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Antarctic Specially Protected and Specially Managed Areas: How Effective is the Current System?

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Abstract:

Protection of the Antarctic environment has been a motivation for Treaty Parties since the establishment of the Antarctic Treaty System in 1964. The current protected areas system, created in 2002, provides little protection, especially within regions most at risk for climate change impacts. The present report reviews the current creation and management processes for Antarctic Specially Protected Areas and Antarctic Specially Managed Areas. The problems and challenges associated with the current system are outlined along with recommendations for ongoing improvement to the system. The efficiency of the current system in protecting Antarctic terrestrial ecosystems against climate change impacts is also assessed. The report concludes that all Treaty Parties need to be equally committed to implementing permit re0quirements while also reporting all permitted activities in order to create an accurate database. Further integration of knowledge from successful international environmental programmes is required along with increased cooperation and communication between Treaty Parties and associated organisations. The Climate Change Response Work Programmes timeline of recommended tasks aims to guide the evolution of protected area management plans to best respond to climate change, however the success of these recommendations relies on collaboration between all associated parties along with quality biological data. Continual improvement of the protected areas system is required in order to preserve Antarctica as a unique place for science and peace.

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Introduction

Protection of the Antarctic environment and its associated and dependent ecosystems has been a central focus of all Antarctic Treaty Parties (Treaty Parties) in the Antarctic Treaty System (ATS) since the 1960s. Following a framework overhaul in 2002, the current protected areas system was created (Hughes, Ireland, Convey, & Fleming, 2015). While at the time the new system reflected the needs and challenges the Antarctic environment was facing, the current mechanisms through which environmental protection is achieved under the ATS provides little to no protective value to the Antarctic environment (Hughes & Convey, 2010). What continues to emerge in the discussion regarding environmental protection in Antarctica is the idea that while "no other continent has the same amount of 'apparent' protection, [the] current situation reflects management *intent* and not management *outcome"* (Shaw, Terauds, Riddle, Possingham, & Chown, 2014, p. 3). This observation reflects the tone of a number of issues that will be explored throughout this report, which critique large sections of the protected areas system and notes a lack of institutional progress, despite prolonged critical debate.

The report will outline the development of the protected areas system and provides background around the mechanics of the protected areas process. It will then cover a range of critical issues and potential recommendations regarding the protected areas system, including a section affording specific attention to the changing climate and environment in Antarctica, and how current policy instruments can accommodate this. There is little doubt that a comprehensive protected area system is required in providing an effective framework for the conservation of the Antarctic environment, and that Antarctica is failing to meet global benchmarks in sustainable protection, but managing human activity in such vast and extreme physical conditions is challenging for any international regime (Shaw et al., 2014). Cynical observers argue that "the capability of current conservation governance arrangements to deal with these challenges may be outpaced", and in reality, whether institutional and political forces can adapt to some of these shortcomings remains unproven (Chown et al., 2012, p. 159).

Protection Measures

The Protocol on Environmental Protection to the Antarctic Treaty

The basic intention behind the protection of natural areas was to maintain the values that those areas may represent. Dedicating protection to an area allows human presence to be regulated in an effort to minimise any negative effects to the values of the area. Regulations can include a number of components ranging from management conditions, to the prohibition of access or restricted activities (Antarctic and Southern Ocean Coalition [ASOC], 2015).

In 1991 the Antarctic Treaty Parties signed The Protocol on Environmental Protection to the Antarctic Treaty (the Environmental Protocol), to ensure that Antarctica's environment and associated ecosystems received enhanced protection. The Antarctic Treaty Parties were convinced that a comprehensive regime to protect Antarctica's environment and dependent ecosystems was in the interests of mankind as a whole (Antarctic Treaty Consultative Parties [ATCP], 1991). By signing the Environmental Protocol, the Treaty Parties committed themselves to the comprehensive protection of Antarctica's environment and to abide by the environmental obligations and prohibitions the document mandated. These included measures on waste management, interaction with flora and fauna, and the prohibition of mineral extraction (Bastmeijer & Van Hengel, 2009). In conjunction with the Environmental Protocol, the Committee for Environmental Protection (CEP) was established to act as an advisory body to the ATS on both environmental and conservation matters.

Prior to the Protocol, the Antarctic protected area system came under the Agreed Measures for the Conservation of Antarctic Fauna and Flora (Appendix 1). This was originally intended to protect areas primarily for scientific research and biological value, but as other sites of value were identified, further protection categories were established. This protection system developed into a complex combination of categories, and meant that there was no longer a clear framework in place. The categories under this system were: Specially Protected Areas (SPAs), Sites of Special Scientific Interest (SSSIs), Specially Reserved Areas (SRAs), Multiple-use Planning Areas (MPAs), and Historic Monuments (Hughes, Pertierra, & Walton, 2013).

Annex V "Area Protection and Management" (Appendix 1) was added to the Environmental Protocol in 2002, and redesigned the Antarctic Protected Area system. Through the development of the Environmental Protocol, a more simplified framework was created. The Antarctic Treaty Parties aimed to align the protected areas system with global conservation methods and ideas of the time (Scientific Committee on Antarctic Research [SCAR], Smith, Walton, & Dingwall, 1992). The Environmental Protocol reclassified protected areas as either Antarctic Specially Protected Areas (ASPAs) or Antarctic Specially Managed Areas (ASMAs). In doing so, it provided the legal framework for the establishment of new ASPAs and ASMAs. Annex V states that any area, including the marine environment, within the Antarctic Treaty area can be designated as a protected area if it has a significant value or a combination of significant values.

Annex V obligates Parties to identify protected areas within a systematic environmental-geographical framework which includes:

- Areas to be kept free from human interference, so in the future comparisons can be made to areas affected by humans
- Examples of major ecosystems including terrestrial, marine and glacial environments
- Areas that have unusual or important species such as breeding sites
- The only known habitat of any species
- Sites with outstanding geological, glaciological or geomorphic features
- Areas with outstanding aesthetic or wilderness values
- Areas, sites or monuments with significant historic value
- And any other areas with outstanding value

These provisions were intended to provide a framework for a protected area network (ATCP, 2011). Protected areas offer the highest form of protection in Antarctica when compared to other management or planning tools under the Antarctic Treaty (1964).

Antarctic Specially Protected Areas

When the Environmental Protocol was implemented in 1998, all SSSIs and SPAs (now reclassified as ASPAs) were legally bound under Article 3 of Annex 5 (Appendix 1). ASPAs are designed to protect one or a combination of values that possess 'outstanding environmental, scientific, historic, aesthetic or wilderness values' (Appendix 1) and are the most common form of protection in the Antarctic Treaty area.

There are currently 75 ASPAs in Antarctica (Figure 1, Appendix 2), with 55% being less than 5 km^2 (Hughes et al., 2013). The smallest ASPA (other than the huts) is just 0.03 km^2 at Cape Adare and the largest at Western Bransfield Strait off Low Island (915.80 km^2) (McIvor, 2014). Since the Environmental Protocol came into force, the rate of creating ASPAs has decreased to average less than one per year (Hughes et al., 2013).

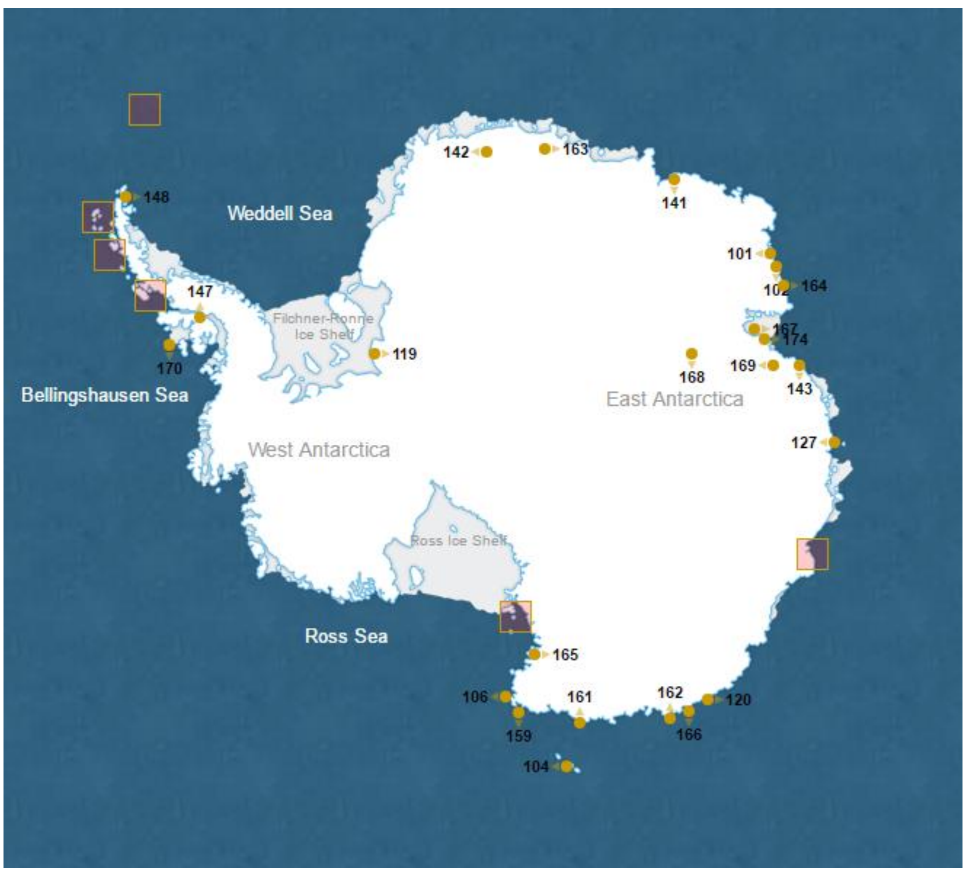

Figure 1: Map displaying ASPAs within the Antarctic Treaty area (Antarctic Treaty Secretariat, 2011a).

