LIST OF ANNEXES

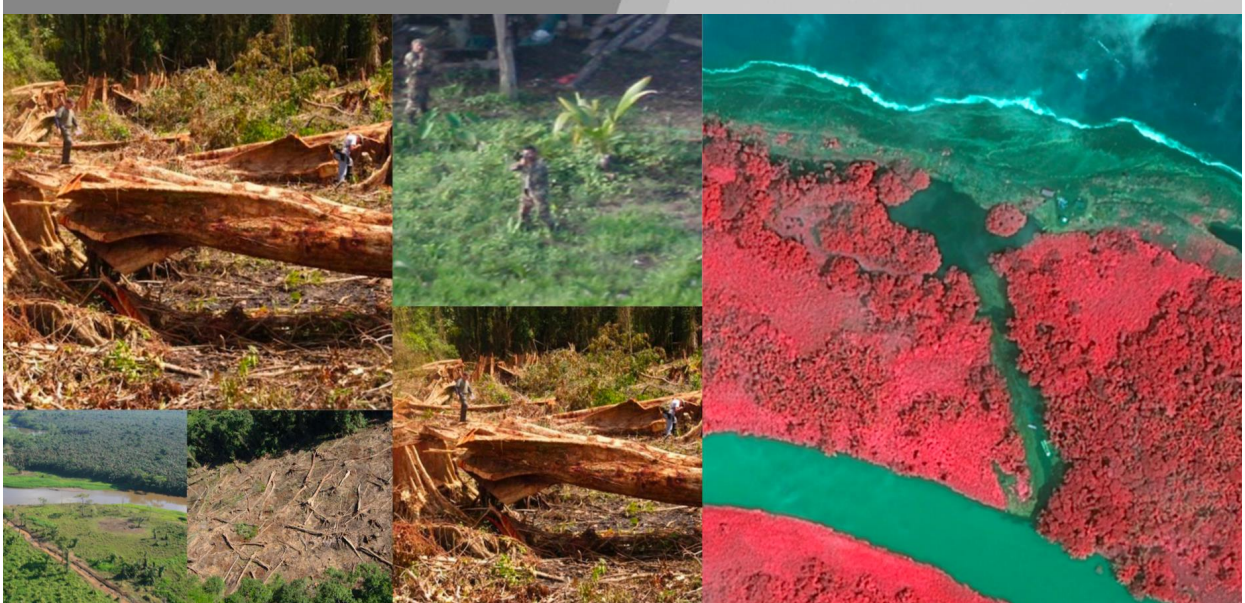
Annex 1

Report by Fundación Neotrópica on the Question of the Methodology for the Assessment of Environmental Damage

3 August 2017

FUNDACION NEOTROPICA

REPORT BY FUNDACIÓN NEOTRÓPICA ON THE QUESTION OF THE METHODOLOGY FOR THE ASSESSMENT OF ENVIRONMENTAL DAMAGE



Bernardo Aguilar-González
Marcia Carranza-Vargas
Marco Hidalgo-Chaverri
Adriana Fernández-Sánchez
Rafael Monge-Vargas
Mariano Castro-Jiménez

3 AUGUST 2017

TABLE OF CONTENTS

Report by Fundación Neotrópica on the Question of the Methodology for the Assessment of Environmental Damage

Bernardo Aguilar-González,
Marcia Carranza-Vargas
Marco Hidalgo-Chaverri
Adriana Fernández-Sánchez
Rafael Monge-Vargas
Mariano Castro-Jiménez

I. Executive Summary

As a general matter, and subject to the existence of a specific treaty regime, the standard of reparation that applies in environmental cases is the general standard of "full reparation for the injury caused". The principles and methodologies to be used by the International Court of Justice (ICJ) to assess what constitutes full reparation are not legally pre-determined and they are thus to be selected by the ICJ on the basis of its own judicial discretion in light of the circumstances of this case.

This report addresses the sole question of the methodology adopted in the expert reports on the question of compensation due in the case concerning Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua). It provides a technical contribution for the reply by the government of Costa Rica to Nicaragua´s Counter-Memorial on this matter, given the term conceded by the International Court of Justice.

We sought to demonstrate that:

a- Nicaragua´s contention with the methodology used in our monetary valuation estimate for the environmental damage caused due to their illegal incursion in Costa Rica´s Humedal Caribe Noreste (HCN) is ill-founded;

b- Our monetary valuation method finds support on solid international state of the art regarding environmental damage estimations in tropical countries with high biodiversity and specifically on their wetlands;

c- Our monetary valuation method represents the legal standards and most common practice in Costa Rica, where the damaged area of Isla Portillos is located. A softer standard would be in contradiction with applicable national laws;

d- The Methodology proposed by Nicaragua grossly undervalues environmental damage, including the misplaced comparison of environmental damage in the early 1990's in desert like conditions. It also uses assumptions that are inconsistent with the applicable legal framework and proven facts in this trial.

We presented a series of legal, policy and judicial precedents in support of the methodological approach used in our valuation report. We supplemented these precedents with relevant technical information and expert opinions. In summary, we believe to have demonstrated:

1) That the methodology used by Fundación Neotrópica is well recognized internationally including tropical biodiversity rich countries as Costa Rica.

Along these lines, we summarized for better understanding the two stages involved in our study (the definition of a three part methodological framework and its application in seven steps). We then focused on international juridical and economic sources for evidence that validates two of the three components in this framework: the ecosystem service approach and the benefit-transfer estimation technique (BTM), which Payne and Unsworth (2017) portrayed as not robust and recognized enough for use in these types of monetary estimates.

We provided sufficient evidence that this opinion is ill founded. Juridical precedent and doctrine, as well as economic doctrine evolution point to the fact that the precedents in international practice invoked by Nicaragua (mostly UNCC standards) to justify their contention are old and predate the mainstreaming of the ecosystem services approach especially in relation to biodiversity conservation. More recent CBD COP decisions, the evolution of court decisions in the United States and Europe as well as the authorized opinion of experts in the field (as Dr. Robert Costanza and Dr. Rudolf de Groot) demonstrate that the Ecosystem Services approach used by Fundación Neotrópica is a recognized approach in International practice and not just an “awareness tool”.

Regarding the Benefit Transfer estimation technique, we have documented not only its ample use. Based on CBD COP decisions, documents, and technical economic literature we have tracked the efforts to improve the applicability of this technique due to its ease of use especially for low and middle-income countries. These sources recognize that the benefit lies in that they may have fewer resources to apply the full range of TVE estimation monetary methods with the timing needed for relevant policy and other types of juridical decisions. The efforts until lately have given a set of criteria to be used in evaluating the different applications of this well-established estimation methodology.

We also presented literature and provided expert opinion on how different RAMSAR documents recognize the validity of both the ecosystem services framework and BTM, amid the full array of TVE estimation methods, for the assessment of the economic value of ecosystem services and environmental damages. Further, we documented the application of the ecosystem services approach and the BTM methodology in recent legal evolution in tropical biodiversity rich countries like Costa Rica pointing to specific use of the seminal paper by Costanza et al. (1997) in these instances.

2) That the methodology used by Fundación Neotrópica is consistent with the common practice in Costa Rica´s courts and academic circles.

We documented juridical and economic theoretical evolution in Costa Rica within the framework of progressive legislation and pioneering courts that shows that our methodology is consistent with the common practice in Costa Rica´s courts and academic circles. Here lies the validation of the third component of our methodological framework: the IPS methodology to assess environmental damage. Both the Administrative Environmental Tribunal (TAA) criteria and practice and the protocol with standards for environmental damage valuation from SINAC provide support for our use of this methodology as the most recognized in the country for the purposes it was chosen. This recognition goes beyond the bounds of Costa Rican academic circles. Due to its soundness, the IPS methodology is recognized and applied in different Latin American contexts.

We make a particular note of the current application by the International Center for Economic Sustainable Development Policies (CINPE) at the National University of the BTM methodology for the valuation of seven RAMSAR wetlands in Costa Rica. This study will be a tool for wetland policy implementation in the nation and demonstrates the acceptance of this estimation technique within the highest academic circles of Costa Rica.

3) That the Calculations for the monetary value of the damage were carefully, appropriately and conservatively done.

We addressed the allegations of Payne and Unsworth (2017) and indirectly from Kondolf (2017) on our application of this methodology. Specifically we reiterated the process of selection and the evidence in the proceedings that supported our selection of ecosystem services to value. We conclude that through our selective process we reduced the possibility for redundancy in selection.

We specifically addressed through expert opinion and technical reports their criteria that neither soil erosion/formation nor natural hazard mitigation should be included. Thorne (2017) allowed us to disqualify this opinion, elaborating on the scientific nature of soils in these types of wetlands and the importance of the wetland, given its international recognition and status as a public protected area, protecting itself. Beyond this, we reiterated evidence of the inhabitance in the region and its dependence on this service. Additionally, technical evidence contributed by SINAC highlighted the importance of this service in the Portillos area given the recent natural events of Hurricane Otto.

On the application of the valuation methods chosen, we went over Nicaragua´s doubts and objections in detail relative to the valuations done through direct valuation or revealed preference methodologies (for standing timber and soil formation/erosion prevention). Additionally, we reviewed the choices made regarding the BTM application to the four ecosystem services for which we used it and the criteria that backs them. We conclude that our calculations were appropriate and carefully done within the bounds of the information available. We also conclude that to the extent possible, we reduced the possibility of transfer biases that may affect BTM.

Nicaragua alleged regarding our estimates for all ecosystem services, that by annualizing them as part of our estimates up to 50 years range of recovery time, we are double counting. We have refuted this argument by demonstrating the need to treat them as the Net Present value of an annuity given the environmental reporting commitments of the country. This practice does not constitute double counting but an adequate application of the IPS methodology. Regarding our conservative 50-year horizon for the recovery, Dr. Thorne´s evaluation of Kondolf´s objection provided sufficient scientific evidence to disqualify Nicaragua´s contention. It also reinforced the fact that the components of the ecosystem in the damaged area that would take longer to recover would be the trees which were cut, with average ages which more than double this term.

Regarding the accounting for several of the ecosystem services chosen, Nicaragua argued that we made a mistake by not assuming any recovery in the supply of the services through time. We contend that in the choice of a discount rate to estimate the Net Present Value we do account for the recovery of the ecosystem. We compared this choice with Dr. Thorne´s data on successional stages and tropical forest recovery rates in recent published literature and concluded our choice was adequately conservative.

We finish the methodological analysis by pointing two major inadequacy of Nicaragua´s proposed valuations method. In the first places, it is dated and inadequate, tending to undervalue the damage as attested by the expert opinion of Dr. Rudolf de Groot and the evolution of the literature and juridical standards that we have documented. Of more concern, the choice of a value based on PES payment rates in Costa Rica indicates a lack of understanding on the nature of those rates by Payne and Unsworth (2007) as they are inadequate for the use they give them in this case, not just by their nature. In addition, they are simply not applicable in public property Protected Areas.

We submitted two experts evaluating our estimations in Appendix 6 and 11 from David Batker, President of Earth Economics and Dr. Joshua Farley, from the University of Vermont. We feel confident that our chosen methodology and application is superior to Nicaragua´s two proposals. Therefore, we reiterate our estimation of US$2,880,745.82 as the monetary value of the environmental damage caused by the actions on which the ICJ focused its verdict on December 2015.

II. Technical Team Credentials

Fundación Neotrópica (FN)

A Costa Rican NGO founded in 1985 by a group of Costa Ricans, concerned about the environmental situation of the country, in order to broaden the area of analysis and vision developed by other NGOs in the field of environmental work. Fundación Neotrópica was born to provide solutions to the problems that prevented sustainability in Costa Rica´s Protected Area buffer zones, and to help communities to achieve a better quality of life. Currently its mission focuses on promoting community empowerment, sustainable productive activities and the fair and equitable sharing of environmental space. We believe our mission promotes environmental justice and leads conservation to be a vehicle to reduce poverty and support communities to become the best allies in effective environmental protection. We consistently support small and medium-size green entrepreneurs, promoting and using best practices in sustainability and sustainable production systems.

FN has carried out technical projects all over Costa Rica and abroad, in other countries like Panama, Guatemala, Cuba, Paraguay, and Benin. Since 2009, FN focused its work on the conservation of Costa Rican and transboundary wetlands (especially mangroves) through its Community-Based Blue Carbon Program (PCAC).

FN has also pioneered the use of the innovative concepts in the environmental field and sustainable development such as “Debt for Nature Swaps”. It established itself as one of the most credible technical voices in the country and the Central American region. It developed several iconic projects (see organization vitae in Appendix 12), in the Osa region (one of the most biodiverse in the world) and other regions of Costa Rica in its earlier years.

As part of its pioneering tradition, FN is currently focusing on the application of innovative fields of work, scientific thought and research such as Ecological Economics and Political Ecology. It seeks the application of participatory processes for the management of environmental conflicts and the promotion of advanced concepts such as multicriteria assessments, valuation of environmental services and damage, ecological debt and biophysical accounting through tools such as ecological, water and carbon footprints and social metabolism. In this effort, FN has made substantial efforts in the field of valuation of ecosystem services and damages that have involved it in nationally and internationally recognized environmental conflicts**.**

A pioneering work on the economic analysis of environmental impacts points out that to conduct the type of expanded economic analysis necessary for such purpose, the analyst has to accept both the implications derived from welfare economics and the need for multidisciplinary work. “It would be unusual for any one person to have the necessary breadth of knowledge to assess properly both the economic and environmental effects of any given project.” (Dixon, et al., 1994). This is why for its monetary valuation under examination (Aguilar-González, et al., 2016) and this report, Neotrópica has assembled a multidisciplinary technical team with enough experience and breadth of knowledge as to face the challenge at hand.

Bernardo Aguilar-González (Team Coordinator-Ecological Economics, Environmental Law, Political Ecology)
Executive Director of Fundación Neotrópica, a Costa Rican technical environmental NGO since 2008, where he has led extensive technical project and consulting work in diverse fields of sustainability sciences including Ecological Economics and Political Ecology. He is an adjunct faculty at the School of Earth Sciences and Environmental Sustainability at Northern Arizona University and a fellow at the Institute for Environmental Diplomacy of the University of Vermont. He is a former faculty member and chair of the Cultural and Regional Studies program in Prescott College, Arizona, USA. His academic work adds up to 24 years of experience in the areas of Ecological Economics, Political Ecology, Sustainable Development Studies, Latin American Studies and Environmental Law with special emphasis in ecosystem service valuation, and ecological conflict analysis. He is currently a Ph.D. candidate (ABD) in Culture and Environmental Management at the UNED-UNA-ITCR inter-university doctorate program in Natural Sciences for Development in Costa Rica. He also holds degrees of Specialist (LLM) in Agrarian and Environmental Law and Juris Doctor (Lic.) from University of Costa Rica. He also has a M.Sc. degree in Agricultural and Applied Economics (Fulbright Scholar-emphasis in Applied Economics, International Trade and Econometrics) from the University of Georgia in Athens, Georgia, USA. His publications include one book, several book chapters, refereed and invited professional journal articles, book reviews, technical reports, and numerous newspaper, newsletter and magazine opinion articles. Other professional and volunteer activities include keynotes, guest lectures, professional presentations, radio interviews and active participation in professional societies and advocacy groups. Since 2010, he is the President of the Mesoamerican and Caribbean Society for Ecological Economics.

Marcia Carranza-Vargas (Ecology and Coastal Marine-Resources Management)
Technical Project Coordinator at Fundación Neotrópica, Costa Rica with which it has worked for the last 8 years. Her work has focused on project coordination, training and research in the areas of coastal wetland ecosystem management and restoration. In this work, she has developed extensive experience in mangrove ecosystem research and monitoring including development of nursery technologies, reforestation methods, environmental education and community engagement. In this area, she has been the technical leader of FN´s internationally awarded Community-Based Blue Carbon Program. She has also achieved extensive experience in conservation and management of Protected Area projects for Costa Rica´s National System of Conservation Areas and Debt-for-Nature Swap Programs. Specifically she has led the development of the Cerros de Escazú Protected Zone and Tivives Protected Zone Management Plans, Cabo Blanco Marine Management Area Management Plan and the development of an arboretum in the Golfo Dulce Forest Reserve. She also led a project for the Consolidation of the Governance Model for the Conservation of the Barra del Colorado Wildlife Refuge (Part of the Humedal Caribe Noreste). Marcia´s academic credentials include a Bachelor’s degree in Biological Sciences: Ecology and

Sustainable Development emphasis from Universidad Latina de Costa Rica. She is currently finishing her Master's degree in Coastal-Marine Resources Management from the Universidad Nacional de Costa Rica, where her thesis focuses on biomass and carbon in the Gandoca Lagoon mangroves at the Gandoca-Manzanillo Wildlife Refuge in the Caribbean coast of Costa Rica.

Marco Hidalgo-Chaverri (Conservation and Wildlife Management-Tropical Biology)
Director of FN´s Center for Studies and Community Empowerment, Alvaro Wille Trejos in Rincón de OSA and Technical Assistant since 2010. He has collaborated technically in several of FN´s projects: the development of the Cerros de Escazú Protected Zone and Tivives Protected Zone Management Plans, the development of an arboretum in the Golfo Dulce Forest Reserve and the Consolidation of the Governance Model for the Conservation of the Barra del Colorado Wildlife Refuge (Part of the Humedal Caribe Noreste). As an independent consultant, he has extensive experience in the development of management plans. For instance, he led the Elaboration of the Management Plan for the Golfito Bay, Golfos Project, for the Marviva Foundation in coordination with SINAC (GEF funding). His academic preparation includes Master's degree studies in Conservation and Wildlife Management from the Regional Program in Wildlife Management of the National University of Costa Rica and a Bachelor´s in Tropical Biology with emphasis in Natural Resource Management from the School of Biological Sciences of the National University of Costa Rica.

Adriana Fernandez-Sánchez (Natural Resources and Environmental Management)
Technical Assistant in natural resource management and environmental management at Fundación Neotrópica for the last five years. She has provided technical support in the execution of community-based mangrove conservation projects, environmental education, community rural tourism, ecological economic valuation, socio-environmental conflict studies and management of Protected Areas. Her work has included drafting of technical reports, documentation, systematization and analysis of information, workshop facilitation in communities with different types of public, technical and logistical support for project proposals and consultancies and preparation of environmental and solid waste management plans. Adriana´s academic credentials include a Licentiate degree in Natural Resources Management and Protection from UNED, Costa Rica and a Bachelor´s degree in Environmental Management from Universidad Nacional de Costa Rica.

Rafael Monge-Vargas (Environmental Policy and Economics)
He is a Policy Advisor at the Office of the Minister of Environment and Energy (MINAE). Rafael has provided support in the process of accession of Costa Rica to the OECD. He is the country coordinator of the WAVES Initiative, for the valuation of the natural capital. He is also the representative of MINAE in the Ecological Blue Flag environmental certification program. His areas of collaboration include climate change, green growth, environmental information and the development of carbon markets in Costa Rica. He has also served as Policy Advisor at the Office of the Vice-Minister of Water, Seas, Coasts and Wetlands in MINAE. In this capacity, he was responsible for the international marine agenda and the coordination of the Control and Marine Surveillance Program of the National Development Plan. His academic preparation includes studies at the Master´s level in Environmental Management and Audits focused on Climate Change. He also holds Bachelor´s and Licentiate degrees in Economics from the University of Costa Rica.

Mariano Castro-Jiménez (International Law)
Has been a consultant for six years in environmental law and policy in the areas of public-private partnerships, marine conservation, development of fisheries, protection of endangered species, consolidation of marine protected areas, governance models for the high seas, climate change and others. In these areas, he has worked with local communities, civil society, government authorities, private sector, local and international NGO's and judicial and law enforcement authorities to enhance the sustainable use of natural resources. His academic credentials include a LLM in Public International Law with emphasis on Peace, Justice and Development from Leiden University in The Netherlands and Degrees as a Specialist in Notary and Registry Law and a Licentiate (JD) in Law from the Universidad Escuela Libre de Derecho in Costa Rica. He also holds an International Diploma in Human Rights Protection from the University for Peace, Heidelberg University & Max Plank Institute.

The full curricula for our organization and team coordinator are found in Appendix 12.

III. Introduction

As a general matter, and subject to the existence of a specific treaty regime, the standard of reparation that applies in environmental cases is the general standard of "full reparation for the injury caused"[1]. The principles and methodologies to be used by the International Court of Justice (ICJ) to assess what constitutes full reparation are not legally pre-determined and they are thus to be selected by the ICJ on the basis of its own judicial discretion in light of the circumstances of this case.

This report addresses the sole question of the methodology adopted in the expert reports on the question of compensation due in the case concerning Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua). It provides a technical contribution for the reply by the government of Costa Rica to Nicaragua´s Counter-Memorial on this matter, given the term conceded by the International Court of Justice.

We seek to demonstrate that:

a- Nicaragua´s contention with the methodology used in our monetary valuation estimate for the environmental damage caused due to their illegal incursion in Costa Rica´s Humedal Caribe Noreste (HCN) is ill-founded;

b- Our monetary valuation method finds support on solid international state of the art regarding environmental damage estimations in tropical countries with high biodiversity and specifically on their wetlands;

c- Our monetary valuation method represents the legal standards and most common practice in Costa Rica, where the damaged area of Isla Portillos is located. A softer standard would be in contradiction with applicable national laws;

[1] Article 34 of the International Law Commission (ILC) Articles, relying to the Factory at Chorzow case. The Payne & Unsworth, (2017) report filed by Nicaragua confirms this.

d- The Methodology proposed by Nicaragua grossly undervalues environmental damage, including the misplaced comparison of environmental damage in the early 1990's in desert like conditions. It also uses assumptions that are inconsistent with the applicable legal framework and proven facts in this trial.

The following five sections develop these objectives. Through them, we reinforce the arguments for us to stand firm in our monetary estimate of US$ 2,880,745.82 in environmental damages and restoration costs for which Nicaragua is liable in our conclusion. After our references, we add the corresponding appendices to substantiate our assertions.

IV. Nicaragua´s Report Criticisms on the Methodology Used by Fundación Neotropica.

Nicaragua seeks to disqualify Costa Rica´s estimate based on the following arguments:

a- The ecosystem service approach is not fit for environmental damage monetary valuation. They argue that it is not a best practice in economics based on several economic and legal international precedents, most notably the position of the UNCC.

b- Even if accepting the ecosystem service approach, they argue our practice uses inappropriate estimation techniques. Their understanding is that we use mostly the benefit-transfer estimation method in an inadequate manner. Further, they point to an alleged double accounting, to an alleged series of mistakes in the selection of the relevant ecosystem services for the valuation (among them lack of evidence) and other factors that would lead to a monetary estimate that amounts to roughly 3% of our estimate.

c- Using what they represent to be "standard" techniques, Nicaragua´s consultants offer a new even lower estimate, based on a very particular use of the replacement cost approach, that amounts to USD 34,987 on their best-case scenario (1.2% of our original estimate) (Payne & Unsworth, 2017).

Next, we address their contentions.

V. The Methodology Used by Fundación Neotrópica is Well Recognized Internationally.

A- Nicaragua muddles the methodology used by Fundacion Neotrópica

The first thing we must do is to clarify the muddling of our methodological framework that the Nicaragua counter-memorial promotes. In our original report, we presented the steps of our method in a sequential and organized manner. For the benefit of the legal proceedings, we synthesize it here with the help of Figure 1.

The methodology included two stages. A first stage involved the selection of the appropriate theoretical and technical elements that would allow framing and executing the monetary estimation according to the socio-ecological context of application. In this case we considered appropriate to choose two elements coming from the international state of the art. The other one was developed and adopted as official in Costa Rica, later exported to other Latin American countries and complies with internationally established parameters.

The first element allows an ordered assessment that would not be partial, yet would prevent double accounting, precisely the ecosystem service framework. The second element includes the monetary estimation techniques

that allow estimation of use and non-use values depending on the information, resources and time available. These are the Total Value Estimation (TVE) Techniques.

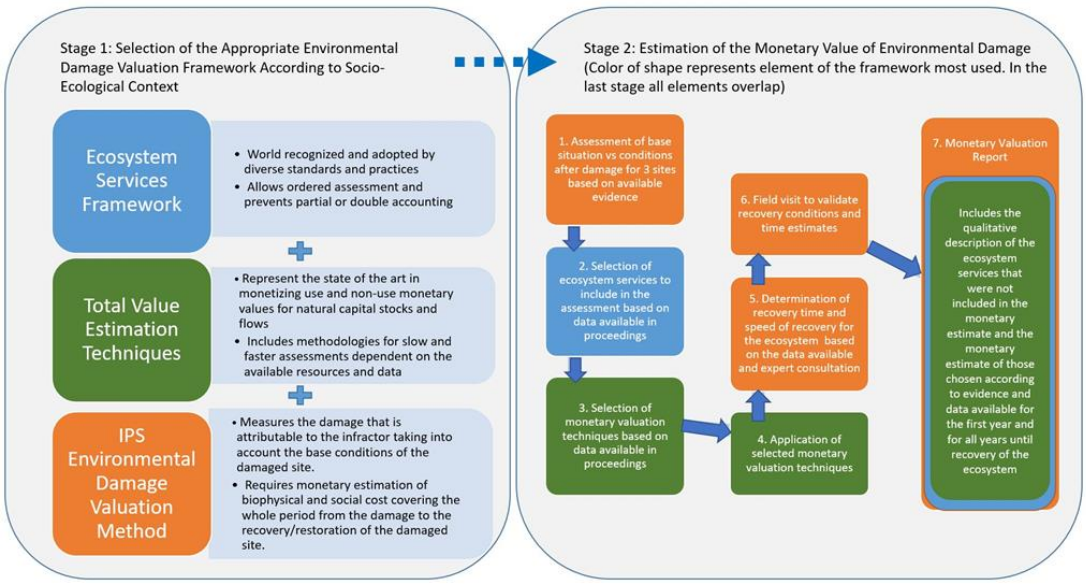


Figure 1- Synthesis of the Methodological Framework Used in Aguilar-González, et. al. (2016). Source: Authors

TVE methods include those used in situations where time, sufficient data and resources are available: direct valuation methods (using market price information), shadow price methods (using price information from good or services that are closely related to the ecosystem good or service being valued) and survey-based methods (also known as revealed preference or contingent valuation approaches). They also include the benefit-transfer methods (BTM) for situations where time, sufficient data and resources are available.

The third component of our methodological framework is the Institute of Policies for Sustainability (IPS) method for environmental damage valuation. It requires taking into account the state of things before the environmental damage in order to assign the percentage of responsibility attributable to the actions of the infractor. It recommends TVE estimation methods for the estimation of the social and biophysical monetary costs of the damage. It also prescribes the estimation of those costs into the future until the ecosystem recovers its capacity to provide its functions and services at the level they were before the environmental damage. As we will show, the IPS framework is the most common official method used in the practice of Costa Rican tribunals.

The second stage of our methodology was the application of the selected three-part framework in seven steps as illustrated in Figure 1. In these steps, we sought to:

1) Fairly assess the base situation prior to the environmental damage,

2) Make and orderly, substantiated choice of the ecosystem services lost according to the technical evidence on file;

3) Choose and 4) apply the most appropriate TVE monetary valuation methods to the most significant and substantiated ecosystem service losses;

5) Determine and 6) Validate through a field visit the recovery time for the ecosystem services valued and

7) Report the qualitative as well as the monetary losses due to the damage for the whole period from the disturbance to the recovery.

We now follow addressing the questioning of our practice done in Nicaragua´s technical team report. We first focus specifically on the issues of the fitness of the ecosystem services approach and the benefit-transfer TVE estimation technique.

B- The precedents in international practice invoked by Nicaragua to justify their contention are old and predate the mainstreaming of the ecosystem services approach especially in relation to biodiversity conservation.

Nicaragua relies essentially on the practice of the United Nations Compensation Commission (UNCC) and, to a lesser extent, that of the United States and European countries. This is problematic because the UNCC concluded its claims processing in 2005, i.e. the very year that the main instrument mainstreaming the 'ecosystem services' approach and terminology – the Millennium Ecosystems Assessment – was published.

The implications of the findings of the Millennium Ecosystems Assessment were assessed by the Conference of the Parties (COP) of the Convention on Biological Diversity (CBD) in 2006, during its eighth meeting. This decision specifically called for research inter alia on "biodiversity valuation" and requested a subsidiary body "to take note in its deliberations of the linkages between biodiversity and relevant socio-economic issues and analysis, including […] valuation of biodiversity and its components, and of the ecosystem services provided"[2] .

During the same COP, the CBD adopted a decision on Incentive measures: application of tools for valuation of biodiversity and biodiversity resources and functions. It specifically calls for parties and other Governments to consider, within their possibilities, the methodologies established in its appendix "…as possible inputs for analysis when considering, on a voluntary basis, the application of methods for assessing the changes of the value of biodiversity resources and functions, and associated ecosystem services, that result from their decision-making."[3] Further it "encourages relevant national, regional and international research institutions to strengthen research activities […] in order to promote a common understanding of valuation techniques among governments and stakeholders, on, inter alia: A) Integration of the values of biodiversity resources and functions and associated

[2] COP-CBD. DECISION ADOPTED BY THE COP OF THE CBD AT ITS EIGHTH MEETING: Implications of the findings of the Millennium Ecosystem Assessment. 2006. UNEP/CBD/COP/DEC/VIII/9. Para. 19 & 21.
[3] COP-CBD. DECISION ADOPTED BY THE COP OF THE CBD AT ITS EIGHTH MEETING: Incentive measures: application of tools for valuation of biodiversity and biodiversity resources and functions. 2006. UNEP/CBD/COP/DEC/VIII/25. Para. 2.

ecosystem services into national accounting and decision-making, taking into account the conceptual framework of the Millennium Ecosystem Assessment."[4]

Article 14(2) of the Convention on Biological Diversity states that "The Conference of the Parties shall examine, on the basis of studies to be carried out, the issue of liability and redress, including restoration and compensation, for damage to biological diversity, except where such liability is a purely internal matter."[5] At its twelfth meeting in 2014, the CBD COP adopted a decision on Liability and redress in the context of this paragraph.[6]

Significantly, Decision XII/14 dissipates any possible doubt as to the relevance of the ecosystem services approach by specifically inviting parties "to take into account, as appropriate, the following in any efforts to develop or adjust national policy, legislation, guidelines or administrative measures concerning liability and redress for damage to biological diversity: (a) The relevant provisions and approaches of the Nagoya – Kuala Lumpur Supplementary Protocol on Liability and Redress; (b) The United Nations Environment Programme's Guidelines for the development of domestic legislation on liability, response action and compensation for damage caused by activities dangerous to the environment; (c) The conclusions of the Group of Legal and Technical Experts on Liability and Redress in the context of paragraph 2 of Article 14 of the Convention on Biological Diversity; (d) The synthesis report on technical information relating to damage to biological diversity and approaches to valuation and restoration of damage to biological diversity, as well as information on national/domestic measures and experiences; (e) The guidance to ecosystem restoration as contained in decision XI/16, as well as in information documents UNEP/CBD/COP/11/INF/17 and UNEP/CBD/COP/11/INF/18); (f) Tools for ecological valuation referred to in the annex to decision VIII/25". [7]

Of particular interest among the above listed is the 2008 Synthesis report on technical information relating to biological diversity and approaches to valuation and restoration of damage to biological diversity, as well as information on national/domestic measures and experiences[8]. It states, "Though developed in a different setting, the definition of biodiversity loss could be a useful starting point for elaborating a definition of damage to biodiversity for purposes of liability and redress rules." By "biodiversity loss", it defines "The long-term or permanent qualitative or quantitative reduction in components of biodiversity and their potential to provide goods and services, to be measured at global, regional and national levels."[9]

---

[4] Ibid., Para. 7.

[5] CONVENTION ON BIOLOGICAL DIVERSITY (adopted 5 June 1992, entered into force 29 December 1993) 1760 UNTS 79.

[6] COP-CBD. DECISION ADOPTED BY THE COP OF THE CBD: Liability and redress in the context of paragraph 2 of Article 14 of the Convention. 2014. UNEP/CBD/COP/DEC/XII/14.

[7] Ibid., Para. 2.

[8] COP-CBD. LIABILITY AND REDRESS IN THE CONTEXT OF PARAGRAPH 2 OF ARTICLE 14 OF THE CONVENTION ON BIOLOGICAL DIVERSITY: Synthesis report on technical information relating to damage to biological diversity and approaches to valuation and restoration of damage to biological diversity, as well as information on national/domestic measures and experiences. 2008. UNEP/CBD/COP/9/20/Add.1.

[9] Ibid., Para. 11 & 12.

Moreover, this report specifically states that the assessment of "actual or potential goods and services" provided by components of biodiversity "would be a key consideration in any assessment of damage and consequent determinations needed to establish primary, complementary and compensatory measures to redress damage to biodiversity and the subsequent attachment of liability."[10]

Although the report suggests that in 2006 (that is, shortly after the Millennium Ecosystems Assessment) State practice still did not refer specifically to damage to biodiversity per se, using instead broader references to damage to the environment or damage to natural resources, "in both cases these more traditional approaches to defining environmental damage include references to the components of biodiversity and the services that they provide."[11] The report further reviews a range of concepts and techniques for the assessment and remediation/compensation of damage to biodiversity that illustrates the conceptual evolution before and shortly after the Millennium Ecosystems Assessment. This evolution, from almost a decade ago, already supports our assertion that the limited perspective that Nicaragua uses to support is disqualification of the ecosystem services approach is dated.

C- The Ecosystem Services Approach used by Fundación Neotrópica is a Recognized Approach in International Practice and not just an "awareness tool".

Following the evolution presented above, a number of studies and guidelines in connection with restoration, valuation of biodiversity, and damage to biological diversity, among others, appeared in the last decade. This growth allows us to assure the current recognition of the ecosystem services approach as a valid international practice for environmental damage assessments.

We believe of particular importance, as included also in the CBD COP's Decision XII/14 on Liability and redress in the context of paragraph 2 of Article 14 of the Convention, the definition of environmental damage in UNEP´S guidelines. Adopted by the Governing Council of the United Nations Environment Program in 2010, Guideline 3, paragraph 2, letter (f) defines "damage" as including "environmental damage". Paragraph 3, letter (b) defines "environmental damage" as "an adverse or negative effect on the environment that […] is significant, which is to be determined on the basis of factors such as: […] (iii) Reduction or loss of the ability of the environment to provide goods and services, either of a permanent nature or on a temporary basis"[12]. Nicaragua ratified the CBD on 20 November 1995 and is therefore a Party, like Costa Rica. In complying with their international obligations with the CBD, both countries should take into account these parameters in any efforts to develop or adjust national policy, legislation, guidelines or administrative measures concerning liability and redress for damage to biological diversity.

It is pertinent to point here also that the practice of states referred to in Payne and Unsworth (2017) is not as clear as Nicaragua argues. The United States has long recognized the relevance of "services" for the assessment of

[10] Ibid., Para. 14.

[11] Ibid., Para. 21.

[12] Guidelines for the development of domestic legislation on liability, response action and compensation for damage caused by activities dangerous to the environment, in Decision SS.XI/5, part B of 26 February 2010

environmental damages. Further, recent developments in Europe suggest that the practice is not as uniform as argued by Nicaragua.

The United States federal courts have recognized the relevance of services for the assessment of environmental damages in the context of three major environmental statutes, as interpreted by federal courts, namely the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Clean Water Act (CWA) and the Oil Pollution Act (OPA). The clearest example is the later, where references to services appear in the regulations.

In a series of three key cases[13], federal courts have affirmed the following propositions: "(1) the measure of damages is the cost of restoration of the injured resources and their services plus compensation for the interim lost value pending recovery of the resources and their services to baseline, including direct use value and passive use value; (2) trustees are not limited to valuation methods specifically identified in the regulations and do not need to provide detailed standards for the use of specific methods; and (3) the contingent valuation method may be reliable for measuring passive use value." (Jones & DiPinto, 2017).

In Europe, following the decisions of the French Cour de cassation[14] and of the Spanish Supreme Court[15], the possibility of an expansive conception of environmental damage for oil pollution casualties developing beyond the narrow treaty framework of the 1992 CLC and FUND has prompted initiatives to address environmental damage trough a voluntary scheme. This voluntary scheme would be entirely based on the concept of ecosystem services[16].

Following the Erika case the French Civil Code amendment defines "ecological damage" in a broader manner that specifically mentions ecosystem functions and collective benefits that humans derive from the environment. The amendment was adopted in August 2016. The new Article 1247 of the French Civil Code states that, "Can be repaired, under the conditions envisioned in the present title, the ecological damage consisting of a non-negligible impairment of the elements or functions of ecosystems or of the collective benefits that humans derive from the environment"[17].

[13] Starting with Ohio (880 F2d 432 State of Ohio v. United States Department of the Interior Asarco National Wildlife Federation, 1989), confirmed by Kennecott (88 F3d 1191 Kennecott Utah Copper Corporation v. United States Department of Interior, 1996) and General Electric (128 F3d 767 General Electric Company v. United States Department of Commerce, 1997).

[14] In the Erika case (Crim 25 sep 2012, N/ H 10-82.938 FP-P+B+R+I N/ 3439).

[15] In the Prestige case (STS Madrid, de 14 enero 2016 (ECLI:ES:TS:2016:11)).

[16] The International Oil Pollution Compensation Funds (IOPC). PROPOSED CONSIDERATION OF A VOLUNTARY SUPPLEMENTARY FUND FOR ENVIRONMENTAL DAMAGE WITHIN THE IOPC FUNDS. 2016. OPC/OCT16/4/2/3. Para. 3.3.

[17] "Art. 1386-20.- Est réparable, dans les conditions prévues au présent titre, le préjudice écologique consistant en une atteinte non négligeable aux éléments ou aux fonctions des écosystèmes ou aux bénéfices collectifs tirés par l'homme de l'environnement." LOI n° 2016-1087 du 8 août 2016 pour la reconquête de la biodiversité, de la nature et des paysages.

The value of ecosystem services has been reflected in different instruments, such as the EU Water Directive[18], that recognizes in article 9 the principle of recovery of the costs of the costs of water services and its close interrelationship with the polluter pays principle. Furthermore, the United Nations Forum on Forests, a subsidiary body created by the Economic and Social Council, adopted a Non-legally binding instrument on all types of forests[19] encourages as part of the national policies and measures the recognition of the range of values derived from goods and services provided by forests and trees outside forests; as well as ways to reflect such values in the marketplace.[20]

The importance ecosystem services is being increasingly reflected on legal and policy instruments. On this regard, the European Council identified that there is an "[…] urgent need to reverse continuing trends of biodiversity loss and ecosystem degradation."[21] This acknowledgement has also been incorporated by the amendment of the Directive of Environmental Impact Assessment (Directive 2014/52/EU).[22]

More examples on studies on the valuation of ecosystem services can be found for different regions in the World. The OECD has analyzed recent use of this kind of approach to develop cost benefit studies of different policies and measures related to the environment, in areas like biodiversity, agriculture, forests, fresh water systems and marine habitats. Literature shows that the methods used for valuation vary a lot, as well as the range of ecosystem services covered (Markandya, 2016), an indication of the consolidation of the approach.

We must note that in trying to disqualify the ecosystem services approach for the monetary assessment of environmental damage, Payne and Unsworth (2017) paraphrase the work of Costanza et. al (2014) as implying that even they as key practitioners of the ecosystem service approach recognized it unfitness for environmental damage valuation. Further, they state that this framework and the Costanza et. al (1997) paper, one of the most relevant using this approach, have been widely criticized and rejected by mainstream economics as inconsistent with sound economic principles and practices (Payne & Unsworth, 2017). Not only do the authors of Nicaragua´s technical report once again use references of at least one decade ago in order to support their points. They also misrepresent the meaning of the author´s writings.

Upon consultation both the first and second author of these papers, Dr. Robert Costanza and Dr. Rudolf de Groot gave us their professional opinion on this interpretation. We include their expert opinions in letters as Appendix 1 & 2.

[18] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000

[19] 2007/40 Non-legally binding instrument on all types of forests, adopted in the seventh session of United Nations Forum on Forests

[20] 2007/40 Non-legally binding instrument on all types of forests, adopted in the seventh session of United Nations Forum on Forests Commitment V paragraph (j)

[21] Conclusions of the European Council 25-26 March 2010

[22] Amends Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment

Costanza, Chair in Public Policy, of the Crawford School of Public Policy at the Australian National University, stated, “Table 1 in Costanza et al. (2014), to which this comment refers, lists “some of the potential uses of ecosystem services valuation” (pp 154). It recognizes that this is not a comprehensive list and does not explicitly exclude damage valuation as one of the applications. Damage valuation can be thought of as one type of ‘policy analysis’, which is included in the list.” (Costanza, July 26, 2017).

Dr. de Groot, Associate Professor from the Environmental Systems Analysis Group in Wageningen University, The Netherlands and Chair of the Ecosystem Services Partnership replied “Regarding the statement that we did “..not include ecosystem loss valuation as a use of ecosystem service valuation”, and therefore the “ES-approach is not robust enough for calculating the costs of ecosystem loss” , I am not sure I fully understand the logic behind this statement. In any case, we DID include “ecosystem loss valuation” in our calculations of the Total Economic Value (TEV) of intact ecosystems, eg. (avoided) damage costs (AC) is quite an important and accepted valuation method (it highlights the free services provided by nature, especially the regulating services (such as water purification, erosion prevention, pollination, C-sequestration and many others) and what it would cost society in the absence of these services which often leads to huge damage costs (health, erosion, crop-loss, climate change etc).” (de Groot, July 28, 2017).

On the wide criticism and rejection by mainstream economists as inconsistent with sound economic principes and practices that Payne and Unsworth claim, Costanza replied: “In this case, the authors were referring to our path-breaking and seminal paper: “Costanza, R., R. dArge, R. deGroot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. Oneill, J. Paruelo, R. G. Raskin, P. Sutton, and M. vandenBelt. 1997. "The value of the world's ecosystem services and natural capital." Nature 387:253-260.” They note some of the early critiques of the paper, all of which have been refuted as either wrong or simple misinterpretations of our results (see e.g. Costanza et al. 2014). The 1997 paper has subsequently been cited over 17,000 times in Google Scholar and is the second most highly cited paper in the ecology/environment area according to the ISI Web of Science. It helped to start a huge increase in scientific research on ecosystem services, with more than 3,000 articles per year currently being published on this topic. It also helped to spur additional projects and institutions including the Millennium Ecosystem Assessment, The Economics of Ecosystems and Biodiversity (TEEB), TruCost, the Ecosystem Services Partnership (ESP), The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the EU Biodiversity Strategy to 2020, and many others. All of this attests to the fact that the ecosystem services approach is now ‘mainstream’ and widely accepted.” (Costanza, July 26, 2017).

D- The Benefit-Transfer Estimation Technique is an Internationally Accepted Practice with Well-Developed Criteria for Application.

Along the same lines as with the ecosystem services approach, Nicaragua alleges that the benefit transfer method (BTM) is not a generally accepted approach for environmental damage assessment, but instead is advocated for use in raising awareness of the importance of healthy environments. This premise is also ill founded, ignoring a substantial part of the evolution in the literature regarding this approach.

First of all, we reiterate that this methodology is used to address situations where obtaining information for slow methodologies is very expensive or impossible to acquire (such as in a highly conflictive situation), due to diverse types of limitations. The extrapolation of values from other studies to the case under analysis depends on the

existence of studies of ecosystems with similar conditions to those of the ecosystem under analysis, and on the existence of reliable information regarding land use percentages of the area under study.

Jones & DiPinto (2017) recognize, in their account of the ecosystem service approach in USA natural resource liability litigation, that for contexts where the contribution of ecological services to direct human uses (such as wetlands protecting drinking water quality, or protecting coastal property and infrastructure from storm surges) is clear, BTM is used to value changes in human uses through production function models that characterize those relationships. Its extensive use is illustrated by the amount of citations mentioned by Dr. Costanza´s letter for their 1997 paper (cited over 17,000 times).

