rate of discovery and the restricted geographic distribution of records leads to the likelihood that many more species are yet to be found and that current biodiversity records for Madagascar are far from comprehensive in describing the fauna and flora of the country.

GBIF presently records 25,619 species known to be present in Madagascar. This list is dominated by plants and animals which account for over 25,000, as can be seen in Table 1.

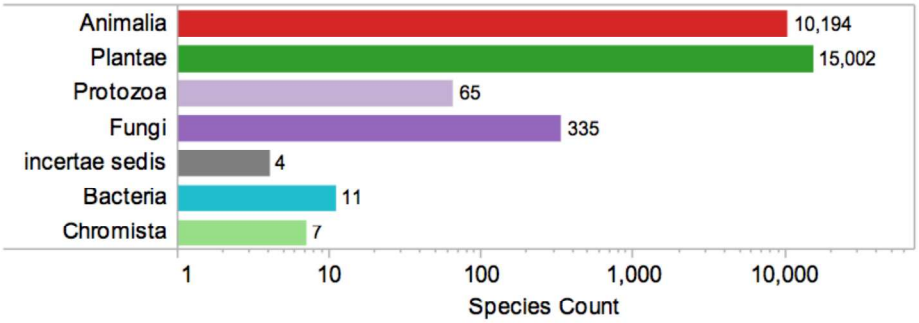


Table 1: Showing the number of species in Madagascar by kingdom using GBIF data.

Using global data it is possible to examine the wider distribution of Madagascan species. Plate 2 shows where records exist across the globe for such species. Species which are found in two or more countries are referred to as being 'cosmopolitan'. Each pie represents the number of occurrences of cosmopolitan species which are found in Madagascar and is segmented by kingdom. It can be seen that a relatively small number of species have a distribution beyond Madagascar, which highlights the well known fact that much of Madagascan biodiversity is unique to the island. It should be noted that some of these records may originate from research institutions or collections and therefore do not represent native or naturalised distribution, other species such as coffees and rice may grow elsewhere as commercial crops.

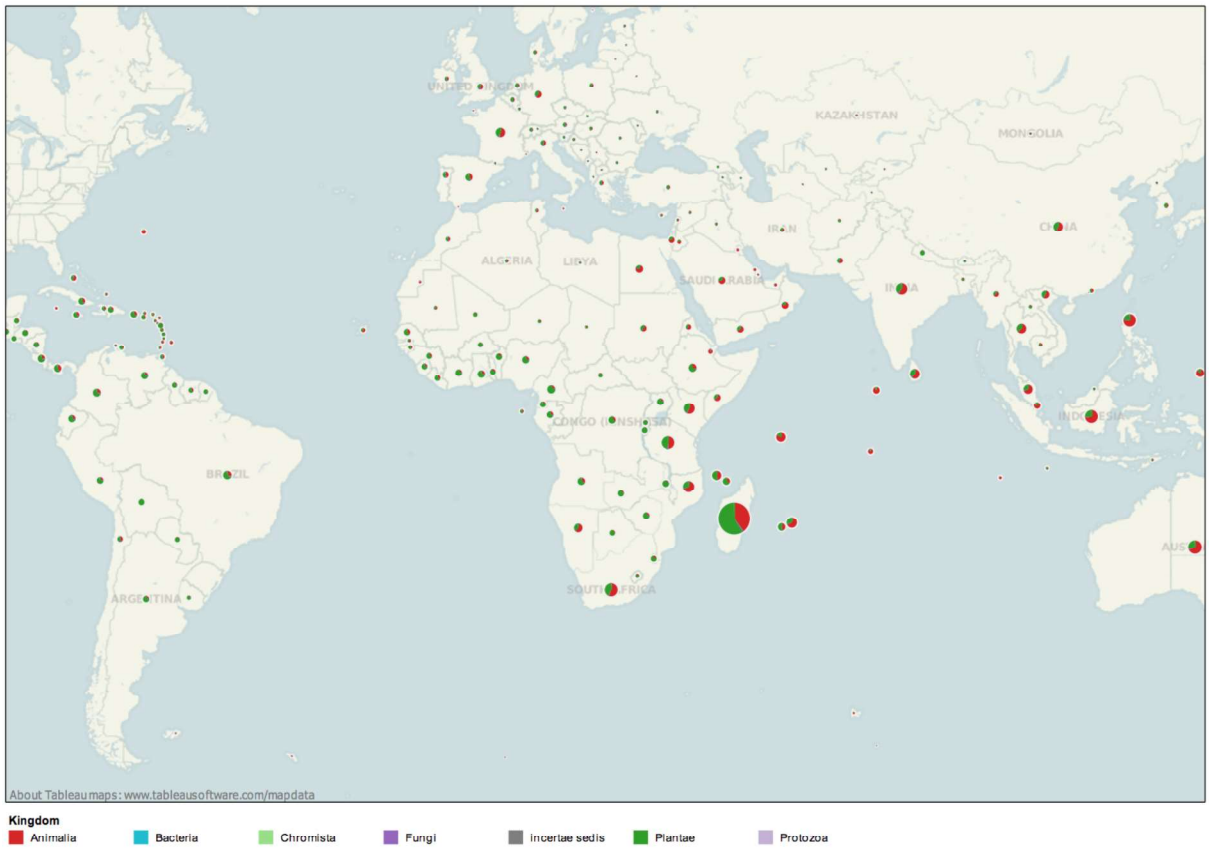


Plate 2: Global distribution of Madagascan species shown by the number of species in GBIF.

Madagascar in the Patent System

As of 2013 there were 2,451 patent documents in the main patent jurisdictions (European Patent Office, the United States, and the Patent Cooperation Treaty) that specifically mentioned Madagascar. Only a small proportion of these documents will refer to species collected in or sourced from Madagascar itself. In addition, patent applicants will also make reference to species that originate in Madagascar but will not mention Madagascar as the source of the genetic resources or traditional knowledge.

Our aim in this section is to provide a brief overview of patent activity for genetic resources of relevance to Madagascar. We then examine the results of research to identify genetic resources and traditional knowledge that originate from Madagascar. In approaching patent activity for genetic resources from Madagascar we focus on three categories of data.

1. Species that are known to be distributed in Madagascar but are also distributed elsewhere in the world. This provides an overview of global patent activity for genetic resources of relevance to Madagascar.
2. Species where a direct reference is made to the collection or origin of a species from Madagascar. This data is based on a review of patents that make reference to a species known to be distributed in the country and the country name.
3. Species where available distribution data suggests that a sample is likely to have originated from Madagascar. This data is known as Distribution data and refers to cases where GBIF presently only records a record for a species from Madagascar and no other country. Because taxonomic information is incomplete this data provides a clue rather than proof that a species originated from Madagascar.

We begin our analysis with an overview of biodiversity that is known to occur in Madagascar in the patent system and then turn to data on species originating from Madagascar.

