Faculty of Law

Invasive Alien Species in a Changing World: a Juridical Analysis of a Global Challenge

A Study of the Interconnection between Climate Change and Invasive Alien Species in Marine Ecosystems

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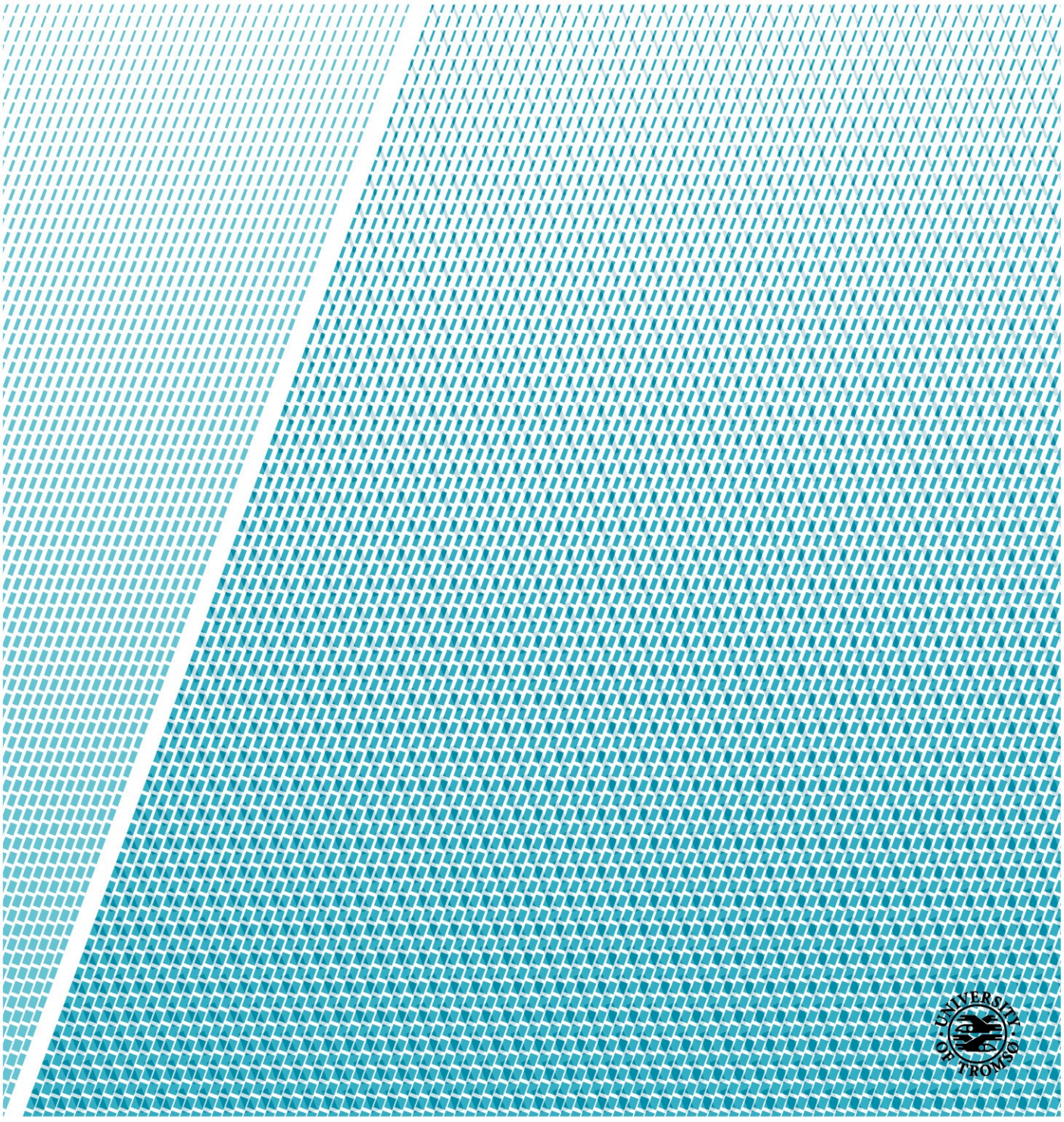

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1. Introduction

Invasive Alien Species (IAS) are regarded as one of the main drivers of biodiversity loss and environmental degradation in the planet.[1] They represent an enormous threat to ecosystems but also to human communities and livelihoods. Because of that, IAS are regulated in a wide range of legal instruments in a categorical way. A three-step hierarchical system of measures composed by their prevention, eradication and control is commonly applied by States to minimize the spread and impact of IAS[2].

However, there are several considerations to be made in relation to this rigid treatment of IAS in the current regulation. Its applicability and topicality will be put into question in the light of one of the biggest ecological impacts of the century: climate change[3]. Species naturally shift their ranges and move towards better suited environments, given that their community structure is dynamic in nature[4], but climate change is increasing and accelerating these movements. According to the Millennium Ecosystem Assessment[5], climate change is one of the greatest drivers of biodiversity loss and is already forcing noticeable changes in ecosystem balances, which has to adapt to the new circumstances through shifting habitats, distributions and life cycles. As a result, species may resort to a series of survival adaptation techniques that go from changes in their biology to the need of moving to new ecosystems in order to avoid extinction[6]. These current circumstances put the ductility and relevance of the regulation of IAS into question. Because of that, the research question that this work will consider is:

Is the current juridical framework for Invasive Alien Species (IAS) enough for addressing the challenges that appear as a consequence of climate change in marine ecosystems? Can it adapt or are there gaps in the regulation appearing?

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[1] *Report of the sixth meeting of the Conference of the Parties to the Convention on Biological Diversity*, UNEP/CBD/COP/6/20. Available at <https://www.cbd.int/kb/record/meetingDocument/2303?RecordType=meetingDocument&Event=COP-06> (Accessed August 30th 2019).

[2] *Guiding Principles for the Implementation of Article 8(h) CBD*, UNEP/CBD/COP/6/20, VI/23, Page 249, 2002.

[3] *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* R.K. Pachauri and L.A. Meyer, IPCC 2014, 151 pp. Available at <https://www.ipcc.ch/report/ar5/syr/> (Accessed August 30th 2019).

[4] *Invasives: A Major Conservation Threat* Marco Lambertini et al. July 22nd , 2011, VOL 333. Available at <https://science.sciencemag.org/content/sci/333/6041/404.2.full.pdf> (Accessed August 30th 2019).

[5] *Introduction to Climate Change* Convention on Biological Diversity. Available at <https://www.cbd.int/climate/intro.shtml> (Accessed August 30th 2019).

[6] *A Perspective on Climate Change and Invasive Alien Species*, 2nd Meeting of the Group of Experts on Biodiversity and Climate Change, Convention on the Conservation of European Wildlife and Natural Habitats, T- PVS/Inf 5 rev, June 16th 2008.

In order to give answer to this question the current regulation will be critically analysed. Several other aspects of the juridical framework will be contemplated alongside this central premise, from the juridical definition of IAS to an ethical reflection of some of the current measures against IAS. The objective of this will be to make a comprehensive assessment of the legal framework. This work will focus on the marine environment and the impact that climate change has in the oceans. Of course, some of the considerations have an inevitably generalistic value and potential because of the universality of the issue of invasiveness and climate change, but any possible extrapolation to terrestrial or other ecosystems will be out of the scope of this work.

1.2. Structure and Methodology

The objective of this work is to make a critical analysis of the legal framework on IAS, considering all sources of law as per Article 38 of the Statute of the International Court of Justice[7]. Because of the particular evolutive nature of environmental law, a big consideration will be given to soft law, which is the unifier and clarifier of a considerably scattered legal corpus. The way of conducting this analysis will comprise two distinct parts: a doctrinal exposition of the legal framework followed by a critical approach to it by the means of, first, putting the law in context and, second, reflecting on it from an ethical and philosophical perspective.

First of all, an explanation of the interconnection of IAS and climate change will be made. In order to conduct a relevant analysis on the ductility of the legal framework that deals with IAS in the face of climate change, it is important to understand the scientific reality that underlies the issue. To do so, a plurality of scientific papers, projections and studies will be considered and explained, even if informationally. It is important to create an interdisciplinary communication between science and law when dealing with environmental matters. Many of the questions that arise when studying climate change and IAS in the marine ecosystems, which will inevitably be the basis of assessing the adaptability of the current regulatory framework, can only be answered through science and empirical research[8]. And, ultimately,

[7] *United Nations, Statute of the International Court of Justice*, April 18th 1946.
[8] *Which Science? Whose Science? How Scientific Disciplines Can Shape Environmental Law* Eric Biber, The University of Chicago Law Review, volume 79, 2012. Available at <https://chicagounbound.uchicago.edu/cgi/viewcontent.cgi?article=5572&context=uclrev> (Accessed August 30th 2019).

when considering the protection of the environment, science needs to be translated into law and policy[9].

Afterwards, a doctrinal exposition of the sources that conform the legal framework that deals with IAS will be made, as well as a brief explanation of the three-step hierarchical approach of measures to combat IAS. Both hard and soft law instruments will be considered equally. In the case of the IAS regulatory framework, it is often through soft law instruments, such as guidelines of implementation, that the content of the hard law provisions is developed, defined and sharpened. An analysis of the legal framework would be impossible without giving soft law the appropriate weight in policy making, planning and application of hard law by the States.

Finally, the regulatory framework will be put in the context of climate change and thus critically analysed. The importance of considering the legal framework on IAS in this way derives from the idea that context conditions law, shapes it, and gives it its legitimacy and social acceptance[10]. Context in a field such as environmental law, whose content is partially informed in other disciplines, is crucial. The objective is identifying the potential gaps of the current legal framework and possible applicability problems in the new circumstances, while trying to assess its adaptability. Additionally, a legal philosophical analysis of the ethical concerns that arise from some of the measures against IAS will be made. Additionally, some potential solutions and changes of perspective will be proposed on the basis of the previous considerations, followed by some concluding remarks.

This work presented a series of challenges. The biggest one was the few existing legal literature that examines the IAS legal framework critically. Many of the reflections that are here presented are the result of analysing the legal framework directly and putting it in the context of climate change. However, most of the literature that examines the effects of climate change on IAS is scientific in nature, which added a layer of difficulty. The bridge to transversally address these issues has been found in the reports and information provided by the several international organisations, such as UN Environment or the Conference of the Parties of CBD, in their effort of raising awareness of the consequences of climate change for the planet.

[9] *Listening to Nature's Voice: Invasive Species, Earth Jurisprudence and Compassionate Conservation*, Sophie Riley, Asia Pacific Journal of Environmental Law. Vol 22 n1, 2019, pp. 117-136.
[10] *Law in Context' Revisited* Philip Selznick, Journal of Law and Society volume 30, number 2, June 2003 pp. 177-86.

2. Climate Change and Invasive Alien Species: An Analysis of their Interconnection

This section will present and describe the interconnection between IAS and climate change in the ocean globally. To be able to critically analyse the juridical framework that regulates IAS it is necessary to first acknowledge and understand the relationship between the two and its consequences for the marine ecosystems from a scientific, even if informational, point of view. In order to do so, a definition of IAS will be provided, a difference between IAS and alien species will be made, and the impact that climate change has on both will be explained.

2.1. Definition of Invasive Alien Species

There is not a legally binding definition of IAS and most of the instruments that regulate them do not provide one either. The Convention on Biological Diversity (CBD)[11] defines IAS as "*the species whose introduction and/or spread outside their natural past or present distribution threatens biological diversity".*[12] The International Union for Conservation of Nature (IUCN) provides a more detailed definition of IAS by stating that the *"animals, plants or other organisms introduced by man into places out of their natural range of distribution, where they become established and disperse, generating a negative impact on the local ecosystem and species"*[13] are included in it. From both these definitions a series of common characteristics that define IAS can be extracted.

First of all, IAS are always outside their natural range of distribution. Secondly, IAS have to be introduced by man in the new ecosystem, and this introduction can be intentional or not[14]. However, in the wording of the CBD definition, *"whose introduction and/or spread outside their natural past or present distribution",* the spread outside their natural distribution is mentioned as an alternative, *"and/or",* to human introduction, which suggests that the species may arrive to a new ecosystem without human intervention. There is no general consensus on to which extent the human factor is necessary in order to consider a species an IAS, especially

[11] *The Convention on Biological Diversity*, June 5th ,1992.
[12] *What are Invasive Alien Species?* Convention on Biological Diversity. Available at <https://www.cbd.int/invasive/WhatareIAS.shtml> (Accessed August 30th 2019).
[13] *Review of the Impact of Invasive Alien Species on Species Protected under the Convention on Migratory Species* (CMS) Shyama Pagad, Piero Genovesi and Riccardo Scalera IUCN SSC Invasive Species Specialist Group, 2013, revised 2014.
[14] Article 196 UNCLOS, Guiding Principle 10 and 11 Guiding Principles for the Implementation of Article 8(h) CBD.

in the context of anthropogenic environmental change, which both forces the movement of species and facilitates their establishment in the new ecosystems[15]. Finally, IAS have to generate a negative impact on the new ecosystem and its native species or, at least, threaten its biological diversity, as well as human livelihoods, economic activities and health, among others.

As it has been mentioned, there is not a unified and transversal definition of IAS, being the one provided by CBD the most commonly used. However, the Convention on the Conservation of Migratory Species (CMS)[16] uses the definition provided by IUCN. The Aichi Biodiversity Target 9 explains the effects of IAS extensively but defines them in similar terms as the ones used in CBD, as *"those alien species which threaten ecosystems, habitats or species"*. The United Nations Convention on the Law of the Sea (UNCLOS)[17] and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)[18] do not define IAS. Finally, the International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention)[19] provides a definition in its Article 1(8), whose main difference with the one in CBD and IUCN is the specific inclusion of pathogens in it, and it even uses a complete different nomenclature for talking about IAS, describing them as "*harmful aquatic organisms and pathogens"* while the IUCN definition talks about *"other organisms"*.

