Biodiversity In The Patent System:

A country study of biodiversity, genetic resources and global patent activity for the Democratic Republic of Congo

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Introduction

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

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

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 Democratic Republic of Congo. 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 from the United States, the European Patent Office and the international Patent Cooperation Treaty in the period 1976-2010. We also conducted additional research on patent activity for Zaire as an historic name for the Democratic Republic of Congo. As such the report provides a baseline for patent activity involving species from The Democratic Republic of Congo as a basis for further research.

Our research focused primarily on documents that make reference to The Democratic Republic of Congo and to cases where existing distribution data suggests The Democratic Republic of Congo 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 (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.

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. Georeferenced 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.

Democratic Republic of Congo

Area:
2,344,858 sq. km.
Coastline:
37 km.
Climate:
Tropical; hot and humid in equatorial river basin; cooler and drier in southern highlands; cooler and wetter in eastern highlands.
Geography:
Vast central basin is a low-lying plateau; mountains in east. Straddles equator; has narrow strip of land that controls the lower Congo River and is only outlet to South Atlantic Ocean; dense tropical rain forest in central river basin and eastern highlands.

Biodiversity in the Democratic Republic of Congo 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 Democratic Republic of Congo (DRC). 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 12,080 species for the DRC with 182,601 georeferenced coordinates for the occurrences of these species in the DRC.

We identified a total of 169,975 documents containing species known to be distributed in the Democratic Republic of Congo. Of these, 18 made some form of reference to the Democratic Republic of Congo. These documents were manually reviewed in MAXQDA software to identify documents specifying a source or origin in the DRC.

The 18 documents that made a specific reference to the DRC contained 6 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 DRC.

In addition, using GBIF distribution data we identified 13 species where GBIF presently records distribution only in the DRC. These species appeared in 27 patent documents where the Democratic Republic of Congo 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 DRC and thus be regarded as a species of likely or potential

significance for the country. For the sake of simplicity we call this data ‘Distribution 1’. These documents were then selected for further review.

The Democratic Republic of Congo has undergone a number of name changes during its recent history. Between 1971 and 1997 it was known as Zaire. This period includes years covered by this report, therefore a further document search was undertaken. We identified 2,315 patent documents that referred to Zaire. 194 documents were identified which contained references to Zaire and to one or more species known to be distributed in the country. These documents were manually reviewed using MAXQDA data analysis software to identify documents specifying a source in Zaire and the results combined with data for the DRC.

Biodiversity and Distribution

Much of the data submitted to GBIF includes geographical coordinates indicating where the recorded species was located. A total of 182,601 coordinates were available for the DRC. Using this data we are able to show the physical distribution across the DRC 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 Tanye Nature Reserve in the east and the centrally located Parc National De La Salonga-Sud - 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.

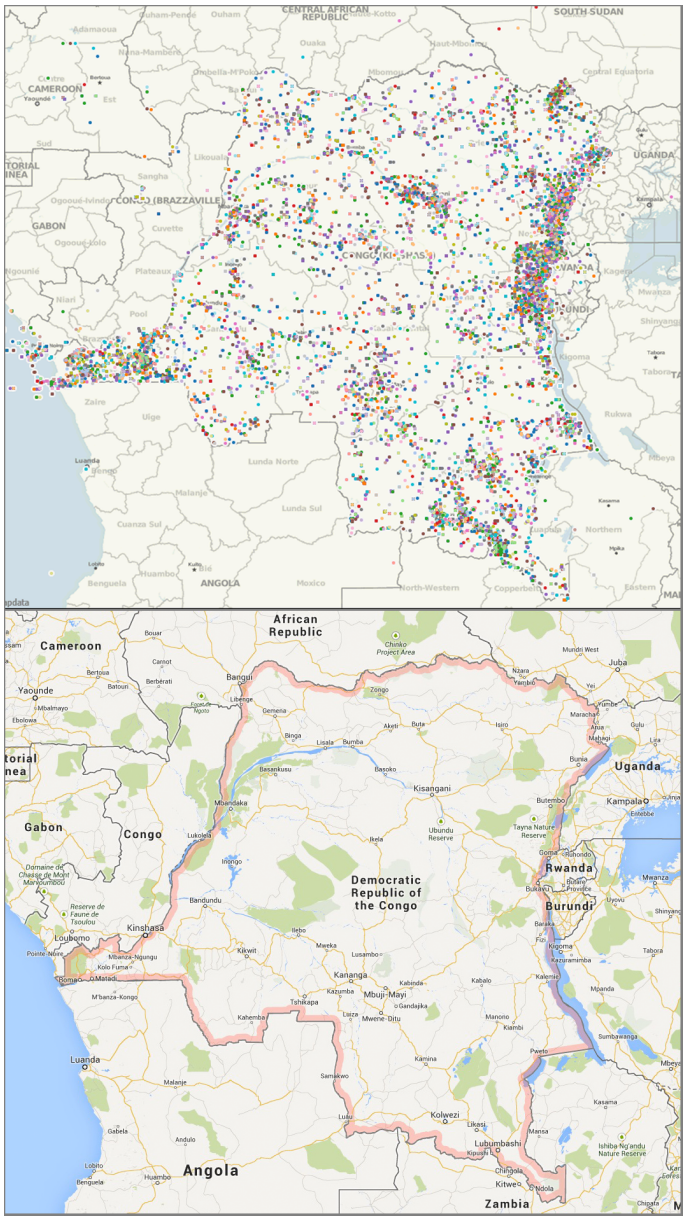


Plate1: Distribution of GBIF records from The DRC (upper) and major settlements and roads (lower) (map courtesy of Google Maps). Each colour point represents a species record coloured by kingdom.

In comparing the two maps it can be seen that there are distinct clusters of georeferenced records. The most striking of these is the dense group of records in the east close to the borders with Uganda and Rwanda. Another dense cluster can be seen in the west around Kinshasa and the lower reaches of the River Congo. Across the remainder of the country the records appear scarce and widely spread following the routes of major roads, with denser areas around population centres and some of the conservation regions. In the hinterland the recording appears to be quite sparse. This pattern of records and the relative scarcity of georeferenced locations in the hinterland suggest that the country has further potential for recording to build an accurate picture of biodiversity and distribution. Despite the large heavily recorded clusters, much of the country remains free of georeferenced records. 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 DRC.

