



*Biodiversity In The Patent System:
A country study of biodiversity, genetic resources
and global patent activity for São Tomé and Príncipe*

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Introduction

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

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

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 São Tomé and Príncipe. 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. Additional research was performed to identify and review all patent documents making reference to São Tomé and Príncipe published anywhere in the world between 1900 and 2013. As such the report provides a baseline for patent activity involving species from São Tomé and Príncipe as a basis for further research.

Our research focused primarily on documents that make reference to São Tomé and Príncipe and to cases where existing distribution data suggests São Tomé and Príncipe is a likely source for the species. This imposes two limitations on the research. First, we focus on identifying species that are a focus of existing research and development. However, the report does not seek to provide the complete global patent landscape for an individual species. Second, because we focused on identifying species from a country we did not search patent data for references to regions (i.e. Africa) or sub-regions (i.e.

¹ ABSPAT is available at <http://www.abspat.net>

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.

São Tomé and Príncipe

Area:

964 sq. km.

Coastline:

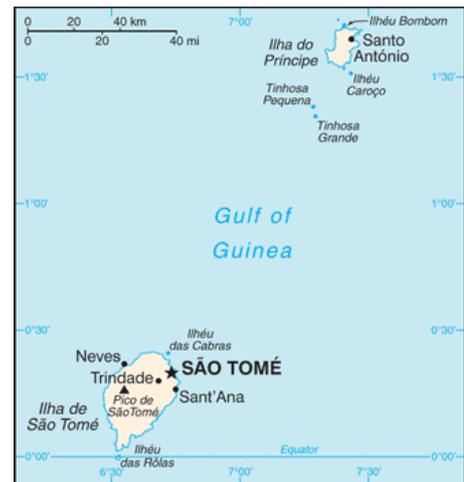
209 km

Climate:

Tropical; hot, humid; one rainy season (October to May)

Geography:

The smallest country in Africa; the two main islands form part of a chain of extinct volcanoes and both are mountainous. Largely rainforest with some savanna and mangroves.



Biodiversity in Sao Tome and Principe 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 São Tomé and Príncipe. 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 1,471 resolved species names for São Tomé and Príncipe with 11,353 georeferenced coordinates for the occurrences of these species in São Tomé and Príncipe.

We identified a total of 45,539 documents containing species known to be distributed in São Tomé and Príncipe. Of these, 10 made some form of reference to São Tomé and Príncipe. These documents were manually reviewed in MAXQDA software to identify documents specifying a source or origin in São Tomé and Príncipe.

The 10 documents that made a specific reference to São Tomé and Príncipe contained five 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 São Tomé and Príncipe.

In addition, using GBIF distribution data we carried out a search for species where GBIF presently records distribution only in São Tomé and Príncipe. However no such species appeared in the data. The idea behind this was to identify cases where a species (based

on available distribution data) was likely to have come from São Tomé and Príncipe and thus be regarded as a species of likely or potential significance for São Tomé and Príncipe.

Finally, we carried out an additional search across all global patent jurisdictions for any documents featuring both the country name São Tomé and Príncipe between 1900 and 2013. This search identified a raw 93 documents with 9 documents containing a species name 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 11,353 coordinates were available for São Tomé and Príncipe. Using this data we are able to show the physical distribution across São Tomé and Príncipe 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 Obo National Park on São Tomé and the Príncipe Ecological Zone - 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.

