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*Why is the regulation of bioprospecting in Antarctica  
lacking and what could the future hold?*

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# *Why is the regulation of bioprospecting in Antarctica lacking and what could the future hold?*

## ABSTRACT

Biological prospecting, or 'bioprospecting', involves developing products from the compounds obtained from living organisms, usually with commercial gain in mind. It is a controversial topic for Areas Beyond National Jurisdiction (ABNJ) mainly due to access and benefit sharing concerns. It is evident that bioprospecting is growing in Antarctica and will continue to do so, with new international players such as Malaysia joining the Antarctic Treaty who have commercial interests in Antarctic organisms. *Ex-situ* specimen repositories, such as genome databases, are also a growing area for potential bioprospectors, with new techniques being developed to enable effective screening of genomic information for novelty, allowing for the use by any party. Despite being a consistent topic at every Antarctic Treaty Consultative Meeting (ATCM) since 2002, there remains a void of specific legislation under the Antarctic Treaty System to manage bioprospecting expectations and activities. Bioprospecting spans many different sectors of international law, resulting in overlaps and significant gaps in legislative areas. While the Antarctic Treaty's associated Madrid Protocol and Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) regulate visits to Antarctica, including species harvesting and associated environmental effects, they are nonspecific when it comes to deriving commercial profit from living organisms by bioprospecting. A lack of clear regulatory measures is partly due to the complexity of the issue. The consensus-based process at ATCMs and sporadic annual meetings have also proved an ineffective mechanism of forming agreement on such a divisive topic. Despite these complications, it is imperative that new legislation is drawn up in order to uphold the Antarctic Treaty information sharing principles and to address the growing exploitation of Antarctic genetic resources.

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## 1 USEFUL DEFINITIONS

ABNJ	Areas Beyond National Jurisdiction
Antarctic Treaty Area	The area south of 60° South Latitude
ASOC	Antarctic and Southern Ocean Coalition
ATS	Antarctic Treaty Secretariat
ATCM	Antarctic Treaty Consultative Meeting
ATCP	Antarctic Treaty Consultative Party
CBD	Convention on Biological Diversity
CCAMLR	Convention for the Conservation of Antarctic Marine Living Resources
Madrid Protocol	The Protocol on Environmental Protection to the Antarctic Treaty
Nagoya Protocol	The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization
SCAR	The Scientific Committee on Antarctic Research
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme

## 2 INTRODUCTION

The Antarctic region is home to a range of organisms with unique adaptive properties for extreme conditions, many of them the result of biochemical processes. As a result, Antarctica is considered a global hot spot for biological prospecting or 'bioprospecting', which involves developing products from the compounds obtained from living organisms. Bioprospecting often goes hand-in-hand with scientific research being undertaken on Antarctic organisms, and research funding can reflect this due to the potential commercial gain (Hughes and Bridge, 2010). Examples of bioprospecting in Antarctica over several decades are widespread and examples can be found in every biological kingdom, and aside from krill, bacterial species are the most widely studied, possibly due to the ease of sample collection and culture, range of diversity, and the variety of extremophile traits they can exhibit. A recent study looked at recent proportions of patents per species grouping between 2011-2014, and found that during this period nearly half (42%) of all patents relate to krill, with another large proportion to microorganisms (19%), yeasts and molds (16%), lichen and fungi (6%), invertebrates (mainly sponges and tunicates) (4%), plants and grasses (4%), fish (mainly antifreeze proteins) and other vertebrates (3%), algae (3%) and unidentified sources (2%) (ATCM, 2015).

Bioprospecting has traditionally been carried out via the collection of samples, identification of desirable phenotypic traits, and the identification and isolation of the genes that code them (Slobodian *et al.*, 2015). Compounds can then be reproduced in a laboratory, patented, and turned into products. Globally, genetic resources are used to derive products for the pharmaceutical, biotechnology, agricultural, personal care, botanical and food and beverage sectors (Grieber *et al.*, 2012). On one hand, bioprospecting is viewed as a 'quasi-scientific' industry, as the primary interest of companies involved is to derive profit from their scientific discoveries (Meduna, 2015), while on the other hand, bioprospecting can be seen as 'encouraging' financial investment in Antarctic science, where funding could have been spent elsewhere (Hughes & Bridge, 2010). Following this view, product discovery and gaining exclusive rights through patenting could theoretically be seen as a financial return on investing in Antarctic science.

