ECONOMIC ASSESSMENT FOR BALLAST WATER MANAGEMENT: THE BAHAMAS

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Introduction

1.1 SHIPPING, BALLAST WATER AND MARINE INVASIVE SPECIES

Shipping is an essential component of world trade, transporting an estimated 90% of all internationally traded goods[1]. Conventional trading ships rely on ballast tanks to prevent capsizing and heavy rolling and to aid in propulsion, steerage and fuel efficiency. Ships fill ballast tanks with water surrounding the ship which includes organisms living in the water. Fish larvae, small fish, crustaceans, algae, invertebrates, bacteria and viruses are transported with the water and are released into new environments when the ship arrives to port and discharges ballast water[2]. When these organisms are released into new environments, they have the potential to become invasive and have severe ecological, economic and health impacts[3]. In a new environment, species may not encounter the same natural inhibitors such as predators, parasites or pathogens which thus allow the species to expand rapidly. These species have the potential to out-compete local flora and fauna if they are not detected and eradicated at an early stage.

The connection between shipping and the transfer of organisms has been well documented. Marine invasive species have been reported in over 80% of the world's marine ecoregions and international shipping has been identified as the most significant introduction method for these species[4]. Approximately 10 billion tonnes of ballast water are transported around the world each year via trading ships and it is estimated that approximately 7,000 marine and coastal species travel daily across

[1] IMO 2008. International Shipping and World Trade - Facts and figures. International Maritime Organization Maritime Knowledge Centre November 2008. 37pp.
[2] Ibrahim and El-naggar. 2012. Ballast water review: Impacts, treatments and management. *Middle-East Journal of Scientific Research,* 12(7): 976-984.
[3] Smithsonian Environmental Research Center, Ballast Water, Accessed June 23, 2015 at: http://www.serc.si.edu/labs/marine_invasions/vector_ecology/bw.aspx
[4] Molnar et al., 2008. Assessing the global threat of invasive species to marine biodiversity. *Frontiers in Ecology and the Environment,* 6(9): 485-492.

the world in ballast water tanks[5]. Marine invasive species include the North American comb jellyfish that has spread throughout the Black, Caspian, North and Baltic Seas and has resulted in the severe depletion of anchovy and sprat stocks[6] and the Chinese mitten crab found in the North and Baltic Seas and along the Atlantic and Pacific coasts of North America that has led to erosion of river banks and clogging of water systems[7].

Economic losses attributed to marine invasive species are extensive, estimated at US$7 billion per year[8]. These damages include costs to fisheries, aquaculture, water supply systems and coastal infrastructure and exclude the indirect costs of damages caused to marine biodiversity and habitats. These indirect costs, while not included in economic losses, can be extensive and consist of impacts to marine species and lowering environmental resilience to stressors such as pollution and climate change.

1.2 SHIPPING AND THE BAHAMAS

Shipping is vital to the Bahamian population and economy. It is a major industry and an important component of food and health security for the nation. Approximately 90% of material resources are imported to The Bahamas via sea including the majority of food and medical supplies.[9] New Providence and Freeport are significant ports of call for foreign-flagged international vessels including ocean-going passenger and merchant ships[10]. The Commonwealth of The Bahamas is also a flag state having one of the world's largest fleets with over 1,600 registered vessels[11].

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[5] WWF, 2009, Silent Invasion: The Spread of Marine Invasive Species via Ships' Ballast Water. http://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Study_Silent_Invasion.pdf

[6] Lehtiniemi et al., 2007. Distribution and abundance of the American comb jelly (*Mnemiopsis leidyi*)-A rapid invasion to the northern Baltic Sea during 2007. *Aquatic Invasions* 2(4): 445-449

[7] Cohen, A. and J. Carlton. 1997. Transoceanic transport mechanisms: the introduction of the Chinese mitten crab *Eriocheir sinensis* to California. *Pacific Science,* 51(1): 1-11.