This surge in its use did generate concerns about the accuracy of its results and sparked a series of criteria to address those concerns. Among them, Decision VIII/25 of the COP-CBD cited above, specifically recognized that benefits transfer was at the time (2006) the subject of considerable controversy in the economics literature and invited the application of the criteria included in the annex on Options for the Application of Tools for Valuation of Biodiversity and Biodiversity Resources and Functions. This annex specifically recognized that "Benefits transfer can provide valid and reliable estimates under certain conditions, including: (i) that the commodity or service being valued be very similar at the site where the estimates were made and the site where they are applied; (ii) that the populations affected have very similar characteristics; and (iii) that the original estimates being transferred must themselves be reliable. When used cautiously, it has the potential to alleviate the problems of deficient primary data sets and limited funds often encountered in valuation. However, benefits transfer is still a developing subject. More work needs to be undertaken to assess its validity in studies where it has been used to value biodiversity. Cautious application and further development of this method needs to be undertaken."[23]

In concordance with this evolution at the time, one of the sources on environmental damage valuation that we used to support our estimation, published by UNEP´s Regional office for Latin America and the Caribbean, fully recognized BTM as one of the valid TVE estimation techniques. It advocates for a comprehensive system of environmental damage valuation where use of all methods is harmonious and complementary (Castañón del Valle, 2006).

Already the Synthesis report at UNEP/CBD/COP/9/20/Add.1. (2008), recognizes BTM as applicable to environmental damage assessments. Specifically, it recognizes the need to adapt valuation techniques to national needs. It states that the "careful application of valuation methodologies is fairly demanding in terms of capacity and time, and that the main constraints, especially for developing countries, in particular the least developed and small island developing States among them, and countries with economies in transition are likely to be costs of implementation, understanding the complementarity of approaches, and the lack of trained specialists." It then advocates for valuation techniques that are comparatively easy and fast to understand and to use. It then recognizes that "One comparatively inexpensive and fast method is benefits transfer – the use of estimates obtained (by whatever method) in one site or case to estimate values in a different site or case. Benefits transfer has been the subject of considerable controversy in the economics literature, as it has often been used inappropriately. According to the Millennium Ecosystem Assessment, a consensus seems to be emerging that

[23] COP-CBD. DECISION ADOPTED BY THE COP OF THE CBD AT ITS EIGHTH MEETING: Incentive measures: application of tools for valuation of biodiversity and biodiversity resources and functions. Op. Cit. P. 5.

benefit transfer can provide valid and reliable estimates under certain conditions. / As estimates based on benefits transfer can be generated with considerably less time and resources than by undertaken primary studies, one may in some decision-making contexts be willing to trade quick and cheap numbers against a certain loss in accuracy, provided that minimum quality standards are met." [24]

By 2010, two important sources make a very detailed presentation of the standards for the application of BTM. The first one is part of the specialized studies used to develop UNEP´s TEEB Report, "The economics of valuing ecosystem services and biodiversity". It acknowledges that If care is taken to closely match policy (where the transferred monetary values will be applied) and study sites (where the transferred monetary values come from) or to adjust values to reflect important differences between sites, BTM can be a useful approach to estimate the value of ecosystem services (Pascual, et al., 2010).

It identifies four categories of BTM: i) unit BT, ii) adjusted unit BT, iii) value function transfer, and iv) meta-analytic function transfer. The simplest one is unit BTM, which involves estimating the value of an ecosystem service at a policy site by multiplying a mean unit value, estimated at a study site by the quantity of that ecosystem service at the policy site. Unit values are generally expressed either as values per household or as values per unit of area. In the former case, aggregation of values is over the relevant population that hold values for the ecosystem in question. In the latter case, aggregation of values is over the relevant area of the ecosystem (Pascual, et al., 2010).

Adjusted unit BTM involves adjusting the transferred unit values to reflect differences in site characteristics. The most common adjustments are for differences in income between study and policy sites and for differences in price levels over time or between sites. Value function transfer BTM uses functions estimated through valuation applications for a study site together with information on parameter values for the policy site to transfer values. Lastly, meta-analytic function BTM uses a value function estimated from multiple study results, together with information on parameter values for the policy site to estimate values (Pascual, et al., 2010).

Pascual et. al (2010) identify eight types of challenges for the application of BTM. First they point to transfer errors. These may be associated with errors in the original estimation of monetary values at the study site(s). For this, the authors caution on the use of the best available primary estimates in study sites.

There may also be generalization errors, when values for study sites are transferred to policy sites that are different without fully accounting for those differences. Such differences may be in terms of population characteristics (income, culture, demographics, education etc.) or environmental/physical characteristics (quantity and/or quality of the good or service, availability of substitutes, accessibility etc.). This problem may also arise from very old study site studies that do not take into account newer methodologies and cause a generalization over time (Pascual, et al., 2010).

[24] COP-CBD. LIABILITY AND REDRESS IN THE CONTEXT OF PARAGRAPH 2 OF ARTICLE 14 OF THE CONVENTION ON BIOLOGICAL DIVERSITY: Synthesis report on technical information relating to damage to biological diversity and approaches to valuation and restoration of damage to biological diversity, as well as information on national/domestic measures and experiences. Op. Cit. Para. 134-136.

Publication selection bias arises when the publication process through which valuation results are disseminated results in an available stock of knowledge that is skewed to certain types of results and that does not meet the information needs of value transfer practitioners. This problem requires, for the case of developing or middle-income countries, breaking the barrier of published literature and delving into thesis, government reports, etc., which may provide, after careful scrutiny, valuable data that still has not made it through a journal or book peer review (Pascual, et al., 2010).

Aggregation of values is also a challenge identified by this study. BTM studies need to take care of summing across services with caution to avoid double counting of ecosystem service values. As long as the ecosystem services are entirely independent, adding up the values is possible. This is a much larger problem with aggregation of a large number of services, increasing the possibility of some being mutually exclusive or redundant (Pascual, et al., 2010).

Challenges related to scale, also constitute an issue to take into account. Consideration of the spatial scale of the provision of ecosystem services and location of beneficiaries is important for the aggregation of values to calculate the total economic value of these services and for dealing with heterogeneity in site and context characteristics (Pascual, et al., 2010).

It is necessary to make acknowledgement of variation in values with ecosystem characteristics and context and proper adjustments are pertinent. Among them, the study recommends equity weighing in cases when socio-economic characteristics are very different in income levels. Other challenges pointed relate to the fact that many ecosystem service values have non-constant returns to scale. In addition, the value of many ecosystem services is expected to decline as the distance between beneficiary and ecosystem increases (Pascual, et al., 2010).

Another study that provides parameters for a careful application of BTM in environmental damage valuation is in the Annals of the New York Academy of Sciences. This study makes a survey of the theory and practice of valuing ecosystem services. It focuses on BTM as a second best option for situations where primary valuation research is not possible. It makes two important contribution to assess the fitness of BTM studies that were included in Table 4 in our monetary valuation study. The ability to transfer values from one context to another is service-specific. Some ecosystem services may be provided at a scale for which benefits are easily transferable. By contrast, values of local-scale services may have limited transferability. The Table also helps evaluate if the study site studies apply the more appropriate TVE valuation techniques by synthesizing those that are more commonly used in the literature. This illustrates that some valuation tools are more appropriate for some ecosystem services than for others (Liu, et al., 2010).

This evolution in the literature is obviously representative of the statements done by Dr. de Groot in the technical opinion he sent through his letter to the Deputy Minister of Foreign Affairs of Costa Rica when he says “Regarding the robustness of ES valuation studies, i.e. TEV-studies: because of the complexity of ecosystems (as providers of ES = the supply-side) and human society (as users of the ES = the demand side) any TEV-calculation is very time and context dependent and therefore subject to much uncertainty. All we wanted to emphasise in the 2014 paper with the “awareness-statement” is that monetary values provided in our papers, and those of others, should be used with care and ideally new, empirical work should be done in any given decision making situation. However, such original ES-valuation studies take much time, money and resources which is often not available and so-called benefit-transfer studies are in such situations the only option. With the rapidly growing number of ecosystem

service valuation studies, and databases (such as provided by the Ecosystem Services Partnership (www.espartnership.org), the robustness of these benefit transfer studies also increases rapidly and I am confident that the value provided by proper benefit transfer studies of ecosystem services values is probably much closer (more robust) to the true welfare effect than the calculations (estimates) provided by the proponents of the alternative use (e.g. a dam, shrimp farm or coastal recreational development) which is based on market values and –predictions that can change rapidly with the political and economic 'wind' and which by definition exclude most externalities." (de Groot, July 28, 2017).

E- RAMSAR itself recognizes the Validity of this Framework for the Assessment of the Economic Value of Ecosystem Services and Environmental Damages

Advisory Mission 69 report, filed in this case, states "Under the Ramsar Convention, the Contracting Parties, through Resolution IX.1 Annex A.j, adopted the relevant aspects of wetland ecosystem services from the Millennium Ecosystem Assessment. In this context, the benefits that people obtain from ecosystems are defined […] These include provisioning services such as food and water; regulatory services such as control of floods, drought, land degradation and disease; supporting services such as soil formation and nutrient cycling; cultural services such as recreational, spiritual or religious; and other non-material benefits." (Ramsar Secretariat, 2010).

Another precedent that serves to prove that both the ecosystem services approach and the BTM are of use for the present case is the Ramsar technical report N. 3 (CBD Technical Series N. 27). This report was prepared to respond to the specific request in Resolution VIII.7 for practical advice and guidance for "evaluating the values and functions, goods and services provided by wetlands". In this line, it provides practical guidance for identifying and determining the value of the ecosystem services (ecological, socio-cultural, and economic) provided by wetlands, and it discusses the advantages and disadvantages of different valuation methods (de Groot, et al., 2006).

When commenting on the use of valuation in environmental impact assessments, de Groot, et. al (2006) state, "In the case of oil spills, economic valuation has shown the direct and indirect damage inflicted upon coastal systems and has provided a basis for financially compensating local people for lost ecosystem services. Often these indirect, and in the past neglected, damages are much higher than the direct clean-up and damage costs. For example, the Prestige Oil spill off the coast of France and Spain in 2002 led to cleanup costs of over 2 billion Euro, but the indirect damage to the fishermen, tourism industry, local people's livelihoods, and lost natural values was calculated at over 5 billion Euro."

Later, when developing TVE estimation techniques, it specifically says about BTM "an increasing body of information is available in the literature and through the Internet. As the literature keeps growing, and databases become more complete and sophisticated, a good start can be made through a thorough desk study and then the application of benefit transfer techniques." (de Groot, et al., 2006).

VI. The Methodology used by Fundación Neotropica is of common use in tropical biodiversity rich countries.

In the years since 2005, references to ecosystem services have become increasingly frequent in tropical States that, like Costa Rica, are biodiversity rich. This current trend in State practice, discussed in this section, further

highlights the fact that the UNCC practice is unsuitable and no longer reflects the current understanding of environmental damage.

A study from 2015 documents the trends relative to liability for environmental harm in seven tropical States (Brazil, the Democratic Republic of the Congo, India, Indonesia, Nigeria, Mexico, and The Philippines). All have in common being significant for the extensive forest cover and biodiversity wealth as well as for their emerging statutory provisions on environmental liability. The authors found that, despite governance challenges and limited experience, the definitions of environmental damage tend to be broader than in the United States or the EU frameworks (Jones, et al., 2015).

In Indonesia, the regulations implementing statutory bases specify categories of environmental goods and services and provide guidelines to calculate damages. A relevant precedent is the Kallista Alam case where a palm oil company holding a disputed logging concession was found liable for clearing 1000 hectares of peat forest with the attendant loss in ecosystem services such as water storage function or carbon sequestration and reduction (Jones, et al., 2015).

In Mexico, the Federal Environmental Liability Act passed in 2013 defines environmental damage as "measurable adverse loss, deterioration, harm, affectation or modification of the chemical, physical and biological conditions of habitats, ecosystems, natural elements and resources as well as of their interaction relationships and the environmental services provided by the same." (Jones, et al., 2015).

In Brazil, Federal Decree 43349/02, which established the National Biodiversity Policy, recognizes that "the use value of biodiversity is determined by cultural values and includes the direct and indirect use, option of future use and also the intrinsic value, including ecological, genetic, social, economic, scientific, educational, cultural, recreational and aesthetic values." (Jones, et al., 2015). In two recent cases decided, respectively, in 2012[25] and 2015[26], the Superior Court of Justice has interpreted this provision together with the principle of full compensation of damages as requiring inter alia compensation for the loss of ecosystem services disruption. Ecosystem services have been specifically used to value the damage arising from the removal of native and exotic trees from an area surrounding a national park, following a methodology developed in a Brazilian study relying in turn on the study by Costanza et. al (1997) challenged by Nicaragua and the Payne & Unsworth report. The estimated loss was circa US$ 14 million[27]

VII. The Methodology used by Fundación Neotrópica is Consistent with the Common Practice in Costa Rica´s courts and academic circles.

Following the trend of other tropical biodiversity rich countries, Costa Rica has also developed a series of guidelines and practices regarding environmental damage valuation. Since the ICJ defined in its Judgment of December 16, 2015, that sovereignty over the disputed territory belongs to Costa Rica, and that Nicaragua, by

[25] S.T.J., REsp No. 1180078/MG, Rel. Minister Herman Benjamin, Second Class, DJE 28/02/2012.

[26] REsp No. 1410698/MG, Rel. Minister Humberto Martins, Second Class, judged on 06/23/2015.

[27] Civil Inquiry No. 007/2011 (DOC-0145-2012-FLORA).

establishing a military presence and excavating three artificial caños in such territory, violated the territorial sovereignty of Costa Rica, we believe these standards and practice need to be taken strongly into account by the Court.

Costa Rica had a relatively early development of environmental regulations in the late 1990s, resulting in the adoption of several progressive regulations (Forestry Law, Biodiversity Law, Organic Law of the Environment Law, Constitutional Reform to Article 50 of its political constitution, etc.). Environmental damage is defined in Costa Rica as "any loss or significant reduction caused to the environment on one or more of its components. They are hard to repair and sometimes, for example, when a species is lost, irreparable."[28]

According to the courts and the doctrine, at least two types of damage are recognized. Pure or ecological damage and non-pure or private ecological damage (González & Peña, 2015). Pure ecological damage affects the common patrimony of all inhabitants (public goods): water, air soil, biodiversity, etc. (Montero-Bustabad, 2012). The same resolution from the Sala Primera of the Supreme Court of Justice states about this type of environmental damage that it "affects flora, fauna, landscape, air, water, soil, this is, the environment. It is the one affecting the ecosystem, inhibiting its natural functions. It is the injury or impairment to the components of nature or the environment[…] It is a damage to the environment through its alteration, partial or total destruction, affecting indirectly the quality of life of all living beings in the planet."[29]

Among the progressive legal notions that accompany this concept, we find criteria regarding the burden of proof and the prescription of the State to act in cases of pure environmental damage. With respect to the burden of proof, the prevailing court interpretation states that in view of the Precautionary Principle (as observed in Costa Rica´s Biodiversity Law), the burden of proof is reversed regarding environmental damage. As stated in article 109 of the Biodiversity Law: "The burden of proof, of the absence of contamination, degradation or unlawful effects, corresponds to whom applies for authorizations, permits or access to biodiversity or to who is accused of environmental damage."[30] Regarding the prescription of the capacity of the State to act in cases for pure environmental damage, legal criteria point to a lack of a prescription term at all (Montero-Bustabad, 2012).

Along the same trends, legal doctrine states that the valuation of environmental damage must be done in a comprehensive way (González & Peña, 2015). Costa Rican doctrine recognizes also that as much as it may be complex to put a monetary value on many of these damages and that any valuation may seem arbitrary, an environmental damage does not cease to be indemnifiable because it is hard to value (Montero-Bustabad, 2012).

These concepts have been expressed methodologically in court and academic practice. In terms of economic literature, several studies have documented the state of the art in terms of monetary valuation practices. In our monetary valuation report for this case, we documented Dr. Mary L. Moreno´s study documenting the Costa Rica experience up to 2005 on economic valuation of services provided by biodiversity, as she labeled it then (the study comes on the year of the Millenium Ecosystem Assessment).

The study demonstrates a substantial development of valuation studies that include several types of ecosystems and apply the full range of TVE methods. In terms of environmental damage monetary valuations, the prevailing

[28] Sala Primera de la Corte Suprema de Justicia. N. 675-2007 de las 10:00 horas del 21/09/2007.

[29] Ibid.

[30] Tribunal Contencioso Administrativo, Sección IV. N. 4399-2010 de las 10:40 horas del 14/12/2010.

trend is the application of the *Instituto de Políticas para la Sostenibilidad* (Institute on Sustainability Policies, IPS) from Costa Rica (Moreno, 2005).

Last year, another state of the art report published by the International Center of Policies for Sustainable Development of the National University (CINPE-UNA) analyzed the trends in the Costa Rican literature and its evolution. It confirms the trend that the prevailing publications regarding environmental damage apply adaptations of the IPS framework (Aguilar González & Segura Bonilla, 2016).

Appendix 3 confirms this academic trend through s technical statement by Moreno, who is the research coordinator and Segura, who is a researcher at CINPE-UNA (one of the most prestigious academic centers in environmental and ecological economics in Costa Rica). In their words, they "have analyzed in depth the theoretical references on methodologies of economic valuation of environmental services and valuation of the damage of ecosystem services in Costa Rica, and have applied several of these methodologies at national and international level. Among the different methodologies used to value environmental damage that we have found and that have been used […] the methodology of the Instituto de Polìticas de Sostenibilidad, IPS (Institute of Sustainability Policy) is the most used in Costa Rica." (Moreno & Segura, July 20, 2017).

In terms of the courts, Costa Rica does not have an environmental jurisdiction per se in the judiciary branch. In this instance, most criminal and civil matters fall into the Penal and Agrarian jurisdictions. Further, those that involve the participation of the State as the enforcer of laws and environmental legal standards go to the Contentious Administrative jurisdiction. All of these jurisdictions have gradually evolved to be technically prepared for environmental cases. Nevertheless, due to its nature, no instance has developed more experience in environmental damage valuation than the Administrative Environmental Tribunal of the Ministry of the Environment. In the next section, we will document more in detail the trends for this instance in terms of the state of the art of environmental damage monetary valuations in order to finish the justification of the methodological framework that we used for the valuation under discussion here.

A- The Practice of the Administrative Environmental Tribunal of Costa Rica in Valuation of Environmental Damage

Costa Rican law[31] created the Administrative Environmental Tribunal (TAA) in 1995 in order to provide more celerity and transparency to environmental justice in Costa Rica, beyond the existing procedures. TAA is a deconcentrated entity ascribed to Ministry of the Environment (MINAE) with jurisdiction over the whole country. It can act by petition or on its own initiative. Its competencies include the procedures and sanctions to those that cause environmental damage[32]. For these duties, it has the possibility of determining the amount of monetary indemnity that is appropriate for environmental damages. For this purpose, it uses the diverse specialized entities of MINAE as auxiliary to its work. These entities have a legal duty of providing this help.

In its practice, TAA has not determined one monetary valuation methodology as official. Some have taken issue with this practice (Sánchez, 2009). Yet, we believe wisely, it has gradually applied several, acknowledging the

[31] Costa Rica. Organic Law of the Environment, Sept. 28, 1995. Art. 103 & ss.

[32] Ibid. Art. 111.

specificity of the socio-ecological contexts and circumstances implied in every case and that new methodologies appear frequently.

A precedent of notice from the TAA is its publication of a Guide of Indicators for the Economic Valuation of Environmental Damages to Coastal Marine Resources in 2014. This guide, sponsored by The Nature Conservancy and supported by the technical NGO PRETOMA, seeks in its own words," that the members of the TAA use these concepts to determine, under their own criteria, if an environmental damage valuation report has the necessary elements to be technically credible, and if the indicators for the valuation of environmental damage in diverse coastal marine environments are the appropriate for such credibility." (MINAE-Tribunal Ambiental Administrativo, 2014).

The Guide suggests a three-component framework that defines the state of the art for the TAA composed of the ecosystem services approach, the TVE estimation techniques and the IPS environmental damage monetary valuation method (MINAE-Tribunal Ambiental Administrativo, 2014). We note that this is the exact same framework combination adopted in our monetary estimate for the case under discussion here.

The document adds a chapter on indicators applicable to mangrove ecosystems where it applies the ecosystem services framework to this particular biome. It makes an interesting note on the evolution of valuation applications when it compares a valuation made in Colombia by the National Comptroller in 1998 to one made in 2010 using the ecosystem services approach. The 2010 valuation yielded a monetary value 13 times larger than the dated one (MINAE-Tribunal Ambiental Administrativo, 2014). The Guide is found as an official document at the TAA web site in: http://tribunalambiental.go.cr/portfolio-item/manual-de-indicadores-para-la-valoracion-economica-de-danos-ambientales, yet it cannot be downloaded. It is downloadable from the PRETOMA web site at: http://www.pretoma.org/wp-content/uploads/2015/01/VALORACI%C3%93N-ECON%C3%93MICA-MARINO-COSTERA.pdf.

Further, the most active entity in providing the TAA with monetary environmental damage valuations is the National System of Conservation Areas (SINAC). We asked the TAA to provide us with an account of which is the methodology used more frequently in this practice. Appendix 4, contains two notes from the TAA where they report their accounts "on the administrative records that have been duly finalized by this Tribunal between the years 2015 and 2016, whether through rendering a Final Act or through the Homologation of Conciliatory Agreements." According to this note, "it can be indicated that of the 69 files completed in the Administrative Environmental Tribunal in the years indicated above, the IPS Methodology was the one that was mostly used in the establishment of the Environmental Damage Valuation, with 34%, in relation to the other types of methodologies used." (Solano, July 28, 2017).

B- The SINAC Protocol and the IPS Methodology.

As an important point to clarify in order to understand the TAA findings, we explain the parameters that SINAC has today for these valuations. As the note from the TAA indicates, "in accordance with Directive No. SINAC-DE-1156 of 23 May 2014, environmental damage valuation carried out by the personnel of the National System of Conservation Areas must be carried out in a mandatory manner applying the guidelines of the "Protocol of Economic Valuation of Environmental Damage" issued that same year. According to this Protocol, four

methodologies for economic valuation of environmental damage (VEDA) are adjusted to the particularity of each case under analysis, namely:

a) The Economic Valuation of Environmental Damage Methodology (IPS), which is recommended for cases such as land use change, forest fires and wetland damage, although this methodology can be applied to almost all situations where natural resources are affected;

b) The Economic Valuation of Environmental Damage Methodology (ACOSA), which is recommended for cases of extraction (products and by-products), hunting, and trafficking of wild flora and fauna;

c) The Economic Valuation of Environmental Damage Methodology (ACA-HN), which is recommended for damage caused by cutting and harvesting of trees in agricultural and non-forest land, without riparian forest, and in forest protection areas; and

d) The Economic Valuation of Environmental Damage Methodology of the Isla del Coco Marine Conservation Area (ACMIC), which is recommended for cases involving damage to marine environments, specifically illegal fishing or illegal actions in which marine species are involved." (Solano, July 28, 2017).

The protocol does not definitely limit the valuation options to these four but it seeks to mainstream the criteria for the selection of environmental damage valuation methods. Further, it details the content for the valuation reports, the personnel that should be involved (favoring multidisciplinary work in complex situations) and other legal and procedural issues (SINAC, 2014).

It is important to recall that the IPS methodology seeks to measure environmental damage by determining the state before and after the action that causes the damage (Figure 2). According to our monetary valuation report[33] it has three components. The first one is the restoration cost as a proxy for the value of biophysical damage. The second is the social cost caused by the loss of generated benefits due to the effects of the natural environment on the state of conservation of the natural environment, and the quality and quantity of flows provided by the natural capital. The third one is the value of the total extracted production, in the case of extractions (Barrantes & Di Mare, 2001).

[33] Equation 5 on p. 30.

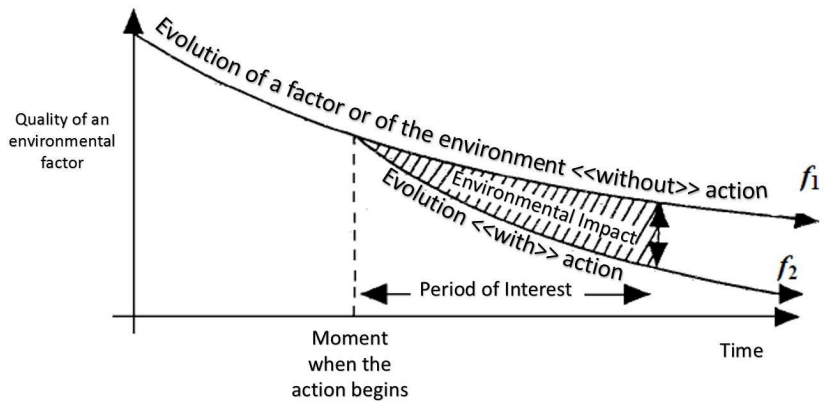


Figure 2-Graphic representation of the environmental damage. Source: Barrantes and Di Mare (2001)

The methodology proposes assessing the initial state of the natural resources involved by measuring the potential to provide the flows or ecosystem services that benefit society. The estimation of the social costs considers the benefits lost due to the environmental damage caused. Thus, it is necessary to determine the group of benefits provided by the natural environment affected and how these benefits have decreased due to the environmental disturbance (Barrantes & Di Mare, 2001; Vega, 2004).

Gerardo Barrantes from IPS makes a report of the widespread use of the methodology in the note presented in Appendix 5. It is important to point that due to its strong recognition, Barrantes points to extended application of the IPS methodology in Latin American contexts in policy and litigation spaces in Ecuador and Colombia and for training purposes in Paraguay and Honduras.

C- The Application of the Benefit-Transfer Methodology by CINPE-UNA for the Valuation of Costa Rican Wetlands

One final observation seems important in order to prove the validity of the methodological framework applied in our valuation report. As Drs. Moreno and Segura point to in their note (Appendix 3), they are "presently working on a research Project on the "*Valoración de los Servcios Ecosistémicos de siete humedales Ramsar de Costa Rica (*Valuation of the Eco-Systemic Services of Seven Ramsar Wetlands of Costa Rica) for the SINAC-MINAE. To do this, we are using the internationally known methodology referred to as *value transfer.* The transfer of benefits better known as *value transfer* is generally used when there are budget limitations and/or time is limited to carry out a detailed study and what is needed is a measure of benefits." They point to the fact that they are still in the calibration and adjustment of the data and have a commitment to deliver results by the end of the current month. They finish pointing out that "The results obtained in this study will serve as input to facilitate the implementation of various policy measures such as the national wetland policy." (Moreno & Segura, July 20, 2017).

Undoubtedly, this is an important fact to support the validity of the use of BTM in our monetary valuation report. Added to this, in his letter to the Viceminister of Foreign Affairs of Costa Rica, David Batker adds a sample of applications of BTM in policy contexts in Latin America (Appendix 6). Earth Economics (www.eartheconomics.org/)

is one of the most important technical NGOs dedicated to ecosystem service valuation worldwide. Their Latin American work using BTM among other techniques includes work in Ecuador, Colombia, Peru, Panama and Costa Rica (Batker, July 28, 2017).

We believe to have proven with the technical and legal precedents and evidence presented until now, that our three part methodological framework is a credible representation of the current international state of the art in environmental damage valuation methods, especially for biodiversity rich tropical countries like Costa Rica. We have also shown sufficient evidence that it represents the standards mandated in Costa Rica and that it is applicable with credibility to wetlands like the RAMSAR protected Humedal Caribe Noreste.

Next, we will address the allegations of Nicaragua regarding our choice of ecosystem services. Immediately after, we will answer to their questioning of our specific calculations.

VIII. The Calculations for the Monetary Value of the Damage were Carefully, Appropriately and Conservatively Done.

Through further elaboration of the arguments already presented in these proceedings through our valuation report and explanatory addenda of November 2016, we will address the questioning of our application of the methodological framework done by Nicaragua based on Payne and Unsworth (2017). For further validation of our methodological application, we submit to the consideration of the ICJ, the technical note where the expert technical NGO, Earth Economics, evaluates the soundness of our monetary valuation report (Appendix 6). In his words, "With regard to the specific case and the analysis provided by Neotropica, I find their analysis to be sound and conservative." (Batker, July 28, 2017).

A- The Careful and Conservative Selection of Ecosystem Services to Value

As we stated in our explanatory addenda, the process for selection of the ecosystem services to be accounted for as losses in the monetary valuation of the environmental damages was meticulously performed in conformity with the technical information on record that confirmed the damages. To this end, our valuation report describes the technical environmental background that supports the valuation, specifically citing the documents and other relevant inputs with their specific location on record in this case. In Table 2[34], we highlighted the technically relevant facts that support the documented losses. The ascertained facts and technical evidence on record, provided by qualified professionals, provide the causal link of the claimed damages. We further evaluated these facts and causalities in our technical multidisciplinary team in consultation with SINAC. As presented here in Figure 1, we sought further validation of our analysis in this regard through a field inspection by means of an overflight of the area (Aguilar-González, November 18, 2016).

Based on this body of evidence, we performed a preliminary selection of candidate ecosystem goods and services for the valuation. Table 8 of the translated report[35] presented this preliminary list (Aguilar-González, et al., 2016). This table listed, in order to demonstrate the selectivity of our process, the ease of performing the valuation of

[34] P. 11 of the translated valuation report

[35] On P. 43.

those goods and services and the transferability of the estimated monetary values from similar ecosystems located in other sites, complying with the prescriptions of Liu et al. (2010) for the purposes of BTM. We also documented in this table the magnitude of the presence in the area of the damages for each category, the perceptible reserves and flows therein, and the extent to which it would be possible (at the time of the report) to verify the loss due to the damages caused. We arrived at a list of 11 categories of preselected goods and services. After careful scrutiny of the fitness of the data available, we selected only six (6) categories for monetary valuation of the attributable damage and eight (8) categories for a qualitative description as reported on Table 8 and 11[36] in our valuation report (Aguilar-González, November 18, 2016).

It is important to note that the careful selection narrowing down the ecosystem services to be valued monetarily, significantly reduces the possibility for redundancy between the services valued. In this sense, we can say that going down from twenty-two possible categories of services to be valued, to only six reduces this possibility substantially. This seems too conservative according to the qualified opinion of Dr. Joshua Farley (Appendix 11), from the University of Vermont, who also evaluated our report, concluding that it "is meticulously prepared and documented, and utilizes state of the art techniques for monetary valuation of ecosystem services (Farley, August 1, 2017).

Some functional ecosystem redundancy is natural to all ecosystems. As a recent report published by the European Commission states, functional diversity "is a measure of the diversity of ecological roles that are needed for an ecosystem to function. If a number of species appear to perform the same role there is presumed to be 'functional redundancy': in other words it is assumed, based on current knowledge, that not all species are needed for the ecosystem to function […] However, in the face of global change, having a number of different species performing similar roles may be vital. Stability is likely to be higher if more than one species perform the same function because a decline in one species may be compensated for by stable or increasing numbers of another, especially if they respond differently to disturbances and environmental change."

Nicaragua accepts our selection of most ecosystem services in the monetary valuation, yet disagrees with our inclusion of soil formation/erosion control and natural hazards mitigation. With this position, they are ignoring the fourteen sources of evidence in the proceedings identified as relevant to justify the inclusion of natural hazards mitigation and the twelve identified to justify soil formation/erosion control in Table 12[37] of our valuation report. Table 12 lists these sources, which had been numbered and explained in Table 2[38], with a detailed account of the technical relevant facts they include and their location in the proceedings (Aguilar-González, et al., 2016).

Of support to our inclusion are the scientific observations of Dr. Colin Thorne in review of the report by Dr. Kondolf, used in support for this exclusion in Nicaragua´s counter-memorial (Kondolf, 2017). His scientific opinion proves that Kondolf´s conclusions are incorrect relative to soil formation/erosion control. Thorne states that, "Based on the evidence outlined above and our current understanding of soil formation, fertility, and

[36] On P. 48.

[37] On pp. 50 and 51 of the translated report.

[38] P. 11 of the translated valuation report.

erodibility, and how the resilience of plants to physical stresses, diseases and pathogens relates to the health of their rhizospheres, there is no doubt that Nicaragua's activities must have impacted soil formation or erosion control services in the areas affected and that it will take at least several decades for the river-deposited sediments filling the caños to evolve into fully functional soils. This is the case because soil forming processes are indivisibly related to growth and maturing of the secondary forest developing in the cleared areas, which […] takes decades to centuries. It follows that because […] secondary forest can never fully replace the primary forest that Nicaragua cut, neither can the soils that existed beneath and in harmony with the old growth trees be fully replicated." (Thorne, 2017).

Further, he also informs the Court of the incorrect conclusion coming from Nicaragua´s counter memorial on the relevance of the natural hazard mitigation service in the area. "In concluding that Nicaragua's activities had no impact on the ability of the disputed area to mitigate natural hazards Dr Kondolf entirely misses the point that the freshwater wetland and its ecosystem are themselves valuable assets at risk from natural hazards associated with the wetlands low elevation and proximity to the Caribbean Sea".[…] In my opinion, natural hazards mitigated by the wetland include coastal flooding, saline intrusion and coastal erosion." (Thorne, 2017). In this sense, Thorne argues the loss of this service to all of those who benefit from a Ramsar wetland, the Costa Rican people who are the owners of this public property area and beyond (as a consequence of its international designation).

Yet, it is important to acknowledge that local populations also depend on this service. We pointed out in our valuation report, a study performed by ACTO technicians in 2013 to evaluate a change in the protected area management category of Calero, Machuca, and Portillos Islands[39]. This study documents 26 possessors with use permits in the area close to the damaged site and about the same number of infrastructures, including those in the community of El Jobo (Monge, et al., 2013). Therefore, not only is there enough evidence that the wetland itself (and those who it benefits as a public protected area and a Ramsar site) but local inhabitants depend on the natural hazard mitigation ecosystem service that the damaged area provides.

It is important to point to the proof of the relevance of this service for the area by the consequences, or lack thereof, of the 2016 direct hit in the area of Hurricane Otto. In Appendix 9, we include a technical note from Laura Rivera, director of the Tortuguero Conservation Area, where she accounts for this.

In her report she states "in places where there was dense forest cover it was observed that, although there was fall of trees, a good part also kept at least its truncheon on foot. When reviewing other affected areas where the forest cover did not exist, it was possible to determine that the effect of the wind on isolated trees was apparently greater, because almost all were knocked down by it. This leads to the suggestion that the higher vegetation density may have allowed a "filtering" of the air currents, generating a lower pressure at the individual level of each tree and palm present. […]Some buildings were affected, mainly those that were in open zones or on the shores of lagoons. In the zone of Puerto Lindo there were strong affectations on the forest resource, but the houses near forests or surrounded by them did not show evidence of affectation." (Rivera, July 31, 2017). The report also provides photographic evidence of her statements.

[39] The report can be found and downloaded at:
https://drive.google.com/file/d/0B2pWR5tBjlFTamFhbE4ydE5aUzg/view?usp=sharing

B- The Conservative Estimate for Standing Timber

In this area Nicaragua lays out several criticisms that we list in order to organize our response. Payne and Unsworth (2017) criticize our approach of multiplying the inventory of timber that was cut by the prices gathered from official sources, after deflating by a harvestable volume factor of close to 50%.

1) They misrepresent our approach by saying that this implies that we are assuming that 50 percent of the standing stock could have been harvested for sale absent Nicaragua´s actions. Further, they state that our calculations are not clear because we do not clarify if the prices used are stumpage prices.

2) They also misrepresent our calculations by saying that we assume that it would have been possible to remove sustainably half of the annual growth of trees each year. Further, they claim that we do not provide evidence that the damaged area may have been sustainably harvested.

3) They criticize our accounting of the potential growth of trees from the year they were cut to the moment of our estimation as incorrect (what we labeled as opportunity cost).

4) They criticize our supposed lack of consideration of the potential recovery of ecosystem services through time. (Payne & Unsworth, 2017).

We reply:

1) We make no assumption about the standing stock being harvested for sale absent Nicaragua´s actions. The fact is that it should not be harvested at all. Our deflation of the standing volume of timber assuming a usable percentage was based on the intention of presenting a more conservative base year estimate. We must admit that when we labeled the tables where we reported the data for wood prices, we did not indicate that these were effectively standing volume prices (as reported by the National Forestry Office)[40] as is the correct approach when reporting on a stock of resources that is not to be removed. Nicaragua unlawfully removed an area of national patrimony that includes standing timber as one of its assets.

2) We do not assume that that it would have been possible to remove sustainably half of the annual growth of trees each year. We assume that the asset degradation will be reflected in Costa Rican physical natural and economic accounts every year as a decrease in the monetary value of the country´s natural assets, until it is fully recovered. This is why we account for the loss annually, deducting from the annual value the recovery of volume that we account for through the use of the discount rate. This is consistent with the country´s establishment of green national accounts according to the WAVES initiative, as it is discussed more in detail in Section VIII.E.

3) We assumed the growth of trees would have continued until the date of the assessment. We could have assumed that they would have continued growing until the full recovery time, which we did not do, in order to

[40] They are reported as “en pie (col/pmt)”. This may be translated as “stumpage (colones/Costa Rican Wood Inch)”. These values usually range between 20% to 35% of the price for sawn wood in the market according to the National Forestry Office reports.

keep our estimates conservative. Our asset loss accounting did not assume any growth in the standing volume in the area damaged through the period between 2016 and 2066.

4) Finally, as we will comment more in detail later (Section VIII.E.), we have assumed a potential recovery of the standing volume when we decided the rate with which we discounted the net present value of the damage on a fifty-year time horizon. Recent studies estimate a median recovery rate in Central American forests from clearing to 95% recovery of 141 years (about 0.71% per year). Worldwide, the estimate from the same study states a 0.41% annual recovery rate from human disturbances to the same level of recovery, based on 166 events of such nature (Cole, et al., 2014). In such case, the recovery time would be close to 244 years. By assuming a 4% discount rate for the calculations of the Net Present Value in this monetary valuation, we are in fact assuming an ample average recovery rate of 1.71% per year. As illustrated by Figure 3, the yearly damage

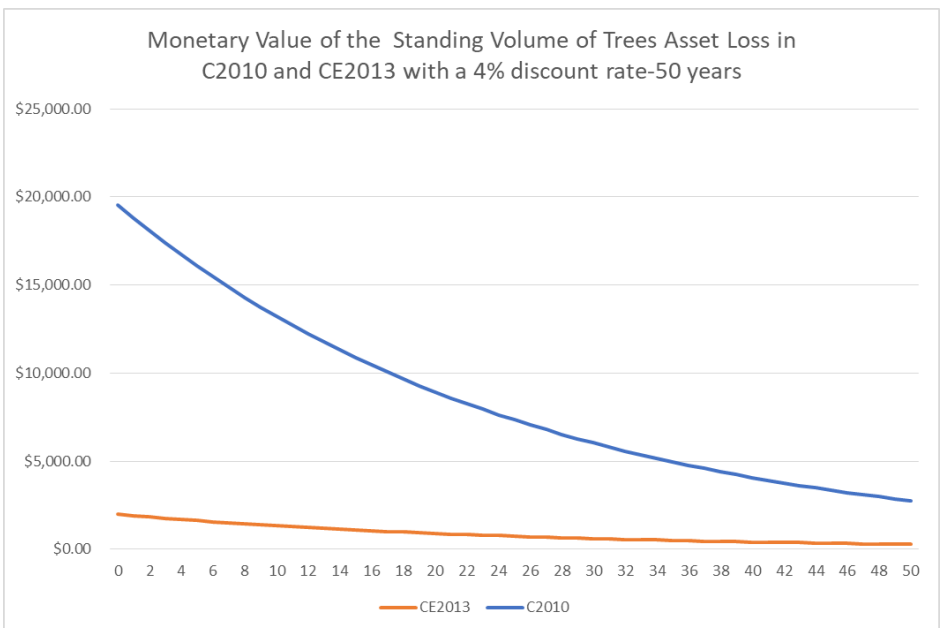


Figure 3-Monetary Value of the Standing Volume of Trees Asset Loss in C2010 and CE2013 with a 4% discount rate-50 years. Source: Authors.

asset damage value for from C2010 decreases from US$19,558.64 to US$277.25. A similar percentage decrease is assumed in the estimate for CE2010.

C- The Conservative Estimate for Soil Formation/Erosion Prevention

We used a replacement cost approach to estimate the losses regarding this service brought about by the destructive actions of Nicaragua. Nicaragua objected to this calculation based on the fact that it assumed that the service was not lost and by stating that we are assuming a constant removal for every year until the recovery period of 50 years (Payne & Unsworth, 2017).

We have already presented enough evidence on the inaccuracy of the assumption that the service was not lost due to Nicaragua´s actions. Further, Dr. Colin Thorne´s report clearly states that the quality of soils that were lost may not be fully recovered through time.

On our calculations, Payne and Unsworth (2017) point out (in note 83, p. 24 of their report) as an alleged error that we used a value of US$5.87 instead of the reported US$5.78 reported in the source document we used (Colegio Federado de Ingenieros y Arquitectos de Costa Rica, 2007). They have indeed discovered a typo which does not affect our calculations as the simple multiplication of the removed soil by the correct number they report yields the monetary values per year that we calculated. These values are very conservative since the cost of excavation and movement of soil from the source we used does not consider 1) the qualities of the soil that were in the damaged area according to the report by Dr. Thorne and 2) the difficulties in accessing this area which would very likely raise this cost.

One important note is that it is incorrect to assume that using a replacement cost and projecting it to a time horizon in order to estimate the net present value of the ecosystem service implies that we assume that such removal will be happening every year. First, replacement cost is a revealed preference or shadow price approach, it is not a direct valuation, but a proxy value that approximates the monetary value of the ecosystem service. Second, the loss is also the result of unlawfully dredging the soil assets from an area of national patrimony.

D- The Careful Selection of Values for the Estimates Using BTM

In general, we adopted a Unit Value BTM approach adjusted by inflation due to time and resource constraints. Among these constraints were the lack of access to the damaged sites at the time when it occurred, the lack of local price information and the high costs in time and resources needed to apply stated or revealed preference methods or the development of a BTM transfer function. We did this for the four remaining ecosystem services reported (raw materials, gas regulation, natural hazard mitigation, habitat and nursery).

We used rigorous parameters in the selection process to minimize the amount of possible transfer errors. We made sure that the study site studies used the most recognized methodologies. We also chose only ecosystem services with medium or high transferability of the service (according to Table 8[41]) (Aguilar-González, November 18, 2016). These practices allow us to address the issues of site study error and some of the generalization errors pointed in Liu, et al. (2010) and Pascual et al. (2010).

As a rule, we also sought for study site studies from similar ecosystems, i.e. tropical coastal wetlands (most of the literature is on mangroves) and study site studies from published peer-reviewed sources, seeking to control for generalization and study site errors. For grey literature we used the Earth Economics review process seeking measures of the quality of the studies that assure equivalency to peer reviewing, as recognized before, an important process in the case of developing nations due to the availability of published studies (Aguilar-González, et al., 2016). An additional clarification is that as a control for generalization errors related to the dating of the study, we used studies that do not date back before the year 2000 (As found in Appendix 1 and 3 of our valuation report). We defined that a 10-year term before the damage would be stringent enough to minimize this error.

[41] On P. 43 of the translated report.

Generally, we took the approach of Costanza, et. al (1997) of averaging the different site study values in order to find a point estimate. Yet, we applied other criteria in view of specific circumstances.

In addressing Nicaragua´s problems with our estimates using this approach we first address the calculation of raw materials. In Table 14[42], we report an average value of ecosystem service per hectare of $175.76 from averaging (Costanza, et al., 1997) the values adjusted for currency and inflation found in the database consulted (Appendix 3[43]). We multiply this value by the hectares affected in C2010 and CE2013. In the case of raw materials, affected areas cleared but without removal of the trees were also included (Aguilar-González, November 18, 2016).