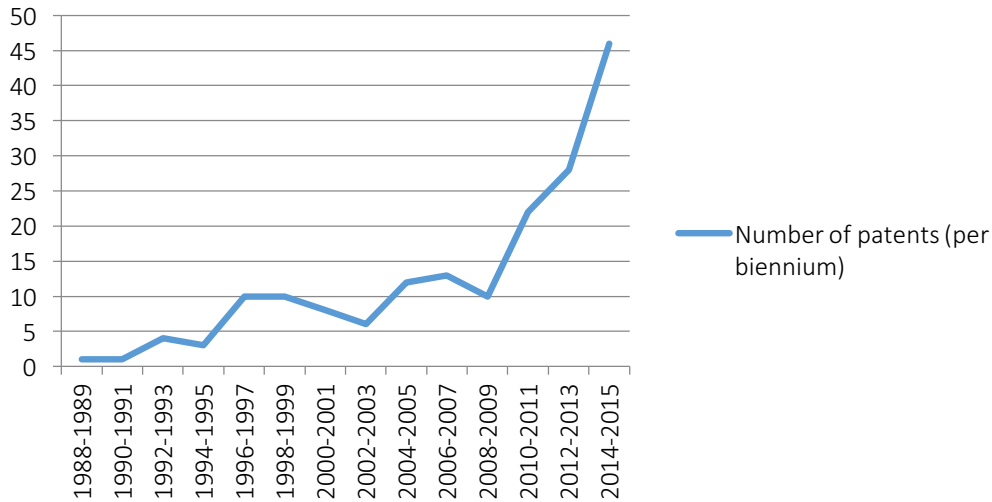
In recent times genomic databases and *ex situ* samples have reduced the need for researchers to travel to Antarctica to collect specimen (ATCM, 2010; Dong-Ha Oh *et al.*, 2012; Nur Athirah *et al.*, 2015). For example, genetic databases can now be used by anyone from afar to search species genetic codes without setting foot in the Antarctic, raising potential access and benefit sharing issues. Given the cost associated with conducting specimen-collection in the Antarctic, this could be seen as a cheap method of prospecting genetic resources. It could also be seen as a non-invasive way (in the sense that there are no direct environmental effects on the Antarctic) of deriving use from existing information.

In the face of an expanding Antarctic industry, the regulatory framework is lacking in many areas and is vague as to which international measures regulate commercial interest in Antarctic species. This report will evaluate the current regulatory measures in the Antarctic for bioprospecting, looking into why Antarctic-specific measures have not progressed far within the Antarctic Treaty System, and how the gaps in the system work against access and benefit sharing, allowing for the exploitation of Antarctic resources. The accessibility of genomic information for species and *ex situ* samples is also discussed, and how these fall outside the current regulatory measures available.

### 3 THE FUTURE OF BIOPROSPECTING IN ANTARCTICA

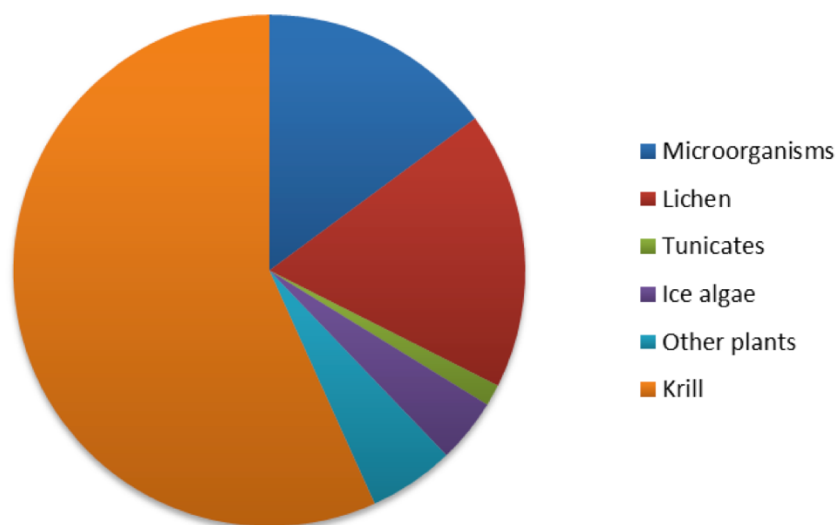
Bioprospecting activities in the Antarctica, and the rest of the globe, are continually growing and a variety of international forums exist to manage the complex legal matters which arise from it. The number of patents filed can be used as a proxy for commercial interest in Antarctic species. For example, Figure 1 graphs patents from in the Antarctic area between 1988 and 2015, showing an exponent growth trend since 2008/09. It is expected that this trend will continue as developing countries are increasingly investing in biotechnology.

## Number of patents (per biennium)



**Figure 1:** The number of patents (per biennium) filed with data from the Access and Benefit-Sharing Patent Index (ABSPAT). Note that surveys may have missed patents that were filed in a foreign language (Source: ATCM, 2015)

In recent times, bioprospecting patenting has been dominated by krill research, closely followed by that of microorganisms (Figure 2). Pharmaceuticals is the main industry benefiting from the use of Antarctic-derived products. Some recent examples include potential cancer therapies from microorganisms found in the lake East Antarctic Dronning Maud Land, fungi with anti-inflammatory compounds and lichens with antibiotic properties from King George Island (ATCM, 2015). Patents relating to krill have included nutritional supplements such as krill oil, pharmaceuticals treating inflammation and applications in aquaculture.



**Figure 2:** Proportions of Antarctic organisms that have yielded patent applications between 2014 and 2015. (Source: ATCM, 2015)

### 3.1 KEY PLAYERS OPERATING IN ANTARCTICA

The Antarctic Treaty has been described as an 'elitist club' with the key players traditionally being post-Cold War countries such as the United States, United Kingdom, Russia and Australia (Brady, 2013; Hemmings, 2014). However, a new 'global order' is forming in Antarctica, with rising interests of Asian countries such as Malaysia, China, Korea, India and Pakistan (Brady, 2013). This follows an increasing trend in economic globalization and entrepreneurship of Asian countries (Jabour, 2013). China and Korea have recently built new bases in Antarctica, while Malaysia and Pakistan have recently acceded to the Antarctic Treaty. Other signatories of the Antarctic Treaty who have been 'active' recently either by ratifying or gaining consultative status are the Czech Republic, Kazakhstan, Belarus, Iceland, Portugal and Venezuela, many of which are old Soviet nations. The emergence of new players in the ATS, who may have different values and economic incentives than the old 'club', means it is likely that commercial interests in Antarctica will continue to grow.