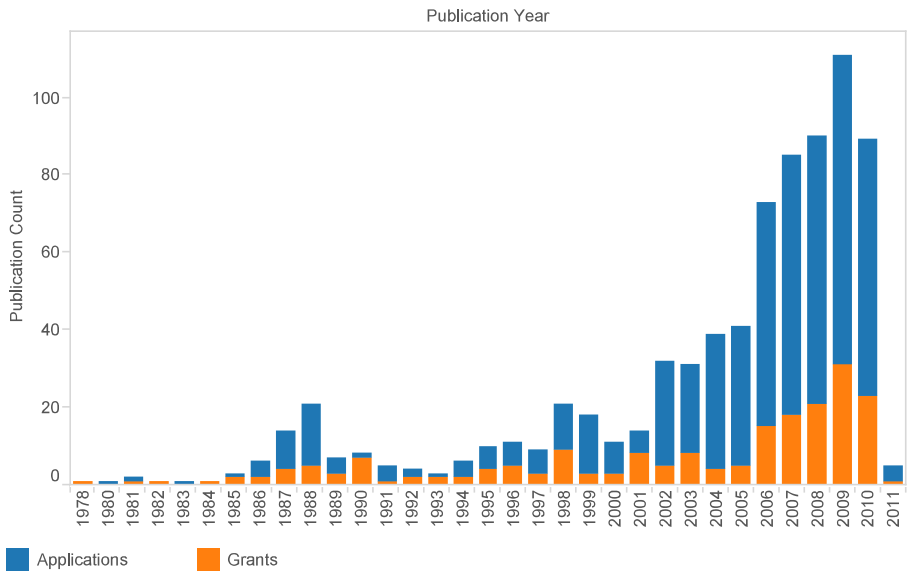
Biodiversity in Madagascar in the Global Patent System

Madagascar shares a significant proportion of its known biodiversity with other countries in Africa and around the world. Plate 3 provides an overview of patent activity for species that are known to occur in Madagascar and other countries around the world. This overview provides information on trends in applications and grants, the top species appearing in patents that are known to occur in Madagascar, top applicants or assignees and technology areas.

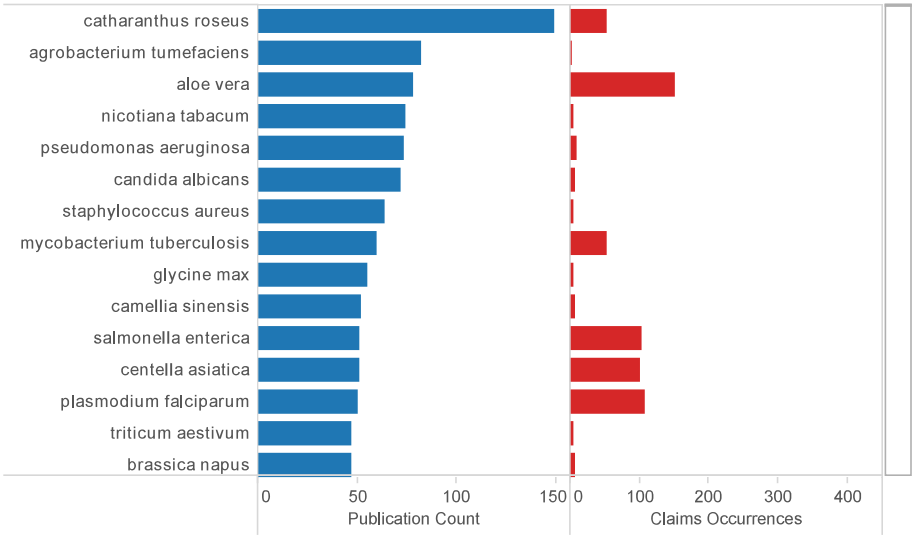
In total we identified approximately 6,764 species in patent data from the major jurisdictions that are known to occur in Madagascar. This data is relevant for Madagascar because it demonstrates that researchers and companies are conducting research and development on species that are known to occur in Madagascar. As Plate 3 makes clear research and development is taking place across a range of technology sectors and is targeted to a variety of markets.

The top species in patent activity for Madagascar include the Rosy Periwinkle (*Catharanthus roseus*), the agricultural biotechnology bacterium *Agrobacterium tumefaciens, Aloe vera* for use in cosmetics and other products, the tobacco plant (*Nicotiana tabacum*), the pathogen *Pseudomonas aeruginosa* and yeast *Candida albicans*

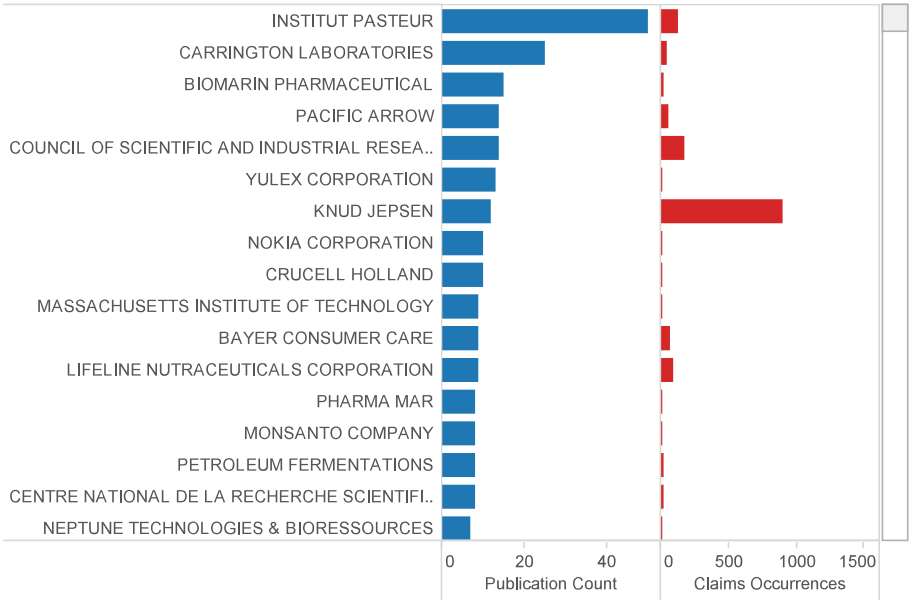
Trends



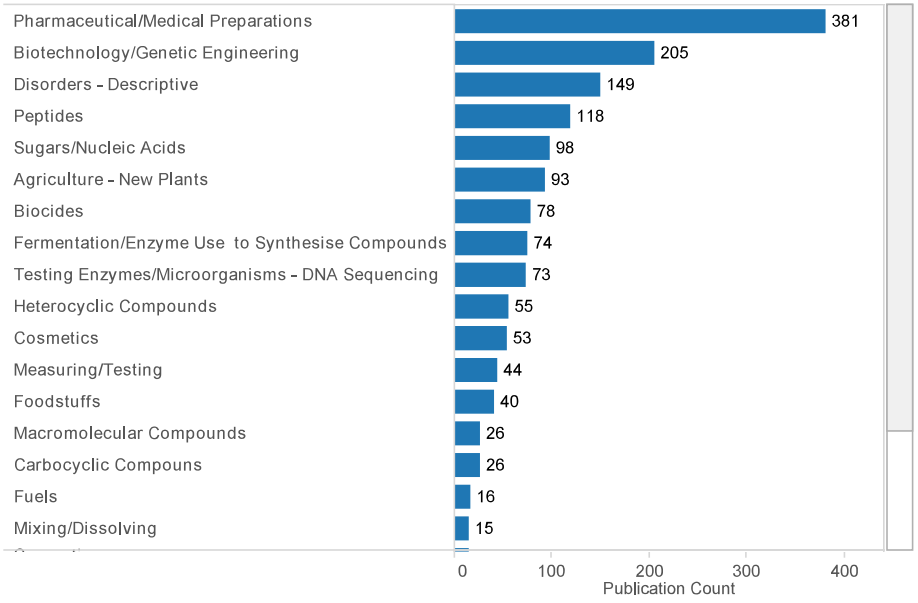
Species



Assignees



Technology Areas



along with tea (*Camellia sinensis*) and Centella (*Centella asiatica*).[1] As this brief list suggests patent activity typically involves research and development that targets particular organisms (i.e. pathogens), important agricultural crops or plants that are a source of approved pharmaceutical drugs or other medicines.

To gain a more focused view of activity we now turn to the results of research to identify organisms appearing in patents that were directly collected in Madagascar or where distribution data suggests that Madagascar is the likely source.

Species from Madagascar in Patent Data

In total we identified 73 species of organisms that were directly sourced from, or potentially originate from, Madagascar based on distribution data. Plate 4 displays the top species for Madagascar that appear in patent data based on a manual review of patent documents. In the next section a summary is provided for each species. This data will also be made available online to allow for further exploration of each case.