Entry into an ASPA is prohibited unless issued with a permit. In New Zealand, the authority that grants permits is the Ministry of Foreign Affairs and Trade (MFAT). To receive a permit the activities to be carried out in that area must be in line with the management plan, as the management plan provides information as to what conditions permits may be granted for. In New Zealand, all visits to ASPAs are recorded and reported so at the end of the year MFAT and other Antarctic Treaty Parties receive a yearly report (Antarctica New Zealand, 2017).

Antarctic Specially Managed Areas

ASMAs are the second form of protection and are established through Article 4 of Annex V. They are designated in areas where human activities may be conducted, either currently or in the future (McIvor, 2014). ASMAs are established to assist in planning and coordination of activities, to avoid conflict, improve cooperation between Treaty Parties, and lower the overall environmental impact. There are currently seven ASMAs in place (Figure 2, Appendix 2), varying in size from 1.11 km^2 at Cape Denison, East Antarctica, to the Amundsen-Scott South Pole Station which is 26,286.03 km^2 (McIvor, 2014).

Entry into an ASMA does not require a permit, but activities within ASMAs are governed by a code of conduct. There are generally a series of zones within ASMAs which have their own set of regulations. ASPAs can be created within the area of an ASMA. There are currently no guidelines for the management of ASMAs. In New Zealand, all entry and activity within a ASMA must be reported to MFAT, who then forward the information onto the Antarctic Treaty System (Antarctica New Zealand, 2017).

Figure 2: Map displaying ASMAs within the Antarctic Treaty area (Antarctic Treaty Secretariat, 2011b).

ASPAs vs. ASMAs

ASPAs have a higher degree of protection compared to ASMAs. It is an offence to enter or conduct activity in an ASPA without a permit, while the conditions of an ASMA only require that a non-mandatory code of conduct should be followed. ASPAs are designated to protect or conserve a significant environmental or scientific value, while the aim of ASMAs is to manage the cumulative impacts of human activities taking place in a particular area (McIvor, 2014). Some argue that ASPA status should be reserved for areas of the most outstanding scientific or environmental value, or at sites where oversampling is a concern. Conversely, while restricted zones within ASMAs have proven useful in areas where high levels of human visitation are possible, it is not clear how existing tools could be used to further protect environmental features or those of a larger spatial scale long-term (Hughes et al., 2015). The readjustment of zones within the current ASPA and ASMA system could prove advantageous in creating better management of heavy-traffic areas, but equally, the repercussions of minor adjustments could in fact create unforeseen issues rather than solutions (Hughes et al., 2015).

Protected Area Process

For an ASPA or ASMA to become formally designated a proposed management plan must be put forward at an Antarctic Treaty Consultative Meeting (ATCM). Any Antarctic Treaty Party, the Committee for Protection (CEP), the Scientific Committee on Antarctic Research (SCAR) or the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) can propose an area to be protected.

The Treaty Party who puts this proposal forward would normally become the proponent party, and is responsible for drafting and updating the management plan. It is important that the management plan is clear on what values the area would protect. The management plan must include details as outlined below:

- An Introduction providing a summary of important features, and why it should be protected
- A description of the values to be protected
- Aims and objectives and what protection will achieve for the site
- Management activities which states what is prohibited or allowed
- Period of designation - protection can be granted indefinitely
- Maps and description of the area, these need to be very detailed to accurately outline the protected area and whether zones will be implemented
- Terms and conditions for entry permits
- Finally, any supporting documentation such as scientific research

In the initial stages of drafting a management plan it is recommended that proponent Parties consult national and international bodies for advice (ATCP, 2011). A draft management plan is submitted to the CEP and if the proposed area has a marine element the management plan must also be submitted to CCAMLR. The CEP can put the plan before the subsidiary Group on management plans for review. If the plan is approved it is then put before the ATCM for consideration and adoption (Appendix 3). The ATCM must reach a consensus on agreement for the management plan to be adopted. If it is approved, protection of the area begins 90 days after the ATCM. The Management Plan is then reviewed every five years (Figure 5, Appendix 3).

Permitting

As the ATS is an international organisation, it does not possess the means of enforcement on its Treaty Parties, and therefore relies on the commitment of customary practice by the Treaty Parties (Hughes & Convey, 2010). The current system for management of ASPAs also falls to the proponent party of that ASPA. The proponent Party designates the requirements and conditions of access, according to the details established in the management plan. In New Zealand, permit approval is requested through the MFAT. A detailed request has to be submitted so that MFAT can report back the Antarctic Treaty Parties on the number of permits granted per year and details of the activities that took place within ASPAs.

Article 10 of Annex V provides the legislation for the exchange of information relating to protected areas. Parties have different approaches to the permitting systems; due to their differing national legislation, some Parties have the ability to provide other nations with permits (Pertierra & Hughes, 2013).

Treaty Parties are required to submit information on a number of aspects relating to permitting. Pre-season information outlines the planned activities for the upcoming year, which includes the protected areas to be visited, the number of permits, and the purpose of ASPA visits (Pertierra & Hughes, 2013). Since 2008, an Electronic Information Exchange System (EIES) has been available to collect the pre-season information (Pertierra & Hughes, 2013). Annual Reports are supposed to be submitted on the activities performed and permits allocated, however, some parties undermine their obligations under the Environmental Protocol by not reporting the full information on permits (Pertierra & Hughes, 2013).

Assessment and Analysis of the Current System

During negotiations on the protected areas system, it was recognised that a long-term approach was necessary and the Antarctic Treaty Parties should try to encompass the full range of Antarctic biodiversity into the protected area network (SCAR, Smith, Walton, & Dingwall, 1992). In response to this, Article 3.2 was created, which states "Parties shall seek to identify [new protected areas], within a systematic environmental-geographical framework" (Appendix 1). This was envisaged as a means of developing a representative network of areas. The new measures adopted within the Protocol have improved the details and management plans of individual protected sites, but there remain a number of issues with the overall system.

For the purpose of this report, the main issues with the system have been categorised into four main topics:

- Designation and Implementation
- Information Management
- Conflicts of interest
- Enforcement difficulties

These issues have hindered the system since its implementation in 2002. In 1992, SCAR and the International Union for Conservation of Nature (IUCN) conducted a workshop on Antarctic Protected Areas and presented 22 recommendations to the XVII ATCM in Venice. A number of the recommendations in 1992 remain at the core of issues today, highlighting the slow, reactive response from the ATS (Chown et al., 2012; SCAR et al., 1992; Shaw et al., 2014).

Designation and Implementation of ASPAs

The existing network of protected areas in Antarctica is not adequately addressing the long-term objectives outlined in the Protocol (Annex V). The current protected areas are sporadic in distribution and unrepresentative of some major Antarctic ecosystems (Hughes et al., 2013). Over the last few years, research into this area has increased. Several studies have investigated the effectiveness of the protected area system in representing the range of unique ecosystems across Antarctica (Hughes & Convey, 2010; Morgan, Barker, Briggs, Price, & Keys, 2007; Terauds et al., 2012).

One such study was conducted by Landcare Research, New Zealand (Morgan et al., 2007). They undertook an environmental domains analysis, whereby data on a variety of physical variables like climate, soil and geological characteristics was used to identify and classify distinct environmental regions across the entire Antarctic continent. In their study, 21 distinct and unique environmental regions were identified (Figure 3). When this map was compared to the locations and distributions of current ASPAs (Figure 1), there were conspicuous gaps in environmental protection across the continent - particularly West Antarctica (environmental domains C and S) and the centre of the Antarctic Plateau (environmental domain E). In light of this study, recommendations have been taken on board by the ATS and initiatives have been recently agreed upon to better develop the underlying frameworks for the protected area system (Hughes et al., 2013).