Malaysia, who started off as a critic of the ATS has shifted their policies towards Antarctica dramatically, and became a signatory to the Treaty and declared their interest in becoming a full consultative party. In 2016, Malaysia ratified the Madrid Protocol (New Strait Times, 2016), which is another step towards this status. Malaysia has been progressively implementing new national policies relating to science and technology and has been open about their economic interest in Antarctica. In 2005 a Biotechnology Policy became established, which envisioned biotechnology as "a new economic engine for Malaysia" (Shabudin *et al.*, 2017). Biotechnology has been recognized in other national legislation as a priority for commercial development. Accession to the ATS and the ability patent products from Antarctic material, was one of the primary reasons for Malaysia to join the ATS (Shabudin *et al.*, 2017).

Evaluating the patents described in ATCM (2015) shows that patents have recently been granted to companies from a range of countries such as the USA, Japan, China, Malaysia, Chile, Denmark, Belgium and Korea. Krill-related patents have predominately been filed by Chinese companies, which is unsurprising given that China harvests the largest quantity of krill from Antarctica, and have had substantial commercial interest in krill related products (Future Oceans, 2016). It is likely that the trend in krill products will continue in the future.

## 4 INTERNATIONAL REGULATORY MEASURES

The Antarctic Treaty (1959) sets ethical standards for bioprospecting in the sense that Antarctica is set aside as an area for peace, science and free information-sharing. However the ATS (and international law more generally) have limited powers when it comes to regulating bioprospecting in Antarctica as a clear regulatory framework is lacking (Grieber, 2011). Bioprospecting is a complex issue as it crosses over into a range of fields such as intellectual property rights, scientific research and exploitation of resources, which has made it challenging to establish and implement an effective framework (Hemmings, 2005; Grieber, 2011). In addition to this, because of the variety of steps involved in bioprospecting, from the collection of samples right through to the development of commercial products, this has it difficult to define the parameters of the term 'bioprospecting' in a legal sense, although it is widely agreed that 'prospecting' implies some form of commercial exploitation.

Under the ATS, there are several agreements in play with the potential to regulate aspects of the bioprospecting industry. The Protocol for Environmental Protection or “Madrid Protocol” and the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) are the two primary agreements. Other multilateral treaties that deserve consideration in the global context are the Convention on Biological Diversity (CBD) and its supplementary Nagoya Protocol, and the United Nations Convention on the Law of the Sea (UNCLOS). These intersect the ATS at various points. In particular, the legal framework is complicated by the fact that the states of seven countries Argentina, Australia, Chile, France, New Zealand, Norway and the United Kingdom claim sovereignty over parts of the Antarctic Treaty area. These claims have remained ‘frozen’ and unresolved since the inception of the Antarctic Treaty. It should be noted that while parts of Antarctica are beyond national jurisdiction, “every government whose citizens are in the Antarctic has jurisdiction over its people, in a nationality sense” (Jabour, 2013).

#### 4.1 THE CONVENTION ON BIOLOGICAL DIVERSITY

Oldham *et al.* (2013) identified three key principles which international debates on bioprospecting are usually structured around. The first principle is that ‘prior informed consent’ is given by those who provide genetic resources and traditional knowledge, for example developing countries or indigenous communities. This is not particularly relevant in the Antarctic space, given the fact Antarctica is seen as a global commons for mankind which is lacking an indigenous population (and therefore, there is no ‘culture’ to be passed on). The second principle of equitable benefit sharing states that those providing the genetic resources and traditional knowledge obtain benefits from the sharing of their knowledge with other users. The third principle is to promote fair access to genetic resources in order to foster research and development. These principles have relevance to the Antarctic in the sense that Article III of the Treaty encourages international cooperation including the exchange of scientific personnel, observations and results, and the fact that benefit sharing has formed the cornerstone of discussions at ATCMs.

The CBD has been written with these three principles in mind. The Convention entered into force in 1993 with the objectives of (1) the conservation of biological diversity, (2) the sustainable use of the components of biological diversity, and (3) the fair and equitable benefits arising out of the utilization of genetic resources. With close to 200 signatories, it is essentially a universally agreed treaty. The CBD only applies to each Contracting Party’s area of national jurisdiction and processes and activities (regardless of where the effects occur), carried out under its jurisdiction or control, within its area of jurisdiction or an ABNJ.