Nicaragua says that given the range of different values, it is appropriate to select the value from the study of greatest relevance to the valuation problem and site being studied (Payne & Unsworth, 2017). They do not indicate which one they think this is. If we applied the criteria of proximity, methodology and socio-cultural similarities, such a proposition would hurt their interest, as the newest study, with a better methodology (remote sensing), made in close socio-cultural and ecological context would be the Camacho-Valdez, V. et al. (2014) which in fact would mean a value per hectare about 3 times larger. If they mean by relevance the number of citations, this would be tricky as not all sources report article statistics in all languages and, as we said before, in developing nations grey literature is an important source. Further, it would be expectable that newer articles, with revised methodologies, would be lower in citations. We stand then by our choice of using the method recommended by Costanza et al. (1997). Therefore, our estimate is conservative.

Further, since this is national patrimony and a RAMSAR, we do not need to prove that it is effectively being used. It is an asset of humanity and the Costa Rican public that was illegally destroyed. Yet, since we have earlier determined that small communities and houses are present in this area (albeit few), given their obvious remote conditions, it is reasonable to assume such use exists from the evidence reported.

Nicaragua also takes exception on the fact that we do not model the recovery time of this ecosystem service. This effort is not needed. We have reliable data on the element that will take longer to recover: the trees, which according to Dr. Thorne´s report will determine the dynamics of the entire ecosystem through time. According to the IPS methodology, as reported in our valuation study and from the note sent by Barrantes (Appendix 5), this is the element that should be used as a parameter to estimate the recovery of the whole system (which coincides with the conclusions by Thorne about successional stages and restoration).

[42] On P. 60 of the translated report

[43] On P. 72 of the translated report

Regarding our estimate for gas regulation, we reiterate that in spite of finding several reference studies, we chose to use as basis the calculations of the study concluded in 2015 by Maureen Arguedas at Centro Agrícola Tropical de Investigación y Enseñanza (CATIE) under the supervision of Dr. Miguel Cifuentes, main expert in Costa Rica on the estimation of carbon reserves in wetlands. This study has the advantage that it is based on the fixed carbon estimate of studies in Costa Rican wetlands, both in biomass and soils. Furthermore, it presents the stock by hectare and the annual fixation (flow) by hectare estimated for the mangrove areas of the Gulf of Nicoya (Arguedas, 2015). Because of the advantages of this level of specificity, and having identified mangroves in the affected area (Araya & Mena, 2013), we opt to use these numbers to estimate both the lost stock and flows of this ecosystem service. Figure 9[44] in our valuation report shows that mangroves are present in the damaged areas. Since it is an unpublished thesis and Nicaragua has questioned its quality, we have included in Appendix 8 a letter from Dr. Muhammad Ibrahim, General Director of CATIE. He says about the study, it "was conceptualized, implemented, reported and approved according to the guidelines and processes of CATIE Graduate School, which is the oldest Graduate School in Latin America in the agricultural and natural resources fields. The results of the investigation comply with international academic standards concerning its rigor and validity." (Ibrahim, July 21, 2017).

Payne and Unsworth state that no consideration is given to the comparative sate of the sites. The Arguedas study is in fact done in the Gulf of Nicoya, a more disturbed site than the Portillos Island area, within a radius of 1 kilometer from the coast line. Since the presence of mangroves in the Portillos area is also in narrow strips, we see that the differences in the areas would not be so serious as to disqualify the estimate used.

On the objection of double counting because we supposedly assume extraction of raw materials, this is a false assumption as said before. Again, the yearly flow of carbon accumulation accrues as an asset that will be lost every year until the ecosystem recovers and it is one part of the functional complexity that characterizes tropical forested wetlands, with an extraordinary capacity of fixing carbon in their biomass and their hydromorphic soils (Arguedas, 2015). Further, the issue of overestimation of the value of this service because it benefits both Costa Ricans and all the world is irrelevant, as it is Costa Rica that has received the stewardship over its territory after registering the wetland as a Ramsar site. This applies to all the ecosystem services assessed. The carbon sinks, both biomass and soil, are located in Costa Rica. Therefore, by being public property, they belong to the general public of the nation. Besides, the exercise of assessing environmental damage at hand is on the issue of how

[44] On P. 55 of the translated report

Nicaragua's actions impaired the capacity of Costa Rica to provide these natural assets or ecosystem services, not about who gets the demand.

On the estimation for natural hazard mitigation, we stand by the source that we pointed: Barbier, et al. (2002). It reports a value of US$2,387.42 USD/ha/yr. for flood prevention, which we adjusted for inflation. We agree with Payne and Unsworth (2017) that in this case, it would have been preferable to use either the average approach, the newest study (from Mexico) or the value for the closest context (from Belize). Either case would have led to a higher estimate as can be seen from Appendix 3[45] in our valuation. As we said in our explanatory addenda, we chose the lowest value from the range of selected studies. This is done given that as recorded in the technical reports and confirmed in the field visit, it is an area with low density of population, with nearby towns 4 kilometres away, few houses on the river meadows, some SINAC infrastructure on the Costa Rican side, and an airstrip on the Nicaraguan side (Aguilar-González, November 18, 2016). As before, we will show that no double counting was done by annualizing this loss.

Regarding Nicaragua´s allegations regarding the estimates for habitat and nursery services, we reiterate that the values were estimated from the average of the studies indicated in Appendix 3 of coastal wetlands with the presence of mangroves in Mexico, Philippines and Thailand. Note that this is an environmental service with a high transferability of values as well.

E- The Accounting of Yearly Values of Losses Up to the Time of Recovery does not Constitute Double Counting but an Adequate Application of the IPS Methodology.

For all of our estimates Nicaragua contends that there is double counting because we annualize the value of the losses in order to estimate the Net Present Value of the damage. Both the flows and stocks of resources that have been damaged by Nicaragua, as we suggested before, are patrimony of all Costa Ricans and of the world, yet under Costa Rican stewardship. Therefore, Costa Rica suffers a loss in its capacity to guarantee the supply of these resources until they are recovered.

As part of its international obligations, monitoring and reporting the state of environmental assets is more common every day. Signatory countries of the Ramsar convention, among them Nicaragua and Costa Rica, have the duty to present their national reports periodically to the COP. Costa Rica has made six national emissions inventories since 1996 in order to monitor the success of its policies in complying with the UNFCC, among them, its carbon neutrality goals. Further, Costa Rica is one of the eighteen countries that in the latter years has been part of a pilot project sponsored by the World Bank to develop annual green monetary accounts under the WAVES program.

[45] On P. 72.

As the Ministry of the Environment of Costa Rica, Dr. Edgar Gutiérrez, attests (Appendix 7), "The World Bank through the WAVES (Wealth Accounting and Valuation of Ecosystem Services) initiative supported the development of the first accounts in Costa Rica. A Steering Committee was formed to guide this process, with the incorporation of the Ministry of Environment and Energy (MINAE), the Ministry of Finance, the Ministry of National Planning and Economic Policy (MIDEPLAN), the National Institute of Statistics and Censuses (INEC) and the Central Bank of Costa Rica. The Central Bank of Costa Rica is the institution responsible of the technical development of the accounts. In the end of 2016, the Area of Environmental Statistics was created in the Economic Division of the Central Bank. This Area is responsible of the elaboration of the environmental accounts, which will be published and updated each year. […]In 2014 the country formally began construction of the Water and Forest Accounts. Then, in June 2015 began the construction of the Energy Account. The first results of these three environmental accounts were published in the country and in the World Bank in May 2016. Currently, work is being done to strengthen existing accounts and to develop new accounts, such as Ecosystem Services Account and the Environmental Expenditures Accounts. By the end of the year, the first publication of the Environmental Protection Expenditures account will be published with the support of ECLAC. The creation of other environmental accounts is being discussed for upcoming years." (Gutiérrez, August 1, 2017).

Therefore, these damages and their monetary value need to be annualized and their monetary value until recovery needs to be calculated as the present value of an annuity, discounting the loss in value of the asset every year. This is why they need to be estimated similarly to the estimation of the Net Present Value (NPV) of a stream of net social benefits which sums the stream of annual future net social benefits (or losses in this case) in today´s value terms (Brent, 1998). The equation would be[46]:

$$SC_t = \sum_1^t BSE/(1+r)^t;$$

Where

SC = is the social cost at time t;

BSE = is the monetary value of the loss of benefits generated by the effects on the state of conservation of the natural environment and on the quality and quantity of flows of goods and services (selected as a representation of all of those provided by the ecosystem) provided by the natural capital of the HCN area affected, to its initial state of conservation,

r: is the discount rate used for the current value of the flow of ecosystem goods and services,

t: is the time that elapses until the HCN area affected returns to its initial state of conservation or, if not possible, to a state of recovery deemed sufficient.

This is the right way of accounting for these annualized losses, not the one proposed by Payne and Unsworth (2017). A user-friendly application can be found online at: https://financialmentor.com/calculator/present-value-of-annuity-calculator. Our estimates can be checked there.

[46] As presented in equation (7) of our valuation report on P. 49.

The Manual for environmental and economic accounts for forestry published by FAO applies a similar approach to the estimation of forest asset accounts. Specifically regarding the Net Present Value of standing timber it uses the following equations:

$V_t = \sum A_{t,x} v_{t,x}$ for = 1, …, T-1

$$v_{t,x} = \frac{P_t Q_T}{(1+r)^{T-x}}$$

It then describes, "The total value of standing timber, V, is the sum of v , the value per hectare of forestland of age class , weighted by A , the total area in age-class , where T, is the actual cutting age, p t is the stumpage price, qT, is the timber yield at actual cutting age. The value is discounted at a rate, r, by the time remaining until harvest, T." (Lange, 2004).

As Gerardo Barrantes noted when referring to this issue (Appendix 5) , "As for the social cost, it is necessary to establish such quantification at least during the period that the restoration may take, since after that period the ecosystem's functionality is restored and again they bring back the benefits they offered to the population. During this period, it is necessary to compensate the affected population for the loss of benefits, such as the effects on the flow of environmental goods and services provided by the natural capital to the population, as well as the affectations of infrastructure, social services, health, among other damages." Barrantes further notes that "As for the time of restoration, it is necessary to consider the resource that takes most time to be restored, so that the other resources can be restored during that period."

The choice of time period to do this was a conservative 50 years, as we stated in our valuation report, considering the fact that the age of the trees in the damaged area was much older. Dr. Thorne´s report has reinsured our estimation by setting the record straight on the recovery time for the damaged area, by far more than what Dr. Kondolf´s opinion stated (Thorne, 2017). Therefore, we conclude that, contrary to Payne and Unsworth´s position, by annualizing the losses into for 50 years we did not fall into a double counting problem.

F- The choice of a Discount Rate is done to Account for the Recovery of the Ecosystem.

Regarding the accounting for several of the ecosystem services chosen, Nicaragua argues that we made a mistake by not assuming any recovery in the supply of the services through time. This is not the case. One of the reasons for which we carefully justified the choice of the 4% discount rate used in our valuation is because it needs to be representative of the rate at which the ecosystem will recover. Therefore, as can be seen in Figure 12[47] of our valuation report the yearly value of the environmental damage will gradually decrease. This will happen as the ecosystem services recover.

As we said in our explanatory agenda, the decision on the discount rate to choose is based on recent literature regarding the specific rates to use. The TEEB report states that different social rates of discount should be used

[47] On P. 61.

for different scenarios, using a zero discount rate in cases of investments for environmental sustainability and other rates for other cases of public investment (Vardakoulias, 2013).

A lead economist in Synapse Economics, Dr. Liz Stanton, summarized in 2010 the situation regarding the discount rates used, stating that current conventional wisdom calls for a discount rate that is somewhat like the short-term "risk-free" interest rate (3 to 5%) for calculating the worth today of values that will exist sometime within the next 20 or 30 years and slightly lower for longer term horizons (Stanton, 2010). More conservatively, the Obama administration recommended of a 2.5-3 and a 5% discount rate to determine the social cost of carbon for an analysis that stretches hundreds of years into the future (Interagency Working Group on Social Cost of Carbon, United States Government, 2010).

Goulder and Williams (2012) report the implicit discount rates in three influential studies on climate change policies to be in a range between 1.4% and 4.3%. These studies include Nicholas Stern's influential 2007 work "The Economics of Climate Change: The Stern Review". This study recognizes the need to distinguish between financial performance rates and rates used in situations where what matters is the effect over social wellbeing, as is the case of this study. The study reaffirms the difficulties of addressing the subjectivity implied in the definition of social welfare functions. Further, it considers the effect of uncertainty in these estimates, suggesting declining rates in long-term horizons (Goulder & Williams, 2012). This last proposal is used in other reports which restate the lack of consensus on specific rates and suggest the use of declining as a pragmatic approach, citing studies that propose rates of 4% for the first 5 years, 3% from year 6 to year 25, 2% from year 26 to 75, 1% between years 76 and 300 and 0% for the longer term horizons (Cunninghmam, 2009).

England uses a somewhat similar approach for discounting the costs and benefits of social projects, where in the first 30 years they apply a rate of 3.5% and for longer periods a lower rate (Vardakoulias, 2013). In view of these international parameters on the difficulty of defining inflection points where differential rates could be used and of the ongoing international discussion, our study adopts a conservative approach through a slightly higher rate amid the ranges found in the literature and the studies for Crucitas in Costa Rica: 4%. It represents the average of the ranges presented by Stanton (2010) and suggested by the Obama administration for the social cost of carbon. It is also the most conservative rate suggested by Goulder & Williams (2012).

In a meta-analysis of 283 forest disturbance and recovery events, reported in 71 studies, across four tropical regions scientists have estimated that most recovery to 95% recovery take between 100 and 500 years, confirming the position presented by Dr. Thorne´s report. In Central America, 85 events gave a median of 141 years. As we pointe above (Section VIII.B. regarding standing timber value estimates) the study also estimated that recovery rates per year ranged between a median 2.84% relative reforestation per year in cases of large infrequent disturbances to 0.41% relative reforestation per year in cases of climatic changes and human induced disturbances (Cole, et al., 2014). Considering these rates, we see our discount rate as a conservative choice.

VIII. The Methodology proposed by Nicaragua grossly undervalues environmental damage.

Having addressed the concerns posed by Nicaragua´s technical reports, we feel confident that our chosen methodology and application of it is superior to Nicaragua´s two proposals. Their assumptions are ill-founded from the misplaced comparison of environmental damage in the early 1990's in desert like conditions to the many assumptions that are inconsistent with proven facts in this trial. As their assumptions are incorrect, the results of

their calculations also monetarily undervalue the damages caused in Isla Portillos. We must raise two points on their alleged more adequate final calculation yielding a monetary estimate of close to US$30,000.

A- The Replacement Cost Approach is Unfit for this Type of Damage Estimate.

They propose the application of a replacement cost approach based on the dated UNCC standards. In the words of Dr. Dolf de Groot, "as far as I know the literature, and from my own studies, Replacement Cost (at the ecosystem level) is actually the least suitable of all ES-valuation methods as a proxy for the value (welfare effect) of the benefits of ecosystems (and their services) and thus what the welfare effects would be after the loss of an ecosystem, because it is unrelated to the actual benefits (value) provided by the intact ecosystem. The values provided in the 2014-paper are actually based on my publication of 2012 which gives a detailed overview of monetary values found for all main biomes (ecosystem complexes) and for Coastal Wetlands, which I assume are at stake in this dispute. The total value of coastal wetlands, incl. Mangroves, is at least 190.000 US$/ha/year (which is the average of 139 value points and thereby one of the best studied biome-types worldwide). Of these 139 value points, only about 15 were based on RC, most values were Market Prices, Factor Income, and Avoided Damage Costs." (de Groot, July 28, 2017).

B- The Inappropriate Use of Payment for Ecosystem Service Incentive Rates

The questionable choice of alternative methodology in Payne and Unsworth (2017) is aggravated by their choice of monetary value to calculate their "replacement cost". They assume to be using a price paid to private entities to conserve, manage and enhance parcels of land to provide ecosystem services, by choosing the rate reported by the IIED for Payments for Ecosystem Services (PES) in Costa Rica. They assume this to be an appropriate value to multiply by the number of damaged hectares and then they apply the non-annualized version of estimating the present value to a recovery time that they deem appropriate based on the assertions of Dr. Kondolf.

The first problem with their reasoning is assuming that the rates paid by FONAFIFO (National Fund for Forest Finance) are good market indicators. Costa Rica´s PES system is far from being a pure market tradeable permit system. The vast majority of the funds used for PES come from a sales tax levied on fossil fuels (Sánchez & Navarrete, 2017).

Further, these rates are not applied in public protected areas, which are not eligible for FONAFIFO PES. Further, no PES program in the nation is designed for wetlands. Further, not even in the case of forests does this PES program consider all the ecosystem services that should be added in an environmental damage valuation. All these factors would make the rates proposed extremely unreliable as a measure of the monetary value of ecosystem services in Costa Rica and lead to undervaluation.

In the words of FONAFIFO director, Jorge Mario Rodríguez (Appendix 10), "It is important to clarify that this is a mechanism used by the Costa Rican Government to monetarily compensate particular forest owners for their conservation efforts, given the fact that the society at large benefits from a variety of services that impact the protection and the improvement of the environment […] Thus, the owners of these forests bear an unequal burden in relation to other citizens and assume responsibilities that must be recognized, especially when their property is restricted with impediments such as the change of land use provided for in Article 19 of the cited Forest Law. […]

Concerning queries two and three related to the wetlands that make up the zone where the environmental damage caused by Nicaragua took place, we consider of special importance the fact that since its beginning in 1997 the program of payments for environmental services excluded payments for environmental services to areas owned by the Costa Rican Government, managed by the National System of Conservation Areas. This obeys to two reasons, first, since these are government properties, no wood can be harvested by the owner since the legislation covering wild protected areas, independently of the type of management, prevents the use of its resources; secondly, the program of payments for environmental services is an instrument intended to be an incentive for private forest owners and not to benefit the State. In the 20 years of operation of the program, no records can be found that show any payment made to the State or to the National System of Conservation Areas. […]

Lastly, I would like to reiterate that it is incorrect to consider the payment for environmental services established by the National Forestry Financing Fund as a mechanism to indemnify or set a value for the environmental damage. The environmental services have been calculated and established as a positive measure to incentivize forest conservation initiatives, a small retribution that society makes to compensate for the conservation efforts carried out. […]

The environmental damage involves a legally and technically different concept, where we are no longer protecting the forest, but rather we are dealing with human actions that have harmed it and transcend the concept of forest to a more extensive ecosystem, with a series or scale of damages in different elements, biotic or abiotic. The valuation of environmental damage cannot be limited to a small amount such as the payment for the environmental service given over a period of time (usually one year), because it never accounts for the replacement price of the resource or its estimated value. Environmental damage is much more complex; its temporality is greater than a year and repairing it can take decades or may even never be repaired.[…]

For the reasons described above, the rates established for the environmental payments applied by FONAFIFO, cannot, under any circumstance be considered as a bench mark to economically estimate compensation for environmental damage, because as has been ratified by Administrative and Judicial Courts, the value of environmental damage is substantially much higher." (Rodríguez, July 20, 2017).

We believe the above reasoning is solid in demonstrating how Payne and Unsworth provide a very unreliable estimate. The validation of its underestimation, would further damage Costa Rica´s interests setting a precedent in liability in benefit of those executing unlawful actions similar to those undertaken by Nicaragua in Costa Rica´s Isla Portillos.

IX. Conclusion

In support of Costa Rica´s compliance with the term given by the ICJ to address the issue of the methodology for the estimation of the monetary value of the environmental damage caused by Nicaragua in this case, we have presented here a series of legal, policy and judicial precedents in support of the methodological approach used in our report. We have supplemented these precedents with relevant technical information and expert opinions. In summary, we believe to have demonstrated:

1) That the methodology used by Fundación Neotrópica is well recognized internationally including tropical biodiversity rich countries as Costa Rica.

Along these lines, we summarized for better understanding the two stages involved in our study (the definition of a three part methodological framework and its application in seven steps). We then focused on international juridical and economic sources for evidence that validates two of the three components in this framework: the ecosystem service approach and the benefit-transfer estimation technique (BTM), which Payne and Unsworth (2017) portrayed as not robust and recognized enough for use in these types of monetary estimates.

We have provided sufficient evidence that this opinion is ill founded. Juridical precedent and doctrine, as well as economic doctrine evolution point to the fact that the precedents in international practice invoked by Nicaragua (mostly UNCC standards) to justify their contention are old and predate the mainstreaming of the ecosystem services approach especially in relation to biodiversity conservation. More recent CBD COP decisions, the evolution of court decisions in the United States and Europe as well as the authorized opinion of experts in the field (as Dr. Robert Costanza and Dr. Rudolf de Groot) demonstrate that the Ecosystem Services approach used by Fundación Neotrópica is a recognized approach in International practice and not just an “awareness tool”.

Regarding the BTM estimation technique, we have documented not only its ample use. Based on CBD COP decisions, documents, and technical economic literature we have tracked the efforts to improve the applicability of this technique due to its ease of use especially for low and middle-income countries. These sources recognize that the benefit lies in that they may have fewer resources to apply the full range of TVE estimation monetary methods with the timing needed for relevant policy and other types of juridical decisions. The efforts until lately have given a set of criteria to be used in evaluating the different applications of this well-established estimation methodology.

We have also presented literature and provided expert opinion on how different RAMSAR documents recognize the validity of both the ecosystem services framework and BTM, amid the full array of TVE estimation methods, for the assessment of the economic value of ecosystem services and environmental damages. Further, we documented the application of the ecosystem services approach and the BTM methodology in recent legal evolution in tropical biodiversity rich countries like Costa Rica pointing to specific use of the seminal paper by Costanza et al. (1997) in these instances.

2) That the methodology used by Fundación Neotrópica is Consistent with the Common Practice in Costa Rica´s courts and academic circles.

We have documented juridical and economic theoretical evolution in Costa Rica within the framework of progressive legislation and pioneering courts that shows that our methodology is consistent with the common practice in Costa Rica´s courts and academic circles. Here lies the validation of the third component of our methodological framework: the IPS methodology to assess environmental damage. Both the Administrative Environmental Tribunal (TAA) criteria and practice and the protocol with standards for environmental damage valuation from SINAC provide support for our use of this methodology as the most recognized in the country for the purposes it was chosen. This recognition goes beyond the bounds of Costa Rican academic circles. Due to its soundness, the IPS methodology is recognized and applied in different Latin American contexts.

We make a particular note of the current application by the International Center for Economic Sustainable Development Policies (CINPE) at the National University of the BTM methodology for the valuation of seven RAMSAR wetlands in Costa Rica. This study will be a tool for wetland policy implementation in the nation and demonstrates the acceptance of this estimation technique within the highest academic circles of Costa Rica.

3) That the Calculations for the monetary value of the damage were carefully, appropriately and conservatively done.

We addressed the allegations of Payne and Unsworth (2017) and indirectly from Kondolf (2017) on our application of this methodology. Specifically we reiterated the process of selection and the evidence in the proceedings that supported our selection of ecosystem services to value. We conclude that through our selective process we reduced the possibility for redundancy in selection.

We specifically addressed through expert opinion and technical reports their criteria that neither soil erosion/formation nor natural hazard mitigation should be included. Thorne (2017) allowed us to disqualify this opinion, elaborating on the scientific nature of soils in these types of wetlands and the importance of the wetland, given its international recognition and status as a public protected area, protecting itself. Beyond this, we reiterated evidence of the inhabitance in the region and its dependence on this service. Additionally, technical evidence contributed by SINAC highlighted the importance of this service in the Portillos area given the recent natural events of Hurricane Otto.

On the application of the valuation methods chosen, we went over Nicaragua´s doubts and objections in detail relative to the valuations done through direct valuation or revealed preference methodologies (for standing timber and soil formation/erosion prevention). Additionally, we reviewed the choices made regarding the BTM application to the four ecosystem services for which we used it and the criteria that backs them. We conclude that our calculations were appropriate and carefully done within the bounds of the information available. We also conclude that to the extent possible, we reduced the possibility of transfer biases that may affect BTM.

Nicaragua alleged regarding our estimates for all ecosystem services, that by annualizing them as part of our estimates up to 50 years range of recovery time, we are double counting. We have refuted this argument by demonstrating the need to treat them as the Net Present value of an annuity given the environmental reporting commitments of the country. This practice does not constitute double counting but an adequate application of the IPS methodology. Regarding our conservative 50-year horizon for the recovery, Dr. Thorne´s evaluation of Kondolf´s objection provided sufficient scientific evidence to disqualify Nicaragua´s contention. It also reinforced the fact that the components of the ecosystem in the damaged area that would take longer to recover would be the trees which were cut, with average ages which more than double this term.

Regarding the accounting for several of the ecosystem services chosen, Nicaragua argued that we made a mistake by not assuming any recovery in the supply of the services through time. We contend that in the choice of a discount rate to estimate the Net Present Value we do account for the recovery of the ecosystem. We compared this choice with Dr. Thorne´s data on successional stages and tropical forest recovery rates in recent published literature and concluded our choice was adequately conservative.

We finish the methodological analysis by pointing two major inadequacy of Nicaragua´s proposed valuations method. In the first places, it is dated and inadequate, tending to undervalue the damage as attested by the expert opinion of Dr. Rudolf de Groot and the evolution of the literature and juridical standards that we have documented. Of more concern, the choice of a value based on PES payment rates in Costa Rica indicates a lack of understanding on the nature of those rates by Payne and Unsworth (2007) as they are inadequate for the use they give them in this case, not just by their nature. Also, they are simply not applicable in public property Protected Areas.

We asked two experts to write notes evaluating our estimations. We enrolled the help of David Batker from Earth Economics, one of the international NGOs with more experience in the field and a strong believer of monetary ecosystem valuation (Appendix 6). We also asked a peer review from a non-believer in monetary valuation, Dr. Joshua Farley from the University of Vermont (Appendix 11). Both of them concluded that our report had an appropriate methodological application. We submit their considerations to the ICJ as part of this report for its consideration.

In closing, we reiterate that we feel confident that our chosen methodology and application is superior to Nicaragua´s two proposals. Therefore, we reiterate our estimation of US$2,880,745.82.

X. References

Aguilar González, B. & Segura Bonilla, O., 2016. *Estado del Arte en Metodologías de Valoración de los Servicios Ecosistémicos y el Daño Ambiental,* Heredia, Costa Rica: CINPE, UNA.

Aguilar-González, B., Carranza-Vargas, M., Hidalgo-Chaverri, M. & Fernández-Sánchez, A., 2016. *Monetary valuation of the environmental damage arising from the construction of artificial caños and clearing of trees and vegetation performed by the Government of Nicaragua in Isla Portillos, Humedal Caribe Noreste, Costa Rica,* San José, Costa Rica: Fundaci{on Neotrópica.

Aguilar-González, B., November 18, 2016. *Explanatory addenda to the Report "Monetary valuation of the environmental damages arising from the construction of artificial caños and clearing of trees and vegetation in Isla Portillos, Humedal Caribe Noreste, Costa Rica, in conformity...,* San José, Costa Rica: Fundación Neotrópica.

Araya, M. & Mena, O., 2013. *Informe de Gira. ACTo-GMRN-EPMF-364-2013,* s.l.: Área de Conservación Tortuguero.

Arguedas, M., 2015. *Valoración económica de servicios ecosistémicos brindados por el manglar del Golfo de Nicoya, Costa Rica,* Turrialba, Costa Rica: Tesis sometida a consideración de la División de Educación y el Programa de Posgrado como requisito para optar por el grado de Magister Scientiae en Socioeconomía Ambiental, CATIE.

Barrantes, G. & Di Mare, M., 2001. *Metodología para la evaluación económica de daños ambientales en Costa Rica,* Heredia, Costa Rica: IPS.

Batker, D., July 28, 2017. *Note to Vice Minister of Foreign Affairs, Alejandro Solano Ortiz, RE: International Court of Justice Case...,* Tacoma, Washington, USA: Earth Economics.

Brent, J., 1998. *Cost-Benefit Analysis for Developing Countries.* Cheltenham, UK: Edward Elgar.

Castañón del Valle, M., 2006. *Valoración del Daño Ambiental,* México DF, México: PNUMA, Oficina Regional para América Latina y el Caribe.

Cole, L., Bhagwat, S. & Willis, K., 2014. Recovery and resilience of tropical forests after disturbance. *Nature Communications,* p. DOI: 10.1038/ncomms4906.

Costanza, R. et al., 1997. The value of the world's ecosystem services and natural capital. *Nature,* Volume 387, pp. 253-260.

Costanza, R. et al., 2014. Changes in the global value of ecosystem services. *Global Environmental Change,* Volume 26, pp. 152-158.

Costanza, R., July 26, 2017. *Letter to the Vice-minister of Foreign Affairs and Worship Republic of Costa Rica,* Canberra, Australia: s.n.

Cunnighmam, R., 2009. *Discount Rates for Environmental Benefits Occurring in the Far-Distant Future,* www.iearesearch.com: Independent Economic Advisers.

de Groot, R., July 28, 2017. *Letter to Alejandro Solano Ortiz, Deputy Minister of Foreign Affairs,* Wageninges, The Netherlands: s.n.

de Groot, R., Stuip, M., Finlayson, M. & Davidson, N., 2006. *Valuing wetlands: Guidance for valuing the benefits derived from wetland ecosystem services,* Gland, Switzerland: RAMSAR Convention Secretariat.

Dixon, J., Scura, L., Carpenter, R. & Sherman, P., 1994. *Economic Analysis of Environmental Impacts.* 2nd ed. London: Earthscan.

Farley, J., August 1, 2017. *Note to respond to a request by Costa Rica's Deputy Minister of Foreign Affairs, Alejandro Solano Ortiz,* Burlington, Vermot: The University of Vermont.

González, R. & Peña, M., 2015. *El Proceso Ambiental en Costa Rica.* 1era. ed. San José, Costa Rica: ISOLMA.

Goulder, L. & Williams, R., 2012. *The Choice of Discount Rate for Climate Change Policy Evaluation,* Washington D.C.: Resources for the Future.

Gutiérrez, E., August 1, 2017. *Note DM-725-2017 to Minister of Foreign Affairs Manuel González Sanz,* San José, Costa Rica: MINAE.

Ibrahim, M., July 21, 2017. *Note DG-368/2017,* Turrialba, Costa Rica: CATIE.

Interagency Working Group on Social Cost of Carbon, United States Government, 2010. *Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866,* Washington, DC., EEUU: Interagency Working Group on Social Cost of Carbon, United States Government.

Jones, C. & DiPinto, L., 2017. The role of ecosystem services in USA natural resource liability litigation. *Ecosystem Services,* Volume In Press, p. https://doi.org/10.1016/j.ecoser.2017.03.015.

Jones, C., Pendergrass, J., Broderick, J. & Phelps, J., 2015. Tropical Conservation and liability for Environmental harm. *Environmental Law Reporter,* 45(11), pp. 11032-11050.

Kondolf, G., 2017. *Review of Costa Rica's Claims for Compensation in the Río San Juan Delta,* Berkeley, California, USA: s.n.

Lange, G., 2004. *Manual for environmental and economic accounts for forestry: a tool for cross-sectoral policy analysis,* Rome, Italy: FAO Forestry Department.

Liu, S., Costanza, R., Farber, S. & Troy, A., 2010. Valuing Ecosystem Services. Theory, Practice, and the Need for a Transdisciplinary Synthesis. *Annals of the New York Academy of Sciences,* Issue 1185, pp. 54-78.

Markandya, A., 2016. *Cost benefit analysis and the environment: How to best cover impacts on biodiversity and ecosystem services,* Paris, France: OECD Publishing.

MINAE-Tribunal Ambiental Administrativo, 2014. *Manual de Indicadores para la valoración económica de daños ambientales en recursos marino costeros ,* San José, Costa ica: PRETOMA-TNC.

Monge, A., Jiménez, M. & Bonila, S., 2013. *Estudios científico-técnicos de la Isla Calero, Machuca y Portillos para considerar su cambio de categoría de manejo,* Pococí, Limón, Costa ica: Área de Conservación Tortuguero, SINAC, MINAE.

Montero-Bustabad, D., 2012. Plazos de Prescripción de las Obligaciones Patrimoniales Surgidas del Daño Ambiental. *Revista de Ciencias Jurídicas,* Issue 129, pp. 67-91.

Moreno, M., 2005. *La valoración económica de los servicios que brinda la biodiversidad: la experiencia de Costa Rica.* [Online]
Available at: http://www.inbio.ac.cr/otus/pdf/valoracion-economica-biodiversidad-cr.pdf

Moreno, M. & Segura, O., July 20, 2017. *UNA-CINPE-DI-OFIC-048-2017 Note,* Lagunillas de Heredia, Costa Rica: UNA-CINPE.

Pascual, U. et al., 2010. The economics of valuing ecosystem services and biodiversity. In: P. Kumar, ed. *The Economics Of Ecosystems And Biodiversity: The Ecological And Economic Foundations.* Londo & Washington DC: Earthscan, pp. 182-156.

Payne, C. & Unsworth, R., 2017. *Report on Environmental Damage Valuation,* New Brunswick, New Jersey - Cambridge, Massachussetts: Unpublished technical report.

Ramsar Secretariat, 2010. *Ramsar Advisory Mission Report N. 69: North-eastern Caribbean Wetland of International Importance (Humedal Caribe Noreste), Costa Rica,* Gland, Suiza: Ramsar Convention Secretariat.

Rivera, L., July 31, 2017. *Note ACTo-GMRN-EPMF--2017. Some observations on the effects caused by Hurricane Otto in the areas within the Tortuguero Conservation Area,* Jiménez, Pococí, Limón, Costa Rica: Area de Conservación Tortuguero, SINAC.

Rodríguez, J., July 20, 2017. *Note DG-OF-174-2017 ,* San José, Costa Rica: FONAFIFO-MINAE.

Sánchez, I., 2009. Deficiencias jurisprudenciales del Tribunal Ambiental Administrativo en la aplicación de normativa y metodologías para la valoración del costo social producto del daño ambiental. *Rhombus-Derecho,* Issue 1, p. http://www.ulacit.ac.cr/files/careers/51_snchezherrera.pdf.

Sánchez, o. & Navarrete, G., 2017. La experiencia de Costa Rica en el pago por servicios ambientales: 20 años de lecciones aprendidas. *Revista de Ciencias Ambientales,* 51(2), pp. 195-214.

SINAC, 2014. *Protocolo Valoración económica del daño ambiental,* San José, Costa Rica: Sistema Nacional de Areas de Conservación.

Solano, R., July 28, 2017. *Note 754-17-TAA,* San José, Costa Rica: Vicepresident A.I., Environmental Administrative Tribunal.

Stanton, L., 2010. *Public Goods: The economics of climate, equity and shared prosperity. The future now for a Fraction of the cost!.* [Online]
Available at: https://lizstanton.wordpress.com/2010/03/30/the-future-now-for-a-fraction-of-the-cost/
[Accessed 1 octubre 2016].

Thorne, C., 2017. *Review of the report by G. M. Kondolf PhD (Annex 2) in Counter-Memorial of the Republic of Nicaragua on Compensation,* Nottigham, UK: s.n.

Vardakoulias, O., 2013. *Discounting and Time Preferences,* Reino Unido: New Economics Foundation.

Vega, E., 2004. *Evaluación Económica del daño ambiental causado por los incendios forestales en Costa Rica,* San José, Costa Rica: IPS.

Appendix 1: Note from Dr. Robert Costanza

Australian National University

CRAWFORD SCHOOL OF PUBLIC POLICY

July 26, 2017

Vice-minister of Foreign Affairs and Worship
Republic of Costa Rica

Dear Vice-Minister

This letter is to clear up a few misrepresentations and errors concerning my research contained in the report by Cymie R. Payne & Robert E. Unsworth, on Environmental Damage Valuation dated 26 May 2017 in the "Case Concerning Certain Activities Carried Out by Nicaragua in the Border Area Compensation Costa Rica v. Nicaragua."

The authors state that "Costanza et al. (2014), which provides an update to the 1997 paper upon which Neotropica relies, does not include damage valuation as one of the applications they claim this approach addresses." (pp. 18-19). Table 1 in Costanza et al. (2014), to which this comment refers, lists "some of the potential uses of ecosystem services valuation" (pp 154). It recognizes that this is not a comprehensive list and does not explicitly exclude damage valuation as one of the applications. Damage valuation can be thought of as one type of 'policy analysis', which is included in the list.

The authors also state that "This framework, and the Costanza et al. study in particular, has been widely criticized and rejected by mainstream economics as inconsistent with sound economic principles and practices." In this case, the authors were referring to our path-breaking and seminal paper: "Costanza, R., R. dArge, R. deGroot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. Oneill, J. Paruelo, R. G. Raskin, P. Sutton, and M. vandenBelt. 1997. "The value of the world's ecosystem services and natural capital." *Nature* 387:253-260." They note some of the early critiques of the paper, all of which have been refuted as either wrong or simple misinterpretations of our results (see e.g. Costanza et al. 2014). The 1997 paper has subsequently been cited over 17,000 times in Google Scholar and is the second most highly cited paper in the ecology/environment area according to the ISI Web of Science. It helped to start a huge increase in scientific research on ecosystem services, with more than 3,000 articles per year currently being published on this topic. It also helped to spur additional projects and institutions including the Millennium Ecosystem Assessment, The Economics of Ecosystems and Biodiversity (TEEB), TruCost, the Ecosystem Services Partnership (ESP), The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the EU Biodiversity Strategy to 2020, and many others. All of this attests to the fact that the ecosystem services approach is now 'mainstream' and widely accepted.

Valuation of environmental damages will always be difficult and there will always be issues and controversy about the details. This is to be expected due to the complex nature of these systems and the services they provide. However, the ecosystem services approach has become an important and credible way of understanding and assessing these services and damages to them.

Sincerely

Robert Costanza

Prof. Robert Costanza
Chair in Public Policy, Crawford School of Public Policy, Australian National University, 132, Lennox Crossing, Canberra ACT 0200, Australia

Appendix 2: Note from Dr. Rudolf de Groot

WAGENINGEN UNIVERSITY
WAGENINGEN UR

For quality of life

P.O. Box 47 | 6700 AA Wageningen | The Netherlands

To: Alejandro Solano Ortiz
Deputy Minister of Foreign Affairs

RE: your letter of July 17th regarding the compensation claim against Nicaragua for environmental damages to Costa Rican wetlands

Dear Mr Ortiz,

Thank you for your letter of July 17th . I understand there are two main issues at stake: 1) Nicaragua's Technical team claims that only the Replacement Cost (RC)-method is appropriate to calculate the economic (monetary) costs of the loss of the Costa Rican wetlands and 2) that the paper I published in 2014 (with Robert Costanza as first author) implies that the ES-approach is not robust enough for calculating the costs of ecosystem loss because we "...do not include ecosystem loss valuation as a use of ecosystem service valuation".

Both statements are quite inaccurate, and actually wrong:

1) Regarding the first point: as far as I know the literature, and from my own studies, Replacement Cost (at the ecosystem level) is actually the least suitable of all ES-valuation methods as a proxy for the value (welfare effect) of the benefits of ecosystems (and their services) and thus what the welfare effects would be after the loss of an ecosystem, because it is unrelated to the actual benefits (value) provided by the intact ecosystem. The values provided in the 2014-paper are actually based on my publication of 2012 which gives a detailed overview of monetary values found for all main biomes (ecosystem complexes) and for Coastal Wetlands, which I assume are at stake in this dispute. The total value of coastal wetlands, incl. Mangroves, is at least 190.000 US$/ha/year (which is the average of 139 value points and thereby one of the best studied biome-types worldwide). Of these 139 value points, only about 15 were based on RC, most values were Market Prices, Factor Income, and Avoided Damage Costs.

2) Regarding the statement that we did "..not include ecosystem loss valuation as a use of ecosystem service valuation", and therefore the "ES-approach is not robust enough for calculating the costs of ecosystem loss" , I am not sure I fully understand the logic behind this statement. In any case, we DID include "ecosystem loss valuation" in our calculations of the Total Economic Value (TEV) of intact ecosystems, eg. (avoided) damage costs (AC) is quite an important and accepted valuation method (it highlights the free services provided by nature, especially the regulating services (such as water purification, erosion prevention, pollination, C-sequestration and many others) and what it would cost society in the absence of these services which often leads to huge damage costs (health, erosion, crop-loss, climate change etc).

Environmental Sciences Group,
Environmental Systems Analysis

DATE
July 28, 2017

SUBJECT

OUR REFERENCE

POSTAL ADDRESS
P.O. Box 47
6700 AA Wageningen
The Netherlands

VISITORS' ADDRESS
Wageningen Campus
Building 100
Droevendaalsesteeg 3a
6708 PB Wageningen

INTERNET
www.wageningenuniversity.nl

CoC NUMBER

HANDLED BY
Dolf de Groot

TELEPHONE
+ 00 31 (0)317 48 22 47

FAX
+00 31 (0)317 41 90 00

EMAIL
dolf.degroot@wur.nl

DATE
May 31, 2013

OUR REFERENCE
20130531/DG/mw

PAGE
2 of 2

Regarding the robustness of ES valuation studies, i.e. TEV-studies: because of the complexity of ecosystems (as providers of ES = the supply-side) and human society (as users of the ES = the demand side) any TEV-calculation is very time and context dependent and therefore subject to much uncertainty. All we wanted to emphasise in the 2014 paper with the "awareness-statement" is that monetary values provided in our papers, and those of others, should be used with care and ideally new, empirical work should be done in any given decision making situation. However, such original ES-valuation studies take much time, money and resources which is often not available and so-called benefit-transfer studies are in such situations the only option. With the rapidly growing number of ecosystem service valuation studies, and databases (such as provided by the Ecosystem Services Partnership (www.es-partnership.org) , the robustness of these benefit transfer studies also increases rapidly and I am confident that the value provided by proper benefit transfer studies of ecosystem services values is probably much closer (more robust) to the true welfare effect than the calculations (estimates) provided by the proponents of the alternative use (e.g. a dam, shrimp farm or coastal recreational development) which is based on market values and –predictions that can change rapidly with the political and economic 'wind' and which by definition exclude most externalities.

I hope this is helpful and I wish you much success with this case and would appreciate if you could keep me informed about the outcome.

Yours sincerely,

Dr Rudolf de Groot
Associate Professor
Environmental Systems Analysis Group
And Chair Ecosystem Services Partnership (www.es-partnership.org)

PS: I provided the 2012-study + the supplement that contains much detailed information on the monetary value of ecosystem services of all major biomes to Dr. Aguilar-Gonzalez

Appendix 3: Note from Dr. Mary Luz Moreno & Dr. Olman Segura

UNA
UNIVERSIDAD NACIONAL
COSTA RICA

CINPE
CENTRO INTERNACIONAL DE POLÍTICA ECONÓMICA
PARA EL DESARROLLO SOSTENIBLE

20 de julio de 2017
UNA-CINPE-DI-OFIC-048-2017

Señor
Alejandro Solano Ortiz, Vicecanciller
Ministerio de Relaciones Exteriores y Culto
San José, Costa Rica.

Estimado señor:

De acuerdo con su solicitud DVM-137-2017 los suscritos, doctora Mary Luz Moreno Díaz y doctor Olman Segura Bonilla, economistas debidamente inscritos en el Colegio de Ciencias Económicas de Costa Rica, profesores investigadores, especialistas en el área de economía de recursos naturales y economía ecológica, que laboramos en el Centro Internacional de Política Económica para el Desarrollo Sostenible (CINPE) de la Universidad Nacional, damos fé y expresamos lo siguiente:

Hemos analizado a profundidad los referentes teóricos sobre metodologías de valoración económica de servicios ambientales y valoración del daño de servicios ecosistémicos en Costa Rica, así como hemos aplicado diversas de estas metodologías a nivel nacional e internacional. Entre las distintas metodologías de valoración del daños ambientales que hemos encontrado y que se han incluido en estudios tales como "La Valoración económica de los servicios que brinda la biodiversidad: la experiencia de Costa Rica" de la Dra. Moreno para el Instituto Nacional de Biodiversidad (INBio) 2005, y en el "Estado del Arte en Metodologías de Valoración de los Servicios Ecosistémicos y el Daño Ambiental" de coautoría del Dr. Segura en el 2016, el método del Instituto de Políticas de Sostenibilidad (IPS) es el más empleado en Costa Rica.