[8] WWF, 2009, Silent Invasion: The Spread of Marine Invasive Species via Ships' Ballast Water. http://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Study_Silent_Invasion.pdf

[9] Nassau Container Port, 2014, ADP Limited Annual Report, http://www.nassaucontainerport.com/support_docs/APD_2014_Annual_Report.pdf

[10] Government of The Bahamas, Port Department. Accessed June 23, 2015 at: http://goo.gl/IaoyKL

[11] Bahamas Maritime Authority. 2014. Corporate Brochure. http://www.bahamasmaritime.com/includes/tng/pub/tNG_download4.php?page=1&KT_download1=66b4ac96cc2fdaf8737c1c62e5dbdce1

Many international ship-owning companies with a range of types of vessels including cargo steamers, tankers, cruise ships, frigates and freighters are registered in The Bahamas. The Bahamas is also visited by many foreign-registered vessels that visit its ports annually.

The exclusive economic zone of The Bahamas includes an area of approximately 630,000 square kilometers[12]. The marine environment of The Bahamas provides highly valuable economic resources including living resources such as fish and shellfish and non-living resources such as aragonite. The marine environment is also an important social and cultural resource for Bahamian residents. However, the quality of the marine environment is increasingly threatened by human activities including impacts from the shipping industry.

Ports with high volumes of international trade that regularly receive discharges of ballast water are particularly vulnerable to the introduction of invasive marine species[13]. As an archipelagic nation highly reliant on importation of goods via international shipping, The Bahamas is considered to be vulnerable to marine invasives. Indeed the nation is currently experiencing significant environmental and economic impacts from the invasive lionfish[14]. Failure to adopt measures to decrease the spread of additional invasive species may result in further detrimental impacts.

1.3 BALLAST WATER CONVENTION

The most effective method of preventing the spread of marine invasive species through ballast water is through management practices and treatment systems that prevent invasions from occurring[15]. Other methods, such as early detection of potentially invasive species, require long-term monitoring and intensive and costly

[12] Sea Around Us, The Bahamas. Accessed June 23, 2015 at: http://www.seaaroundus.org/data/#/eez/44?chart=catch-chart&dimension=taxon&measure=tonnage
[13] WWF, 2009, Silent Invasion: The Spread of Marine Invasive Species via Ships' Ballast Water. http://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Study_Silent_Invasion.pdf
[14] Bahamas National Trust, 2010. Invasive Species of The Bahamas: Red Lionfish. http://www.bnt.bs/UserFiles/HTMLEditor/lionfish.pdf
[15] WWF, 2009, Silent Invasion: The Spread of Marine Invasive Species via Ships' Ballast Water. http://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Study_Silent_Invasion.pdf

eradication efforts which may also detrimentally affect local marine species. It is more cost-effective to take measures to prevent the spread of species rather than trying to eradicate a species after it has been discovered and established.

The 2004 International Maritime Organization's (IMO) Convention on the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) is an international instrument aimed at preventing trading ships from spreading harmful invasive species through transfer of ballast water[16]. The BWM Convention aims to reduce the transfer of invasive marine species without causing significant delays or expenses while maintaining competitiveness and efficiency. The BWM Convention details a standard set of design and operation guidelines that will minimize transfer of species via shipping on a global scale. The BWM Convention will enter into force after ratification by 30 states, representing 35% of world merchant shipping tonnage. Once the BWM Convention has entered into force, all ships must manage their ballast water by exchanging or treating it using an approved ballast water treatment system or ships may apply for exemption based on specific requirements. As of May 2016, 50 states have ratified the BWM Convention representing 34.8% of world merchant shipping tonnage[17].

1.4 PURPOSE OF REPORT

This report provides an analysis of the economic value of resources at risk to marine invasive species in The Bahamas and an estimate of the cost of implementing the BWM Convention in The Bahamas. The report provides a rationale for the need for a ballast water management strategy for The Bahamas and provides costs associated with implementing such a strategy.

The report was conducted using the GloBallast guidelines for conducting economic assessments for ballast water management[18]. Total economic value is

[16] IMO. 2004. International Convention for the Control and Management of Ships' Ballast Water and Sediments.
[17] IMO, 2016. Summary of Status of Conventions. http://www.imo.org/en/About/Conventions/StatusOfConventions/Pages/Default.aspx
[18] GloBallast, 2010. Economic Assessments for Ballast Water Management: A Guideline. http://globallast.imo.org/wp-content/uploads/2014/11/Mono19_English.pdf

used to assess both direct and indirect values of resources at risk while document analysis and interviews are used to provide costs associated with implementing the BWM Convention.