Plate 4 reveals that based on detailed analysis of patent documents certain species move to the fore in patent data. These include *Cedrelopsis grevei* which is endemic to Madagascar. The bark from this plant is used in cosmetics and antimicrobial preparations and extends to reference to the use of medicinal plants in Madagascar to treat malaria. As such, Cedrelopsis is an interesting potential target for further investigation.

The second ranked species for Madagascar is one of the best known species in the modern pharmacopeia in the form of *Catharanthus roseus* (Madagascan periwinkle), Catharanthus roseus is the source of the anti-cancer compounds vincristine and vinblastine. These alkaloids were discovered and developed by researchers at Eli Lilly and Co in the 1950s with Vincristine being approved for marked in 1963 as Oncovin for treating Leukemia.[2] This species goes by a variety of names (*Vinca rosea*, *Lochnera rosea* and *Ammocallis rosea* along with Madagascan periwinkle) which affects data capture when searching for the species. *Catharanthus roseus* is also now widely cultivated as an ornamental plant. The data in Plate 3 (above) focused on capturing variant Latin names for Catharanthus roseus while Plate 4 concentrates on those patent documents that make reference to *Catharanthus roseus* that also refer to Madagascar as the source of the species. This well known example reveals some of the challenges involved in identifying the country of origin of genetic materials. Thus, as of 2013 a search of patent databases for the words vinblastine or vincristine revealed 85,422 documents. As this makes clear, alkaloids derived from *Catharanthus roseus* are a significant focus of ongoing research and development. As such, the data presented in Plate 3 and 4 provides an indicator of the importance of a species for further research. In some cases species will be the source of a significant portfolio of patent activity involving its constituent genetic components and compounds.

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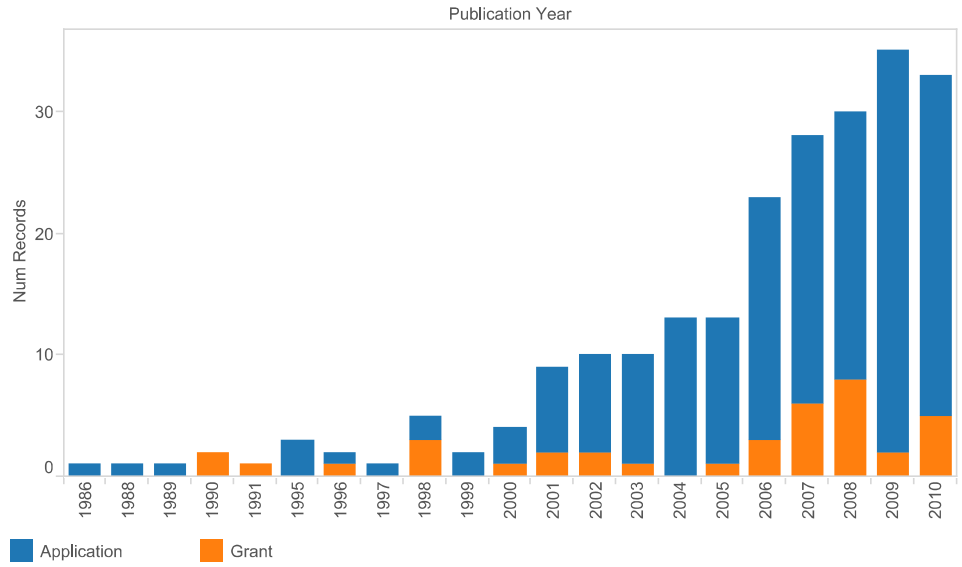
[1] The list if species in Plate 3 excludes model organisms such as E. coli and Arabidopsis thaliana because these species are distributed worldwide and typically dominate the results because of their central role in biotechnology.

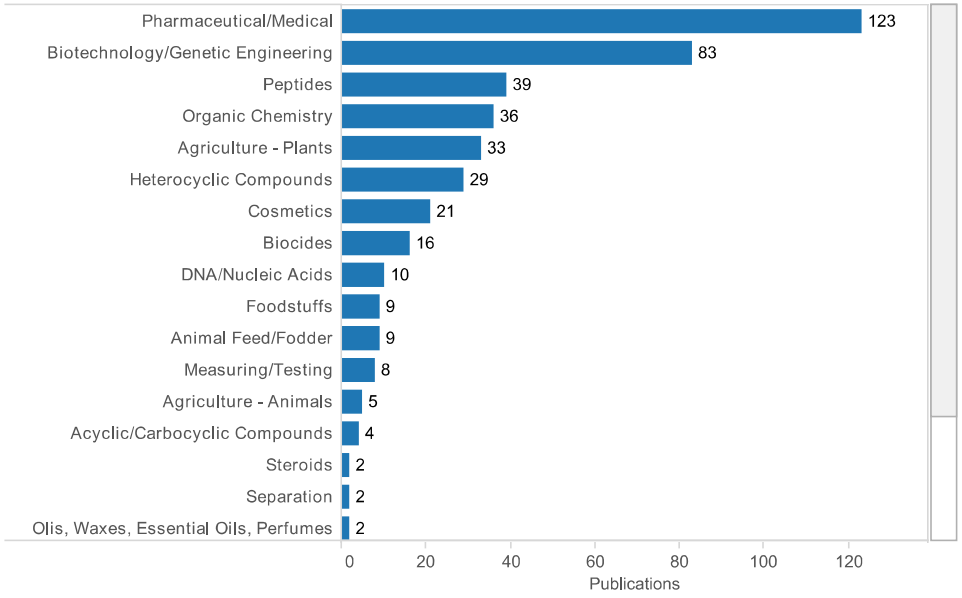
[2] Johnson, I et al. (1963) The Vinca Alkaloids: A New Class of Oncolytic Agents. Cancer Res 23: 1390-1427.

Species

Species	Kingdom	Data Type	Distribution	
Cedrelopsis grevei	plantae	Origin & Distri..	Endemic	23
Euphorbia hedyotoides	plantae	Distribution	Endemic	21
Catharanthus roseus	plantae	Origin	Endemic	21
Coffea species	plantae	Distribution	Cosmopolitan	18
Ravensara anisata	plantae	Distribution	Uncertain	13
Paecilomyces viridis	fungi	Distribution	Cosmopolitan	13
Mycobacterium madagascariense	bacteria	Distribution	Cosmopolitan	8
Microcebus murinus	animalia	Distribution	Endemic	8
Catharanthus ovalis	plantae	Distribution	Endemic	8
Ormocarpopsis species	plantae	Distribution	Endemic	7
Kalanchoe orgyalis	plantae	Distribution	Uncertain	7
Kalanchoe aromatica	plantae	Distribution	Uncertain	7
Kalanchoe ambolensis	plantae	Distribution	Uncertain	7
Adansonia grandidieri	plantae	Distribution	Endemic	7
Moringa hildebrandtii	plantae	Distribution	Endemic	6
Catharanthus longifolius	plantae	Distribution	Endemic	6
Eulemur rubriventer	animalia	Distribution	Endemic	5
Jatropha mahafalensis	plantae	Distribution	Endemic	4
Herpestis monnieri	plantae	Distribution	Cosmopolitan	4
Erythroxylum pervillei	plantae	Origin & Distri..	Endemic	4
Vernonia species	plantae	Origin	Endemic	3
Tristellateia madagascariensis	plantae	Distribution	Endemic	3
Paroedura pictus	animalia	Distribution	Cosmopolitan	3
Strychnopsis thouarsii	plantae	Distribution	Endemic	2
Psorospermum molluscum	plantae	Origin	Endemic	2
Neobeguea mahafalensis	plantae	Origin	Endemic	2
Lepilemur dorsalis	animalia	Distribution	Endemic	2
Latrodectus menavodi	animalia	Distribution	Cosmopolitan	2
Kalanchoe tubiflora	plantae	Origin	Endemic & Co..	2
Kalanchoe pinnata	plantae	Origin	Endemic & Co..	2
Kalanchoe linearifolia	plantae	Distribution	Endemic	2
Kalanchoe daigremontianum	plantae	Origin	Endemic & Co..	2
Gerbera hypochaeridoides	plantae	Distribution	Uncertain	2
Dypsis decipiens	plantae	Distribution	Endemic	2
Bryophyllum beauverdii	plantae	Distribution	Uncertain	2
Allocebus trichotis	animalia	Distribution	Endemic	2



Technology Areas



Within our more narrowly focused dataset *Catharanthus roseus* is a focus of activity for agriculture and new varieties of plants i.e. 'Dhawal' is claimed to be a high alkaloid producing periwinkle plant (US6548746B1) while another application focuses on an organ culture using *Catharanthus roseus* to produce indole alkaloids (EP200225A2). These examples usefully highlight that in addition to the revenues that can be generated through particular pharmaceuticals, wider research and development may also emerge focusing on producing the organisms or their components to service particular markets.