2.2. Invasive Alien Species and Alien Species

The IUCN differentiates between IAS and alien species, defining the latter as follows: *"Alien species (non-native, non-indigenous, foreign, exotic) means a species, subspecies, or lower taxon occurring outside of its natural range (past or present) and dispersal potential (i.e. outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans) and includes any part, gametes or propagule of such species that might survive and subsequently reproduce."*[20]. This differentiation is important. A foreign species may not cause any negative impact to the new ecosystem and thus it would

[15] *Perspectives on the 'alien' versus 'native' species debate: a critique of concepts, language and practice* Charles R. Warren, Progress in Human Geography 31(4), 2007, pp. 427–446.
[16] *Convention on the Conservation of Migratory Species of Wild Animals*, June 23rd, 1979.
[17] *United Nations Convention on the Law of the Sea*, December 10th, 1982.
[18] *Convention on International Trade in Endangered Species of Wild Fauna and Flora*, March 3rd 1973.
[19] *International Convention for the Control and Management of Ships' Ballast Water and Sediments*, February 13th , 2004.
[20] *Review of the Impact of Invasive Alien Species on Species Protected under the Convention on Migratory Species* (CMS) Shyama Pagad, Piero Genovesi and Riccardo Scalera IUCN SSC Invasive Species Specialist Group, 2013, revised 2014.

not be considered invasive. Also, a non-native species may not be able to survive in the new ecosystem, not having the chance of impacting it in any way and thus not falling into the category of invasive. It also implies that an alien species may become invasive *a posteriori* if the conditions on an ecosystem change, or if it becomes weaker or disrupted as a consequence of a variety of factors, among them, climate change, as it will be argued below. Nevertheless, the opposite is a much more difficult scenario: a species that becomes invasive to an ecosystem will not be able to settle and become native until a certain amount of time has passed and, even then, the status of naturalization will be disputed[21], given the enormous negative impact that it causes and the long term consequences that it has for an ecosystem.

2.3. Interconnection with Climate Change

The species that have a high resilience and expansion rate, as well as good adaptability to new environments, have a bigger chance of becoming invasive. The appearance of IAS in an ecosystem, and its interaction with it, disrupts its balances and predator-prey relationships, being one of the main causes of biodiversity loss[22], as well as harming marine industries, human health, and other ecosystem services and dependent communities[23]. Because of that, islands are especially vulnerable to IAS given the isolation of their ecosystems[24]. IAS transform the ecosystems and its consequences, including the risk of biotic homogenisation[25], are not easily managed.

Climate change adds a new dimension to this. The global temperature of the planet is rising as a direct consequence of human activities, as it was first conclusively stated in the IPCC AR5.[26] Its effects are especially acute in the oceans, as one of the main CO2 accumulators[27], causing the disruption of marine ecosystem balances, habitat degradation and biodiversity loss. It has to be taken into account that climate change has a wide variety of consequences in ocean conditions and each of them provokes a different ecological response. The main ones to

[21] *When Does an Alien Become a Native Species? A Vulnerable Native Mammal Recognizes and Responds to Its Long-Term Alien Predator* Alexandra J. R. Carthey , Peter B. Banks, February 15th, 2012.
[22] *What are Invasive Alien Species?* Convention on Biological Diversity. Available at <https://www.cbd.int/invasive/WhatareIAS.shtml> (Accessed August 30th 2019).
[23] *Marine invasive alien species: a threat to global biodiversity* Nicholas Bax et al. Marine Policy Volume 27, Issue 4, July 2003, Pages 313-323. Available at <https://www.sciencedirect.com/science/article/pii/S0308597X03000411< (Accessed August 30th 2019).
[24] *Islands and Invasive Alien Species*, Convention on Biological Diversity. Available at <https://www.cbd.int/island/invasive.shtml> (Accessed August 30th 2019).
[25] McKinney & Lockwood 1999; Olden et al.
[26] *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* R.K. Pachauri and L.A. Meyer, IPCC 2014, 151 pp. Available at <https://www.ipcc.ch/report/ar5/syr/> (Accessed August 30th 2019).
[27] *On Geoengineering and the CO2 Problem* Cesare Marchetti, March 1977, Volume 1, Issue 1, pp 59–68.

be considered in relation with IAS are five[28]. First of all, and being probably the most widely known one, an increase in the ocean water temperature as a consequence of the increased air temperature and greenhouse gas concentrations as well as other factors, such as ocean ice melting. Secondly, a rise in the sea level, which leads to a series of alterations in currents and ocean circulation. Thirdly, a decrease in the ocean salinity, driven by an increase of the storm frequency and altered rainfall amounts. Fourthly, acidification of the water and other chemical changes, such as an increase of the presence of CO2 and a decrease of the water pH. Finally, altered patterns of primary production[29]. However, the long-term consequences of these changes will vary from species to species, from ecosystem to ecosystem and they are not always predictable. Additionally, the combined action of all these elements in a particular marine area is not yet clear[30]. There is, nevertheless, more and more scientific evidence of climate change impacting and modifying the effect that IAS have on a given ecosystem, generally incrementing their chances of success[31].

The potential responses of alien species to the effects of climate change in the ocean have been studied by a number of experts[32]. IAS that are adapted in warmer ecosystems can become more abundant. They can expand their ranges to currently non warmer latitudes that will become available to them in the future as a consequence of the rise on temperatures. These new species arriving to higher latitudes may pressure the native species and lead to their extinction or oblige them to seek refuge in even higher latitudes. Additionally, the rise in the sea temperature can cause stress on the species, producing mass mortalities that can lead to empty niches in an ecosystem which can be occupied by alien species, a situation that, among others, raises the question of positive effects of alien species, as it will be argued in further sections of this work. Finally, native species are also moving north as a reaction to the effects of climate change in the water, becoming alien to the new ecosystems and potentially invaders as well.

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[28] *The impacts of climate change in coastal marine systems* Christopher D. G. Harley et al. Ecol Lett. February 2006, 9(2) pp. 228-4; *A Perspective on Climate Change and Invasive Alien Species*, 2nd Meeting of the Group of Experts on Biodiversity and Climate Change, Convention on the Conservation of European Wildlife and Natural Habitats, T- PVS/Inf 5 rev, June 16th 2008.

[29] *Ibid.*

[30] *Meta-analysis reveals complex marine biological responses to the interactive effects of ocean acidification and warming* Ben P. Harvey et al. Ecol Evol. 2013 Apr; 3(4) pp.1016–1030. Available at <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3631411/> (Accessed August 30th 2019).

[31] *A Perspective on Climate Change and Invasive Alien Species*, 2nd Meeting of the Group of Experts on Biodiversity and Climate Change, Convention on the Conservation of European Wildlife and Natural Habitats, T- PVS/Inf 5 rev, June 16th 2008.

[32] *A Perspective on Climate Change and Invasive Alien Species, 2nd Meeting of the Group of Experts on Biodiversity and Climate Change, Convention on the Conservation of European Wildlife and Natural Habitats, T- PVS/Inf 5 rev, June 16th 2008 ;* Carlton 2001, Hobbs & Mooney 2005.

The interconnection of IAS and climate change will be considered in three different ways throughout this thesis:

1. Climate change produces a deep change in the ocean water, such as increased temperature and variations in nutrients availability, changes on current patterns, etc. This may urge certain species to migrate to new areas where conditions are more suitable or change their distribution patterns if their thermal tolerance limit is surpassed[33]. An increase of the ocean temperature, even of 2ºC, allows some species that were limited by temperature to expand their presence and creates the global tendency of migration of species towards the poles. Additionally, the increase of CO2 levels has been linked to an increase of IAS, especially plant forms, in detriment of endemic species[34].

2. Climate change results in weaker and imbalanced ecosystems in the ocean by decreasing its ecological resistance[35], offering the alien species that arrive to these new altered ecosystems the possibility to thrive, fill some of the niches in the weak ecosystems, and potentially become invasive. This may lead to the disappearance of entire species and the radical disturbance of predator-prey relationships, community dynamics, diversity and functional groups.

3. IAS increase the impact of climate change in a particular ecosystem. Being a huge stressor on a given ecosystem, they weaken it and make it both less resilient to changes and more sensitive to other stressors closely linked to climate change. This combination of multiple stressors creates a number of cumulative effects that have a great impact on the ecosystems and their services, especially if they overlap in the same area[36]. Also, IAS can act as a single stressor in an ecosystem creating a repetitive impact on it that accumulates over time exacerbating its negative effects and thus, making it more vulnerable.

Some authors have started to formulate some crucial questions that could allow for a better understanding of the relationship between IAS and climate change: "*How entry pathways of*

[33] *The physiology of climate change: how potentials for acclimatization and genetic adaptation will determine 'winners' and 'losers'* G. N. Somero, J Exp Biol. March 2010 15;213(6), pp. 912-20. Available at <https://jeb.biologists.org/content/213/6/912> (Accessed August 30th 2019).
[34] *Linking Plant Invasions to Global Environmental Change* Montserrat Vilà et al. Linking Plant Invasions to Global Environmental Change, Chapter 8, from book Terrestrial Ecosystems in a Changing World, January 2007, pp.93-102.
[35] *A Perspective on Climate Change and Invasive Alien Species,* 2nd Meeting of the Group of Experts on Biodiversity and Climate Change, Convention on the Conservation of European Wildlife and Natural Habitats, T- PVS/Inf 5 rev, June 16th 2008.
[36] *Cumulative effects in marine ecosystems: scientific perspectives on its challenges and solutions. Technical Report* Megan Match et al. WWF-Canada and Center For Ocean Solutions, January 2014, pp. 60.

invaders could be affected by climate change? Will some ecosystems become more or less susceptible to be invaded? Will some non-indigenous species that are currently benign become invasive? Will impacts of existing invaders decrease or become more severe?[37]*"*. It is not in the scope of this thesis to try to answer all of these questions but, following their reasoning, this work will try to predict the ductility of the regulatory framework and the prospective adaptation of law to the changes that climate change introduces in the effects that IAS have on ecosystems and its consequences. The potential of all the species that migrate to new areas, or that expand their presence, of becoming invasive will be considered. Special attention will be given to the assessment of the traditional eradication, containment and control measures against IAS, to try to determine if they are still adequate.

3. Relevant Legal Framework for Invasive Alien Species

Throughout this thesis the main legal instruments on IAS in the marine environment will be analysed in light of the impacts of climate change in the marine ecosystems and its interconnection with IAS, with a focus on UNCLOS, the CBD, along with its Guiding Principles for the Implementation of Article 8(h), and the BWM Convention. The CMS and some of the agreements reached under its auspices, such as the Agreement on the Conservation of Albatrosses and Petrels (ACAP)[38], as well as CITES, will additionally be analysed. Other instruments of soft law, such as the Aichi Biodiversity Target number 9[39] will also be considered.

Some of these instruments focus on specific entryways of IAS, such as the BWM Convention or CITES, and put in place a mechanism of prevention in the form of guidelines or permits. In the case of the BWM Convention, for instance, the previous occurrences of alien species invading an ecosystem to which they arrived through the ballast water, and the increase on trade internationally, made it urgent for the IMO to create an instrument to try to prevent this from happening again. Some other instruments, such as UNCLOS, CBD or CMS go further and put in place mechanisms of eradication, control and containment of IAS to implement if prevention fails. All of them will be presented here to be further analysed in the light of climate change, and the changes to the marine ecosystems that it implies, in section five of this work.

[37] Dukes & Mooney 1999.
[38] *Agreement on the Conservation of Albatrosses and Petrels*, June 19th 2001.
[39] *Aichi Biodiversity Targets CBD* Available at <https://www.cbd.int/sp/targets/> (Accessed August 31st 2019); *Aichi Biodiversity Target 9 Technical Rationale Extended* COP/10/INF/12/Rev.1.

3.1. UNCLOS

UNCLOS regulates the introduction of IAS in an ecosystem in Section 1 of Part XII, that sets the general provisions for the protection and preservation of the marine environment. The only article of UNCLOS that deals with IAS specifically is Article 196, which was the first provision of an international legal instrument to address IAS. However, UNCLOS does not provide a definition of IAS or alien species. Additionally, the way it regulates IAS, through two provisions in Article 196 that cover two different matters, may seem a little confusing and requires interpretation:

1. States shall take all measures necessary to prevent, reduce and control pollution of the marine environment resulting from the use of technologies under their jurisdiction or control, or the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto.
2. This article does not affect the application of this Convention regarding the prevention, reduction and control of pollution of the marine environment.

At first sight, Article 196(1) seems to place IAS and alien species in the same category as pollution to the marine environment. Nevertheless, they do not fit in the definition of pollution in Article 1(1)(4), given the fact that they are not substances or energy[40], so it is doubtful that Article 196 allows to regulate them as if they were pollution caused by the use of technologies in the sea. Even if it does not provide a definition of IAS, Article 196(1) wording allows to subtract some of the requirements for non-native species to be considered as IAS under UNCLOS and the impact, or potential impact, that they need to have on the new environment for this provision to apply. It thus covers *"the intentional or accidental introduction of alien or new species to a particular part of the marine environment which may cause significant and harmful changes thereto".*

First of all, UNCLOS tacitly differentiates between IAS and alien species through the requirement of potential damage, or harmful changes to the environment, as a trigger for the prevention, reduction and control measures, by using the formulation "*which may cause*". From this it can be inferred that only the ones that may cause these damage or harmful changes are to be considered IAS, as opposed to the ones that do not pose this danger, being

[40] *United Nations Convention on the Law of the Sea : a commentary.* Alexander Proelss; Amber Rose Maggio; Eike Blitza; Oliver Daum. 2017.

thus innocuous. The latter would simply be considered alien species, following the distinction in concepts presented in section 2.1. and 2.2. of this work. Furthermore, UNCLOS distinguishes between "*alien*" and "*new species*" in the formulation of Article 196 without clarifying the difference between those two terms. At first glance, and taking the definition of alien species provided by the IUCN as a reference, it may seem that these two terms could be synonyms. Nevertheless, "*new species*" may refer to a species that have been genetically modified by humans purposely, as defined by the Global Invasive Species Program[41], being thus anthropogenically introduced in the environment in a different manner than alien species, which simply originate in a different ecosystem. Moreover, Article 196 UNCLOS covers voluntary and involuntary introduction, addressed as "*intentional or accidental introduction*". From these first two characteristics it can be gathered that UNCLOS addresses the fact that alien species can become or not invasive to an ecosystem and that they can be introduced intentionally or accidentally. Additionally, Article 196 UNCLOS establishes the requirement that these alien species or IAS have to produce, or potentially be able to produce, significant or harmful changes to the environment. Finally, this introduction has to occur or produce its effects *"in a particular part of the marine environment"*. So the significant and harmful changes or the potential changes caused by alien species or IAS must be at least significant. The use of the word "*may*", as Czybulka suggests, seems to indicate that the effects or changes that are not toxic, harmful or pathologic may also be included here[42]. Furthermore, Article 196(1) places the obligation to the states to take *"all measures necessary to prevent, reduce and control.."* IAS in the activities within their jurisdiction and control. Article 196 (2) states that Article 196 does not affect the application of UNCLOS *"regarding the prevention, reduction and control of pollution of the marine environment"* set in Article 194 specifically and throughout Part XII, leaving these regulations unaffected. Only Article 194(5) could be interpreted in the light of combating alien species or IAS as a measure to protect and preserve fragile ecosystems[43].