Effectively, the CBD recognises the sovereign right of states to exploit their own genetic resources, and to control exploitation of those resources by other states within the limits of their own environmental policies (ensuring that damage is not caused to other States or ABNJ as a result of this exploitation). A large component of the CBD is to encourage environmentally sustainable legislation to be developed amongst contracting parties. A financial mechanism exists under the CBD for contracting parties to give ‘developing’ contracting parties, who may be at a financial disadvantage, the ability to implement essential elements of the CBD. To supplement the CBD, the Nagoya Protocol entered into force in 2014 with the aim of providing a legal framework for fair and equitable sharing of benefits arising out of the utilization of genetic resources. This was predominately a response to the issue of misappropriation (by patenting and gaining exclusive rights) of

traditional knowledge and biological resources (Oldham *et al.*, 2013). Importantly, this mechanism enables legal follow up on person(s) who were granted access to genetic resources to ensure those person(s) comply with the terms of access and environmental protocols.

While the CBD has limited applicability in regulating ABNJ, it has progressed ideas on access and benefit sharing, creating a model framework for international relations in this area. Therefore it is a useful piece of legislation to bear in mind for the Antarctic Treaty, which has no formal mechanism of regulating the commercial exploitation of biodiversity.

#### 4.2 THE UNITED NATIONS CONVENTION ON THE LAW OF THE SEA

The UNCLOS, which entered into force in 1994, is a comprehensive legal regime which establishes governance over the use and resource exploitation of the world's oceans and seas. The UNCLOS recognises ownership rights over the seas, which extend out a fixed distance from a sovereign state's territory, so these rights can vary depending on the state's territorial boundary and whether the state has a continental shelf. These include the state's territorial sea, contiguous zone and exclusive economic zone (EEZ). The "High Seas" are identified as areas of the sea with no ownership rights, and "The Area" is the international seabed area (including seabed, ocean floor and subsoil) with no ownership rights. Both The High Seas and The Area are therefore located in ABNJ. The UNCLOS is applicable to the Antarctica, which is, for the most part, regarded as an ABNJ. This is somewhat complicated by the frozen sovereignty claims over parts of Antarctica which have been discussed previously. To add to these complications, Heard Island and the McDonald Islands, and Macquarie Island, recently had their continental shelf co-ordinated ratified by The Commission on the Limits of the Continental Shelf, and therefore extend below 60 ° South and into the Antarctic Treaty area (Jabour, 2013).

Given the sovereignty issues, the relationship of UNCLOS and the ATS jurisdictions is not ultimately clear. If the claims over the Antarctic continent are not recognised, then it could be argued that the UNCLOS "high seas" extend up to the Antarctic continent. It is also undecided whether UNCLOS, an international instrument, is a priority over the ATS for the management of the seas in areas the potential sovereignty areas (Grieber, 2011). Oldham *et al.* (2013) also raises an interesting point - that research looking for extremophiles has increasingly been penetrating the deep sea beyond national boundaries governed under UNCLOS (beneath the ocean floor subsoil). This could be seen as another gap in the legislation.

UNCLOS is not explicit in the access and benefit sharing regulation of 'marine genetic resources', as this term is not present in the treaty text (Grieber, 2011). There is currently disagreement over whether the UNCLOS can govern marine genetic resources in ABNJ, as parts of the treaty could be interpreted as being inclusive of them due to the text being non-specific in areas (Grieber, 2011). In particular, Part XIII of UNCLOS relating to 'marine scientific research' could be seen as providing an access and benefit sharing system for genetic resources, as it requires information on scientific programmes and their objectives and knowledge from marine scientific research to be published and disseminated, along with promoting data and information flow (especially to developing states) and international cooperation. However it has also been argued that 'marine scientific research' does not equate to 'bioprospecting', and so this system may not be applicable.



### 4.3 THE MADRID PROTOCOL

The Madrid Protocol was ratified in 1998 by the Treaty Parties. The Protocol sets out the environmental principles for conducting activities in the Antarctic, and designates that Antarctica is a natural reserve, devoted to peace and science. Several elements of interest to bioprospecting exist in the Protocol, including:

- Article 8.1 and Annex I which set out the requirements for Environmental Impact Assessments (EIAs) to be undertaken by parties for activities carried out in the Antarctic. Under Article 8.1 this includes any activity “pursuant to scientific research programmes, tourism and all other governmental and non-governmental activities in the Antarctic Treaty area”. In summary, if the activity is initially assessed as having a “less than minor or transitory impact” it can proceed without an assessment, while those with a “minor or transitory impact” undergo a permitting process under national regulations, and those likely to have a “more than minor or transitory” impact require a Comprehensive Environmental Evaluation (CEE), which is forwarded to all Treaty parties for comment and a final decision.
- Article 3.1 which aims to protect the Antarctic environment, including the intrinsic values of Antarctica. It also states that “activities shall be planned and conducted in the Antarctic Treaty area so as to accord *priority* to scientific research and to preserve the value of Antarctica as an area for the conduct of such research, including research essential to understanding the global environment.”
- Article 17 which requires all parties to submit annual reports to the ATCM on the steps taken to implement the Protocol. This article is not specific about whether EIAs need to be reported on, however this is implied as they are the only gateway mechanism which might prevent activities from occurring in the Antarctic.
- Annex II of the protocol, which provides for the protection of Antarctic flora and fauna and the prevention of non-native species introductions. Permits are required in order to take wildlife from the environment, and these are only issued under certain circumstances, such as to provide specimen for scientific research, or for educational or cultural purposes institutions such as museums or gardens.
- Annex IV which assigns liability for the cost of response and clean up in the event of an environmental emergency. This Annex has not yet been ratified by the Treaty parties.