El IPS realizó originalmente dicha metodología para el Sistema Nacional de Áreas de Conservación (SINAC) del Ministerio de Ambiente y Energía (MINAE) de Costa Rica, desde el 2001.

Por otro lado, en el CINPE-UNA estamos actualmente realizando una investigación sobre "Valoración de los Servicios Ecosistémicos de Siete Humedales Ramsar de Costa Rica" para el SINAC-MINAE. Para lo cual estamos utilizando la metodología internacionalmente reconocida como transferencia de valor. La transferencia de beneficios o conocida como transferencia de valor es generalmente usada cuando existen restricciones

1

presupuestarias y/o hay poco tiempo disponible para conducir un estudio original pormenorizado y se necesita la medida de los beneficios.

Cabe indicar que a esta altura del estudio no podemos adelantar los valores calculados de los servicios ecosistémicos de los diferentes humedales, dado que las cifras con que contamos son preliminares y todavía estamos en el proceso de calibración y ajuste de los datos. Nuestro compromiso es entregar el estudio de valoración a finales del mes de agosto del 2017. Los resultados obtenidos en este estudio, servirán como insumo para facilitar la implementación de varias medidas de política como lo es la política nacional de humedales.

Atentamente,

Mary Luz Moreno Díaz, Ph.D.

Olman Segura Bonilla, Ph.D.

UNA
National University
Costa Rica

CINPE
International Center of Economic Policy for
Sustainable Development

20 July 2017
UNA-CINPE-DI-OFIC-048-2017

Mr.
Alejandro Solano Ortiz, Vice-Minister
Ministry of Foreign Affairs and Worship
San José, Costa Rica.

Dear Sir:

As per your request through note DVM-137-2017, the undersigned, Dr. Mary Luz Moreno Díaz and Dr. Olman Segura Bonilla, both economists duly registered at the Professional Association of Economic Sciences, professors and researchers especialized in the field of economy of natural resources and ecologial economy, staff members at the International Center of Economic Policy for Sustainable Development (CINPE) of the Universidad Nacional, attest and express the following:

We have analyzed in depth the theoretical references on methodologies of economic valuation of environmental services and valuation of the damage of ecosystem services in Costa Rica, and have applied several of these methodologies at national and international level. Among the different methodologies used to value environmental damage that we have found and that have been used in Works such as "*La Valoraciòn económica de los servicios que brinda la biodiversidad: la experiencia de Costa Rica* (Economic Valuation of Services provided by Biodiversity: The Costa Rican Experience) written by Dr. Moreno for the *Instituto Nacional de Biodiversidad*, 2005 (INBio-National Biodiversity Institute) and the *Estado del Arte en Metodologías de Valoración de los Servicios Ecosistémicos y el Daño Ambiental* (State of the Art in Valuation Methodologies of Eco-Systemic Services and Environmental Damage) co-authored by Dr. Segura in 2016, the methodology of the *Instituto de Polìticas de Sostenibilidad*, IPS (Institute of Sustainability Policy) is the most used in Costa Rica.

In 2001, IPS created this methodology originally for the *Sistema Nacional de Áreas de Conservación* (National System of Conservation Areas) under the Costa Rican Ministry of the Environment and Energy (MINAE)

On the other hand, we are presently working on a research Project on the "*Valoración de los Servcios Ecosistémicos de siete humedales Ramsar de Costa*

Rica (Valuation of the Eco-Systemic Services of Seven Ramsar Wetlands of Costa Rica) for the SINAC-MINAE. To do this, we are using the internationally known methodology referred to as *value transfer*. The transfer of benefits better known as *value transfer* is generally used when there are budget limitations and/or time is limited to carry out a detailed study and what is needed is a measure of benefits.

It should be noted that at this point in the study we cannot advance the calculated values of the ecosystem services of the different wetlands, given that the figures we have are preliminary and we are still in the process of calibration and adjustment of the data. Our commitment is to deliver the valuation study by the end of August 2017. The results obtained in this study will serve as input to facilitate the implementation of various policy measures such as the national wetland policy.

Cordially,

Mary Luz Moreno Díaz, Ph.D. Olman Segura Bonilla, Ph.D.

Appendix 4: Notes from Administrative Environmental Tribunal

TRIBUNAL AMBIENTAL ADMINISTRATIVO

minae

San José, 18 de julio, 2017
722-17-TAA

Sr. Lic. Arnoldo Brenes Castro
Coordinador de Litigios Internacionales
Ministerio de Relaciones Exteriores
S.O.

Estimado señor,

Por este medio le saludo respetuosamente y me permito darle respuesta a su Oficio 07-AM-2017.

En relación con su solicitud de brindarles estadísticas respecto al uso de la metodología IPS para la Valoración Económica de Daño Ambiental hecho por MINAE en los últimos dos años, me permito informarle que hemos tomado en cuenta para el levantamiento de estas estadísticas los expedientes administrativos que han sido debidamente finalizados en este Judicatura entre los años 2015 y 2016, sea a través del dictado de Acto Final o de la Homologación de Acuerdos Conciliatorios.

De este análisis tenemos que son varias las metodologías aplicadas por el SINAC en la elaboración de la Valoración Económica del Daño Ambiental (VEDA), a saber: IPS, VALCA, ACOPAC y otras. En el caso que nos ocupa y en aras de responder la consulta realizada por su persona, se puede indicar que de los expedientes finalizados en el Tribunal Ambiental Administrativo en los años supra indicados, la Metodología IPS fue la que mayoritariamente se utilizó en el establecimiento de la Valoración Económica del Daño Ambiental, con un 34 % entre los otros tipos de valoración usados. Cabe indicar que la Valoración Económica de Daño Ambiental es un insumo técnico muy importante a tomar en cuenta en la resolución de los expedientes que se tramitan en esta instancia.

TELEFONO 2253-7130 TELEFAX 2253- 7126
San José, San Pedro de Montes de Oca, 200 metros sur y 150 metros oeste del Automercado Los Yoses, frente a la Soda El Balcón.

TRIBUNAL AMBIENTAL ADMINISTRATIVO

minae

Para poder brindar más información relacionada a las Metodologías de Valoración Económica de Daño Ambiental utilizados por el Sistema Nacional de Áreas de Conservación (SINAC), le adjunto los Oficios SINAC-SE-PPC-183-2017 de fecha 3 de julio del 2017 suscrito por Juan Carlos Villegas Arguedas, en su condición de Jefe a.i. de Prevención, Protección y Control , Oficio SINAC-DE-1156 de fecha 23 de mayo del 2014 suscrito por Rafael Gutiérrez Rojas, en su condición de Director Ejecutivo, así como el Protocolo de Valoración Económica del Daño Ambiental 2014, elaborado por el Sistema Nacional de Área de Conservación.

Quedo a sus órdenes para cualquier consulta adicional,

Sin otro particular se suscribe,

Licda. Maricé Navarro Montoya
Vice-Presidente
Tribunal Ambiental Administrativo

MINISTERIO DE AMBIENTE ENERGÍA Y TELECOMUNICACIONES
TRIBUNAL AMBIENTAL ADMINISTRATIVO

C/c. Archivo

TELEFONO 2253-7130 TELEFAX 2253- 7126
San José, San Pedro de Montes de Oca, 200 metros sur y 150 metros oeste del Automercado Los Yoses, frente a la Soda El Balcón.

Administrative Environmental Tribunal **Ministry of the Environment and Energy**

San José, 18 July 2017
722-17-TAA

Mr. Arnoldo Brenes Castro
Ministry of Foreign Affairs
S. O.

Dear Sir,

I hereby respectfully greet you while giving response to your note 07-AM-2017.

In relation to your request that we provide statistics on the use of the IPS methodology for Economic Valuation of Environmental Damage carried out by MINAE during the last two years, we have taken into account the administrative records that have been duly finalized by this Tribunal between the years 2015 and 2016, whether through rendering a Final Act or through the Homologation of Conciliatory Agreements.

This analysis yields that there are several methodologies used by SINAC when carrying out Economic Valuation of Environmental Damage (VEDA), namely IPS, VALCA, ACOPAC, and others. In the instant case, and in order to respond to your query, it can be indicated that of the files completed in the Administrative Environmental Tribunal in the years indicated above, the IPS Methodology was the one that was mostly used in the establishment of the Environmental Damage Valuation in relation to the other types of methodologies used. It should be noted that the Economic Valuation of Environmental Damage is a very important technical tool to be taken into account in the resolution of the files that are processed in this instance.

In order to provide more information regarding the methodologies for Economic Valuation of Environmental Damage used by the National Conservation Areas System (SINAC), I am attaching note SINAC-SE-PPC-183-2017 of 3 July 2017, signed by Juan Carlos Villegas Arguedas, as acting Chief of Prevention, Protection and Control, note SINAC–DE-1156 of 23 May 2014 signed by Rafael Gutiérrez Rojas as Excutive Director, and the 2014 Protocol for Economic Valuation of Environmental Damage, prepared by the National Conservation Areas System.

I remain at your service for any additional questions.

Sincerely,

Licda. Maricé Montoya Navarro
Vice-president
Administrative Environmental Tribunal

TRIBUNAL AMBIENTAL ADMINISTRATIVO

minae

San José, 28 de julio, 2017
754-17-TAA

Sr. Lic. Arnoldo Brenes Castro
Ministerio de Relaciones Exteriores
S. O.

Estimado señor,

Por este medio le saludo respetuosamente y me permito aclararle la respuesta dada por este Despacho mediante Oficio 772-17-TAA de fecha 18 de julio del 2017.

Conforme se le indicó en dicho Oficio, para la información brindada se tomó en cuenta los expedientes administrativos que fueron debidamente finalizados en este Judicatura entre los años 2015 y 2016, sea a través del dictado de Acto Final o por Homologación de Acuerdos Conciliatorios.

En este sentido, es importante mencionar que de conformidad con la Directriz SINAC-DE-1156 de 23 de mayo de 2014, las valoraciones de daño ambiental realizadas por el personal del Sistema Nacional de Áreas de Conservación deben realizarse de manera obligatoria aplicando los lineamientos del "Protocolo de Valoración Económica del Daño Ambiental" emitido ese mismo año. De conformidad con este Protocolo, hay cuatro metodologías de valoración económica del daño ambiental (VEDA) que se ajustan a la particularidad de cada caso bajo análisis, a saber:

a) La Metodología de Valoración Económica del Daño Ambiental del Instituto de Políticas Sociales (IPS), que se recomienda para casos donde estén presentes acciones como cambio de uso de suelo, incendios forestales y afectación de humedales, aunque esta metodología se puede aplicar a casi todas las situaciones donde los recursos naturales son afectados;

b) La Metodología de Valoración Económica del Daño Ambiental (ACOSA), que se recomienda para casos de extracción (productos y subproductos), cacería, y trasiego de flora o fauna silvestre;

c) La Metodología de Valoración Económica del Daño Ambiental (ACA-HN), que se recomienda para afectaciones derivadas de corta y aprovechamiento de árboles en terrenos de uso agropecuario y sin bosque, sin bosque ripario, y en áreas de protección con bosque; y

TELEFONO 2253-7130 TELEFAX 2253- 7126
San José, San Pedro de Montes de Oca, 200 metros sur y 150 metros oeste del Automercado Los Yoses, frente a la Soda El Balcón.

TRIBUNAL AMBIENTAL ADMINISTRATIVO

minae

d) La Metodología de Valoración de Daño Ambiental del Área de Conservación Marina Isla del Coco (ACMIC), que se recomienda para casos de afectación de ambientes marinos, específicamente pesca ilegal o ilícitos ambientales en los que se involucren especies marinas.

Aclarado este punto, y en aras de responder la consulta realizada por su persona, mediante Oficio 07-AM-2017, se puede indicar que de los 69 expediente finalizados en el Tribunal Ambiental Administrativo en los años supra indicados, la Metodología IPS fue la que mayoritariamente se utilizó en el establecimiento de la Valoración del Daño Ambiental, con un 34%, en relación con los otros tipos de valoración usados.

Cabe indicar que la Valoración Económica de Daño Ambiental es un insumo técnico muy importante a tomar en cuenta en la resolución de los expedientes que se tramitan en esta instancia.

Quedo a sus órdenes para cualquier consulta adicional.

Sin otro particular se suscribe,

MINISTERIO DE AMBIENTE ENERGÍA Y TELECOMUNICACIONES
TRIBUNAL AMBIENTAL ADMINISTRATIVO

Licda. Ruth Solano Vásquez
Vice-Presidente a.i.
Tribunal Ambiental Administrativo

C/c. Archivo

TELEFONO 2253-7130 TELEFAX 2253- 7126
San José, San Pedro de Montes de Oca, 200 metros sur y 150 metros oeste del Automercado Los Yoses, frente a la Soda El Balcón.

Administrative Environmental Tribunal **Ministry of the Environment and Energy**

San José, 28 July 2017
754-17-TAA

Mr. Arnoldo Brenes Castro
Ministry of Foreign Affairs
S. O.

Dear Sir,

I hereby respectfully greet you while clarifying the response given by this Office through note 772-17-TAA of 18 July 2017.

As indicated in said note, to prepare the information provided we took into account the administrative records that have been duly finalized by this Tribunal between the years 2015 and 2016, whether through rendering a Final Act or through the Homologation of Conciliatory Agreements.

In this sense, it should be mentioned that in accordance with Directive No. SINAC-DE-1156 of 23 May 2014, environmental damage valuation carried out by the personnel of the National System of Conservation Areas must be carried out in a mandatory manner applying the guidelines of the "Protocol of Economic Valuation of Environmental Damage" issued that same year. According to this Protocol, there are four methodologies for economic valuation of environmental damage (VEDA) that are adjusted to the particularity of each case under analysis, namely:

a) The Economic Valuation of Environmental Damage Methodology (IPS), which is recommended for cases such as land use change, forest fires and wetland damage, although this methodology can be applied to almost all situations where natural resources are affected;

b) The Economic Valuation of Environmental Damage Methodology (ACOSA), which is recommended for cases of extraction (products and by-products), hunting, and trafficking of wild flora and fauna;

c) The Economic Valuation of Environmental Damage Methodology (ACA-HN), which is recommended for damage caused by cutting and harvesting of trees in agricultural and non-forest land, without riparian forest, and in forest protection areas; and

d) The Economic Valuation of Environmental Damage Methodology of the Isla del Coco Marine Conservation Area (ACMIC), which is recommended for cases involving damage to marine environments, specifically illegal fishing or illegal actions in which marine species are involved.

With this point clarified, and in order to respond to your request of information made through note 07-AM-2017, it can be indicated that of the 69 files completed in the Administrative Environmental Tribunal in the years indicated above, the IPS Methodology was the one that was mostly used in the establishment of the Environmental Damage Valuation, with 34%, in relation to the other types of

methodologies used. It should be noted that the Economic Valuation of Environmental Damage is a very important technical tool to be taken into account in the resolution of the files that are processed in this instance.

I remain at your service for any additional questions.

Licda. Ruth Solano Vásquez
Vice-president
Administrative Environmental Tribunal

Appendix 5: Note from Gerardo Barrantes-IPS

26 de julio de 2017

Señor
Alejandro Solano Ortiz
Vicecanciller de Relaciones Exteriores y Culto
República de Costa Rica

Estimado Señor:

En atención a la nota DVM-137-2017 donde se me solicita que indique en cuáles países se utiliza o se ha utilizado la metodología del Instituto de Políticas para la Sostenibilidad (IPS) relacionada con la evaluación económica del daño ambiental con el fin de fijar el valor del daño ambiental, le comento:

1. La metodología ha sido aplicada en diversos casos en Costa Rica, tales como los que se enuncian a continuación en los que he tenido la oportunidad de aportar capacidades y que han sido discutidos en instancias judiciales del país:

    a. Evaluación del Daño Ambiental ocasionado por el incendio de Químicos Holanda en la provincia de Limón. Para la Secretaría Técnica Nacional Ambiental (SETENA). Costa Rica. junio - abril, 2008.
    b. Valoración Económica de daño ambiental en el Río Pacuare: Caso Cooperativa Agroindustrial de Palma de Aceite RL (expediente 38-01-TAA). Colaboración de la Fundación Instituto de Políticas para la Sostenibilidad (IPS) al Tribunal Ambiental Administrativo TAA-MINAE - Costa Rica. Abril 2004.
    c. Valoración del daño ambiental ocasionado por las aguas de drenaje del distrito de riego arenal tempisque al parque nacional palo verde. Elaborado por la Comisión para la Valoración del Daño Ambiental del Área de Conservación Arenal Tempisque del Sistema Nacional de Áreas de Conservación. Julio 2003.
    d. Valoración económica del daño ambiental ocasionado por el derrame de vinaza en el Río Bebedero. Participación en la Comisión que se conformó para tal fin. Colaboración del Instituto de Políticas para la Sostenibilidad (IPS) al Área de Conservación Arenal-Tempisque - Costa Rica setiembre 2001- enero 2002.

    Hay que señalar que la metodología de IPS es una de las tres metodologías que han sido oficializadas en Costa Rica por parte de la Procuraduría General de la República (PGR), para ser aplicadas en los casos de daño ambiental, y que en diversos casos el Sistema Nacional de Áreas de Conservación (SINAC) ha venido aplicando con cierta regularidad.

2. La metodología IPS también ha sido aplicada en el Programa de Reparación Ambiental y Social (PRAS) del Ministerio de Ambiente de Ecuador (MAE), en dos casos concretos en los que tuve la oportunidad de aportar mis capacidades:

    a. Evaluación económica del daño ambiental: Caso Oleoductos de Crudos Pesados. Programa de Reparación Ambiental y Social (PRAS). Ministerio de Ambiente del Ecuador. 2011.
    b. Evaluación económica del daño ambiental: Caso de minería ilegal en Ecuador. Programa de Reparación Ambiental y Social (PRAS). Ministerio de Ambiente del Ecuador. 2011.

    La metodología ha servido de base en el PRAS para otros casos de daño ambiental, permitiendo disponer de una herramienta metodológica de evaluación a la institución.

3. También hay que indicar que la metodología de IPS sirvió de base para un caso en Colombia relacionado con la exploración petrolera, aplicándola al caso Evaluación del daño ambiental: Programa Sísmico Clarinero Norte 3D, cuya denuncia fue contra la empresa HOCOL. El caso surgió ante la denuncia de la familia Arismendi y la participación de CORPPORINOQUIA y la Procuraduría General de la República, así como el Ministerio de Ambiente y la Autoridad Nacional de Licencias Ambientales, por lo que la Empresa HOCOL se vio en la responsabilidad de realizar un análisis del daño ambiental que se le atribuye en el proyecto.

Además de la aplicación de la metodología en diversos casos, durante el período 2002 – 2016 IPS ha realizado diversos procesos de capacitación en la región latinoamericana donde han participado gran cantidad de profesionales y funcionarios de diversas disciplinas. Esos procesos de capacitación han estado dirigidos a fortalecer los procesos de gestión y evaluación del daño ambiental. En términos institucionales han recibido capacitación personal técnico del Ministerio Público de Paraguay y también personal técnico del Ministerio Público de Honduras.

En general, la evaluación del daño ambiental implica establecer el estado de conservación de los ecosistemas, antes y después del daño ambiental ocasionado, mediante la aplicación de indicadores de evaluación debidamente ponderados y valorados. La diferencia en el estado de conservación representa la magnitud del daño ambiental ocasionado. Desde el punto de vista económico se consideran dos dimensiones fundamentales del daño, que son el costo de restauración de las condiciones de los ecosistemas afectados y el costo social por los beneficios perdidos debido a la afectación de los ecosistemas.

Con respecto al costo de restauración hay que determinar los recursos a restaurar, la magnitud del daño causado, así como los requerimientos para la restauración y el tiempo que demanda la restauración. En cuanto al tiempo de restauración es necesario considerar aquel recurso que tarda más tiempo para la restauración de modo que los demás recursos puedan ser restaurados en el transcurso de ese período. Dado que una acción específica puede afectar

uno a más recursos naturales a la vez, el costo total debe ser la suma de todos los costos particulares asociados a la restauración de cada recurso afectado.

En cuanto al costo social es necesario establecer dicha cuantificación por lo menos durante el período que tarde la restauración, dado que después de ese período se restablece la funcionalidad de los ecosistemas y nuevamente vuelven a aportar los beneficios que brindaban a la población. Durante ese período es necesario compensar a la población afectada debido a la pérdida de beneficios, tales como las afectaciones al flujo de bienes y servicios ambientales que aporta el capital natural a la población, así como a las afectaciones de infraestructura, servicios sociales, salud, entre otras afectaciones.

Sin más por el momento, me despido de usted cordialmente, quedando en la disposición de aportar en lo que esté a mi alcance y en lo que corresponda.

M.Sc. Gerardo Barrantes Moreno
Maestría en Política Económica con énfasis en Economía Ecológica y Desarrollo Sostenible
Correo Electrónico: gerardo@ips.or.cr
Tel. +506 8303 3226

26 July 2017

Mr. Alejandro Solano Ortiz
Vice-Minister of Foreign Affairs and Worship
Republic of Costa Rica

Dear Sir:

In note DVM-137-2017 you asked me to indicate the countries in which the methodology of the Instituto de Políticas para la Sostenibilidad (Institute of Sustainability Policy, IPS) related to the economic valuation of environmental damage is or has been used to determine a value for environmental damage. Allow me to elaborate:

1. The methodology has been applied in several cases in Costa Rica, such as the ones that I will mention next in which I participated. These cases have been discussed in different judicial processes in the country:

   a. Evaluation of Environmental Damage caused by the fire at *Químicos Holanda* in the province of Limón. The study was commissioned by the *Secretaría Técnica Nacional Ambiental* (SETENA) (National Environmental Technical Secretariat) June-April, 2008.

   b. Economic Valuation of the Environmental Damage to the Pacuare River*: Case Cooperativa Agroindustrial de Palma de Aceite RL (*File 38-01-TAA). The Project was carried out by the *Fundación Instituto de Políticas para la Sostenibilidad (IPS*) (Institute of Sustainabily Policy Foundation) as a collaboration to the Administrative Environmental Tribunal -*MINAE* - Costa Rica, Abril 2004.

   c. Valuation of environmental damage caused by the drainage waters of the Arenal Tempisque Irrigation District to the Palo Verde National Park. This report was carried out by the Commission for the Valuation of Environmental Damage of the Arenal Tempisque Conservation Area of the National System of Conservation Areas. July, 2003.

   d. Economic Valuation of Environmental Damage caused by vinasse drainage in the Bebedero River. I was a member of the Institute of Sustainable Policy (IPS) Project team. The Project was carried out at the request of the Arenal-Tempisque Conservation Area-Costa Rica, September 2001- January 2002.

It should be noted that the IPS methodology is one of the three methodologies that have been formalized in Costa Rica by the Procuraduría General de la República (Attorney General's Office-PGR), to be applied in cases of environmental damage, and that in several cases the National System of Conservation Areas (SINAC) has been applying it with some regularity.

2. The IPS Methodology has also been applied by the *Programa de Reparación Ambiental y Social* (PRAS) Environmental and Social Repair Program of the Ecuadoran Ministry of the Environment (MAE), in two occasions in which I had the opportunity to participate:

    a. Economic valuation of environmental damage: Case of Crude Oil Pipelines. Environmental and Social Repair Program (PRAS). Ministry of Environment of Ecuador. 2011.

    b. Economic valuation of environmental damage: Case of illegal Mining in Ecuador. Environmental and Social Repair Program (PRAS). Ministry of Environment of Ecuador. 2011.

    The PRAS has used the methodology as the basis for other cases of environmental damage, thus making it available to be used as a valuation methodological tool at the institution.

3. It is important to add that the IPS methodology was used as the valuation tool for environmental damage in a case in Colombia related to oil exploitation against the company HOCOL, *Programa Sísmico Clarinero Norte 3D*, (Clarinero Norte 3D Seismic Program.) The case emerged out of a denounce by the Arismendi family and the participation of CORPPORINOQUIA, the General Attorney's Office, the Ministry of the Environment and the National Authority of Environmental Permits. This situation forced HOCOL to carry out an analysis of the environmental damage that was attributed to them.

In addition to the application of the methodology in various cases, during the period 2002 – 2016, IPS has carried out various training programs in the Latin American region where a large number of professionals and officials from various disciplines have participated. These training programs have been aimed at strengthening environmental damage management and valuation. In institutional terms, technical personnel from the Public Prosecutor's Office of Paraguay and also technical personnel of the Public Ministry of Honduras have been trained by the IPS.

In general, the valuation of environmental damage involves establishing the state of conservation of ecosystems, before and after the environmental damage, through the application of properly weighted and valued assessment indicators. The difference in the

conservation status represents the magnitude of the environmental damage caused. From the economic point of view, two fundamental dimensions of damage are considered, namely, the cost of restoring the conditions of the affected ecosystems and the social cost of the benefits lost due to the damage of the ecosystems.

With respect to the cost of restoration, it is necessary to determine the resources to be restored, the magnitude of the damage caused, as well as the requirements for the restoration and the time demanded by the restoration. As for the time of restoration, it is necessary to consider the resource that takes most time to be restored, so that the other resources can be restored during that period. Since a specific action may affect one or more natural resources at a time, the total cost must be the sum of all the particular costs associated with restoring each affected resource.

As for the social cost, it is necessary to establish such quantification at least during the period that the restoration may take, since after that period the ecosystem's functionality is restored and again they bring back the benefits they offered to the population. During this period, it is necessary to compensate the affected population for the loss of benefits, such as the effects on the flow of environmental goods and services provided by the natural capital to the population, as well as the affectations of infrastructure, social services, health, among other damages.

Without further ado, I cordially remain in the best disposition to contribute with anything within my power.

Gerardo Barrantes Moreno M.Sc.
Master's Program in Economic Policy with an Emphasis on Ecological Economy and Sustainable Development
email: *gerardo@ips.or.cr*
Tel. +506 8303 3226

Appendix 6: Note from David Batker-Earth Economics

EARTH ECONOMICS

July 28, 2017

To: H.E. Mr. Alejandro Solano Ortiz,
Vice Minister of Foreign Affairs,
Costa Rica

From: David Batker
President, Earth Economics
Tacoma, Washington, USA

RE: International Court of Justice *Case Concerning Certain Activities Carried Out by Nicaragua in the Border Area Compensation, Costa Rica v. Nicaragua*

Dear Vice Minister Solano Ortiz,

Please find my comments concerning use of ecosystem services valuation (ESV) for the assessment of environmental damages.

Without reference to *Case Concerning Certain Activities Carried Out by Nicaragua in the Border Area Compensation, Costa Rica v. Nicaragua*, currently under consideration at the International Court of Justice, Earth Economics is pleased to provide information regarding our work in ESV and the application of ESV for environmental damage assessments. Appendix A provides detailed examples of this work.

With regard to the specific case and the analysis provided by Neotropica, I find their analysis to be sound and conservative. Neotropica examined only the directly impacted areas, yet the actions sanctioned by the Government of Nicaragua may have altered the entire area's hydrology with the new channels. The fully affected area will likely be larger than simply the direct impact of the cut channels, logged forests, and disturbed wetlands. For example, logging often leads to further tree loss through "wind throw", where neighboring trees are blown over once wind buffering from other trees has been lost.

The analysis conducted by Fundacion Neotropica is standard and best-practice economics utilized worldwide. ESV is a valid approach to assessing environmental damages. Fundacion Neotropica was able to identify six ecosystem services which were damaged and valued, as well as a further eight ecosystem services damaged which were not valued. The eight ecosystem services present but not valued mean that the results represent an underestimation of the full damages. In addition, Neotropica did not calculate damages past 50 years. It may well be that without sufficient restoration, the damages could persist for well beyond 50 years.

eartheconomics.org Taking nature into account

Office 253.539.4801 *Address* 107 N. Tacoma Avenue
Fax 253.539.5054 Tacoma, WA 98403

EARTH ECONOMICS

Neotropica valued six of 14 identified ecosystem services that were damaged. Here are my comments on the six areas valued by Neotropica and the Nicaraguan critique.

Timber: The Nicaraguan Expert Report fully admits that timber was damaged and that this damage has a financial value that should be compensated. The Neotropica value is reasonable. The larger the trees, the more wood fiber is added each year. For example, the trees that were cut would have added substantially larger girth and fiber each year than the trees that were planted to replace them, thus the gross quantity of timber produced will "not catch" up to the original forest within the next 50 years. The Nicaraguan Government's consultants trivialize the timber and do not provide a credible value. Timber is an appreciating asset, adding value every year. It is public property, increasingly required in National Income Accounts to be green accounts assessed on an annual basis. In fact, Costa Rica is one of 18 countries for which the World Bank is developing these accounts through the WAVES program.

Fiber and Energy: The Nicaraguan Expert Report fully admits that raw materials were damaged and that this damage has a financial value that should be compensated. These are renewable resources harvested annually, and the Neotropica approach is a sound approach.

Gas Regulation: The Nicaraguan Expert Report fully admits that carbon sequestration (gas regulation) was damaged and that this damage has a financial value that should be compensated. The membership of the United Nations (UN) and the International Court of Justice (ICJ) have almost a complete overlap with the signatory nations of the Paris Accord for the UN-sponsored Climate Convention. The ICJ cannot be consistent with member nations or international law without recognizing that actions promoting climate change cause environmental damages and that the same nations have recognized a social cost of carbon. The Neotropica approach is correct in estimating the loss of carbon sequestration and recognizing that it is an annual loss.

Natural Hazard Mitigation: I have studied the value of ecosystems for providing hazard mitigation since 1985 and have provided reports for the State of Louisiana and the US Federal Emergency Management Agency (FEMA). FEMA has adopted dollar values per acre that Earth Economics provided in their benefit-cost tool for flood and hurricane damage mitigation for all 50 U.S. states for private and public infrastructure. Earth Economics was twice hired by FEMA to provide BTM values for natural disaster mitigation to FEMA which were adopted into FEMA policy.

Central American nations are particularly and most acutely vulnerable to hurricanes and floods. Both natural disasters are mitigated by the natural ecosystems and features damaged by the Nicaraguan government's actions. The Nicaraguan Expert Report makes an incorrect and misleading claim that the damaged areas provide no natural hazard mitigation. On the contrary, large storms are weakened by all physical barriers. The standard for measuring the hazard

Office 253.539.4801 *Address* 107 N. Tacoma Avenue
Fax 253.539.5054 Tacoma, WA 98403

EARTH ECONOMICS

mitigation value of natural systems is on a per hectare bases, exactly as Neotropica has done. Storm surges (king tides, storm waves, and tsunamis) are weakened by coral reefs, mud flats, mangroves, beaches, standing timber and the sinuosity of the rivers and deltas. The actions of the Nicaraguan government clearly disturbed the systems that provide these benefits, and those benefits were lost. Other studies in Louisiana and Europe show higher dollar values per hectare than the conservative totals that Neotropica provided.

Habitat and Nursery: The Nicaraguan Expert Report fully admits that habitat and nursery areas were damaged and that this damage has a financial value that should be compensated. Yet, they attempt to dismiss most of the value as if it is a stock and not a flow. Habitat and nursery values are an annual flow of value. For example, an estuary provides nursery value and larval fish habitat every year, enabling commercial and subsistence fisheries along the coast. Neotropica has conservatively, and correctly, treated the calculation of future damages for habitat and nursery services as a flow of benefits. It is not a stock of benefits as the Nicaraguan consultants have treated it. Their approach is not valid.

Soil Formation/Erosion Control: Tropical forests create soils and reduce soil erosion. Logged areas are prone to landslides, mass wasting, and erosion. These ecosystem services are clearly present in this case, have a dollar value, and should be included in the damage assessment. Neotropica has approached this problem with the correct methodology and values. The Nicaraguan Expert Report is incorrect, incomplete, and grossly underestimates the damages incurred by Costa Rica.

In addition
The dredging of the channels provides a path for saltwater intrusion farther up the river. By reducing the sinuosity of the river and providing a direct path inland, the channels also conduct storm surge waters further inland, more quickly causing greater flooding. Furthermore, inland saltwater in the event of a large storm will likely kill freshwater vegetation and animal life in the preserve.

The damage was done in a critical habitat area which the people of Costa Rica set aside as a protected area for aesthetic, biological diversity, bequest, and conservation values. Many Costa Ricans were harmed by this illegal invasion and destruction of this national treasure, just as a house invasion and robbery damages the family who has been robbed. This value has not been accounted for and the Court should take into account this significant social damage. Based on my experience with environmental damages, this value alone would be at least as large as or larger than the market and ecosystem service damages estimated by Neotropica.

Overall, the Nicaraguan Expert report advises a paltry fine of $84,294, which would be a travesty of justice if approved. Considering that eight damaged ecosystem services were not valued in the study, that damages beyond the immediately impacted area were not included in the dollar

Office 253.539.4801 *Fax* 253.539.5054 *Address* 107 N. Tacoma Avenue Tacoma, WA 98403

EARTH ECONOMICS

valuation, and that each of the valuations, with the exception of timber, were conservatively calculated, it is clear that the Neotropica value is likely significantly below the true value of damages and should be adopted by the ICJ, if not enlarged, considering the non-market damages that exist but for which no dollar values were calculated.

Over our nearly 20-year history, Earth Economics has worked extensively with ESV. We believe that ESV is an appropriate method for use in both domestic and international litigation to establish the relative magnitude of environmental damage and to estimate compensation. Appendix A includes a list of legal cases, consultations, and various projects that Earth Economics has worked on that reflect the broad acceptance of ESV as an accurate measure of environmental damages. Moreover, these examples illustrate the legal application of ESV in policymaking and decision frameworks.

Sincerely,

David Batker
President

eartheconomics.org Taking nature into account

Office 253.539.4801 *Address* 107 N. Tacoma Avenue
Fax 253.539.5054 Tacoma, WA 98403

EARTH ECONOMICS

Appendix A

Earth Economics is a nonpartisan organization that has applied natural capital asset and ecosystem services valuation methodology as a means for representing the value of nature in the design of policy, funding mechanisms, and management plans. Our framework for valuing ecosystem services has been applied at all geographic scales throughout the U.S. and internationally. Working with leading ecologists, economists and modelers, we serve a large circle of government agencies, policy makers, non-profits, businesses, and multi-lateral organizations with research, reports, presentations, workshops, and investigations.

Legal Cases or Consultations:

- **Environmental Damage Assessment for Legal Cases in Coastal Louisiana, USA (2015-2017):** We worked with the State of Louisiana and with legal firms to value the benefits provided by coastal wetlands in the Gulf of Mexico. Our assessments ranged from coast-wide general assessments to very specific losses on private sites.
- **Environmental Impacts in the Anchicaya River Basin, Colombia (2013-2014):** Within a class action lawsuit, Earth Economics conducted an ecosystem services valuation on the impacts from 500 thousand cubic meters of contaminated sediment released from an unmaintained hydro dam. The valuation mapped all ecosystem service values to legal definitions of impacts within the Colombian framework. The estimated impacts were about U.S. $150 million. The valuation resulted in a court ruling in April 2015 requiring the hydro dam company to compensate the impacted communities. The court is negotiating an award of about $60 million for degradation of fish populations, water supply, mangroves, and crops. (link)
- **Economic-Ecological Aspects of Open Pit Mining and Cyanide Lixiviation in Costa Rica, The Crucitas Mine Case (2011-2012):** This ecosystem services valuation on the impacts of the mining project was financed by the Costa Rican Environment Ministry and carried out by Earth Economics and Fundacion Neotropica. Ecosystem service flows were estimated to be between $670,000 and $11.8 million (2012 USD). A conservative estimate of $4.6 million was used, including restoration costs. The economic impact report was certified by the Supreme Court of Costa Rica and used to justify compensation payments to people affected by the mining activity.
- **Third Environment Court of Chile (2016):** International Conference: Adjudication in Specialized Courts / Conferencia Internacional: Adjudicación en Cortes Especializadas: Earth Economics presented to an international panel of judges, scholars, and professional practitioners working on environmental law. The discussion revolved around the creation

Office 253.539.4801
Fax 253.539.5054
Address 107 N. Tacoma Avenue
Tacoma, WA 98403

EARTH ECONOMICS

of a specialized court and the design of an appropriate functional framework, particularly for incorporating economic and scientific aspects.

- **Webinar on the application of ecosystem services framework in legal cases (2016):** Earth Economics hosted a webinar on February 17th, 2016 to convene economic and legal experts, practitioners, and other authorities in a guided discussion intended to generate useful guidelines and best practices for legal applications of ecosystem services valuation.
- **Earth Justice Workshop (2015):** Earth Economics presented to the Earth Justice team, including practitioners from across the nation, on methodologies for environmental damage valuation.
- **Expert Witness Testimony in the Thurston County Court House (2016-2017):** In the case named 'Shoreline Substantial Development Permit for an Intertidal Geoduck Aquaculture Operation: Permit number/SEPA case number: 201406516 - THURSTON COUNTY Court House', Earth Economics acted as an expert witness to evaluate the impact of commercial intertidal geoduck operations on private tide lands. Earth Economics testimony was within an appeal of the environmental determination (SEPA) by nearby property owners regarding the potential impacts to eelgrass, recreation, aesthetics, and the use of plastics that could be brought upon by the proposed geoduck aquaculture operation. Project number: 2014108800

Other Relevant Projects:

- **Camisea Pipeline Project, Peru (2007):** We believe this to be the first ESV of a fossil fuels pipeline project. EE calculated the financial, ecological, and social impacts and the policy implications of failing to incorporate ESV and an open, participatory process in the natural gas pipeline required in the Camisea Project. The project was a major multilateral infrastructure development project, including a major transnational pipeline originating in the Camisea region and ending at Pisco, a port south of Lima for exportation. This study showed the potential loss of billions of dollars in ecosystem goods and services and severe social and environmental damage and loss of public trust.
- **Panama and Costa Rica-Global Mechanism to Combat Desertification and Land Degradation (2015):** In partnership with Fundación Neotrópica, Earth Economics has estimated the losses in ecosystem services due to land cover changes for areas under Panama and Costa Rica´s national action plan to comply with the United Nations Convention to Combat Desertification for the Global Mechanism of this convention and in coordination with the ministries of the environment of both countries. Specifically, the analysis is informing policy decisions related to the Corregimiento de Cerro Punta in Chiriquí, Panama and the Jesús María Watershed in Costa Rica.

Office 253.539.4801 *Fax* 253.539.5054 *Address* 107 N. Tacoma Avenue Tacoma, WA 98403

EARTH ECONOMICS

- **Ecuadorian Amazon Project with the Pachamama Alliance (2007):** An ecosystem valuation of the Ecuadorian Amazon land currently considered for oil exploration projects. The analysis included the valuation of the land loss from road networks connecting oil drilling and exploration sites.
- **United States, nationwide (2013):** Effective June 2013, FEMA adopted a new policy to include ecosystem service values provided by Earth Economics in their Benefit-Cost Analysis tool, which applies to all hurricane and flood mitigation expenditures by FEMA (about 80% of their mitigation spending). This inclusion helps shift billions of dollars of investment towards more fiscally and ecologically sustainable outcomes. For example, by showing the economic benefits of moving frequently flooded homes out of the floodplain, more people will be removed from harm's way and natural habitat will be restored (link).
- **Mississippi Delta (2010):** Earth Economics' analysis and work in Louisiana (with other groups and local partners such as Louisiana State University) resulted in the Corps' first cost-benefit analysis exemption and application of multi-criteria decision making to include economics, public safety, and wetland restoration. In 2010, EE released the most comprehensive economic valuation of the Mississippi Delta to date, including an economic analysis of three restoration scenarios for the Delta (press coverage examples: Washington Post; LA Times). Currently, Earth Economics is working on a socioeconomic analysis of restoration work in the Delta, specifically measuring ecosystem service benefits of four large diversions totaling $2 billion in investment.
- **Washington State, statewide (2011):** In 2011, Washington State's funding for state parks was in jeopardy. Earth Economics produced factsheets that demonstrated the importance of state natural resource jobs to the Washington State economy in dollar figures. Senators leveraged these factsheets during the 2011 legislative session to help gain overwhelming bipartisan support for the "Discover Pass" $30 per vehicle fee. The Discover Pass created a permanent funding mechanism for Washington State Parks. While other states, such as California, were closing parks in 2011, every one of Washington State's parks remained open.
- **California, Tuolumne County (2013):** EE conducted an economic assessment of the damages to natural capital caused by California's third largest fire on record, the 2013 Rim Fire. After FEMA initially rejected California's application for a Major Disaster Declaration, Governor Jerry Brown included the analysis of impacts to natural capital and ecosystem services that showed significantly greater damage as part of an appeal package sent to FEMA and President Obama for a Major Disaster Declaration. The appeal was granted, providing significant federal disaster assistance to Tuolumne County, San Francisco Public

Office 253.539.4801
Fax 253.539.5054
Address 107 N. Tacoma Avenue
Tacoma, WA 98403

EARTH ECONOMICS

Utilities Commission (SFPUC), the State of California, and affected business and citizens (press coverage example: LA Times).

- **Washington State, Tacoma (2011):** Metro Parks Tacoma hired Earth Economics in 2011 for an Economic Impact Study to value the park system's natural assets, direct and indirect economic impacts, and immense social value. Earth Economics found that park ecosystem services provided as much as $13 million in benefits, while social benefits totaled $18 million per year. These results were used by Metro Parks Tacoma to support a $198 million bond measure for parks in 2014 (for a city of only 200,000 people). The bond measure passed by a 2-1 margin (link).
- **Restoration Return on Investment in Washington State (2014):** Earth Economics conducted a return on investment of the North Wind's Weir Restoration project in the Duwamish River, Washington State. In the report, the environmental benefits provided by the restored transition zone of the lower Duwamish River are considered over time (link).
- **Green/Duwamish Watershed, Washington State (2009-2010):** EE coordinated funding mechanism identification and prioritization for salmon restoration in the Green/Duwamish Watershed in Washington State. As a result, legislation was drafted by King County for a new and innovative kind of special district in WA, called a Watershed Investment District.
- **Nisqually Watershed, Washington State (2014):** EE worked with the Nisqually Tribe in Washington State to identify several funding mechanisms that would generate revenue of approximately $3 million. These resources would be required, in addition to existing sources of funding, to fully implement watershed maintenance and natural asset improvement projects to meet restoration goals of the Nisqually Watershed Recovery Program by 2055.

Office 253.539.4801
Fax 253.539.5054
Address 107 N. Tacoma Avenue
Tacoma, WA 98403

Appendix 7. Note from Minister Edgar Gutiérrez

REPÚBLICA DE COSTA RICA
Ministerio de Ambiente y Energía
Despacho del Ministro

San José, 1 de Agosto del 2017
DM-725-2017

Señor
Manuel González Sanz
Ministro de Relaciones Exteriores y Culto

Estimado señor Ministro,

En el contexto de la documentación que el Ministerio de Relaciones Exteriores y Culto está preparando para presentar a la Corte Internacional de Justicia en relación con el cobro a Nicaragua dentro del caso "Ciertas Actividades de Nicaragua en la Zona Fronteriza", y de conformidad con su solicitud verbal, me complace brindarle información sobre el sistema de Contabilidad del Capital Natural en Costa Rica.

El desarrollo de un sistema para la Contabilidad del Capital Natural (CCN) en Costa Rica se construye utilizando los estándares del Sistema de Cuentas Económicas y Ambientales, aprobado por la Comisión de Estadística de las Naciones Unidas. Las cuentas desarrolladas bajo la CCN permiten cuantificar de manera integrada el valor biofísico y económico de los recursos naturales y su relevancia para la riqueza nacional. También producen una serie de indicadores que analizan el suministro y uso de recursos naturales y su interacción con las diferentes actividades económicas del país. Las cuentas ambientales pretenden trabajar como herramientas para contribuir a los procesos de toma de decisiones y formulación de políticas públicas.

El Marco Central del Sistema de Contabilidad Ambiental-Económica (MC-SCAE) es la norma estadística internacional que se utiliza para la elaboración de las cuentas ambientales en Costa Rica. El MC-SCAE sigue una estructura contable consistente con el Sistema de Cuentas Nacionales (SCN) de 2008. Estas dos normas están directamente alineadas y el SCN es la fuente principal de los conceptos, definiciones y normas contables en las que se basa el SCAE. Las cuentas ambientales son un sistema de contabilidad satelital, generado bajo las bases del SCN.