Other examples that are endemic to Madagascar include *Euphorbia hedyotoides* which, along with many other other Euphorbias, is listed in patent activity for anticancer treatments along with anti-infectives for viruses and skin treatments. The plant species *Erythroxylum pervillei* is a focus of activity for potential antibiotics and anticancer treatment. Fungi are represented in the data for Madagascar by the cosmopolitan fungi *Paecilomyces viridis* which is listed in biotechnology related applications for the production of polyketide synthase and wider applications for therapeutic drugs, functional foods and other potential products.

Interest in Madagascan species extends to the marine environment and is represented by three species. *Ecionemia acervus* is a marine sponge that was collected near Tulear using SCUBA diving gear and is a focus of a 2010 patent application for Anticancer compounds by the company Pharma Mar. A second sponge *Homophymia lamellosa* was collected near Saint Marie Island by Pharma Mar and is also referenced in the 2010 application for anticancer compounds. A third marine sponge collected in Madagascan waters is *Theonella swinhoei* which is the focus of a 2006 application for triterpene saponins with claimed activity for inhibiting tumour growth.

In one case, we also identified research and development that formed part of an access and benefit sharing agreement. A plant known only as Plant MG899 is a focus of two applications for a peptide with insecticidal properties filed by Dow Agrosciences in February 2004 (US2005261174A1, WO2005115149A2). These applications are unusual because the applications arise from an International Cooperative Biodiversity Group Cooperative Research Agreement with Virginia Polytechnic Institute and State University. As one application makes clear:

> "The compound of formula (I) was isolated from an extract of the bark of a Madagascan plant coded MG899 provided under a Madagascar International Cooperative Biodiversity Group Cooperative Research Agreement funded by NIH and administered by Virginia Polytechnic Institute and State University."(US20050261174A1)

The terms of benefit-sharing with Madagascar arising from this agreement are not known. However, this case demonstrates that access and benefit-sharing agreements can be made visible in the patent system. In this particular case no patent grant is recorded. This suggests that the applications encountered prior art that rendered the compound unpatentable. Nevertheless, it is important to note that the success or otherwise of individual patent applications is not the measure of the potential economic importance of a species. Rather, patent applications indicate that a species may have potential economic importance for further investigation.

Madagascar has a rich portfolio of species that appear in patents. Much attention typically focuses on the potential for developing 'blockbuster' pharmaceuticals. However, it is important to recognise that a range of sectors provide potential markets that may produce

more immediate and sustainable returns than high value but low probability areas of research and development such as approved pharmaceuticals. We now turn to the range of technology areas involved in patent activity for species from Madagascar.

Technology Areas

Table 2 provides a brief summary of the technology areas involved in patent activity for species from Madagascar and is follows by a more detailed breakout of activity.

Table 2: Technology Areas

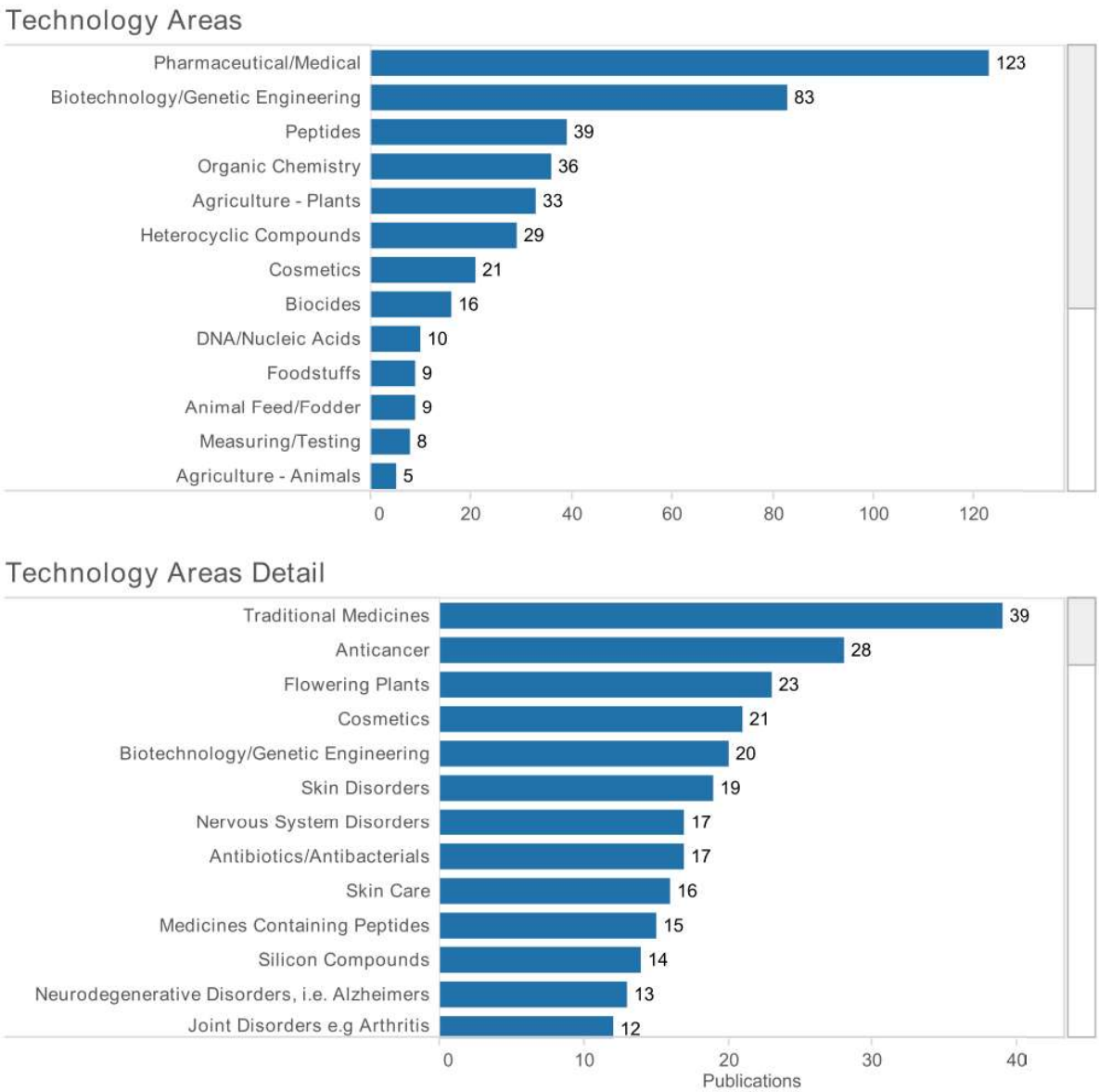


Table 2 makes clear that pharmaceuticals and other medical applications rank top. Biotechnology and Genetic Engineering typically focus on applications directed to medicine but also extend into areas such as agriculture. However, we also observe activity for cosmetics, biocides, foodstuffs and animal feed. The panel on Technology Areas Detail breaks down these categories to focus on the specifics. For example, traditional medicines (known as herbal medicines in the patent system) are a significant component of activity in the Pharmaceutical/Medical sector. We can also see that potential applications range through anti-cancer treatments, cosmetics, antibiotics, treatments for nervous system disorders and antivirals also feature in the upper rankings.