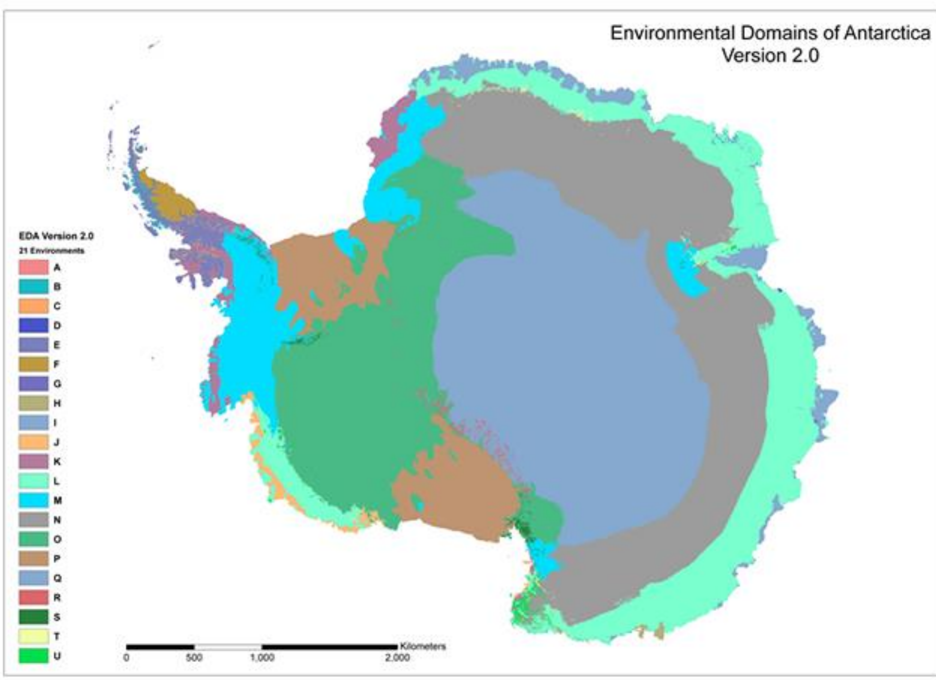

Figure 3: Environmental Domains Analysis (Morgan et al., 2007).

Building on the Landcare Research study, Terauds et al. (2012) performed a biogeographic analysis of the ice-free areas of Antarctica. This particular study was based on the framework created by the environmental domains analysis, to further take into account the biological footprint of the continent. This study identified 15 distinct ice-free regions of unique biodiversity and ecosystems and classified them as Antarctic Conservation Biogeographic Regions (ACBRs) (Figure 4). Hughes et al. (2015) then identified that five of the 15 distinct regions were not represented at all in the current protected area system. These assessments made in the 2015 study further reinforce the argument that the underlying framework of the protected areas system continues to undermine the efficacy of Antarctica's environmental protection system. In this way, a lack of representativeness across the protected area network may lead to the loss of unique biodiversity and ecosystems. Hughes et al. (2015) recommend that future protection systems must begin a coordinated identification of representative habitats and the designation of appropriate protected areas, alongside more proactive management and enforcement of designated area management plans. The study broadly recognised a need for the designation of a more representative network of ASPAs protecting terrestrial vegetated habitats, particularly in ACBRs where no ASPAs currently exist (Hughes et al., 2015; Terauds et al., 2012).

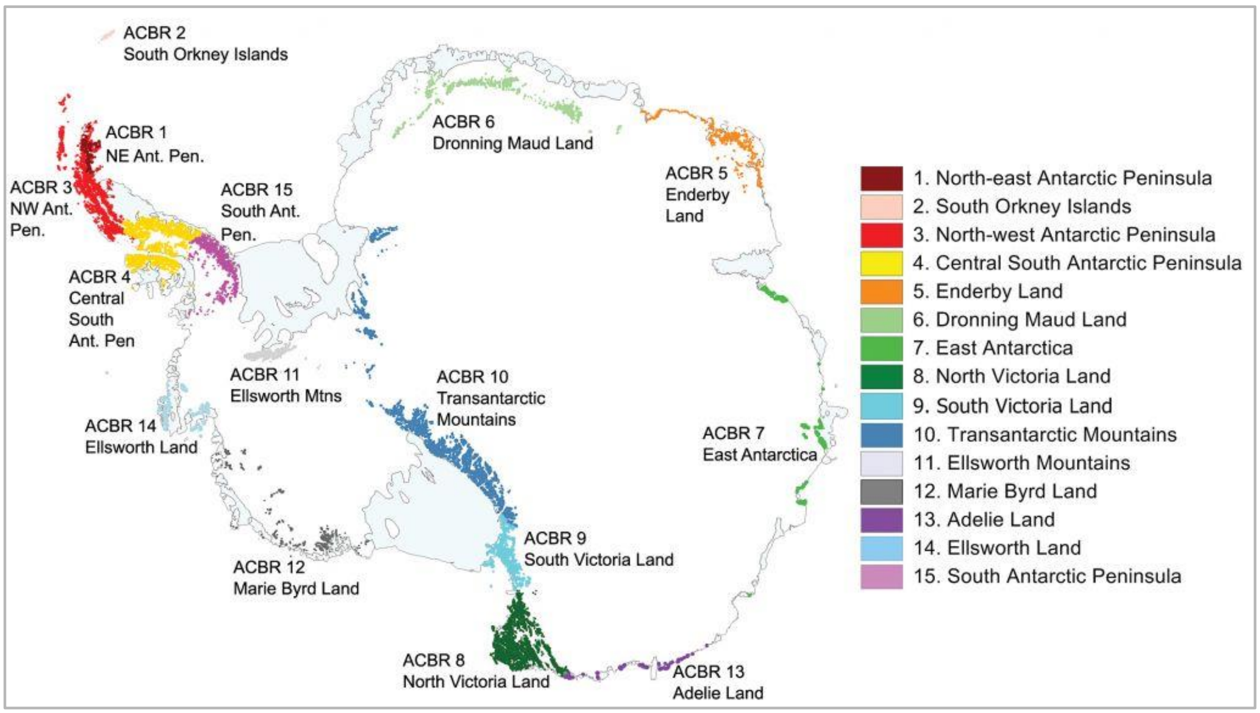

Figure 4: Antarctic Conservation Biogeographic Regions (Terauds et al., 2012).

Hughes et al. (2016) notes that throughout the development and implementation of the protected area system "the protection of specific geological features and values has not featured as prominently as the protection of biological values" (p. 5). The danger associated with this lack of protection afforded to geological features in Antarctica is the potential for oversampling of rare fossils, rocks or minerals that may not be found anywhere else on the planet (Hughes et al., 2016). In order to protect the continent's non-renewable geological specimens for future scientific studies, the paper argues that further consideration should be given to four focus sections. These include the criteria for geoconservation, an effort to improve recording and sharing of information on geological material that has been sampled, a greater use of specimens in existing geological collections where appropriate, and better monitoring of sampling impact at vulnerable sites to inform environmental management decisions (Hughes et al., 2016).

Information Management

As noted above, the original requirements of the protected areas system stipulated that Treaty Parties permitted to visit ASPAs (whether for research, tourism or historical purposes) would be required to file reports on their visits. This reporting process within the EIES was intended to facilitate continual oversight on the condition of each ASPA, and create an ongoing record of the human traffic and subsequent environmental impacts on each ASPA site. However, in many cases it has been reported that this system has been largely ignored by the scientists themselves and/or the authorities granting their permits, making informed management decisions very difficult to achieve (Hughes et al., 2013).

When reviewing the effectiveness of the EIES, Pertierra and Hughes (2013) found a number of inconsistencies in the information submitted by Parties. Some parties did not submit any ASPA permit information during one season despite subsequent information in an ASPA management plan indicating that they had conducted scientific work in the area during that same season. Another Party submitted multiple permit applications to the EIES however none of the ASPAs were visited subsequently. In addition to missing permit information, parties also allocated permits for much longer periods of time than required for the activity. This was thought to accommodate any issues that may cause delays, but in fact contributed to a much larger problem around inaccurate information within the EIES. The value lost by research parties misusing and ignoring the EIES meant that information exchange became extremely inconsistent and limited the EIES' usefulness. The issue here was that the permit information could not be used to evaluate the length of time spent in each ASPA per year and therefore estimations of potential impacts were significantly more difficult to ascertain (Pertierra & Hughes, 2013).

Collecting information in a central database is not useful if it cannot be utilised. The purpose of exchange is to build up a record of information and activity that can be used to monitor human impacts in different ASPA regions. The information could then be used by a range of parties for future environmental management assessments, and analysis of the environments' coping viability to human impacts. In the case where scientific research is the primary purpose, it would be invaluable to specify the scientific discipline for which the area is designated, for example, microbiology, where higher standards of biosecurity may be required to minimise microbial contamination within the area (Hughes et al., 2013). Further, increased levels of information across a number of platforms and disciplines would help to make the EIES a more robust and useful system.

Conflicts of interests within ASPAs

Despite Annex V to the Protocol requiring ASPA proposals to define the values for which the area should be protected, there can be some ambiguity between prioritising conservation values or scientific values. If the intended reason for protection is not clear, it can lead to difficulties in the management of an area as science and conservation can have vastly different management requirements (Hughes et al., 2013). For example, a sub-site of ASPA 140 which covers parts of Deception Island contains a unique assemblage of plant species that grow near areas of volcanic activity. The sub-site was originally designated for conservation but with the reclassification of protected areas that came with the adoption of the Environmental Protocol, this intention became obscured. As a result, numerous science parties have conducted research in the area and caused environmental impacts by trampling the delicate vegetation (Hughes et al., 2013). This inadvertent conflict with the intentions and management plan for the ASPA highlights the need for clarity on proposals as to the main reason for protection.

