Biodiversity In The Patent System:

A country study of biodiversity, genetic resources and global patent activity for the Central African Republic

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Introduction

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

Section 1 provides an overview of biodiversity in the Central Africa Republic 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 Burundi in the period 1976-2010. This is followed by detailed analysis of patent documents that make reference to the Central African Republic and data based on species that are limited to distribution in Burundi

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 the Central African Republic. 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 initially limited to searches of patent data containing a species name from the United States, the European Patent Office and the international Patent Cooperation Treaty in the period 1976-2010. Additional research was performed to identify and review all patent documents making reference to Central African Republic published anywhere in the world between 1900 and 2013. As such the report provides a baseline for patent activity involving species from Burundi as a basis for further research.

Our research focused primarily on documents that make reference to the Central African Republic and to cases where existing distribution data suggests the Central African Republic 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-

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

regions (e.g. 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.

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 fifteen 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 under-utilised 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

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

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 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.

Central African Republic

Area:
622,984 sq. km.
Coastline:
Landlocked.
Climate:
Tropical; hot, dry winters; mild to hot, wet summers.
Geography:
Vast, flat to rolling, monotonous plateau; scattered hills in northeast and southwest. Mostly Savannah with Sahel in the north and forest in the south.

Biodiversity in the Central African Republic 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 participating collections who share biodiversity information.

Using this resource we have obtained biodiversity records for species which occur in the Central African Republic. 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 4,275 resolved species names for the Central African Republic with 20,006 georeferenced coordinates for the occurrences of these species in the Central African Republic.

We identified a total of 79,815 documents containing species known to be distributed in the Central African Republic. Of these, 16 made some form of reference to the Central African Republic. These documents were manually reviewed in MAXQDA software to identify documents specifying a source or origin in the Central African Republic.

The 16 documents that made a specific reference to the Central African Republic contained 3 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 the Central African Republic.

In addition, using GBIF distribution data, we identified 2 species where GBIF presently records distribution only in the Central African Republic. However, these species appeared in no patent documents where the Central African Republic 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 the Central African Republic and thus be regarded as a species of likely or potential significance for the Central African Republic.

Finally, we carried out an additional search across all global patent jurisdictions for any documents featuring the country name Central African Republic published between 1900 and 2013. This search identified 814 raw documents with 55 documents containing species names which were manually reviewed using MAXQDA software. This search was undertaken to ensure that as much up-to-date data as is available was incorporated into the results. For the sake of simplicity we call this data 'Global 2013'.

Biodiversity and Distribution

Much of the data submitted to GBIF includes geographical coordinates indicating where the recorded species was located. A total of 20,006 coordinates were available for the Central African Republic. Using this data we are able to show the physical distribution across the Central African Republic of all GBIF recorded species. Plate 1 shows two maps: The upper map shows plotted points, each indicating a GBIF record. The points are coloured to indicate the kingdom to which the species belongs. 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 lower map shows major settlements and roads. It also includes the location of some protected areas such as national parks and nature reserves, such as Vassako-Bolo Strict Nature Reserve and the Chinko Project Area - places expected to be of significance for biodiversity. A larger version of the distribution map can be found in the appendix of this country report.

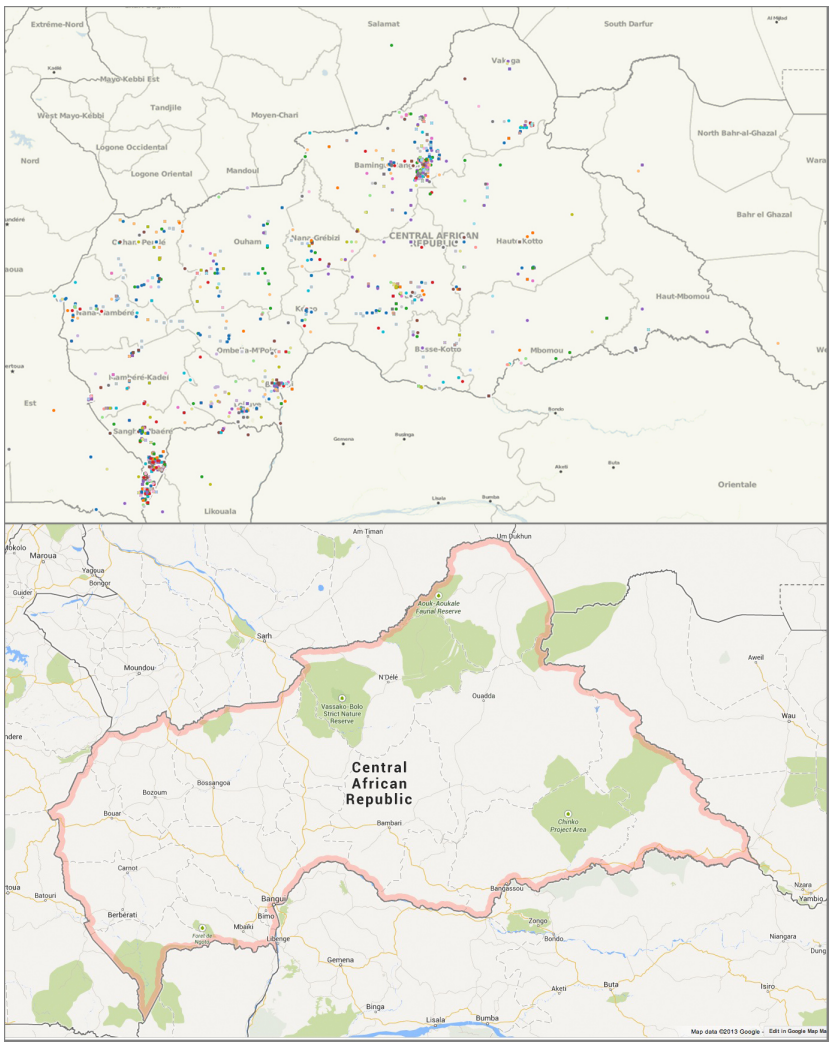


Plate1: Distribution of GBIF records from the Central African Republic (upper) and major settlements and roads (lower) (map courtesy of Google Maps). Each colour point represents a species record coloured by kingdom.

It is very interesting to compare the two maps. The distribution map shows that records are not uniformly dispersed across the country. There are a number of dense clusters of records, most notably in the south west of the country, focused around the Dzanga-Sangha National Park and in the north of the country in the area of Saint Floris National Park. Other smaller clusters can be seen to the east in the Andre Felix National park close to the town of Oanda Djallé and also in and around the town of Bambari and the capital city Bangui. Another feature of these mapped distribution records are the strings of data points which cross the country. When compared with the lower map it can be seen that the strings of data points closely follow the routes of major roads. This pattern, which is a familiar one across the georeferenced data of African countries, suggests that recording has been carried out where access is relatively easy but not elsewhere and therefore that the country has further potential for recording to build an accurate picture of the biodiversity. We would note that georeferencing of species data has an important role to play in facilitating the identification of where species are located in a country. While caution is required in the case of endangered species we would emphasise the wider importance of promoting georeferencing in enhancing knowledge and understanding of biodiversity in the Central African Republic.