2
Methodology

2.1 VALUE OF RESOURCES AT RISK

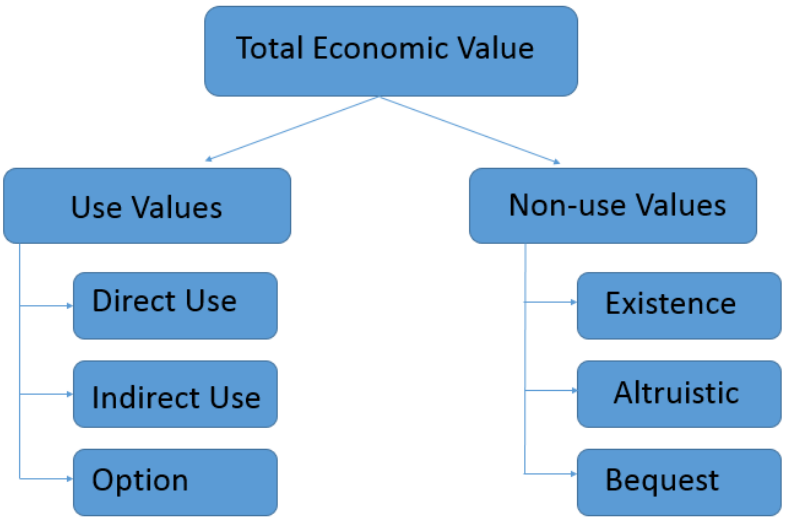
The methodology used to complete the assessment of values of resources at risk to marine invasive species is Total Economic Value (TEV). TEV is an appropriate methodology to provide an overall measurement of the economic value of environmental assets[19]. The total value of environmental assets is based on both use values and non-use values[20]. Use values are related to actual, planned and possible usage of environmental assets while non-use values are related to the willingness to maintain an environmental asset although there is no actual, planned or possible use.

Use values break down the economic value of environmental assets into three categories. Firstly, direct use values are those that are based on direct interaction with the environmental resource or service. Direct use values include activities such as tourism and fisheries that directly engage with marine ecosystems. Secondly, indirect use values are those that based on the indirect services provided by environmental assets[21]. For marine ecosystems in The Bahamas, this would be ecosystem services such as the protection from floods, storm surges and coastal erosion that is provided by offshore coral reefs or near shore mangroves. Thirdly, option values are those that are based on the ability to use environmental assets in the future. For marine ecosystems, this is related to economic values placed on conserving resources for future use and benefits.

[19] GloBallast, 2010. Economic Assessments for Ballast Water Management: A Guideline. http://globallast.imo.org/wp-content/uploads/2014/11/Mono19_English.pdf
[20] OECD. 2006. Cost-Benefit Analysis and The Environment. http://www.oecd-ilibrary.org/environment/cost-benefit-analysis-and-the-environment_9789264010055-en
[21] Department for Environmental Food and Rural Affairs, 2011. An Introductory Guide to Valuing Ecosystem Services, Department for Environmental Food and Rural Affairs. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/191502/Introductory_guide_to_valuing_ecosystem_services.pdf

Non-use values are also termed passive-use values and can be classified as existence, altruistic and bequest values[22]. Existence values are related to keeping an environmental resource in existence although the resource has no actual or planned use. This is akin to motives of stewardship such as providing protection to endangered species. Altruistic values are related to concern that the environmental resource is available for passive enjoyment current generations. Bequest values are related to concern that environmental resources be available for passive enjoyment by future generations. Non-use values are difficult to estimate but are important where there are no substitutes for existing environmental resources.

FIGURE 1: COMPONENTS OF TOTAL ECONOMIC VALUE



2.2 COSTS OF ENACTING THE BWM CONVENTION

The methodology used to determine the costs of enacting the Ballast Water Convention included a desktop review of costs associated with implementing the convention in other states as well as interviews with relevant stakeholder and

[22] OECD. 2006. Cost-Benefit Analysis and The Environment. http://www.oecd-ilibrary.org/environment/cost-benefit-analysis-and-the-environment_9789264010055-en

national experts on ballast water to determine needs and capacity. These costs are based on current conditions within the country and are subject to change with time and loss or addition of human capacity.

3
Value of Resources at Risk

3.1 DIRECT USE VALUES

3.1.1 Shipping and Maritime Industry

Shipping is a vital component of the Bahamian economy and is critical to human security. The Bahamas operates one of the largest shipping registries in the world with more than 1,000 registered vessels with a gross tonnage of approximately 58 million from 60 countries. This registry generates an annual revenue of approximately US$14 million of which US$4 million adds to the Government of The Bahamas consolidated fund[23].