In addition to the conflict between science and conservation values, scientists of different disciplines may have different requirements to each other (Cowan et al., 2011; Hughes & Convey, 2010; Hughes et al., 2013). Some steps have been taken to resolve scientific conflict through the use of zoning in ASPAs to protect sub-sites for different types of research (e.g. ASPA 126 Byers Peninsula or ASPA 118, Cryptogram Ridge, Mt Melbourne). However, to date there are only about 15 ASPA management plans that describe seasonal or permanent restricted zones (Hughes et al., 2013). Increased use of this conservation mechanism could be harnessed in order to allow protection of both scientific and conservation values and cater to the requirements of different scientific disciplines (ASOC, 2012; Harris, 2000).

The role of advisory committees like SCAR is not insignificant in supporting the success of the protected areas system in Antarctica. SCAR's Environmental Code of Conduct for Terrestrial Scientific Field Research in Antarctica and Code of Conduct for the Exploration and Research of Subglacial Aquatic Environments aim to help guide scientific practice within the protected areas system (SCAR, 2016). Comprehensive and broad consultation of a number of parties occurs throughout the development of codes of conduct. These codes of conduct are intended as 'non-mandatory guides to best practice', in which their "implementation at any particular location would be a matter for National Programmes to consider in consultation with each other and appropriate experts" (SCAR, 2016, p. 3). Because of this creation and implementation process, there is a perception that these kinds of documents are created from a 'bottom-up' regulatory approach. Therefore they are considered as more genuine regulatory processes from within the Antarctic community (Cook, 1990). Whether this perceived acceptance of the process actually translates into better implementation of environmental principles is yet unproven.

Enforcement

Even with management plans in place, enforcement of the Environmental Protocol and the ASPA conditions is a challenge due to a number of external factors. One of these is the extreme nature of the Antarctic environment. On-site supervision such as a warden service similar to that used in protected areas elsewhere is impractical in ASPAs, however active supervision and monitoring is crucial to ensuring the values of the ASPA are upheld (SCAR et al., 1992). The problem is that monitoring ASPAs is both a costly and time-consuming burden for proponent nations - perhaps countervailing the purpose of protection in the first place (Cantú-Salazar & Gaston, 2010). A further debate around this is the trade-off between the human impacts caused by monitoring against the benefit of the information that could be gained.

Traditional arguments around the tension between national sovereignty and international environmental regimes argue that states cannot fully commit to regime principles whilst also maintaining sovereignty norms (Elliott, 1994; Vidas, 2000). Elliott (1994) goes as far to claim that "voluntarism and decentralisation have proved inadequate in managing transboundary or global environmental insecurities" (248), and in this way, environmental protection agreements (like the protected areas system) are inherently compromised by several often diverging national interests. This arguably demonstrates how even in the absence of overt demonstrations of nationalist politics, the initial arguments regarding sovereignty and jurisdiction over Antarctica remain omnipresent in the actions of the treaty parties and their inconsistency of commitment to protection and management at any nationalist cost (Vidas, 2000).

The problem lies inherently in the idea that if no-one has ownership of Antarctica then no-one has responsibility to police the environment, and thus the Antarctic Treaty System as a whole struggles to foster genuine and accountable environmental protection at the cost of the treaty parties themselves. These observations highlight the difficulty of creating genuine and accountable environmental protection in a political landscape where sovereignty norms prevail, and "raise the question of whether voluntary restraint and compliance can ever be effective in achieving environmental protection" (Elliott, 1994, p. 265). For there to be any positive change in the future, the Parties must collectively act on their agreed responsibility to maintain Antarctica 'as a natural reserve' (Hughes et al., 2015), despite individual reservations about other National Antarctic Programs (NAPs). While conflicting interests between states within ASPAs may arise specifically due to the protection of different values and interests of those entering the area, these geopolitical constraints are also characterised within the wider realm of general environmental protection in Antarctica (Hughes et al., 2013).

The difficulties in managing the diverging interests of various NAPs also lend themselves to the idea that much of the struggle related to slow decision making within both the ATS and protected areas system is due to the consensus based model the parties follow (Elliot, 1994). The ATS and the instruments created within it (The Environmental Protocol and subsequently the protected areas system) were designed to limit any new instruments, legislation or amendments to those that could only occur under consensus of the parties involved (Elliott, 1994). This means that culturally, socially, and economically distinct countries - ranging from

New Zealand, the United Kingdom to China and Chile - would have to agree on all aspects of the tabled issue in order for it to be carried forward in the specific decision making process (Vidas, 2000). Because of this, and despite rapidly changing environmental demands, changes to existing frameworks in both the protected areas system and the ATS have been slow and reactive rather than precautionary. This further highlights the need for Treaty Parties to identify and combat future potential challenges now. Given the slow pace at which ASPAs are designated, it may be useful to adopt a precautionary approach and protect areas not yet perceived as threatened, for example West Antarctic, which are currently regions unrepresented in the Antarctic protected area system (Hughes et al., 2013).

Five of the 28 Consultative Parties are proponents for 78.9% of all ASPAs (UK, New Zealand, USA, Australia and Chile) with the UK alone the proponent for almost 20% (Hughes et al., 2013). In terms of monitoring and management of these ASPA regions, the mechanics of maintenance usually falls on the shoulders of the proponent country due to the ASPA region being designated closest to the proponent country's base (Hughes et al., 2013). While this approach is sensible, it arguably breeds a culture of expectation that environmental protection should subsequently fall on the proponent nations of the ASPAs and not the entire party system (Hughes et al., 2013). This discourse further accentuates the unequal buy-in and representation from treaty parties in the protected areas system, contributing to a number of implementation issues as laid out above.

Potential Effects of Global Environmental Change

One emerging difficulty faced by the protected areas system is that of a rapidly changing environment. Considering scientific enquiry and conservation efforts represent the glue that holds the Antarctic Treaty system together, changes to, or complete loss of unique Antarctic terrestrial and marine ecosystems would create significant political and ecological implications. Antarctic terrestrial ecosystems are some of the hallmarks of science and conservation efforts in Antarctica. Therefore, protection of these special environments is of utmost importance, especially in the face of a rapidly changing climate.

Many ASMAs and ASPAs aim to protect Antarctica's unique terrestrial ecosystems, however, given the contemporary context of an unstable and unpredictable climate, is enough being done to ensure the terrestrial ecosystems most at risk are adequately protected? During this period of rapid, unchartered environmental change, fluidity is required in both the geographical definition of protected areas as well as the management practices within these areas. In the following sections, the report will provide an assessment of the effectiveness of the ASPA system in protecting Antarctic terrestrial ecosystems given the accumulating impacts of climate change within Antarctica.

Climate Change in Antarctica

Antarctic terrestrial ecosystems are the embodiment of harsh environments (Fountain et al., 1999). The main life-limiting factor in such systems is the extremely low temperatures. Low temperatures control primary productivity, growth rates and overall survival of organisms, as well as impairing the availability of liquid water (Nielsen, Wall, Adams, & Virginia, 2011; Peck, Convey, & Barnes, 2006). Precipitation rates are very low in Antarctica, particularly in inner continental regions, which are only able to support ecosystems with low species richness and abundance (Wall & Virginia, 1999). With most organisms existing at the edges of their physiological capabilities, even the smallest of changes to temperature and precipitation regimes have the potential to hugely impact the biological communities of Antarctic terrestrial ecosystems (Nielsen et al., 2011).

Rapid climate warming has been observed in parts of maritime Antarctica where some local temperatures have raised by almost 3°C (Turner et al., 2005). There is, however, high spatial variability in temperature and precipitation changes across the continent, with both increases and decreases observed at a local level (Nielsen et al., 2011). Nonetheless, an increase in both temperature and precipitation is predicted in the Antarctic region throughout the remaining course of the 21st century and beyond (Turner et al., 2005).

As well as an overall increase in temperature, the frequency and severity of extreme climate events are expected to increase in the coming years (Hoffman & Parsons, 1997; Solomon et al., 2007). For example, heatwaves are predicted to increase in occurrence. Heatwaves are defined as extreme temperature events during which average daily temperature is more than 5 degrees higher than the usual average for at least five consecutive days (Tebaldi, Smith, Nychka, & Mearns, 2005). Such events, with frequency, will lead to unprecedented increases in moisture availability to Antarctic terrestrial ecosystems, especially those in coastal areas (Nielsen et al., 2011; Turner et al., 2005). Initial increase in moisture availability may give way to an arid environment in the long term. It is highly likely that precipitation will not be enough to counteract melt rates, thus resulting in a net loss of moisture, including permanent snow and ice reserves which act as vital moisture reservoirs for terrestrial ecosystems (Robinson, Wasley, & Tobin, 2003).