UNCLOS sets in Article 196 a framework for the treatment of IAS that goes hand in hand with the rest of part XII, in light of which it will be analysed here. First of all, Article 196 does not define which measures of prevention, reduction and control of IAS the states can adopt. As alien species and IAS do not fit in the definition of pollution of Article 1(1)(4), only

[41] *Review of the efficiency and efficacy of existing legal instruments applicable to invasive alien species,* Secretariat of the Convention on Biological Diversity, CBD Technical series no.2., 2001, SCBD, pp. 42. (Annexe II).
[42] *Ibid.*
[43] *Ibid.*

Article 194(5), which states that the measures taken by the states *"shall include those necessary to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life.",* can be applied in relation to alien species and IAS. It could legitimize, as argued by Czybulka, possible interventions of States in favour of the environment, forcing them to regulate and control the IAS' pathways of entry into a territory[44].

Article 197, together with Article 196, further develops the duty of cooperation among States on a global and regional basis, for the protection and preservation of the marine environment and sets the basis for the BWM Convention, designed to avoid one of the main pathways of entry of IAS and alien species, by means of regulating the management of the ballast water system of the ships. Especially interesting for the purpose of IAS, as regarded in this work, is Articles 235 UNCLOS, which sets the grounds for the liability of the States for transboundary harm, in this case for transboundary invasions related to alien species and IAS[45]. Finally, Article 192 UNCLOS sets the general obligation for states to protect and preserve the marine environment. This provision underlies and defines the main objective of Part XII, and Article 196 has to be understood through it.

3.2. CBD

The CBD regulates IAS in Article 8(h) without providing a definition and in a very briefly manner. This provision establishes the obligation for States to *"prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species".* From the wording of this provision it can be deduced that for a non-native species to be regulated by Article 8(h) it does not suffice to be alien but it needs to threaten the ecosystems, habitats or species of that new ecosystem. Again, the wording seems to imply that the potential of causing harm is enough for alien species to be considered as IAS under CBD, thus triggering the prevention, control or eradication requirement of Article 8(h). The context of this obligation is Article 8, which covers the in-situ conservation of biodiversity, which means the conservation of the ecosystems and the maintenance, or recuperation, of the species that depend of it in their natural surroundings, as per Article 2 CBD. This placement shows that CBD contemplates IAS as a direct impediment of the fulfilling of that objective of in-situ conservation.

[44] *Ibid.*
[45] *Ibid.*

The objective of the CBD, as set in Article 1, is the conservation of biological diversity, its sustainable use and the equitable sharing of the benefits arising from the exploitation of genetic resources. To achieve these general objectives, States have to cooperate among each other, as per Article 5 CBD, and develop strategies, plans, policies and programs, following Article 6 CBD. Furthermore, Article 7 CBD establishes the obligation of identifying and monitoring the *"components of biological diversity important for its conservation and sustainable use"*. It further adds the duty to *"identify processes and categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, and monitor their effects through sampling and other techniques"*. This means that in order to assess the potential threat to the environment that alien species may cause, which triggers Article 8(h) CBD, activities and processes that offer the possibility of causing harm need to be identified, while having previously recognized the important components for biodiversity. Additionally, as per Article 14(2) CBD, the Conference of the Parties shall examine the issue of liability and redress for damage to the biological diversity, including restoration and compensation. On the subject of transboundary harm to biodiversity, Article 3 CBD determines the responsibility of States not to cause damage to the environment of other States or areas beyond national jurisdiction. These provisions set the duty not to cause damage by transferring IAS to the territory of other States, or to areas beyond national jurisdiction, as well as the compensation in the case of that happening.

3.2.1. Guiding Principles for the Implementation of Article 8(h)

The CBD regulates IAS very briefly. For this reason, and because of the enormous threat to ecosystems that IAS represent, during the Sixth Meeting of the Conference of the Parties to the CBD, the Guiding Principles for the Implementation of Article 8(h) were agreed upon in the Annex of the report that resulted from the meeting[46].

In section II of the report the urgency of addressing the issue of IAS is highlighted, with special consideration to the increase of risks as a result of, among others, climate change. Additionally, the report recognizes that certain gaps and inconsistencies are to be found in the regulatory framework for the threat that IAS entail to biodiversity. In part IV (a) the States are urged to adopt national IAS strategies and Action plans and seek cooperation among them, as

[46] *Guiding Principles for the Implementation of Article 8(h) CBD*, UNEP/CBD/COP/6/20, VI/23, Page 249, 2002.

well as to involve stakeholders, indigenous and local communities, while implementing the Guiding Principles. Part IV (b) urges states and relevant organizations to recognize the effects of climate change in relation to the threat of IAS to biodiversity and related ecosystem goods and services. Finally, on part IV (c) the states and relevant organizations are encouraged to promote research and assessment on IAS, including the means to enhance the resilience of the ecosystems against the threat IAS pose, as well as their recovery. Finally, part V of the report calls for a greater capacity building system to work towards the eradication of IAS.

The Annex contains the Guiding Principles for the Prevention, Introduction, and Mitigation of Impacts of IAS that Threaten Ecosystems, Habitats or Species. The document provides guidance for states to develop effective strategies to minimize the spread and impact of IAS, as is stated in its Introduction, through 15 non-binding principles divided in 4 sections:

Part A sets the general principles, that include the use of the precautionary approach, as per Principle 1, especially when considering eradication, containment and control measures, stating that the lack of scientific information should not postpone the application of such measures. Principle 2 sets a three-stage hierarchical approach based on rapid eradication of IAS. Principle 3 sets the need for the ecosystem approach. Principles 4-6 include the role of states and their cooperation to fight IAS, the research and monitoring of IAS and the creation of public awareness.

Part B includes Principles 7-9, which deal with the prevention of introduction of IAS. They urge the states to adopt quarantine and border control measures through programs and agreements, as well as an exchange of information and an increase on cooperation and capacity building.

Part C contemplates the intentional, as per Principle 10, and unintentional, as per Article 11, introduction of IAS in an ecosystem. The intentional introduction shall be done after a risk analysis and assessment, on the basis of the precautionary approach, and only the introductions that do not have the potential to harm or disrupt the local ecosystems may be allowed. As for the unintentional introductions, Principle 11 establishes that states need to have plans to address them to allow for rapid and effective action. This should go hand in hand with the study of common pathways of introduction and an environmental impact assessment.

Finally, Part D deals with the mitigation of the impact of IAS. Principle 12 establishes that, once an IAS has entered an ecosystem, states *"should take appropriate steps such as eradication, containment and control, to mitigate adverse effects"*. These measures shall be early taken on the basis of precaution and in a way that is not harmful to humans and they have to be ethically acceptable to stakeholders. Principles 13-15 regulate these eradication, containment and control measures, being eradication the preferred one in the early stages of the invasion. Containment measures aim to reduce the spread of IAS as much as possible and should go hand in hand with monitoring efforts. Finally, control measures focus on reducing the number of IAS and the damage they cause on an ecosystem, including *"mechanical control, chemical control, biological control and habitat management"*.

3.2.2. Aichi Biodiversity Target 9

The Aichi Biodiversity Targets are twenty targets set on the context of five strategic goals to halt the loss of biodiversity by 2050[47]. They were formulated in the context of the Strategic Plan 2011-2020[48], during the tenth meeting of the Conference of the Parties, envisioned after the conclusions of the third edition of the Global Biodiversity Outlook[49]. The Aichi Biodiversity Target number 9 deals with IAS in the following terms: *"By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated and measures are in place to manage pathways to prevent their introduction and establishment"*. This target is additionally related to the Sustainable Development Goal Target 15.8, whose objective is that *"By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species"*[50].

In the extended technical rationale of the Aichi Biodiversity Target 9, a definition of IAS and a detailed list of the harmful effects that they can have in an ecosystem are provided as follows: *«Invasive alien species are those alien species which threaten ecosystems, habitats*

[47] *Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets* COP 10 Decision X/2, Available at <https://www.cbd.int/decision/cop/?id=12268> (Accessed August 31st 2019); *Key Elements of the Strategic Plan 2011-2020, including Aichi Biodiversity Targets* Available at <https://www.cbd.int/sp/elements/default.shtml> (Accessed August 31st 2019).
[48] *Strategic Plan for Biodiversity 2011-2020, including Aichi Biodiversity Targets* Available at <https://www.cbd.int/sp/default.shtml> (Accessed August 31st 2019).
[49] *Global Biodiversity Outlook (GBO)* Available at <https://www.cbd.int/gbo/> (Accessed August 31st 2019).
[50] *Sustainable Development Goals, Goal 15 Life on Land* Available at <https://www.unenvironment.org/explore-topics/sustainable-development-goals/why-do-sustainable-development-goals-matter/goal-15> (Accessed August 31st 2019).

or species (Article 8(h)). They are a major threat to biodiversity and ecosystem services, as identified by most Parties in their fourth national reports. They often have a particularly detrimental effect in island ecosystems. In some ecosystems, such as many island ecosystems, invasive alien species are the leading cause of biodiversity loss. In addition, invasive alien species can pose a threat to food security, human health and economic development. Increasing trade and travel means the threat is likely to increase unless additional action is taken.»[51].

This Target requires the detection of pathways of introduction, quarantine and higher border control measures, and coordination. The preferred solutions to the presence of IAS are the control and eradication of IAS and the pathways of introduction that have the biggest impact on biodiversity, along with early detection and rapid response. The indicators and baseline information to assess the progress and achievements linked to this Target listed are the number of states with national IAS policies, strategies and action plans, as well as the number of parties to the international instruments that deal with IAS. A list of alien species known to be IAS should also be created and made available through the Global Invasive Alien Species Information Partnership[52]. A list of guiding questions to correctly create national strategies and targets is provided, as well as some requirements for a successful application of the actions, such as conducting a previous risk assessment, and a list of possible indicators based on observed trends[53]. Finally, parties are encouraged to elaborate and share national reports on the achieving of the Target[54].

The Aichi Biodiversity Target 9, being adopted in the CBD framework, is closely linked to Article 8(h) CBD and its Guiding Principles, focusing on the national development and

[51] *Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets* COP 10 Decision X/2, Available at <https://www.cbd.int/decision/cop/?id=12268> (Accessed August 31st 2019); *Trade, transport and trouble: managing invasive species pathways in an era of globalization* Hulme, *P E,* Journal of Applied Ecology, 2009, 46(1), pp. 10-18; *Aichi Biodiversity Target 9 Technical Rationale Extended* COP/10/INF/12/Rev.1.
[52] *Global Invasive Alien Species Information Partnership* Available at <https://www.cbd.int/invasive/giasipartnership/> (Accessed August 31st 2019); *Operational Plan for Global Invasive Alien Species Information Partnership* UNEP/CBD/COP/11/INF/34, September 28th 2012, Available at <https://www.cbd.int/doc/meetings/cop/cop-11/information/cop-11-inf-34-en.pdf> (Accessed August 31st 2019); *GRIIS Global Register of Introduced and Invasive Species* Available at <http://griis.org/> (Accessed August 31st 2019).
[53] *Quick guide to the Aichi Biodiversity Targets, Invasive Alien Species Prevented and Controlled* Available at <https://www.cbd.int/doc/strategic-plan/targets/T9-quick-guide-en.pdf> (Accessed August 31st 2019).
[54] *Decision Adopted by the Conference of the Parties to the Convention on Biological Diversity XIII/27.* CBD/COP/DEC/XIII/27 December 15th 2016. Available at <https://www.cbd.int/doc/decisions/cop-13/cop-13-dec-27-en.pdf> (Accessed August 31st 2019).

implementation of measures against IAS, as well as cooperation and coordination among the international community.

3.3. BWM Convention

The BWM Convention is an instrument adopted under the auspices of the IMO that tries to give answer to one of the most common ways of unintentional introduction of IAS on an ecosystem: the ballast systems of ships. Ballast water, as described in Article 1(2) of the BWM Convention is the use of water to maintain the ship trim, floatability, draught and stability when is empty of its cargo. Because ships take water from the sea in which they are located when they leave their cargo and release it in a completely different place, with completely different ecosystems, species, etc., alien species introductions are common if no mechanism of prevention is in place. The report that resulted from the sixth meeting of the Conference of the Parties to the CBD encourages the IMO, in Part III (7), *"to complete the preparation of an international instrument to address the environmental damage caused by the introduction of harmful aquatic organisms in ballast water and to develop as a matter or urgency, mechanisms to minimize hullfouling as an invasion pathway"*. In its Preamble, the BWM Convention highlights its intention of developing Article 196(1) UNCLOS with the objective of addressing one of the main pathways of introduction of IAS.

The BWM Convention defines IAS in Article 1(8) using the term *«harmful aquatic organisms and pathogens»* in the following terms *«aquatic organisms or pathogens which, if introduced into the sea including estuaries, or into fresh water courses, may create hazards to the environment, human health, property or resources, impair biological diversity or interfere with other legitimate uses of such areas.* Again the main characteristic for invasiveness is the potential hazard to the environment and the consequences the alien species introduced through ballast water may cause.

The BWM Convention requires states to implement a plan on ballast water management to minimize and eliminate the transfer of harmful aquatic organisms and pathogens, as well as the cooperation among them to cooperate to agree on and continuously develop international standards. The BWM Convention has an Annex with 5 sections where the specific regulations for the control and management of ships' ballast water and sediment are developed, requiring the existence of a ballast water management plan and a book, specific rules for ships in relation to the year of construction, ballast water exchange rules, special requirements in

especially vulnerable areas, as well as some standards of procedure and certification requirements.

3.4. CMS

The Convention on the Conservation of Migratory Species aims to the conservation and sustainable use of migratory animals and their habitats[55]. It provides a classification of their status on Appendix I, which provides a list of the endangered migratory species, and Appendix II, that lists the species that have an unfavourable conservation status. The CMS additionally encourages parties to reach agreements in order to restore or maintain the favorable status of the particular species.

Article III(4)(c) creates the obligation for the States *"to the extent feasible and appropriate, to prevent, reduce or control factors that are endangering or are likely to further endanger the species, including strictly controlling the introduction of, or controlling or eliminating, already introduced exotic species."*. The CMS requires the parties to cooperate in the prevention, early detection and rapid response against IAS, and calls for collaboration among governments, economic sectors and non-governmental and international organizations to prevent its international movement[56].

As per Article II(3)(a) and Article VIII, the Scientific Council of the CMS periodically reviews and measures the impact of IAS on migratory species and publishes reports that allow the parties to adopt strategies to try to mitigate its effects. The CMS has a Secretariat, as per Article IX, that is be provided by the United Nations Environmental Programme, which helps to increase, among others, cooperation and integration of measures for the protection of the migratory species.