GBIF presently records 4,423 species known to be present in the Central African Republic (this figure includes unresolved species names, hence the increase from the number

quoted above). This list is dominated by plants and animals which account for all but 77 species as can be seen in Table 1. Other kingdoms are poorly represented with only fungi being recorded, and this, perhaps, illustrates a rather low level of recording and collection.

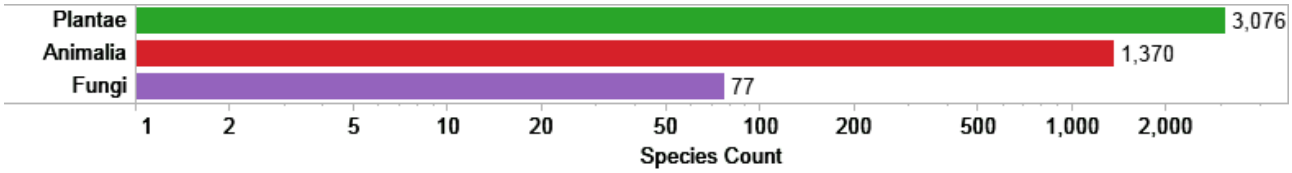


Table 1: Showing the number of species in the Central African Republic by kingdom using GBIF data.

Using global data it is possible to examine the wider distribution of Central African species. Plate 2 shows where records exist across the globe for such species. Species that are found in two or more countries are referred to as 'cosmopolitan'. Each pie represents the number of species that are found in the Central African Republic in a particular kingdom. It can be seen that a substantial number of species have a very wide regional distribution throughout central Africa and in particular those countries which have tropical rainforest and moist savannah biomes. This reflects the georeferenced records which are at their densest in the Dzanga-Sangha National Park, a part of the country which contains tropical rainforest. A smaller number have global distributions, although 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.

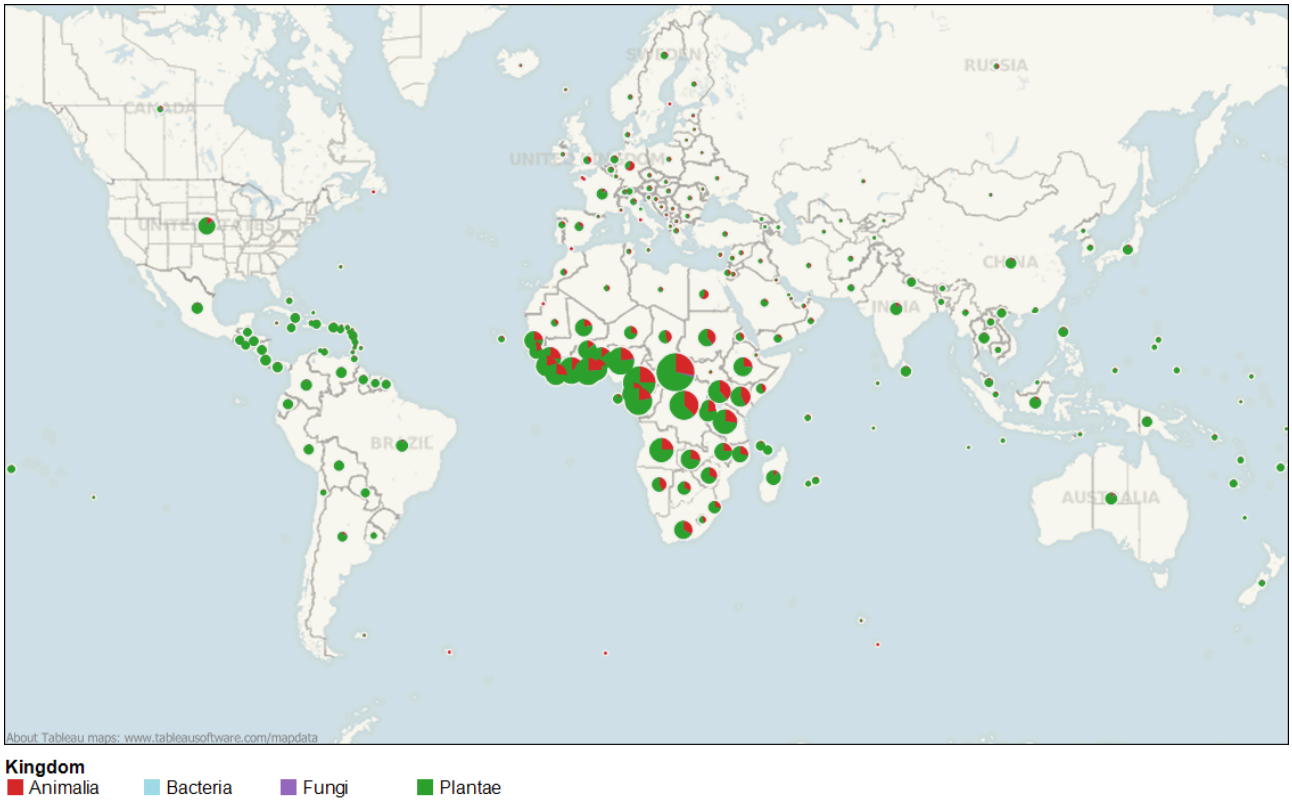


Plate 2: Global distribution of Central African species shown by kingdom and the number of species recorded in GBIF.

Biodiversity in the Central African Republic in the Patent System

As of 2013 a total of 527 patent documents in the main patent jurisdictions (European Patent Office, the United States, and the Patent Cooperation Treaty) specifically mention the Central African Republic. This provides a general overview of references to the Central African Republic in the patent system across all areas of invention. Only a proportion of these documents will also refer to species collected in, or sourced from, the Central African Republic. In addition, patent applicants will make reference to species that originate from the country but will not mention the Central African Republic as the source of 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 the Central African Republic. We focus on patent activity in the main patent jurisdictions in the period between 1976 and 2010. We then examine the results of research to identify genetic resources and traditional knowledge that originate from the Central African republic. In approaching patent activity for genetic resources from the country we focus on three categories of data.

1. Species that are known to be distributed in the country but are also distributed elsewhere in the world. This provides an overview of global patent activity for genetic resources of relevance to the Central African Republic.
2. Species where a direct reference is made to the collection or origin of a species from the Central African Republic. 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 the Central African Republic. This data is known as Distribution data and refers to cases where GBIF presently only records a species as occurring in the Central African Republic and no other country. Because taxonomic information is incomplete, this data provides a clue rather than proof that a species originated from the country.