In some case a single species may enjoy a career in different areas of science and innovation. Table 3 displays the technology areas associated with a selection of species from Madagascar.

Table 3: Species and Technology Areas

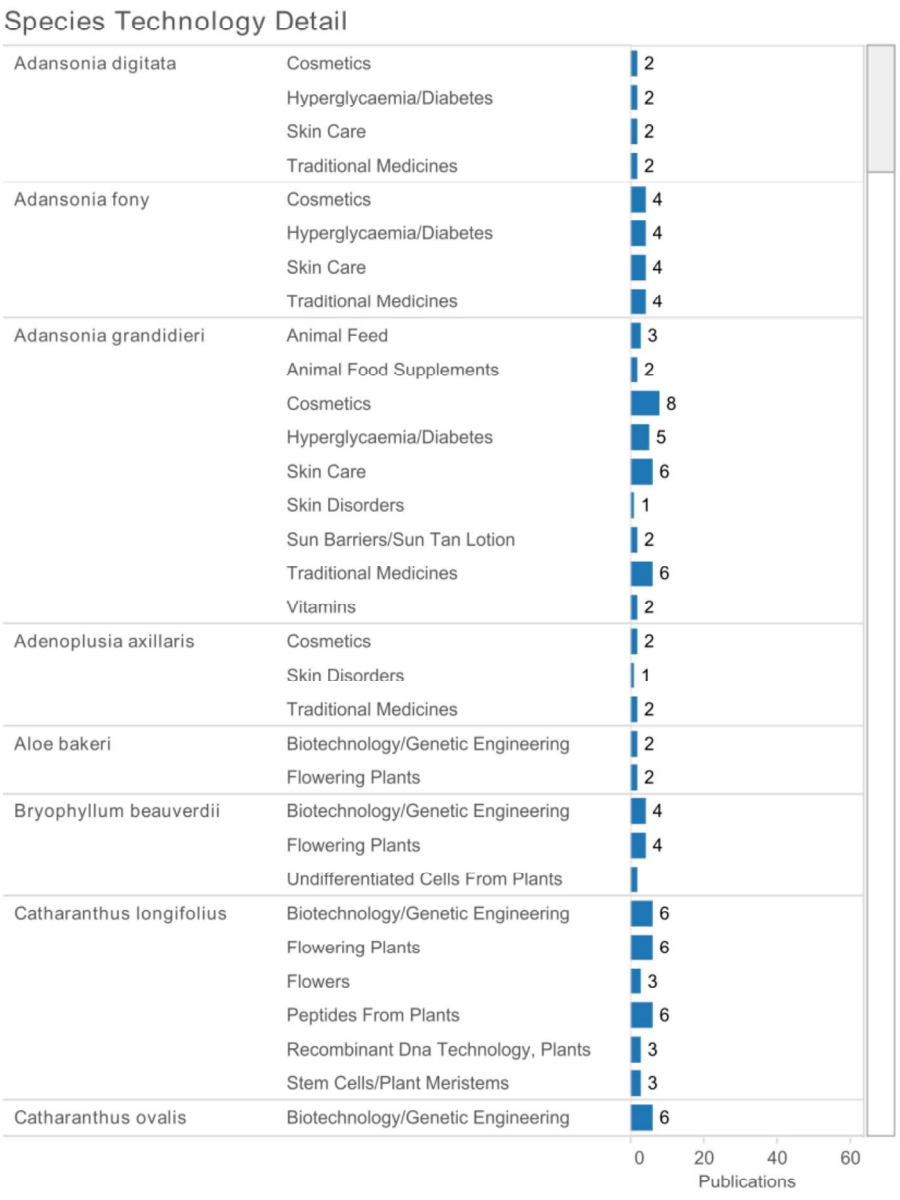


Table 3 usefully reveals that two members of the genus *Adansonia* (Baobab) are a focus of research for cosmetics and treatments for hyperglycaemia or diabetes. In contrast a third member of the genus *Adansonia grandidieri* is also a focus of potential applications in animal feed and for skin care products and for vitamins. This reveals that a particular species may be a focus of activity for a range of different products and markets. However, these cases can also reveal the need for careful stewardship with *Adansonia grandidieri* listed as endangered on the IUCN Red List and *Adansonia fony* listed as Lower Risk/Near Threatened.

Patent Claims:

Additional insights can be provided by examining the types of claims that are being made in relation to the species. A patent application may contain multiple claims but is required to contain only one invention. The first claim sets out the major focus of the claimed invention and frames all other claims.

Patents are awarded for three main classes of invention:

a) Compositions of matter
b) Methods or processes
c) Machines

In some jurisdictions claims may be permitted for new plant varieties either under standard patent legislation or under specific legislation (i.e. US Plant Patents)

Table 4 displays a summary of the top terms appearing in patent claims relating to genetic resources for Madagascar.

Table 4 reveals that the top category of patent claims is for methods, such as methods of producing a plant. a compound or other desired outcome. Method claims are frequently more restrictive in their coverage of genetic resources because the genetic component is only claimed in so far that it is relevant to performing the method. That is, it is the method that is the focus of the invention. Therefore it is the method, and the use of the claimed genetic component in performing that method, that is the subject matter of protection.

Patent activity that involves claims to a process or processes are similar to methods claims. Typically, these claims focus on the process for producing a desired product (such as a chemical or a cosmetic). It is the process itself that is the focus of the invention (i.e. a process for producing alkaloids from Catharanthus) rather than the components. However, patent claims for processes are typically constructed so that a component produced using the process is included in the scope of protection. However, the same component produced using a different process would not logically fall within the scope of this type of patent.

A third major formal category of patent claim is for compositions of matter (compositions). Compositions are commonly extracts, compounds or combinations of ingredients (i.e. in pharmaceuticals or cosmetics and herbal medicines). Patent claims for compositions typically include a list of the compounds or ingredients that are the subject matter for protection. These claims are also commonly broadly constructed such that the use of compounds from the species, the genus, and in some case the family, are incorporated into the scope of the claims. While composition of matter claims may be constructed in