El Banco Mundial por medio de la iniciativa WAVES (Contabilidad de la Riqueza y Valoración de los Servicios de los Ecosistemas) apoyó el desarrollo de las primeras cuentas ambientales en Costa Rica. Se creó un Comité Directivo para guiar este proceso, con la incorporación del Ministerio de Ambiente y Energía (MINAE), el Ministerio de Hacienda, el Ministerio de Planificación y Política Económica (MIDEPLAN), el Instituto Nacional de Estadística y Censos (INEC) y el Banco Central de Costa Rica (BCCR). El Banco Central de Costa Rica es la institución responsable del desarrollo técnico de las cuentas. En 2014 el país comenzó formalmente la construcción de las cuentas de agua y bosque. Luego, en junio de 2015 comenzó la construcción de la cuenta de energía. Los primeros resultados de estas tres cuentas ambientales se publicaron en el país y en el Banco Mundial en mayo de 2016.

Tel. (506) 2257-5456/2257-0922 ext. 1162 ó 1163 • Fax (506) 2257-0697
Apdo. Postal 10104-1000 San José, Costa Rica
Correo electrónico: ministrominae@minae.go.cr

En noviembre de 2016, se creó la Unidad de Estadísticas Ambientales en la División Económica de BCCR. Esta unidad es responsable de la elaboración de las cuentas ambientales, que serán publicadas y actualizadas anualmente. Actualmente se está trabajando para fortalecer las cuentas existentes y desarrollar nuevas cuentas, como la cuenta de servicios ambientales (CSA) y la cuenta de gastos de protección ambiental (CGPA). Para fines de año, se realizará la primera publicación de la CGPA con el apoyo de la CEPAL. La creación de otras cuentas ambientales se está considerando para los próximos años.

Los primeros resultados de las cuentas pueden consultarse en el siguiente enlace: http://www.bccr.fi.cr/cuentas_ambientales. Los cuadros estadísticos y los documentos de trabajo han sido publicados para acceso público. La información de las Cuentas Ambientales se está utilizando para el diseño de políticas y estrategias para el desarrollo sostenible, en áreas como la gestión de energía y recursos hídricos, monitoreo forestal y servicios, y su interrelación con la economía.

Atentamente,

Dr. Edgar E. Gutiérrez Espeleta
Ministro

MINISTERIO DEL AMBIENTE Y ENERGÍA
COSTA RICA

REPÚBLICA DE COSTA RICA
Ministerio de Ambiente y Energía
Despacho del Ministro

San José, August 1st. 2017
DM-725-2017

Mr
Manuel González Sanz
Minister of Foreign Affairs

Dear Minister González,

In the context of the written pleadings that the Ministry of Foreign Affairs and Worship is preparing to submit to the International Court of Justice related to the compensation claim against Nicaragua in the "Certain Activities Carried Out by Nicaragua in the Border Area" case, and in accordance with your verbal request, I am happy to provide you with some information regarding Costa Rica's system for Natural Capital Accounting.

The development for a system for Natural Capital Accounting (NCA) in Costa Rica is constructed using the standards of the System of Environmental and Economic Accounts, approved by the UN Statistical Commission (UNSC). The accounts developed under the NCA allow quantifying, in an integrated way, the biophysical and economic value of natural resources and their relevance to national wealth. They also produce a series of indicators that analyze the supply and use of natural resources and their interaction with the different economic activities of the country. The environmental accounts aim to work as tools to contribute to decision-making processes and formulation of public policy.

The System of Environmental-Economic Accounting Central Framework (SEEA-CF) is the international statistical standard that is used for the elaboration of the environmental accounts in Costa Rica. The SEEA-CF follows a consistent accounting structure with the System of National Accounts 2008. These two standards are directly aligned, and the SNA is the primary source for the concepts, definitions and accounting standards on which the SEEA is based. The environmental accounts are a satellite accounting system, generated under the foundations of the SNA.

The World Bank through the WAVES (Wealth Accounting and Valuation of Ecosystem Services) initiative supported the development of the first environmental accounts in Costa Rica. A Steering Committee was formed to guide this process, with the incorporation of the Ministry of Environment and Energy (MINAE), the Ministry of Finance, the Ministry of National Planning and Economic Policy (MIDEPLAN), the National Institute of Statistics and Censuses (INEC) and the Central Bank of Costa Rica (BCCR). The Central Bank of Costa Rica is the responsible institution of the technical development of the accounts. In 2014 the country formally began construction of the water and forest accounts. Then, in June 2015 began the construction of the energy account. The first results of these three environmental accounts were published in the country and in the World Bank in May 2016.

Tel. (506) 2257-5456/2257-0922 ext. 1162 ó 1163 • Fax (506) 2257-0697
Apdo. Postal 10104-1000 San José, Costa Rica
Correo electrónico: ministrominae@minae.go.cr

In November 2016, the Environmental Statistics Unit was created in the Economic Division of BCCR. This unit is responsible of the elaboration of the environmental accounts, which will be published and updated on a yearly basis. Currently, work is being done to strengthen existing accounts and to develop new accounts, such as the ecosystem services account (ESA) and the environmental protection expenditure account (EPEA). By the end of the year, the first publication of the EPEA will be published with the support of ECLAC. The creation of other environmental accounts is being discussed for upcoming years.

The first results of the accounts can be consulted in the following link: http://www.bccr.fi.cr/cuentas_ambientales. Statistical tables and working documents are published for public access. The information of the Environmental Accounts is being used for the design of policies and strategies for sustainable development, in areas such as energy and water resources management, forest monitoring and services, and their interrelation with the economy.

Sincerely,

Dr. Edgar E. Gutiérrez Espeleta
Minister of Environment and Energy

MINISTERIO DEL AMBIENTE ENERGIA * COSTA RICA *

Appendix 8: Note from Dr. Muhammad Ibrahim-CATIE

CATIE
Soluciones para el ambiente y desarrollo

21 de julio, 2017
DG-368/2017

Señor
Viceministro de Relaciones Exteriores y Culto
Alejandro Solano Ortiz
Costa Rica

Estimado Señor Viceministro Solano:

Gracias por su atenta comunicación del pasado 17 de julio del presente año, en la cual le solicita al Dr. Miguel Cifuentes, apoyar y convalidar los resultados de la tesis de Magister Scientiae, Valoración económica de servicios ecosistémicos brindados por el manglar del Golfo de Nicoya, Costa Rica, de la colega Maureen Arguedas.

El Dr. Cifuentes en este momento se está recuperando de una cirugía que se le efectuó el día de ayer y no le es posible atender directamente la consulta. Sí he hablado con él y con otros colegas antes de preparar esta respuesta.

Esta investigación de tesis fue conceptualizada, implementada, reportada y aprobada en el contexto del reglamento y los procesos de la Escuela de Postgrado del CATIE, la Escuela de Postgrado más antigua de América Latina en el campo de la agricultura y los recursos naturales. En este contexto, los resultados de la investigación cumplen con estándares académicos internacionales en cuanto a su rigor y validez.

Sin otro particular, quedo a las órdenes, con las muestras de mi mayor consideración.

Muhammad Ibrahim, Ph. D.
Director General

fc: archivo

Sede Central CATIE/CATIE Headquarters
Cartago, Turrialba 30501
Costa Rica
Tel. (506) 2558-2000
www.catie.ac.cr

CATIE
Solutions for Environment and Development

21 July 2017
DG-368/2017

Mr.
Alejandro Solano Ortiz
Vice-Minister of Foreign Affairs and Worship
Costa Rica

Dear Mr. Vice-Minister Solano:

Thank you very much for your kind note dated 17 July of the present year in which you ask Dr. Miguel Cifuentes to support and validate the results of our colleague Maureen Arguedas' Master thesis entitled Economic Valuation of Eco-Systemic Services derived from the Gulf of Nicoya Mangrove.

Dr. Cifuentes is presently recovering from a surgery operation he went through yesterday and is unable to provide an answer. I did talk to him and other colleagues in preparation for this response.

This thesis research was conceptualized, implemented, reported and approved according to the guidelines and processes of CATIE Graduate School which is the oldest Graduate School in Latin America in the agricultural and natural resources fields. The results of the investigation comply with international academic standards concerning its rigor and validity.

Should the need arise, please do not hesitate to contact me.

Muhammad Ibrahim, Ph.D
Director General

Appendix 9: Note from Laura Rivera-SINAC

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
ÁREA DE CONSERVACIÓN TORTUGUERO
DIRECCIÓN DE RECURSOS FORESTALES Y VIDA SILVESTRE
DEPARTAMENTO DE MANEJO FORESTAL

03 de agosto de 2017

ACTo-GMRN-EPMF–2017

Señor
Alejandro Solano Ortiz
Vicecanciller de la República
Ministerio de Relaciones Exteriores y Culto

ASUNTO: Algunas observaciones sobre efectos del huracán Otto causados en zonas afectadas dentro del Área de Conservación Tortuguero.

Estimado Vicecanciller:

A raíz del paso del huracán Otto el pasado 24 de noviembre del 2017sobre el Área de Conservación Tortuguero (ACTo), se contó con la oportunidad de realizar un sobrevuelo a las zonas afectadas el día 26 de noviembre del 2016.

Dentro de varios objetivos para este trabajo, se consideró la observación de afectaciones dejadas por el paso del huracán y además posibles cambios del paisaje en la zona, entre otros. Algunos de los resultados se indican a continuación.

SOBRE LAS AFECTACIONES

En términos generales, la principal afectación a nivel continental fue sufrida por los bosques y humedales ubicados dentro del Refugio de Vida Silvestre Barra del Colorado y el Corredor Fronterizo Costa Rica-Nicaragua. Se pudo determinar la pérdida de cobertura de dosel, tanto en el sector de Cerros Coronel, Puerto Lindo, Laguna Samay y principalmente entre Laguna Agua Dulce, Laguna de Atrás, Isla Portillos y la Desembocadura del Río San Juan; la pérdida de ramas, copas y caída completa de árboles provocaron la apertura completa del dosel del bosque, lo cual generaba un impacto visual muy alto.

Es rescatable que en los sitios donde había cobertura boscosa densa se observó que, si bien se dio caída de árboles, también una buena parte mantuvo al menos su tronco descopado en pie. Al revisar otras zonas afectadas donde la cobertura forestal no existía, se pudo determinar que el efecto de los vientos sobre árboles aislados fue al parecer mayor, pues casi la totalidad estaban tirados en el suelo producto de los vientos. Ello lleva a pensar que la densidad mayor de vegetación puedo haber permitido una "filtración" de las corrientes de aire, generando una menor presión a nivel individual de cada árbol y palma presentes.

Algunas edificaciones se vieron afectadas, principalmente las que se encontraban en zonas abiertas o a orillas de lagunas. Resalta que en la zona de Puerto Lindo se dieron fuertes afectaciones sobre el recurso bosque, pero las casas aledañas o rodeadas por este no mostraron evidencias de afectación.

COSTA RICA
GOBIERNO DE LA REPÚBLICA

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
ÁREA DE CONSERVACIÓN TORTUGUERO
DIRECCIÓN DE RECURSOS FORESTALES Y VIDA SILVESTRE
DEPARTAMENTO DE MANEJO FORESTAL

SOBRE EL CAMBIO DE PAISAJE

Como se mencionó, el recurso forestal fue el mayor perjudicado por los efectos de Otto en la zona del Refugio Barra del Colorado y del Corredor Fronterizo Costa Rica Nicaragua. Definitivamente que la exuberancia y verdor de esta zona cambió en ese momento por un ambiente más desolador, de gran impacto a la vista. Sin embargo y a *grosso modo*, el grado de perturbación mostró una gradiente, pues en las zonas mayormente alejadas de la línea de costa el impacto era menor y conforme había mayor cercanía a la trayectoria del huracán los efectos eran más visibles. Esto hacía pasar de zonas con algunas ramas quebradas y palmas con algunas hojas removidas, a otra donde había mayor cantidad de árboles descopados y palmas con disposición de hojas en un sólo sentido. Hasta llegar a áreas donde el dosel fue eliminado y las palmas fueron inclinadas producto de la fuerza del viento.

CONSIDERACIONES

- El recurso forestal boscoso (incluyendo ecosistemas de humedal) fue el recurso que mayormente se vio afectado por el paso del huracán.
- Lo anterior generó un cambio drástico en el paisaje, con algún grado de disminución entre los sitios cercanos a la trayectoria del huracán respecto de toda el área con evidencias de afectación.
- La mayor cohesión de las áreas boscosas permitió que muchos árboles se mantuvieran en pie a pesar de haber perdido su copa completa. Al contrario de las áreas con cobertura menos densa o ausente donde la mayor parte de árboles sucumbieron a los vientos.
- Puede enumerarse que la presencia de áreas de bosque como una masa compacta permitió la "filtración" de las corrientes de aire, incidiendo positivamente para el recurso en algún grado en la fuerza con que estas afectaron a lo interno del ecosistema. Lo que podría considerarse como un servicio ecosistémico. Como coincidencia, para la celebración 2017 del día mundial de Humedales (02 de febrero), la *Convención Relativa a los Humedales de Importancia Internacional especialmente como Hábitat de Aves Acuáticas* (mejor conocida como Convención Ramsar) publicó su tema anual "Humedales para la Reducción de Riesgo de Desastres". Es decir, hay conocimiento pleno a nivel mundial de este servicio procedente del ecosistema humedal (y bosque, como lo es en este caso).
- Hay evidencia que infraestructura rodeada por áreas de bosque sufrió menor afectación directa que otras en áreas sin presencia de cobertura forestal densa.

Se adjuntan algunas fotografías e imágenes ilustrativas de lo anteriormente reseñado.

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

COSTA RICA
GOBIERNO DE LA REPÚBLICA

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
ÁREA DE CONSERVACIÓN TORTUGUERO
DIRECCIÓN DE RECURSOS FORESTALES Y VIDA SILVESTRE
DEPARTAMENTO DE MANEJO FORESTAL

Foto 1 y 2. Vista parcial de casa a orillas del río San Juan (en finca Aragón) antes y después (encerrada en círculo) del paso del huracán Otto. Nótese que la misma estaba en una zona desprovista de bosque y fue considerablemente afectada.

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

COSTA RICA
GOBIERNO DE LA REPÚBLICA

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
ÁREA DE CONSERVACIÓN TORTUGUERO
DIRECCIÓN DE RECURSOS FORESTALES Y VIDA SILVESTRE
DEPARTAMENTO DE MANEJO FORESTAL

Foto 3 y 4. Casos opuestos sobre afectación del huracán. Mientras que en la foto 3 se dio la pérdida total de la vivienda, en el caso de la foto 4 la vivienda no mostró ninguna afectación (a pesar de haber zonas impactadas que se extienden fuera de la imagen, encerradas en círculos). Nótese la diferencia de cobertura alrededor de cada caso. Ambas fotografías fueron tomadas el mismo día (26 de noviembre, 2016).

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

COSTA RICA
GOBIERNO DE LA REPÚBLICA

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
ÁREA DE CONSERVACIÓN TORTUGUERO
DIRECCIÓN DE RECURSOS FORESTALES Y VIDA SILVESTRE
DEPARTAMENTO DE MANEJO FORESTAL

Foto 5 y 6. Vista parcial de áreas de bosque afectado y viviendas ubicadas dentro del mismo. Nótese que en este caso las viviendas no sufrieron daños a pesar de que en la zona el ecosistema fue fuertemente impactado.

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

COSTA RICA
GOBIERNO DE LA REPÚBLICA

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
ÁREA DE CONSERVACIÓN TORTUGUERO
DIRECCIÓN DE RECURSOS FORESTALES Y VIDA SILVESTRE
DEPARTAMENTO DE MANEJO FORESTAL

Foto 7. Vista parcial de caída masiva de árboles en áreas de potrero. A diferencia de este sector, puede observarse que las áreas alrededor con cobertura boscosa muestran mayoritariamente troncos descopados en pie. Al fondo de lado derecho el río San Juan.

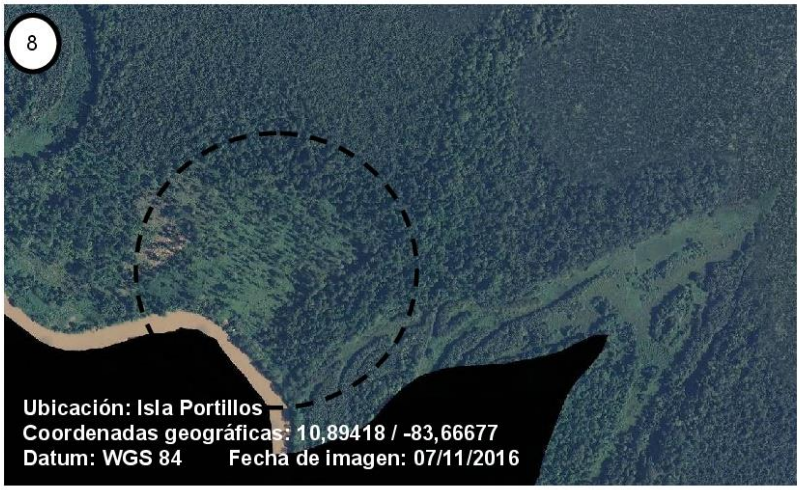


Imagen 8. Vista parcial por medio de imagen aérea de zona relativa a foto 7 previo al paso del huracán.

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

COSTA RICA
GOBIERNO DE LA REPÚBLICA

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
ÁREA DE CONSERVACIÓN TORTUGUERO
DIRECCIÓN DE RECURSOS FORESTALES Y VIDA SILVESTRE
DEPARTAMENTO DE MANEJO FORESTAL

Imagen 9. Vista parcial por medio de imagen satelital de zona relativa a foto 7 posterior al paso del huracán. Nótese como el área con árboles aislados se muestra descubierta por completo, a diferencia de las zonas con bosque, las cuales mantienen una estructura bien diferenciada.

Cordialmente,

Ing. Laura Rivera Quintanilla
DIRECTORA ACTo

LRQ/oficios 2017*31.07.2017.

C: Archivo de Dirección, Área de Conservación Tortuguero.

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

COSTA RICA
GOBIERNO DE LA REPÚBLICA

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
ÁREA DE CONSERVACIÓN TORTUGUERO
DIRECCIÓN DE RECURSOS FORESTALES Y VIDA SILVESTRE
DEPARTAMENTO DE MANEJO FORESTAL

03 de agosto de 2017

ACTo-GMRN-EPMF–2017

Mister
Alejandro Solano Ortiz
Vice-Minister
Ministry of Foreign Affairs and Worship

SUBJECT: Some observations on the effects caused by Hurricane Otto in the areas within the Tortuguero Conservation Area.

Dear Vice-Minister:

Following the passage of Hurricane Otto on 24 November 2017 on the Tortuguero Conservation Area (ACTo), a flyover of the affected areas was conducted on 26 November 2016.

Among the several objectives for this task were included the observation of affectations left by the passage of the hurricane and also possible changes of the landscape in the area, among others. Some of the results are listed below.

REGARDING THE AFFECTATIONS

In general terms, the main continental affectations were suffered by the forests and wetlands located inside the Barra del Colorado Wildlife Refuge and the Costa Rica-Nicaragua Border Corridor. The loss of canopy cover could be determined, both in the area of Cerros Coronel, Puerto Lindo, Laguna Samay and mainly between Laguna Agua Dulce, Laguna de Atrás, Isla Portillos and the mouth of the San Juan River; the loss of branches, tree tops and complete fall of trees caused the full opening of the forest canopy, which generated a very high visual impact.

It worthwhile mentioning that in places where there was dense forest cover it was observed that, although there was fall of trees, a good part also kept at least its truncheon on foot. When reviewing other affected areas where the forest cover did not exist, it was possible to determine that the effect of the wind on isolated trees was apparently greater, because almost all were knocked down by it. This leads to the suggestion that the higher vegetation density may have allowed a "filtering" of the air currents, generating a lower pressure at the individual level of each tree and palm present.

Some buildings were affected, mainly those that were in open zones or on the shores of lagoons. In the zone of Puerto Lindo there were strong affectations on the forest resource, but the houses near forests or surrounded by them did not show evidence of affectation.

COSTA RICA
GOBIERNO DE LA REPÚBLICA

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

REGARDING THE CHANGE IN LANDSCAPE

As mentioned, the forest resource was the most harmed by Otto's effects in the Barra del Colorado Refuge area and the Costa Rica Nicaragua Border Corridor. The exuberance and greenery of this zone definitely changed to a more desolated environment, of great impact to the sight. However, roughly, the degree of disturbance showed a gradient, because in the areas far from the coastline the impact was lower and as there was more proximity to the hurricane's trajectory the effects were more visible. This resulted in a transition from areas with some broken branches and palms with some leaves removed, to others where there were more trees without tops and palms with disposition of leaves in only one direction, until reaching areas where the canopy was removed and the palms were tilted by the force of the wind.

CONSIDERATIONS

• The forest resource (including wetland ecosystems) was the resource most affected by the hurricane.
• This caused a drastic change in the landscape, with some degree of decrease between sites close to the hurricane's trajectory with respect to the entire affected area.
• The greater cohesion of forested areas allowed many trees to remain standing despite losing their full top, unlike areas with less dense or absent coverage where most trees succumbed to the winds.
• It can be stated that the presence of forest areas allowed the "filtration" of air currents, positively protecting the resource to some degree from the force which affected the ecosystem. This could be considered as an ecosystemic service. As a coincidence, for the celebration of World Wetlands Day (02 February), the Convention Concerning Wetlands of International Importance especially as Waterfowl Habitat (better known as the Ramsar Convention) published its annual theme "Wetlands for Risk Reduction Of Disasters."
• There is evidence that infrastructure surrounded by forest areas suffered less direct damage than others in areas with no dense forest cover.

Some photographs and images that illustrate the above are attached.

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
ÁREA DE CONSERVACIÓN TORTUGUERO
DIRECCIÓN DE RECURSOS FORESTALES Y VIDA SILVESTRE
DEPARTAMENTO DE MANEJO FORESTAL

Photos 1 and 2. Partial view of house next to the shore of the San Juan River (in Finca Aragón) before and after (within the circle) the passing of Hurricane Otto. It can be noted that is located in an area without forest and that it was considerably damaged.

COSTA RICA
GOBIERNO DE LA REPÚBLICA

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
ÁREA DE CONSERVACIÓN TORTUGUERO
DIRECCIÓN DE RECURSOS FORESTALES Y VIDA SILVESTRE
DEPARTAMENTO DE MANEJO FORESTAL

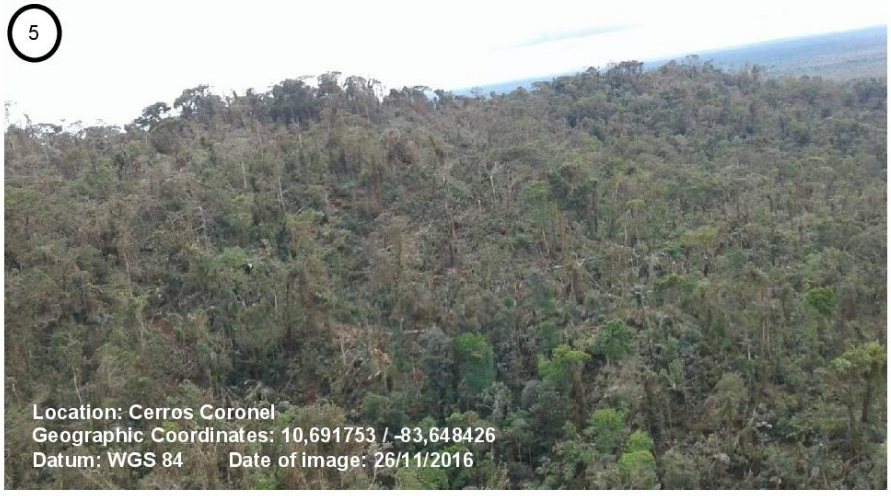
Photos 3 and 4. Contrasting cases regarding the hurricane's effects. While in photo 3 the house was totally destroyed, the house in photo 4 was not affected at all (in spite there being affected zoned in the surrounding areas, within the circles). Note the difference in the covering around each case. Both photos were taken the same day (26 November 2016).

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

COSTA RICA
GOBIERNO DE LA REPÚBLICA

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
ÁREA DE CONSERVACIÓN TORTUGUERO
DIRECCIÓN DE RECURSOS FORESTALES Y VIDA SILVESTRE
DEPARTAMENTO DE MANEJO FORESTAL

5



6

Photos 5 and 6. Partial view of the affected forest and the houses within it. Note that in this case the houses did not suffer damages in spite of being in an área where the ecosystem was heavily impacted..

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

COSTA RICA
GOBIERNO DE LA REPÚBLICA

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
ÁREA DE CONSERVACIÓN TORTUGUERO
DIRECCIÓN DE RECURSOS FORESTALES Y VIDA SILVESTRE
DEPARTAMENTO DE MANEJO FORESTAL

Foto 7. Partial view of massive fall of trees in a deforested area. In contrast, the areas where there is forest cover only show standing trees without top. The margin of the San Juan River is on the right side.

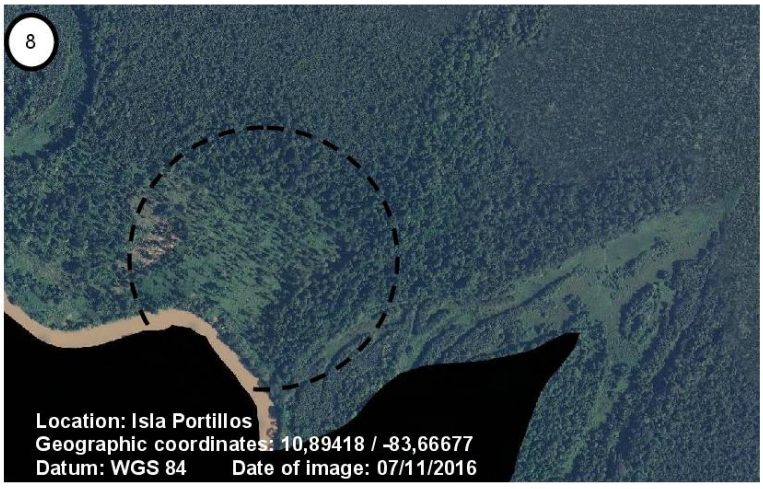


Image 8. Partial view from a satellite image of the area shown on photo 7 before the passing of the Hurricane.

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

COSTA RICA
GOBIERNO DE LA REPÚBLICA

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
ÁREA DE CONSERVACIÓN TORTUGUERO
DIRECCIÓN DE RECURSOS FORESTALES Y VIDA SILVESTRE
DEPARTAMENTO DE MANEJO FORESTAL

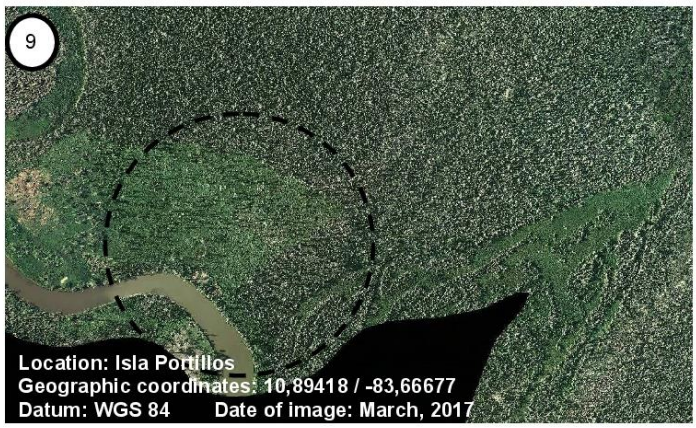


Image 9. Partial view from a satellite image of the area shown on photo 7 after the passing of the Hurricane. Note how the area with isolated trees is totally unprotected, in contrast to the áreas with forest, which present a well-differentiated structure.

Sincerely,

Ing. Laura Rivera Quintanilla

Director, Tortuguero Conservation Area

OMV/Respuesta a cancillería_situación Otto-Bosque.docx°03.08.2017

C:

Dirección: Estación Experimental Los Diamantes,
Jiménez, Pococí, Limón
Tel. (506)27102929 • Fax: (506)27107673 •
www.acto.go.cr

Appendix 10: Notes from FONAFIFO

Ofreciendo recursos para el desarrollo del sector forestal

minae FONAFIFO

Viernes 23 de junio 2017
DG-OF-154-2017

Señor
Alejandro Solano
Viceministro
Ministerio de Relaciones Exteriores y Culto

Estimado señor:

Tengo el agrado de saludarlo cordialmente con ocasión de referirme a su consulta sobre las tarifas que aplica el Fondo Nacional de Financiamiento Forestal, en el programa de Pago de Servicios Ambientales actualmente en funcionamiento.

Sobre el particular, es necesario señalar que el artículo 22 de la Ley Forestal 7575 del 16 de abril de 1969 establece que el pago por servicios ambientales tiene: "el propósito de retribuir, al propietario o poseedor, por los servicios ambientales generados al conservar su bosque, mientras no haya existido aprovechamiento maderable en los dos años anteriores a la solicitud del certificado ni durante su vigencia". Como tal, es importante señalar que el pago que FONAFIFO hace constituye un mecanismo financiero orientado a la conservación de áreas forestales que se encuentran prestando servicios ambientales y no por la restauración de dichas áreas o la compensación por servicios ambientales perdidos.

Se debe recordar que el concepto de pago por servicios ambientales se refiere a acciones y políticas de carácter económico que pretenden constituirse como medidas precautorias o preventivas para que ecosistemas y bosques de importancia no se perjudiquen y se preserven en el futuro. Este concepto parte de que las personas o empresas que tienen la propiedad de estos recursos están soportando una carga desigual en beneficio de la sociedad y, por lo tanto, se les debe compensar. En efecto, dados los beneficios que la sociedad obtiene, producto de las acciones de protección de los recursos naturales, en especial los bosques (protección del recurso agua, acciones de mitigación en contra de gases de efecto invernadero, protección del suelo, los elementos de la biodiversidad, y muchos otros servicios que estos prestan), debe reconocer a estos propietarios un pago justo por esta importante acción. Este mecanismo puede generarse mediante muchas formas: impuestos, tasas, mecanismos voluntarios etc.

Es incorrecto considerar el pago por servicios ambientales como la contraparte o como mecanismo de indemnización de un daño ambiental, pues no existe correspondencia entre los bienes perjudicados (contaminación, eliminación de vegetación, impacto al recurso hídrico, daño a la biodiversidad, etc.) y el pago para que un bosque o ecosistema se conserve.

www.fonafifo.go.cr Tel: +506 2545.3500 • Fax: +506 2235.4803
Cañas: 2668.6058 • Guápiles: 2710.1542 • Limón: 2758.6864 • Nicoya: 2686.6876
Palmar Norte: 2786.6551 • San Carlos: 2461.0331 • Caribe Norte: 2766.7202

Ofreciendo recursos para el desarrollo del sector forestal

Viernes 23 de junio 2017
DG-OF-154-2017

Señor
Alejandro Solano
Viceministro
Ministerio de Relaciones Exteriores y Culto

Estimado señor:

Tengo el agrado de saludarlo cordialmente con ocasión de referirme a su consulta sobre las tarifas que aplica el Fondo Nacional de Financiamiento Forestal, en el programa de Pago de Servicios Ambientales actualmente en funcionamiento.

Sobre el particular, es necesario señalar que el artículo 22 de la Ley Forestal 7575 del 16 de abril de 1969 establece que el pago por servicios ambientales tiene: "el propósito de retribuir, al propietario o poseedor, por los servicios ambientales generados al conservar su bosque, mientras no haya existido aprovechamiento maderable en los dos años anteriores a la solicitud del certificado ni durante su vigencia". Como tal, es importante señalar que el pago que FONAFIFO hace constituye un mecanismo financiero orientado a la conservación de áreas forestales que se encuentran prestando servicios ambientales y no por la restauración de dichas áreas o la compensación por servicios ambientales perdidos.

Se debe recordar que el concepto de pago por servicios ambientales se refiere a acciones y políticas de carácter económico que pretenden constituirse como medidas precautorias o preventivas para que ecosistemas y bosques de importancia no se perjudiquen y se preserven en el futuro. Este concepto parte de que las personas o empresas que tienen la propiedad de estos recursos están soportando una carga desigual en beneficio de la sociedad y, por lo tanto, se les debe compensar. En efecto, dados los beneficios que la sociedad obtiene, producto de las acciones de protección de los recursos naturales, en especial los bosques (protección del recurso agua, acciones de mitigación en contra de gases de efecto invernadero, protección del suelo, los elementos de la biodiversidad, y muchos otros servicios que estos prestan), debe reconocer a estos propietarios un pago justo por esta importante acción. Este mecanismo puede generarse mediante muchas formas: impuestos, tasas, mecanismos voluntarios etc.

Es incorrecto considerar el pago por servicios ambientales como la contraparte o como mecanismo de indemnización de un daño ambiental, pues no existe correspondencia entre los bienes perjudicados (contaminación, eliminación de vegetación, impacto al recurso hídrico, daño a la biodiversidad, etc.) y el pago para que un bosque o ecosistema se conserve.

www.fonafifo.go.cr Tel: +506 2545.3500 • Fax: +506 2235.4803
Cañas: 2668.6058 • Guápiles: 2710.1542 • Limón: 2758.6864 • Nicoya: 2686.6876
Palmar Norte: 2786.6551 • San Carlos: 2461.0331 • Caribe Norte: 2766.7202

Ofreciendo recursos para el desarrollo del sector forestal

En el caso del Fondo Nacional de Financiamiento Forestal, las tarifas establecidas para las diferentes categorías de pago por servicios ambientales, se establecen como una forma de propiciar la conservación y permitir a los propietarios financiar actividades sostenibles.

El Pago por Servicios Ambientales no implica una compensación por depreciación de las propiedades o el pago de precios de mercado o valores monetarios equivalentes por servicios ambientales específicos, sino que entran en juego valores sociales, políticos y ambientales que son indispensables a la hora de diseñar políticas y tomar decisiones. En el caso específico de Costa Rica, factores de gran relevancia que se toman en consideración en la definición del valor a pagar por hectárea, son la disponibilidad presupuestaria del país y el número de hectáreas que se requiere conservar dentro del sistema, que son elementos ajenos a la valuación económica de los servicios ambientales.

De igual manera, se debe indicar la figura del daño comprende acciones mucho más complejas, que deben valorarse desde una perspectiva multidisciplinaria de las ciencias ambientales y más allá de esta, deberán ser cuantificadas y monitoreadas durante años y décadas dado el delicado equilibrio de estos recursos.

Por los motivos descritos, las tarifas establecidas para el pago de servicios ambientales que aplica FONAFIFO bajo ninguna circunstancia pueden considerarse como un parámetro de cálculo para valorar económicamente la compensación por daños ambientales, que tienen valores mucho más elevados tanto en la jurisprudencia administrativa, como en la judicial del país.

Atentamente,

DIRECCION GENERAL FONAFIFO MINAE

Ing. Jorge Mario Rodríguez Zúñiga
Director General
Fondo Nacional de Financiamiento Forestal

www.fonafifo.go.cr Tel: +506 2545.3500 • Fax: +506 2235.4803
Cañas: 2668.6058 • Guápiles: 2710.1542 • Limón: 2758.6864 • Nicoya: 2686.6876
Palmar Norte: 2786.6551 • San Carlos: 2461.0331 • Caribe Norte: 2766.7202

MINAE FONAFIFO

Friday 23 June 2017
DG-OF-154-2017

Mister
Alejandro Solano
Vice-Minister
Ministry of Foreign Affairs and Worship

Dear Sir:

It is my pleasure to extend my greetings to you while I take the opportunity to answer your question concerning the rates applied by the National Forestry Financing Fund, in the Program of Payments for Environmental Services, currently in operation.

On this matter, it is important to mention that Article 22 of the Forest Law 7575 of April 16, 1969, establishes that payments for Environmental Services "…have the purpose to compensate property owners or holders for the environmental services rendered to society through their conservation efforts, if there has not been wood harvested during the two years prior to the certificate request or throughout its validity period." As such, it is worth noting that payments made by FONAFIFO constitute a financial mechanism that seeks to preserve forestry areas which are rendering environmental services and was not conceived as a way to finance the restauration of such areas or to compensate for lost environmental services.

It should be remembered that the concept of payment for environmental services refers to actions and policies of an economic nature that are intended as precautionary or preventive measures so that ecosystems and forests of importance are not harmed and are preserved in the future. This concept is based on the fact that the people or companies that own these resources are bearing an unequal burden for the benefit of society and, therefore, must be compensated for. In fact, given the benefits that society derives from natural resources protection actions, especially forests (protection of water resources, mitigation actions against greenhouse gases, soil protection, biodiversity, and many other services they provide), these owners must be recognized with a fair payment for this important action. This

mechanism can be generated in many ways: taxes, fees, voluntary mechanisms, etc.

It is incorrect to consider payments for environmental services as a mechanism to indemnify for an environmental damage caused, as there is no correspondence between the goods damaged (contamination, vegetation loss, impact to water resources, damage to biodiversity, etc.) and payments addressed for the conservation of a forest or an eco-system. In the case of the National Forestry Financing Fund, the rates established for the different categories of payment for environmental services have been established as a way to promote conservation efforts and allow owners to finance sustainable initiatives.

Payment for Environmental Services does not imply compensation for depreciation of properties or payment of market prices or equivalent monetary values for specific environmental services. Other aspects play a role such as social, political and environmental values that are indispensable when designing policies and making decisions. In the specific case of Costa Rica, factors of great importance that are taken into account in the definition of the value to pay per hectare are the budget availability of the country and the number of hectares that are required to be conserved within the system. These are elements that are not part of the economic valuation equation of environmental services.

In the same way, it should be indicated that the concept of damage includes much more complex actions, which must be assessed from a multidisciplinary perspective of the environmental sciences and beyond; these actions must be quantified and monitored for years and decades given the delicate balance of these resources.

In view of the reasons mentioned before, the rates established by FONAFIFO cannot, under any circumstance, be considered as a calculation parameter to economically value the compensation for environmental damages which have substantially higher values both in the administrative and judicial jurisprudence of the country.

Cordially,

Ing. Jorge Mario Rodríguez Zúñiga
General Director
National Forestry Financing Fund

Ofreciendo recursos para el desarrollo del sector forestal

San José, 20 de julio de 2017
DG-OF-174-2017

Señor
Alejandro Solano Ortiz
Vice Ministro de Relaciones Exteriores y Culto

Estimado señor:

Mediante la presente me es grato saludarlo y a la vez me refiero a su oficio DVM- 137-2017, de fecha 17 de julio del año en curso, según el orden de sus consultas:

1- En primera instancia nos indica usted que los representantes de Nicaragua señalan que el Fondo Nacional de Financiamiento Forestal paga 294 dólares por hectárea por concepto de pago por servicios ambientales y que ese monto es un buen referente para calcular el daño ambiental.

Es importante aclarar que este es un mecanismo que el Gobierno de Costa Rica reconoce a los particulares propietarios de bosque por las acciones de conservación de bosque, pues la sociedad está recibiendo una serie de servicios que inciden en la protección y el mejoramiento del medio ambiente (la Ley Forestal los enlista como: "...mitigación de emisiones de gases de efecto invernadero (fijación, reducción, secuestro, almacenamiento y absorción) protección del agua para uso urbano, rural o hidroeléctrico, protección de la biodiversidad para conservarla y uso sostenible, científico y farmacéutico investigación y mejoramiento genético, protección de ecosistemas, formas de vida y belleza escénica natural para fines turísticos y científicos. ") así dispuesto por el artículo 3 inciso k de la Ley Forestal N° 7575. Así las cosas, los dueños de estos bosques soportan una carga desigual respecto de otros ciudadanos y asumen cargas que deben ser reconocidas, en especial cuando se les limita su propiedad con impedimentos como el cambio de uso de la tierra previsto en el artículo 19 de la citada Ley Forestal.

Esta intención queda evidente y expresa en el párrafo primero del artículo 22 de la Ley Forestal con el cual inicia el capítulo II "Incentivos para la Conservación" donde expresamente se señala en lo que interesa: "Se crea el Certificado para la Conservación del Bosque (CCB), con el propósito de retribuir, al propietario o poseedor, por los servicios ambientales generados al conservar su bosque, mientras no haya existido aprovechamiento maderable en los dos años anteriores a la solicitud del certificado ni durante su vigencia, la cual no podrá ser inferior a veinte años..."

2- En cuanto a sus consultas dos y tres, relativas a los humedales que conforman la zona de daño ambiental ocasionado por Nicaragua, consideramos de especial importancia que desde el inicio del programa de pago por servicios ambientales en el año 1997, han quedado excluidas del pago de los servicios ambientales las áreas que son propiedad del Gobierno de Costa Rica, administrados por el Sistema Nacional de Áreas de Conservación., Ello fundamentalmente por dos razones: la primera es que al ser propiedad pública, estas zonas están fuera del rango de riesgo de corta por parte del titular, dado que la legislación que regula las áreas silvestres protegidas, independientemente de su categoría de manejo, les impide cualquier aprovechamiento o manejo; y segundo, que el programa de pago por servicios ambientales es un instrumento de fomento económico para pagar a los sujetos privados propietarios de los bosques y no para incentivar al Estado. Según nuestros registros de 20 años de vigencia del programa no existe pago alguno al Estado o al Sistema Nacional de Áreas de Conservación, solo personas físicas o jurídicas privadas. En este sentido el artículo 46 de la Ley Forestal dispone expresamente que los mecanismos de Fomento y la creación del Fondo Nacional de Financiamiento Forestal son para

www.fonafifo.go.cr Tel: +506 2545.3500 • Fax: +506 2235.4803
Cañas: 2668.6058 • Guápiles: 2710.1542 • Limón: 2758.6864 • Nicoya: 2686.6876
Palmar Norte: 2786.6551 • San Carlos: 2461.0331 • Caribe Norte: 2766.7202

Ofreciendo recursos para el desarrollo del sector forestal

financiar a pequeños y medianos productores; dicha disposición en lo que interesa dispone: "Se crea el Fondo Nacional de Financiamiento Forestal, cuyo objetivo será financiar, para beneficio de pequeños y medianos productores, mediante créditos u otros mecanismos de fomento del manejo del bosque, intervenido o no, los procesos de forestación, reforestación..."

3- Por último, deseo reiterar que es incorrecto considerar el pago por servicios ambientales establecido por el Fondo Nacional de Financiamiento Forestal como un mecanismo para indemnizar o valorar el daño ambiental. Los servicios ambientales han sido calculados y establecidos como una medida positiva para incentivar acciones de conservación del bosque, una pequeña retribución de la sociedad por los esfuerzos de conservación realizados.

El daño ambiental implica un concepto jurídica y técnicamente diferente, donde ya no estamos protegiendo el bosque, sino que las acciones humanas que lo han perjudicado trascienden el concepto de bosque a uno más extenso como ecosistema, con una serie o escala de perjuicios en diferentes elementos, bióticos o abióticos. La valoración del daño ambiental no puede limitarse simplemente a un pequeño monto como el pago por el servicio ambiental dado en un periodo de tiempo (generalmente un año), porque además nunca comprende el precio de reposición del recurso o su valor estimado. El daño ambiental es mucho más complejo; la temporalidad es mayor a un año y puede abarcar décadas o inclusive nunca llegar a repararse.

Por los motivos descritos, las tarifas establecidas para el pago de servicios ambientales que aplica FONAFIFO bajo ninguna circunstancia pueden considerarse como un parámetro de cálculo para valorar económicamente la compensación por daños ambientales, que tienen valores mucho más elevados según criterios de Tribunales Administrativos y Judiciales.