GBIF presently records 13,032 species known to be present in the DRC (this figure includes unresolved names, hence the increase in species from the number quoted above). This list is dominated by plants with 6,439 records and animals with 6,069 species. Protozoa, fungi, bacteria and chromista are well represented with 522 species which suggests that a high degree of recording has been undertaken.

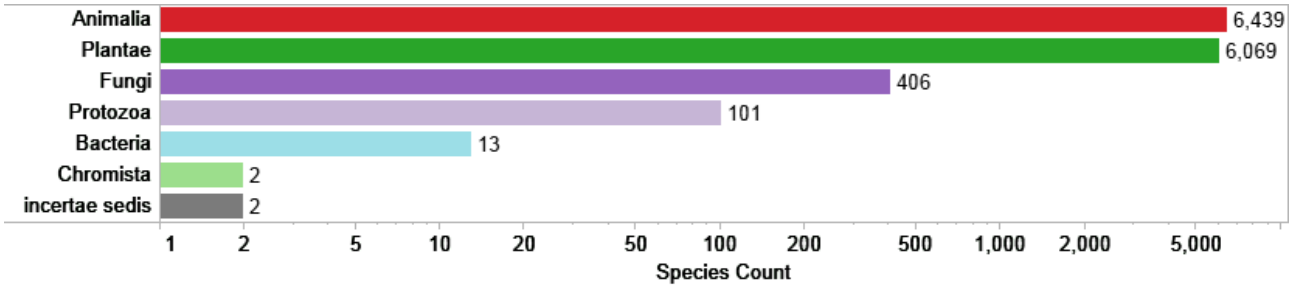


Table 1: Showing the number of species in The DRC by kingdom using GBIF data.

Using global data it is possible to examine the wider distribution of the Congolese 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 DRC in a particular kingdom. It can be seen that a substantial number of species have a wide regional distribution along the southern coast of West Africa countries. Throughout the rest of sub-Saharan Africa, particularly the tropical countries, there is also shared biodiversity. A smaller number have global distributions, although it should be noted that some of these global records may originate from research institutions or collections and therefore do not represent native or naturalised distribution.

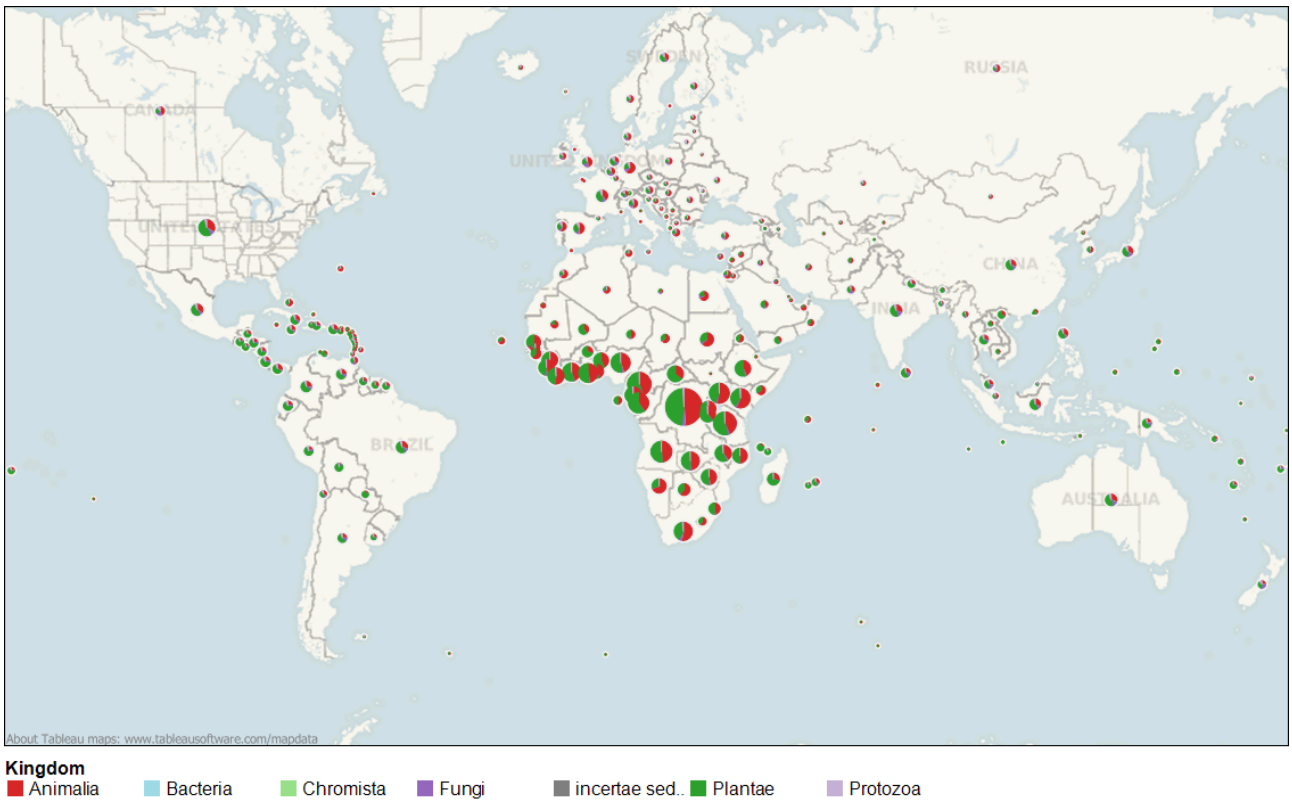


Plate 2: Global distribution of species from the DRC shown by Kingdom and the number of species recorded in GBIF.

Biodiversity in The Democratic Republic of Congo in the Patent System

As of 2013 a total of 1,784 patent documents in the main patent jurisdictions (European Patent Office, the United States, and the Patent Cooperation Treaty) specifically mention the DRC. This provides a general overview of references to the DRC 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 DRC. In addition, patent applicants will make reference to species that originate from the DRC but will not mention the DRC 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 DRC. 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 DRC. In approaching patent activity for genetic resources from the DRC we focus on three categories of data.