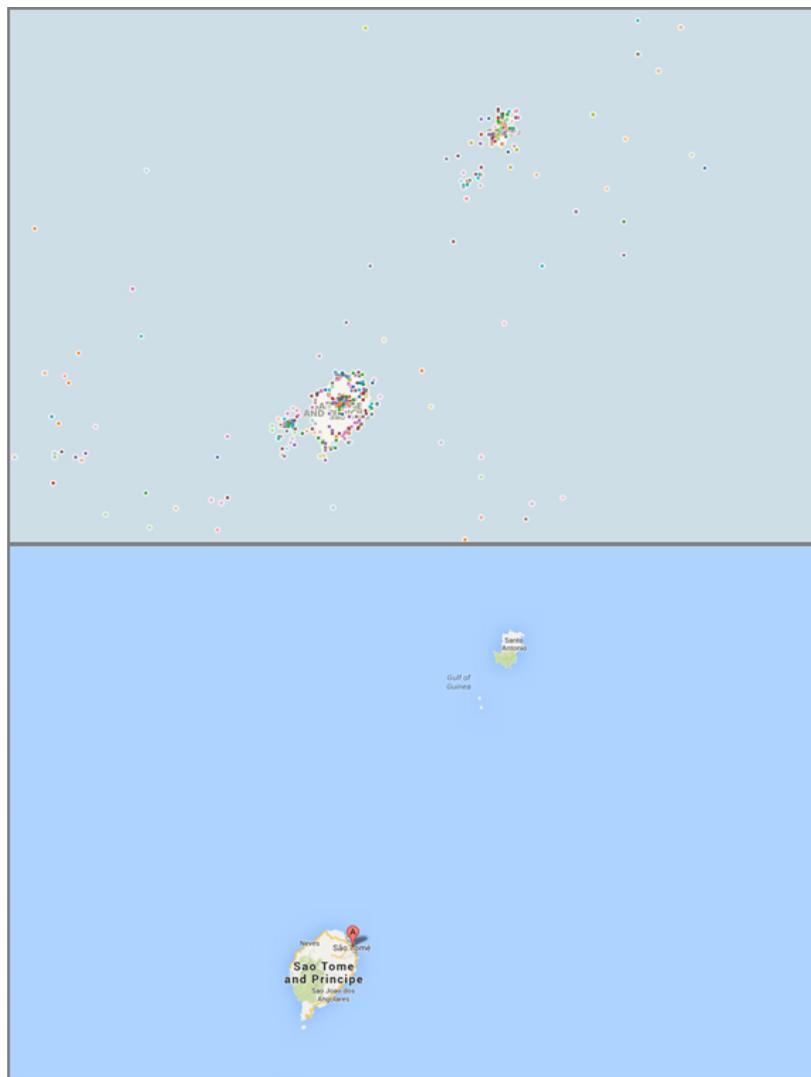


Plate 1: Distribution of GBIF records from São Tomé and Príncipe (upper) and major settlements and roads (lower) (map courtesy of Google Maps). Each colour point represents a species record coloured by kingdom.

It can be seen that the distribution data on São Tomé is concentrated along the coasts and the one main road which enters the island's interior from the city of São Tomé in the north. This type of distribution has been seen across Africa in georeferenced biodiversity records

as towns and transportation routes provide convenient access to biological sampling locations. There is also a cluster off the south west coast. This may be an indication of fishing grounds which can be a major source of data collection. Due to the small size of Príncipe, and the high density of records, it is unclear as to whether there is a pattern to the records. It should be noted that the number of georeferenced records is high. Another important observation is that there are records from the marine environment covering a substantial area of ocean around the islands. 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 São Tomé and Príncipe.

GBIF presently records 1,578 species known to be present in São Tomé and Príncipe (this figure includes unresolved names, hence the increase in species from the number quoted above). This list is dominated by plants and animals which account for 1,457 species as can be seen in Table 1. Other kingdoms are well represented. This, especially when considering the small size of the islands, suggests that recording and collection in São Tomé and Príncipe has been broad ranging despite the low overall number of species records.