Given that the majority of goods are imported into the country, there are many businesses that service the shipping industry. The provision of container handling, stevedoring, customs brokerage and local delivery as well as port and ship repair facilities are all services provided that contribute to the economy. In total, the shipping and maritime industry is estimated to contribute 20% to the Bahamian economy[24].

Approximately 11,500 people were employed in the Transport, Storage and Communication industries in 2011 which includes the shipping industry[25]. For 2014, the Gross Value Added (GVA) of the marine transport industry accounted for B$245 million[26].

Given the reliance of the nation on the shipping and maritime industries, it is critical that The Bahamas has an effective programme for managing ballast water. As a significant port of call for foreign-flagged international vessels including ocean-

[23] Commonwealth Secretariat. 2013. The Development of a National Maritime Policy for the Commonwealth of The Bahamas.
[24] Commonwealth Secretariat. 2013. The Development of a National Maritime Policy for the Commonwealth of The Bahamas.
[25] Bahamas Department of Statistics, 2012. Employed Persons by Sex and Industrial Group, 2011
[26] Bahamas Department of Statistics, 2015. National Accounts Report, 2014, http://statistics.bahamas.gov.bs/download/097208700.pdf

going passenger and merchant ships[27], a functional BWM programme ensures that The Bahamas is maintaining international standards and is an active global participant in preventing the spread of marine invasive species. In addition, as one of the largest flag states globally, The Bahamas plays a major role on a global scale in preventing the spread of marine invasive species through BWM requirements that registered vessels must comply with.

3.1.2 Coastal tourism

Tourism is the main driver of the Bahamian economy and is largely dependent upon the nation's image as a destination for sun, sand and sea to attract over 6 million tourists per year[28][29]. The health of the marine ecosystem is vital to tourism as some part of the coastal environment affects most tourist experiences. The primary reason given by tourists for vacationing in The Bahamas was identified as beaches[30]. In addition, specific marine activities such as snorkeling, scuba diving and recreational fishing directly rely on a healthy marine ecosystem. The Bahamas is also world-renowned as a flat fishing destination with international anglers visiting the islands for bone fishing.

Tourism employs approximately 50% of the population of The Bahamas and for 2014 the GVA of the tourism industry, based on hotels and restaurants, accounted for B$922 million[31].

Ballast water poses a threat to coastal tourism through the potential introduction of invasive species that may compromise the marine resources that the industry relies on. For example, harmful algal blooms occur when colonies of algae grow out of control. These blooms are known colloquially as 'red tides' since they often turn the water a deep red color and can make the surrounding air difficult to

[27] Government of The Bahamas, Port Department. Accessed June 23, 2015 at: http://goo.gl/IaoyKL
[28] Ministry of Tourism. 2014. Frequently Requested Statistics Brochure. www.tourismtoday.com
[29] Ministry of Tourism, 2015. Air Sea Landed and Cruise Arrivals 1998-2014. http://tourismtoday.com/docs/stats/AirSeaLandedandCruiseArrivals1998-2014.xls
[30] Ministry of Tourism, 2008. Exit Study Report, 2007. http://www.tourismtoday.com/docs/stats/exit-full-year-2007.doc
[31] Bahamas Department of Statistics, 2015. National Accounts Report, 2014, http://statistics.bahamas.gov.bs/download/097208700.pdf

breathe.[32]. These blooms of algae occur almost annually off the coast of Florida and increased occurrences have been reported in other US coastal states[33]. Research has shown that ballast water can result in the transfer of foreign algae and lead to the development of harmful algal blooms[34]. The occurrence of harmful algal blooms in The Bahamas would have severe impacts on coastal tourism as the industry greatly relies on the health and natural beauty of its marine resources.

3.1.3 Fisheries

The fisheries industry is an integral component of the economy of The Bahamas. While directly employing less than 4% of the population, fisheries accounts for a large proportion of exports and is a traditional and vital livelihood for residents of the Family Islands[35]. Fisheries in The Bahamas can be categorized into three groups: recreational/subsistence, sport-fishing and commercial fishing. Recreational/subsistence fishing is conducted by both Bahamian residents and visitors and involves the capture of mostly reef fish, lobster and conch. Sport-fishing focuses on catch and release of deep water fish and of bonefish. Sport-fishing has allowed for the development of fishing lodges on Family Islands that support rural livelihoods. Commercial fishing is reserved for Bahamian citizens. As seen in Table 1, landings from commercial fisheries was valued at B$84 million in 2012. Of this, B$77 million was exported[3637], representing a significant percentage of the $829 million total exports for the 2012 fiscal year[38].