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

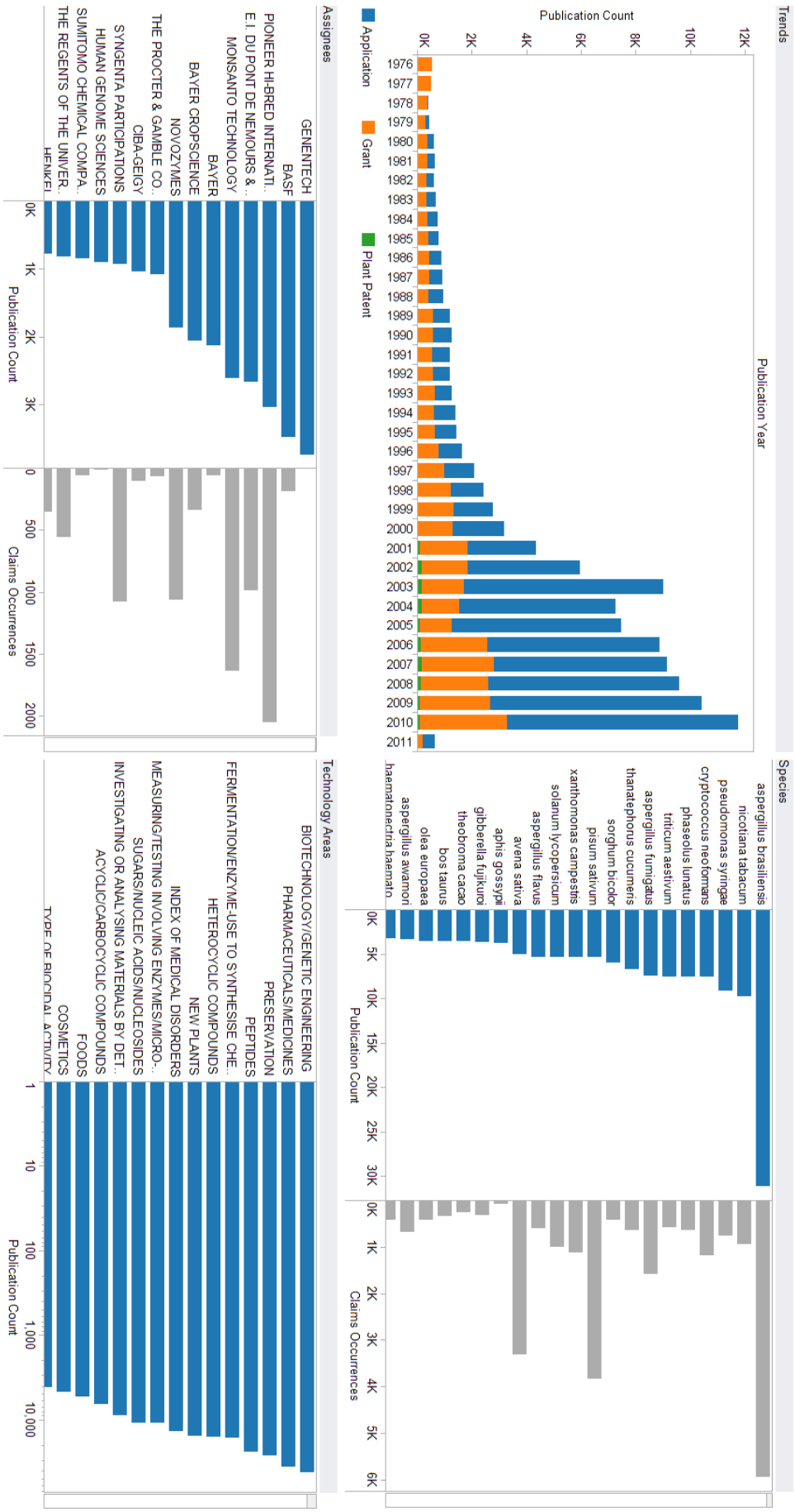
We begin our analysis with an overview of biodiversity that is known to occur in the DRC in the patent system and then turn to data on species originating from the DRC.

The DRC 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 DRC 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 DRC, top applicants or assignees and technology areas.

In total we identified approximately 2,103 species names in patent data from the major jurisdictions that are known to occur in the DRC. When model organisms including crops such as *Zea mays* (maize) and *Homo sapiens* are excluded this falls to 2,057 species names and 1,518 accepted scientific names.[3] This data is relevant for the DRC because it demonstrates that researchers and companies are conducting research and development on species that are known to occur in the DRC. 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.

[3] The 1518 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.

Plate 3: Overview of patent activity featuring species occurring in the Democratic Republic of Congo.



The top species of relevance to the DRC in global patent data include species used in biotechnology such as *Aspergillus brasiliensis* (formerly *Aspergillus niger*) and *Aspergillus awamori*. In total we identified 805 plant names in global data of relevance to the DRC with crops represented by species including cocoa (*Theobroma cacao*), beans (*Phaseolus lunatus*), peas (*Pisum sativum*), tomato (*Solanum lycopersicum*), cereals (*Sorghum spp, Avena sativa* and *Triticum aestivum*), the olive tree (*Olea europaea*) and tobacco (*Nicotiana tabacum*). Other species include the plant pathogens *Pseudomonas syringae, Xanthomonas campestris, Aspergillus flavus, Gibberella fujikuroi* and *Thanatephorus cucumeris* and the infectious fungi *Cryptococcus neoformans* and *Aspergillus fumigatus.* Insects are represented by the cotton aphid (*Aphis gossypii*) which is a serious plant pest. Cattle (*Bos taurus*) is the only livestock species which appears on the list of top species - cattle are often seen in documents relating to animal diseases.

As can be seen, this list is dominated by agricultural species and crop pathogens as well as infectious fungi.