Cordialmente,

Ing. Jorge Mario Rodríguez Zúñiga
Director General

DIRECCION GENERAL FONAFIFO MINAE

www.fonafifo.go.cr Tel: +506 2545.3500 • Fax: +506 2235.4803
Cañas: 2668.6058 • Guápiles: 2710.1542 • Limón: 2758.6864 • Nicoya: 2686.6876
Palmar Norte: 2786.6551 • San Carlos: 2461.0331 • Caribe Norte: 2766.7202

MINAE FONAFIFO

San José, 20 July 2017
DG-OF-174-2017

Mister
Alejandro Solano Ortiz
Vice-Minister of Foreign Affairs and Worship

Dear Sir:

I take this opportunity to extend my greetings to you while referring to your note DVM-137-2017 of the present year, to respond to your queries in the same order as they were presented:

1- You indicate that the Nicaraguan representatives state that the *Fondo Nacional de Financiamiento Forestal* (National Forestry Financing Fund) pays USD $294 per ha as payment for environmental services and that such amount can be used as a bench mark to estimate environmental damages.

   It is important to clarify that this is a mechanism used by the Costa Rican Government to monetarily compensate particular forest owners for their conservation efforts, given the fact that the society at large benefits from a variety of services that impact the protection and the improvement of the environment (The Forest Law refers to these services as "…greenhouse gases mitigation (fixing, reduction, sequestration, storage and absorption) protection of water for urban, rural or hydroelectric use, protection of biodiversity for its conservation sustainable, scientific and pharmaceutical use, research and genetic improvement, protection of ecosystems and diverse forms of life and natural scenic beauty for tourism and scientific purposes. "), as established in Article 3 Paragraph K of the Forest Law No. 7575. Thus, the owners of these forests bear an unequal burden in relation to other citizens and assume responsibilities that must be recognized, especially when their property is restricted with impediments such as the change of land use provided for in Article 19 of the cited Forest Law.

   This intention is evident and clearly expressed in the first paragraph of article 22 of the Forest Law which marks the beginning of Chapter II "Incentives for Conservation." This paragraph expressly states: "The Forest Conservation Certificate (CCB), was created for the purpose of remunerating the owner or holder for the environmental services generated by conserving their forest, as long as there has been no timber harvest in the two years prior to the application for the certificate or during its validity, which cannot be less than twenty years ..."

2- Concerning queries two and three related to the wetlands that make up the zone where the environmental damage caused by Nicaragua took place, we consider

of special importance the fact that since its beginning in 1997 the program of payments for environmental services excluded payments for environmental services to areas owned by the Costa Rican Government, managed by the National System of Conservation Areas. This obeys to two reasons, first, since these are government properties, no wood can be harvested by the owner since the legislation covering wild protected areas, independently of the type of management, prevents the use of its resources; secondly, the program of payments for environmental services is an instrument intended to be an incentive for private forest owners and not to benefit the State. In the 20 years of operation of the program, no records can be found that show any payment made to the State or to the National System of Conservation Areas. Payments have only been made to either corporate or natural private persons. Article 46 of the Forest Law expressly states that the promotion mechanisms and the creation of the National Forestry Financing Fund seek to finance small and middle size producers. Such provision states "The National Forestry Financing Fund was created with the objective to finance, for the benefit of small and middle size producers, by means of credit or other incentives the management of forest areas, whether intervened or not, the forestation, reforestation processes…"

3- Lastly, I would like to reiterate that it is incorrect to consider the payment for environmental services established by the National Forestry Financing Fund as a mechanism to indemnify or set a value for the environmental damage. The environmental services have been calculated and established as a positive measure to incentivize forest conservation initiatives, a small retribution that society makes to compensate for the conservation efforts carried out.

4- The environmental damage involves a legally and technically different concept, where we are no longer protecting the forest, but rather we are dealing with human actions that have harmed it and transcend the concept of forest to a more extensive ecosystem, with a series or scale of damages in different elements, biotic or abiotic. The valuation of environmental damage cannot be limited to a small amount such as the payment for the environmental service given over a period of time (usually one year), because it never accounts for the replacement price of the resource or its estimated value. Environmental damage is much more complex; its temporality is greater than a year and repairing it can take decades or may even never be repaired.

For the reasons described above, the rates established for the environmental payments applied by FONAFIFO, cannot, under any circumstance be considered as a bench mark to economically estimate compensation for environmental damage, because as has been ratified by Administrative and Judicial Courts, the value of environmental damage is substantially much higher.

Cordially yours,

Ing. Jorge Mario Rodríguez Zúñiga
General Director

Appendix 11: Note from Dr. Joshua Farley

The UNIVERSITY of VERMONT

DEPARTMENT OF COMMUNITY DEVELOPMENT
AND APPLIED ECONOMICS

August 1, 2017

In response to a request by Costa Rica's Deputy Minister of Foreign Affairs, Alejandro Solano Ortiz, I have carefully reviewed the report entitled *Valuation of the environmental damage arising from the construction of artificial caños and clearing of trees and vegetation performed by the Government of Nicaragua in Costa Rican territory on Isla Portillos, as required by the Judgment of the International Court of Justice of 16 December 2015,* prepared by Fundacion Neotropica. I summarize my analysis of the report here.

The report is meticulously prepared and documented, and utilizes state of the art techniques for monetary valuation of ecosystem services. Though monetary valuation of ecosystem services is somewhat controversial, it is regularly used both by government policy makers and by legal systems around the world when determining the costs and benefits of different policies and actions. For example, the authors apply the methods and cite the work of Earth Economics, whose valuations are now being used by the US government's Federal Emergency Management Agency (FEMA).

While the authors frequently state that they are making conservative estimates of monetary values, my main concern with this report is that the valuations are too conservative for several reasons.

First and most obvious, the study provides monetary values for only six categories of ecosystem services, with a qualitative analysis of eight others, and mention of an additional eight. The root word of ecology, oikos, also means house in Greek. The value of a house is determined by all the benefits it provides. Systematically excluding the monetary value of most of those benefits would grossly underestimate the value of the house, and the same is true when systematically excluding the value various benefits provided by ecosystems.

Second, most valuation studies for ecosystem services, including several used in this study, are based on willingness to pay (WTP). The relevant question is not how much Costa Ricans are willing to pay for ecosystem services they already owned, but rather how much compensation they would have required to willingly forego those services, a measure known as willingness to accept (WTA). Numerous studies have shown that monetary valuations of ecosystem services based on WTA greatly exceed those based on willingness to pay (Horowitz & McConnell, 2002).

Third, resources that are essential to human well being are characterized by inelastic demand. By definition, this means that a one percent decrease in quantity leads to a greater than one percent increase in value. For example, the small decrease in oil supply during the OPEC oil embargo in 1973-74 led prices to quadruple. All life depends on the ecosystem services provided by healthy ecosystems, so they are clearly even more essential than oil, and both quantity and quality of global ecosystems are in decline. Monetary values should be increasingly rapidly:

College of Agriculture & Life Sciences, Morrill Hall, 146 University Place, Burlington, VT 05405-0106
Telephone (802) 656-2001, FAX (802) 656-1423, http://www.uvm.edu/~cdae/dept/

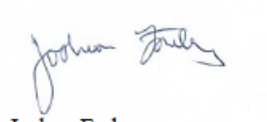
monetary values for benefit transfers should be adjusted accordingly, and the analysis should also account for rapidly rising values over the next 50 years.

Fourth, I would argue that a 4% discount rate is much too high for ecosystem services over the next 50 years, especially since the analysis assumes constant values of ecosystem services. Ensuring the sustainable provision of ecosystem services is a question of ethics and justice, while justifications for discounting are based solely on efficiency (Daly, 2014). When used at all, discount rates for issues of sustainability should be as low as possible (Stern, 2006; Voinov & Farley, 2007; Weitzman, 1998).

I would also like to comment on Nicaragua's apparent claim that it should only be liable for replacement costs, and not for the value of services lost. If Nicaragua had destroyed houses and other human made infrastructure rather than ecosystems, it would obviously be unreasonable to argue that replacing that infrastructure over the next 50 years would be adequate, since this would ignore 50 years' worth of services the infrastructure would otherwise have provided. The same logic applies in this case.

I conclude with a final but perhaps legally irrelevant observation. In Civil Court cases, the goal of justice is typically to make the victim whole. This is certainly one of the goals in this case. In criminal cases however, the goal is often to deter future transgressions by penalizing the transgressor. In my view, the environmental destruction in question was a criminal act, and it would be more efficient to err on the side of excessive payment rather than underpayment.

Sincerely,



Joshua Farley
Professor, Community Development and Applied Economics
Fellow, Gund Institute for Ecological Economics
205 B Morrill Hall
University of Vermont
Burlington, VT 05405
Phone: 802-656-2989
Fax: 802-656-1423

References:

Daly, H. (2014). *From Uneconomic Growth to a Steady-State Economy*. New York: Edward Elgar.

Horowitz, J. K., & McConnell, K. E. (2002). A Review of WTA/WTP Studies. *Journal of Environmental Economics and Management, 44*(3), 426-447.

Stern, N. (2006). *Stern Review: The Economics of Climate Change*. Retrieved from Cambridge:

Voinov, A., & Farley, J. (2007). Reconciling sustainability, systems theory and discounting. *Ecological Economics, 63*(1), 104-113.

Weitzman, M. L. (1998). Why the Far-Distant Future Should Be Discounted at Its Lowest Possible Rate. *Journal of Environmental Economics and Management, 36*(3), 201-208.

Appendix 12 : Organization and Executive Director Curriculum Vitae

FUNDACIÓN NEOTRÓPICA

CURRICULUM VITAE

(SELECTED 1985-2017)

FEATURED AWARDS

Green Latinoamerican Award the Fundación Neotrópica was nominated among the 500 best socio-environmental cases of America Latina with two initiatives, both within the categories of Biodiversity and Forests, and Human Development, Social Inclusion and Education: The projects "Building Sustainable Tourism Destinations" and “Carbon Blue Community ". Both cases were exhibited on September 23 and 24, 2015. August 14, 2015.

Ford Award for Conservation and the Environment Fundación Neotrópica, for a second time received from Ford Company a recognition for its work in the community conservation of the mangroves of Golfo Dulce for its Blue Communities project and its Blue Carbon Community program. October 21, 2015

INBio Award for Merit in the Conservation of Costa Rican Biodiversity For its outstanding contribution to the conservation of biodiversity for 29 years, the Jury chose the Neotrópica Foundation for the INBio Merit Award for the Conservation of Costa Rican Biodiversity in 2014 due to: its long trajectory of uninterrupted work at the service Conservation, its efforts for the protection and sustainable use of biodiversity in buffer zones, the formation and consolidation activities of Editorial Heliconia, and the work done in the Osa peninsula. November 4, 2014

Ford Award for Conservation and the Environment The Fundación Neotrópica received from Ford Company and its representative in the National Automotive Nation NASA S.A., a recognition for its work in the conservation of the mangroves of Golfo Dulce and a donation of about $ 11,000 to strengthen its work. December 6, 2012
Defender of the Inhabitants of the Republic in the category Organization of the Civil Society "For its pioneering activity in the development and sustainable solutions of the region, through research, execution and dissemination of actions that generate viable options for the destructive use of the base of renewable natural resources." October 29,1999

Pioneering Projects

The Blue Communities Project 2013-2015, "Social Development and Transfer of Experiences of Community Management and Conservation in Costa Rican Pacific Coastal Communities”. The Blue Communities Project,

financed by the Swiss Embassy, was a project focused on increasing sustainability in the conservation and management in The Térraba-Sierpe National Wetland (HNTS) and transfer experiences to the Puntarenas mangrove reserve in the Golfo de Nicoya (Central Pacific). It is important to highlight that one of the main means of increasing the participation and success of the activities was the use of the Local Implementation Units model based on the method known as “farmer to farmer” in order to create a team of local promoters from the beneficiary communities. Other actions included were environmental education and reforestation of mangrove areas. Another fundamental stage in the project was the actualization of the Socio Environmental Diagnostics of the HNTS. Nurseries were created to deal with mangrove reforestation developed by inhabitants of the wetland.

The Blue Carbon Corporate Community Program 2012-2017 In the base to the wide previous experience in Conservation of wetlands, the Neotrópica Foundation began a work in 2012 with private companies, integrating efforts of corporate social responsibility obtaining the support of companies with brands of renown (Local Companies Trademark Representatives Of Volkswagen, Ford, Davines and Praxair) to support the Community Blue Carbon Program (PCAC), an effort to generate sustained and sustainable work in mangrove conservation. This program seeks to develop actions of community conservation of wetlands in different areas of the south and Central Pacific Pacific, a UN through the community management system that includes reforestation, monitoring, sensitization, training in sustainable productive activities and promotion of good practices. The program was created with the objective of ensuring sustained funding for community conservation laboratories initiated by the Mangle-Benin and Ecoticos projects, based on national corporate funds. Due to its innovative design, in response to the needs posed by the country's legal framework and its results, the Community Blue Carbon Program received a Ford Prize for conservation in 2012 and again received an Environmental Donation from Ford Central America for Conservation and the Environment.

Consolidation of the Arboretum of the Golfo Dulce Forest Reserve as an instrument to increase the knowledge and awareness of the local actors in the matter of forest conservation:
This project seeks to contribute to the conservation, maintenance and restoration of tropical forests in the communities of San Juan, Chal Bay and Rincon in the Golfo Dulce Forest Reserve (RFGD) in the Osa Peninsula in the Pacific south of Costa Rica. This project is funded by the First Exchange of Debt for Nature, administered by INBio funds.

Elaboration of the General Management Plan for the Tivives Protective Zone: The objective is to grant the Tivives Protective Zone a General Management Plan, prepared in a participatory manner, involving different actors who can contribute ideas for planning the development and management of this ASP for the next 10 years. This Project is financed by the Second Exchange of Debt by Nature, funds administered by the Costa Rica Por Siempre Association.

The CiVi.net Project 2011-2014. The Capacity of Civil Society Organizations (CSOs) Networks in Community Environmental Management “The CiVi.net Project was part of the Seventh Framework Cooperation Program of the European Union, focused on community-based management of environmental challenges. The project aimed to analyze transfer and disseminate successful and sustainable community-based solutions with regards to ecosystem service management in Latin America. The main focus was on institutional settings in terms of original rules and related governance models which help to prevent and resolve tensions arising from the

distribution of benefits and costs from the use of environmental space. The role of civil society organizations within these governance models was thereby at the core of the research. The CiVi.net project studied our experiences with the ECOTICOS and Mangle-Benin projects in order to analyze, promote and share the learning experiences between these two areas: The Térraba-Sierpe National Wetland (HNTS), which is the largest wetland area on the Pacific coast of Central America and the Golfo Dulce (GD), in the South Pacific of the country, but at the same time, analyze the transferability of these experiences to the Golfo de Nicoya, in the Central Pacific area. Actually, the Golfo de Nicoya zone shows a strong link with the Central Valley, one of the most densely populated regions and the main generator of water/solid waste of the country.

The ECOTICOS project 2009-2010. The ECOTICOS project was implemented with the aim to help find viable solutions to socio-environmental conflicts related to the Térraba-Sierpe National Wetlands (HNTS) recognizing its importance as the largest and most complex wetland of its kind that remains in the Central American Pacific. The project was supported by several universities from the United States (Vermont University, Florida Institute of Technology) and Costa Rica (University of Costa Rica) and Earth Economics, with financial support from Blue Moon Fund. The goal was to establish a scalable and replicable framework that promotes the environmental Education and Communication (ECO) and also the integration of Technical, Institutional and Conceptual Solutions (TICOS) to promote the sustainable development of mangrove Térraba-Sierpe of Costa Rica. This was done through a combination of ecosystem valuation and social multicriteria analysis and methodologies that allowed to internalize the notion of the economic benefits of the wetland and to elicit the preferences of stakeholder groups toward scenarios that included the existence and non-existence of the management plan.

Mangle-Benin Project 2009: "Project to Support the Sustainable Management and Conservation of Biodiversity in the Gbaga Channel of Benin and Golfo Dulce in ACOSA, Costa Rica", which was part of the South-South Cooperation Program in support of the Kingdom of the Netherlands. The main objective of this project in its reciprocal phase in Costa Rica was to contribute to the sustainable management and conservation of the biological resources of the mangrove ecosystems of Golfo Dulce (Osa Peninsula) through the participation of local communities And the reduction of poverty in the OSA Conservation Area (ACOSA), Costa Rica. The specific objectives were to restore and establish a plan for the protection of mangroves and the biodiversity of the Golfo Dulce ecosystems in ACOSA, as was done with the Gbaga channel in Benin and to promote methods of participatory sustainable management of this resource.

Environmental education program 2007-2017. Since 2007, Fundación Neotrópica has developed its Friends of Nature Environmental Education Program in different schools in the Central Valley, with an annual program of workshops and educational tours, mainly focused on the subject of the River Basin, and Ecologycal Foot Print. For almost 10 consecutive years the program has reached more than 4,000 children.
In 2010, we worked with 3 schools in the canton of Tibás, and later with educational centers in the Protective Zone Cerros de la Carpintera. With the sponsorship of Group CESA, ASEHSA, CEMEX, SC Johnson, Costa Rican Trails, EPA and Coopeservidores.

In 2015, the initiative promoted by the organization and stores EPA "Help is easy" managed to raise about 20 million colones, to carry out activities that include workshops and field trips aimed at children 9-10 years of school Guachipelín, Spain School in San Antonio de Belén, José Rafael Araya Pedagogical Unit in Tibás, Juan

Santa María School in Curridabat and San Rafael de Arriba School in Desamparados. In 2016, a new Environmental Education program sponsored by CESA was launched at the Centeno Güel Special Education Center, which has a student population of around 600 children with different special conditions such as visual impairment, mental retardation, hearing problems and language. So, FN was the first organization in the whole country to implement an Environmental Educational Program that is inclusive.

Tropical Youth Center 1992-2000 (I and II Phases). The Tropical Youth Center (CJT) and now Tropical Center (CT) was created as the environmental education area of the BOSCOSA Program. It was established thinking about the childhood and the youth, as much of Peninsula of OSA as of Costa Rica and the world. Through the sale of environmental education services at national and international level, it has allowed it to generate income with which free environmental education is carried out for children and young people from the Peninsula of Osa and other communities outside of it, since their Mission is to stimulate changes that generate sustainable attitudes and actions in the way human beings value and make use of the social and environmental environment.

BOSCOSA Program 1988-1996. In the mid-1980s, the discussion of natural resource conservation strategies that had been implemented by both private conservation organizations and governments, mainly in the tropics and underdeveloped countries. The United States-based World Wildlife Fund (WWF) Tropical Forests Program decided to support diverse projects in Peru, Mexico, Costa Rica and Brazil, and in 1987, and the Government of Costa Rica designed a project that seeks to maintain forest cover in some biologically important areas of the country, as a pilot project that could be replicated in other areas. WWF consultant Richard Donovan, WWF representative and then Director of the Neotropical Foundation, Dr. Mario Boza, established basic agreements stating that the Fundación Neotrópica would be the local implementer organization. In contact with the Ministry of Natural Resources Energy and Mines, MIRENEM (now MINAE), Richard Donovan, already from the Fundación Neotrópica and as Project Director, laid the groundwork for an initiative that tackled the problem of deforestation and change of use of the land, based on three components of action that were the forest component, the agricultural component and the social component.

Economic Valuation of Environmental Damage

The Foundation has carried out pioneering efforts in the field of valuation of ecosystem services that have been implicated in recognized environmental conflicts, such as the cases of the Térraba-Sierpe National Wetland and the Crucitas Mining Project. In all these efforts, Neotrópica has dared to adapt and mix methodological approaches according to the specific contexts of conflicts with novel results. The success of his approach has led it to other prestigious works in collaboration with Stanford University, the Global Mechanism to Combat Desertification of the UN and the National Environment Authority in Panama. Its work in this area has been documented in recent publications such as the book Ecological Economics from the Ground Up published by the publisher Routledge with Hali Healey, Joan Martinez-Alier and other well-known publishers.

Also, the FN has worked closely with Earth Economics, an American NGO expert in valuing environmental services and with a prestigious international knowledge center such as the Gund Center for Ecological Economics at the University of Vermont. This collaborative relationship is expressed today in a pioneering joint

work assessing the environmental damage caused by the sludge spill due to the poor management of a hydroelectric dam in the Ahincayá River Basin in Colombia.

In addition, the Foundation, together with Earth Economics, has been working on the development of an exhaustive research on the impacts of narco-deforestation on protected areas in Central America, which estimates the current and potential environmental damage that has been historically detected As a result of this illegal activity since 2006, when traffic patterns in Central America changed, also documenting and analyzing the Distributive Ecological Conflicts (CEDs) related to drug trafficking and the pressure they generate on protected wilderness areas, Which in the end result in a very important loss of environmental services.

Monetary Assessment of Environmental Damage Caused by Actions to Open Artificial Pipes and Deforestation on Isla de los Portillos in the Northeast Caribbean Wetlands, Costa Rica In accordance with the resolution of December 16, 2015 of the International Court of Justice of Hague. Fundación Neotrópica, San José, Costa Rica.2016

Economic Assessment of Ecosystem Goods and Services, Costs of Land Degradation and Development of Scenarios and Alternatives of Land Use and Land Management Case Study of Cerro Punta, Panama. San José, Costa Rica: Fundación Neotrópica -Earth Economics. 2013

Economic Evaluation of the Environmental Impacts on the Ecosystem Services of Lower Anchicayá for the Sludge Dumping of the Hydroelectric Power Plant, Anchicayá Colombia This consultancy consisted in the economic evaluation of the environmental and social impacts generated by the Bajo Anchicayá hydroelectric dam in Colombia when there was an unplanned discharge of 500,000 cubic meters of sludge over the river basin of the same name. It was conducted in conjunction with Earth Economics, a specialized US NGO.2013

Technical Opinion on the Methodologies of Economic Assessment of Environmental Damage that SINAC considers to formalize The National System of Conservation Areas of Costa Rica (SINAC) asked the Fundación Neotrópica for an opinion on the methodologies that SINAC considers official to carry out economic valuations of environmental damage with recommendations and possible improvements, in order that SINAC could have better tools to develop its valuations. In response to this request, the Fundación Neotrópica carried out a review of the documentation based on the Foundation's technical expertise. 2013

Consultancy "Economic-Ecological Assessment of Environmental Damage Related to Changes in Soil Coverage on Infinite Industries owned by Resolution 244-2008-SCH of the Huetar-Norte Conservation Area, Costa Rica Consultancy to value, in fulfillment of the request of the national general attorney in note pgr-168-2011, through a fast ecological-economic methodology and the appropriate information, the possible damages caused by the tree removal in the farms of industries Infinito Sociedad Anonimo according to the resolution 244-2008-SCH from the Huetar-Norte Conservation Area. 2012.

A Summary of Actual and Potential Environmental Service Losses Due to the Current Ecological Conflict in the Portillos/Calero Island Region in the Caribe Norwest Wetland in Northeastern Costa Rica. San José, Costa Rica: Fundación Neotrópica, 36 pp. For the Ministry of Foreign Relations, San José, Costa Rica.2011

A Preliminary Ecological-Economic Estimation of the Environmental Service Loss Due to the Current Ecological Conflict in the Isla Portillos Region in the Caribe Norwest Wetland in Northeastern Costa Rica San José, Costa Rica: Fundación Neotrópica, 37 pp.2010.

ECOTICOS project: Multidimensional Valuation for Environmental Conflict Analysis In Costa Rica. Martinez Alier,J. et. al. (eds.) Ecological Economics from the Bottom Up, Routledge Publishers, UK.2010.

WETLAND CONSERVATION PROJECTS

Policy Influence and New Project Since 2010 FN became one of the leading organizations in the National Front for the Defense of Wetlands (FNH). FN organized the national campaign known as Misión Humedales Vida para Todos (Mission Wetlands: Life for All) which launched a nation-wide effort to raise awareness on the importance of wetlands for the nation and the world given the border crisis between Costa Rica and Nicaragua for a small stretch of land in the Northeast Caribbean Wetlands (Humedal Caribe Noreste HCN). The impact of this campaign and the crisis with Nicaragua were decisive to create the Vice ministry of Water, Seas and Wetlands as part of the Ministry of the Environment. FN participated as one of the invited actors to discuss the proposal for its creation in 2012. Further, since its creation, FN has consistently supported its work. Two technical valuation studies to be used in the International Court of Law (ICL) for the assessment of the damages caused to the HCN were donated by FN to the Costa Rican government. They appear as technical evidence in the proceedings of the case.2009-2021.

Restoration, conservation and sustainable management of Costa Rican coastal wetlands in the face of climate change. 2017 The French Fund for the Environment (FFEM) approved a €6 million project to support the replication of the FN's Blue Carbon Community Program (PCAC), along the entire Pacific Coast of Costa Rica. The model will be reinforced with better and improved wetland restoration techniques included through a partnership with the University of Campeche in Mexico. It will use the new wetlands policy as a framework and develop a national blue carbon strategy in order to make sure that communities continue receiving benefits from their support, work and involvement in mangrove conservation. The beneficiary of the project will be the National System of Conservation Areas and the Ministry of the Environment. FN will lead the technical execution. A transfer of experiences with organizations from Benin is also included. 2017-2021.

Ecological Economics

Member of the Local Organizing Committee of the II Latin American Congress on Environmental Conflicts (COLCA)2016. The Latin American Congress on Environmental Conflicts, is an initiative that invites Latin American specialists to discuss environmental conflicts and their consequences in our region and seek solutions. This Congress allowed the opening of a transdisciplinary discussion space facilitating the interaction between the local actors of the affected communities, civil society organizations, the academic sector and the scientific community, as well as representatives of public management, and the private sector. These include urban, peri-urban, rural conflicts linked to agricultural, mining, extractive, climate change, and community participation models and tools for conflict analysis. The event was organized jointly by the School of Biology of the UCR, the

Neotropical Foundation, the Environmental Administrative Tribe, the Mesoamerican Society of Ecological Economics (SMEE), and the COLCA network.

Investments in Sustainable Land Management in Costa Rica through an assessment of the economic value of land and the identification of incentives and market mechanisms.2015 ". It seeks to encourage public and private investment in sustainable land management by demonstrating the economic benefits of sustainable land management compared to unsustainable costs, business-as-usual, land use / management practices And the use of incentives. To this end, Neotrópica Foundation, together with Earth Economics, carries out an economic assessment in the study area, analyzes the deep causes of desertification in vulnerable ecosystems in the study area, prioritize analysis of political, normative, financial obstacles and opportunities for Extension of sustainable land management, among other products. This consultancy is carried out in Costa Rica, with special emphasis on the region of the lower basin of the Jesus Maria River.

Member of the Local Organizer Committee of the 7th Annual Ecosystem Services Partnership (ESP) - Conference 2014.The emphasis of this Seventh International ESP Conference is on the use of the concept of ecosystem services at the local level, focusing on Latin America, with a special emphasis on Costa Rica. It allowed us to learn about the different ways in which ecosystem services are being used by local communities as economic alternatives to protect ecosystems and provide livelihoods for local people. Scientists representing several EU-funded projects presented their results in community-based ecosystem management: CiVi.Net, COBRA, Eco Adapt, CombioServe and COMETLA. Its objectives were to analyze the progress of ESP, advances in the fields of ecosystem services Science, Policy and Practice and to provide an event for its working groups, national networks and associations.From 8 To 12 September 2014

Member of the Organizing Committee of the Congress Eco Eco Alternatives 2014 The main focus of this Congress was to present varieties of Ecological Economics "Advancing towards Alternatives for the peoples and ecosystems of Latin America". This Congress allowed the exchange of different experiences of ecological economy in the Latin American region; while reflecting on how to reverse the negative effects of human activity on the environment through economic, social and environmental sustainability. The event was organized by the Mesoamerican Society of Ecological Economics (SMEE), Neotrópica Foundation and the School of Biology of the UCR.

Presidency of the Mesoamerican Society of Ecological Economics (SMEE)2010: Since 2010, during the First Biennial Congress of the SMEE in Mexico, the Neotrópica Foundation assumes the secretariat of the SMEE and the Presidency of its Board of Directors. This is in accordance with the mission of the Fundación Neotrópica which prescribes the adoption of areas of innovative environmentalism that allow it to achieve empowerment and social self-management in order to achieve a fair distribution of the costs and benefits of conservation and development in Costa Rica and beyond.

Other Consultancies:
Services for the "Natural Resources Management Program With Indigenous Peoples in Central America "of the Indigenous and Peasant Coordinating Association of Community Agroforestry in Central America (ACICAFOC) with the support of CICA7Stozil and KFW 2010-2020.

"Support in decision-making for the integration and extension of sustainable land management" (Panama) 2016-2017.
Consultancy "Course on Economic Valuation of Ecosystem Goods and Services and Evaluation of Some of the Studies Accomplished in Cuba.2015.
Investments in Sustainable Land Management in Panama through an assessment of the economic value of land and the identification of incentives and market mechanism 2013.

Environmental Conflicts

Accessible Environmental Justice: Costa Rican Map of Socio-Environmental Conflict "2016. In order to contribute to environmental justice in the country, the project developed a digital platform of socio-environmental conflict in Costa Rica that will be collaborative and accessible to the population, increasing the visibility of the socio-environmental conflicts in the country as well as the governmental actions against such cases. The Costa Rican map of socio-environmental conflict will allow the use of technology to make public and accessible more information on an increasingly sensitive issue in the country. The government and civil society will have a valuable tool of communication and collaboration that, in turn, will favor citizen empowerment. Organizations, communities and individuals will have at their disposal a new instrument in favor of environmental security as a human right, and access to environmental justice in the country will have been strengthened.

The possible socio-ecological costs of cocaine trafficking in Central America subproject of Mc. Sweeney, K. et. Al (2015). "Evidence of Drug Policy Reform: Drugs, Deforestation and Slender Development in Rural Central America": This project documents, quantifies and visibilizes the impacts of narcotics trafficking and anti-narcotic activities for conservation and rural development in Central America.
Specifically, the component in charge of the Fundación Neotrópica documents first the change in the value of environmental services resulting from changes in land use in areas identified as "hot spots" because of the ecosystems they protect: (Guatemala), Xiraltique-Bahía Jiquilisco Biosphere Reserve (El Salvador), Patuca National Park-Tawhaka-Asagni Biosphere Reserve, Río Plátano and Bosawas Biosphere Reserve (Honduras-Nicaragua), Osa Conservation Area Rica) and Darien Biosphere Reserve (Panama).These areas also document distributive socio-ecological conflicts that are related to the activity of drug trafficking and affect these areas. This analysis characterizes the conflicts through a framework of analysis of political ecology based on the format used by the World Atlas of Environmental Justice (http://ejatlas.org).

Study on the conflict generated by mining extraction projects in Guatemala ". This Consultancy is part of the Human Development Report of the United Nations Development Program (UNDP) in Guatemala. He sought to investigate conflicts arising from extractive mining projects in order to understand their territorial dynamics, the contending actors and the role played by central and local government in them.2015

Global Atlas of Environmental Justice. The Fundación Neotrópica collaborates with the Atlas of Environmental Conflicts within the framework of the EJOLT Project (Environmental Justice Organizations, Liabilities and Trade) for the part of Central America and the Caribbean. This project is funded by the European Union and led by the

Autonomous University of Barcelona. The Atlas consists of an interactive mapping platform that analyzes the trajectory of more than a thousand ecological conflicts. 2013-2017.

COURSES

Course "Tools of political ecology and distributive socio-ecological conflicts" of COLCA 2016.
Course on Ecological Economics and Environmental Justice 2014
Introductory Course of the Congress Eco Eco Alternatives 2014 "Alternatives for today's Latin America: Key tools for the Ecological Economy and Political Economy
Introductory Course on Ecological Economics: "Tools for Valuation, Evaluation and Reconciliation of Ecological Economics and Political Ecology".2013

Other consultancies and projects

Elaboration of the General Management Plan and Achievement Plan for Marine Resources site conservation importance (SIC) Cabo Blanco. 2016-2017.
Consolidation of the Governance Model for the site of importance for marine conservation in Barra del Colorado. 2015-2016.
General Management Plan for the Protective Zone Cerros de Escazú. 2014-2016.
National course and workshop of resident birds of the Peninsula of Osa. 2014-2016.
"Consultancy for the elaboration of a Communication Plan for the Cooperative of Multiple Services of Entrepreneurs in Rural Tourism of Corcovado R.L. (COOPETURIC) ".2014-2015.
Elaboration of a Strategy for Coastal Marine Conservation of Barra del Colorado.2014-2015.
Review and update of the General Plan of Management of the Mixed Wildlife Refuge Maquenque. 2013-2016.
"Creation of the Strategy for the Sustainable Tourism Development of the Pájaro Campana Biological Corridor, through a model of Community Rural Tourism". 2013-2015.
"Promotion of Community Rural Tourism in the Rincón Rainforest Biological Corridor and Ecotourism Strengthening for Rain Forest Conservation in the Rincón Rainforest Sector, Guanacaste Conservation Area". 2013-2015.
Clean Energy for the Community Rural Tourism Network of the Osa Peninsula, Costa Rica"2013-2014.
Execution of the Management Plan of the Jesús María Basin. 2013-2014.
Environmental Awareness Project for Senior citizen. 2013-2014.
Systematization of the Sustainable Development Project for the Rio Frío Basin. 2011.
Promotion of Community Rural Tourism for the conservation of forests in the Osa Conservation Area.2011-2012.
Design and promotion of the rural and community tourism component within the framework of the Joint Program "Development of Competitiveness for the Brunca Region in the Tourism and Agribusiness Sectors, with Emphasis on the Creation of Green and Decent Jobs for the Reduction of Poverty" .2011.
Project "Sow Water for the Future". 2010-2011.
Social and Environmental Meetings.2009-2010.
Tourism research "Development and tourism potential: the case of the Sierpe Tourist Center in the Corcovado Corridor - Golfito, South Pacific of Costa Rica".2009-2010.
Local Empowerment Project in Ecotourism: Sustainability in Osa. 2008-2009.

Environmental Practices for the Recovery of the Damas River Basin ". 2005-2008.
Technical Coalition of the Osa Biological Corridor.2001-2017.
Strengthening of the self-management capacity of the community of La Gamba, phase I and sustainable self-development of the buffer zone of the Piedras Blancas National Park and the Golfito Wildlife Refuge. 1998-2001.
Project for the Amortization Zone for Sustainable Development in the Tortuguero Area (Pocotsi).1993-1995.
Environmental Program for Central America (PACA).1992-1993
Parks in danger-Corcovado National Park.1991-1994

Bernardo Aguilar-González,
Ecological Economist,
Environmental Lawyer,
Latin American Studies
-
PO Box 690-2050
San Pedro de Montes de Oca
San José, Costa Rica

Phone/Fax 011(506) 2253-2130 - office
011(506) 8920-6174 – cel.
baguilar@neotropica.org

CURRICULUM VITAE

Professional Experience

I- Current

Executive Director
Fundación Neotropica, San José, Costa Rica.
August 2008-Current
Executive Director in charge of funding, project management and administration, planning, personnel management and technical support for Fundación Neotrópica, one of the oldest and most prestigious environmental NGOs in Costa Rica which has, during the last 31 years, done work in community-based sustainable development, research, education and corporate programs in topics centered in community-based conservation of coastal wetlands, sustainable tourism, buffer zones, biological corridors and planning and management of ecosystems and water resources in general. Developed a new mission and vision and helped the NGO recover from 5 year deficit to operating with success (1 million dollar budget and 20 employees) through the introduction of newer areas of sustainability studies: Ecological Economics and Political Ecology. Developed and executed pioneer projects in the areas of ecosystem service valuation, community wetland conservation, sustainable tourism and socio-environmental conflict resolution.

II- Other Current Academic Affiliations

Adjunct Faculty
Center for Environmental Sciences and Education, Northern Arizona University, Flagstaff, Arizona, USA*- August 2001-Current.*

Fellow

Institute for Environmental Diplomacy and Security, University of Vermont, Burlington, Vermont, USA- *March 2012-Current.*

III- Select Past Academic (Administration, Teaching and Research) after 1992

Director
Masters in Ecological Economics Program
School of Environment and Development
Universidad para la Cooperación Internacional, Costa Rica.
January 2013-January 2014
Designer and Director of a transdisciplinary master's program in Ecological Economics/Political Ecology using a distance education model through a Moodle platform.

Instructor
Universidad para la Cooperación Internacional, Costa Rica.
June 2008-December 2012
Graduate Instructor in the areas of Ecological Economics, sustainability and Environmental Law.

Instructor
Universidad Nacional de Costa Rica, Heredia, Costa Rica.
June 2010-November 2010
Graduate Instructor in courses of environment and development for the Masters in Public Planning Program.
Instructor
Universidad Latina de Costa Rica, Heredia, Costa Rica.
June 2008-2010.
Summer instructor for courses on Ecosystem Health and Public Health, Sustainability and Equality: Important Aspects of Environmental Sociology (class and field based) for students from the University of California, Irvine.

Affiliate Faculty
PhD in Sustainability Education Program, Prescott College, Prescott, Arizona, USA
July 2007-June 2008
Affiliate faculty in the area of Ecological Economics for an open university Ph.D. program in the area of Ecological Economics. In charge of electronic tutoring, materials production and blog participation and maintenance.

Faculty
Cultural and Regional Studies, Resident Degree Program, Prescott College, Prescott, Arizona, USA
January 1999-June 2008.
Non-ranked faculty position (on salary level equivalent to associate professor in tenured system) in the areas of Latin American Studies, Ecological Economics, Political Ecology and Environmental Law. Courses offered included "Principles of Ecological Economics", "Global Development Issues and Energy Economics"; "Law, Society and the Environment"; "Social Problems: Research Methods and Theories"; "Statistics for Research"; "Environmental Law"; etc. The position has also included the organization of field courses on: "US-Mexico Interface: The Border-

An Introduction to Latin America"; "Globalized Sustainable Development: A Contradiction?"; "Socialism, Democracy and Conservation"; "Costa Rica and the New Millennium: Studies on Holistic Resource Management and Sustainable Development in Developing Nations"; "Peru, Conservation Systems and Culture" in Mexico, Costa Rica, Cuba, Nicaragua, Panama, Venezuela, Bolivia and Peru. The position included research in the same areas of inquiry and experience in grant writing and project management.

Program Coordinator (Chair)
Cultural and Regional Studies, Resident Degree Program, Prescott College, Prescott, Arizona, USA
July 2002-January 2005.
In charge of academic coordination, administration, curriculum design and budgeting for the Cultural and Regional Studies program at Prescott College. This area includes competence areas in Latin American, Eastern European, African and other Regional Studies, Religion and Philosophy, Border Studies, Gender Studies, Political Economy and Peace Studies.

Graduate Advisor
Master of Arts Degree, Prescott College, Prescott, Arizona, USA
January 1999-June 2008.
Advise students of a Master of Arts graduate program in different areas of social and environmental sciences: Latin American Studies, Ecological Economics, International Development, Sustainable Development, Sustainable Small Scale Fisheries, Geography and Ecosystem Management.

Program (Academic) Director/Acting Field Director
Center for Sustainable Development Studies-The School for Field Studies, Atenas, Alajuela, Costa Rica.
Program: Sustainable Development Studies,
September 1997-January 1999.
Directed study abroad undergraduate field program addressing options for sustainable development in developing nations. This program is based on a case study, experiential education model. Duties included field teaching in different subjects of Environmental Policy, Natural Resource/Watershed Management and Ecological Economics with special emphasis on natural resource valuation. I was also in charge of personnel and academic coordination. Advising and coordinating research projects according to a conservation project program were also part of the duties. This position entailed an affiliation as ***Lecturer*** with ***Boston University*** in Boston Massachusetts, through which students attending the center program get undergraduate credit in their respective universities.

Resident Faculty,
Center for Sustainable Development Studies-The School for Field Studies, Atenas, Alajuela, Costa Rica. *August 1992-September 1997.*
Professor of an "Ecological Economics, Ethical and Juridical Aspects of Sustainable Development" course in a multi-disciplinary undergraduate field program on sustainable development. Course included a strong component in allocative and biophysical methods of natural resource valuation. Duties included design, field lecturing and execution of research projects in Ecological Economics and Environmental La. Duties also included case study design and coordination in areas relative to international interdependence and its implications for

sustainable development. This position entailed also an affiliation as ***Lecturer*** for ***Boston University*** in Boston Massachusetts, through which students attending the center program get undergraduate credit in their respective universities.

IV- Recent Grants Awarded and Executed (Selection, team leader or co-leader). Marked * include work with watersheds/water resources.

* Aguilar González, B., et al.. (2017) Restauración, conservación y manejo sostenible de los manglares de Costa Rica y Benín frente al cambio climático ***("Restoration, conservation and sustainable management of mangroves in Costa Rica and Benin to address climate change")*** Grant provided by the French Fund for the Global Environment.

* Carranza, M. et al. (2015) Plan General de Manejo de la Zona Protectora Tivives (***General Management Plan for the Tivives Protected Zone***). Grant provided by the Second Debt for Nature Swap Program to Fundación Neotrópica.

* Carranza, M. et al. (2015) Plan General de Manejo de la Zona Protectora Cerros de Escazú (***General Management Plan for the Cerros de Escazú Protected Zone***). Grant provided by the Second Debt for Nature Swap Program to Fundación Neotrópica.

Aguilar González, B., et al.. (2015) ***"Potential Socio-Ecological Costs of Cocaine Trafficking in Central America"*** subproject in McSweeney, K. et. al. (2015) ***Evidence for Drug Policy Reform: Drugs, Deforestation, and Skewed Development in Rural Central America***. Grant provided by the Open Society Foundation to Ohio State University.

* Aguilar-González, B., et. al. (2013) Comunidades Azules: Desarrollo Social y Transferencia de Experiencias de Gestión y Conservación Comunitaria en Comunidades Costeras del Pacífico de Costa Rica (***Blue Communities: Social Development and Transference of Experiences in Community-Based Conservation and Management in Coastal Communities of the Costa Rican Pacific***). Grant provided by the Swiss Embassy to Fundación Neotrópica.

* Aguilar-González, B. et al. (2013) Revisión y Actualización del Plan General de Manejo del Refugio de Vida Silvestre Mixto Maquenque (***Revision and Updating of the General Management Plan for the Maquenque Mixed Wildlife Refuge***). Grant provided by the Second Debt for Nature Swap Program to Fundación Neotrópica.

Aguilar-González, B., et. al. (2012) Promoción del Turismo Rural Comunitario para el Fortalecimiento Institucional del Parque Nacional Rincón de la Vieja y la Protección de Bosques en el Área de Conservación Guanacaste, Costa Rica (***Promotion of Rural Community-Based Tourism for the Institutional Strengthening of Rincón de a Vieja National Park and the Proteciton of Forests in the Guanacaste Conservation Area, Costa Rica***). Grant provided by the First Debt for Nature Swap Program to Fundación Neotrópica.

Matzdorf, B., Sattler, C., et. al. (2011) ***The capacity of civil society organizations (CSOs) and their networks in community based environmental management***. Grant provided by the FP7 Program of the European Union, to the ZALF Institute, Germany. Partnership with organizations from Germany, Austria, Switzerland, The Netherlands and Brazil with field sites in Brazil and Costa Rica (Fundación Neotrópica).

Monge, A., Aguilar, B. et. al. (2010). Promoción del Turismo Rural Comunitario para la conservación de los bosques en el Área de Conservación Osa (***Promotion of Rural Community-Based Tourism for the Conservation of Forests in the Osa Conservation Area***). Grant Provided by the First Debt for Nature Swap Program, Costa Rica to Fundación Neotrópica.

* Amengkapoe, C. and Aguilar, B. (2009). ***Project to Support the Sustainable Management and Conservation of the Biodiversity in the Mangroves of the GBAGA Channel in Benin and the Golfo Dulce in ACOSA Costa Rica.*** Grant Provided by the government of Holland under the South South Cooperation Program administered by Fundecooperación, Costa Rica. Partnership with NGO from Benin, West Africa. Executed locally by Fundación Neotrópica).

* Moulaert, A. et. al. (2008) ***ECOTICOS (Technological, Institutional and Conceptual Solutions for the Sustainable Development of the Térraba-Sierpe Mangrove of Costa Rica).*** In charge of Multicriteria Analysis Component. Partnership with University of Vermont and other organizations from the US and Costa Rica. Grant provided by the Blue Moon Foundation, USA, Executed locally by Fundación Neotrópica.