The main difference of the CMS and the instruments mentioned above is the fact that it strictly refers to the alien species that endanger or further endanger the status[57] of the

[55] *Convention on the Conservation of Migratory Species of Wild Animals, CMS* Available at <https://www.cms.int/en/legalinstrument/cms> (Accessed August 31st 2019).
[56] *Invasive Alien Species and Migratory Species* UNEP/CMS/ScC17/Doc.11 October 19th 2011 Available at <https://www.cms.int/sites/default/files/document/Doc_11_Invasive_Species_E_0.pdf> (Accessed August 31st 2019).
[57] The conservation status of a migratory species and its consideration as unfavourable or endangered has to be understood in the meaning of Articles 1(1)(c), (d) and (e) CMS. An endangered species in that sense means *"that the migratory species is in danger of extinction throughout all or a significant portion of its range;"*.

migratory species[58], that are included in the Appendixes. The CMS does not use the term "*invasive*" but "*introduced exotic species that endanger or are likely to endanger*" the migratory species, which includes alien species that have the potential of becoming invasive, in the sense that they can eventually negatively impact the native species or, in this case, the target species of the CMS. This is an important difference with instruments such as UNCLOS, CBD and BWM Convention, which refer specifically to IAS and oblige the parties to take the appropriate measures when they endanger the environment, its ecosystems or its biological diversity in general. On the contrary, in the CMS, if a alien species, even if invasive, does not have a negative impact on these migratory species in particular the states would not be obliged to prevent, control and eliminate it at all.

3.4.1. ACAP

This Agreement was concluded following Articles IV and V CMS to cooperate in reaching a favourable state of conservation of Albatrosses and Petrels[59], as per Article II(1) ACAP. Article III(1)(b) establishes the obligation to the parties to *"eliminate or control non-native species detrimental to albatrosses and petrels;".* This provisions follows the same logic as the CMS in the sense that it refers to "*non-native*" species and not to their invasiveness, as well as having as a trigger for the obligation of eliminating or controlling such alien species the detrimental effect to albatrosses and petrels in particular.

This Agreement works through an Action Plan for the achievement and maintenance of a favourable conservation status of the Albatrosses and Petrels, following the obligation set in Article VI, that includes conservation of the habitats, research and collation of information, among others. In order to implement this Action Plan, the Agreement establishes the obligation of cooperation and capacity building to the parties in Articles V and IV respectively. The decisions will be taken on the meeting of the parties, as per Article VIII, arranged by the Secretariat, established in accordance with Article X. In order to do so, they will count with the information and reports made by the Advisory Comittee and its working groups in the sense of Article IX.

[58]Migratory Species has to be understood in the meaning of Article 1(1)(a) of CMS, i.e. *"the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries".*

[59]Favourable in the meaning of Article I(2)(n) of the *Agreement on the Conservation of Albatrosses and Petrels*, May 11th, 2018.

Some guidelines focusing on the eradication and control of alien species that may have a negative impact on Albatrosses and Petrels have been published under the auspices of ACAP, such as the Guidelines for eradication of introduced mammals from breeding sites of ACAP-listed seabirds or the Biosecurity and quarantine guidelines for ACAP breeding sites.

3.5. CITES

The Convention on International Trade in Endangered Species of Wild Fauna and Flora establishes a regime of export and import permits, granted by a national Scientific and Management Authority designated according to Article IX of CITES, of species threatened with extinction or that may become threatened if a regulation on their export and import were not to exist. A list of species is provided in Appendix I, Appendix II and Appendix III according to the level of danger of the species as a result of trade.

Trade on species is a concern in relation to IAS. The movement of living species and the introduction of alien species in a new ecosystem, either intentional or by accident, as would be the case of a plant or animal introduced without permits or that escapes, can be a potential entry path of IAS. The Conference of the Parties of CITES has issued several recommendations in relation to this, asking to the parties to consider the risks and problems that invasive species can cause when creating national legislation about trade of living animals of plants, considering the regulations of the receptor country when exporting potential invasive species to it. The parties are additionally asked to coordinate CITES and CBD to further enhance the cooperation among parties on the issue of introduction of potentially invasive species[60]. However, there are no specific measures that the parties are obliged to adopt in relation to IAS, aside from the permit system of trade of living animals and plants that CITES establishes.

The legal framework that deals with IAS is scattered and, in order to address them, many different instruments need to be considered, which may seem as a complex task *a priori*. However, similarities can be drawn from the way IAS are treated in them, specially in the type of measures that States shall implement to protect the ecosystems from their harmful effects. From considering all these instruments globally, a hierarchical system of measures

[60] *Trade in Invasive Alien Species* Resolution Conf. 13.10 (Rev. CoP14) Available at <https://www.cites.org/sites/default/files/document/E-Res-13-10-R14.pdf> (Accessed August 31st 2019).

against IAS can be deduced, consisting on prevention, early detection, eradication, containment and control, which will be presented and analyse in the next section of this work.

4. Three-step Hierarchical Approach to Invasive Alien Species

This section will consist of an exposition of the current measures against IAS included in the legal instruments presented before. The traditional way of approaching IAS is a series of measures that have as an objective the disappearance of the threat or the negative effect that IAS cause into an environment, with the aim of protecting and preserving it. For the purpose of better analysing them, they will be divided in three steps, following the logic of the three stage hierarchical approach set in the Guiding Principle 2 of the Guiding Principles for the Implementation of Article 8(h) CBD: prevention and early detection measures, eradication measures and containment and control measures.

4.1. Prevention and Early Detection

This is the first step considered in the current juridical framework against IAS. The idea that informs it is to prevent potential IAS to enter a given ecosystem and, in the case in which they enter, to detect their entrance as soon as possible. It is the most cost-effective measure and it is thus prioritized. A brief exposition on how prevention measures are regulated in each instrument will be presently done. Prevention can be achieved in a variety of ways but it is the most environmentally benign measure, having as some of its distinct obligations the identification of pathways of introduction, as well as the gathering and sharing of information. For this reason it will be emphasized in this section of the work, as opposed to the eradication and control measures, which will be the main focus of section five.

In UNCLOS there is the obligation for the states to take prevention measures against IAS set in Article 196, but these are not defined: «*States shall take all measures necessary to prevent, reduce and control (...) the intentional or accidental introduction of species, alien or new, to a particular part of the marine environment, which may cause significant and harmful changes thereto.».* Even if IAS and alien species are not pollution in the sense of Article 1(1) (4) UNCLOS, there are some provisions of Part XII that can be applied to prevent their introduction on an ecosystem. First of all, States have the duty to cooperate in the creation of rules, standards and recommended practices and procedures for the protection and

preservation of the marine environment, as per Article 197 UNCLOS. Cooperation is of vital importance in preventing IAS and alien species, given the transboundary nature of ecosystems. According to this Article, States are responsible for the creation of common rules, standards and recommended practices and procedures to prevent IAS or alien species from harming the marine environment. Furthermore, Article 206 UNCLOS places the obligation for the States to assess the potential changes to the environment that the activities carried out under their jurisdiction may produce and publish the results. This can be used to prevent the introduction of IAS or alien species linked to activities such as aquaculture. UNCLOS is, thus, a framework under which States, individually or through direct cooperation or through the competent organizations, can take the measures that they deem convenient to prevent the introduction of IAS and alien species in their ecosystems, in addition to the assessment of the activities that can potentially have such introduction as a result.

The CBD establishes the obligation in Article 8(h) for the States to prevent the introduction of IAS that threaten ecosystems, habitats or species. The CBD does not mention which measures or describe them in any way. Article 7(c) CBD further sets the obligation of identifying processes and activities that can have a negative impact on biodiversity and Article 14.1 CBD establishes the obligation for the States to conduct environmental impact assessments of the activities that may harm biodiversity and encourages cooperation between States. These two articles have a vague wording of the type of adverse effects that the activities may have on biodiversity, as opposed to most of Part XII of UNCLOS that deals specifically with pollution, and thus can be applied in relation to IAS.

The specific measures to prevent the introduction of IAS can be found in the Guiding Principles for the Implementation of Article 8(h) CBD. First of all, in the General Part contained in Section A, there is a general framework of Guiding Principles in which the prevention measures are based. The Guiding Principle 1 refers to the application of the precautionary approach[61] to the efforts for the identification and prevention of unintentional introductions of IAS and the decisions taken accordingly. The Guiding Principle 2 establishes the three-steps hierarchical approach to combat IAS, in which prevention is given preference as the most cost-effective and environmentally desirable measure. The introduction of IAS

[61] As can be found in the CBD Preamble, where there is a threat of significant reduction or loss of biological diversity, lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat.

has to be prevented between States but also within the same State and it has to be done rapidly to impede its establishment in an ecosystem. Guiding Principle 3 sets the obligation to apply the ecosystem approach[62] to all of the measures dealing with IAS adopted by the States. The Guiding Principle 4 obliges the States to recognize the risk that the activities carried out within their jurisdiction may have for other States as a potential source of introduction of IAS and the obligation to minimize it. This obligation includes the sharing of information on any potentially invasive behaviour as well as any potential IAS.

Furthermore, in Section B there are the specific measures to prevent the introduction of IAS. The Guiding Principle 7 sets the obligation for the States to put in place quarantine and border control measures to prevent the entrance of alien species that are or can potentially become invasive to ensure that the intentional introductions of alien species, which are described in the Guiding Principle 10, shall have the appropriate authorisation, and the unintentional ones, which are described in the Guiding Principle 11, shall be minimized. These measures have to be taken by States in accordance with their existing national legislation and they have to be based on a risk analysis of the threats that IAS pose and their potential pathways of entry. Finally, the Guiding Principle 7 states that "*early detection systems and regional and international coordination are essential to prevention".* Additionally, the Guiding Principle 8 places on the States the obligation of exchanging information about alien species. States should assist in the creation of an inventory and relevant databases to compile and share it in the context of prevention, introduction, monitoring and mitigation. It is further stated that the information should include "*incident lists, potential threats to neighbouring countries, information on taxonomy, ecology and genetics of invasive alien species and on control methods."* This information about alien species has to be widely disseminated, along with national, regional and international guidelines, procedures and recommendations, and should be facilitated through the "*clearing-house mechanism"* of CBD[63]. Also, States are encouraged to share the requirements of importation of IAS they already have in place. The Guiding Principle 8 specifically mentions the Global Invasive Species Programme, which is a a partnership network of scientific and technical experts worldwide, and the information they

[62] As described in decision V/6 of the Conference of the Parties: a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way.
[63] The mission of the "*clearing-house mechanism*", established further to Article 18.3 CBD through Decision X/ 15, is to contribute significantly to the implementation of the Convention on Biological Diversity and its Strategic Plan for Biodiversity 2011-2020, through effective information services and other appropriate means in order to promote and facilitate scientific and technical cooperation, knowledge sharing and information exchange, and to establish a fully operational network of Parties and partners.

facilitate and the recommendations they issue as an example of widely disseminated information. Finally, the Guiding Principle 9 states the need of cooperation among States for the prevention of IAS and gives four examples of the kind of cooperative efforts which are not meant to be a *numerus clausus* enumeration, consisting of sharing of information programs, agreements on the regulation of trade of certain alien species, the creation of capacity-building programs and cooperative research efforts towards the identification, prevention, early detection, monitoring and control of IAS.

The Guiding Principles 10 and 11 differentiate between intentional and unintentional introductions of alien species. The Guiding Principle 10 deals with the intentional introduction of alien species to the territory of a State. The first part establishes the prohibition of any kind of introductions of alien species without the authorization of a competent authority of the recipient State. The competent authority has to authorize an introduction after a process, whose central part consists of a risk analysis which may include an environmental impact assessment. On the basis of this risk analysis the States shall only authorize the introduction of the alien species that are very unlikely to cause harm or threaten their biological diversity. The Guiding Principle 10 further adds that States can impose conditions for the introduction of an alien species and gives some examples, including conditioning the introduction to the creation of a mitigation plan and the creation of specific monitoring procedures. In the second part of the Guiding Principle 10 States re encouraged to base their decisions on the introduction of alien species on the precautionary approach, according to which "*where there is a threat of reduction or loss of biological diversity, lack of sufficient scientific certainty and knowledge regarding an alien species should not prevent a competent authority from taking a decision with regard to the intentional introduction of such alien species to prevent the spread and adverse impact of invasive alien species".* The Guiding Principle 11 deals with the unintentional introduction of alien species in the territory of a State. Part one of this Guiding Principle encourages the States to have provisions in place to address unintentional introductions, including intentional introductions that have become invasive. These measures can be statutory and regulatory and include the creation or strengthening of institutions to apply them, being the minimum effectivity threshold the fact that they allow for a rapid and effective action against unwanted introductions. The second part of this Guiding Principle focuses on introduction pathways. The States have the obligation to identify and minimize them, including the obligation of conducting an environmental impact assessment and a risk analysis of the activities that have the potential of

resulting in unwanted introductions, such as fisheries, shipping and ballast water or aquaculture *inter alia*.

The Guiding Principle 5 addresses the early detection of IAS through researching and monitoring them as well as a baseline taxonomic study of biodiversity. This Principle explains what research and monitoring include further in great detail. Monitoring must include "*both targeted and general surveys, and benefit from the involvement of other sectors, including local communities"* and research must include "*a thorough identification of the invasive species and should document: (a) the history and ecology of invasion (origin, pathways and time-period); (b) the biological characteristics of the invasive alien species; and (c) the associated impacts at the ecosystem, species and genetic level and also social and economic impacts, and how they change over time."*

The Aichi Biodiversity Target 9 calls for improved border control and quarantine measures as a method of preventing IAS from entering an ecosystem, including coordination among the responsible bodies for animal and plant health, early warning mechanisms, rapid response measures and management plans. It calls for an implementation of already existing tools and instruments, such as the BWM Convention to prevent the introduction of alien species through the ballast water, one of the most common pathways of entry of IAS[64]. In the Quick Guide to the Aichi Biodiversity Targets an explanation of the outcomes of meeting Target 9, which includes the identification of IAS, its pathways, and its prioritization in order to effectively address them when more than one IAS is present. The methodology suggested to achieve this by the States is the creation of national targets to meet the Aichi Biodiversity Target 9 globally.