[32] National Oceanic and Atmospheric Administration, 2015. Red tides
[33] National Oceanic and Atmospheric Administration, 2015. Red tides
[34] Smayda, T. 2007. Reflections on the ballast water dispersal-harmful algal bloom paradigm. *Harmful Algae* 6(4): 601-622
[35] Bahamas Department of Statistics, 2012. Employed Persons by Sex and Industrial Group, 2011
[36] Ministry of Agriculture and Marine Resources, 2013. Total Landings Bahamas CY 2012
[37] Ministry of Agriculture and Marine Resources, 2013. Fishery Product/Resource Exports for CY 2012.
[38] Bahamas Department of Statistics, 2013. 2012 Annual Foreign Trade Statistics Report,

TABLE 1: VOLUME AND VALUE OF FISHERIES RESOURCES FOR 2012[39]

Fishery Resource	Total 2012 Annual Live Weight Catch (lbs)	Value (B$)
Crawfish Tails	7,223,470	$72,801,565
Conch	1,731,793	$5,663,918
Snappers	953,058	$2,567,789
Stone Crabs	140,599	$1,233,878
Nassau Grouper	154,225	$620,358
Other Grouper	144,349	$468,838
Jacks	96,980	$247,847
Hogfish	83,695	$218,712
Grunts	140,304	$180,436
Crawfish Whole	20,898	$117,287
Others	31,630	$91,043
Grouper Fillet	10,764	$69,680
Queen Triggerfish	36,457	$56,168
Barracuda	8,329	$11,894
Total	**10,776,551**	**$84,349,413**

The last fisheries specific census was conducted in 1995 and found that there were 9,300 persons employed directly and indirectly in the industry[40]. The 2011 Occupations and Wages survey found that there were 6,040 people directly employed in the Agriculture, Hunting, Forestry and Fishing industries[41]. For 2014, the GVA of the fisheries industry was approximately B$80 million[42].

Ballast water poses a threat to the fisheries industry through the introduction of non-native species that affect the health of marine ecosystems that both directly and indirectly impact fisheries resources. For example, harmful algal blooms, discussed in Section 3.1.2 of this report have the potential to kill fish and make shellfish dangerous for human consumption[43]. This would have dire impacts on both economic revenue from fisheries as well as on human health. The lionfish, an invasive

[39] Ministry of Agriculture and Marine Resources, 2013. Total Landings Bahamas CY 2012
[40] Food and Agriculture Organization of the United Nations, 2009 National Fishery Sector Overview. ftp://ftp.fao.org/Fi/document/fcp/en/FI_CP_BS.pdf
[41] Bahamas Department of Statistics, 2011. Employed Persons by Sex and Industrial Group.
[42] Bahamas Department of Statistics, 2015. National Accounts Report, 2014, http://statistics.bahamas.gov.bs/download/097208700.pdf
[43] National Oceanic and Atmospheric Administration, 2015. Red tides

species from the Pacific region, is currently found in very high densities in the waters of The Bahamas[44]. Lionfish have significant impacts on local ecology and have detrimental implications for the fishing industry. The fish prey on over 70 different species including commercially important species like snapper and Nassau Grouper[45]. Lionfish also affect native fish by reducing their available food supply while also preying on small and juvenile fish, shrimps and crabs.

3.1.4 Aquaculture

Aquaculture is in the initial stages of development in The Bahamas with considerable room for growth. The Government of The Bahamas encourages the development of aquaculture ventures in order to enhance food security, provide employment opportunities and diversify the economy[46]. There are several small-scale aquaculture operations that are in initial stages of research and development. However, the lack of an aquaculture policy has hindered development of this industry[47]. Currently, there are no large scale commercial aquaculture operations in the nation. Ballast water may threaten an aquaculture industry through the introduction of non-native species that affect the health of marine ecology.