* Sisk, T., Muñoz-Erickson, T., Aguilar-González, B. and Loesser, M. (2004) ***Assessing The Effectiveness Of The Holistic Ecosystem Health Indicator (HEHI) As A Monitoring Tool To Evaluate The Adaptive Capacity Of Community-Based Collaboratives***. Grant provided by the Community Based Collaborative Research Consortium, University of Virginia, USA.

Fernandez-Giménez, M., Muñoz-Erickson, T., Aguilar-González, B. and Curtin, C. (2004) ***Assessing the Adaptive Capacity of Collaboratively Managed Rangeland Ecosystems.*** Grant provided by the Community Based Collaborative Research Consortium, University of Virginia, USA.

* Sisk, T., Muñoz-Erickson, T., Loesser, M., Bayha, J. and Aguilar-González, B. (2003) ***A Tool For Sustainability: Measuring Outcomes with Indicators of Ecosystem Health.*** Grant provided by the Environmental Protection Agency P3 Award Program, USA.

V- Consulting Experience (Selection, team leader or co-leader). Marked * include work with watersheds/water resources.

Fundación Neotrópica
San José, Costa Rica. July 2008-current:

* Fundación Neotrópica (2016) **Valorización económica ecológica de las mejores tecnologías de Manejo Sostenible de la Tierra y diseño de un mecanismo de financiamiento para su implementación en las cuencas de los ríos Parita y Tonosí en la República de Panamá *(Ecological economic valuation of the best technologies for Sustainable Land Management and design of a funding mechanism for implementation in the Parita and Tonosí watersheds in the Republic of Panama)*** for FAO-GEF and the Ministry of the Environment, Parita and Tonosí Watersheds, Provinces of Herrera and Los Santos, Panama.

* Adelphi Gmbh y Fundación Neotrópica (2016) **Servicios de Consultoría para la asesoría del Programa "Manejo de Recursos Naturales con Pueblos Indígenas en Centroamérica" *(Advise Consulting Services for the "Natural Resource Management with Indigenous Peoples in Central America" Program)*** for Asociación Coordinadora Indígena y Campesina de Agroforestería Comunitaria de Centroamérica – ACICAFOC/KFW, several sites, Central America.

* Fundación Neotrópica Sub-contract for Segura Bonilla O. (2016) **Valoracion del Daño Ambiental Ocasionado por la Deforestacion en el Area de Influencia del Proyecto Paraguay Biodiversidad *(Valuation of Environmental Damages Caused by Deforestation in the Influence Area of the Paraguay Biodiversity Project)*** for Proyecto Paraguay Biodiversidad-ITAIPU, Paraguay.

* Fundación Neotrópica & Earth Economics (2015) ***Triggering investments in Sustainable Land Management in Panama through an assessment of the Economic Value of Land and the Identification of Incentives and Market-Based Mechanisms*** for MINAE and the General Mechanism of the United Nations Convention to Combat Desertification, Jesús María Watershed, Costa Rica.

Aguilar, Bernardo (2015) ***"Estudio sobre la conflictividad generada por proyectos de extracción minera en Guatemala" (Study on the conflicitivty generated by mining extraction in Guatemala).*** For UNDP, Guatemala.

* Aguilar, Bernardo (2015) ***"Curso sobre Valoración Económica de los Bienes y Servicios Ecosistémicos y Evaluación de Algunos de los Estudios Realizados en el País" (Course on the Economic Valuaiton of Environmental Gods and Services and Evaluation of Some National Studies)*.** For UNDP, IES and CITMA, La Habana, Cuba.

* Fundación Neotrópica & Earth Economics (2013) ***Triggering investments in Sustainable Land Management in Panama through an assessment of the Economic Value of Land and the Identification of Incentives and Market-Based Mechanisms*.** For Autoridad Nacional del Ambiente and the General Mechanism of the United Nations Convention to Combat Desertification, Cerro Punta, Chriquí, Panamá.

* Fundación Neotrópica (2012) ***Identificación de actividades viables de producción sostenible para pobladores de la Reserva Forestal Golfo Dulce (Identification of viable sustainable productive activitiesfor the population of the Golfo Dulce Forest Reserve)*** For the Iniciativa Osa y Golfito of the Woods Institute for the Environment, Stanford University, San José, Costa Rica.

Fundación Neotrópica & Earth Economics (2012) ***Consultoría para Valorar, en Cumplimiento a la Solicitud de la Procuraduría General de la República en Oficio PGR-168-2011, Mediante Una Metodología Económico-Ecológica de Valoración Rápida y la Información Apropiada, los Posibles Daños Ambientales que Causó la Tala Rasa Ejecutada en las Fincas Propiedad de Industrias Infinito Sociedad Anónima según Resolución 244-2008-SCH del Área de Conservación Huetar-Norte.(Consultancy to Value, in Fulfillment of the Request of theNational General Attorney in Note PGR-168-2011, Through a Fast Ecological-Economic Methodology and the Appropriate Information, the Possible Damages Caused by the Tree Removal in the Farms of Industrias Infinito Sociedad Anónima According to the Resolution 244-2008-SCH from the Huetar-Norte Conservation Area).*** For the Ministry of the Environment, Energy and Telecommunications, San José, Costa Rica**.**

Fundación Neotrópica (2011) ***Consultoría en Diseminación, y Validación de Estudio de Valoración Económico Ecológica de los Daños Ambientales Causados por las Acciones del Gobierno de Nicaragua en la Región de Isla Portillos en el Humedal Nacional Caribe Noreste y de Explicación de las Decisiones de la Corte Internacional de Justicia de la Haya. (Consultancy in Dissemination and Validation for the Ecological Economic Valuation of Environmental Damages Caused by the Actions of the Government of Nicaragua in the Region of Isla Portillos in the Caribe Noreste National Wetland and Explanation of the Decisions of the International Court of Justice at The Hague).*** For the Ministry of Foreign Relations, San José, Costa Rica.

Fundación Neotrópica (2010) ***Consultoría para el Diseño e Impulso del Componente de Turismo Rural y Comunitario en el Marco del Programa Conjunto "Desarrollo de la Competitividad para la Región Brunca en los Sectores de Turismo y Agroindustria, con Énfasis en la Creación de Empleos Verdes y Decentes para la Reducción de la Pobreza" (Consultancy for the Design and Impulse of a Rural Community Tourism Component in the Framework of the Program "Development of Competitiveness for the Brunca Region in the Sectors of Tourism and Agro-industry with Emphasis in the Creation of Green Employment for the Reduction of Poverty").*** For the United Nations Development Program, San José, Costa Rica.

V- Legal Experience in Courts and in Private Practice:

Minor Claims Judge,
Supreme Court of Justice, San José, Costa Rica*. May 1992-September 1992:*
Minor claims judge serving different courts in the Central Valley of Costa Rica. Jurisdictions served included Misdemeanors Criminal Law, Family Law and Transit Law.

Attorney at law,
Grupo 185, San José, Costa Rica. *January 1992-May 1992:*
Emphasis on Agrarian, Labor and Environmental Law. Handling of cases and court decision studies in these matters.

Attorney at Law,
Umaña, Soto & Asocs., San José, Costa Rica, *September 1987-September 1989:*
Emphasis on Agrarian, Labor and Environmental Law. Handling of cases and court decision studies in these matters.

VI- Guest Lectures and Peer Reviewing

- Class and field guest lecturer in the fields of sustainability, Latin American Studies, Ecological Economics and Valuation of Natural Resources at various institutions including:
Institute for Central American Development Studies; Organization for Tropical Studies; Associated Colleges of the Midwest, University of Costa Rica, United Nations University and University of Tokyo, Japan in Costa Rica. University of Pennsylvania, Dickinson College, Bates College, University of New Hampshire, Middlebury College, Colby College, Rensselaer Polytechnic Institute, University of Massachusetts, Monterey Institute for International Studies and Verde Valley School in the United States.
Peer Reviewer for *Ecological Economics, Ecosystem Health, Ecology and Society & Quarterly Review of Biology.*
Former member of the editorial board of *Ecosystem Health*

Education (Chronological)

I- Higher Education

Collaborative Program (Universidad Nacional, Instituto Tecnológico de Costa Rica, Universidad Estatal a Distancia, Universidad Nacional Autónoma de México, Universidad Autónoma de Chapingo), San José, Costa Rica. *Current with expected end by December 2017.*
PhD. in Natural Sciences for Development Program. Currently in candidacy (ABD) with an approved dissertation proposal: ***"Una Estimación de la Deuda Ecológica de la Zona Urbana Metropolitana por Medio de la Valoración Alternativa Económica-Ecológica para la Zona Protectora Cerros de La Carpintera en el Valle Central de Costa Rica. [An Estimation of Ecological Debt of the Metropolitan Urban Area through an Alternative Ecological Economic Valuation for the Cerros de la Carpintera Protected Zone in the Central valley of Costa Rica]."***

University of Georgia, Athens, Ga. USA. *September 1989-December 1991:*
Masters of Science in Agricultural and Applied Economics with emphasis in Applied Economics, international coffee trade and econometric methods. Thesis: Aguilar, B. ***"A Free Coffee Market? Consequences of the Suspension of Economic Clauses in the International Coffee Agreement."*** 1991 .

Universidad de Costa Rica, San José, Costa Rica*. February 1988-February 1989:*
Specialist (credits equivalent to LLM) in Agrarian and Environmental Law. Studies focused on management powers and the distribution of proceeds in agrarian enterprises.

Universidad de Costa Rica, San José, Costa Rica*. February 1979-October 1987:*
Attorney at law (equivalent to Juris Doctor). Thesis: Aguilar, B. & A. Torrealba. ***"El Perfil Funcional de la Organización Subjetiva en la Empresa de Reforma Agraria (Contribuciones a la Búsqueda de un Modelo Optimo para Costa Rica). [The Functional Profile in the Subjective Organization of Land Reform Enterprises (Contributions to the Search for an Optimal Model for Costa Rica)]."***. 1987. Approved with distinction.

II- Other Training Programs:
Available upon request

Publications and Other Professional Products

I- Books

Aguilar, B. (2002) ***Paradigmas Económicos y Desarrollo Sostenible: La Economía al Servicio de la Conservación (Economic Paradigms and Sustainable Development: Economics for Conservation)***. San José, Costa Rica, Editorial UNED. (working now in English translation).

II- Book Chapters (Selection after 2000)

Sepúlveda-Machado, M. & Aguilar-González, B. (2015) ***Significance of blue carbon in ecological aquaculture in the context of interrelated issues: A case study of Costa Rica*****. In: S. Mustafa & R. Shapawi, edits.** ***Aquacultre Ecosystems. Adaptability and Sustainability*****. West Sussex, UK: John Wiley & Sons, pp. 182-242.**

Raes, L.; Moss, D.; Aguilar-González, B.; Kim, V.; Slusser, J.; Cslle, Z.; Murgueitio, E.; Maldonado, J.; Hall, J. (2015) ***Society and Water Related Ecosystem Services*****. In Hall, J.; Kim, V.; Yanguas, E. eds.** ***Managing watersheds for ecosystem services in the steepland Neotropics*****. Smithsonian Research Institute-Interamerican Development Bank, pp. 67-83.**

Aguilar-González, B. (2014) ***Decisiones deliberativas bajo un enfoque multicriterial para Latinoamérica (Participatory Decision-making through Multicriterial Analysis for Latin America)*** **. In Vallejo, M.C. & M. Aguado (eds.)** ***Reflexiones sobre los límites del desarrollo.*** **FLACSO, SENPLADES: Quito, Ecuador, pp. 83-130.**
https://drive.google.com/file/d/0B2pWR5tBjlFTZ0pzTTJCSl9NNGs/view?usp=sharing

Aguilar González, B., (2013) ***Deuda Ecológica y Justicia Ambiental. Aplicación en América Latina y Especificidades de Costa Rica (Ecological Debt and Environmental Justice. Case Studies from Latin America with Specificities for Costa Rica)*****. In Pengue, W. & H. Feinstein (eds.). Nuevos enfoques de la Economía Ecológica. Editorial Lugar, Buenos Aires, Argentina.**
https://drive.google.com/file/d/0B2pWR5tBjlFTWjBDa2JlNnh6RTg/view?usp=sharing

Aguilar González, B., (2013) ***Deuda Ecológica y Justicia Ambiental. Aplicación en América Latina y Especificidades de Costa Rica (Ecological Debt and Environmental Justice. Applications in Latin America with***

Emphasis in Costa Rica)*. In Pengue, W. & H. Feinstein (eds.). *Nuevos enfoques de la Economía Ecológica (New Foci of Ecological Economics) Editorial Lugar, Buenos Aires, Argentina.

Aguilar-González, B., & Moulaert-Quirós, A. (2013). *ECOTICOS: Multidimensional Valuation for Environmental Conflict Analysis in Costa Rica*. In H. Healey, J. Martínez-Alier, L. Temper, M. Walter, & J. Gerber, *Ecological Economics from the Ground Up.* London: Earthscan-Routledge.
https://drive.google.com/file/d/0B2pWR5tBjlFTbWJPN1I3M21XcXM/view?usp=sharing

Aguilar-González, B., et. al. (2010) *Keys to the Western Economy; An Ecologist Outlook. Interviews by Carlos Rivas.* Editorial Kaycron: Buenos Aires, Argentina.

Aguilar-González, B. (2010) Entries: *Aztlan* (with Chang, J.*), Costa Ricans* (with Chang, J. and Leonard, D.), *El Grito, Latino Studies* and *Soccer.* In Leonard, D. and Lugo-Lugo, C. (eds.) ***Latinos and Latinas in US History and Culture: An Encyclopedia***. M.E. Sharpe, Inc, Armonk, NY, pp. 58-59, 140-141; 220-221;290-291;500-503.

Aguilar-González, B. (2007) *La valoración económico-ecológica y la presente coyuntura socioecológica latinoamericana (Ecological economic valuation and the current socioecological juncture in Latin America).* UICN-UNA. Valoración económica, ecológica y ambiental. Análisis de Casos en Iberoamérica, Editorial Universidad Nacional de Costa Rica, Heredia, Costa Rica. pp. 29-31.

Aguilar-González, B. (2007) *Reflexiones y Estudios de Caso Utilizando una Teoría Mutidimensional del Valor: Recomendaciones para Centro América (Reflections and Case Studies Using a Multidimensional Theory of Value: Recommendations for Central America).* UICN-UNA. Valoración económica, ecológica y ambiental. Análisis de Casos en Iberoamérica, Editorial Universidad Nacional de Costa Rica, Heredia, Costa Rica. pp. 35-78 .
https://portals.iucn.org/library/efiles/documents/2007-054.pdf

Muñoz, T., Loesser, M. and B. Aguilar (2004) *Identifying Indicators of Ecosystem Health for a Semiarid Ecosystem: A Conceptual Approach* in van Ripper III, C. and Cole, K. (ed) *The Colorado Plateau. Cultural, Biological and Physical Research.* Tucson, University of Arizona Press. PP. 139-152..

Aguilar, B. & Semanchin, T. (2002) *The Implications of Ecological Economic Theories of Value to Cost-Benefit Analysis: Importance of Alternative Valuation for Developing Nations with Special Emphasis on Central America*. In Puttaswamaiah, K. (ed.) *Cost-Benefit Analysis. Environmental and Ecological Perspectives.* New Brunswick: Transaction Publishers. pp. 367-420.

Hall, C.; Hall, M. & Aguilar, B. (2000) *A Brief Historical and Visual Introduction to Costa Rica*. in Hall, C., et. al. (ed.) *Quantifying Sustainable Development. The Future of Tropical Economies*. San Diego, Academic Press. PP. 19-44.

Aguilar, B. & Klocker, J. (2000) *The Costa Rican Coffee Industry.* in Hall, C., et. al. (ed.) *Quantifying Sustainable Development. The Future of Tropical Economies*. San Diego, Academic Press. PP. 595-628.

III- Refereed and Invited Journal Articles:

Aguilar, B. & P. Cerdán (2016) ***Economia social y solidaria en los humedales costeros de Costa Rica frente al cambio climático (Social and solidarityy economy in the coastal wetlands of Costa Rica to address climate change).*** **Ambientico 258. Pp.63-69.**

Aguilar, B. (2015) ***Deuda Ecológica e Injusticia Ambiental en Áreas Protegidas Suburbanas: Estudio de Caso en la Zona Protectora La Carpintera en Costa Rica.*** **Revista de Investigaciones Económicas de la Universidad de Panamá. Vol. 10, N. 2. pp. 70-86**

Aguilar, B. (2015) ***Efectos Económico-Ecológicos de la Degradación del Suelo en Panamá: Estudio de Caso en Cerro Punta, Chiriquí. (Ecological Economic Effects of Land Degradation in Panama: A Case Study of Cerro Punta, Chiriquí).*** **Revista de Investigaciones Económicas de la Universidad de Panamá. Vol. 8, N. 2. pp. 57-62**

Muñoz-Erickson, T., B. Aguilar-González, M.R. Loeser y T.D. Sisk. (2010) ***A Framework to Evaluate Ecological and Social Outcomes of Collaborative Management: Lessons from Implementation with a Northern Arizona Collaborative Group (Un Marco para Evaluar los Resultados Ecológicos y Sociales del Manejo Colaborativo: Lecciones de la Implementación con un Grupo Colaborativo en el Norte de Arizona)*****.** Environmental Management. Vol. 45, N. 1. PP. 132-144. DOI 10.1007/s00267-009-9400-y.

Aguilar González, B. (2009) ***El índice integral de salud de ecosistemas (ISEE): un indicador multicriterio de sustentabilidad netamente latinoamericano (The holistic ecosystem health indicator (HEHI): A truly latin american multicriteria indicator of sustainability)****.* Revista Iberoamericana de Economía Ecológica. Vol. 13: 57-77. URL: http://www.redibec.org/IVO/rev13_05.pdf

Aguilar González, B. (2008) ***Oportunidades para la Economía Ecológica y la Ecología Política en Costa Rica: La Zona Protectora Cerros de La Carpintera y Otros Parques de Papel en el Valle Central (Opportunities for Ecological Economics and Political Ecology in Costa Rica: The Cerros de la Carpintera Protected Zone and Other Paper Parks in the Central Valley)*****.** Revista Economía y Sociedad. Vol 13, No 33-34. URL: https://www.google.co.cr/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCsQFjAA&url=http%3A%2F%2Fwww.revistas.una.ac.cr%2Findex.php%2Feconomia%2Farticle%2Fdownload%2F83%2F53&ei=L9abUoD8FdGPkAeV7YCYBA&usg=AFQjCNHPTfFb7U4dy7gFyCyk36EdlSCbPQ

Muñoz-Erickson, T. A., B. Aguilar-González, and T. D. Sisk.(2007) ***Linking ecosystem health indicators and collaborative management: a systematic framework to evaluate ecological and social outcomes.*** Ecology and Society 12(2): 6. [online] URL: http://www.ecologyandsociety.org/vol12/iss2/art6/

Muñoz-Erickson, T. and Aguilar-González, B. (2004) ***Evaluating the Ecological and Social Outcomes of Collaborative Management: Ecosystem Health Indicators for Monitoring Effectiveness*****.** Journal of Community-Based Collaboratives Research. Spring 2004.

Aguilar, B. (1999) ***Applications of Ecosystem Health for the Sustainability of Managed Ecosystems in Costa Rica.*** Ecosystem Health. (5)1: 36-48. http://onlinelibrary.wiley.com/doi/10.1046/j.1526-0992.1999.09905.x/abstract

Aguilar, B. & Semanchin, T. (1998) ***The Implications of Ecological Economic Theories of Value to Cost-Benefit Analysis: Importance of Alternative Valuation for Developing Nations with Special Emphasis on Central America.*** Indian Journal of Applied Economics (7)3: 367-420. URL: http://www.ots.ac.cr/bnbt/19678.html

IV- Published Invited Reviews:

From 2000, 11 invited reviews in topics of Ecological Economics, sustainability and managed ecosystems for the Quarterly Review of Biology, from SUNY Stony Brook, USA. Details are available upon request.

V- Technical Reports:

Available upon request. More than 30 technical reports from products related to consultancy and project work.

VI- Newspaper and Magazine Articles

More than 50 articles published in Costa Rican, Nicaraguan and US (Arizona) daily newspapers on topics of Ecological Economics, Natural Resource Valuation, Radical Experiential Education, Collaborative Conservation, Wetland Conservation, Sustainability Studies, Latin American/Border Studies, Migration Studies and Environmental Law. More details are available upon request.

VII- Keynotes, Invited Presentations, Panels and Lectures.

More than 20 keynotes and invited presentations and panel participations in expertise areas in Costa Rica, Argentina, Ecuador, USA, México, Russia, Ecuador and Brazil. Details are available upon request.

.

VIII- Professional and Scientific Meeting Presentations/ Professional and Scientific Meeting Proceedings:

Over fifty presentations at professional and scientific meetings in the Americas, Africa and Europe in topics related to Ecological Economics, Natural Resource Valuation, Radical Experiential Education, Collaborative Conservation, Wetland Conservation, Sustainability Studies, Latin American/Border Studies, Migration Studies and Environmental Law. Details are available upon request.

IX- Radio Interviews

Over one hundred appearances at interviews and talk radio programs in radio stations in the United States, Mexico, Russia, The Netherlands, Nicaragua, Venezuela and Costa Rica in topics related to Ecological Economics, Natural Resource Valuation, Collaborative Conservation, Wetland Conservation, Sustainability Studies, Latin American/Border Studies, Migration Studies and Environmental Law. Details are available upon request.

Other Synergistic activities

Including TV appearances and others are available upon request.

Honors

Bernardo Aguilar Award. *Created by the students of the United States Society for Ecological Economics for the member that has inspired more students/practitioners to work in the field of Ecological Economics. 2003.*

Certificate of Recognition for Outstanding Contribution to Cultural Exchange and International Understanding*, University of Georgia, June 1991.*

Phi Beta Delta Honor Society for International Scholars, *Tau Chapter, University of Georgia,* April 1991.

Fulbright Scholarship, *United States Information Service****,*** *Scholarships for Peace Program,* 1989-1991.

US AID Short Training Scholarship for Student Leaders*, Scholarships for Peace Program,* October-December 1985.

Professional Affiliations

Lawyers Bar of Costa Rica since 1987.
American Association of Agricultural Law 1989-1991.
American Association of Agricultural Economics 1990-2000.
International Society for Ecological Economics since 1993. Newsletter editor 2007-2010.
International Society for Ecosystem Health and Medicine 1994 – 2003 Member of the Board of Directors 1997-1999, Member of the Advisory Board 1999-2003.
United States Society for Ecological Economics since 2000 – Member of the Board of Directors 2004-2006, 2007-2011. Newsletter editor May 2006-2009. Nominated for the President-Elect Position (2006).
Mesoamerican and Caribbean Society for Ecological Economics since 2008. Member of the Board of Directors, 2010, President of the Board 2010-current.
National Association of Ethnic Studies 2003.
Association for Borderland Studies 2003.
Costa Rican Economists Professional Association since 2012.

Volunteer Work/ Board Participation

Banco Popular y de Desarrollo Comunal
San José, Costa Rica
Member in representation of the Ministry of the Presidency. 2014-2017.

National Conservation Area Council
San José, Costa Rica
Member in representation of Central Volcanic Range Conservation Area. 2013 to the 2017.

Earth Economics
Tacoma, Washington, USA
Advisory Group Member. 2012 to the present.

Biodiversity Partnership Mesoamerica
San José, Costa Rica
Executive Board Member. 2012 to 2015.

Regional Conservation Area Council-Central Volcanic Range Conservation Area
San José, Costa Rica
Board Member in representation of environmental NGOs. 2009 to the present.

José Figueres-Ferrer Museum,
La Lucha Sin Fin, Costa Rica
Board member, June 2008 to the present.

Aztlan Center for Immigrant Resources, *Prescott College for the Liberal Arts and the Environment, Prescott, Arizona.*
Member of coordinating group. Fall 2000-2008.

Arizona Coalition for Migrant Rights
Board member December 2005-2007

Technical Skills

Languages: Spanish (native speaker), English (fluent speak read and write), Italian (basic speaking, fluent reading and basic writing), Portuguese (basic speaking, fluent reading and basic writing), Russian (basic speaking, reading and writing).

Computers: spreadsheets; statistics and econometric packages and Gauss language; databases; telecommunications; mathematical; word processors; utilities in general.

Personal

Costa Rican citizen. Born on September 19, 1961 in San José, Costa Rica: Good health. More details available upon request.

References

Available upon request.

Annex 2

Review of the report by G.M. Kondolf Phd (Annex 2),
by Professor Colin R Thorne,

28 July 2017

Review of the report by G. M. Kondolf PhD (Annex 2)

in

COUNTER-MEMORIALOF THE REPUBLIC OF NICARAGUA ON COMPENSATION
(02 June 2017)

by

Professor Colin R. Thorne

25 July 2017

BACKGROUND

I am Colin Thorne, Professor of Physical Geography at the University of Nottingham. I have been requested by Costa Rica to prepare an independent expert review for the International Court of Justice in response to Annex 2 of the Counter Memorial of Nicaragua, which was submitted to the International Court of Justice on 2 June 2017, in the *Case Concerning Certain Activities Carried out by Nicaragua in the Border Area (Costa Rica v Nicaragua)*. Annex 2 is authored by Dr G. Mathias Kondolf and dated May 2017. It is titled, 'Review of Costa Rica's Claims for Compensation in the Río San Juan Delta'. The text may be found on pages 151 – 162, and supporting images are on pages 163 – 188.

MY QUALIFICATIONS

I hold the Chair of Physical Geography at the University of Nottingham, United Kingdom. I have BSc and PhD degrees in Environmental Science from the University of East Anglia, United Kingdom. I have over 40 years professional experience in matters relating to physical geography and environmental science. My research concentrates on fluvial hydraulics and sediment transport in natural, modified and managed rivers, particularly with respect to the implications for erosion, sedimentation, and flood risk.

MY EXPERT REPORTS IN THE *CERTAIN ACTIVITIES* CASE TO DATE

In the *Certain Activities* Case, I have previously submitted:

1. an independent expert report titled "Assessment of the physical impact of works carried out by Nicaragua since October 2010 on the geomorphology, hydrology and sediment dynamics of the San Juan River and the environmental impacts on Costa Rican territory"[1], which is Appendix 1 to Costa Rica's Memorial (the ***First Report***). In my First Report, I discuss the impact of the *caño* constructed between the San Juan River and Harbor Head Lagoon (the ***2010 caño***) and of Nicaragua's dredging program on the San Juan River.
2. another independent report, titled "Report on the Impact of the Construction of two New Caños on Isla Portillos"[2] dated 10 October 2013, which was prepared following Nicaragua's further works in the northern part of Isla Portillos in 2013, and in the context of the Hearings for new provisional measures requested by Costa Rica against Nicaragua (the ***Second Report***). In my Second Report, I discuss the impact of the second and third *caños* constructed between the San Juan River and the Caribbean Sea (the ***West and East caños***).
3. a Written Statement[3] for Cross Examination in the context of the Oral Hearings on the merits for this case, written in March 2015.

DR KONDOLF'S METHODOLOGY IN SUMMARY

The methodological basis for Dr Kondolf's report in Annex 2 of Nicaragua's counter memorial relies on qualitative interpretation of remotely-sensed images of the areas affected by Nicaragua's

[1] C Thorne, "Assessment of the physical impact of works carried out by Nicaragua since October 2010 on the geomorphology, hydrology and sediment dynamics of the San Juan River and the environmental impacts on Costa Rican territory", October 2011; CR Memorial, Appendix I

[2] C. Thorne, "Report on the Impact of the two New Caños on Isla Portillos", 10 October 2013; Costa Rica's Request for the Indication of New Provisional Measures, 23 September 2013, Attachment 33

[3] C. Thorne, "Written Statement", March 2013; Requested by the I.C.J. for the Oral Hearings on the Merits in the case "Certain Activities by Nicaragua in the Border Area (Costa Rica c. Nicaragua)"

activities provided on pages 163 – 188 of Nicaragua's counter memorial. No other scientific or technical observations, measurements or data are provided to support his opinions, which are in summary that:

(1) Nicaragua's works did not impact soil formation or erosion control services[4];

(2) Nicaragua's works also had no impact on the ability of the disputed area to mitigate "natural hazards"[5]; and

(3) the recovery that has already occurred at the site to date indicates that realistic recovery periods range from 1-2 years for refilling the caños, 1-5 years for the regrowth of grass and underbrush, and 4-5 years for the re-establishment of trees sufficient to perform most functions expected from a woodland[6].

MY SUMMARY ASSESSMENT OF Dr KONDOLF'S METHODOLOGY

In Annex 2, Dr Kondolf states that in connection with the Certain Activities case, he has "overflown the river mouth five times from October 2012 to October 2016 and conducted three site visits over the same period, the most recent in October of 2016"[7].

It is clear that Dr Kondolf has both overflown the area affected by Nicaragua's activities and made a site visit as recently as October 2016. This overflight and site visit presented Dr Kondolf with the opportunity to observe and record conditions in the affected areas at first hand. Had he chosen to do so, he could have taken photographs, made measurements of key variables (such as tree height) and collected technical data (for example, measurements defining the properties of sediments in-filling the caños). He would have then been able to analyse and interpret his observations and data as necessary to come to a view regarding the degree to which conditions in the areas excavated and cleared by Nicaragua have recovered. In preparing Annex 2, this course of action would have constituted a scientific and technically-sound methodology.

Due to the weakness of Dr Kondolf's methodology, I believe that the opinions expressed in Annex 2 of Nicaragua's counter memorial have no scientific or technical validity. In the remainder of this report, I set out in more detail my reasons for coming to this conclusion.

CONTEXT FOR RESPONDING TO Dr KONDOLF'S METHODOLOGY

In evaluating damage resulting from the activities that are the subject of the *Certain Activities* Case, it is, in my opinion, necessary to do so in the context that the wetlands affected are designated as being of *International Importance* under the Ramsar Convention on Wetlands (as defined in Ramsar, 1971) and that it was, therefore, unwise for Nicaragua to excavate the 2010 caño (for reasons elaborated in Ramsar, 2010). It follows that excavation of additional caños in 2013, was also unwise. To establish this context it is helpful to consider the content of these two Ramsar documents.

Ramsar (1971) sets out that:

[4] G.M. Kondolf, "Review of Costa Rica's Claims for Compensation in the Río San Juan", May 2017; NCM on Compensation, Annex 2, p. 4 (158)

[5] Ibid, p. 5 (159)

[6] Ibid, p. 6 (160)

[7] Ibid, p. 1 (155)

a. the primary criterion for designation of a wetland as being considered as being of International Importance is that it "contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region"[8]. The significance of wetlands designated as being of International Importance is then clarified by Ramsar's vision for that designation, which is "To develop and maintain an international network of wetlands which are important for the conservation of global biological diversity and for sustaining human life through the maintenance of their ecosystem components, processes and benefits/services"[9].
b. Ramsar's intention in listing a wetland as being of International Importance is clearly expressed in Objective 3 for that designation, which is "To foster cooperation among Contracting Parties, the Convention's International Organization Partners, and local stakeholders in the selection, designation, and management of Ramsar Sites"[10] with the aim of pursuing "opportunities between two (or more) Contracting Parties for Ramsar Site 'twinning' or cooperative management agreements for wetlands along migratory species routes, across common borders, or with similar wetland types or species"[11] and enabling "other forms of cooperative venture between two or more Contracting Parties that can demonstrate or assist in achieving long-term conservation and sustainable use of Ramsar Sites and wetlands in general"[12].
c. When evaluating wetlands, the Ramsar Secretariat specifically endorses the "total value equation"[13] published by the United Nations Environment Programme (DeGroot et al. 2006). This equation accounts not only for a wetland's commercial or consumptive value, but also its *intrinsic value*, which is what Immanuel Kant defined philosophically as its *dignity* (Kant 1781). The UNEP's TEV recognises the right of wetlands and their ecosystems to exist, based on the contributions they make to life on Earth. This establishes that a wetland of international importance should be managed wisely because its value is globally significant, even if protecting and conserving that wetland puts its natural resources beyond commercial reach.

In contextualising my response to the methodological weaknesses in Dr Kondolf's report, I further draw more specifically on 'Ramsar Advisory Mission Report N° 69: North-eastern Caribbean Wetland of International Importance (Humedal Caribe Noreste), Costa Rica' which was issued by the Ramsar Secretariat on 17 December 2010[14], following construction of the 2010 caño, but prior to further vegetation clearance and dredging undertaken by Nicaragua to construct the East and West caños.

Ramsar (2010) is based on a Ramsar Mission carried out between from 27 November to 1 December 2010. This mission report sets out that:

[8] Ramsar Secretariat 1971. Convention on Wetlands of International Importance: Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance, Ramsar (Iran), Section 6.1.1., Criterion 1

[9] Ibid, Section 3.1, para. 10

[10] Ibid, Section 3.2, Objective 3

[11] Ibid, Section 3.1, para. 21

[12] Ibid, Section 3.2, para. 22

[13] De Groot, R.S. Stuip, M.A.M.Finlayson, C.M.Davidson, N."Valuing wetlands: guidance for valuing the benefits derived from wetland ecosystem services" Ramsar Technical Report No. 3/CBD Technical Series No. 27. , 2006, p. 6

[14] Ramsar Secretariat, "Ramsar Advisory Mission Report No. 69: North-Eastern Caribbean Wetland of International Importance (Humedal Caribe Noreste), Costa Rica", 17 December 2010; CR Memorial on the merits, vol. IV, Annex 147

a. the Humedal Caribe Noreste (HCN) of which the affected area is part has been designated as a wetland of International Importance since 20 March 1996.
b. this wetland includes lakes, flooded forests, rivers and estuarine lagoons that are of great importance as a resting place for Neotropical migratory birds. It is also home to several endemic species of salamanders.
c. The wetland's International Importance based on the following criteria:
    i. As a unique or representative wetland, being a natural wetland characteristic of the Costa Rican Caribbean coastal zone.
    ii. It supports species and subspecies of plants and animals that are vulnerable or under threat of extinction.
    iii. It is highly valued as a stronghold of the region's genetic and ecological diversity.
    iv. It is an obligatory stopover for migratory birds from North America, providing shelter for over one million birds that come to rest and feed.
    v. 8 families, 25 genera and 54 species of freshwater fish are registered. Communities of freshwater fish in the freshwater lagoons (80 species) are more diverse than those in the nearby sea (42 species) because large structural heterogeneities exist in the freshwater lagoons in the form of a variety of aquatic vegetation, submerged trees, silt, debris, etc.
    vi. the wetland's aquatic ecosystems provide a stopover site for migratory fish and a breeding site for 26 species of fish. They shelter one of the two populations of Costa Rican Tropical gar and the only population of manatees in Costa Rica - a species that has been declared under threat of extinction.
    vii. 134 species of mainly aquatic migratory birds are found and the aquatic ecosystems support the main patches of yolillo of the Costa Rican Caribbean.
    viii. the wetlands provide a source of fishing products for local inhabitants.
    ix. beach areas provide food and a breeding site for the Green sea turtle (*Chelonia mydas*) and the Leatherback turtle (*Dermochelys coriacea*).
    x. of the 779 plant species present, 36 are endemic to Costa Rica.
    xi. a third of Costa Rica's species of fauna declared under threat of extinction are present in the wetland.
    xii. there are probably around 54 species of amphibians and 110 species of reptiles, many of which are subject to conservation status.
d. Available data on the wealth and abundance of aquatic and terrestrial flora and fauna clearly highlight how valuable the area is in terms of its biodiversity, which is closely linked to the characteristics of its freshwater aquatic and terrestrial ecosystems. The wetland is consequently important for the conservation of Costa Rica's unique species.
e. It is crucial to maintain the river's freshwater discharge and patterns in order to preserve it as a healthy and sustainable wetland in the long term.
f. Deforestation should be avoided so as to prevent the erosion and reduction of aquifer recharge.
g. To maintain the current ecological conditions of the wetland, the surface run-off patterns should be restored.
h. Taking into account the current state of the wetland and in the light of scenarios put forward, it is recommended that the Caribe Noreste Ramsar Site should be included on the Montreux Record (which is a list of wetlands at risk).

i. The designation of sites for inclusion in the List of Wetlands of International Importance should be "on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology" (Article 2, paragraph 2). Under Article 3, paragraph 1, of the Convention, the Contracting Parties are obliged to "formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory".
j. The concept of wise use is one of the three pillars of the Convention and refers to the maintenance of the ecological character through the implementation of ecosystem approaches within the context of sustainable development.

The Ramsar (2010) mission report concluded unequivocally that "The construction of the artificial canal [*i.e. the 2010 caño*] will transform the Laguna los Portillos [Harbor Head Lagoon] and wetland island … from an ecosystem with numerous habitats (structural heterogeneity) to a single, more extensive habitat dominated by the condition imposed by the San Juan River … The partial flooding of the wetland due to the construction of the artificial canal and the clearing of vegetation would alter the distribution and abundance of terrestrial species through the loss of habitat and reduction of food supply and shelter; [it would isolate an important zone of wetland] from the remainder of the wetlands located on the Isla Portillos, turning it into a barrier for terrestrial fauna with restricted mobility"[15].

Despite Ramsar's recommendations, Nicaragua constructed two further caños following issue of Ramsar's 2010 mission report.

It is in the context of the general vision and values shared by all parties to the Ramsar Convention (Ramsar 1971), and more specifically, the reasons for designation of wetlands in the HCN as being of International Importance damaged by and at risk following Nicaragua's activities (Ramsar 2010), that I have reviewed and responded to Dr Kondolf's methodology.

SUMMARY RESPONSE TO Dr KONDOLF'S OPINION

Dr Kondolf's methodological approach leads him to the opinion that Nicaragua's works did not impact soil formation or erosion control services, had no impact on the ability of the disputed area to mitigate "natural hazards", and that the recovery that has already occurred at the site to date indicates that realistic recovery periods range from 1-2 years for refilling the caños, 1-5 years for the regrowth of grass and underbrush, and 4-5 years for the re-establishment of trees sufficient to perform most functions expected from a woodland.

In my opinion, specific methodological weaknesses in Dr Kondolf's science regarding soil formation, erosion processes, flood risk and replacement of primary by secondary forest render these opinions ill-founded. This is great significance because, if accepted, Dr Kondolf's opinions would render ineffective much of the protection currently provided to wetlands of International Importance within Nicaragua by their Ramsar designation. This is the case because, intentionally or unintentionally, Dr Kondolf's expert opinion may be interpreted as indicating that damage to wetlands protected under the Ramsar Convention that is caused by dredging, channel excavation and forest clearance is largely inconsequential and, in any case, time-limited, with recovery expected within 5 years or less.

[15] Ramsar Secretariat, "Ramsar Advisory Mission Report No. 69: North-Eastern Caribbean Wetland of International Importance (Humedal Caribe Noreste), Costa Rica", 17 December 2010; CR Memorial on the merits, vol. IV, Annex 147, p. 124-125

DETAILED RESPONSE

In the following sub-sections, I justify my summary response based on my review of methodological weaknesses in science underpinning Dr Kondolf's first and second opinions (on soil formation or erosion control services and absence of impact on the ability of the disputed area to mitigate natural hazards) with respect to:

(a) the time necessary for river-deposited sediments filling the caños to evolve into wetland soils, and;
(b) why disturbance did materially reduced the wetland's capacity to mitigate natural hazards and how long it may take for it that capacity to recover to its pre-disturbance value.

In responding to Dr Kondolf's third opinion (that 4-5 years of secondary growth is sufficient for the re-establishment of trees sufficient to perform most functions expected from a woodland), I will evaluate his scientific methodology by drawing on the relevant academic and peer-reviewed literature to substantiate my opinion that:

(c) it is accepted within forest ecology that several of the most valuable functions of primary forest like that felled by Nicaragua can never be replicated by secondary forest, and it takes decades to centuries for a secondary forest to mature to the point that it provides most of the functions expected from a primary forest.

(A) Impacts of river-deposited sediments in-filling the caños and time need for them to evolve into wetland soils

Dr Kondolf's opinion that Nicaragua's works did not impact soil formation or erosion control services in the wet woodland because the caños soon filled in is misconceived. This is because there is a world of difference between recently-deposited, mineral, river sediments and soil, and formation of an organic soil by natural, bio-chemical and physical processes takes decades to millennia. Dr Kondolf states on page 157 of his report that "the caños have filled in with sediment"[16]. In the context of what follows here, it is significant that Dr Kondolf confirms that it is *sediment* and not *soil* that is currently being deposited in the caños.

On this topic, on page 119 of the the Ramsar mission report of 2010, Ramsar scientists noted that, "Soil changes can be expected….. This will lead to changes in the geochemical characteristics of the soil…... Sediment from the San Juan River will alter the original structure of the soil in the island wetland, since the soil particle size (sand, silt, clay) and the ionic exchange with the shallow saturation will be mixed with the different sediments and water quality provided by the San Juan River and diverted towards the Laguna Los Portillos via the artificial canal."[17]

The fact is that the properties of sediment and soil differ by practically every measure of significance, due mainly to the relative absence of organic matter, humus and microbial life from the former and its great abundance in the latter. There is literally a biological world of difference between a body of freshly deposited river sediment (known as alluvium) and a body of mature soil

[16] G.M. Kondolf, "Review of Costa Rica's Claims for Compensation in the Río San Juan", May 2017; NCM on Compensation, Annex 2, p. 3 (157)
[17] Ramsar Secretariat, "Ramsar Advisory Mission Report No. 69: North-Eastern Caribbean Wetland of International Importance (Humedal Caribe Noreste), Costa Rica", 17 December 2010; CR Memorial on the merits, vol. IV, Annex 147, p. 119

and in the following paragraphs I will explain briefly how sediment and soil differ and why it takes decades to millennia for biological, biophysical and biochemical soil forming processes to naturally convert sediment into soil.

My account is consistent with and informed by a growing body of literature that is very efficiently summarized in the sixth chapter of a recent book titled 'The Hidden Half of Nature' (Montgomery and Biklé 2015). I have therefore drawn mainly on that chapter and reference in compiling the account that follows.

To explain why Nicaragua's activities did damage soils, soil formation and natural erosion control functions (or 'services' to use the terminology of 'ecosystem services') in the areas affected, it is first necessary to note that (1) it was floodplain soil that was excavated to form the artificial channels of the caños, but it is river-deposited sediment that is refilling those channels and, (2) that the soil excavated and/or exposed by channel digging and forest clearance had formed in parallel with the old growth forest growing above and rooted within it.

Sediment is a broad term that covers granular particles that are initially derived by weathering of rock and which come in a very wide range of sizes, from boulders larger than 256 mm in diameter to clays that are finer than 0.0064 mm (too small to be visible to the naked eye). Sediments deposited on the bed of the lower Rio San Juan are predominantly classed as sand (0.0125 to 2 mm) but with some silt (0.0064 to 0.0125 mm). There is little clay in the river bed. Sediments deposited outside the channel (on the floodplain and in adjacent wetlands are generally finer, comprising mostly silts and clays. Based on field photographs and samples, it appears that the sediment infilling the caños and accumulating in cleared areas is mostly deposited river bed sediments: i.e. a mixture of sand and silt, but with some clay.

Deposition of these sediments provides the raw material needed to rebuild the soil that was excavated, but it has been known for a very long time that (1) several other ingredients must be added to sediment to create soil including, particularly, organic matter, and (2) it takes time for organic matter to rot down to produce the soil components largely responsible for making soils fertile, plus humus that helps give the soil its characteristically-open structure and fabric.

In the tropics, warm temperatures and an abundant supply of organic matter from dense stands of plants and trees generally fuels soil forming processes that are more vigorous than those in colder climates. Conversely, in wet regions like the HCN, a great deal of organic matter is needed to build and maintain soil fertility because infiltration and soil water seepage wash away a lot of the soil's nutrients. Overall, the take home message is that the time taken for sediment to be converted into soil by natural, soil forming processes is measured in decades to centuries in hot, humid areas with abundant supplies of organic matter and vigorous soil forming processes, ranging up to millennia in cold, dry regions with sparse inputs of organic matter and slow soil forming processes

Soils beneath the mature and old growth forests in the HCN have had centuries to develop and lots of organic matter arrives at the forest floor daily in the form of leaves, seeds, fruits, nuts, bark, twigs and broken branches that fall from large, standing trees, plus dead plants from the undergrowth, animal faeces and, periodically, the rotting carcases of the animals themselves.