Climate Change Impacts on Antarctic Terrestrial Ecosystems

The degree to which local terrestrial ecosystems are impacted by a changing climate will depend on an array of current microclimate conditions (Nielsen et al., 2011; Peck et al., 2006). Such conditions include average daily temperatures, soil moisture and species community composition, including the presence or absence of vegetation (Nielsen et al., 2011). The number and efficiency of invasive species entry pathways will also determine the extent to which individual terrestrial ecosystems are impacted.

At a species level, the predicted responses to a warmer, moister climate include increased efficiency and duration of metabolic activity as well as increased growth rates and shortened life cycles (Convey, 2006). At a population level, species are expected to increase in abundance and thus expand their local distributions (Nielsen et al., 2011; Wall & Virginia, 1999). At a community level, relative species abundances are expected to shift, with responsive, opportunistic species favoured over unique, cold adapted species (Nielsen et al., 2011; Wall & Virginia, 1999). Alterations to community composition will likely lead to changes in ecosystem functioning of which flow on effects will be significant.

The abundance of unique, cold adapted species in Antarctic terrestrial ecosystems will also likely succumb to invasive foreign species, whose survival and establishment in Antarctica will be facilitated by the warmer temperatures and moister environments (Convey, 2011). Adaptations to the cold which allow Antarctic organisms to survive, such as antifreeze protein production, come with costly trade-offs, thus these unique species would be rendered non-competitive in a milder environment (Nielsen et al., 2011). Successful establishment of invasive species may also result in the exploitation of previously unoccupied ecological niches, and lead to the introduction of new trophic functions into the sensitive ecosystem (Convey, 2011). Such ecological changes would make restoration of unique Antarctic terrestrial ecosystems very challenging, if not impossible, following the establishment of any invasive species (Convey, 2011).

Another potential way in which climate change will negatively affect Antarctic terrestrial biota is through physiological stress induced by freeze-thaw events (Robinson et al., 2003; Turner et al., 2015). Greater climate variability means that freeze-thaw cycles will increase in frequency (Robinson et al., 2003; Turner et al., 2015). The physiological stress of frequent freeze-thaw events will potentially be very damaging to all manner of life throughout Antarctic terrestrial ecosystems, even more so than constantly low temperatures (Nielsen et al., 2011; Robinson et al., 2003).

Climate Change Response Recommendations

ASMAs and ASPAs designed to protect and conserve Antarctic terrestrial ecosystems must be regularly reviewed and have fluid management plans based on working data sets in order to effectively protect an ecosystem in its contemporary state. As it stands, there is a lack of incorporation of up-to-date biological data in protection and management plans for Antarctic terrestrial ecosystems (Lynch, Foley, Thorne, & Lynch, 2016).

Lynch et al. (2016) published a review of the use of biological data in informing Antarctic environmental policy, including in the formation and management of specially protected areas. For the purposes of their review, they examined 89 documents associated with ASPA and ASMA management plans which provided data for penguin species (Lynch et al., 2016). It was concluded that the integration of accurate, up to date biological data in Antarctic environmental policy documents is insufficient to accurately predict future trends and thus develop appropriate management strategies. For example, of the 89 documents reviewed, 35 did not offer any quantitative data at all, six provided undated quantitative data and 48 offered dated, quantitative data but did not provide a traceable source. While 27 did provided a source for their data, 14 referred to sources that were not peer-reviewed (Lynch et al., 2016).

To accompany their conclusion, Lynch et al. (2016) supplied a recommendation list for the criteria biological data should meet in order to adequately inform environmental protection and management decisions. According to their recommendations, proponents should present biological data which establishes baseline biological conditions in the area of the proposed or reviewed ASPA. Only the most up to date, traceable, peer-reviewed data should be used with both the associated methodology and uncertainties thoroughly outlined for use in future surveys. Adequate maps, imagery and coordinates should also be supplied to assist in future surveys.

Other than improving the biological data used to inform environmental policy and conservation decisions, management plans for Antarctic specially protected areas must evolve to best prevent introductions of invasive species as well as species homogenisation.

The risk of successful invasion would be higher in a warmer Antarctic climate due to higher chance of successful establishment (Convey, 2011). To decrease the risk of invasive species establishment, remote sensing techniques should become strongly relied upon for fulfilling scientific enquiry in protected areas (Hughes & Convey, 2010). Heavy use of remote sensing techniques will reduce the amount of human traffic in protected areas, thus reducing the risk of introducing propagules, spores and other biological material that is associated with the movement of humans (Hughes & Convey, 2010).

Special protection should be given to ecosystems supporting unique assemblages of species as well as local endemism hotspots (Terauds et al., 2012). This will help to reduce species homogenisation between Antarctic terrestrial ecosystems by evading the spread of opportunistic species (Wall & Virginia, 1999). Such protection could be achieved through minimising human movement between biologically isolated regions and maximising use of remote sensing techniques (Hughes & Convey, 2010).

Climate Change Response Work Programme

The Antarctic Treaty Meeting of Experts on impacts of climate change for management and governance of the Antarctic region made conclusions and recommendations for Antarctic climate change response (ATME, 2010). From this, the climate change response work programme (CCRWP) was developed. The programme aims to provide a mechanism for identifying and revising both goals and specific actions by the CEP. Through this, the CCRWP will be supporting efforts within the ATS to prepare for, and develop resilience to, the environmental impacts a changing climate will bring, along with the associated governance and management implications. A range of parties are expected to follow the recommendations and timeline provided by CCRWP including SCAR, NAPs, the CEP and any other interested parties.

One climate change related issue identified in the CCRWP is the potential changes terrestrial biotic and abiotic environments will undergo. One of the seven proposed actions associated with this issue is to review the existing ASPA network as well as the process for designation of ASPAs to ensure that the network takes into account potential climate change impacts and considers how management plans might evolve to best respond. Another proposed action is to protect areas representing each biogeographic region, as well as areas that could potentially provide refuge to species and ecosystems most at risk.

It is promising to see that climate change is being acknowledged in the context of ASPAs and there have been timelines put in place by the CCRWP to achieve tasks associated with the use of ASPAs in climate change response. However, the actions proposed by CCRWP will only be effective if the informing biological data is up to date and meets the criteria set by Lynch et al. (2016) as previously discussed.

Conclusion

When presenting at the 1998 Antarctic Protected Areas Workshop, keynote speaker Sir Martin Holdgate concluded his speech by asking what the Antarctic protected area system should look like by 2020. He expected that there would be over 100 strict nature reserves representing geographical, habitat and ecological areas. He also proposed that ten large ASMAs would be needed across Antarctica, with additional smaller ASMAs surrounding the coastline where increasing anthropogenic pressure is being directed (Njaastad, 1998). Considering the progress of the protected areas system to date, it seems unlikely that Sir Martin’s aspirations for environmental protection will be realised.

When the ASMA and ASPA systems are assessed in isolation they appear to be effective, as the thorough process of adoption of each area’s management plan ensures the protection proposed is sufficient to protect its particular value. However, the systematic environmental geographical framework that The Environmental Protocol hoped to achieve is still neither a representative nor comprehensive protection framework. For the protected areas system in Antarctica to be both meaningful and effective, regulations in protected areas need to be much stronger than regulations outside those areas (ASOC, 2015).

All Treaty Parties need to be equally committed to implementing permit requirements and reporting on the number and type of permitted activities allowed per season, so that an accurate and informative database can be created and utilised. To facilitate the improvements required to the protection system, Treaty Parties also need to further engage with other international environmental policy instruments and organisations associated with successful systems (Chown et al., 2012). All Parties also must invest in the protection of Antarctica by becoming active proponents and not relying on the Parties that have previously adopted the protection mantle responsibility. Antarctic Treaty Parties must also work more collaboratively with Antarctic organisations like SCAR, the CEP, and ASOC to together implement an effective and pragmatic system for protecting unique Antarctic biological assemblages, in order to avoid compromising Antarctica's role as a continent dedicated to science and peace (Hughes & Convey, 2010).

It is important that ASPAs and ASMAs are utilised to their fullest potential in protecting Antarctica's unique and fragile environment from the evolving impacts of climate change and ever-increasing human presence in Antarctica. Although the CCRWP has set some promising goals and expectations for climate change response in Antarctica, the effective execution of their recommended tasks relies heavily on the willingness and cooperation of a range of Antarctic parties including SCAR, NAPs and the CEP. Data used to inform policy decisions will also influence the effectiveness of the recommended CCRWP tasks. Quality and up-to-date biological data is crucial in accurately predicting population trends, and thus developing effective protection management plans.

Now more than ever we must consider the environmental impact of conducting science in Antarctica. With the increasing risk of human induced impacts, the protected areas system must evolve to best protect the environment. While Antarctica is "often described as 'a continent for science', the value of Antarctica for science must be weighed against the environmental impact of scientific work and its logistic support" (Hughes & Convey, 2010, p. 107). Outlining the intentions and process of the protected areas system, highlighting the current challenges presented by implementation and management of the system, the managing of conflicting interests and enforcement difficulties, and the rapidly evolving environmental conditions has allowed this report to effectively explore and assess Antarctica's current protected areas system. Ultimately, the Antarctic community must work together to honour its commitment to preserving and conserving Antarctica, and continue to develop systems like Antarctica's protected areas, in order to maintain the environmental integrity of a place so unique, to so many.