Annual reports submitted under Article 17 are a good source of information on activities being carried out in the Antarctic and in checking what EIAs have granted under Article 8.1, however not many countries adhere to the reporting requirements. A recent review by ASOC and UNEP (2011) showed that more than 30% of parties had never reported their progress under Article 17 and from 2000 to 2010 only around 50% of consultative treaty parties on any given year had submitted a report. This demonstrates that information sharing can be seen by parties as a voluntary act without any serious repercussions, despite being a key principle of the Antarctic Treaty.

#### 4.4 THE CONVENTION ON THE CONSERVATION OF ANTARCTIC MARINE LIVING RESOURCES

The CCAMLR was ratified in 1982 by the Treaty Parties with the aim of conserving Antarctic marine living organisms, by regulating harvesting and associated activities so that they are undertaken sustainably. The Convention area is the same as the Antarctic Treaty area (South of 60°S latitude) and extends outwards from that line to the Antarctic Convergence in order to be inclusive of ecosystem boundaries (although, this is set out in precise lines, so that the Convention area is easily understood). The aspects of the Convention with relevance to bioprospecting include:

- Article II which sets out that ‘conservation’ of marine living resources includes ‘rational use’. Any harvesting and associated activities have to align with three main principles of conservation, in summary these are – the prevention in the decrease in size of the population which ensure stable recruitment, maintenance of ecological relationships between the harvested resource and those linked to it and prevention of changes or minimisation of the risk of changes in the marine ecosystem which are not potentially reversible over two or three decades.
- Article XX which requires Convention members to provide statistical, biological and other data and information annually to the Treaty parties and Scientific Committee on Antarctic Research (SCAR). Other information relating to harvesting activities and measures taken to implement CCAMLR can be requested separately.

#### 4.5 ANTARCTIC TREATY CONSULTATIVE MEETINGS

Bioprospecting has been a consistent topic at Antarctic Treaty Consultative Meetings (ATCMs) since 2002 when concerns were put forward by the United Kingdom about the regulation of bioprospecting under the ATS (ATCM, 2002). In 2005 Resolution 7 was agreed to at the Antarctic Treaty Consultative Meeting (ATCM) in Stockholm which encouraged the Antarctic Treaty information sharing principles of Article III(1) to be upheld. It also encouraged parties to ‘keep under review the question of biological prospecting’ and to exchange information on an annual basis relating to the topic as appropriate. As the result of much discussion and concern around whether the ATS was appropriate for the management of bioprospecting, another resolution was agreed to in 2009, which reaffirmed that the Antarctic Treaty and associated measures (Madrid Protocol and CCAMLR) are the appropriate tools for managing bioprospecting in the Antarctic Treaty Area (ATCM, 2009). The resolution also encouraged ‘active consideration’ of items raised at ATCMs relating to bioprospecting. Recently in 2013, Resolution 6 was agreed to which noted that bioprospecting continues to occur, and that a lack of clear working definition of the term is a consideration. This resolution again encouraged consultative parties to report on bioprospecting activities carried out under their respective legal regimes, and to examine ways of improving the information exchange (such as adapting the Information Exchange System for this purpose).

Other developments of note in ATCMs have been:

- In a 2008 working paper, the Belgium Government and United Nations University Institute of Advanced Studies (UNU-IAS) discuss set up the “Bioprospector” website (<http://www.bioprospector.org/bioprospector/antarctica/home.action>)

to allow searchable to up to date bioprospecting information on research and commercial products (ATCM, 2008). Recent attempts to access this website (as at 10 February 2017) have been unsuccessful, suggesting that it is no longer in operation. Up until 2015 (ATCM, 2015) it had provided useful information which could be used to determine research trends, as well as sourcing information on the companies that undertook the work.

- In 2009, a working paper was submitted analyzing the gaps in the Antarctic Treaty System regarding the management of bioprospecting. This paper highlighted a concerning number of gaps in the regulation concerning “definitions, access to specimens, commercialization, benefit sharing and reporting” (ATCM, 2009a).
- In 2010 an information paper was presented by Belgium and UNEP on the role of *ex situ* collections of Antarctic biological material in Antarctic bioprospecting. This paper noted that *ex situ* collections can “come in many types and sizes, ranging from small university laboratories and national public collections to large commercial collections”, and that while they are important for biodiversity conservation, research and development, they can complicate the matter of ‘monitoring’ under the treaty, when used for matters not initially envisioned when they were collected (ATCM, 2010a). *Ex-situ* samples are discussed later in this report.
- In 2014 a working paper was presented by Belgium specifically addressing the concerns which were brought up by Resolution 6 in 2013. A working definition of bioprospecting was proposed with a draft resolution encouraging governments to require Environmental Impact Assessments under the Madrid Protocol for bioprospecting under their jurisdiction. It was hoped that EIAs could serve as a declaration of bioprospecting activities, meaning that all bioprospecting would be reported on in annual reports of countries to the ATS (ATCM, 2014). Consensus was not reached with regard to this working paper, for several reasons discussed below.
- In 2015 an information paper was presented by the Netherlands which built off and updated the trends discussed in the 2008 information paper. It highlighted that Antarctica is increasingly becoming an area of commercial interest and discusses the recent policy developments and supporting instruments to these policies established at an international level (ATCM, 2015). Aspects of this paper have been discussed previously.