However, along the lines of the caños, inputs of organic matter are depressed because the mature or old growth trees were felled and removed to make way for the channels, the young plants that have replaced them have yet to build sufficient biomass to input to the fresh sediment substantial quantities of organic matter, and many of the habitats needed to attract wildlife no longer exist.

For these reasons alone, it must be decades before the organic content and fertility of soils currently forming from caño-filling sediments can approach the values characteristic of soils beneath the old growth/mature tree stands cleared by Nicaragua to make way for the caños.

The explanation above is based on 'classic' soil science, which focuses on physics and chemistry as the fundamental drivers of soil formation. However, the importance of soil biology, especially micro-biology, is increasingly being recognised, casting further light on how Nicaragua's activities damaged other aspects of soils, soil forming processes and soil functions – not only along the caños, but also in the areas cleared of mature and/or old growth forest.

New research (summarised succinctly in chapter 6 of Montgomery and Biklé, 2015) reveals the huge contribution made to soil formation and fertility by micro-organisms – especially microbes such as bacteria, fungi, archaea, and protists. It was until recently assumed that microbes were simply responsible for breaking down organic matter to release nutrients in soluble forms accessible to plants. However, new science now shows that up to 80% of the organic matter in a soil may actually be formed from remains of the microbes themselves.

We now also understand that microbes not only turn organic matter and (after dying), themselves into plant food, they also form intricate, symbiotic relationships with all living plants and, especially, trees. Microbes form a colony, a 'living halo', around the roots of mature and old growth trees called a rhizosphere. This microbial colony absorbs the waste products of photosynthesis exuded by the tree, feeds itself by recycling that waste, and then returns the waste products to the tree in the form of nutrients and metabolites essential for the tree to grow and function (see Figure 1, below).

But there is much more to the relationship between trees and microbes than the exchange of waste for food. While the great majority of microbes form mutually beneficial relationships (see Figure 2, below), a smaller number of pathogenic microbes (viruses and some fungi) attack the tree, damaging or even killing it. The tree's microbial allies assist it by fighting the attackers in another example of symbiosis. How do the microbes know that the tree is under attack? The tree tells them using sophisticated micro-biological and chemical markers and signals that are understood in principal, but still not in detail (see Figure 3, below).

The relevance of all this to Nicaragua's activities and the damage they did to soils and soil forming processes is this: when the caños were excavated and the vegetation was cleared, it was not just the trees and avian, aquatic and terrestrial ecosystems visible above ground that were devastated. Below ground, an invisible microbiome (made up of hundreds of rhizospheres, with billions of individual microbes) was also destroyed, reducing the capacity of the affected areas to recover or maintain their fertility, rendering regrowth vulnerable to attack by pathogens, and lengthening the time it will take for new soil to form in the excavated and cleared areas.

Finally, with respect to natural erosion control functions (or services), to explain why Nicaragua's activities adversely affected these functions, it is only necessary to point out two facts concerning

the erodibility of sediments and soils. First, fine sands and silts in the size ranges typical of sediments infilling the caños are known to be the most easily entrained granular materials on Earth. During a major fluvial or coastal flood, water velocities within the wetland could certainly exceed those necessary to re-entrain and remove sediments in the fine sand and silt size ranges, especially along the lines of the caños, where removal of large trees allows faster than pre-disturbance flow due to reduced friction and drag following tree removal. Second, it has long been known that sediment and soil reinforced by the roots of live vegetation is up to 10,000 times more erosion resistant than an otherwise equivalent, bare earth surface.

Although soil formation and vegetation regrowth means that erosion control functions in the areas affected by Nicaragua's activities are recovering, they were severely impacted and it will take decades for their erosion resistance to return to pre-disturbance values.

Based on the evidence outlined above and our current understanding of soil formation, fertility, and erodibility, and how the resilience of plants to physical stresses, diseases and pathogens relates to the health of their rhizospheres, there is no doubt that:

(1) Nicaragua's activities must have impacted soil formation, function and erosion control services in the areas affected, and;

(2) it will take decades for the river-deposited sediments filling the caños and blanketing the cleared areas to supply all of the functions expected of mature forest soils.

This must be the case because soil forming processes are indivisibly related to growth and maturing of the secondary forest developing in the cleared areas, which (as explained below in sub-section C), takes decades. It follows that because (also as explained below), secondary forest can never fully replace the primary forest that Nicaragua cut, neither can the soils that existed beneath and in harmony with the old growth trees be fully replicated.

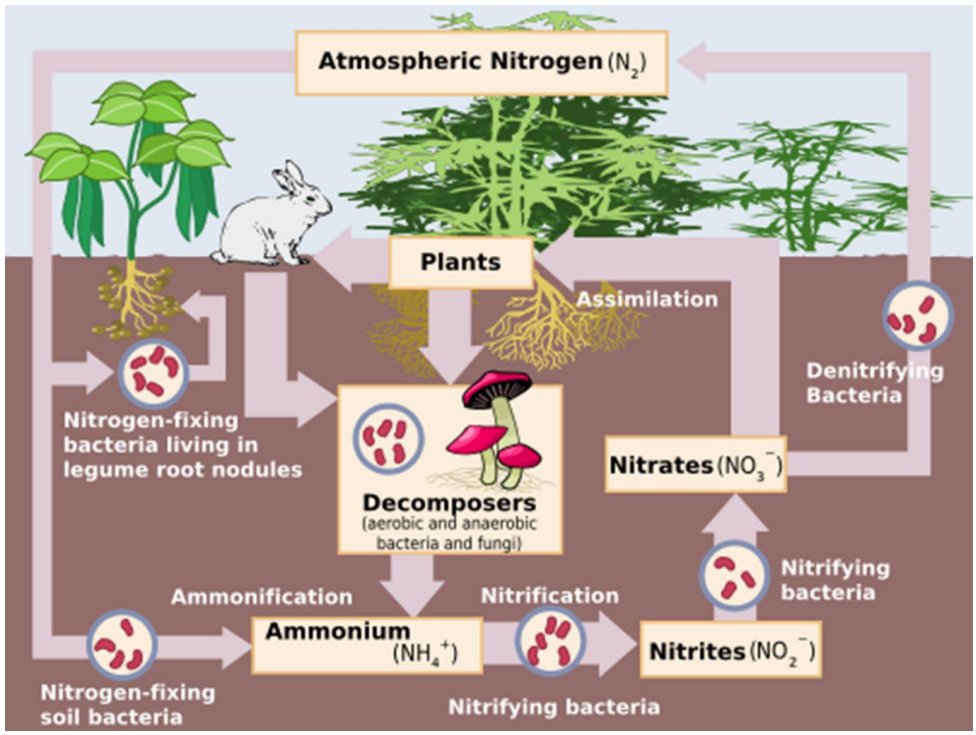


Figure 1. Diagram showing how microbes in the soil cycle and recycle chemicals to make soil fertile and feed plants. Source: http://serc.carleton.edu/eslabs/carbon/5a.html

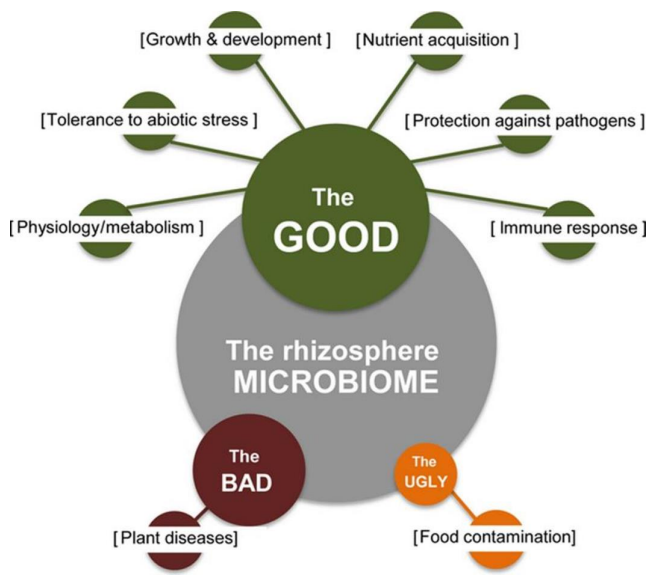


Figure 2. Diagram showing range of predominantly positive impacts of microbes on plants.

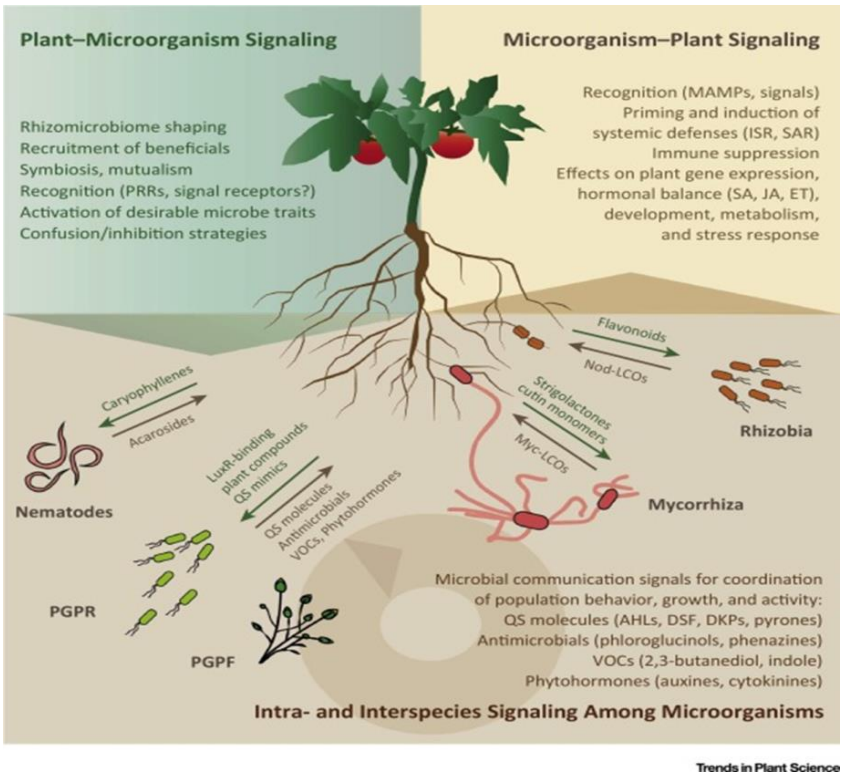


Figure 3. Diagram illustrating how plants and microbes signal each other. Source: http://www.cell.com/trends/plant-science/abstract/S1360-1385(16)00006-6

(B) How the pre-disturbance wetland mitigated natural hazards and time needed for recovery of that mitigating effect

In concluding that Nicaragua's activities had no impact on the ability of the disputed area to mitigate natural hazards Dr Kondolf entirely misses the point that the freshwater wetland and its ecosystem are themselves valuable assets at risk from natural hazards associated with the wetland's low elevation and proximity to the Caribbean Sea. These hazards include coastal flooding and salt water intrusion.

The 2010 Ramsar mission report makes significant observations relevant to this point including on flood control. On pages 108-109, Ramsar note that the HCN is composed of "a mosaic of water bodies and courses, which accumulate and redistribute the volume of water from the San Juan and Colorado rivers during flood periods. Even when there are no human settlements in the area, this capacity to absorb floods permits normal development of ecological processes and ecotourism activities"[18], and on page 114 "Any change in such a pattern [of freshwater flow] due to natural

[18] Ramsar Secretariat, "Ramsar Advisory Mission Report No. 69: North-Eastern Caribbean Wetland of International Importance (Humedal Caribe Noreste), Costa Rica", 17 December 2010; CR Memorial on the merits, vol. IV, Annex 147, p. 108-109

processes (e.g. floods) or anthrophic events (e.g. channelling, water transfer, damming) would therefore alter the distribution and abundance of species"[19]

With respect to salt water intrusion, Ramsar 2010 notes on page 112 that "It is very important to take into consideration groundwater discharge in both regional and local aquifers, as this enables the hydrodynamic balance of salt water intrusion in the HCN sector to be maintained"[20], and in reference to changes in the surface-water hydrology, it is noted on page 119 that "The process and capacity to retain sediments and nutrients in and around the island wetland affected will be altered and there will be a drastic change in flood control and sedimentation flux"[21]. It follows that activities that reduce the capacity of that wetland to mitigate the natural hazards mentioned by Ramsar (2010) are unwise and, therefore, unacceptable in a wetland of International Importance.

In my opinion, natural hazards that threaten the wetland include not only coastal flooding and saline intrusion, but also the much greater risk of coastal erosion.

With respect to coastal flooding, construction of the caños created artificial flow paths through the wet woodlands in the forms of a surface water connection between the Harbor Head Lagoon and the Rio San Juan in the case of the 2010 caño, and lines of weakness in the sand bar separating the Rio San Juan from the Caribbean Sea in the case of the West and, particularly, the East caños.

Linked to these flow paths for surface water are changes to the sub-surface hydrology. For example, replacement of mature wetland soil with uncompacted, relatively coarse, river-deposited sediment (i.e. mostly sands rather than silts) creates a seepage corridor with an unnaturally high sub-surface hydraulic conductivity all along the line of the caño, even after it has filled-in. The effect is to change the groundwater hydrology, which in a wetland interacts with the surface water system to re-position the saline front (that is the line separating salty from fresh groundwater), with potentially profound impacts on the wetland ecosystem.

For both these reasons, constructing the 2010 caño reduced the effectiveness of the old growth forest and wetland as a barrier between the Harbor Head Lagoon and the Rio San Juan in mitigating natural hazards associated with both coastal flooding and salt water intrusion (both surface and sub-surface) not only in the Harbour Head Lagoon and the area directly affected by construction, but also in surrounding the wetlands and upstream along the Rio San Juan.

Construction of the west and east caños, and especially the eastern caño, negated the effect of the sand bar and lowest course (i.e. the estuary) of the Rio San Juan in mitigating natural hazards associated with ingress of salt water and deposition of marine sediments inland and along the main channel of the Rio San Juan, as well as freshwater courses and water bodies connected to it.

To prevent the eastern caño from becoming the primary course of the Rio San Juan, it was blocked by Costa Rica, in accordance with provisional measures issued by the Court. From a geomorphic perspective, the blockage dam can be regarded as providing only temporary protection. While the dam has held to date, if it fails under the load placed upon it by a future storm surge, coastal flood effects, salt water and marine sediments will penetrate farther inland along the Rio San Juan than

[19] Ibid, p. 114
[20] Ibid, p. 112
[21] Ibid, p. 119

would have been the case prior to its excavation, posing an increased hazard to ecosystems and ecosystem services in the Isla Los Portillos.

In my opinion, unless and until the eastern caño *completely* refills and *fully* revegetates, a small but not negligible risk remains of the dam failing under load and the eastern caño capturing the main flow of the RSJ during or following a major storm surge. Consequently, the eastern caño has reduced the capacity of the wet woodland to mitigate coastal flooding and salt water intrusion hazards and extended the area at risk within the northern part of the Isla Los Portillos.

In his report accompanying Nicaragua's counter-memorial in 'Certain Activities' Dr Kondolf saw destruction of the existing, freshwater dominated ecosystem in and around the Harbor Head Lagoon, and its subsequent replacement with a brackish or saltwater ecosystem, as a potential *benefit* of construction of the 2010 caño[22]. But the existing freshwater dominated wetland ecosystem is of International Importance and any activity that puts that ecosystem at risk of collapse would, therefore, clearly be unwise. This precisely why Ramsar recommend that the HCN should be included on the Montreux Record (which is a list of wetlands at risk of degradation).

Even if Dr Kondolf's position were accepted and it was decided that action risking destruction of the present freshwater-dominated system and its replacement by a salt-water dominated system constituted 'wise' management, there would be a time-lag between collapse of the existing freshwater ecosystem and maturing of the new, estuarine ecosystem. During that period, much of the value of the wetland would be lost, which is simply unacceptable. In any case there can be no guarantee that the new ecosystem would ever become more valuable that the one put at greater risk by Nicaragua's activities in creating the 2010 and eastern caños.

In the case of the 2010 caño, if and when in future the bar separating the Harbor Head Lagoon from the Caribbean Seais is over-topped and/or breached, it is now significantly easier for sea water to penetrate into the brackish and freshwater systems along the line of the 2010 caño - which has created a preferential flow path for coastal flood water surging inland from the Harbour Head Lagoon and into the interior wetland and river. This weakness is permanent because the forest, for reasons set out below in sub-section C, will never fully recover the resilience to coastal flooding it had prior to disturbance.

The western and, particularly, eastern caños similarly created preferential pathways for marine tides, surges, sediments and organisms to gain access to the interior of the wetland, the river and freshwater lagoons connected to it.

Coastal erosion presents an altogether different type of risk to the wetland and primary forest – one of annihilation. While the impacts of increased coastal flooding and saline intrusion may be dire, those of coastal erosion are potentially catastrophic.

When, on page 156 of his report, Dr Kondolf states that "erosion is not an issue in the disputed area"[23] he is referring to fluvial erosion. However, on page 157 he goes on to conclude that "the

[22] G.M. Kondolf, "Distributary Channels of the Río San Juan, Nicaragua and Costa Rica: Review of Reports by Thorne, UNITAR, Ramsar, MEET, and Araya-Montero", July 2012; p.19-20 (NCM on the merits, Appendix 1, p. 483-484

[23] G.M. Kondolf, "Review of Costa Rica's Claims for Compensation in the Río San Juan", May 2017; NCM on Compensation, Annex 2, p. 2 (156)

delta landform can be seen as existing in the balance between the supply of sediment from upstream and its deposition within the delta, which tend to build the delta, and natural subsidence (from compaction of sediments) and coastal wave erosion, which tend to reduce the delta"[24] and this is certainly wrong.

It is only necessary to examine the historical sequence of maps and satellite images presented between pages I-4 and I-29 of the first Thorne report[25] to understand why. The maps and images reproduced there indicate that the coastline to the north and east of the area disturbed by Nicaragua's activities has retreated by about 1 kilometre in a little over a century – an average annual erosion rate of 10 metres per year. Based on my scientific analysis of the geology, geography and geomorphology of the micro-delta (as set out in the first Thorne Report and not contested by Dr Kondolf, there is no reason to suppose that the erosive attack of the Caribbean on this section of the coast will abate during the foreseeable future. In short the delta landform cannot possibly be seen as existing in the balance between the supply of sediment from upstream and its deposition within the delta, which tend to build the delta, and natural subsidence (from compaction of sediments) and coastal wave erosion, which tend to reduce the delta. Dr Kondolf's error stems from a fundamental methodological weakness in choosing to limit the science base for his report to interpretation of satellite images taken between 2010 and 2017 and failing to consider longer-term evidence readily available from historical maps.

Historically, coastal erosion has removed land that was created only a few years or decades previously by deposition of sand and silt carried to the coast and used by the Rio San Juan to build its micro-delta. The capacity of that land to resist erosion was low because it lacked mature trees and old growth forest – plants that provide natural erosion resistance – thereby mitigating the natural hazard posed by waves, storm surges and coastal currents. Erosion has slowed more recently, as the shoreline has approached the much older, mature forest at the proximal end of the micro-delta, as is evident from even a cursory examination of the satellite images in the first Thorne report.

It is only necessary to recognise how Nicaragua's activities in clearing the forest (which increased the erodibility of the affected areas, and created easy pathways for coastal water to enter the wetland via the 2010 and, especially, the eastern caños) to understand how and why these activities reduced the capacity of the wet woodland to protect itself from coastal erosion.

In essence, any chain of coastal defences is only as strong as its weakest link, and in cutting through the forest and clearing pathways for coastal flood and surge waters to breach that natural defence, Nicaragua reduced, and perhaps has even compromised, the natural capacity of the wooded wetland to mitigate the hazard presented by coastal erosion.

Blocking the eastern caño and natural siltation of the 2010 caño have restored *some* of the lost mitigation capacity, but by no means all of it. Until the eastern caño completely fills in and the area fully revegetates with mature trees, the dam constructed by Costa Rica remains susceptible to erosion following over-topping and/or breaching during a storm surge. Secondary regrowth along

[24] G.M. Kondolf, "Review of Costa Rica's Claims for Compensation in the Río San Juan", May 2017; NCM on Compensation, Annex 2, p. 3 (157)

[25] C Thorne, "Assessment of the physical impact of works carried out by Nicaragua since October 2010 on the geomorphology, hydrology and sediment dynamics of the San Juan River and the environmental impacts on Costa Rican territory", October 2011; CR Memorial, Appendix I, p I-4-I - 19 (328-353)

the path of the 2010 caño can never fully replicate the great strength and high erosion resistance of the primary forest that preceded it. In short, the capacity of the wet woodland to mitigate the erosion hazard has permanently been reduced by Nicargaua's activities.

(C) Comparisons and contrasts between primary and secondary forests and their ecosystems, and recovery of ecosystem services following clearance of old growth forest

There is a large and rich literature comparing primary and secondary forests, in both temperate and tropical biomes. Stages in tree growth, patterns of species succession, trends in associated biodiversity, and the ecological functions and values in old growth forests that are absent during earlier stages of forest development are generally similar between temperate and tropical forests. The biggest difference is that tropical forests (like those in Costa Rica) generally reach their climax stage faster than temperate forests (like those of the Pacific Northwest, where I have conducted research since 1983).

For the most part, secondary forests, and in some cases even tree plantations, are better than no forest. However, secondary forests and tree plantations cannot compensate for failure to protect primary forests with respect to conserving biodiversity simply because some species are dependent on habitats provided only by old growth forests (for example: many trees that are hollow, have broken tops, sloughed and/or cracked bark, and decay pockets; large downed-logs, etc.). In essence it is the increasing complexity of old growth forests that widens the variety of ecological niches in ways essential to supporting increased biodiversity.

Franklin and Spies (1991) is a text book on the ecological features of forests, covering composition, structure, and function. This book explains that species abundance is higher in old growth forests than in otherwise comparable, younger stands of trees due to old growth stands having attributes that differ substantially from, or are simply absent in, the younger stands. While some of the specific data cited by Franklin and Spies are now outdated, their general interpretations still hold true. For example, older forests tend to exhibit higher structural diversity (e.g. variety of tree sizes, complex and multiple canopy layers, large dead wood, complex understories, large snags, deformed or broken-topped trees: details are given on pages 74-76 of their book). My point is that none of this is particularly new scientific knowledge.

Guariguata and Ostertag (2001) investigated changes in tropical forest structure and function during succession. Key points include:

- while plant species richness in secondary forests can approach old-growth levels a few decades after disturbance, returning to a species composition similar to old-forest is a much longer process, requiring a 100 years or more in some studies (see page 195).
- the time it takes for a secondary forests to accumulate biomass resembling that of the old-growth forest that preceded it is indeterminate, but studies to date conclude that biomass levels in secondary forests had not reached old-growth levels after 50 to 80 years, because secondary forests cannot approach old-growth levels without the presence of very large trees, which take more than a century to grow (see page 198).

Table 4 on page 200 (reproduced below as Table A, for convenience), provides a conceptual sequence of tropical forest succession and associated time frames, structures and functions.

Franklin et al. (2002) provide a good account of the structural and functional changes forests go through as they age in the Pacific Northwest. Tables 1 and 2 (reproduced below in Table B, for convenience) provide a good summary of the sequence of important structural features that develop as the forest matures. As Tables 1 and 2 make clear, creation of many valuable niches and habitats is not even initiated until increasing density and natural mortality start to thin the pioneer tree and plant species: obviously a 4-5 year old stand of trees that has only just reached a closed canopy condition cannot possibly perform most functions expected from a mature woodland, let alone an old-growth stand of primary forest.

Table A. This is Table 4 reproduced from Guariguata and Ostertag (2001)[26]

Table 4
A conceptual model showing a hypothesized sequence for the processes occurring during secondary forest succession, in reference to old-growth conditions. The crux of the model is that overstory species composition resembles old-growth conditions as the last step in the sequence; other forest characteristics or processes may resemble old-growth much earlier. The times are meant to be a guide to the time scale of these processes, but these are based on very limited empirical data

Process	Canopy vegetation	Time scale (years)	Notes
Initial colonization	Grass, herbs, ferns	1–5	Factors that affect initial colonization include: 1. Landscape features (distance to forest, topography) 2. Climate and microclimate 3. Presence/absence of past vegetation (seed bank, resprouts, remnant trees and shrubs) 4. Site characteristics (nutrient availability, soil compaction, mycorrhizae, type and intensity of past land use) 5. Multi-species interactions (seed predation, herbivory, perch availability, pathogens, competition, phenological stage)
Early forest development	Short-lived pioneers	5–20	Early stages of forest development include: 1. Canopy closure 2. Fine root biomass levels become similar to mature forest 3. Stemflow and throughfall levels become similar to mature forest 4. High rates of litterfall, NPP, and turnover of nutrients 5. Rapid accumulation of biomass, along with self-thinning and the appearance of standing dead 6. Accumulation of species, and the possibility that understory species richness is similar to mature forest
Late forest development	Long-lived pioneers	20–100	Later stages of forest development include: 1. More frequent small-scale disturbances, particularly small canopy gaps 2. Prevalence of advanced regeneration 3. Greater storage of nutrients in biomass, perhaps lower rates of NPP and litterfall 4. Low spatial heterogeneity in understory light levels
Old-growth forest	Shade-tolerant trees	100–400	Old-growth forest characterized by: 1. Very diverse overstory tree species composition 2. Prevalence of large canopy gaps, other chronic disturbances 3. Very large trees 4. High spatial heterogeneity in understory light levels

[26] Guariguata, M.R. and Ostertag, R., 2001. Neotropical secondary forest succession: changes in structural and functional characteristics. Forest ecology and management, 148(1), p. 200

Table B. These are Tables 1 and 2 reproduced from Franklin et al. (2002)[27]

Table 1
Some structural features of forest stands including individual structural elements and spatial patterns of structural elements

Important attributes	
Individual structures	
Live trees	Species, density, mean diameter, range in diameter, height, canopy depth
Large-diameter live trees	Species, density, decadence (including presence of decay columns), crown condition, bark characteristics
Large-diameter branches	Species, density, size, individual or arrays, presence of arboreal "soil"
Lower-canopy tree community	Composition, density, height
Ground community	Composition, density, deciduous/evergreen
Standing dead trees (snags)	Species, size, decay state, density
Large woody debris (logs)	Species, density, decay state, volume, mass
Uproots (root wads and holes)	Density, size, age
Organic layers	Depth, chemical and physical properties, biota
Spatial patterns	
Vertical distribution of foliage/canopy	Depth, continuity, cumulative distribution
Horizontal distribution of structures	Spatial pattern (e.g. random, dispersed, or aggregated)
Gaps and anti-gaps	Size, shape, density

Table 2
Some structural processes that are operational during the successional development of forest stands in approximate order of their first appearance

Disturbance and legacy creation
Establishment of a new cohort of trees or plants
Canopy closure by tree layer
Competitive exclusion (shading) of ground flora
Lower tree canopy loss
  Death and pruning of lower branch systems
Biomass accumulation
Density-dependent tree mortality
  Mortality due to competition among tree life form; thinning mortality
Density-independent tree mortality
  Mortality due to agents, such as wind, disease, or insects
Canopy gap initiation and expansion
Generation of coarse woody debris (snags and logs)
Uprooting
  Ground and soil disruption as well as creation of structures
Understory re-development
  Shrub and herb layers
Establishment of shade-tolerant tree species
  Assuming pioneer cohort is shade-intolerant species
Shade-patch (anti-gap) development
Maturation of pioneer tree cohort
  Achievement of maximum height and crown spread
Canopy elaboration
  Development of multi-layered or continuous canopy through
    Growth of shade-tolerant species into co-dominant canopy position
    Re-establishment of lower branch systems on intolerant dominants
Development of live tree decadence
  Multiple tops, dead tops, bole and top rots, cavities, brooms
Development of large branches and branch systems
Associated development of rich epiphytic communities on large branches
Pioneer cohort loss

[27] Franklin, J.F., Spies, T.A., Van Pelt, R., Carey, A.B., Thornburgh, D.A., Berg, D.R., Lindenmayer, D.B., Harmon, M.E., Keeton, W.S., Shaw, D.C. and Bible, K., 2002. Disturbances and structural development of natural forest ecosystems with silvicultural implications, using Douglas-fir forests as an example. Forest Ecology and Management, 155(1), p. 402

Michel and Winter (2009) put numbers to these differences. They found statistically significant differences between the abundance of microhabitats in mature-old growth, natural stands compared to younger stands subject to management. Recently managed stands averaged just 115 microhabitats/ha. Younger stands that had not been managed recently did much better, averaging 520 microhabitats/ha. But naturally mature, old-growth stands were far better still, averaging 745 microhabitats/ha[28]. The point here is that Dr Kondolf's opinion that secondary growth 'can perform most functions expected from a woodland' is not necessarily incorrect, but it is entirely inapplicable in the case of the 'woodland' cleared by Nicaragua, which was an irreplaceable, natural, old growth forest.

Focusing specifically on literature on tropical forests, Barlow et al. 2007 investigated biodiversity in primary, secondary, and plantation forests in the Brazilian Amazon. They found that responses varied between taxa, in terms of species richness and the percentage of species present only in primary forests (see Figures 1 and 2 from their paper, reproduced below for convenience as Figures 4 and 5), but almost all taxa showed marked differences in community structure and composition across the three forest types (see their Figure 3, on page 18557 of Barlow et al., 2007). Secondary forests and plantations were shown to be capable of accommodating several taxa, suggesting they can provide conservation value, especially if surrounded by intact primary forest, which appears to be a 'best-case' scenario[29]. On this basis, it is reasonable to expect that secondary regrowth in the areas cleared by Nicaragua can, in future, provide multiple taxa with a good degree of biodiversity, though it is nowhere near achieving that yet and will not do so for decades. Nevertheless, Barlow et al.'s study provides some of the clearest empirical evidence currently available to demonstrate the uniqueness importance of undisturbed primary tropical forests, like those in the HCN.

Figures 4 and 5 are Figures 1 and 2 reproduced from Barlow (2007)[30]

[28] Michel, A.K. and Winter, S., 2009. "Tree microhabitat structures as indicators of biodiversity in Douglas-fir forests of different stand ages and management histories in the Pacific Northwest, USA". Forest Ecology and Management, 257, p. 1456

[29] Barlow, J., Gardner, T.A., Araujo, I.S., Ávila-Pires, T.C., Bonaldo, A.B., Costa, J.E., Esposito, M.C., Ferreira, L.V., Hawes, J., Hernandez, M.I. and Hoogmoed, M.S., 2007. Quantifying the biodiversity value of tropical primary, secondary, and plantation forests. Proceedings of the National Academy of Sciences, 104(47), p. 18556-18557

[30] Idem

Figure 4.

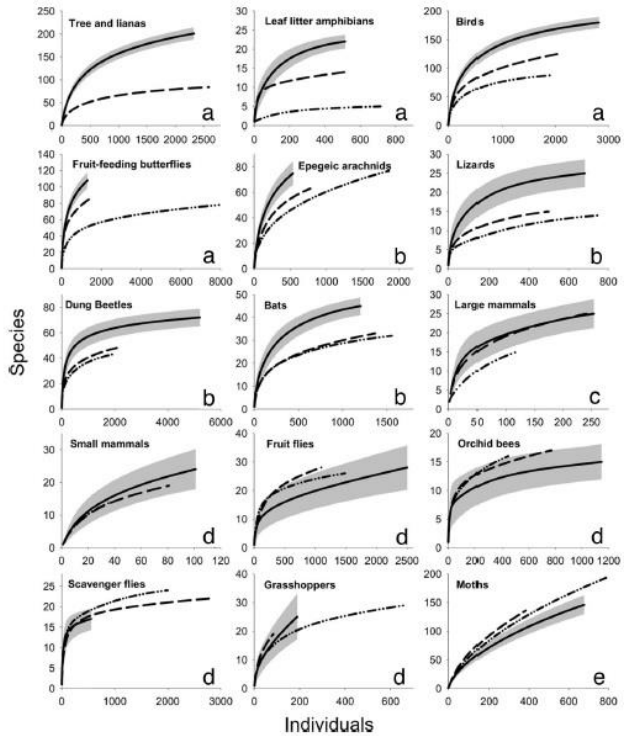


Fig. 1. Individual-based species accumulation curves for primary (unbroken line with shaded 95% confidence intervals) and secondary forests (dashed line) and *Eucalyptus* plantations (dotted-dash line). (Letters a–e) Five response types, grouping taxa according to our analytical criteria (see *Materials and Methods*) that showed the following: significant differences between samples from all habitat types (letter a), no clear significant difference between samples from secondary forest and *Eucalyptus* (letter b), no clear significant difference between samples from primary and secondary forest (letter c), no clear difference between any habitat (letter d), and primary forest appearing as less species-rich than other forest habitats (letter e).

Figure 5.

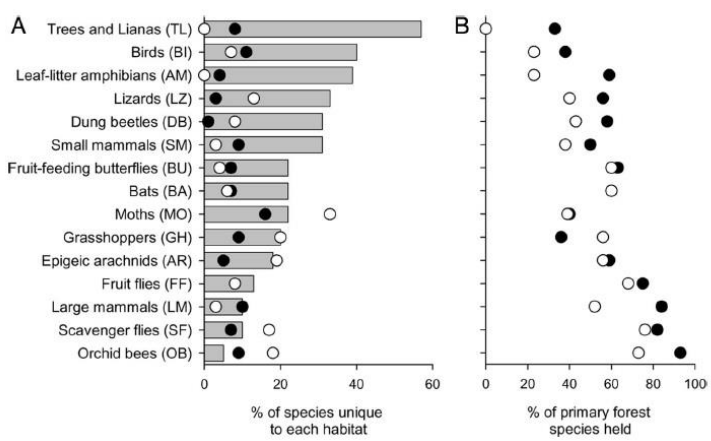


Fig. 2. The percentage of species unique to primary, secondary, and plantation forests (*A*) and the percentage of species recorded in primary forest that were also recorded in secondary forest and plantations (*B*). Primary, secondary, and plantation forests are represented by gray bars, black circles, and white circles, respectively.

Chazdon (2008) studied patterns and processes of vegetation dynamics during secondary tropical forest succession. He found that biodiversity and succession pathways differ between primary and secondary forests depending on the diversity metric selected, the nature of forest's surroundings, and type and degree of disturbance, among other factors. Some key points relevant to the case in point are that:

- The stand initiation phase (beginning of succession immediately following disturbance) is the time when the stand is most vulnerable to invasive species, which can have long-lasting effects on forest succession, species diversity and composition, in some cases persisting throughout the successional trajectory (page 388). This suggests that if invasive species have colonized the disturbed areas of the HCN during the last seven years their influence on future succession, species diversity and composition may be permanent.
- It is not until tropical forests enter the understory re-initiation stage (generally 10 to 20 years after disturbance) that they go through a gradual shift in tree species abundance and composition that persists over decades and sometimes centuries. Not until secondary forests approach the old growth stage (decades to centuries later), does the tree canopy contain species not present during the earlier successional stages, developing complex vertical and horizontal structures with some very large old trees (some living others dead), large downed wood and decay elements, and diverse canopy and understory vegetation (see pages 388 to 389).
- Forests regenerating after primary forest clearance may never reach the same species richness and composition as the preceding primary forest (see page 400)[31].

Morris (2010) reviewed the literature on tropical forest biodiversity, pointing out that we should not only consider changes in species richness or diversity when comparing primary and secondary forests, but should also examine species interactions and their ecosystem functions, about which comparatively little is known. On this important topic, Morris suggests that damage to species interactions and their ecosystem functions in primary forests may increase disproportionally as a function of disturbance intensity, raising the concern that even if species richness and diversity recovers following disturbance, species interactions may not (see page 3715 in Morris, 2010)[32]. As Nicaragua's activities were about as disturbing as is conceivable, it seems likely that loss of species interactions and their ecosystem functions in the affected areas may be irreversible.

In a broader study, Gibson et al. (2011) applied meta-analysis to data from no less than 138 studies of the differences in biodiversity between primary forests and forests subjected to a variety of human-influenced disturbances. They report that forest clearance and replanting (i.e. conversion from primary to secondary growth) consistently and significantly reduce biodiversity in tropical forest landscapes worldwide. The impacts of selective logging were shown to be substantially reduced compared to other, more drastic disturbances, but still had detrimental effects. The activities performed by Nicaragua would most certainly rank at the upper bound of what Gibson et al. (2011) conceive to be 'drastic disturbances'.

[31] Chazdon, R.L., 2008. Beyond deforestation: restoring forests and ecosystem services on degraded lands. science, 320(5882), p. 400

[32] Morris, R.J., 2010. Anthropogenic impacts on tropical forest biodiversity: a network structure and ecosystem functioning perspective. Philosophical Transactions of the Royal Society of London B: Biological Sciences, 365 (1558), p. 3715

Gibson et al. (2011) found secondary forests of varying ages to be capable of recovering intermediate levels of biodiversity, depending on forest age and land-use history, though these remained much lower than those in primary forests (see page 380, column 2)[33]. That said, Gibson et al.'s overall conclusion is however absolutely clear: in terms of sustaining biodiversity, primary forests are irreplaceable.

This brief review of published literature that is all readily available via the web leads me to my last and most serious criticism of Dr Kondolf's methodology: his over-reliance on remotely-sensed images and failure to make any scientific measurements, or collect any scientific data during his site visit in October 2016. This compounded by his failure to use his overflight to take photographs or make first hand observations of the affected areas.

On page 157-8 of his report, Dr Kondolf states that "It is not possible to measure tree heights from the imagery [on pages 163 to 188 of his report], but the plan-form tree outlines visible on the imagery have similar form and dimensions to those of the surrounding woodland by 2014"[34]. A rigorous environmental scientist would have made accurate measurements of tree heights (old and new) in the field in October 2016 using a surveying tape and inclinometer – a simple but effective methodology.

Regrowth of grass, shrubs and pioneer tree species in the areas cleared by Nicaragua has indeed been rapid. That is to be expected in this humid, tropical region. However, due to his decision to rely solely on satellite images, Dr Kondolf is unable to give any scientific or technical account whatsoever of the species of plants colonizing the cleared areas, and so the degree to which invasive species have taken the opportunity to establish themselves presented by Nicaragua's activities is unknown. A rigorous environmental scientist would have used a quadrat survey to count and identify colonizing vegetation, allowing direct comparisons to be made with vegetation assemblages in adjacent areas that were not cleared by Nicaragua to make way for its caños.

Greening of the devastated areas due to rapid recolonization is indeed apparent in the chronological series of aerial images provided by Dr Kondolf at the end of his report.[35] However, based on the literature review above, it is beyond doubt that in height and complexity, the trees now growing in the recovering areas bear no resemblance to the old growth forest cleared by Nicaragua in 2010. Field measurements on the ground in October 2016 would have demonstrated this and in failing to make (or at least report) such measurements and rely solely on changes observed in satellite images, Dr Kondolf makes a serious methodological error.

CONCLUSION

If Dr Kondolf's opinions were to be accepted, the outcome (whether intentional or unintentional) would be to suggest that damage resulting from excavating artificial channels and clearing primary, old growth forests within Ramsar-protected wetlands of International Importance along the Rio San Juan is temporary, with recovery being essentially complete inside 5-years. This would entirely

[33] Gibson, L., Lee, T.M., Koh, L.P., Brook, B.W., Gardner, T.A., Barlow, J., Peres, C.A., Bradshaw, C.J., Laurance, W.F., Lovejoy, T.E. and Sodhi, N.S., 2011. Primary forests are irreplaceable for sustaining tropical biodiversity. Nature, 478(7369), p. 380

[34] G.M. Kondolf, "Review of Costa Rica's Claims for Compensation in the Río San Juan", May 2017; NCM on Compensation, Annex 2, p. 3 (157)

[35] Ibid, Appendix A, p. 174-178

negate the intent of the Ramsar Convention in providing protection for the designated wetlands. It would also provide a pretext for dredging and deforestation in other wetlands protected by the Ramsar Convention, globally.

Based on the findings of my review, Dr Kondolf's opinions are over-reliant on qualitative interpretation of satellite images. Dr Kondolf was unable to estimate even the most basic property of regrowth in the cleared areas (i.e. tree height) from these images, yet chose not to measure tree height - or anything else - during his overflight and site visit in October 2016, an incomprehensible methodological lapse for any environmental scientist, let alone one of Dr Kondolf's experience. Dr Kondolf's remarks on soil formation, erosion, natural hazard mitigation and the ecological services provided by secondary forest are at odds with the relevant scientific literature. Due to its methodological errors and lack of concordance with the relevant literature, in my opinion Dr Kondolf's report has no technical basis and no scientific validity and it should be discounted.

Professor Colin Thorne

2 Parker Gardens
Nottingham, UK

28 July 2017

REFERENCES

Barlow, J., Gardner, T.A., Araujo, I.S., Ávila-Pires, T.C., Bonaldo, A.B., Costa, J.E., Esposito, M.C., Ferreira, L.V., Hawes, J., Hernandez, M.I. and Hoogmoed, M.S., 2007. Quantifying the biodiversity value of tropical primary, secondary, and plantation forests. *Proceedings of the National Academy of Sciences*, *104*(47), pp.18555-18560.

Chazdon, R.L., 2008. Beyond deforestation: restoring forests and ecosystem services on degraded lands. *science*, *320*(5882), pp.1458-1460.

De Groot, R.S. Stuip, M.A.M.Finlayson, C.M.Davidson, N. "Valuing wetlands: guidance for valuing the benefits derived from wetland ecosystem services" Ramsar Technical Report No. 3/CBD Technical Series No. 27. , 2006, pp. 46

Franklin, J.F., Spies, T.A., Van Pelt, R., Carey, A.B., Thornburgh, D.A., Berg, D.R., Lindenmayer, D.B., Harmon, M.E., Keeton, W.S., Shaw, D.C. and Bible, K., 2002. Disturbances and structural development of natural forest ecosystems with silvicultural implications, using Douglas-fir forests as an example. *Forest Ecology and Management*, *155*(1), pp.399-423.

Gibson, L., Lee, T.M., Koh, L.P., Brook, B.W., Gardner, T.A., Barlow, J., Peres, C.A., Bradshaw, C.J., Laurance, W.F., Lovejoy, T.E. and Sodhi, N.S., 2011. Primary forests are irreplaceable for sustaining tropical biodiversity. *Nature*, *478*(7369), pp.378-381.

Guariguata, M.R. and Ostertag, R., 2001. Neotropical secondary forest succession: changes in structural and functional characteristics. *Forest ecology and management*, *148*(1), pp.185-206.

Kant. I. 1781. 'everything has either a *price* or a *dignity*. Anything that has a *price* can be replaced by something else as its equivalent, but anything that is above all *price,* and therefore admits of no equivalent, has a *dignity*.' *(From Groundwork of the Metaphysics of Morals, translated and edited by Mary Gregor [NY: Cambridge, 1998], pp. 42-43.).*

Michel, A.K. and Winter, S., 2009. Tree microhabitat structures as indicators of biodiversity in Douglas-fir forests of different stand ages and management histories in the Pacific Northwest, USA. *Forest Ecology and Management*, *257*(6), pp.1453-1464.

Montgomery, D.R. and Biklé, A., 2015. *The Hidden Half of Nature: The Microbial Roots of Life and Health*. WW Norton & Company, pp. 320

Morris, R.J., 2010. Anthropogenic impacts on tropical forest biodiversity: a network structure and ecosystem functioning perspective. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *365*(1558), pp.3709-3718.

Ramsar Secretariat 1971. Convention on Wetlands of International Importance: Strategic Framework and guidelines for the future development of the List of Wetlands of International Importance, *Ramsar (Iran)*.

Ramsar Convention on Wetlands 2010. Ramsar Advisory Mission Report N° 69: North-eastern Caribbean Wetland of International Importance (Humedal Caribe Noreste),Costa Rica. 17 December 2010 (Costa Rica's Memorial on the Merits, Annex 147).