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Appendices

Appendix 1: Annex V

ANNEX V TO THE PROTOCOL ON ENVIRONMENTAL PROTECTION TO THE ANTARCTIC TREATY AREA PROTECTION AND MANAGEMENT

ARTICLE 1 - DEFINITIONS

For the purposes of this Annex:

(a) "appropriate authority" means any person or agency authorised by a Party to issue permits under this Annex;

(b) "permit" means a formal permission in writing issued by an appropriate authority;

(c) "Management Plan" means a plan to manage the activities and protect the special value or values in an Antarctic Specially Protected Area or an Antarctic Specially Managed Area.

ARTICLE 2 - OBJECTIVES

For the purposes set out in this Annex, any area, including any marine area, may be designated as an Antarctic Specially Protected Area or an Antarctic Specially Managed Area. Activities in those Areas shall be prohibited, restricted or managed in accordance with Management Plans adopted under the provisions of this Annex.

ARTICLE 3 - ANTARCTIC SPECIALLY PROTECTED AREAS

1. Any area, including any marine area, may be designated as an Antarctic Specially Protected Area to protect outstanding environmental, scientific, historic, aesthetic or wilderness values, any combination of those values, or ongoing or planned scientific research.

2. Parties shall seek to identify, within a systematic environmental-geographical framework, and to include in the series of Antarctic Specially Protected Areas:

(a) areas kept inviolate from human interference so that future comparisons may be possible with localities that have been affected by human activities;

(b) representative examples of major terrestrial, including glacial and aquatic, ecosystems and marine ecosystems;

(c) areas with important or unusual assemblages of species, including major colonies of breeding native birds or mammals;

(d) the type locality or only known habitat of any species;

(e) areas of particular interest to ongoing or planned scientific research;

(f) examples of outstanding geological, glaciological or geomorphological features;

(g) areas of outstanding aesthetic and wilderness value;

(h) sites or monuments of recognised historic value; and

(i) such other areas as may be appropriate to protect the values set out in paragraph 1 above.

3. Specially Protected Areas and Sites of Special Scientific Interest designated as such by past Antarctic Treaty Consultative Meetings are hereby designated as Antarctic Specially Protected Areas and shall be renamed and renumbered accordingly.

4. Entry into an Antarctic Specially Protected Area shall be prohibited except in accordance with a permit issued under Article 7.

ARTICLE 4 - ANTARCTIC SPECIALLY MANAGED AREAS

1. Any area, including any marine area, where activities are being conducted or may in the future be conducted, may be designated as an Antarctic Specially Managed Area to assist in the planning and co-ordination of activities, avoid possible conflicts, improve cooperation between Parties or minimise environmental impacts.

2. Antarctic Specially Managed Areas may include: (a) areas where activities pose risks of mutual interference or cumulative environmental impacts; and (b) sites or monuments of recognised historic value.

3. Entry into an Antarctic Specially Managed Area shall not require a permit.

4. Notwithstanding paragraph 3 above, an Antarctic Specially Managed Area may contain one or more Antarctic Specially Protected Areas, entry into which shall be prohibited except in accordance with a permit issued under Article 7.

ARTICLE 5 - MANAGEMENT PLANS

1. Any Party, the Committee, the Scientific Committee for Antarctic Research or the Commission for the Conservation of Antarctic Marine Living Resources may propose an area for designation as an Antarctic Specially Protected Area or an Antarctic Specially Managed Area by submitting a proposed Management Plan to the Antarctic Treaty Consultative Meeting.

2. The area proposed for designation shall be of sufficient size to protect the values for which the special protection or management is required.

3. Proposed Management Plans shall include, as appropriate:

(a) a description of the value or values for which special protection or management is required;

(b) a statement of the aims and objectives of the Management Plan for the protection or management of those values;

(c) management activities which are to be undertaken to protect the values for which special protection or management is required;

(d) a period of designation, if any;

(e) a description of the area, including:

(i) the geographical co-ordinates, boundary markers and natural features that delineate the area;

(ii) access to the area by land, sea or air including marine approaches and anchorages, pedestrian and vehicular routes within the area, and aircraft routes and landing areas;

(iii) the location of structures, including scientific stations, research or refuge facilities, both within the area and near to it; and

(iv) the location in or near the area of other Antarctic Specially Protected Areas or Antarctic Specially Managed Areas designated under this Annex, or other protected areas designated in accordance with measures adopted under other components of the Antarctic Treaty system;

(f) the identification of zones within the area, in which activities are to be prohibited, restricted or managed for the purpose of achieving the aims and objectives referred to in subparagraph (b) above;

(g) maps and photographs that show clearly the boundary of the area in relation to surrounding features and key features within the area;

(h) supporting documentation;

(i) in respect of an area proposed for designation as an Antarctic Specially Protected Area, a clear description of the conditions under which permits may be granted by the appropriate authority regarding:

(i) access to and movement within or over the area;

(ii) activities which are or may be conducted within the area, including restrictions on time and place;

(iii) the installation, modification, or removal of structures;

(iv) the location of field camps;

(v) restrictions on materials and organisms which may be brought into the area;

(vi) the taking of or harmful interference with native flora and fauna;

(vii) the collection or removal of anything not brought into the area by the permit-holder;

(viii) the disposal of waste;

(ix) measures that may be necessary to ensure that the aims and objectives of the Management Plan can continue to be met; and

(x) requirements for reports to be made to the appropriate authority regarding visits to the area;

(j) in respect of an area proposed for designation as an Antarctic Specially Managed Area, a code of conduct regarding:

(i) access to and movement within or over the area;

(ii) activities which are or may be conducted within the area, including restrictions on time and place;

(iii) the installation, modification, or removal of structures;

(iv) the location of field camps;

(v) the taking of or harmful interference with native flora and fauna;

(vi) the collection or removal of anything not brought into the area by the visitor;

(vii) the disposal of waste; and

(viii) any requirements for reports to be made to the appropriate authority regarding visits to the area; and

(k) provisions relating to the circumstances in which Parties should seek to exchange information in advance of activities which they propose to conduct.

ARTICLE 6 - DESIGNATION PROCEDURES

1. Proposed Management Plans shall be forwarded to the Committee, the Scientific Committee on Antarctic Research and, as appropriate, to the Commission for the Conservation of Antarctic Marine Living Resources. In formulating its advice to the Antarctic Treaty Consultative Meeting, the Committee shall take into account any comments provided by the Scientific Committee on Antarctic Research and, as appropriate, by the Commission for the Conservation of Antarctic Marine Living Resources. Thereafter Management Plans may be approved by the Antarctic Treaty Consultative Parties by a measure adopted at an Antarctic Treaty Consultative Meeting in accordance with Article IX(1) of the Antarctic Treaty. Unless the measure specifies otherwise, the Plan shall be deemed to have been approved 90 days after the close of the Antarctic Treaty Consultative Meeting at which it was adopted, unless one or more of the Consultative Parties notifies the Depositary, within that time period, that it wishes an extension of that period or is unable to approve the measure.

2. Having regard to the provisions of Articles 4 and 5 of the Protocol, no marine area shall be designated as an Antarctic Specially Protected Area or an Antarctic Specially Managed Area without the prior approval of the Commission for the Conservation of Antarctic Marine Living Resources.

3. Designation of an Antarctic Specially Protected Area or an Antarctic Specially Managed Area shall be for an indefinite period unless the Management Plan provides otherwise. A review of a Management Plan shall be initiated at least every five years. The Plan shall be updated as necessary.

4. Management Plans may be amended or revoked in accordance with paragraph 1 above.

5. Upon approval Management Plans shall be circulated promptly by the Depositary to all Parties. The Depositary shall maintain a record of all currently approved Management Plans.

ARTICLE 7 - PERMITS

1. Each Party shall appoint an appropriate authority to issue permits to enter and engage in activities within an Antarctic Specially Protected Area in accordance with the requirements of the

Management Plan relating to that Area. The permit shall be accompanied by the relevant sections of the Management Plan and shall specify the extent and location of the Area, the authorised activities and when, where and by whom the activities are authorised and any other conditions imposed by the Management Plan.

2. In the case of a Specially Protected Area designated as such by past Antarctic Treaty Consultative Meetings which does not have a Management Plan, the appropriate authority may issue a permit for a compelling scientific purpose which cannot be served elsewhere and which will not jeopardise the natural ecological system in that Area.

3. Each Party shall require a permit-holder to carry a copy of the permit while in the Antarctic Specially Protected Area concerned.

ARTICLE 8 - HISTORIC SITES AND MONUMENTS

1. Sites or monuments of recognised historic value which have been designated as Antarctic Specially Protected Areas or Antarctic Specially Managed Areas, or which are located within such Areas, shall be listed as Historic Sites and Monuments.