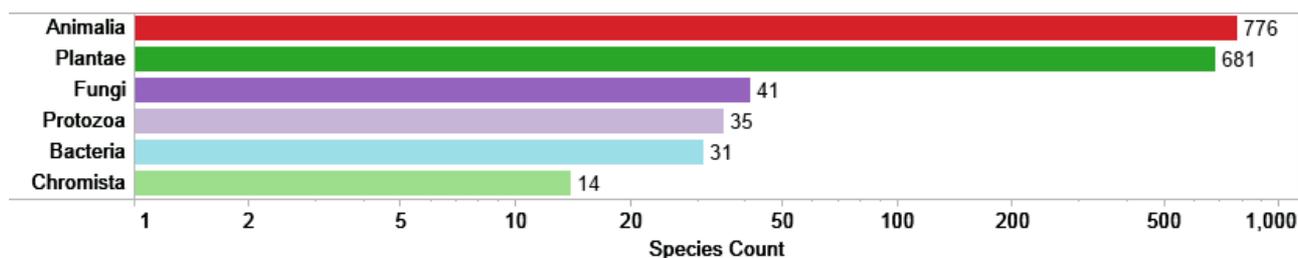


Table 1: Showing the number of species in São Tomé and Príncipe by kingdom using GBIF data.

Using global data it is possible to examine the wider distribution of São Tomé and Príncipe 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 São Tomé and Príncipe in a particular kingdom. It can be seen that a substantial number of species have a very wide regional distribution, particularly along the southern coast of west Africa. There are also clusters in the Caribbean and Central America. This suggests that many of the species may be marine as these species often have global natural distribution, 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.