The BWM Convention has as the primary objective the prevention of the introduction of alien species through the ballast water of ships, as stated in Article 2(1) BWM Convention, which is one of their main pathways of entry. In the last decades the shipping traffic has increased and it is predicted that this trend continues, especially with the opening of new shipping routes without ice-breakers and the longer periods with little to no ice in the Arctic, which entails a bigger risk of alien species introductions, sometimes in what are already vulnerable ecosystems. Article 2(1) sets the general obligation for the States to give full effect of the BWM Convention in order to prevent, minimize and ultimately eliminate the introduction and

[64] *Aichi Biodiversity Target 9 Technical Rationale Extended* COP/10/INF/12/Rev.1.

transfer of alien species through the management of the ballast water of the ships, as defined in Article 1(3). Article 2(4) urges the States to cooperate towards the achievement of the aim of the convention and Article 2(5) encourages them to continuously develop the standards of management of ballast water. Article 2(8) prompts States to try to prevent the ships flying their flag to use ballast water with potential alien species. These general rules set the basis of the specific technical rules and ballast water management plans, as per Annex I Regulation B-1 and Regulation B-3, to prevent the introduction of alien species through ballast water.

The CMS has a different approach to the prevention of IAS. In Article 3(4)(c) it sets the obligations for the States *"to the extent feasible and appropriate, to prevent, reduce or control factors that are endangering or are likely to further endanger the species, including strictly controlling the introduction of, or controlling or eliminating, already introduced exotic species"*. In this case, the requirement of preventing alien species from entering is mentioned in relation to "*factors that are endangering or likely to further endanger the species"*. When specifically talking about alien, or exotic, species the CMS talks about *"controlling the introduction",* and control and eradication measures. Finally, the ACAP does not even include prevention measures when talking about alien species.

CITES is in itself a prevention instrument in the same way that the BWM Convention is. The regulations and system of permits that it establishes in order to avoid unwanted introductions of alien species in a new ecosystem that can potentially become invasive is a way of addressing a specific pathway of entry of IAS in a given ecosystem before it happens. The objective of CITES is thus the regulation of a very specific pathway of human introduction of alien species in an ecosystem with the aim of it being done in the safest manner possible to avoid invasions.

4.2. Eradication

Once IAS are present and have settled in an environment the first option is to eradicate them as soon as possible with the objective to prevent damage and spread as much as possible. This measure is emphasized in several instruments, such as The Guidelines to implement article 8(h) CBD or the Aichi Biodiversity Target 9 among others.

UNCLOS does not specifically mention any eradication measure against IAS or alien species, however, Article 196 UNCLOS talks about *"all measures necessary to prevent, reduce and*

control" IAS but these measures are not further described. It can be interpreted that *"reduction"* measures include the eradication of IAS or alien species that could potentially cause harm to the marine environment, directly or in cooperation with other States, as per Article 197 UNCLOS. The objective of these measures is to protect and preserve the marine environment, in accordance with Article 192 UNCLOS.

The CBD specifically mentions eradication as one of the measures against the alien species that threaten the ecosystems, habitats or species, along with their prevention and control, in Article 8(h). This is later developed in the Guidelines for the implementation or Article 8(h) CBD, in which these measures are developed. The Guiding Principle 12 clarifies the purpose of both eradication and containment and control measures. They are designed to be applied only when IAS have been established in an ecosystem. The Guiding Principle 12 states that these measures have to be safe to humans, the environment and agriculture, as well as ethically acceptable for the stakeholders in the areas affected by the IAS. This is one of the most controversial requirements that will be analysed in depth in the following sections of this work. The Principle further adds that the eradication needs to be implemented on the basis of the precautionary approach and in the earlier stages possible. Following the definition of the precautionary approach of the Rio Declaration of Environment and Development, which states that *"where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation",* it can be deduced that what the Guiding Principle 12 is implying is that eradication measures shall not be postponed for the lack of scientific certainty, given that the objective is dealing with a threat that could potentially create some irreversible damage. Eradication measures are conceived in CBD as a way of taking quick measures against IAS once they have entered a territory. According to the Guiding Principle 13, eradication is the best course of action when the introduction is done when feasible. It goes hand in hand with early detection systems, to be able to intercept the invasion as soon as possible and monitoring post eradication. It further adds that consideration needs to be given to the potential secondary effects of eradication on biodiversity. In the Aichi Biodiversity Target 9 eradication is treated in the same way, emphasizing the need to prioritize eradication efforts[65]

[65] *Ibid.*

The ACAP provides a substantially different approach to eradication, stating the obligation to "*eliminate or control non-native species detrimental to albatrosses and petrels"*. This approach differs in the requirements for an alien species to be subject to eradication, shifting the focus from the potential harmful effect to the environment as a whole to the potential detrimental effect over albatrosses and petrels in particular.

4.3. Containment and Control

If the eradication of the IAS already present and settled in an environment fails to meet its objective or is unworkable, then the next preferred solution is to try to contain and control the IAS as far as possible with the objective of protecting the new environment as much as possible, even if the presence of the IAS cannot be avoided. However, control and containment measures frequently are a gateway to eradication, once it becomes possible, or when a new outburst of IAS appears in the ecosystem in which the control and containment measures are applied.

UNCLOS mentions control specifically in Article 196. It does not describe the kind of control measures, only in terms of necessity by stating that States shall take *"all the measures necessary to prevent, reduce and control"*. Again, these measures are not described further in UNCLOS but control is specifically mentioned.

In CBD Article 8(h) control is also specifically mentioned but only defined in the Guiding Principle 15 of the Guidelines of Implementation of Article 8(h) CBD. In this Guiding Principle the control measures have two different objectives. First of all, to reduce the damage that the IAS have produced in the affected ecosystem and secondly to reduce the number of said IAS. Later, the control measures are described as a wide range of integrated management techniques that go from habitat management to mechanical, biological or chemical control of IAS. These control measures go hand in hand in the Guidelines for the Implementation of Article 8(h) CBD with the containment measures, as per Guiding Principle 14, in which they are set to be used when eradication is not appropriate. The objective of the containment measures is to limit the spread of the IAS. These measures go together with regular monitoring of the affected environment and the readiness of quick action plans, in order to eradicate any new outbreaks of IAS. These two measures are informed by the same objective of reducing the number of IAS in an ecosystem and seem to be closely intertwined. However,

the reconstruction of the affected environment is only found in the last step of the process categorised under the control measures and it is an objective that can only be found in CBD.

The CMS and ACAP also specifically mention control in the measures that the States have to adopt against IAS without further describing them. The control and containment measures are the last step on these three-step hierarchical measures system and, as such, is the last resort. In the case of the Guidelines for the Implementation of Article 8(h) CBD the control measures have an additional positive and reconstructive objective which cannot be found elsewhere. In the other instruments the containment and control measures are the alternative of a failed or impossible eradication effort.

The ensemble of these measures makes a really straight-forward system of dealing with alien species and IAS. However, there is a clear difference in the approach of the first step and the two others. The prevention measures are mostly innocuous for the alien species in particular but have an enormous effect on the ecosystem. The eradication and control ones are, as it will be analysed in section five of this work, much more aggressive and may pose some concerns when considered in the context of climate change.

5. A Critical Approach to the Prevention, Early Detection, Eradication, Containment and Control Measures against Invasive Alien Species[66]

The treatment of IAS in the legal framework that has been swiftly analysed in the previous section raises a few questions that are going to be addressed here. First of all, to which extent the prevention, early detection, eradication and containment measures remain an equally useful strategy against IAS in light of climate change. Secondly, these measures will be reflected upon from an ethical perspective, paying particular attention to eradication and control. Additionally, the very legal definition of IAS will be considered. Finally, an analysis of the possible gaps, along with some potential changes in the juridical framework will be conducted.

[66]This formulation tries to include all the measures that the framework of IAS mentions and the different existing nomenclatures depending on the legal instrument, i.e. the "prevention, early detection, eradication and/or control of invasive alien species" of CBD, the prevention, reduction and control" measures of 196 UNCLOS, the control, eradication and prevention measures of Aichi Biodiversity Target 9, the measures to address the damage and those minimize the entry pathways of IAS on the BWM Convention, the measures of controlling the introduction of, or controlling or eliminating already introduced IAS of the CMS, the elimination and control measures of ACAP and the prevention efforts of CITES.

5.1. Climate Change Changes Everything

Climate change is radically changing the ecosystems and, as it has been argued in section two, it alters the natural movement of species worldwide. When all species are potentially invasive for other ecosystems, where does the definition of IAS starts and ends? And, what is left of the current regulation?

First of all, the cause for climate change has to be determined. The definition of IAS by the IUCN requires human introduction, while in the CBD this could be regarded as an alternative[67]. If the *"and/or spread"* clause is interpreted in the sense of alternative to human introduction of IAS, then the species that migrate due to climate change could be legally considered as IAS in virtue of CBD. The main consequence of this is the fact that the measures against IAS would then be applicable, including the eradication and control ones. This interpretation would also have consequences for the law in itself, raising the question of its suitability in view of this new type of alien species, which arrive to the ecosystems as a result of the consequences of climate change, falling into the legal category of IAS. Some of the legal measures may prove not to be suitable for this particular type of IAS.

However, the requirement of human introduction, both directly and indirectly, for a species to be covered by the legislation on IAS is of general understanding and it is implied in many instruments, such as Article 196 UNCLOS. Thus, if climate change, which is the trigger for the marine species to move and the epicenter of all the disturbances in the oceans, that alter their conditions and weaken their ecosystems, is anthropogenic in origin, then the arrival of alien species to new ecosystems, and their potential invasiveness, can be argued to be unintentional or indirect human introduction.

The United Nations Framework Convention on Climate Change Article 1.2. defines climate change as "*a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods"*. Furthermore, in the IPPC 5th synthesis report on climate change[68] it is stated that "*The IPCC is now 95 percent certain that humans are the main cause of current global warming"*.[69] Additionally, in the Special Report

[67] As argued in 1.1. section of this thesis, second paragraph.
[68] *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* R.K. Pachauri and L.A. Meyer, IPCC 2014, 151 pp. Available at <https://www.ipcc.ch/report/ar5/syr/> (Accessed August 30th 2019).
[69] *Ibid* (foreword).

on the impacts of global warming of 1.5ºC above pre-industrial levels[70] the human influence on climate warming is expressed as "*the dominant cause of observed warming since the mid-20th century".*[71] There is then a general consensus among the international community of the fact that climate change is anthropogenic in its origin and, as such, the movement of species that has its origin in the change of circumstances in the marine ecosystems is the direct consequence of human activities. As a result of this, the species that move to other ecosystems and become invasive, as argued in the first chapter of this thesis, are IAS in the legal sense because ultimately they have been introduced by humans through the impact that their activities have in the environment in general and in oceans in particular. So all the instruments that deal with IAS, and the prevention, early detection, eradication and containment and control measures that they provide, are applicable. This proves to be challenging under the new circumstances and it could have disastrous consequences.

Of course, there is a difference to be made between the alien species that are introduced in an ecosystem through the traditional pathways of entry, such as the ones transported by ballast water or are a result of activities such as aquaculture, which later can become invasive, and the climate change-induced movement of species and their potentiality of becoming invasive in the new ecosystems. The legal framework if applied in the same way in both situations may have different consequences. The different legal instruments that deal with IAS were conceived to deal with the traditional pathways of entry of IAS and in the traditional circumstances of the ecosystems. So even instruments such as the BWM Convention, which is exclusively a prevention instrument that only accounts for a very specific pathway of entry of IAS, may prove to be insufficient to address the new situation arising on their own, because the picture has broadened up. The legal framework may still be relevant and useful for the particular purpose that it was conceived, and in the context of the traditional pathways of entry of IAS and healthy ecosystems, but probably insufficient when considering some of the new factors and circumstances that affect and disrupt the environment. In the case of the new pathways of entry relating to climate change, some of the instruments, if applied directly and without any other consideration, would have the opposite effect than the one intended, as it has been argued before. The focus in this section will be in the three-step hierarchical system of measures studied in light of the consequences of climate change in the oceans.

[70] *IPPC Special Report. Global Warming of 1.5 ºC* Available at <https://www.ipcc.ch/sr15/> (Accessed August 31st 2019).
[71] *Ibid* (Chapter One, first paragraph).

In addition, the marine ecosystems are becoming weaker as result of the changing conditions and they are more vulnerable to invasions, which can occur faster and do more damage. This is a circumstance that was not considered when drafting the legal framework for IAS. It is particularly important to protect these ecosystems from invasions that further imbalance them, but also more challenging, given the fact that their dynamics are disturbed so it is difficult to foresee the impact that the traditional measures against IAS can cause on them. Marine ecosystems are particularly dynamic and rich in biodiversity[72], especially if compared with terrestrial ones, and the complexity of their ecological communities makes it difficult to fully grasp the consequences of species loss as a result of the effect of climate change on the general functioning of the ecosystem[73]. A balance between avoiding the stressor of invasiveness and applying a highly static system of laws, as is the IAS legal framework that does not allow for exceptions in the application of the measures for the prevention and especially eradication and control, of IAS, to a highly dynamic ecosystem needs to be reached.

Starting from the prevention and early detection measures, which have to be considered taking into account that the tendency worldwide is one of movement of species that goes hand in hand with the perennial potential of becoming invasive in the reception ecosystems, which are already weakened. All the species moving will be alien in the sense of the IUCN definition and, according to Article 196 UNCLOS, States have the duty to take all measures necessary to prevent the introduction of alien species that may cause significant and harmful changes on the new environment. If we start from the premise that marine ecosystems are weakened as a result of the consequences of climate change, then all alien species are liable of producing such harmful changes on the environments they arrive to. The same obligation exists in Article 8(h) CBD, in which States have the duty of preventing the introduction of the alien species that threaten ecosystems, habitats or species. Prevention and early detection are considered the most cost-effective measures and are given preference[74] in the three-step hierarchical approach explained in the previous section of this work. However, is it an obligation that can be accomplished in the context of movement of species as a result of

[72] *Priority Actions to Achieve Aichi Biodiversity Target 10 for Coral Reefs and Closely Associated Ecosystems* Annex to decision XII/23 of the Conference of the Parties to the Convention on Biological Diversity. Available at <https://www.cbd.int/doc/publications/cbd-aichi-target-10-en.pdf> (Accessed August 31st 2019).
[73] *Animal diversity and ecosystem functioning in dynamic food webs* Florian D. Schneider et al. Nature Communications volume 7, 2016. Available at <https://www.nature.com/articles/ncomms12718> (Accessed August 31st 2019).
[74] Guiding Principle 2 of *Guiding Principles for the Implementation of Article 8(h) CBD* UNEP/CBD/COP/6/20, VI/23, Page 249, 2002.

climate change? There are a few new variables that are added to the equation. Prevention of IAS in the context of climate change may have to consider and include some of the climate change prevention elements in order to be effective and to correctly identify the potential movement of species and ecosystem variations and their interconnections to correctly assess the potentiality of invasiveness and harmful effects in the new ecosystems.