3.1.5 Marine Resources

The marine resources of the nation represent an emerging source of income. Currently *antillogorgia elisabethae* is harvested in the waters of The Bahamas and exported for use in cosmetic applications in the United States[48]. The export of this species results in the payment of custom duties and other fees that are remitted to the Government of The Bahamas. In addition to the export of this species, there is the potential for the harvesting and exporting of other marine resources through

[44] Green, S and I. Cote, 2009. Abundance of Invasive Lionfish (*Pterois volitans)* on Bahamian Coral Reefs. https://www.gcfi.org/Lionfish/Papers/2009/GreenGCFI61_Paper.pdf
[45] Invasive Species of The Bahamas, BNT
[46] FAO. Aquaculture Legislation for the Commonwealth of The Bahamas. Accessed June 23, 2015 at http://www.fao.org/docrep/field/003/ac413e/AC413E01.htm
[47] The Tribune, 2014. Commercial Fishfarming the Way for The Bahamas.
[48] Species 2000 & IT IS Catalogue of Life, 2013, Antillogorgia elisabethae, http://eol.org/pages/992277/hierarchy_entries/49625041/details

bioprospecting[49]. While the current GVA of marine resources is not known, this sector has the potential to contribute greatly to the Bahamian economy in the future. Ballast water threatens this burgeoning industry through the introduction of non-native species that may affect the health of marine ecology and associated marine resources.

3.2 INDIRECT USE VALUES

3.2.1 Ecosystem Services

Ecosystem services refers to the direct benefits received by humans from ecosystems. For coastal and marine ecosystems, this incudes coastal protection, nursery services and carbon sequestration as seen in Table 2.

TABLE 2: ECOSYSTEM SERVICES OF COASTAL AND MARINE HABITATS[50]

Habitat	Ecosystem Services
Mangroves	• Nursery habitat for commercially important fish species; • Aid in stabilization of coastal shoreline; • Decrease erosion, flooding and damages from tropical storms; • Important for carbon sequestration.
Seagrass	• Critical component in nutrient cycling; • Aid in stabilization of sediment and shoreline stabilization; • Important for carbon sequestration; • Provide nursery habitats for commercially important fisheries.
Coral reefs	• Protect shorelines through breaking waves and storm surges; • Aid in filtering waste;

[49] Meyer, Hartmut, 2014. Patents on Caribbean Genetic Resources and Traditional Knowledge, http://www.abs-initiative.info/fileadmin/user_upload/Activities/2012/Trinidad_Tobago_3-4092012/ABS_Workshop_Trinidad-GIZ-Patents.pdf

[50] The Nature Conservancy, 2010. Ecosystem Services.

	• Important for carbon sequestration; • Major source of fisheries production; • Significant tourism attraction for snorkeling and scuba diving.
Wetlands	• Important for commercial fisheries; • Decrease storm surge impacts; • Important for carbon sequestration' • Important to tourism related bone-fishing, kayaking and birdwatching
Beaches	• Contribute to local sediment dynamics; • Provide natural shoreline protection; • Habitat for benthic animals and microalgae; • Significant tourism attraction.

There have been a number of studies that estimate the value of ecosystem services in The Bahamas. However, these studies have focused on specific ecosystem services in particular islands and there is currently no valuation of ecosystem services on a national scale[51]. Existing studies provide an indication of the high economic value associated with ecosystem services as detailed in Table 3.

TABLE 3: STUDIES OF ECOSYSTEM SERVICES VALUATION IN THE BAHAMAS

Study	Area Studied	Coastal and Marine Ecosystems Assessed	Value of Assessed Coastal and Marine Ecosystem Services
Hargreaves-Allen, 2010[52]	Andros	Beaches, Coral Reefs, Estuaries, Mangroves, Sea Grass	B$106.6 million per year • *Coral reef: $621/ha/yr* • *Mangrove systems: $307/ha/yr* • *Estuaries: $378/ha/yr* • *Seagrass: $2.9/ha/yr*

[51] Thomas, A. et al. 2015. A Situational Analysis of the Environment of The Bahamas
[52] Hargreaves, Allen, V. 2010. An Economic Valuation of the Natural Resources of Andros Island, Bahamas. http://conservation-strategy.org/sites/default/files/field-file/Andros_Exec_summary_II.pdf