This outlines only a small selection of papers submitted over the years. From the three resolutions that have been agreed to, the most recent Resolution in 2013 demonstrated that ATCPs believe the current regulatory framework to be sufficient for bioprospecting in the Antarctic (Jabour, 2013), despite a multitude of working and information papers emphasising that further measures are urgently needed. Slow progress on complex matters is typical for the ATS, which is a consensus based-system, and so a variety of viewpoints are usually held by parties on every issue.

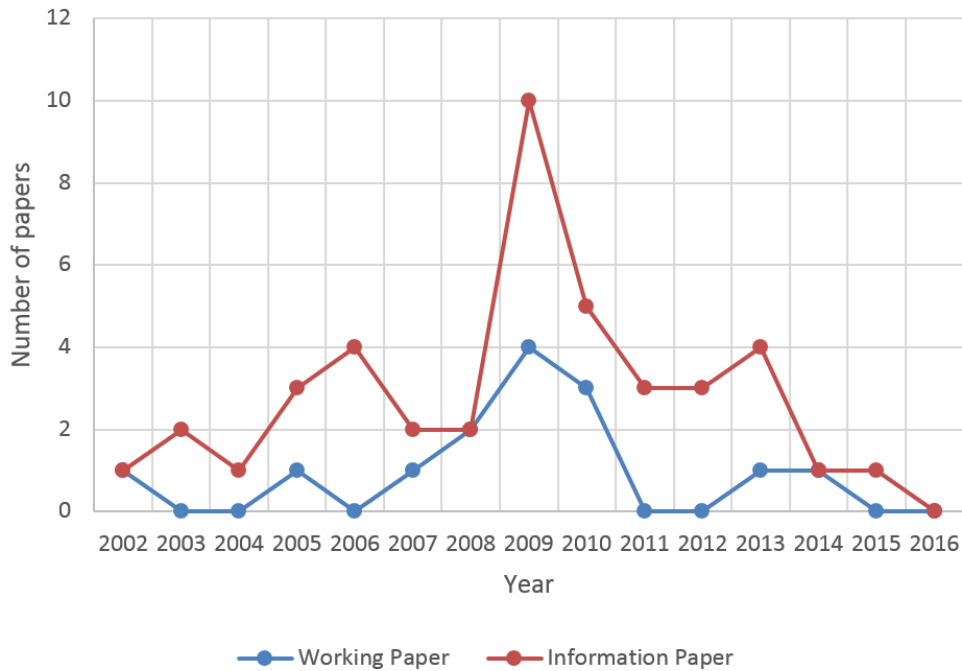
For example, when the 2014 working paper to specifically include bioprospecting in EIAs was proposed by Belgium, consensus was not obtained for a variety of reasons. First, some parties thought that due to discussions happening in international forums on fair and equitable benefit-sharing, it would be better to ‘wait and see’ what came out of these talks, to see if they are applicable in Antarctica. Secondly, ATCPs had differing opinions

over whether overarching issues should be discussed at an intersessional contact group, or that the issues should be left for the next meeting (ATCM, 2014a). There were also differing opinions on the proposed working definition of 'bioprospecting'. The recommendation for the working definition was as follows:

*“An activity of search, identification description, collection, survey, monitoring, cultivation, replication, or any other scientific investigation processes, performed on indigenous biological species, carried on within the area defined in Article VI of the Antarctic Treaty, with the initial intention to consider potential industrial or commercial derived products or applications, notably through the development of patentable material or process.”* (ATCM, 2014).

Consensus from all parties could not be obtained on this definition as “some parties found the working definition proposed by Belgium too broad or impracticable with respect to their scientific research activities while others found it too narrow with respect to what might constitute research with potential commercial application” (ATCM, 2014a). There was also clarification sought over some of the technical terms. Interestingly, if this definition had been accepted bioprospecting undertaken on Antarctic species outside of the Antarctic Treaty area, such as research involving obtaining information from *ex situ* samples (for example, genomic databases), would not be covered by the definition.

Many information and working papers relating to bioprospecting have been submitted by ATCPs and expert advisers (such as SCAR and UNEP) over the years. Trends show that the number of papers have dropped off since 2013 (see Figure 3), with the largest number of papers submitted in 2009. The spike in papers in 2009 is reflective of international forums, which were negotiating the Nagoya Protocol at the time. The recent drop off in interest is likely due to the ATCPs postponing discussion until after developments in international policy take shape. Some of these international discussions include: The operationalisation of the Nagoya Protocol, discussions at the Ad-hoc Open Ended Informal Working Group on conservation and sustainable use of marine resources in ABNJ (hereby referred to as IWG), and developments on the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) (ATCP, 2015).