The assignees in the overall data for species of relevance to the DRC 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 Human Genome Sciences. Also, companies which develop new crops such as Monsanto and Syngenta feature prominently. Domestic and industrial chemical products are represented by Henkel and Sumitomo as well as Procter and Gamble. As this makes clear, there are a wide range of general and specialised technology areas and markets of relevance to biodiversity from the DRC. 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 DRC or where distribution data suggests that the DRC is the likely source.

Species from The Democratic Republic of Congo in Patent Data:

In total we identified five species of organism that potentially originated from the DRC, these are shown in Plate 4. In the next section a summary is provided for these 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, five species appear in the data compared with the overview provided in Plate 3. The species with most publications is *Acetogenium kivui.* This is a thermophilic and anaerobic bacteria which was originally isolated from Lake Kivu. The chemicals company INEOS Europe Ltd et al (WO2009112335A1 and 6 others) developed a process for production of alcohols using a fermentation process which utilised bacteria including *Acetogenium kivui.*

Corynanthe pachyceras is a Central African tree which has bark containing an alkaloid known as yohimbine that is used in some herbal remedies. Schwabe Willmar GMBH & Co have claimed an extract from the bark and also its use as a treatment for a number of medical conditions (WO2007054269A2, US2009142428A1).

The species *Harungana madagascariensis* is 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. Although there is no specific claim that the plant used for this particular invention was collected or otherwise sourced from the DRC, the patent description makes reference to traditional knowledge from the DRC thus: "...in Zaire (DRC), the Kote culture macerate bark and bathe with it to treat scabies, and bark and root decoctions are administered to treat bleeding hemorrhoids and dysentery, and the Turumba culture treat anemia by bathing in a leaf infusion dripping leaf juice onto the eye. The Mbuti pygmy culture from the Lolwa river in the Ituri forest of Northeast Zaire utilize the bark for abdominal problems, skin rash, and eczema".

Uvaria brevistipitata is a species of flowering plant from a genus for which there are 37 resolved species names, however *U. brevistipitata* is an unresolved name and it is unclear which resolved species name should be applied. CSSAHA Inc (US5607673A & WO1998006413A1) claim an extract derived from the plant and its use in the treatment of HIV infected patients.

Finally, *Pan paniscus* is an ape, commonly known as the bonobo, endemic to the forests of the DRC, and considered to be the closest relative to *Homo sapiens*. The Government of the United States of America et al claimed in WO1995029240A1 "The isolation and characterization of a novel primate T-cell lymphotropic virus designated STLVpan-p…" The virus was isolated from bonobo females from zoological collections in the USA that were born wild in the DRC (Zaire). This case is included to illustrate the difficulties which can be encountered in identifying the source of genetic materials, as the genetic viral material was isolated in the USA from animals which had originated from the DRC.

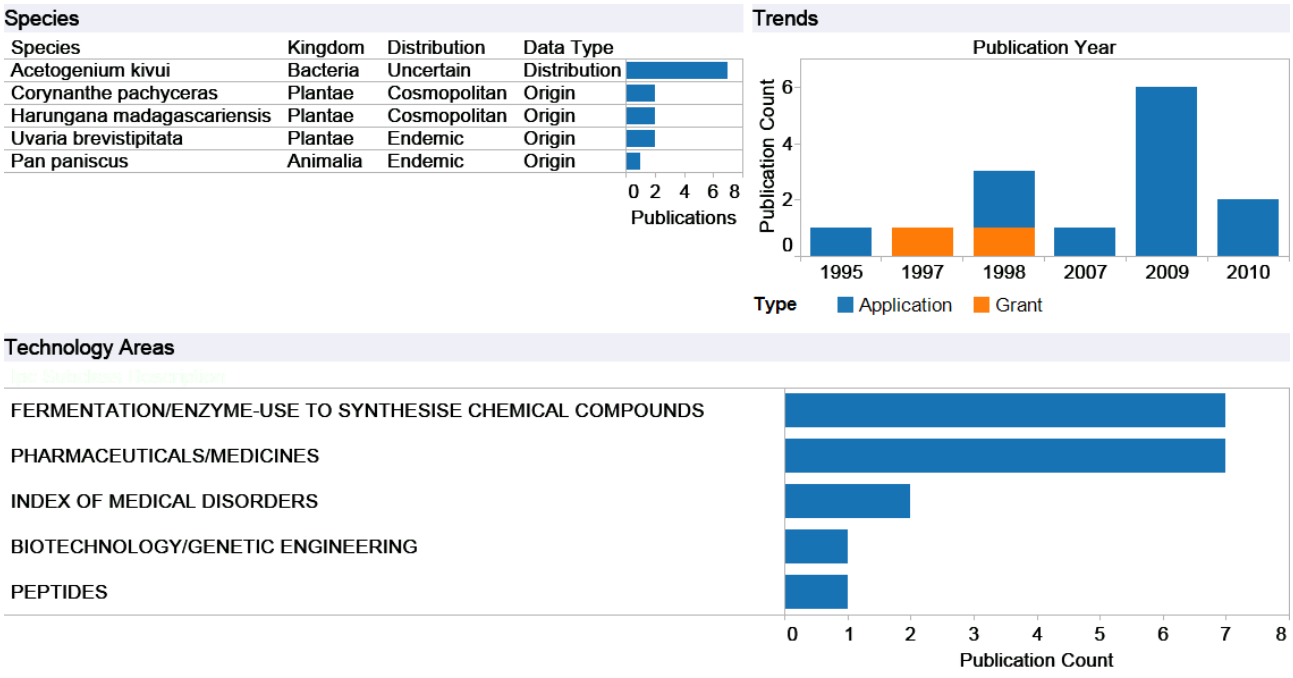


Plate 4: Species from The Democratic Republic of Congo.

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 focusing 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.

Despite the small amount of evidence of biological resources sourced from the country it should be noted that the DRC has substantial portfolios of both recorded biodiversity and species that appear in patents as can be seen in Table 1 and Plates 2 & 3. It is important to emphasise that species may be involved in research and development in different areas of science and technology and may serve different markets. In some cases a species may be the target of a particular invention. In other cases a patent may suggest potential uses of a particular organism while in others, the species will be the direct focus of the claimed invention. We now turn to more detailed analysis of the technology areas involving species relevant to the DRC.