A big part of prevention and early detection measures are the identification of pathways of entry, exchange of information, and cooperation among States, as it can be see in the Guiding Principle 7 and 8 of the Guideline Principles for the Implementation of Article 8(h) of CBD, including border control measures, as stated in the Guiding Principle 7 and in the Aichi Biodiversity Target 9. These are measures that would play a big role in trying to study and know more about the interconnections between IAS and climate change. It is always important to cooperate on the basis of shared scientific knowledge and thus these prevention measures are very important and continue to be in the face of the new pathways and movements of alien species and IAS. They could help identifying the species that may become invasive, and to try to elaborate some predictions by tracing the movement of currents, temperature changes and other variables.

These prevention measures may prove to need supplementary layers of measures and actions if we put them next to the climate change obligations and engagements that States have, in an attempt to address the pathways of entry of the IAS related to climate change. This is connected to the preamble of CBD in which it is stated that "*it is vital to anticipate, prevent and attack the causes of significant reduction or loss of biological diversity at source"*. If the source of these new alien species and IAS pathways of entry is climate change, then it is necessary to broaden the prevention measures by adding some of the prevention measures included in the climate change regulations, as it will be argued further in the next sections of this work.

On the other hand, the eradication measures, which will be step two in the three-step hierarchical approach, show perfectly how the state of the art in relation to IAS has changed and will continue to change as a consequence of climate change. These type of measures are being prioritized in some instruments, such as the Aichi Biodiversity Target 9, in the extended technical rationale of which[75] they are encouraged as a way of fighting against the increasing

[75] *Strategic Plan For Biodiversity 2011-2020: Further Information Related to the Technical Rationale for the Aichi Biodiversity Targets, Including Potential Indicators and Milestones* UNEP/CBD/COP/10/INF/12/REV1. Available at <https://www.cbd.int/kb/record/meetingDocument/77515?Event=COP-10> (Accessed August 31st

pathways of entry and the great quantity of IAS already present in the states. In the Guiding Principle 13 of the Guiding Principles of Implementation of Article 8(h) CBD they are categorized as *"the best course of action to deal with the introduction and establishment of IAS"*. However, if the trend continues to be the movement of species and if they have a greater chance of becoming invasive in the new ecosystems, due to the fact that they are already weakened, then eradication may prove to have the contrary effect. The goal of applying eradication measures, as per the Guiding Principle 12 of the Guidelines for the Implementation of article 8(h) CBD, is mitigating the adverse effects that IAS may produce on a given ecosystem. However, the eradication measures have to be *"safe for the environment"*. If we take the perspective of the marine environment as a whole interconnected network of ecosystems, even if more or less isolated, and even with its differences and unique characteristics, then eradicating the species that move or expand their presence as a result of climate change may not be safe for the environment in the sense of it being unharmed, as a consequence of the potential contrary effect of applying the measures without any other consideration, as we shall see presently. Furthermore, they may prove to contravene the objective of CBD, which is protecting the biodiversity, that shapes the rest of the provisions and instruments adopted under its framework. It may also go against Article 192 UNCLOS, which establishes the general obligation of protecting and preserving the marine environment.

Marine ecosystems are the result of an organic balance that is more or less stable when healthy[76]. This idea of balance of nature refers to the natural resilience and adaptability of an ecosystem in the face of changes and perturbations a well as its capacity to go back to its original state[77]. When this equilibrium is radically disrupted by changes in temperature, currents, among others, to a point that exceeds the level of disturbance that the ecosystem has the capacity of responding to[78], then it becomes weaker and less resilient, which, as a consequence, increases the chances of a species becoming invasive. However, these new species may also fill the gaps left by the indigenous species that were not able to move to

2019).

[76] Ecological balance as described by the WWF. *Ecological Balance* Available at <https://wwf.panda.org/knowledge_hub/teacher_resources/webfieldtrips/ecological_balance/> (Accessed August 31st 2019).

[77] E*cological Stability: An Information Theory Viewpoint* Robert W. Rutledge, Journal of Theoretical Biology Volume 57, Issue 2, April 1976, Pp. 355-371.; *Navigating the complexity of ecological stability*, Ian Donohue et al., Ecology Letters, 2016, pp.1172–1185.

[78] *Navigating the complexity of ecological stability*, Ian Donohue et al., Ecology Letters, 2016, pp.1172–1185.

more suitable environments after the changes in the ecosystem[79]. Additionally, these alien species sometimes are useful or have a beneficial effect on the new environment, even if not always its apparent from the beginning[80]. In any of these cases, already analysed in the section in which the interrelation between climate change and IAS was explained, the eradication of these alien species, once they have been recognized as invasive, can prove to be detrimental and harmful to the environment that the legal framework tries to protect.

The species that move are often faced with the alternative of extinction and, as argued before, the ones that are capable of expanding their range are often the strong species and, as such, have the potential of disrupting the ecosystem in which they establish themselves and ultimately of becoming invasive. One clear example of this can be found in the situation of polar bears in Nunavut. As a consequence of climate change and the shrinking of the sea ice, which results in an increased use of terrestrial space, polar bears are increasing their attacks on human populations[81] and extending their range of presence[82]. This has been specially serious in Nunavut, where the death of a local hunter confronting a polar bear has awaken the debate on whether or not Inuits should be granted more hunting quotas, as they demand. However, if polar bears were to be considered invasive in the new ecosystems, and if eradication measures were to be applied in these cases, then these species would stand no chance of survival in the face of climate change. Following the case of polar bears, what is pushing them to extend their range and what is causing a human-bear conflict[83] is the progressive disappearance of their own habitats, meaning they do not have an alternative but to move, at the cost of causing disruption and harmful consequences in the new ones. In the case of fisheries moving northwards, taking the argument to the extreme in a hypothetical example to illustrate the damage that such measures can cause, applying eradication measures against them if they prove to disrupt the new ecosystems, would have catastrophic economic consequences, as well as for the livelihoods of thousands of people and the food security of many. This could be the case of the snow crab, which is an IAS that holds a great economic

[79] *A Perspective on Climate Change and Invasive Alien Species*, 2nd Meeting of the Group of Experts on Biodiversity and Climate Change, Convention on the Conservation of European Wildlife and Natural Habitats, T- PVS/Inf 5 rev, June 16th 2008.
[80] *Sometime Invasive Species Are Good* Brandon Keim, Wired Magazine, February 28th 2011. Available at </www.wired.com/2011/02/good-invasives/> (Accessed August 31st 2019).
[81] *Polar bear attacks on humans: Implications of a changing climate* James M. Wilder et al., the wildlife society bulletin, 10.1002/wsb.783., 2017.
[82] *As polar bear attacks increase in warming Arctic, Inuits and scientists search for solutions* PBSO News, December 26th 2018. Available at <https://www.pbs.org/newshour/science/as-polar-bear-attacks-increase-in-warming-arctic-inuits-and-scientists-search-for-solutions> (Accessed August 31st 2019).
[83] *Ibid.*

value in the Barents sea[84], being a greatly productive and profitable commercial fishery. Its eradication would have such an important economic repercussion that it is maintained at a great environmental cost, given the fact that their presence may have a harmful lasting impact on the seabed ecosystem balances of the region[85]. But even if their consequences are not economic or so obviously tangible, these measures can have big repercussions on the environment as a whole. Furthermore, and in relation to the above, the Guiding Principle 13 of the guiding principles of implementation of article 8(h) CBD, states that consideration needs to be given to the potential secondary effects of eradication on biodiversity.

However, the Guiding Principle 12 states that such eradication measures have to be applied on the basis of the precautionary approach, as defined in the preamble of CBD, the applicability of which in relation to IAS determined in the Guiding Principle 1 that expresses that the "*lack of scientific certainty about the various implications of an invasion should not be used as a reason for postponing or failing to take appropriate eradication, containment and control measures".* This illustrates the great dichotomy in relation to IAS that appear as a consequence of climate change: IAS coming from anthropogenic induced movement stand no chance of survival if eradicated when they arrive to the new ecosystems but they add even more stress on an already stressed ecosystem. On one hand they move from their ecosystems because they become inhabitable for them and thus they have no other option but moving. On the other hand, their appearance disrupts the new ecosystem, which is already weakened by the consequences of climate change, and has a potential harmful effect, which in this scenario would be enhanced as a consequence of the previous loss of resilience of the ecosystem. Eradicating IAS would imply treating the symptom only and not the cause for ecosystems loss of resilience and the reason that triggers these shifts in range and presence of species, which is human induced climate change. This apparently catch-22 situation could be solved if the narrative changes from alien versus native species towards a more inclusive and broader one

[84] *Snow crab (Chionoecetes opilio) – a new invasive crab species becoming an important player in the Barents Sea ecosystem* Jan H. Sundet and Sergey Bakanev, ICES CM 2014/F:04. Available at <http://www.ices.dk/sites/pub/CM%20Doccuments/CM-2014/Theme%20Session%20F%20contributions/F0414.pdf> (Accessed August 31st 2019).

[85] *The snow crab – a new and important player in the Barents Sea ecosystem* Jan H. Sundet, Framsenteret, February 15th 2016, Available at <http://polarenvironment.custompublish.com/the-snow-crab-a-new-and-important-player-in-the-barents-sea-ecosystem.5844740-373134.html> (Accessed September 1st 2019); *The evaluation of adverse impacts from fishing on crab essential fish habitat* NMFS and NPFMC staff discussion paper, January 2012. Available at <https://www.npfmc.org/wp-content/PDFdocuments/conservation_issues/EFH/BBRKC_EFH212.pdf> (Accessed September 1st 2019); *4.6 Snow crab effect on benthos* Harald Gjøsæter et al., the Barents Portal, December 2017. Available at <https://www.barentsportal.com/barentsportal/index.php/en/human-activities/173-interactions-drivers-and-pressures-2016/759-snow-crab-effect-on-benthos> (Accessed September 1st 2029).

in which all the marine ecosystems, their interconnections and their well-being are considered, as it will be argued in the next section of this work.

The only exception to this state of the art is ACAP, in which Article III(1)(b) expresses that non-native species that are detrimental to albatross and petrels must be eliminated or controlled. In this particular case, the only requirement for eradication of alien species is the potential harmful effect to albatross and petrels, which will be discussed in the following section of this chapter.

Containment and control measures are the last step on the three-step hierarchical approach. These measures are to be applied when the prevention and eradication ones have failed or have not been enough. In the Guiding Principle 14 of the Guidelines for the implementation or article 8(h) CBD, they are addressed individually. The containment measures are suggested *"when eradication is not appropriate",* and they consist of limiting the spread of IAS. However, it is also stated that the population or the range of the IAS is small enough so in the case of the species that have arrived as a result of the consequences of climate change may not be appropriate if they migrate in bulk or if different species arrive to the same ecosystem. The containment is accompanied by monitoring and quick action for eradicating the species of IAS if a new outbreak were to happen. The control measures, as per the Guiding Principle 15, on the other hand, are the last step possible, the focus of which is placed on reducing the damage caused by the IAS in the ecosystem as well as reducing the number of IAS. This Guiding Principle further adds that effective control must rely on a series of control mechanisms, such as mechanical, chemical and biological control, as well as habitat management. So both containment and control measures have an eradication component to them.

Alternatively, if these movements of species as a result of the changing conditions are not to be considered human introduction in the event of invasiveness, then the situation turns out to be very different. The regulation for IAS could only be applied by interpreting the wording of the definition of CBD as offering both ways of introduction, human and an eventual natural[86] spread: "*the species whose* ***introduction and/or spread*** *outside their natural past or present distribution threatens biological diversity".*[87] Because of this, only the instruments that are based on this definition, the CBD and its guidelines for the implementation or Article 8(h),

[86] Natural event is used here as opposed to human introduction or the consequences of a human action or activity.
[87] *What are Invasive Alien Species?* Convention on Biological Diversity. Available at <https://www.cbd.int/invasive/WhatareIAS.shtml> (Accessed August 30th 2019).

and the Aichi Biodiversity Target 9, could apply and only by means of interpretation, with the already mentioned exception of ACAP. However, in general terms, then they would not fit in the definition of IAS, as they would not be introduced, intentionally or unintentionally. Then they would be classified with terms such as *"migrating"*, *"spreaded"* or *"extended-ranged"* species, as defended by part of the scientific community[88]. Even if they would not fit in the legal definition of IAS there would still be a potential negative impact on the new ecosystems and the species would definitely be alien so either an interpretation of the wording of the legal instruments would have to be made or a broader definition of IAS, alien and native species would have to be considered, as it will be argued in the solutions section of this work, along with a different perspective of the same problem, such as focusing on enhancing resilience of the recipient ecosystem. A similar situation that may arise as a result of the consequences of climate change in the marine ecosystems is that of native species that because of the imbalances of their own ecosystems acquire an advantage over the rest and become invasive, after the predator-prey relationships are disrupted, potentially posing the same threat to ecosystems as IAS. This situation, even if analogous to that of IAS, could never fit in the legal definition of IAS and thus it may prove very difficult to address. Nevertheless, the boundaries of human introduction are blurred in the face of these new circumstances. While it has been attempted to establish a difference between the movement of species as a consequence of climate change and the traditional pathways of introduction in the legal instruments[89], it might prove to be a highly debatable differentiation[90].

In conclusion, the current regulation, if applied blindly and without any other consideration, may have the opposite effect to the one that was intended, which is protecting the marine environment from invasions.

5.2 Ethical Concerns

Along with the gaps and potential problems that climate change adds to the IAS regulation, there is some ethical problems with some of the measures to fight them. They will be analysed here along with the added layer of complexity that climate change entails.

[88] *Alien plants in checklists and floras: towards better communication between taxonomists and ecologists* Petr Pyšek, David M. Richardson, Marcel Rejmánek, Grady L. Webster, Mark Williamson & Jan Kirschner, 2004, page 133.
[89] *Guiding Principles for the Implementation of Article 8(h)* CBD, footnote 52, Section IV(c).
[90] *Perspectives on the 'alien' versus 'native' species debate: a critique of concepts, language and practice* Charles R. Warren, Progress in Human Geography 31(4), 2007, pp. 427–446.

It has been stated in the previous section that the eradication measures against IAS can have the opposite effect to the protection of an ecosystem if applied without any other consideration. However, these measures pose some ethical concerns. Eradication measures, and ultimately control and containment measures too, given the fact that they include eradication as an emergency mechanism and integrated management techniques, are based on the idea of physically eliminating the alien species that pose a threat to the environment. With climate change, as it has been argued throughout this work, there is likely to be an increment of IAS along with distressed ecosystems so it is pressing to establish if eradication, control and containment measures are ethical and consequent with the global objective of preserving biodiversity and ultimately the marine ecosystems.