**Figure 3:** Showing the number of working papers and information papers presented at Antarctic Treaty Consultative Meetings on bioprospecting since it became a searchable topic in 2002. Data was sourced from the Antarctic Treaty Secretariat meeting document database (ATS, 2017)

#### 4.6 PATENTING AND INFORMATION SHARING

Patenting of a product, or establishing exclusive legal rights, is often seen as the end result of bioprospecting. At this stage, the biological resources in Antarctica are open to patenting, which includes “biochemicals, genes, proteins and micro-organisms [...] provided that the invention in question meets the general patent criteria of novelty, inventiveness and industrial application” (Tvedt, 2011). Genetic resources can become intellectual property, which threatens scientific research and the free sharing of knowledge (Oldham *et al.*, 2013). It can be difficult to obtain exact trends for patented products from Antarctica as no one system exists for lodging and keeping track of patents (Puig Marco, 2014).

The strengths and weaknesses of the patenting system have been debated by Oldham *et al.* (2013). One of the strengths which is often used by industry to justify the patent system is that it can be seen as a ‘return’ on the research investment of developing a product (often in the face of competition). Patenting ensures temporary protection from others seeking to use that discovery, although it requires disclosure of inventions to the public upon expiry. Patenting can also encourage investment in a company due to this exclusive access, freeing up more funds for further prospecting. A key issue with patenting in a ‘global commons’ situation is that scientific data and results are kept secret until they are published. Patenting therefore raises questions about freedom of information and the use of resources, especially with the ATS information-sharing principles in mind. SCAR in particular have raised concerns that acquiring intellectual property rights may not be consistent with Articles II and III of the Antarctic Treaty (ATCM, 2009b). The ATS does not

include any specific timeframes for reporting scientific results and so parties can sit on data and results for long periods.

This raises questions over where patenting rights lie with commercial operations operating alongside with national science programmes (Hughes and Bridge, 2010). Presumably, national science programmes, and Antarctic scientists in general, would want to adhere to ATS information sharing principles, however they may be pressured to restrict this before innovative discoveries can be made and patented. Limited research on this area exists, and it is likely kept behind closed doors by the parties involved (ATCM, 2009b)

#### 4.7 *EX SITU* PROSPECTING

The issue of *ex-situ* collections was first examined in an Antarctic Treaty Consultative Meeting in 2010 by the UNEP and Belgium (ATCM, 2010a). This paper noted that a variety of Antarctic genetic and specimen collections exist in different forms, such as gene banks, museums and private scientific collections. Genomic resources in particular are freely available for many Antarctic species as a result of the Antarctic Treaty System information sharing principles: GenBank, for example, lists full genomes and nucleotide sequences from a range of Antarctic species (NCBI, 2017). These repositories are useful for providing research material without making a costly trip to the Antarctic, and the benefit of their use is that direct environmental effects to Antarctica from specimen collection is prevented. As genomic resources grow, so too do innovative methods of screening databases for novel compounds and laboratory culturing techniques. For example, 'metagenomic' screening techniques now exist using billions of nucleotides from different biological regions on earth, which can allow screening for novel proteins and enzymes (Hicks and Prather, 2014).

The UNEP and Belgium have noted that: "In some cases where *ex situ* collections are vectors for commercial use, it can be difficult to trace the lineage of a particular organism or strain from its source to a patent or product. This is particularly true for bacteria and other micro-organisms, where information about their location of collection is often lacking or not easily accessible" (ATCM, 2010a). This is reflective of the fact that *ex situ* material use occupies a grey area of international law. While the initial sample have come from Antarctica, when part of it is used *ex situ* for a purpose not initially envisioned when collected, the ATS ceases to apply, as the activity is no longer in the Antarctic Treaty area. Requirements for monitoring and reporting on activities are not applicable, and so the use of this material is difficult to track. In addition to this, most Antarctic material available in databases is open to any state or commercial operation whether bounded by the Antarctic Treaty or not. It is unclear however whether non-ATS parties have been utilising this openly available information.

There have been some recent innovations in the science community for microorganism species monitoring. For example, a tracking and monitoring system has been established by the World Federation of Culture Collections and the World Data Centre for Microorganisms for microbial strains and species (ATCM, 2015), enabling the tracking of their utilisation, although it is unclear whether this measure will apply to Antarctic species. Data tracking from genomic databases is something which Antarctic parties could consider when discussing the use of *ex-situ* specimen.

## 5 DISCUSSION AND RECOMMENDATIONS

With economic interest in Antarctic organisms set to continue into the future it is important that ATCPs try and agree upon ways in which bioprospecting will be regulated under the ATS in order to uphold the Antarctic Treaty values. A working definition of bioprospecting is a key measure which needs attention by ATCPs, in order to adequately define which laws are applicable in Antarctica, and classify whether it is included under the banner of 'scientific research'. Jabour (2013) has also suggested that, as the various ATS agreements have different areas of application, a clear agreement on 'where' the Antarctic is located is required.

So far the only matter that has been firmly agreed upon by the ATCMs, is to decide that the ATS is the appropriate tool for regulate bioprospecting in the future, rather than other international measures such as the CBD. With this hurdle aside, the modification of either the Madrid Protocol or CCAMLR to incorporate specific measures into the legislation is required. This could be achieved relatively easily if ATCMs were committed to working through the issues to agree on a solution. However it would appear that the ATCMs would prefer to delay until further international discussions on access and benefit sharing have taken place - despite the topic of bioprospecting legislation being a constant concern for over a decade. The fact of the matter is that consensus is incredibly difficult to achieve in the ATS setting for bioprospecting due to differing values at play over whether Antarctic organisms should be exploited. As Jabour (2013) has pointed out "Common heritage and global commons may be noble ideals but they do not find support among the ATCPs, most of which are highly developed countries that do not, themselves, stand to benefit from access or benefit-sharing arrangements from current bioprospecting activities".