Technology Areas:

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

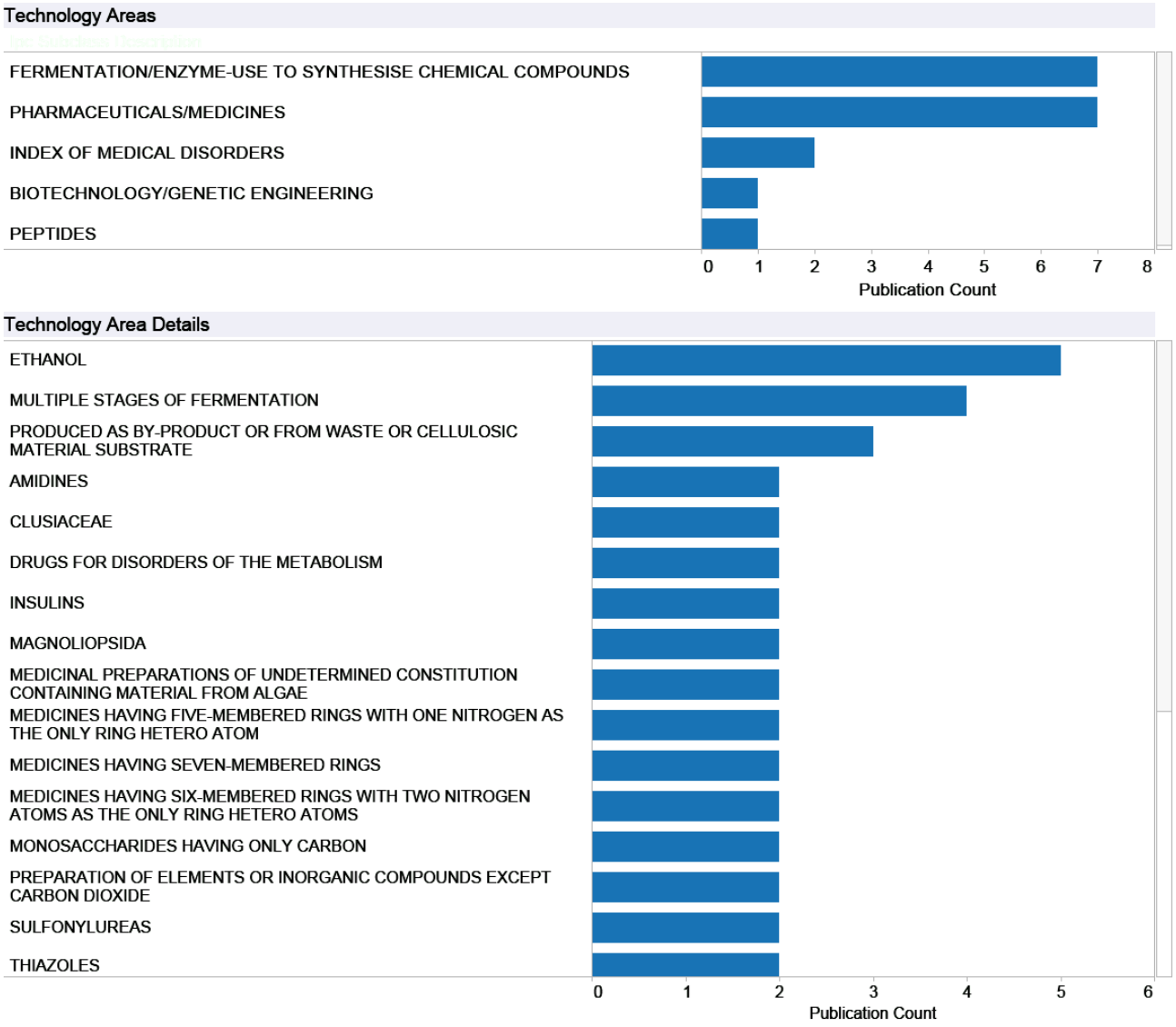


Table 2: Technology Areas.

The general overview of technology areas provided in Plate 3 emphasises fermentation/ enzyme use to synthesise chemical compounds. Pharmaceuticals and medicines are also prominent. Given the very small sample of documents it is unsurprising that this pattern is confirmed.

Patent activity for fermentation processes involves the species *Thermoanaerobacter kivui* in the production of alcohols Other species are used in the development of pharmaceuticals and medicines include *Uvaria brevistipitata* from which extracts are taken and administered, and *Corynanthe pachyceras,* a plant with traditional uses to treat impotence, from which an extract is prepared to treat various conditions including urinary tract disorders. Table 3 illustrates this breakdown of technology areas by species.