			• *Beaches: $907/ha/yr* • *Wetlands: $294/ha/yr*
Hargreaves-Allen, 2011[53]	Exuma	Beaches, coral reefs, estuaries, seagrass	B$229.5 million per year • *Beaches: $215,954/km²/yr* • *Coral Reefs: 139,429/km²/yr* • *Estuaries: $87,304/km²/yr* • *Seagrass:* • *$54,593/ km²/yr*
Clavelle and Jylkka, 2013[54]	Parts of Abaco: Cross Harbour and East Abaco Creeks	Mangroves, wetlands, seagrass, coral reef	B$10.9 million per year • *Mangroves: $2,692/ha/yr* • *Seagrass: $820/ha/yr* • *Coral reef: $737/ha/yr* • *Wetlands: $1500/ha/yr*

3.3 OPTION VALUES

Option values are those that are based on the ability to use environmental assets in the future. For marine ecosystems, this is related to economic values placed on conserving resources for future use and benefits. There are currently no available studies of option values for The Bahamas for marine resources.

3.4 EXISTENCE, ALTRUISTIC AND BEQUEST VALUES

Non-use values are determined by surveying the population on attitudes towards preserving and protecting environmental assets for current and future

[53] Hargreaves, Allen, V. 2011. The Economic Value of Ecosystem Services in the Exumas Cays; Threats and Opportunities for Conservation. http://conservation-strategy.org/sites/default/files/field-file/Exuma_report_summary_July_2011.pdf

[54] Clavelle, T. and Z. Jylkka. 2013. Ecosystem Service Valuation of Proposed Protected Areas in Abaco, The Bahamas. http://sfg.msi.ucsb.edu/current-projects/SFG_Abaco_FinalReport_041614.pdf

generations[55]. There is currently no national survey of Bahamian attitudes towards existence, altruistic or bequest values. However, a 2010 study of visitors to New Providence, Grand Bahama and Abaco found that 95% of respondents were open to paying a minimum of $5 to protect the natural and cultural environment of The Bahamas[56]. To roughly extrapolate this study, $5 can be multiplied by the total number of visitors to The Bahamas annually-6.3 million[5758]- to obtain an estimate of $31.5 million for existence, altruistic and bequest values.

[55] An Introductory Guide for Valuing Ecosystem Services, DEFRA
[56] Marketing & Consultants Limited, 2008. Willingness to Pay Survey Report
[57] Ministry of Tourism. 2014. Frequently Requested Statistics Brochure. www.tourismtoday.com
[58] Ministry of Tourism, 2015. Air Sea Landed and Cruise Arrivals 1998-2014. http://tourismtoday.com/docs/stats/AirSeaLandedandCruiseArrivals1998-2014.xls

4
Costs of Enacting the Convention

4.1 PREPARATORY PHASE COSTS

4.1.1 Capacity building, coordination and communication

Introductory Training and Workshops

Key personnel in affected institutions need to be identified and begin participation in the ballast water management strategy for the nation. Additionally, a number of persons have participated in prior workshops on ballast water management for The Bahamas and need to be re-engaged to ensure continuity of education and knowledge transfer. This can be achieved through a series of introductory training and workshops. At the introductory stage, one day workshops that introduce the BWM Convention and solicit input from personnel should be appropriate. Workshops can be held in New Providence and Grand Bahama with relevant personnel from Family Islands traveling to either of these locations.

Estimated cost for 4 workshops: $20,000

Trainer	$ 1,000
Training documents and printed materials	$ 400
Catering and venue -(approx. 30 participants)	$ 1,600
Travel and accommodation costs (Family Islands personnel) -(4 persons at $500/person)	$ 2,000
Total per workshop:	$ 5,000

Stakeholder Meetings

Key stakeholders need to be engaged in education and training about ballast water in order to develop a coordinated and complementary approach to control the spread of invasive aquatic species. Workshops on implications of ballast water, strategies to prevent spread of aquatic marine invasives and the role of stakeholders need to be held to raise awareness of the issue and identify roles and responsibilities.

A series of one day workshops that facilitate cooperation from NGO's, academic and research institutions and users of marine resources can be held.

Estimated cost for 4 stakeholder meetings: $20,000

Facilitator/trainer:	$ 1,000
Documents and printed materials:	$ 400
Catering and venue:	$ 1,600
-(approx. 30 participants)	
Travel and accommodation costs (Family Islands participants)	$ 2,000
-(4 persons at $500/person)	
Total per meeting:	$ 5,000

4.1.2 National and Regional Task Force meetings

National meetings

The formation of a National Ballast Water Task Force (NBWTF) has already been completed. The NBWTF will need to meet at least on a quarterly basis to review and assess progress on the BWM strategy for The Bahamas and to make any necessary recommendations.