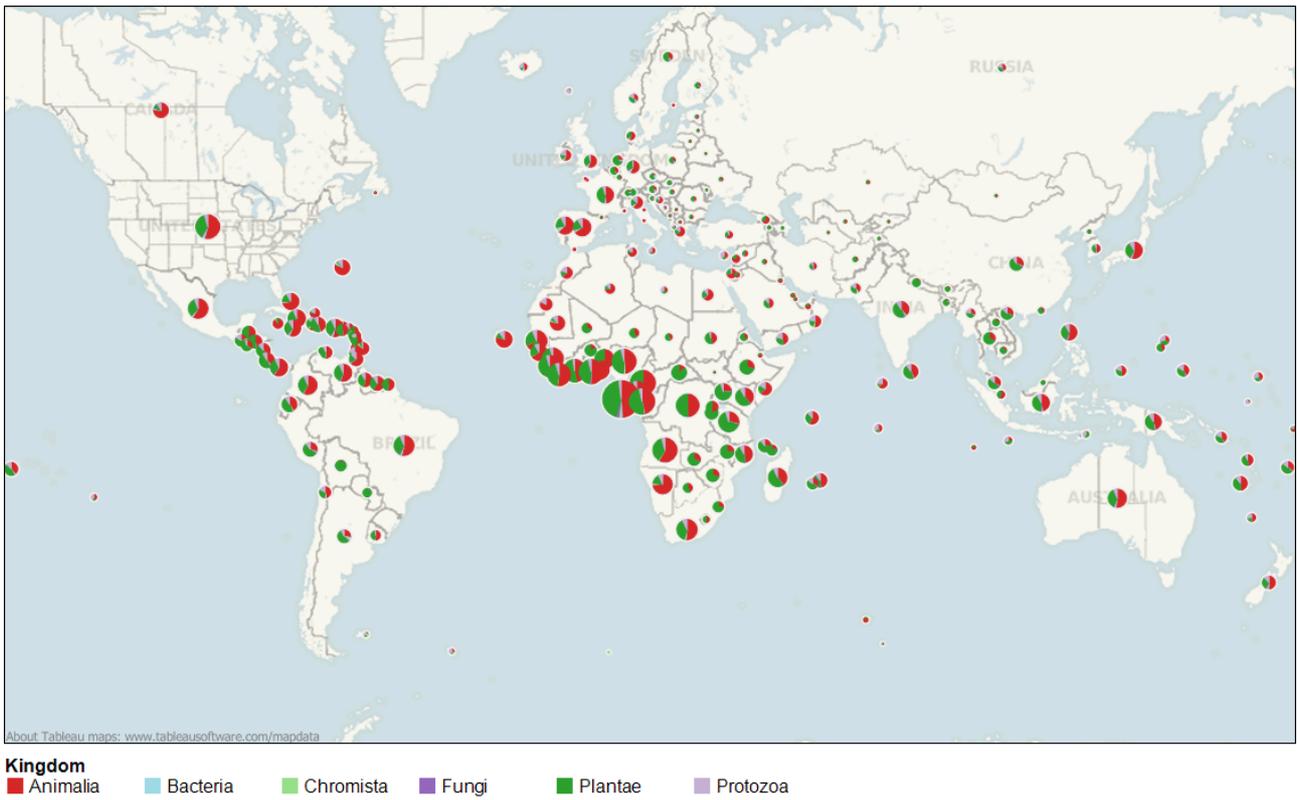


Plate 2: Global distribution of São Tomé and Príncipe species shown by kingdom and the number of species recorded in GBIF.

Biodiversity in São Tomé and Príncipe in the Patent System

As of 2013 a total of 80 patent documents in the main patent jurisdictions (European Patent Office, the United States, and the Patent Cooperation Treaty) specifically mention São Tomé and Príncipe. This provides a general overview of references to São Tomé and Príncipe 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, São Tomé and Príncipe. In addition, patent applicants will make reference to species that originate from São Tomé and Príncipe but will not mention São Tomé and Príncipe 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 São Tomé and Príncipe. 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 São Tomé and Príncipe. In approaching patent activity for genetic resources from São Tomé and Príncipe we focus on three categories of data.

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

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

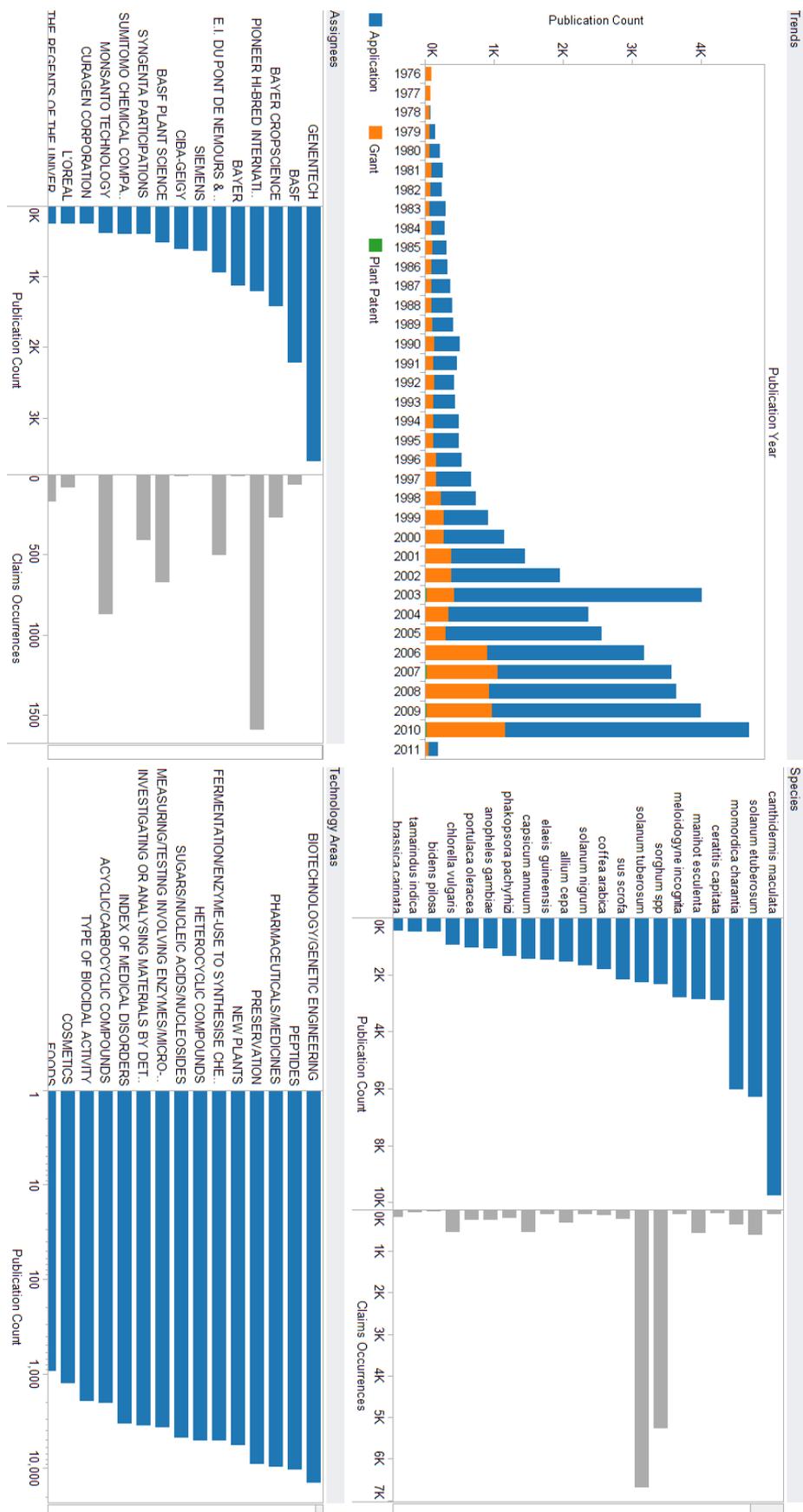
São Tomé and Príncipe shares a significant proportion of its known biodiversity with other countries in Africa, Central America and around the world. Plate 3 provides an overview of patent activity for species that are known to occur in São Tomé and Príncipe and other countries around the world. This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