Much of the discussion around bioprospecting at ATCMs has been related to the sharing of information. Commercialisation and patenting are opposing forces to information sharing. Article III of the Treaty promotes international cooperation and information-sharing from scientific operations, and provides that scientific observations and results from Antarctica should be made freely available. Arguably, bioprospecting is an extension of a parties' scientific endeavours in the Antarctic, whether purely commercial, or associated with a national science programme. Therefore all results should be shared. To prevent withholding information indefinitely until a discovery is patented, there needs to be some form of time limit on results publication, and repercussions if information is not shared with other treaty parties.

Globally most companies no longer see genetic resources as available for 'free use', and usually factor in cost-benefits that "typically includes a mix of monetary benefits like fees per sample, milestone payments, royalties on net sales, and licensing agreements, as well as non-monetary benefits like training, capacity-building, research exchanges, supply of equipment, technology transfer and joint publications" (ATCM, 2009a). The ATS system is behind areas with national jurisdiction as its resources can be prospected freely by commercial enterprises without any repercussions. Because resources are free from regulation, this is likely encouraging private companies to exploit Antarctic genetic resources, while Treaty parties remain stagnated in the negotiation phase. This is evident through an indicative analyses of patents showing patent numbers from Antarctica nearly quadrupling over the past six years (Figure 1) (ATCM, 2015).

Another concern for further regulation of bioprospecting in the Antarctic via the ATS is whether companies will simply choose to operate under countries that have not joined

the ATS, in order to carry out research and remain exempt from the Treaty. Although there is minimal evidence to suggest that this is currently occurring for bioprospecting, alignments of convenience (for example, flags of convenience in tourism) occur frequently in order to bypass international regulations.

## 5.2 RECOMMENDATIONS

Based on what has been discussed in this report, several recommendations have been listed below, which are thought to be the most realistic and pressing short term goals for ATCPs to focus on:

- In the absence of a comprehensive agreement on bioprospecting regulation in Antarctica, a working group should be set up to promptly develop 'best practice' guidelines to be put on the Antarctic Treaty Secretariat, based on the current legal requirements and expectations. This could be similar to the ones developed for frequented sites in Antarctica. Temporary guidelines may be easier to agree to at ATCMs than full Resolutions while international discussions on access and benefit sharing are occurring.
- To prevent further delays in agreement over regulatory measures, a date should be set by ATCPs to agree on the development of a comprehensive regulatory measure for bioprospecting, with a dedicated working group established for this purpose. This could address definitions, timeframes for results publication, tweaking the legal instrument (Madrid Protocol or CCAMLR) which bioprospecting will fall under and addressing the issues of access and benefit sharing. Opposing countries to previous legislative efforts could be asked to assist in drafting this.
- A financial redistribution system should be developed for the ATS, to share the monetary benefits derived from bioprospecting activities. There are plenty of examples that this idea could be modelled off, such as those set up under the CBD, Convention on the Regulation of Antarctic Mineral Resource Activity (CRAMRA), or even Annex IV of the ATS (liability for emergencies). Financial redistribution could operate by levying commercial gains from Antarctic-related products, to be paid into a joint treaty fund, which could in turn be used to assist developing countries with their science programmes, or used to fund joint science projects of significance to mankind. A levy system could be enforced via Treaty parties via domestic legislation.
- Further emphasis should be placed on enforcement of the current Treaty System, especially information sharing and the submission of annual reports. There is no purpose in improving the system if parties do not currently submit any information about their activities in the Antarctic. This recommendation also applies to activities beyond – at present it is difficult to piece together what any one state is undertaking under their science programmes in the Antarctic at any given time.
- A biological prospecting database (such as Bioprospector) should be restarted, in order to provide accurate data and trends on bioprospecting in the Antarctic.
- A better understanding of *Ex-situ* collections from ABNJ should be obtained, and access and benefit sharing of these repositories warrants further discussion in international forums. The Antarctic Treaty may not be able to sufficiently regulate this issue, but potentially it could become incorporated into other international legislation, such as the CBD.



## 6 CONCLUSION

Bioprospecting in Antarctica is a complex issue which ATCPs have struggled to address adequately over the years. Current international legislation on bioprospecting overlaps in some areas and shows significant gaps in others, providing a confusing framework. It is clear that a new comprehensive legislation needs to be introduced due to address the growing industry. The fact that bioprospecting does not currently align with core components of the Antarctic Treaty on information sharing makes this even more pressing. Key recommendations made in this report include the creation of temporary bioprospecting best practice 'guidelines' for parties, setting strict deadlines for revisiting regulatory discussions and coming to an agreement, reinstating the Bioprospector database (or another form), improved enforcement of annual record submissions, and the creation of a joint fund for access and benefit sharing.

As the Treaty and its signatory base develops negotiating new regulatory measures may become more difficult, given that some countries are starting to include biotechnology (and therefore bioprospecting) in their national science plans. One growing industry which is likely to become more prevalent in the future is genomic database mining of freely accessible data from ABNJ, which poses an interesting question for international law in general.

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