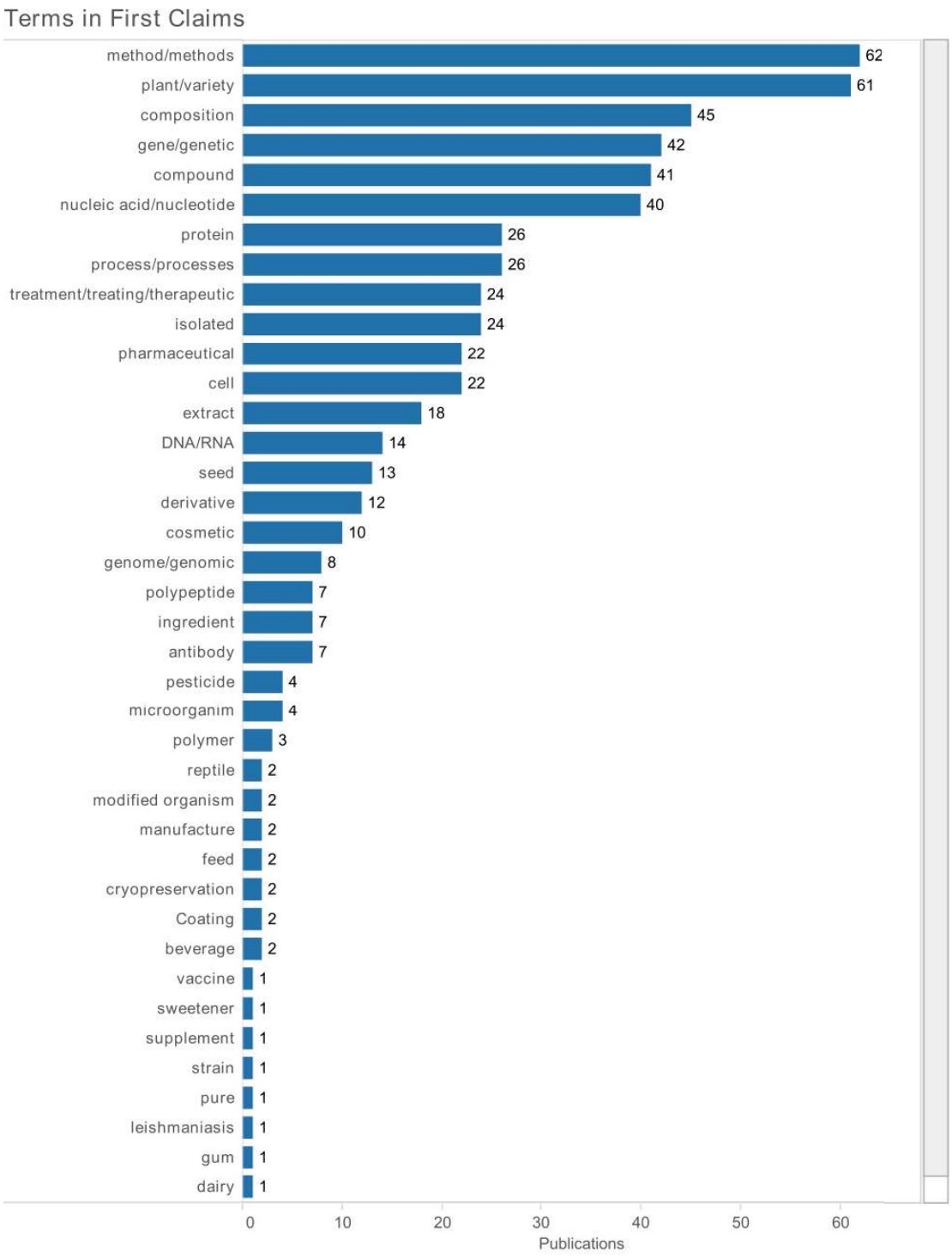
various ways, broad claims may well impinge upon the ability of producers from a country to export products containing the claimed components into markets where a patent is in force.

Finally, references to plants or plant varieties in patents can encompass a variety of inventions. For example, a patent involving genetic engineering such as a “Bioreactor using viviparous plant” focuses on a method for preparing a transgenic viviparous plant from the genus *Kalanchoe* or *Bryophyllum*. The patent then claims a transgenic plant produced through the method. Specific references to plant varieties may include US plant patents such as “Catharanthus roseus named Lli” (US20050251887P1) which makes a single claim to a new and distinct variety of Catharanthus roseus. This is a restricted form of protection for that specific variety under US Plant Patent Legislation. In other cases such as 'Dhawal', a high alkaloid producing periwinkle plant” (US6548746B1) a standard utility patent has been issued for a new and distinct high alkaloid producing plant with NCIMB accession number 41147. This patent enjoys standard patent protection.

As this brief discussion of patent claims suggests it is important to pay close attention to both the type and the content of patent claims. In addition it is important to establish whether a patent has been granted and the jurisdictions where a patent has been granted and is in force. This type of analysis is particularly important when considering the potential development of products for markets. However, freedom to operate, patent validity, patentability, patent infringement and patent landscape analysis requires specialist analysis beyond the scope of the present report. Given the increasing importance of these issues for economic development the World Intellectual Property Organization has established a Patent Landscaping group under its development agenda that commissions specialist patent research at the request of member states.[3]

[3] http://www.wipo.int/patentscope/en/programs/patent_landscapes/

Table 4: Terms Appearing in the First Claim of Patent Documents



Global Impacts and Global Markets:

We have seen above that a range of species are involved in patent activity of relevance to Madagascar. However, many patent applications simply go nowhere. A means for identifying important patents is therefore needed.Here we discuss two measures: a) patent citations, and; b) patent families.

Table 5 displays the citation scores by species and assignee for species relevant to Madagascar. When a patent is filed and published it becomes prior art. Later patent applications that make claims for the same invention will find that the scope of what they claim as new, involving an inventive step, and useful will be limited by the earlier claims. This is recorded in the patent system as a citation. The more often that a patent is cited by later patents is a measure of the importance and impact of that patent within the patent system. In some cases a single patent application may attract over a thousand citations.

In the case of the data for Madagascar, Table 5 reveals that the endemic species *Euphorbia hedyotoides* appears in a significant number of citations to filings by Leo Lab and Peplin Research. In the case of Peplin research the patents focus on methods of treatment of conditions using specified compounds from one of a very large number of Euphorbia species including *Euphorbia hedyotoides*. This case provides a good example of the way in which broad claims, in this case a methods based claim, can be constructed to prevent the use of specified compounds that may come from the species being used by others for a wide range of conditions such as acne or prostate cancer. In other cases such as *Ravensara anisata* a species may appear in lists of essential oils for inclusion in an antiviral patch or other products. This example serves to illustrate that *Ravensara anisata* could be of potential value as a source of essential oils. Other examples for a species that is directly sourced from and endemic to Madagascar include *Cedrelopsis grevei* which is listed in pesticidal compositions, for cosmetics and in animal feed for increasing milk production suggesting that the species may have a range of potential uses. As these examples make clear, patent data can highlight the potential uses and markets for species.

A second measure of the importance of patents is provided by the size of patent families. Table 6 ranks assignees based on counts of numbers of patent family members. A patent family is simply a set of patent documents that link back to an original parent filing (known as a “priority” filing). These patent documents can be filed anywhere in the world and can be tracked using unique identifiers known as INPADOC numbers that link back to the parent document.[4] In contrast with patent citations that provide an indicator of the impact of a patent on others in the patent system, the size of a patent family reveals how important a patent is to applicants. The reason for this is that they must pay fees each time they file a patent application that is linked to the parent. Table 6 ranks patent family data by species and shows the global map for the distribution of patent documents linked to the species.

[4] INPADOC stands for International Patent Documentation Centre which established the system. INPADOC is now part of the European Patent Office.