In total we identified approximately 332 species names in patent data from the major jurisdictions that are known to occur in São Tomé and Príncipe. When model organisms including crops such as *Zea mays* (maize) and *Homo sapiens* are excluded this falls to 331 species names and 252 accepted scientific names.³ This data is relevant for São Tomé and Príncipe because it demonstrates that researchers and companies are conducting research and development on species that are known to occur in São Tomé

³ The 252 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.

and Príncipe. 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 São Tomé and Príncipe.



The top species of relevance to São Tomé and Príncipe in global patent data are extremely varied. In total we identified 149 plant names in global data of relevance to São Tomé and Príncipe including *Bidens pilosa*, a flowering plant in the aster family from which over 200 compounds have been extracted, the nightshades *Solanum tuberosum* (a Chilean species) and *Solanum nigrum*, Common Purslane (*Portulaca oleracea*) which is a plant having both nutritional and medical uses, *Momordica charantia* known as the bitter melon, African oil palm (*Elaeis guineensis*) and tamarind (*Tamarindus indica*). Crops include cassava (*Manihot esculenta*), cereals (*Sorghum spp*), the potato (*Solanum tuberosum*), the onion (*Allium cepa*) and pepper (*Capsicum annuum*). Also included is the nematode crop pest *Meloidogyne incognita*. *Phakopsora pachyrhizi* is a fungal plant pathogen which causes Asian soybean rust. Other species include *Canthidermis maculata* or the Oceanic Triggerfish, a circumglobal bony fish species. Insects are represented by *Anopheles gambiae* (a complex of at least seven morphologically indistinguishable species of mosquitoes) and *Ceratitis capitata* (the Mediterranean fruit fly, a species of fruit fly capable of causing extensive damage to a wide range of fruit crops). Algae are also represented by *Chlorella vulgaris*, a single celled planktonic algae used as a food supplement.