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

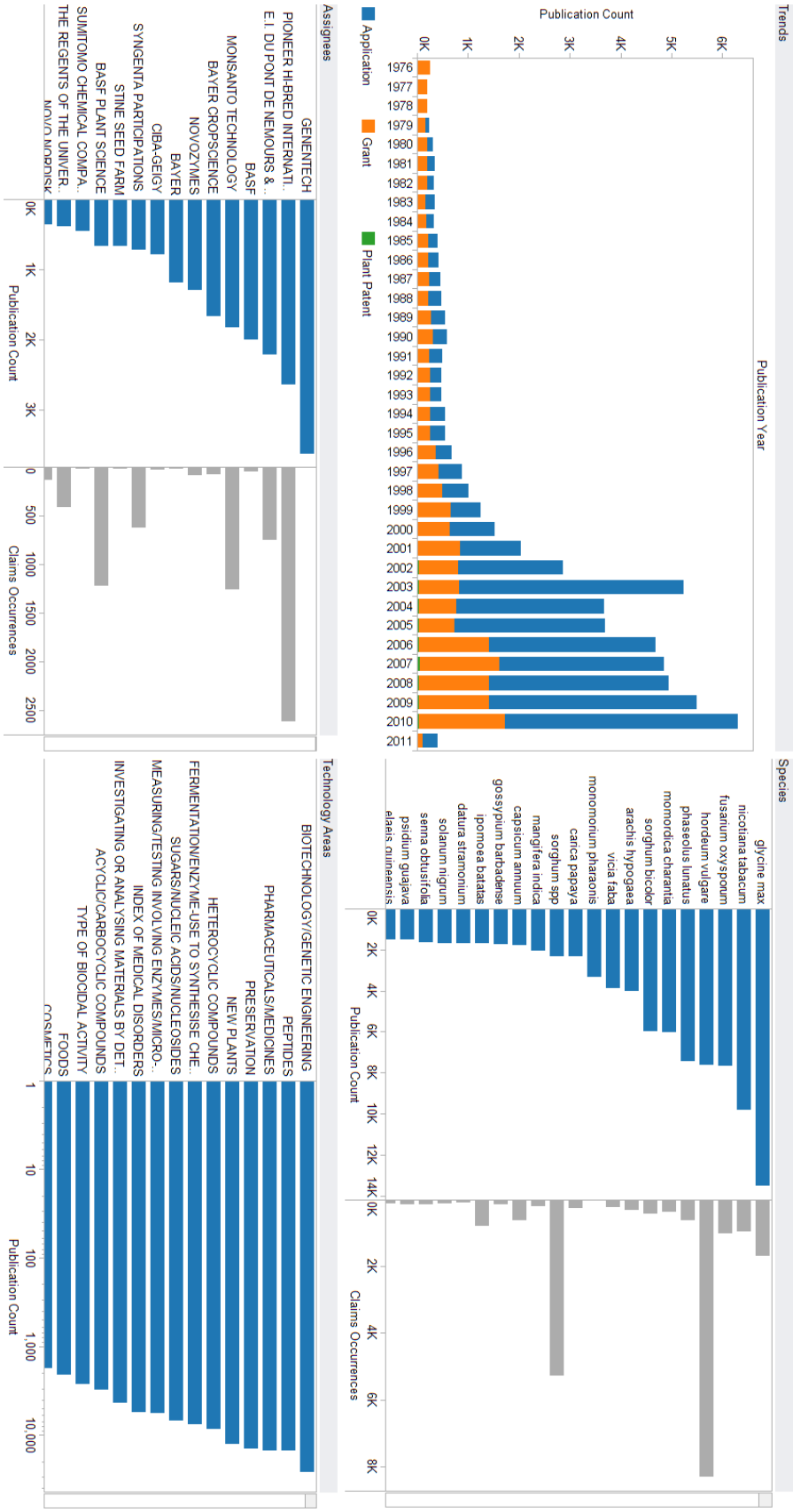
The Central African Republic shares a significant proportion of its known biodiversity with other countries in Africa and around the world. Plate 3 provides an overview of patent activity for species that are known to occur in the country and other countries around the world. This overview provides information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

In total we identified approximately 891 species names in patent data from the major jurisdictions that are known to occur in the Central African Republic. When model organisms including crops such as *Zea mays* (maize) and *Homo sapiens* are excluded this falls to 876 species names and 662 accepted scientific names.[3] This data is relevant for the Central African Republic because it demonstrates that researchers and companies are conducting research and development on species that are known to occur in the country.

[3] The 662 figure excludes common model organisms such as E. coli, Arabidopsis thaliana, Bacillus subtilis and Zea mays (maize) that are globally distributed and are used as research tools in biotechnology. These species appear prominently in patent data for all almost countries and are therefore excluded.

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.

Plate 3: Overview of Patent Activity featuring Species occurring in the Central African Republic.



The top species of relevance to the Central African Republic in global patent data are dominated by crops. In total we identified 507 plant names in global data of relevance to the Central African Republic with crops represented by species including varieties of soya (*Glycine max*), beans (*Vicia faba* and *Phaseolus lunatus*), peanut (*Arachis hypogaea*), cereals (*Sorghum spp* and *Hordeum vulgare*), papaya (*Carica papaya*), mango (*Mangifera indica*), pepper (*Capsicum annuum*), sweet potato (*Ipomoea batatas*), senna (*Senna obtusifolia*), cotton (*Gossypium barbadense*), apple guava (*Psidium guajava*), and tobacco (*Nicotiana tabacum*). Other species include the nightshades *Datura stramonium* and *Solanum nigrum*, which have many traditional medical uses; the plant pathogen *Fusarium oxysporum,* a globally distributed soil dwelling fungal species; *Momordica charantia* or bitter melon is grown as a food crop and has pharmaceutical uses; the Pharaoh ant (*Monomorium pharaonis*) is a pest species in buildings across the world. It can be seen that the majority of these species are crop species or species which affect crops.

The assignees in the overall data for species of relevance to the Central African Republic range across a spectrum from biotechnology (e.g. Genentech and Novozymes), companies such as BASF and Bayer in areas such as biocides/insecticides and agriculture (e.g Du Pont and Pioneer Hi-Bred International). More detailed analysis of technology areas revealed pharmaceutical companies such as Ciba Geigy and Novo Nordisk (which specialises in treatments for diabetes). Also, companies which develop new crops such as Syngenta, Monsanto and Stine Seed feature prominently. As this makes clear, there are a wide range of general and specialised technology areas and markets of relevance to biodiversity from the Central African Republic. 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 the country or where distribution data suggests that the Central African Republic is the likely source.

Species from the Central African Republic in Patent Data:

In total we identified three species of organisms that were directly sourced from, or potentially originate from, the Central African Republic based on distribution data. Plate 4 displays these species 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, three species appear in the data compared with the overview provided in Plate 3.

The first species is *Symphonia globulifera.* This species is a timber tree that is widespread in tropical zones of the Americas and Africa; the tree is used for timber and also has medicinal uses. John Hopkins University, Stephen Baylin and Kevin Pruitt (WO20082646A2) claim a method of activating methylation silenced genes in a subject by administering a histone deacetylase (HDAC) inhibitor. In this invention one of the inhibitors used can be guttiferone which can be obtained from "Symphonia globulifera L.f., originally collected in the Ndakan Gorilla Study Area of the Central African Republic in March 1988". Boston University, Stephen R. Farmer, Wang Hong and Qiang Li (WO2008119070A1 and US201210692A1) claim "a method of treating a disorder in a subject, the method comprising administering a SIRTI inhibitor and a PPAR[gamma] agonist to the subject." and state the same source of guttiferone.