Assignees Citing

Species	Patent Assignees	Kingdom	Data Type	Distribution	
Euphorbia hedyotoides	LEO LAB LTD	plantae	Distribution	Endemic	28
	PEPLIN RES PTY LTD	plantae	Distribution	Endemic	74
Ravensara anisata	AROMA TECHNOLOGIES	plantae	Distribution	Uncertain	2
	ATRIX LAB INC	plantae	Distribution	Uncertain	7
	ESSENTIAL HEALTH LLC	plantae	Distribution	Uncertain	1
	LECTEC CORP	plantae	Distribution	Uncertain	40
	PEPLIN RES PTY LTD	plantae	Distribution	Uncertain	13
	QLT USA INC	plantae	Distribution	Uncertain	7
	UNIV MINNESOTA	plantae	Distribution	Uncertain	31
Coffea species	BASF PLANT SCI GMBH	plantae	Distribution	Cosmopolitan	17
	DEN KGL VETERINAER&LAN..	plantae	Distribution	Cosmopolitan	0
	ESCAGENETICS CORP	plantae	Distribution	Cosmopolitan	13
	EVOLUGATE LLC	plantae	Distribution	Cosmopolitan	2
	MEDIMUSH AS	plantae	Distribution	Cosmopolitan	0
	METANOMICS GMBH	plantae	Distribution	Cosmopolitan	26
	PEPLIN RES PTY LTD	plantae	Distribution	Cosmopolitan	13
	SAMYANG GENEX RES INST	plantae	Distribution	Cosmopolitan	13
	UNIV KOBENHAVNS	plantae	Distribution	Cosmopolitan	0
Paecilomyces viridis	CHONG KUN DANG CORP	fungi	Distribution	Cosmopolitan	0
	DAIICHI SANKYO CO LTD	fungi	Distribution	Cosmopolitan	2
	DSM IP ASSETS BV	fungi	Distribution	Cosmopolitan	2
	MERCK & CO INC	fungi	Distribution	Cosmopolitan	39
	PEPLIN RES PTY LTD	fungi	Distribution	Cosmopolitan	13
	SANKYO CO LTD	fungi	Distribution	Cosmopolitan	2
Catharanthus ovalis	ERIOCHEM SA	plantae	Distribution	Endemic	0
	GRAIN BIOTECH AUSTRALIA..	plantae	Distribution	Endemic	0
	METANOMICS GMBH	plantae	Distribution	Endemic	21
	PEPLIN RES PTY LTD	plantae	Distribution	Endemic	13
	RIJKSUNIV LEIDEN	plantae	Distribution	Endemic	30
Catharanthus roseus	ALLELIX BIOPHARMECUTICA..	plantae	Origin	Endemic	13
	COUNCIL SCI&IND RES INDIA	plantae	Origin	Endemic	1
	GOLDSMITH SEEDS INC	plantae	Origin	Endemic	3
	HUHTAMAEKI OY	plantae	Origin	Endemic	5

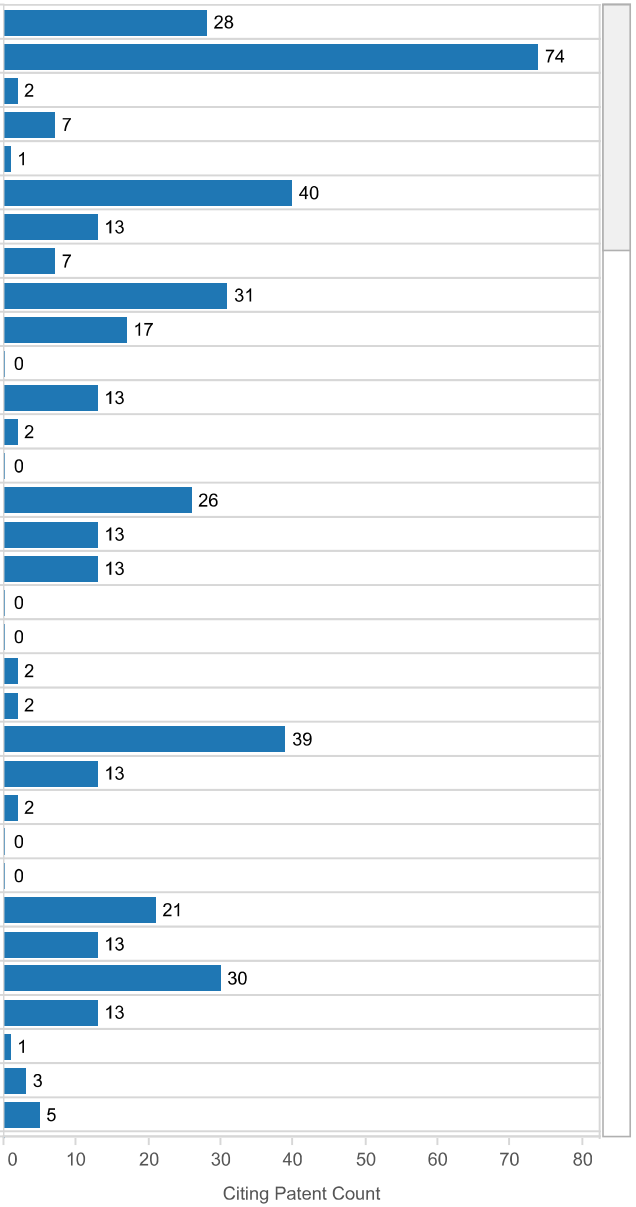
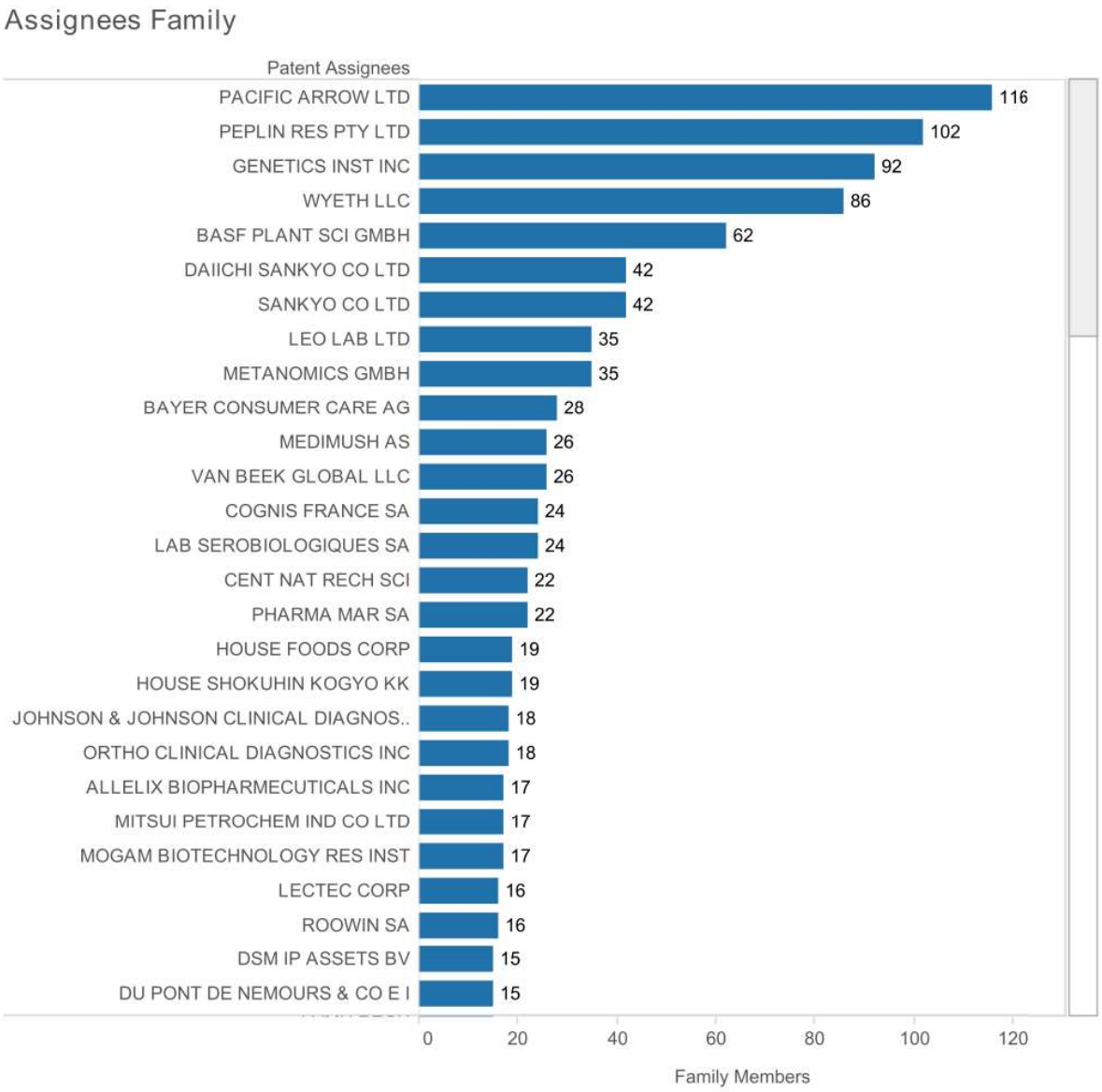