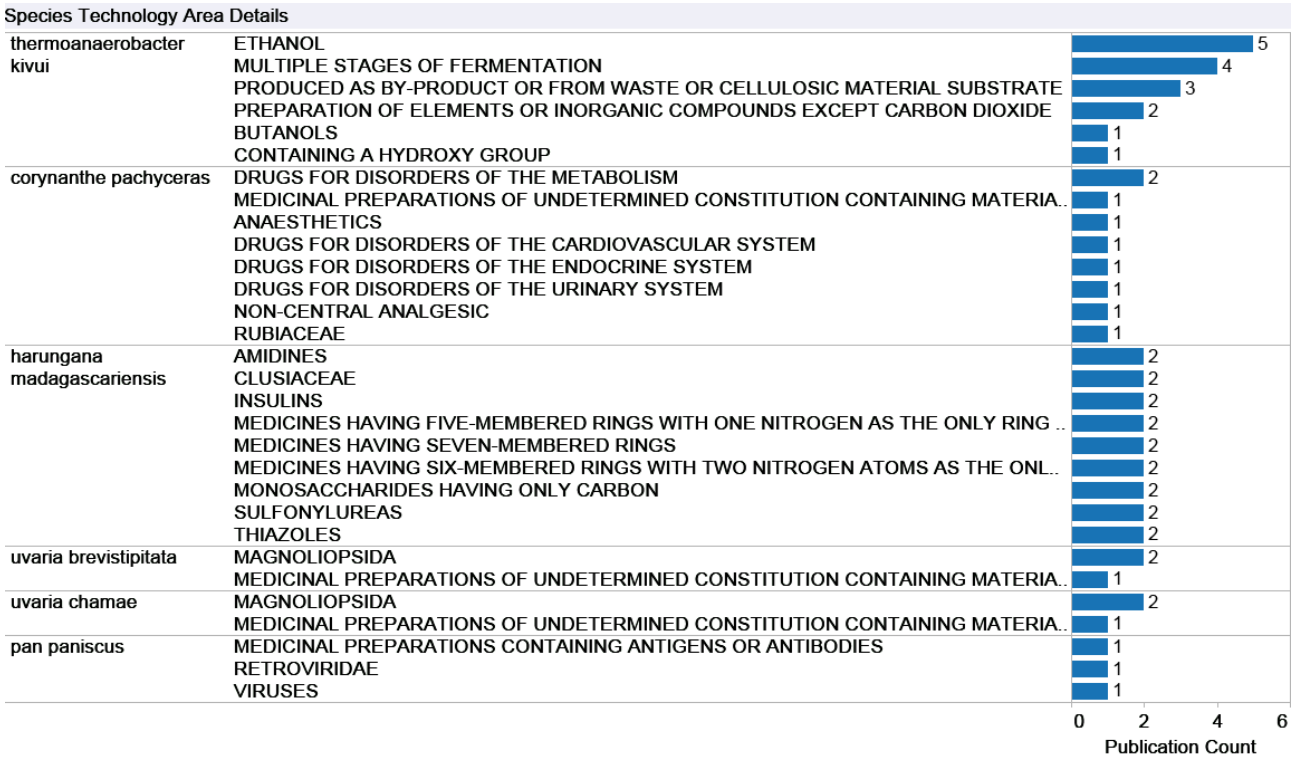


Table 3: Species Technical Areas.

Table 3 usefully reveals the range of potential applications and technology areas where a species and its components may be deployed. As such, a 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).

The first class of patent claims 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.

A prominent example of this type of claim can be found in WO2007054269A2 (Schwabe Willmar GMBH & Co) in which what is claimed is “an extract from the bark of corynanthe pachyceras having a content of polyphenols and alkaloids”. The same claim then proceeds to state that the extract is obtainable from a process comprising a number of defined steps. In the same document Claim 22 is for “a method for treating a subject suffering from or susceptible to a disease of the lower urinary tract, sexual disorder, lipid metabolism disorder, cardiovascular disease and/or acute and/or chronic pain condition, the method comprising: administering an effective amount of an extract of claim 1 to the subject”. As can be seen from this example, the *primary* claim is for a composition of matter in the form of the plant extract, but the claim is also for the process of preparation. The document also claims a method of administering the extract to patients suffering from various ailments.

Claim 22 in the above example is 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. Where the patent claims begin with the term “A method” or “Methods for” 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.

Patent activity that involves claims to a process or processes are similar to methods claims. Typically, these claims focus on the process for producing or manufacturing a desired product (such as a chemical, a cosmetic or beverage). It is the process itself that is the focus of the invention. For example, in connection with ethanol and alcohol production, INEOS claims “A process for the production of ethanol, said process comprising: a) passing a biomass feedstock to a first fermentation step wherein it is subjected to anaerobic fermentation at a pH below 6.0 and at a temperature in the range 20 to 70<0>C to convert the biomass to a solution comprising acetic acid as the predominant product, b) passing a gasifiable feedstock to a gasification step wherein it is subjected to gasification to produce a gaseous mixture comprising carbon monoxide and hydrogen, and c) passing the solution comprising acetic acid from step (a) and the gaseous mixture from step (b) to one or more further fermentation steps wherein they are subject to fermentation to produce ethanol.” (WO2009112334A1).

Finally, one feature of patent activity involving species that originate from, or are distributed in, the DRC is the appearance of species names in long lists of species, genera or families of organisms rather than evidence of the direct collection of an organism or sample in the country. This is characteristic of many patent applications involving species from African countries but is unlikely to be particular to Africa. The purpose of these references can be described as incorporation of the referenced species, genus or family

into the scope of the patent claims. In the above example by INEOS, the description states that “examples of suitable solventogenic bacteria which may be used include *Acetogenium kivui, Acetobacterium woodii, Acetoanaerobium noterae, Clostridium aceticum, Butyribacterium methylotwphicum, Clostridium acetobutylicum, Clostridium thermoaceticum*” and so on. As we have suggested above, incorporation can provide useful clues on the potential properties and uses of organisms. The purpose of incorporation, from a patent lawyer’s perspective, is likely to be defensive. However, it is important to recognise the uncertainties and restrictions that essential incorporation of species, genera and families of organisms into patent claims may impose on producers from countries of origin in accessing markets.

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 DRC. 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 4 displays the citation scores by species and assignee for species relevant to the DRC. 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 being 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 DRC, Table 4 reveals the citation scores for species of relevance to the DRC organised by species and assignee. The top cited species is *Uvaria brevistipitata* which has received six citations from two documents. *Harungana madagascariensis* has received two citations from two documents. Both of these citation lists are rather small which suggests that the impact of the original work has been rather limited. The

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

documents featuring other species however have not received any citations at all, and this suggests that to date work on these inventions has not been of wider interest.[5]

Patent Assignees	Species	Citing Patent Count
C.S.S.A.H.A.	uvaria brevistipitata	5
	uvaria chamae	5
SHAMAN PHARMACEUTICALS	harungana madagascariensis	2
DR. WILLMAR SCHWABE & COMPANY	corynanthe pachyceras	0
INEOS EUROPE	acetogenium kivui	0
THE GOVERNMENT OF THE UNITED S..	pan paniscus	0
WILSON, DON, D.	uvaria brevistipitata	0
	uvaria chamae	0

Table 4: Species and Assignee Citing Patents.