The second species is *Harungana madagascariensis,* a flowering plants in the family Hypericaceae and the sole member of the genus. It has wide distribution across sub Saharan Africa and can be found in both forest and savannah habitats. Shaman Pharmaceuticals Inc of the USA (US5837255A and WO1998025639A1) claim a method for reducing blood glucose by administering harunganin or visimin. The abstract of these applications states: "The use of extracts from Harungana or Vismia spp. or anthracenone compounds harunganin and vismin contained therein or isolated therefrom as hypoglycemic agents, as well as methods for obtaining the hypoglycemic agents are described. According to a preferred embodiment, the extracts are derived from H. madagascariensis. As hypoglycemic agents, the extracts or anthracenone compounds harunganin and vismin are useful for treating insulin-dependent (type I) and non-insulin-dependent (type II) diabetes."

Although there is no specific claim that the plant used for this particular invention was collected or otherwise sourced from the Central African Republic, the patent description makes reference to traditional knowledge from the country thus: "...the Pygmies of the Lobaye river in southwest Central African Republic administer a stem bark decoction orally, and use a plant extract as a bath to treat diarrhea and dysentery (and) in the Bangui region of the Central African Republic, a bark decoction is used to treat menstrual troubles and blennorrhagia, bark powder is applied to wounds, leaf decoction is administered to treat stomach ache, yellow inner bark sap is applied topically over the abdomen of women for treatment of infertility, root is used as an antidote against vegetal poisons".

The third species identified in the data was a species of *Kibdelosporangium,* a recently described genus of bacteria originally collected from a soil sample from Central African Republic. In three documents (WO2011079034A1 CN102781935A & CA2780357A1) Merck, Sharp and Dohme et al claim compounds from extracts of *Kidelosporangium* for use as anti-bacterial agents.

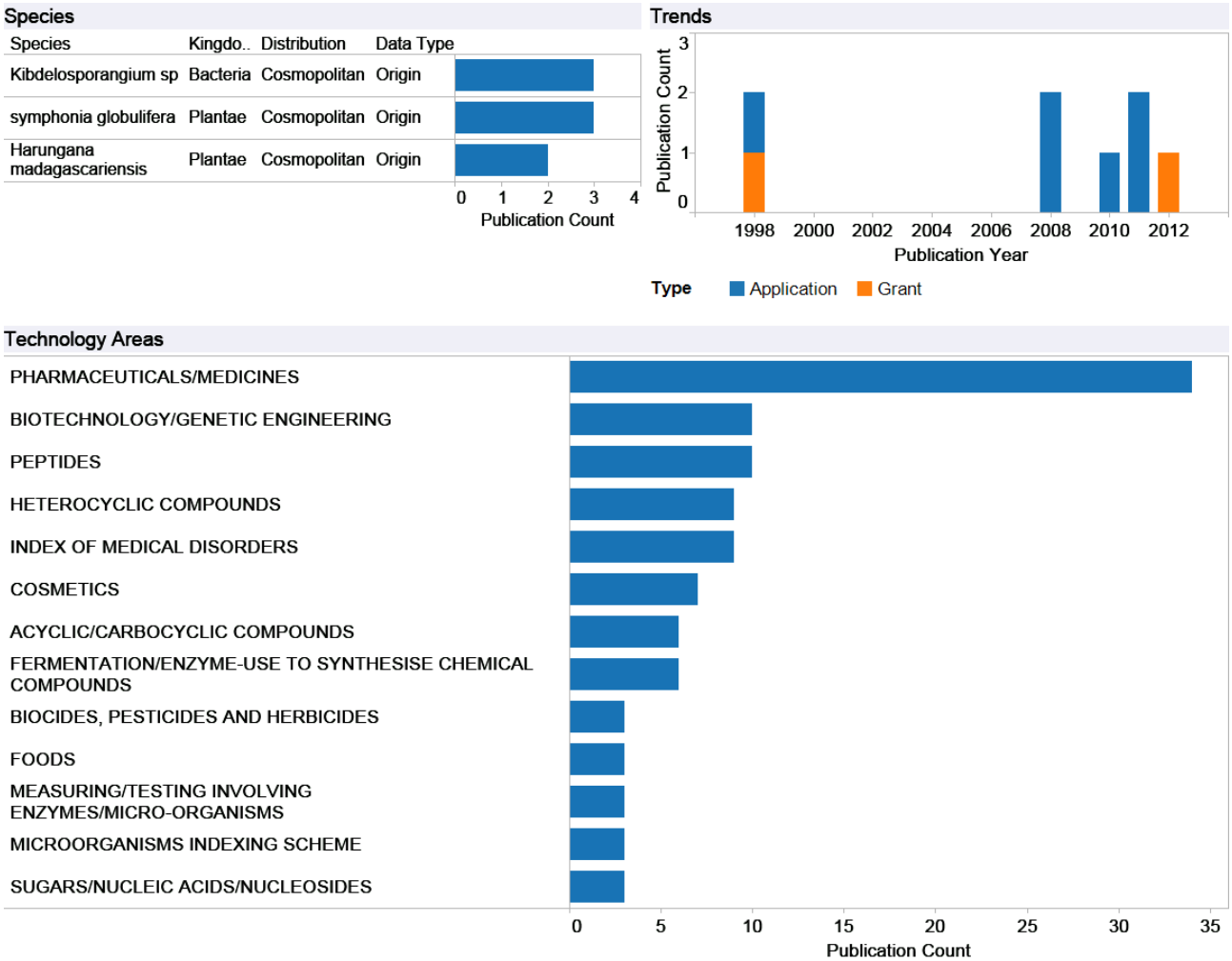


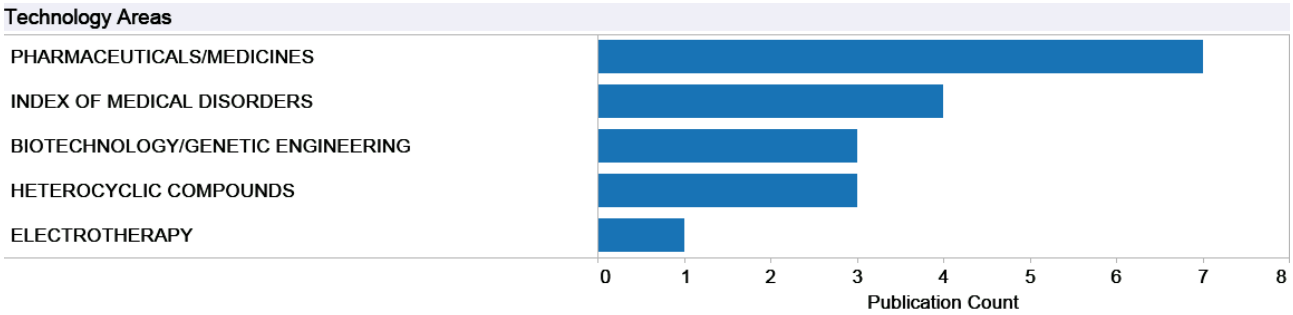
Plate 4: Species potentially sourced from the Central African Republic.

Full details of the species identified in the research are provided in the final section of this report. In the case of Harungana it should be noted that references to traditional knowledge included additional African countries. Therefore this example will also be found in the associated reports focussing on those countries. This detail highlights how cosmopolitan species such as Harungana, that are native to several African countries, may hold significant potential for collaboration in economic development and conservation.