The assignees in the overall data for species of relevance to São Tomé and Príncipe are from across a spectrum from biotechnology (e.g. Genentech), companies such as BASF and Bayer in areas such as biocides/insecticides, agriculture (e.g. Du Pont and Pioneer Hi-Bred International). More detailed analysis of technology areas revealed pharmaceutical companies such as Ciba Geigy and Curagen. Also companies which develop new crops such as Syngenta and Monsanto feature prominently as does Sumitomo Chemical, which has interests in pharmaceuticals and crop science. Other areas of speciality include cosmetics (L'Oreal). This makes clear that there is great variety in the industries and products which may be relevant to São Tomé and Príncipe. To examine the true impact of activity we now turn to the results of research to identify organisms appearing in patents that were directly collected in São Tomé and Príncipe or where distribution data suggests that São Tomé and Príncipe is the likely source.

Species from São Tomé and Príncipe in Patent Data:

After extensive analysis of patent documents no species of organism that was directly sourced from, or potentially originated from São Tomé and Príncipe based on distribution data was identified.

In considering this result we would note that while no species have been identified as originating from São Tomé and Príncipe, that the many cosmopolitan species which are native not only to several African countries, but also maritime countries in the Caribbean and Central America, may hold significant potential for collaboration in economic development and conservation.

São Tomé and Príncipe would appear to have a diverse portfolio of species that appear in patents. It has been seen that these species can be found across many areas of research and products. However it has been shown that these species have not been collected or otherwise acquired directly from São Tomé and Príncipe.

Patent Claims:

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 major formal category of patent claim is for compositions of matter (compositions). Compositions are commonly extracts, compounds or combinations of ingredients (i.e. in pharmaceuticals or cosmetics and herbal medicines). Patent claims for compositions typically include a list of the compounds or ingredients that are the subject matter for protection. These claims are 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.

The second category of patent claims is for methods, such as methods of producing a plant, a compound or other desired outcome. Method claims are frequently more restrictive in their coverage of genetic resources because the genetic component is only claimed in so far that it is relevant to performing the method. That is, it is the method that is the focus of the invention. Therefore it is the method, and the use of the claimed genetic 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 a beverage). It is the process itself that is the focus of the invention.

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

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

Concluding Remarks:

It can be seen from other African country studies in this series of reports into patent activity that the acquisition of biological materials varies greatly from country to country. A number of countries such as Madagascar, South Africa and Kenya have been the source of many such acquisitions. Other countries have been found to have little or no activity. Despite a thorough and extensive review of patent documents featuring species known to have São Tomé and Príncipe distribution and patents which mention the country name no evidence was found to suggest that any species have been obtained from São Tomé and Príncipe.

Observations made during the course of this analysis that help to understand this situation are as follows:

Firstly, as stated above, the available data on species which have São Tomé and Príncipe distribution appears to be limited. The number of georeferenced records and range of species from different kingdoms suggest a broad ranged history of recording, however only 1,471 resolved species names are recorded in GBIF data. A number of these species are endemic to the islands.

The species known to be distributed in São Tomé and Príncipe and which are found in the patent landscape are dominated by widely distributed, cosmopolitan species, including marine species with circumglobal distribution. This distribution means that the species which appear in patents are available from a large number of sources. The companies and other assignees identified are multinational companies or institutions based in the major industrial countries. It may be that the remoteness of the islands discourage or make it impractical to acquire organisms from São Tomé and Príncipe when they are likely to be available for less effort and expense elsewhere. This does not mean that biodiversity and traditional knowledge in São Tomé and Príncipe is unimportant. Nor do these findings signify that biodiversity and traditional knowledge in São Tomé and Príncipe 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 São Tomé and Príncipe 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 São Tomé and Príncipe 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 São Tomé and Príncipe or where distribution data suggests that São Tomé and Príncipe is a likely source.

Appendix 1

Distribution map of GBIF records in São Tomé and Príncipe coloured by taxonomic kingdom.