A second measure of the importance of patents is provided by the size of patent families. Table 5 shows the 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 INEOS, focusing on a process for producing alcohol through fermentation of feedstocks (US2010105118A1 EP2123766A1 EP2017346A1 and four others), has a family size of 32, and this reflects a considerable investment and confidence in the value of their work. The second ranked family size is 12 from two documents (WO2007054269A2 US2009142428A1 Schwabe Willmar GMBH & Co) featuring *Corynanthe pachyceras* as a treatment for a number of disorders including those of the urinary tract collecting system, sexual disorders, lipid metabolism disorders, cardiovascular diseases, and acute and chronic pain, which reflects the company’s investment in phytomedicines. As such, this example provides an indicator of the potential uses and importance of such organisms in innovation.

[5] Table 4 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.

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

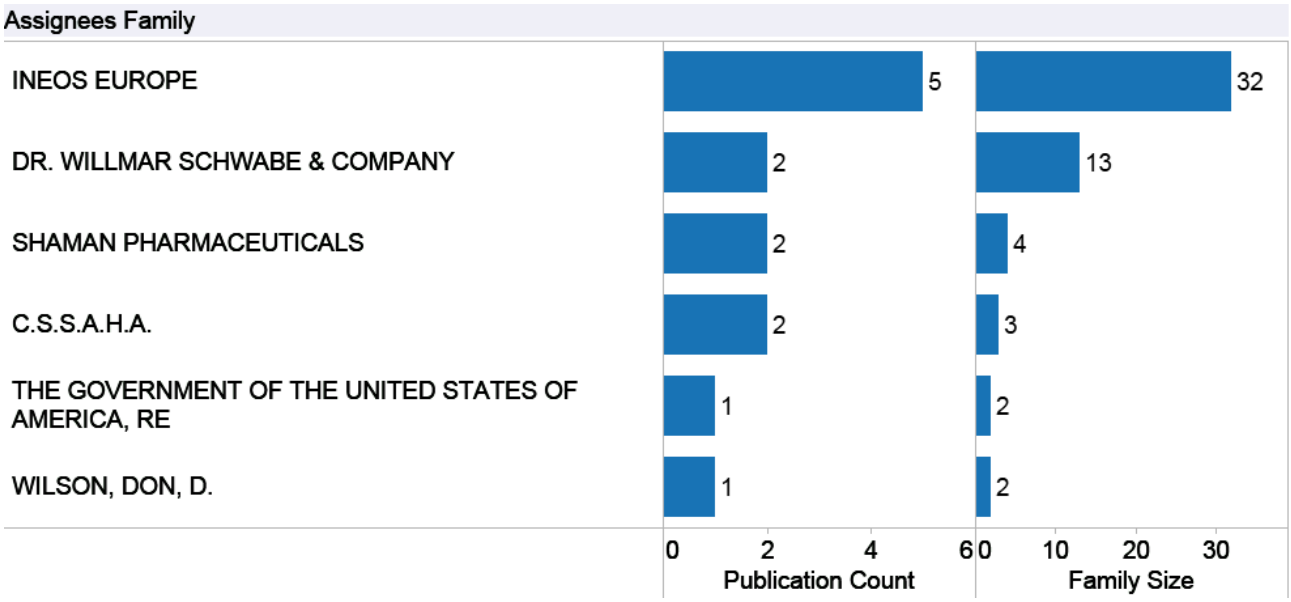


Table 5: Patent Assignees and Patent Families.

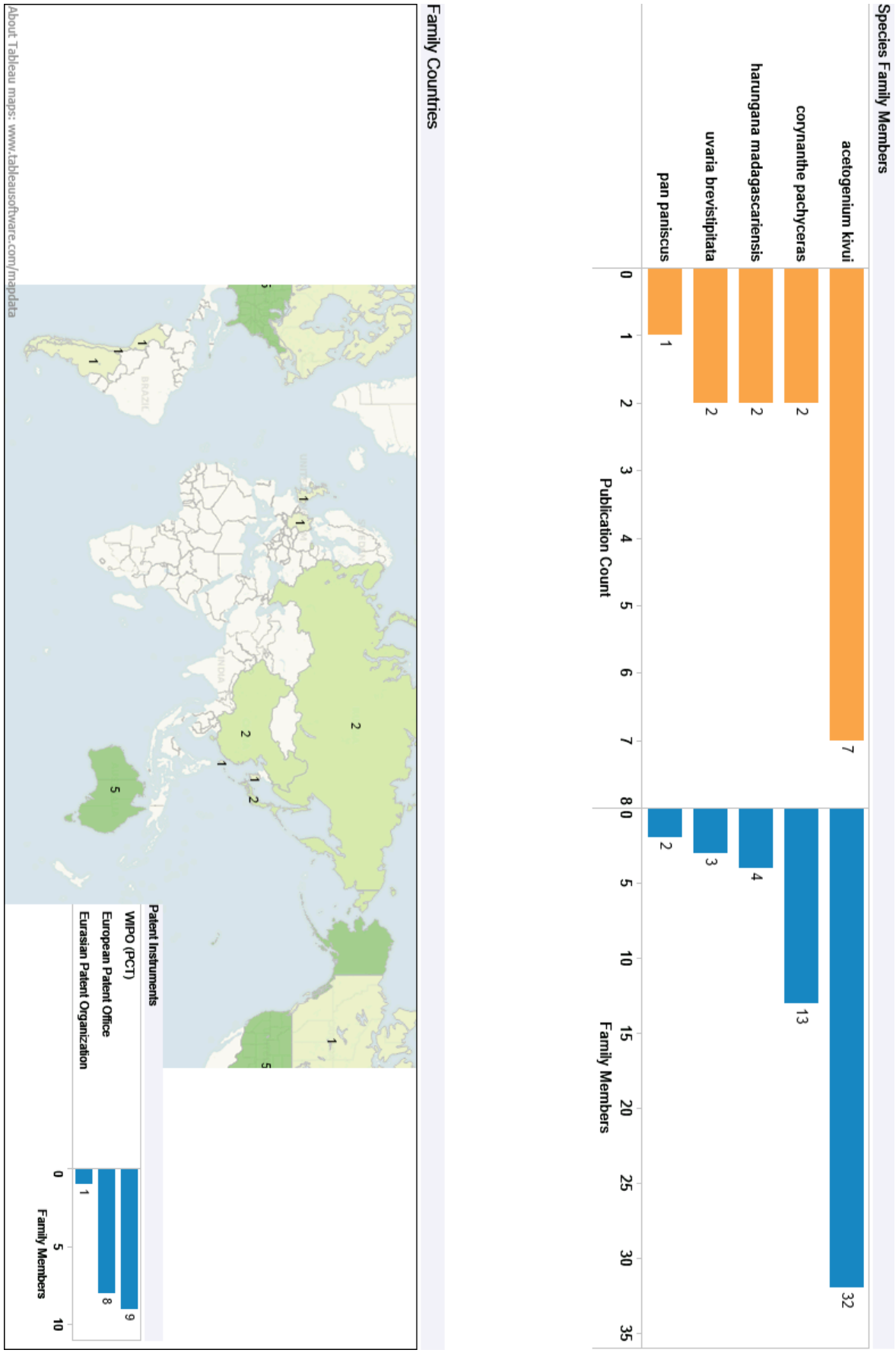
As this makes clear, while care is required in analysing why a particular species is referenced in a patent document, it is possible to trace the economic importance of particular patents to patent applicants using patent family data.