As has been seen, the recorded range of species found in the Central African Republic appears to be very limited with plants and animals dominating and fungi contributing only a small number of species. No other kingdoms are represented, and this would be unexpected in a well recorded country. In addition, the top species known to be distributed in the Central African Republic and which appear in patent data are dominated by cultivated species. This lack of comprehensive data and the low number of results for species originating from the Central African Republic makes it difficult to draw any conclusions regarding the potential of the country to be the source of organisms appearing in the patent record. We now turn to more detailed analysis of the technology areas involving species relevant to the Central African Republic.

Technology Areas:

Table 2 provides a brief summary of the technology areas involved in patent activity for the Central African Republic and is followed by a more detailed breakdown of activity.



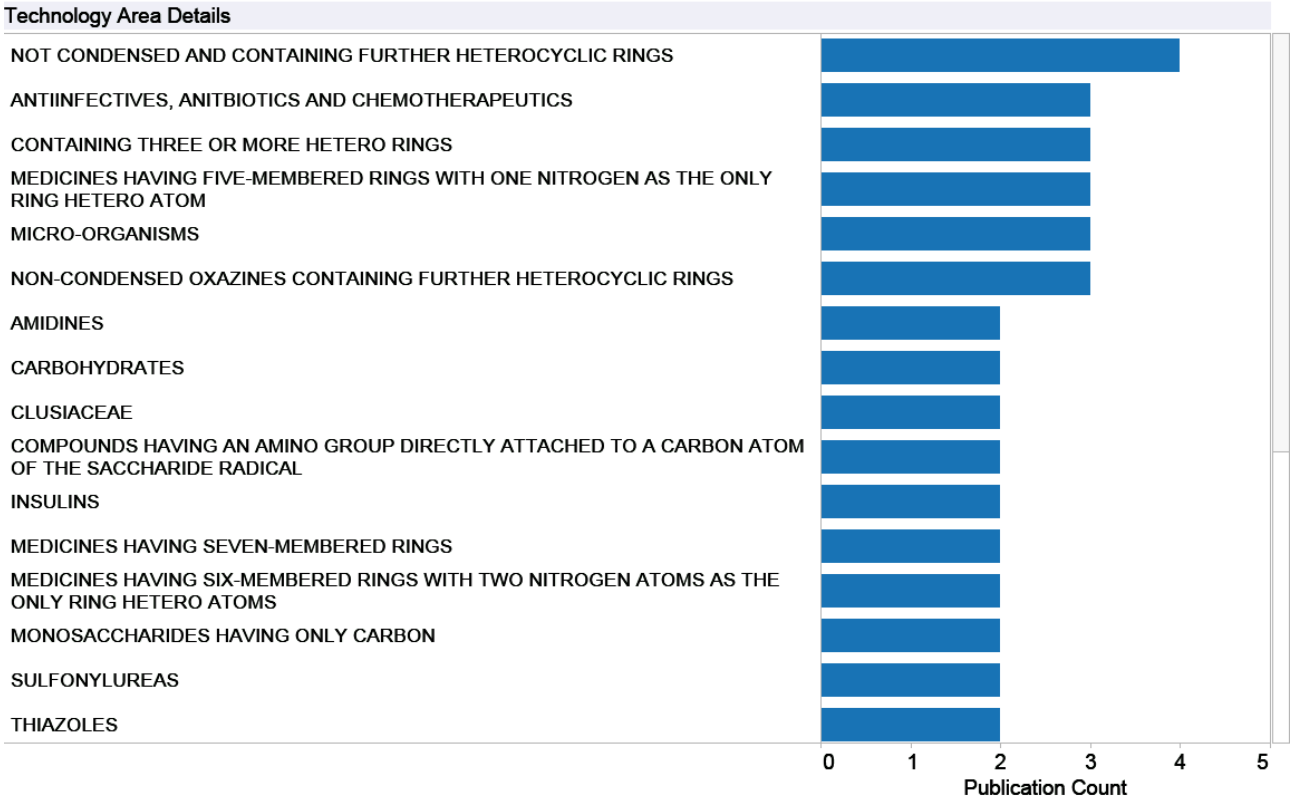


Table 2: Technology Areas.

The general overview of technology areas provided in Plate 3 emphasises biotechnology and pharmaceuticals. The narrower dataset that focuses on species from, or likely to originate from, the Central African Republic repeats this pattern. It can be seen that *Harungana madagascariensis* and *Symphonia globulifera* are used to provide extracts for medical preparations utilising several properties of the species. *Kibdelosporangium* is used as an anti-bacterial and as such the technological areas are focused on biotechnology. A breakdown of technology areas by species is shown in Table 3.

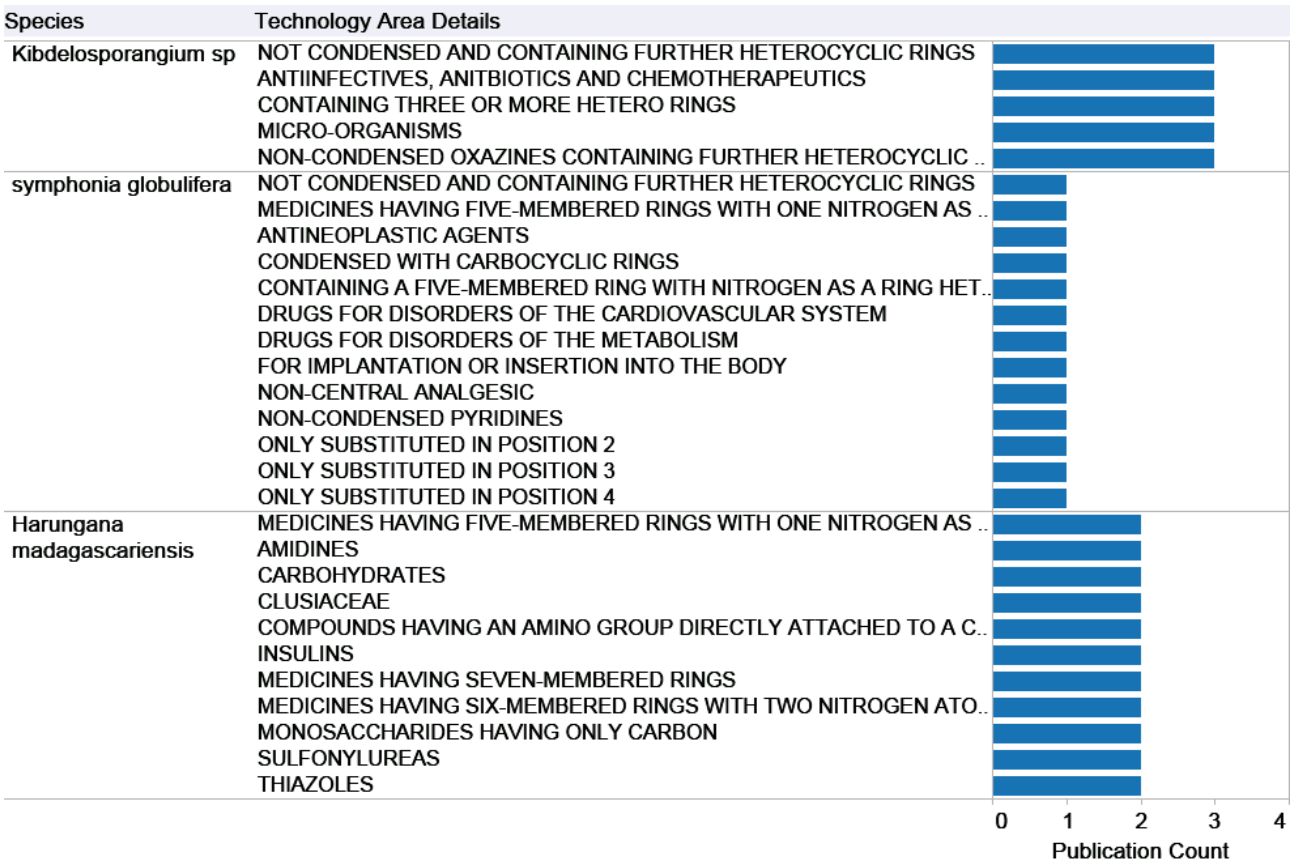


Table 3: Species and Technology Areas.