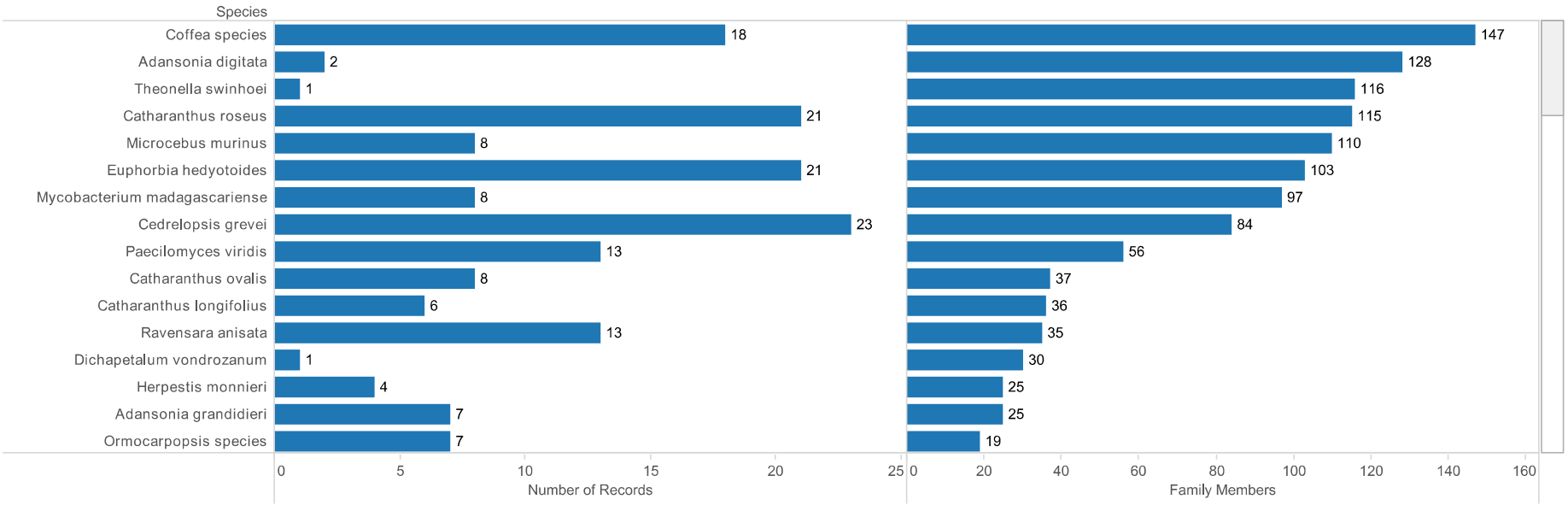
Table 6: Patent Assignees and Family Members



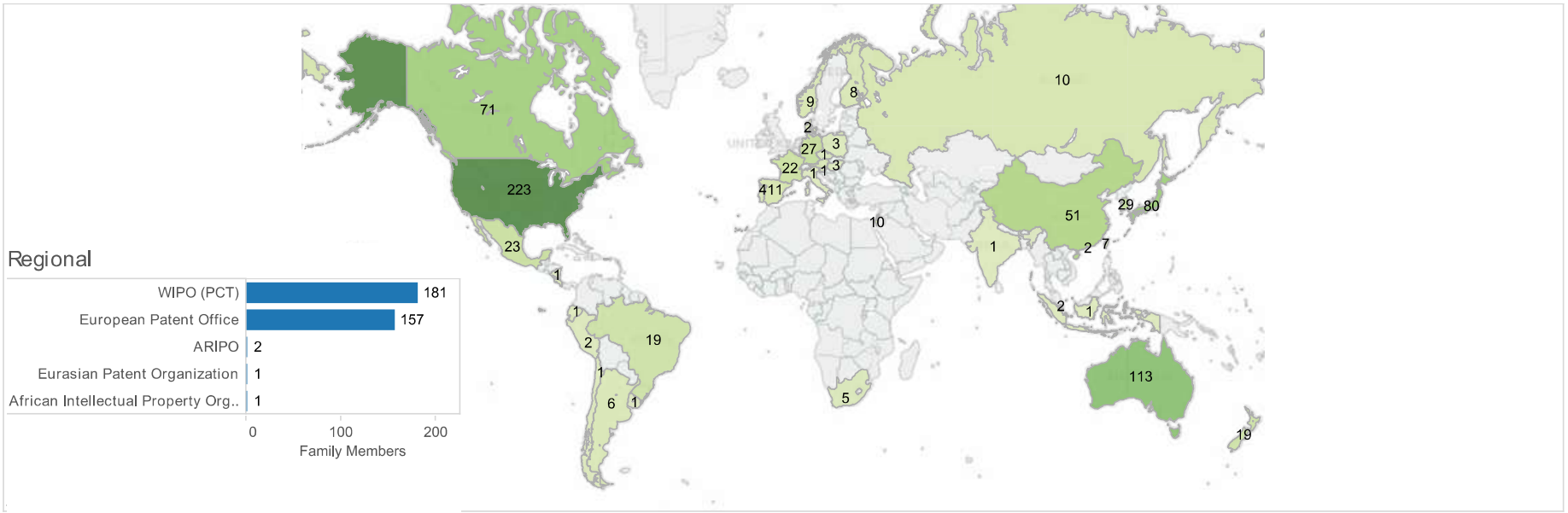
Patent family data of this type is useful in revealing the applicants who are most vigorously pursuing patent protection involving a species or, as is frequently the case, a group of species around the world. In this case the Hong Kong based Pacific Arrow Ltd, along with Peplin Research and the Genetics Institute appear prominently in the data. However, this type of analysis can also be extended to the species level to consider the global impacts of patent activity and the position of patents involving a species in global markets.

Plate 3 displays the results for patent family data by species and a global map of countries where family members linked to the species have been recorded. Please note that the map does not display the geographical locations for regional and international patent offices. Plate 3 is useful because it reveals what might be called the global reach or careers of species. We can immediately see that patents involving coffee species, which typically list large numbers of coffee species including species endemic to Madagascar.

Species Family Members



Family Map



have the widest reach in our data. In addition, *Adansonia digitata* (Baobab) also has an extensive reach as does the marine sponge *Theonella swinhoei*. We would note that while *Catharanthus roseus* features prominently in these rankings the data does not take account of the many thousands of patent documents that contain references to vincristine and vinblastine as part of the patent landscape for this species.

Analysis of this type is also useful because it exposes the markets where protection is being sought as provided in the Family map. As we might expect the United States is a primary market with Japan and Australia also featuring prominently. However, both China and India are also emerging into this landscape, with limited information available in the case of India. It is striking that available data suggests that patent applicants are not pursuing protection in Madagascar or other African countries with the limited exception of South Africa. This suggests that opportunities may exist within internal markets in Africa where patent protection is unlikely to prove to be a barrier. At the same time, patent data also suggests countries where markets may exist for products involving biodiversity from Madagascar. Finally, as the reference to the International Cooperative Biodiversity Group project above suggests, there may be opportunities for the development of collaborations or partnerships with those conducting research and development involving species from Madagascar.

Concluding Remarks:

This report has focused on identifying species in patents that originate from or are likely to originate from Madagascar based on available distribution data. Our purpose has been to highlight the existing and potential role of these species for economic development in support of conservation. We would emphasise that our aim was not to identify the complete portfolio of patent activity for a particular species or genetic resources. In reality each of these patent activity for each of these species forms part of a landscape that stretches beyond the data presented in this report. Rather, the contents of this report and the next section presenting summaries for each species provide a basis for further exploration of the potential of Madagascan species for economic development and conservation.

The next section presents a series of summary cards for each of the species identified in the course of this research. An online interactive version of these cards will be made available through abspat.net to facilitate further research.