2. Any Party may propose a site or monument of recognised historic value which has not been designated as an Antarctic Specially Protected Area or an Antarctic Specially Managed Area, or which is not located within such an Area, for listing as a Historic Site or Monument. The proposal for listing may be approved by the Antarctic Treaty Consultative Parties by a measure adopted at an Antarctic Treaty Consultative Meeting in accordance with Article IX(1) of the Antarctic Treaty. Unless the measure specifies otherwise, the proposal shall be deemed to have been approved 90 days after the close of the Antarctic Treaty Consultative Meeting at which it was adopted, unless one or more of the Consultative Parties notifies the Depositary, within that time period, that it wishes an extension of that period or is unable to approve the measure.

3. Existing Historic Sites and Monuments which have been listed as such by previous Antarctic Treaty Consultative Meetings shall be included in the list of Historic Sites and Monuments under this Article.

4. Listed Historic Sites and Monuments shall not be damaged, removed or destroyed.

5. The list of Historic Sites and Monuments may be amended in accordance with paragraph 2 above. The Depositary shall maintain a list of current Historic Sites and Monuments.

ARTICLE 9 - INFORMATION AND PUBLICITY

1. With a view to ensuring that all persons visiting or proposing to visit Antarctica understand and observe the provisions of this Annex, each Party shall make available information setting forth, in particular:

(a) the location of Antarctic Specially Protected Areas and Antarctic Specially Managed Areas;

(b) listing and maps of those Areas;

(c) the Management Plans, including listings of prohibitions relevant to each Area;

(d) the location of Historic Sites and Monuments and any relevant prohibition or restriction.

2. Each Party shall ensure that the location and, if possible, the limits, of Antarctic Specially Protected Areas, Antarctic Specially Managed Areas and Historic Sites and Monuments are shown on its topographic maps, hydrographic charts and in other relevant publications.

3. Parties shall co-operate to ensure that, where appropriate, the boundaries of Antarctic Specially Protected Areas, Antarctic Specially Managed Areas and Historic Sites and Monuments are suitably marked on the site.

ARTICLE 10 - EXCHANGE OF INFORMATION

1. The Parties shall make arrangements for:

(a) collecting and exchanging records, including records of permits and reports of visits, including inspection visits, to Antarctic Specially Protected Areas and reports of inspection visits to Antarctic Specially Managed Areas;

(b) obtaining and exchanging information on any significant change or damage to any Antarctic Specially Managed Area, Antarctic Specially Protected Area or Historic Site or Monument; and

(c) establishing common forms in which records and information shall be submitted by Parties in accordance with paragraph 2 below.

2. Each Party shall inform the other Parties and the Committee before the end of November of each year of the number and nature of permits issued under this Annex in the preceding period of 1st July to 30th June.

3. Each Party conducting, funding or authorising research or other activities in Antarctic Specially Protected Areas or Antarctic Specially Managed Areas shall maintain a record of such activities and in the annual exchange of information in accordance with the Antarctic Treaty shall provide summary descriptions of the activities conducted by persons subject to its jurisdiction in such areas in the preceding year.

4. Each Party shall inform the other Parties and the Committee before the end of November each year of measures it has taken to implement this Annex, including any site inspections and any steps it has taken to address instances of activities in contravention of the provisions of the approved Management Plan for an Antarctic Specially Protected Area or Antarctic Specially Managed Area.

ARTICLE 11 - CASES OF EMERGENCY

1. The restrictions laid down and authorised by this Annex shall not apply in cases of emergency involving safety of human life or of ships, aircraft, or equipment and facilities of high value or the protection of the environment.

2. Notice of activities undertaken in cases of emergency shall be circulated immediately to all Parties and to the Committee.

ARTICLE 12 - AMENDMENT OR MODIFICATION

1. This Annex may be amended or modified by a measure adopted in accordance with Article IX(1) of the Antarctic Treaty. Unless the measure specifies otherwise, the amendment or modification shall be deemed to have been approved, and shall become effective, one year after the close of the Antarctic Treaty Consultative Meeting at which it was adopted, unless one or more of the Antarctic Treaty Consultative Parties notifies the Depositary, within that time period, that it wishes an extension of that period or that it is unable to approve the measure.

2. Any amendment or modification of this Annex which becomes effective in accordance with paragraph 1 above shall thereafter become effective as to any other Party when notice of approval by it has been received by the Depositary.

Appendix 2

Table 1. Information for each Antarctic Specially Protected Area and Antarctic Specially Managed Area modified from (McIvor, 2014; Morgan et al., 2007; Unknown, 2011).

ASPA / ASMA	#	Name	Proponent(s)	Primary reason for designation	Main Environmental Domain	Other Environmental Domains
ASPA	101	Taylor Rookery, Mac. Robertson Land	Australia	C	D	
ASPA	102	Rookery Islands, Holme Bay, Mac. Robertson Land	Australia	C	Not classified	
ASPA	103	Ardery Island and Odbert Island, Budd Coast	Australia	C	Not classified	
ASPA	104	Sabrina Island, Balleny Islands	New Zealand	B	Not classified	
ASPA	105	Beaufort Island, Ross Sea	New Zealand	C	S	M
ASPA	106	Cape Hallett, Victoria Land	United States	C	U	
ASPA	107	Emperor Island, Dion Islands, Marguerite Bay, Antarctic	United Kingdom	C	Not classified	

		Peninsula				
ASPA	108	Green Island, Berthelot Islands, Antarctic Peninsula	United Kingdom	C	Not classified	
ASPA	109	Moe Island, South Orkney Islands	United Kingdom	B	Not classified	
ASPA	110	Lynch Island, South Orkney Islands	United Kingdom	B	Not classified	
ASPA	111	Southern Powell Island and adjacent islands, South Orkney Islands	United Kingdom	C	G	A
ASPA	112	Coppermine Peninsula, Robert Island, South Shetland Islands	Chile	B	G	
ASPA	113	Litchfield Is.,Arthur Harbour, Anvers Is., Palmer Archipelago	United States	C	Not classified	
ASPA	114	Northern Coronation Island., South Orkney Islands	United Kingdom	C	E	G
ASPA	115	Lagotellerie Island, Marguerite Bay, Antarctic Peninsula	United Kingdom	B	Not classified	
ASPA	116	New College Valley, Caughley Beach, Cape	New Zealand	C	O	

		Bird, Ross Island				
ASPA	117	Avian Island, off Adelaide Island, Antarctic Peninsula	United Kingdom	C	E	
ASPA	118	Summit of Mount Melbourne, Victoria Land	New Zealand	C	U	
ASPA	119	Forlidas Pond and Davis Valley ponds, Dufek Massif	United States	C	R	O
ASPA	120	Pointe-Geologie Archipelago, Terre Adélie	France	B	H	
ASPA	121	Cape Royds, Ross Island	United States	C	P	
ASPA	122	Arrival Heights, Hut Point Peninsula, Ross Island	United States	I	S	
ASPA	123	Barwick and Balham Valleys, Southern Victoria Land	United States	G	S	O, P
ASPA	124	Cape Crozier, Ross Island	United States	C	S	P
ASPA	125	Fildes Peninsula, King George Island, South Shetland Islands	Chile	F	G	
ASPA	126	Byers Peninsula, Livingston Island, South Shetland Islands	Chile, United Kingdom	C	G	E

ASPA	127	Haswell Island	Russian Federation	E	L	
ASPA	128	Western shore of Admiralty Bay, King George Island	Poland	C	G	A, E
ASPA	129	Rothera Point, Adelaide Island	United Kingdom	A	E	
ASPA	130	‘Tramway Ridge’, Mount Erebus, Ross Island	New Zealand	B	S	
ASPA	131	Canada Glacier, Lake Fryxell, Taylor Valley, Victoria Land	New Zealand	C	S	
ASPA	132	Potter Peninsula, King George Island, South Shetland Islands	Argentina	B	G	E
ASPA	133	Harmony Point, Nelson Island, South Shetland Islands	Argentina, Chile	C	E	G
ASPA	134	Cierva Point and offshore islands, Danco Coast, Antarctic Peninsula	Argentina	C	B	E
ASPA	135	North-East Bailey Peninsula, Budd Coast, Wilkes Land	Australia	C	D	
ASPA	136	Clark Peninsula, Budd Coast, Wilkes Land	Australia	C	L	D
ASPA	137	North-west White	United States	C	P	O, S

		Island, McMurdo Sound				
ASPA	138	Linneaus Terrace, Asgard Range, Victoria Land	United States	C	S	
ASPA	139	Biscoe Point, Anvers Island	United States	C	E	
ASPA	140	Parts of Deception Island, South Shetland Islands	United Kingdom	E	G	
ASPA	141	'Yukidori Valley', Langhovde, Lützow-Holmbukta	Japan	B	D	
ASPA	142	Svarthamaren, Mühlig-Hofmannfjella, Dronning Maud Land	Norway	C	T	L, U
ASPA	143	Marine Plain, Mule Peninsula, Vestfold Hills, Princess Elizabeth Land	Australia	B	D	
ASPA	144	Chile Bay (Discovery Bay), Greenwich Island, South Shetland Islands	Chile	E	Not classified	
ASPA	145	Port Foster, Deception Island, South Shetland Islands	Chile	E	Not classified	
ASPA	146	South Bay, Doumer Island,	Chile	E	E	