Table 3 usefully reveals the range of potential applications and technology areas where a species and its components may be deployed. It is apparent that species may be a focus of activity for a range of different products and markets. However, in the case of threatened species there will be a need for careful stewardship and conservation of target species.

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 (e.g. US Plant Patents).

Table 4 displays a summary of the top terms appearing in patent claims relating to genetic resources for the Central African Republic. As can be seen from this list, method and

compound feature prominently along with more specific terms relating to individual inventions, as would be expected with such a small statistical sample.

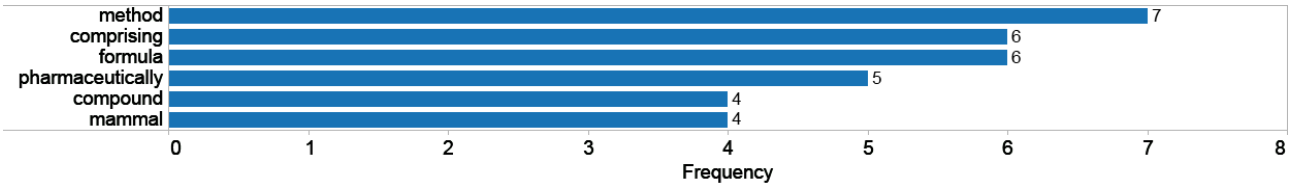


Table 4: Terms Appearing in the First Claims of Patent Documents.

The first category of patent claims are for methods, such as methods of producing a compound or treatment which leads to a 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 or biological component in performing that method, that is the subject matter of protection. For example, in claims made in relation to *Harungana madagascariensis* the first claim states "A method for reducing the blood glucose of a mammal, comprising administering to said mammal a hypoglycemically effective amount of a composition comprising harunganin or vismin, or a pharmaceutically acceptable salt thereof." (WO1998025639A1). This claim clearly states that the claim is for both a method for carrying out a treatment and also a composition using a genetic component. In claims relating to *Symphonia globulifera* the first claim is for a method: In document WO2008082646A2 by The Johns Hopkins University the first claim is stated as "A method of activating methylation silenced genes in a subject comprising administering a histone deacetylase (HDAC) inhibitor". In the similar document by The Trustees of Boston University (WO2008119070A1) the claim is for "A method of treating a disorder in a subject, the method comprising administering a SIRTI inhibitor and a PPAR[gamma] agonist to the subject".

The other major formal category of patent claim is for compositions of matter (compositions). Compositions are commonly extracts, compounds or combinations of ingredients (e.g. 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. In the case of *Kibdelosporangium* the claims are for a compound. In the first claim of document CA2780357A, Merck Sharp and Dohme Corp claim "A purified compound… and pharmaceutically acceptable salts thereof, wherein: R1 and R2 are independently selected from the group consisting of hydrogen and halogen; and R3 is selected from the group consisting of hydrogen and C1-C6 alkyl". In this case the claim is first and foremost for the compound.

These types of claims are frequently broadly constructed such that the use of compounds from the species, the genus, and in some cases 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.

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, the jurisdictions where a patent has been granted, and whether it is in force. This type of analysis is particularly important when considering the potential development of products for markets. However, detailed patent analysis such as 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 initiative under its development agenda that commissions specialist patent research at the request of member states.[4]

Global Impacts and Global Markets:

We have seen above that a range of species are involved in patent activity of relevance to the Central African Republic. However, it is important to note that many patent applications simply go nowhere. They may embody the hopes and ambitions of individuals, researchers, universities and companies but do not ultimately have an impact either in the patent system or in the market. 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 the Central African Republic. 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 or involving an inventive step, will be limited by these earlier claims. This is recorded in the patent system as a citation. The more often that a patent is cited by later patent applications 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 (e.g. *Thermus aquaticus* in biotechnology). Patent citation counts are therefore an important measure of the importance of patent activity because these scores reveal the impact of patent activity on other applicants.

In the case of the Central African Republic, Table 5 reveals citation scores for species of relevance to the country organised by species and assignee.[5] The top cited species receives 5 citations in 3 patents from the Johns Hopkins University and the Trustees of Boston University involving *Symphonia globulifera*. This suggests that while the work carried out by these institutions received some interest, this has so far been very limited. The documents featuring *Kibdelosporangium* however have not received any citations at all, suggesting that to this date work on this species has not been of wider interest.

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

[5] Table 5 aggregates the patent scores by species and assignee. If an assignee has four documents with citations involving the species, the numbers are aggregated to arrive at the total.