Traditionally, non native species have been vilified and considered inevitably harmful, being many times equated to IAS without second thoughts, and this somehow biased narrative has been predominant over the last decades[91]. However, new approaches and perspectives are appearing that challenge this too generalistic and simplistic way of approaching a subject that has such a great impact in conservation and biodiversity[92].Of course, great pests and IAS are one of the main drivers of biodiversity loss and are huge stressors for ecosystems but that is not the end of the story. There are multiple layers that are often not considered because of the automatic assumption of alien species having always disastrous consequences.

First of all, alien species are not always drivers of biodiversity loss. However, if a given non-native species is considered an immediate potential threat, by automatically assuming its invasiveness, measures may be put in place before assessing its actual effect on a given ecosystem. And this potential threat does not always materialize. There are several studies that suggest that, in certain cases, IAS are not a threat to the extinction to most of the native species in the majority of ecosystems[93] with the exception of islands that, given their isolation,

[91] *Don't judge Species on their Origins,* Mark A. Davis, Nature volume 474, 2011, pp.153–154 Available at <http://www.especes-exotiques-envahissantes.fr/wp-content/uploads/2017/11/dont_judge_species_on_their_origins.pdf> (Accessed August 31st 2019).

[92] *The Potential Conservation Value of Non-Native Species* Martin A. Schlaepfer, Conservation Biology, Volume 25, No. 3, 2011, pp. 428–437; *Don't judge Species on their Origins,* Mark A. Davis, Nature volume 474, 2011, pp.153–154 Available at <http://www.especes-exotiques-envahissantes.fr/wp-content/uploads/2017/11/dont_judge_species_on_their_origins.pdf> (Accessed August 31st 2019); *Invasion Biology* Davis, M. A., Oxford Univ. Press, 2009; *Listening to Nature's Voice: Invasive Species, Earth Jurisprudence and Compassionate Conservation*, Sophie Riley, Asia Pacific Journal of Environmental Law. Vol 22 n1, 2019, pp. 117-136.

[93] *Don't judge Species on their Origins,* Mark A. Davis, Nature volume 474, 2011, pp.153–154 Available at <http://www.especes-exotiques-envahissantes.fr/wp-content/uploads/2017/11/dont_judge_species_on_their_origins.pdf> (Accessed August 31st 2019).

are more vulnerable to invasions than any other ecosystem[94]. Sometimes the arrival or introduction of alien species in a new ecosystem has resulted in an increase of species in the given ecosystem, adding richness and variation to it[95], which could be the case with many of the species that move as a consequence of climate change. There are other cases in which alien species and species that were originally considered IAS have had a positive effect on the new environment and some of them even become an important part of the economy of a region, as is the case of the snow crab in the Barents sea[96], and have even helped in the conservation efforts of a region, helping in restoring native species or acting as substitutes for extinct ecosystem engineers by providing some ecosystem services[97], to the extent that some ecosystems may now depend on the substitute species[98]. This challenges the eradication measures that are omnipresent in all of the legal instruments that deal with IAS. In these instruments there are no exceptions to eradication of IAS, except for regular monitoring of the situation in the case of the containment measures as explained in the Guiding Principle 14 of the Guidelines for the implementation of article 8(h) CBD which is, again, linked with eradication of any new outbreaks.

It has been already mentioned that IAS have been reported to become substitutes for extinct species[99]. Traditionally, there have been voluntary introductions of alien species to try to cover the gaps left by a species that has disappeared in an ecosystem[100]. In the context of the movement of species due to the consequences of climate change, the arrival of new alien species can prove to be, as it has been argued before in this work, a solution to the extinction of other weaker native species that have disappeared due to changes in their ecosystems and their inability to spread. Finally, alien species can add variety and richness to biodiversity through speciation, by genetically mixing themselves with the native ones. This cross-

[94] *Guidelines for invasive species planning and management on islands* IUCN, 2018. Available at <https://portals.iucn.org/library/sites/library/files/documents/2018-030-En.pdf> (Accessed August 31st 2019).
[95] *Don't judge Species on their Origins,* Mark A. Davis, Nature volume 474, 2011, pp.153–154 Available at <http://www.especes-exotiques-envahissantes.fr/wp-content/uploads/2017/11/dont_judge_species_on_their_origins.pdf> (Accessed August 31st 2019).
[96] *Snow crab (Chionoecetes opilio) – a new invasive crab species becoming an important player in the Barents Sea ecosystem* Jan H. Sundet and Sergey Bakanev, ICES CM 2014/F:04. Available at <http://www.ices.dk/sites/pub/CM%20Doccuments/CM-2014/Theme%20Session%20F%20contributions/F0414.pdf> (Accessed August 31st 2019).
[97] *The Potential Conservation Value of Non-Native Species* Martin A. Schlaepfer, Conservation Biology, Volume 25, No. 3, 2011, pp. 428–437; *Sometime Invasive Species Are Good* Brandon Keim, Wired Magazine, February 28th 2011. Available at </www.wired.com/2011/02/good-invasives/> (Accessed August 31st 2019).
[98] *The Potential Conservation Value of Non-Native Species* Martin A. Schlaepfer, Conservation Biology, Volume 25, No. 3, 2011, pp. 428–437.
[99] *Ibid.*
[100] *Ibid.*

breeding of species may result in the most resilient branches and the better fit for survival in the face of climate change[101]. But because there is no exceptions, the potential innocuous alien species, the IAS that later settle and stop having a detrimental effect, and the ones that can actually have a potential beneficial effect on the ecosystem, are going to be eradicated without further consideration not raising any concern for the use of such lethal methods. This would imply going against the main objective of CBD, which is conserving biodiversity, and Article 192 UNCLOS, which sets the obligation of preserving and protecting the marine ecosystem, and that are the core duties of the States. However, precaution forces States to act to combat IAS even without possessing all the relevant information. This may create a deadlock situation in which States have the obligation to apply measures against IAS in the basis of the precautionary approach, the result of which may contravene the objective of the legal instruments.

Secondly, alien species and IAS, and any kind of species, are considered as groups and not as individual living animals, plants or organisms. For instance, the CBD categorises wildlife in collectives[102]. This, as has been argued by Sophie Riley[103], helps regulators to override the well-being of the individual entities in the name of collectives of species and allows them to apply eradication and control measures without any further ethical consideration. However, the responses to climate change, changes in ecosystems and environmental factors are individual[104]. So in the context of climate change this individual versus collective debate becomes even more relevant because of the idiosyncrasy of having a collective-based set of rules and measures which will be applied in a situation in which the response is intrinsically individualistic.

Thirdly, but very linked to the two previous arguments, when a species is qualified as an IAS this consideration is a definite and absolute state in which they will be forever detrimental to the new ecosystem. However, as argued, alien species can become beneficial to the new ecosystem, native species can become invasive towards their new ecosystem and alien species

[101] *Ibid.*
[102] *Listening to Nature's Voice: Invasive Species, Earth Jurisprudence and Compassionate Conservation*, Sophie Riley, Asia Pacific Journal of Environmental Law. Vol 22 n1, 2019, pp. 117-136.
[103] *Ibid.*
[104] *A Perspective on Climate Change and Invasive Alien Species*, 2nd Meeting of the Group of Experts on Biodiversity and Climate Change, Convention on the Conservation of European Wildlife and Natural Habitats, T- PVS/Inf 5 rev, June 16th 2008.

and IAS can eventually naturalize or even become transformers of the new ecosystem[105]. Ecosystems are organic and their synergies, relationships and equilibriums dynamic, specially in the face of climate change, so they evolve over time, and thus, a measure as definitive as eradication should not be the most encouraged and basic one to deal with alien species and IAS.

Moreover, eradication measures may be simply against some of the provisions in the Guiding Principles that develop article 8(h) CBD. In the Guiding Principle 12 of the guidelines for the Implementation of Article 8(h) CBD it is mentioned that the measures taken in respect of IAS should be *"environmentally benign"* and *"ethically acceptable for stakeholders"*[106]. As Sophie Riley argues, the eradication and containment and control measures may be against these two requirements because they may prove to have a detrimental effect on the environment, as it has been argued in the previous section of this work, and because they may not be ethically acceptable in some cases. Finding a universally agreed upon definition of what it ethically accepted may prove to be a difficult task but, on the contrary, stating what is environmentally benign or not is an easier task, as it will be presently discussed. Blindly and categorically applying eradication measures against IAS without further considerations can potentially have a detrimental effect on the ecosystem, as it has been argued in the previous section. In that sense, in some cases eradication measures can be far from being environmentally benign, contravening one of the requisites for the Guiding Principles and the application of Article 8(h) CBD. However, the requisite of environmental benignness can also be found in section C of the "other options" part of the Guiding Principles for the Implementation of Article 8(h) CBD, in which States are urged to develop *"environmentally benign methods to control and eradicate IAS"*. Following the same argument, this requirement represents a contradiction, given that the control and eradication measures, if applied indiscriminately, can't be environmentally benign.

There is one legal instrument that represents, as it has been mentioned in the previous section, an exception to the generally accepted three-step hierarchical approach of the measures against IAS. The ACAP has a really interesting way of approaching the matter of alien species. In its Article III(1)(b) it creates the obligation for the States to *"eliminate or control*

[105] *Alien plants in checklists and floras: towards better communication between taxonomists and ecologists* Petr Pyšek, David M. Richardson, Marcel Rejmánek, Grady L. Webster, Mark Williamson & Jan Kirschner, 2004, page 133.
[106] *Listening to Nature's Voice: Invasive Species, Earth Jurisprudence and Compassionate Conservation*, Sophie Riley, Asia Pacific Journal of Environmental Law. Vol 22 n1, 2019, pp. 117-136.

non-native species detrimental to albatrosses and petrels". The difference between this and the other instruments is that here alien species are not to be eradicated to benefit the ecosystem in general but to benefit the albatrosses and petrels in particular. This creates a hierarchy of importance among the species and perfectly illustrates another central issue that arises in relation to eradication, containment and control measures, which is, as Vito De Lucia argues, the categorization of part of the nature, the one that is not albatrosses or petrels, as *"bare nature",* understood as life divested of its potentialities and possibilities, which justifies its eradication given its lack of intrinsic value[107], in this particular case the one given to albatrosses and petrels by ACAP. Different levels of value of nature are thus established, which allows for eradicating life with impunity and to do so, ironically, in the name of protection and conservation[108]. This biopolitical logic that seems to have a very thin barrier between the politics of life and a politics of death, that justifies killing to protect life[109], is not restricted to ACAP, it applies to all of the regulatory framework of eradication measures in regards of IAS. The basis of this distinction is the categorization of some species as invasive[110], which links with the need for a legal framework that comprises a better nomenclature and a wider range of categorization in regards of IAS to include all the different relationships that alien and native species can have with a given ecosystem, as it will be argued in the following section.

It has been mentioned that containment and control measures include eradication in them. In the Guiding Principle 15 habitat management is also mentioned, which is made on the basis of the ecosystem approach[111]. There are various techniques and types of habitat management but they present a radical difference with eradication, given that they focus on conservation and protection, as well as sustainable use in some cases, of an ecosystem or habitat. A different kind of ethical discussion may arise in relation to the way humans interfere and shape nature and what part of nature to protect, to which extent, and on which grounds. There are different perspectives that go from contractarianism, according to which humans are at the centre of the

[107] *Bare Nature. The Biopolitical Logic of the International Regulation of Invasive Alien Species.* De Lucia, Vito. Journal of environmental law, 2018; Volum 31 (1). ISSN 0952-8873.s, pp.109 - 134.
[108] *Ibid.*
[109] Biopolitics as defined by Foucault, as the political rationality that focuses on the administration of life and populations: *"to ensure, sustain, and multiply life, to put this life in order"; Bare Nature. The Biopolitical Logic of the International Regulation of Invasive Alien Species.* De Lucia, Vito. Journal of environmental law, 2018; Volum 31 (1). ISSN 0952-8873.s, pp.109 - 134.
[110] *Bare Nature. The Biopolitical Logic of the International Regulation of Invasive Alien Species.* De Lucia, Vito. Journal of environmental law, 2018; Volum 31 (1). ISSN 0952-8873.s, pp.109 - 134.
[111] *Ecosystem Approach*, Conference of the Parties to the Convention on Biological Diversity, COP 5 Decision V/6. Available at <https://www.cbd.int/decision/cop/?id=7148> (Accessed August 31st 2019).

legal protection of nature[112], to Earth jurisprudence and the Great Law, according to which humans have a reciprocal relationship with the rest of nature and, as a consequence, all the beings that form it have fundamental rights, including the right to exist[113].

As it has been argued in this section, there are several ethical debates that arise from the measures against IAS, specially eradication and control. Climate change makes this ethical concerns more pressing because it takes the effects of such measures in biodiversity and ecosystems to the extreme. Additionally, the fact that climate change is anthropogenic by nature maximises the importance of finding a balance in the regulatory measures that deal with alien species and IAS.

5.3. Potential Solutions and Changes

After having analysed the issues with the regulation on IAS in relation to climate change and having shortly debated the ethical concerns that are associated with some of the measures encouraged to deal with them particularly, there is no doubt on the fact that new gaps are appearing in the regulation and that some of the measures and solutions proposed may no longer be effective or, even worse, may have the contrary effect to the one intended. In this section, some potential solutions and changes will be mentioned and analysed.

One of the first things that stands out is the fact that the definition of IAS and alien species may be the epicentre of some of the situations related to the impacts of climate change not being regulated or creating confusion. A new and more inclusive definition of what IAS and alien species are or, at least, including climate change as a different pathway of entry of alien species along with a different treatment of these alien species and potential IAS is needed. A definition that focuses on the negative impacts and not on the fact of a species being alien or native to an ecosystem and the way of addressing them should consider individual animals along with their groups. Additionally, the current definition focuses on the stage of invasiveness[114], which has shaped the measures and management measures embodied in the legal instruments. Ideally, the bipolar narrative that focuses on the nativeness or alieness of a species would shift towards a broader perspective focusing on the ocean as a whole and the

[112] *Ethics of Wildlife Management and Conservation: What Should We Try to Protect?* Christian Gamborg et al., Nature Education Knowledge 3(10):8. Available at <https://www.nature.com/scitable/knowledge/library/ethics-of-wildlife-management-and-conservation-what-80060473/> (Accessed August 31st 2019).
[113] *Listening to Nature's Voice: Invasive Species, Earth Jurisprudence and Compassionate Conservation*, Sophie Riley, Asia Pacific Journal of Environmental Law. Vol 22 n1, 2019, pp. 117-136.
[114] *A neutral terminology to define 'invasive' species* Robert I. Colautti and Hugh J. MacIsaac, Diversity and Distributions, 2004, 10, pp. 135–141.

interconnection of its different ecosystems, taking the whole marine environment as a base point. The marine environment is interconnected in a deeper way than any other in the planet. In it, both adjacent and distant ecosystems are interconnected by a series of exchanges, such as transport of nutrients or organisms[115], that makes it difficult to establish boundaries between them. In that sense, the narrative of alien species vis-à-vis native species seems insufficient.