		Palmer Archipelago				
ASPA	147	Ablation Point-Ganymede Heights, Alexander Island	United Kingdom	F	C	E, F, K
ASPA	148	Mount Flora, Hope Bay, Antarctic Peninsula	United Kingdom	F	A	
ASPA	149	Cape Shirreff, Livingston Island, South Shetland Islands	United States	E	G	E
ASPA	150	Ardley Island, Maxwell Bay, King George Island	Chile	C	Not classified	
ASPA	151	Lions Rump, King George Island, South Shetland Islands	Poland	C	A	G
ASPA	152	Western Bransfield Strait off Low Island, South Shetland Islands	United States	E	E	G
ASPA	153	Eastern Dallmann Bay off Brabant Island, Palmer Archipelago	United States	C	B	E
ASPA	154	Botany Bay, Cape Geology, Victoria Land	New Zealand	C	S	
ASPA	155	Cape Evans, Ross Island	New Zealand	H	S	

ASPA	156	Lewis Bay, Mount Erebus, Ross Island	New Zealand	I	O	S
ASPA	157	Backdoor Bay, Cape Royds, Ross Island	New Zealand	H	P	
ASPA	158	Hut Point, Ross Island	New Zealand	H	S	
ASPA	159	Cape Adare, Borchgrevink Coast	New Zealand	H	U	
ASPA	160	Frazier Islands, Windmill Islands, Wilkes Land	Australia	C	Not classified	
ASPA	161	Terra Nova Bay, Ross Sea	Italy	E	S	T
ASPA	162	Mawson’s Hut, Commonwealth Bay, George V Land, East Antartica	Australia	H	L	
ASPA	163	Dakshin Gangotri Glacier	India	E	D	I, L
ASPA	164	Scullin and Murray Monoliths, Mac Robertson Land, East Antarctica	Australia	C	D	L
ASPA	165	Edmonson Point, Wood Bay, Ross Sea	Italy	AB	K	T, U
ASPA	166	Port-Martin, Terre Adélie	France	H	L	
ASPA	167	Hawker Island, Vestfold Hills,	Australia	C	D	

		Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica				
ASPA	168	Mount Harding, Grove Mountains, East Antarctica	China	F	N	S, T
ASPA	169	Amanda Bay, Ingrid Christensen Coast, Princess Elizabeth Land, East Antarctica	Australia, China	C	L	
ASPA	170	Marion Nunataks, Charcot Island, Antarctic Peninsula	United Kingdom	C	E	C
ASPA	171	Narębski Point, Barton Peninsula, King George Island	Korea (RoK)	C	G	
ASPA	172	Lower Taylor Glacier and Blood Falls,Taylor Valley, McMurdo Dry Valleys, Victoria Land	United States	F	S	
ASPA	173	Cape Washington and Silverfish Bay, Terra Nova Bay, Ross Sea	United States, Italy	C	U	
ASPA	174	Stornes, Larsemann Hills, Princess Elizabeth Land	Australia, China, India, Russian Federation	F	D	
ASPA	175	High Altitude	United States		C	U

		Geothermal sites of the Ross Sea region				
ASMA	1	Admiralty Bay, King George Island	Brazil, Ecuador, Peru, Poland, United States	n/a		
ASMA	2	McMurdo Dry Valleys, Southern Victoria Land	New Zealand, United States	n/a		
ASMA	3	Cape Denison, Commonwealth Bay, George V Land, East Antarctica	Australia	n/a		
ASMA	4	Deception Island	Argentina, Chile, Norway, Spain, United Kingdom, United States	n/a		
ASMA	5	Amundsen-Scott South Pole Station, South Pole	United States	n/a		
ASMA	6	Larsemann Hills, East Antarctica	Australia, China, India, Romania, Russian Federation	n/a		
ASMA	7	Southwest Anvers Island and Palmer Basin	United States	n/a		

Primary Reason for Designation (McIvor, 2014)

A – areas kept inviolate from human interference so that future comparisons may be possible with localities that have been affected by human activities;

B – representative examples of major terrestrial, including glacial and aquatic, ecosystems and marine ecosystems;

C – areas with important or unusual assemblages of species, including major colonies of breeding native birds or mammals;

D – the type locality or only known habitat of any species; E – areas of particular interest to on-going or planned scientific research;

F – examples of outstanding geological, glaciological or geomorphological features;

G – areas of outstanding aesthetic and wilderness value;

H – sites or monuments of recognised historic value;

I – such other areas as may be appropriate to protect the values set out in Article 3 Paragraph 1 ("to protect outstanding environmental, scientific, historic, aesthetic or wilderness values, any combination of those values or on-going or planned scientific research")

Main Environmental Domain (Morgan et al., 2007).

A. Antarctic Peninsula northern geologic

B. Antarctic Peninsula mid-northern latitudes geologic

C. Antarctic Peninsula southern geologic

D. East Antarctic coastal geologic

E. Antarctic Peninsula and Alexander Island main ice fields and glaciers

F. Larsen Ice Shelf

G. Antarctic Peninsula offshore island geologic

H. East Antarctic low latitude glacier tongues

I. East Antarctic ice shelves

J. Southern latitude coastal fringe ice shelves and floating glaciers

K. Northern latitude ice shelves

L. Continental coastal-zone ice sheet

M. Continental mid-latitude sloping ice

N. East Antarctic inland ice sheet

O. West Antarctic Ice Sheet

P. Ross and Ronne-Filchner ice shelves

Q. East Antarctic high interior ice sheet

R. Transantarctic Mountains geologic

S. McMurdo – South Victoria Land geologic

T. Inland continental geologic

U. North Victoria Land geologic

Appendix 3: Management Plan approval process

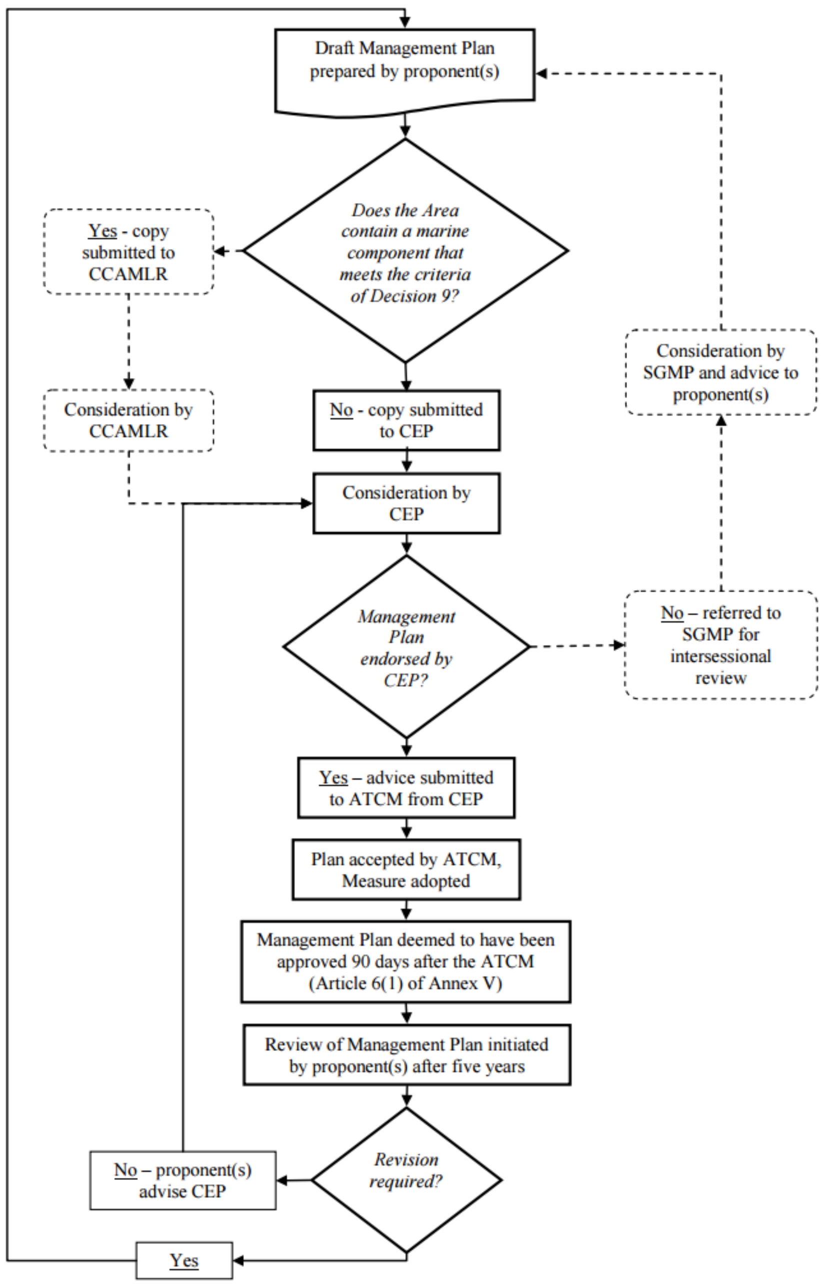

Figure 5: Flow chart of the approval process of an ASPA Management Plan (ATCP, 2011).