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. We can immediately see the prominence of *Acetogenium kivui* and *Corynanthe pachyceras* in this data.

Analysis of this type is also useful because it exposes the markets where protection is being sought as provided in the Family Countries map. It is quickly clear that the dominant markets for species potentially originating from the Democratic Republic of Congo are the United States of America and Australia. 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 Democratic Republic of Congo.

Plate 5: Global distribution of family members.



Concluding Remarks:

The research into biodiversity and patent activity featuring species originating from the Democratic Republic of Congo has been notable for the substantial number of records but low number of species identified where the available data suggests that the species was acquired from the country.

The DRC is one of the largest countries in Africa and is likely to share much of it's biodiversity with neighbouring countries such as Gabon and the Republic of Congo. The number of species, recorded in data held by GBIF, is high when compared to that of neighbouring countries, and yet, when the nature of the rich biological habitats which exist in the country are considered, the number could be expected to be far higher. This suggests that insufficient records are available to build a complete picture of the true diversity that exists in the country. The reasons for the relative lack of activity in the patent record can only be a matter of speculation. It may be that political upheavals and instability over recent decades has contributed to a lack of focus on Congolese biodiversity. This does not mean that biodiversity and traditional knowledge in the Democratic Republic of Congo is unimportant. Nor do these findings signify that biodiversity and traditional knowledge in the Democratic Republic of Congo 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 Democratic Republic of Congo 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 DRC 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 DRC and historic Zaire or where distribution data suggests that the DRC of historic Zaire 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 and, in the case of the DRC , 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 DRC. It does not refer to the wider patent landscape for the species consisting of the total of 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.

<table>
<tr><td>Species name:
Acetogenium kivui</td><td>Kingdom: Bacteria</td><td rowspan="2">No Image Available</td></tr>
<tr><td colspan="2">Brief description of species:
Originally thought to be a new genus, now reclassified as Thermoanaerobacter kivui. Members of this genus are thermophilic and anaerobic. Originally isolated from Lake Kivu.</td></tr>
<tr><td colspan="2">Distribution: Uncertain</td><td>No of documents: 7</td></tr>
<tr><td colspan="3">WO2009112335A1 WO2009112334A1 WO2009010347A2 US2010330640A1 US2010105118A1 EP2123766A1 EP2017346A1</td></tr>
<tr><td colspan="3">Detail: Used in the fermentation process for the production of C2+ alcohols, ethanol and butanol from methane containing biomass (feedstocks).</td></tr>
</table>

Species name: *Corynanthe pachyceras*	Kingdom: Plantae	
Brief description of species: A small tree of the Rubiaceae family also known as false Yohimbe. The bark is traditionally used to treat male impotence.		
Distribution: Cosmopolitan	No of documents: 2	
WO2007054269A2 US2009142428A1		
Detail: The invention relates to extracts from the bark of corynanthe pachyceras, and the use thereof for treating diseases of the urinary tract collecting system, sexual disorders, lipid metabolism disorders, cardiovascular diseases, and acute and chronic pain conditions and to preparations of the extracts.		

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 several African countries.		

Species name: *Uvaria brevistipitata*	Kingdom: Plantae	No Image Available
Brief description of species: Uvaria is a genus of flowers in the soursop family. U. brevistipitata is presently an unresolved species name.		
Distribution: Uncertain/endemic	No of documents: 2	
US5607673A WO1998006413A1		
Detail: Use of a substantially purified extract of a plant root from the family Annonaceae and the genus Uvaria wherein the species is brevistipitata for treating AIDS patients.		

Additional Species

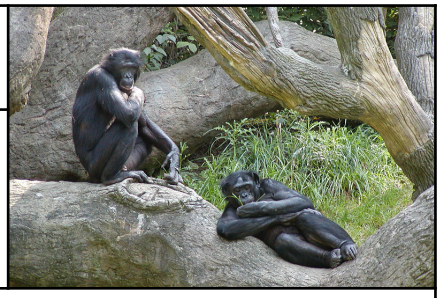
Species name: *Pan paniscus*	Kingdom: Animalia	
Brief description of species: The bonobo, a great ape which is found in the Congo Basin of the DRC. It is the closest known relative to Homo sapiens.		
Distribution: Endemic	No of documents: 1	
WO1995029240A1		
Detail: The isolation and characterization of a novel primate T-cell lymphotropic virus designated STLVpan-p is disclosed. The invention relates to the proviral DNA of this virus.		

Image Credits:

Harungana madagascariensis - Bart Wursten 140420-1.jpg
Corynanthe pachyceras Georg Zenker DAA8E866-26D0-451F-AE03-F4885040484E.jpg
Pan paniscus - Greg Hume 800px-Bonobo-04.jpg

Appendix 1

Distribution map of GBIF records in The Democratic Republic of Congo coloured by taxonomic kingdom.