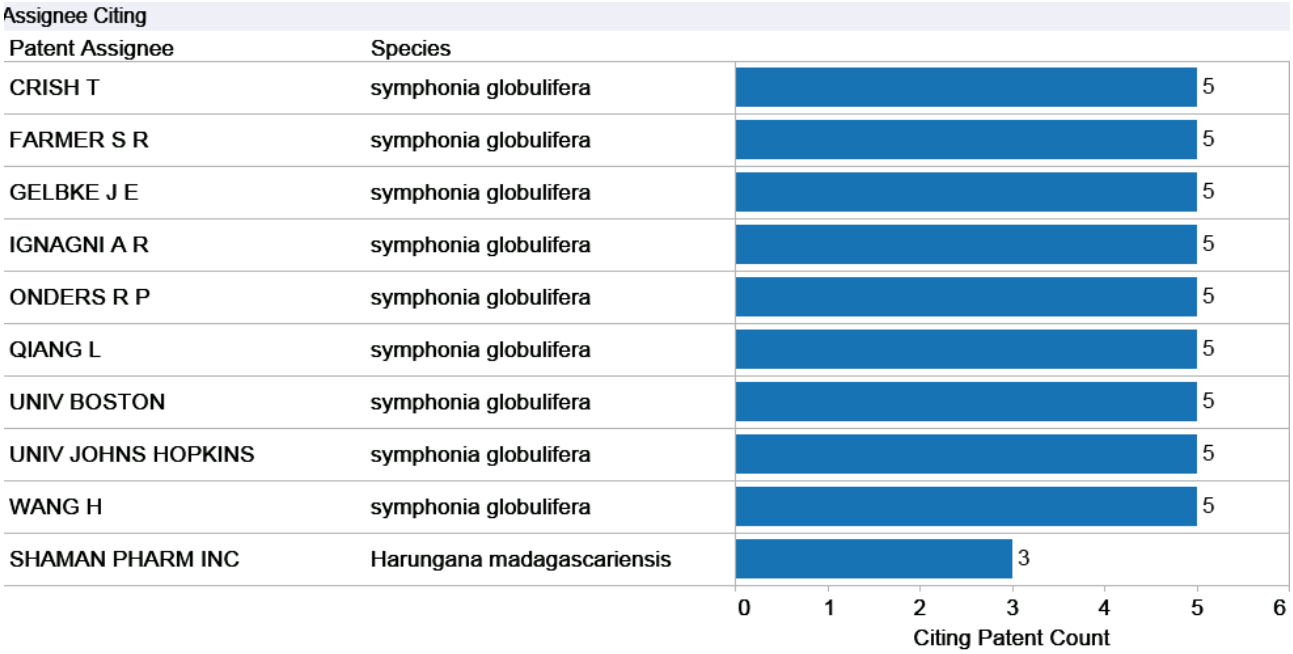


Table 5: Species and Assignee Citing Patents

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.[6] In contrast with patent citations that provide an indicator of the impact of a patent on other applications 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 (priority) application.

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 Merck Sharp and Dohme, in their work on *Kibdelosporangium* as an antibiotic, has a family of 11 patents from three priority filings. Note that the long list of assignees reflects that several individuals are listed as assignees for the same patent documents. The list of families associated with each individual reflects the number of patents with which they are associated and does not signify separate patents. This number suggests that Merck Sharp and Dohme considered that their invention had sufficient economic potential to require protection in multiple countries. Despite this protection it has been noted above that no citations have been received and it might be interpreted that the high number of family members also reflects the financial strength of the Merck Sharp and Dohme company, enabling it to protect any inventions it regards as having potential. Similarly, Johns Hopkins University has filed six family members. While this is a low number, for a University it might be considered a high number, and reflect confidence in their research.

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

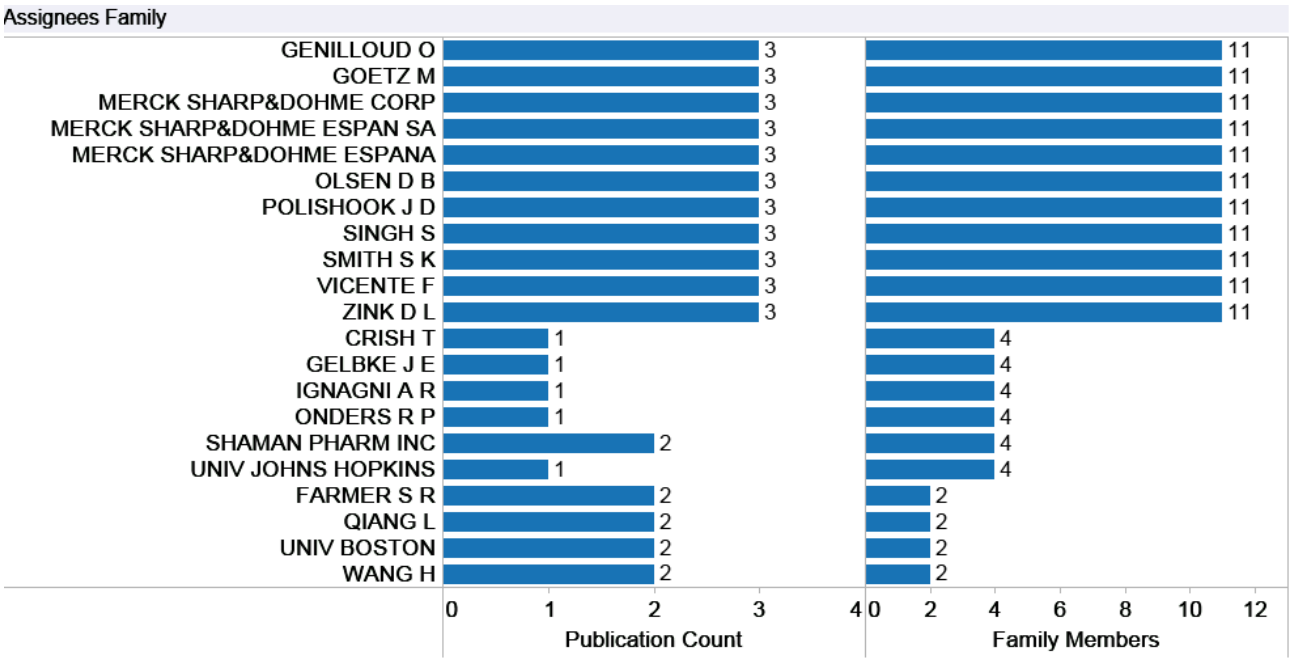


Table 6: Patent Assignees and Patent Families.

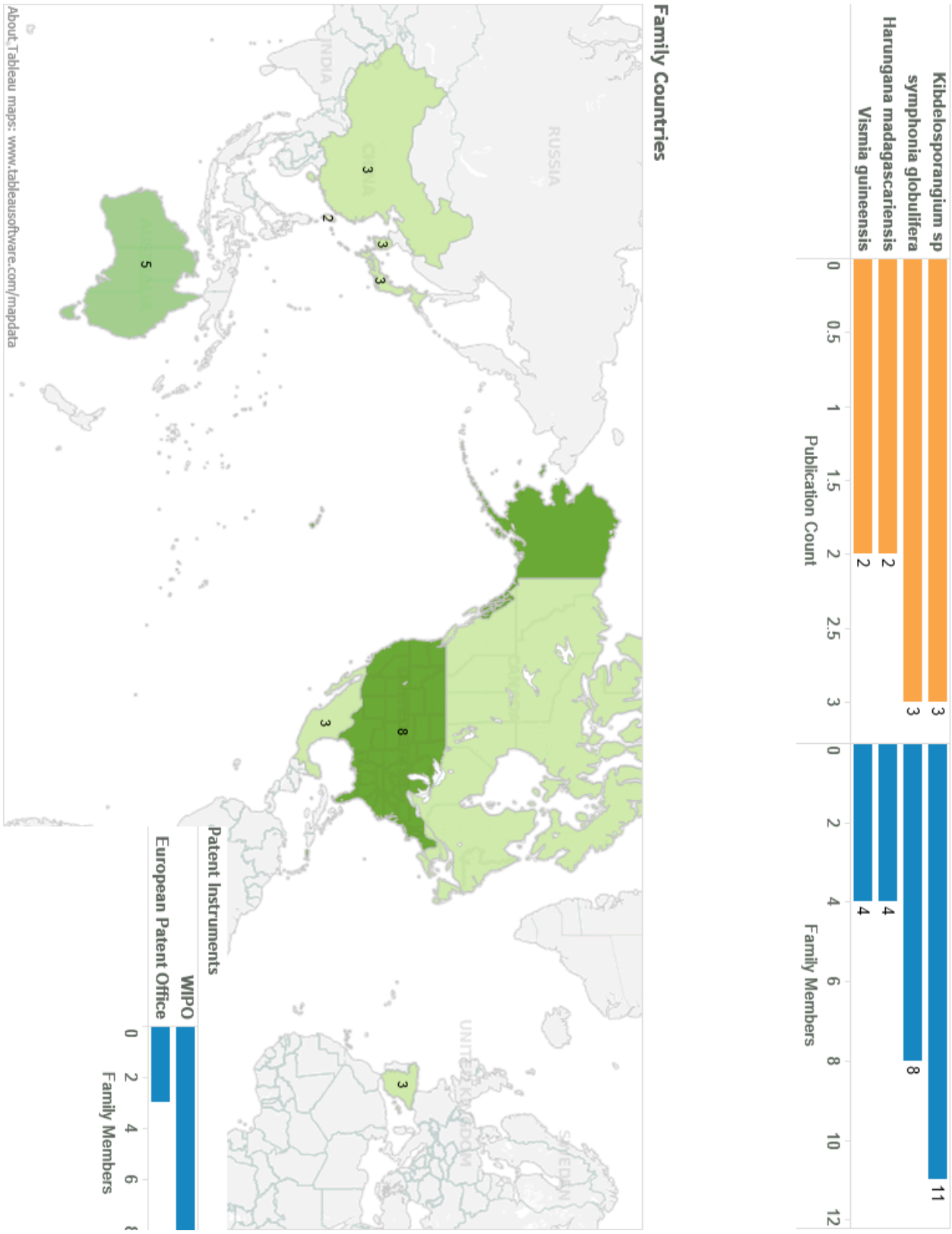
As this makes clear, while care is required in analysing why a particular species is referenced in a patent document, it is possible to trace the economic importance of particular patents to patent applicants using patent family data.