There have been several works that focus on creating a better nomenclature for alien species to cover more of their in-between relationships with the new ecosystems, such as the one proposed by Petr Pyšek et al. in relation to alien plants, who suggests a much more comprehensive terminology that tries to cover all the stages and different relationships that a non-native species can develop in relation to the new ecosystem[116]. These range from the classical native and alien species to cover many other situations such as casual aliens, which are the alien or native species that appear, or that are re-introduced after having disappeared, as a by-product of human activities but only occasionally, naturalization, the stadium in which a once alien species has found its place in the new ecosystem, invasiveness, which is defined as the potential of a species to spread far from its original ecosystem, transformers, which are the species that shape the ecosystems to which they arrive, and weeds, which are the species that become pests and harm the new ecosystem. This illustrates the narrowness of the legal definition of IAS and alien species, which is currently a bipolar one: alien species can be invasive or not towards a new ecosystem. Another problem that the current legal framework has in regards of nomenclature is the fact that it is not consistent. On the contrary, each instrument uses different terms to refer to alien species and IAS. For instance, the CMS uses *"exotic species"* instead of alien species while UNCLOS uses *"alien or new"* species and the CBD uses *"alien species",* to cite a few of the differences in nomenclature. This creates a situation in which analysis of the specific wording of the different instruments is necessary to determine if they are referring to the same type of species or not. The regulation of alien species and IAS is scattered *per se,* but the fact that there is an additional layer of differentiation in the form of nomenclature adds unnecessary complexity. The legal framework would thus benefit from a unified nomenclature system for alien species and IAS

[115] *Coastal marine ecosystem connectivity: pelagic ocean to kelp forest subsidies.* Zuercher, R., and A. W. E. Galloway, ESA Journals, Ecosphere 10(2), 2019. Available at <https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/ecs2.2602> (Accessed August 31st 2019).
[116] *Alien plants in checklists and floras: towards better communication between taxonomists and ecologists* Petr Pyšek, David M. Richardson, Marcel Rejmánek, Grady L. Webster, Mark Williamson & Jan Kirschner, 2004, page 133.

that also broadens the definition to add the wide range of intermediate situations that may arise in the complex ecological relationships that a non-native species can develop with the new ecosystem to which it arrives.

The Guiding Principle 12 of the guidelines for the implementation of Article 8(h) CBD states that eradication and control measures need to be implemented in the earlier stages possible. This last requirement of the Guiding Principle 12 illustrates some of the issues with the current bipolar definition of alien species and IAS in the legal framework. There is a wide range of consequences of an alien species arriving to a new ecosystem and not all of them are clear from the beginning. However, with a more comprehensive and detailed approach to define the different relationships that alien and native species can develop with the ecosystems it will be, first of all, easier to understand the different effects of alien and invasive species on an ecosystem and thus better identify their pathways of entry and adequate prevention measures. Secondly, it would allow for a much more sensible implementation of eradication and control measures. With a better understanding of the relationships between alien species and the ecosystems, their categorization as harmful for the environment should be more accurate by creating intermediate stages between being alien to the ecosystem, invasive or reaching the level of pest, following the previously suggested terminology. In combination with a broader approach to the marine ecosystems, that includes their interconnection, it would produce a very ductile way of legally conceiving alien species and IAS and with a higher adaptability to the changing conditions of the marine environment.

Of course, and even if it is not always the case, IAS have a negative impact on biodiversity and the ecosystems. Some instruments, such as the BWM Convention continue to be relevant and appropriate for the purpose they were designed. It is never desirable to introduce a species in an ecosystem, maybe with the exception of voluntarily and highly controlled exceptions such as the ones proposed in CITES, either by a very specific activity, such as the introductions in ballast water or as a by-product of some activities such as aquaculture, or as a result of a combination of human activities, as is the case in the alien and IAS that move to new ecosystems as a result of climate change. The fact that some measures are not desirable, or no longer achieve the intended result, may not be interpreted as if IAS should be deregulated. However, a balance needs to be found. The focus should shift from eradicating and controlling invasions and alien species towards a more sensible approach that considers the causes of these invasions, especially climate change, which would in this particular

respect shift the focus to the UN Climate Change Convention and the engagements that States have in this respect, such as the Paris Agreement on reduction of greenhouse gases. Or better yet, a combination of both regulations and obligations should be considered by the States. The reasoning should be focusing on the altered ecosystems more than on the eradication of the alien species that take advantage of them, trying to restore their natural balances as far as possible[117]. There are some initiatives that seem to go in that direction, such as the rewilding, the ecosystem restoration and other progressive approaches to strengthening disrupted ecosystems. The focus is on regaining the ecosystem resilience and rebuilding it, compensating for its degradation and loss as a way of fighting against the effects of climate change[118]. The difference between these approaches lays on the role of humans. In the case of rewilding nature is encouraged to take care of itself by enabling natural processes to take place with the objective of creating wilder habitats which may prove to be more resistant to changes[119]. In the case of ecosystem restoration, it shares the objective of achieving stronger ecosystems but it can be done either through allowing natural regeneration or by planting trees and different kinds of plants, or other nutrient producers in the case of marine ecosystems[120]. Additionally, there may be space for alien species in these initiatives given their potential helpful role in the restoration of ecosystem, as it has been argued previously[121].

The idea of considering both regulations may still be seen as premature. However, there are several points in common between both. Some of the key obligations in that respect are research, monitoring, assessment and cooperation to try to minimize the risks of invasion. This kind of obligations are shared between the IAS framework and the UN Framework Convention on Climate Change and other climate change instruments and engagements, along with education and public awareness. This shows that bridges can be built between both

[117] *Listening to Nature's Voice: Invasive Species, Earth Jurisprudence and Compassionate Conservation*, Sophie Riley, Asia Pacific Journal of Environmental Law. Vol 22 n1, 2019, pp. 117-136.
[118] *New UN Decade on Ecosystem Restoration offers unparalleled opportunity for job creation, food security and addressing climate change* UN Press Release, March 1st 2019. Available at <https://www.unenvironment.org/news-and-stories/press-release/new-un-decade-ecosystem-restoration-offers-unparalleled-opportunity> (Accessed August 1st 2019); *What is Rewilding?* Rewilding Europe. Available at <https://rewildingeurope.com/what-is-rewilding/> (Accessed August 31st 2019).
[119] *What is Rewilding?* Rewilding Europe. Available at <https://rewildingeurope.com/what-is-rewilding/> (Accessed August 31st 2019).
[120] *New UN Decade on Ecosystem Restoration offers unparalleled opportunity for job creation, food security and addressing climate change* UN Press Release, March 1st 2019. Available at <https://www.unenvironment.org/news-and-stories/press-release/new-un-decade-ecosystem-restoration-offers-unparalleled-opportunity> (Accessed August 1st 2019).
[121] *The Potential Conservation Value of Non-Native Species* Martin A. Schlaepfer, Conservation Biology, Volume 25, No. 3, 2011, pp. 428–437; *Sometime Invasive Species Are Good* Brandon Keim, Wired Magazine, February 28th 2011. Available at </www.wired.com/2011/02/good-invasives/> (Accessed August 31st 2019).

regulatory frameworks. For instance, the requisite of making environmental impact assessments, as per Guiding Principle 11 of the Guiding Principles for the implementation of article 8(h) CBD, to determine the risk of unintentional introductions associated with certain activities carried out by States. This requirement can also be found in Article 4(1)(f) UN Framework Convention on Climate Change but with the intention of reducing the effects of the measures taken by the States to minimize climate change and its effects over the quality of the environment, among others. The impact assessment obligation of CBD could be broadened to cover also the impacts of climate change on the oceans. In that same sense, one of the measures found in Article 7 of the Paris Agreement deserves special attention because of the potential application in regards of the weakening effect of climate change on marine ecosystems and the subsequent increase of threat of IAS. This Article states the importance of building and enhancing adaptive capacity to reduce vulnerability to climate change. Achieving the goal of building resilience in the marine ecosystems would radically reduce the threat of alien species and their potential invasiveness. There is a need for interconnections between both regulations. A bit is starting to be done in that direction, with initiatives and perspectives such as the Ecosystem Based Adaptation strategies driven by CBD[122] that intend to increase the adaptability of species and ecosystems in the face of climate change and that include IAS as one of the points to take into account in order to achieve that aim. This illustrates the need of addressing both climatic and non climatic stresses in order to protect the ecosystem.

Additionally, some alternative approaches have been suggested to address the IAS regulation problematic, and even if not specifically related to climate change, they are worth mentioning in respect of the ethical concerns that the current regulation presents. Earth jurisprudence and compassionate conservation will be briefly mentioned here as different, and somehow radical, approaches to the way law treats the environment that could help addressing some of the ethical concerns from a different perspective. The earth jurisprudence perspective makes human law subordinate to a series of rules called the Great Law[123] that highlights the dependence of human beings to nature, in a way that any human legal instrument has to respect nature and to protect it, transforming all living creatures as subjects with the same legal status under this great law. Following that reasoning, human laws would need to *"listen*

[122] *Introduction to Climate Change* Convention on Biological Diversity. Available at <https://www.cbd.int/climate/intro.shtml> (Accessed August 30th 2019).
[123] *Listening to Nature's Voice: Invasive Species, Earth Jurisprudence and Compassionate Conservation*, Sophie Riley, Asia Pacific Journal of Environmental Law. Vol 22 n1, 2019, pp. 117-136.

to nature"[124], which would require a bigger input from science and a more ethically driven way of legislating, focusing on the interdependency of life. In the case of IAS this would mean focusing on the recuperation of ecosystems and the original causes for them becoming invasive rather than killing the animals that have taken advantage of the weakened ecosystems[125], as it has been already defended in this work. As for the compassionate conservation, it is a way of challenging the traditional approaches that defend killing some species in order to save others[126]. Like the Earth Jurisprudence approach, it challenges the anthropocentric way of conceiving legal frameworks. Compassionate conservation in the case of IAS would mean to exclusively use eradication measures when the harm that they cause would be reversible *a posteriori*[127]. These and other biocentric approaches[128] that give species and living individuals an intrinsic value may need to be considered as a way of addressing the urgency of climate change in general, and the regulation of IAS in particular.

This does not mean that all of the current regulation to combat IAS is outdated and no longer relevant. However, there are, as argued in this section of the work, some measures and perspectives that may need changes, as argued throughout this section of the work. For instance, the three-step hierarchical approach may have to be modified or layered a bit more, especially concerning the eradication and control measures. However, prevention continues to be a critical part, along with monitoring and assessment. Additionally, the whole framework would benefit from a more comprehensive definition of alien species and IAS, as it has been analysed before, as well as to be informed by a broadened perspective that includes climate change and its consequences in the marine ecosystem. Especially the overzealous regulations, such as ACAP and the way it deals with alien species, need to be shaded and put into the current context in order to be adapted to the new circumstances, to avoid the risk of damaging the environment that they intend to protect.

6. Concluding Remarks

The legal framework that addresses alien species and IAS is scattered in a variety of instruments. However, there is a certain uniformity in the way they are treated. A three-step hierarchical system of measures, which is delineated in the Guidelines for the Implementation of Article 8(h) CBD, but the outline and core content of which is also present in all the other

[124] *Ibid.*
[125] *Ibid.*
[126] *Ibid.*
[127] *Ibid.*
[128] As opposed to anthropocentric

instruments, is the usual and established way of dealing with alien species and IAS. This three-step approach is composed by the prevention and early detection, eradication, containment and control measures. Nevertheless, this classical system raises a series of issues in the context of climate change.

Climate change has a deep impact on the oceans, provoking big ecosystem imbalances and movement of species as a result of changes in temperature, currents, salinity and acidity of the water, among others. This has a big impact in the manner in which species become alien in other ecosystems and in the vulnerability of these new ecosystems, already weakened by climate change, to invasions. This new situation challenges the relevance and topicality of some of the legal framework, especially in regards to the eradication and control of alien and IAS. Additionally, new relationships between the ecosystems and the alien and native species are appearing as a result of climate change and its impact. This challenges the traditional bipolar narrative that classifies species as alien or native, which may prove to be insufficient to describe the different ecological realities. The different ecosystems in the marine environment are more interconnected and interdependent than the terrestrial ones and thus, the eradication and control measures need to be carefully implemented, specially in the context of climate change, given the fact that some intermediate connections may appear between alien, native species and ecosystems as a result of the imbalances that the changing conditions causes. In this scenario some alien species may prove to be beneficial for the ecosystem and can even be helpful to rebuilt its resilience.

Moreover, these eradication and control measures evoke some ethical concerns. It is important to reflect on the solutions that require the killing of some individuals in order to protect others, or the group, to see if they are ethically acceptable. The strict logic that informs the eradication and control measures, specially in some instruments such as ACAP, may have a detrimental effect in the context of climate change. Some species are confronted with the choice of extending or changing their range of presence or extinction. If they take advantage of the already weakened new ecosystem and become invasive, is it really a solution to eradicate them? If the root of the problem is the anthropogenic pressures, specially the impact of climate change in the marine ecosystems, then they may have to be addressed along with the alien species and IAS framework. The focus of the legal framework may need to change from eradication towards the protection and building resilience in the ecosystems.

The legal framework that deals with alien species and IAS is still relevant. It is ductile and capable of adapting to the new circumstances in many of the measures that it suggests, such as the first step of the three-step hierarchical system of measures, which is prevention, and the instruments that focus on it. However, in the light of the new circumstances, a more comprehensive approach needs to be taken when considering applying some of the more radical measures. This would include a wider definition of alien species and IAS that is more coherent with the great range of relationships that alien and native species develop towards the ecosystems that would allow a more shaded, case to case and circumstantial application of the eradication and control measures. In a changing world the relationship between marine ecosystems becomes more complicated and tinged. Law has to be able to adapt and grow closer to the ecological reality in order to stay true to the objective of protecting the environment and its biodiversity. As the ancient Roman proverb went, *tandem aliquando invasores fiunt vernaculi.*[129]

[129] In time invaders become the natives.

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