This type of analysis can 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 5 displays 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 5 is useful because it reveals what might be called the global reach or careers of species.

Analysis of this type is also useful because it exposes the markets where protection is being sought as provided in the Family Countries map. As we might expect the United States is a primary market with Mexico, China Japan and Australia also featuring prominently. Spain is the only European country to feature, due to Merck Sharp and Dohme having a Spanish division. It is also striking that available data suggests that patent applicants are not pursuing protection in African countries. 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 the Central African Republic.

Plate 5: Global Distribution of Family Members.



Concluding Remarks:

The research into biodiversity and patent activity featuring species originating from the Central African Republic has been notable by the paucity of references to collection from the country. No documents were identified which referred to species where the available data suggests that said species is endemic to the country. Therefore the analysis was restricted to documents which contained reference to a species known to be distributed in the Central African Republic and also referred to the country name. In the cases of the species identified as being of relevance to the Central African Republic this relevance was due to references made to traditional knowledge and of plant properties discovered in species first collected from the Central African Republic.

The Central African Republic is a land-locked country with limited infrastructure, dominated by savannah with a small area of forest in the south west. The savannah biomes extend across central and western Africa and also across much of the continent south of the equator. Similarly, the forest area is a small corner of the vast area of tropical rainforest which spreads from the Gulf of Guinea and across the Congo. The relatively low number of species recorded in data held by GBIF suggests that insufficient records are available to build a complete picture of the true diversity that exists, but it is likely to share much biodiversity with neighbouring countries. The reasons for the lack of activity in the patent record can only be a matter of speculation in the context of this report. Political and social unrest in recent decades and the relative ease of accessibility to other countries from which collections of species could be made may have contributed to the lack of focus on biodiversity in the Central African Republic. This does not mean that biodiversity and traditional knowledge in the Central African Republic is unimportant. Nor do these findings signify that biodiversity and traditional knowledge in the Central African Republic are not relevant to research and development. Instead, it implies that based on available evidence there is very little reason to be concerned about biopiracy and that experience in other African countries could usefully inform policy development in the Central African Republic in developing capacity in access and benefit-sharing.

The purpose of this report has been to highlight the existing and potential role of species of relevance to the Central African Republic for economic development in support of conservation. We would emphasise that our aim has not been to identify cases of biopiracy or misappropriation. In addition, the aim of the research was not to identify the complete portfolio of patent activity for a particular species or genetic resource. We have focused on those patent documents that make direct reference to the Central African Republic or where distribution data suggests that the country is a likely source.

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

Species Summary Tables

The following summary tables describe the species and patent activity involving the species. This data is based on known distribution of species where a named species has been identified as having been obtained from the country and, in the case of the Central African Republic, reference to traditional knowledge and use of that species:

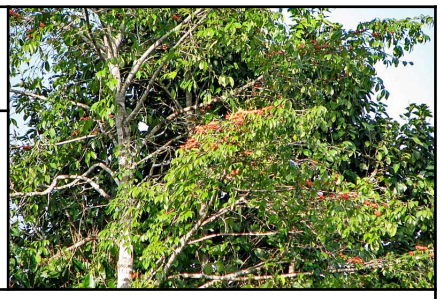
In reading these tables note that the number of documents refers to the number of documents retained during research on the origin of species of relevance to the country. It does not refer to the wider patent landscape for the species consisting of the total number of documents making reference to the species, or its components, in the global patent system.

Species may appear in patent documents in this list for a variety of reasons:

1. Because they are a focus of the invention;
2. Because they are a target of the invention (i.e. pathogens);
3. Because they are incorporated into the claims of the invention;
4. Because a reference to a species, including in very limited cases a literature reference, indicates that the species is of potential interest for economic development and merits further investigation.

This report focuses on identifying species that are of potential interest for economic development and conservation based on their appearance in patent data. The data in this summary section should not be used to draw conclusions about misappropriation or biopiracy.

Species name: *Harungana madagascariensis*	Kingdom: Plantae	
Brief description of species: Harungana madagascariensis is a species of flowering plants in the family Hypericaceae and the sole member of the genus. It has many medicinal uses.		
Distribution: Cosmopolitan	No of documents: 2	
US5837255A; WO1998025639A1		
Detail: Hypoglycemic agent extracted from Harungana used in a treatment for diabetes. This plant has traditional medical uses in Central African Republic.		

Species name: *Symphonia globulifera*	Kingdom: Plantae	
Brief description of species: Symphonia globulifera is a timber tree native to Central America, South America and Africa. This plant is also used as a medicinal plant as it is a source of guttiferone		
Distribution: Cosmopolitan	No of documents: 3	
WO2008082646A2; WO2008119070A1; US2010210692A1		
Detail: WO2008082646A2: WO2008119070A1, US2010210692A1: Methods of treatment of disorders using SIR1 modulators and compositions containing SIRT1 modulators		

Species name: *Kibdelosporangium sp.*	Kingdom: Bacteria	
Brief description of species: A recently described genus of bacteria originally collected from a soil sample from Central African Republic		
Distribution: Uncertain	No of documents: 3	
WO2011079034A1 CN102781935A CA2780357A120110630		
Detail: Compounds derived from Kibdelosporangium sp. used as an antibacterial agent.		

Image Credits

Harungana madagascariensis - Bart Wursten 140420-1.jpg
Symphonia globulifera - Alex Popovkin Symphonia_globulifera_L._f.jpg

Appendix 1

Distribution map of GBIF records in Central African Republic coloured by taxonomic kingdom.