Estimated costs of 4 meetings per year: $1,000

Venue:	In kind
Catering:	$ 250
Total per meeting:	$ 250

Regional meetings

As part of the Regional Strategic Action Plan to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens in Ships' Ballast Water and Sediments Wider Caribbean Region, The Bahamas is committed to participate in the establishment and implementation of regional arrangements and cooperation to ensure effective ballast water management for the Wider Caribbean Region[59]. This regional coordination is achieved in part through regular meetings with member nations of which The Bahamas must participate in.

[59] RAC-REMPEITC, GloBallast, IMO. 2012. Regional Strategic Action Plan to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens in Ships' Ballast Water and Sediments Wider Caribbean Region. https://www.google.com/webhp?sourceid=chrome-instant&rlz=1C1TSNP_enUS514US514&ion=1&espv=2&ie=UTF-8#

Estimated costs of 2 representatives attending two meetings per year: $20,000

Cost of attending regional meeting (per person)	$ 5,000
-including travel, accommodations, per Diem	

4.1.3 Legislative and policy reform costs

Capacity has been built relating to the BWM Convention at the Office of The Attorney General through the involvement of personnel in ballast water legislation training. In particular, preliminary work has been completed on an Act to incorporate the BWM Convention in The Bahamas[60]. Building upon this preliminary work and in collaboration with the development of the National Maritime Policy, legislation and policy for ballast water management needs to be developed. If this is done through the Office of The Attorney General, costs will be minimal but timing will depend upon capacities and workload of appropriate personnel.

4.1.4 Legislative review and implementation

The Office of The Attorney General will be responsible for reviewing any ballast water legislation and for starting the legislative process of approval through Cabinet. Upon passing of national legislation, affected institutions will need to be appraised of any associated requirements. This step should be able to be accomplished using existing procedures.

4.1.5 Port biological baseline surveys

Article 6 of the BWM Convention encourages states to conduct scientific and technical research and monitoring of non-indigenous species which requires the assessment of baseline conditions[61]. Port biological baseline surveys provide inventories of marine life at commercial ports frequented by ships that carry ballast water. These surveys allow for identification and quantification of non-indigenous species and provide a baseline against which future changes are measured.

Standard protocols for general biological surveys of non-indigenous and native species in shipping ports have been established by the Australian Centre for

[60] IMLI The Bahamas. Accessed June 22, 2015 at http://www.imli.org/directories/bahamas

[61] IMO. 2004. International Convention for the Control and Management of Ships' Ballast Water and Sediments.

Research on Introduced Marine Pests and have been used to assess conditions at a number of ports in different states[62]. In collaboration with IOI, CSIR-NIO and IUCN, GloBallast has also issued guidance for the conduct of port biological baseline studies[63]. There are different levels of port biological baseline surveys that range from very simple surveys with minimal resources to sophisticated surveys that require significant resources. Although port biological baseline surveys are not a specific requirement of the BWM Convention, it is recommended that some form of baseline survey be carried out. Baseline studies that have been conducted in other ports have cost approximately US$500,000 per port[6465].

Given the archipelagic nature of The Bahamas, there would be significant expenses in conducting port surveys at all shipping ports. Therefore it is recommended that baseline surveys be conducted for the major shipping ports in New Providence, Grand Bahama and Abaco. Arrangements can potentially be made to share costs between the Government of The Bahamas and privately owned Grand Bahama Port Authority for the Grand Bahama survey as have been made in other states[66]. Another potential source of funding can be through grants and in collaboration with existing environmental institutions such as BEST Commission.

Estimated costs of 3 port biological baseline surveys: $1,500,000

Baseline surveys (per port)	$ 500,000

[62] GloBallast: Port Biological Baseline Surveys. Accessed June 22, 2015 at http://globallast.imo.org/pbbs/

[63] Awad, A., Haag, F., Anil, A.C., Abdulla, A. 2014. GEF-UNDP-IMO GloBallast Partnerships Programme, IOI, CSIR-NIO and IUCN. Guidance on Port Biological Baseline Surveys. GEF-UNDP-IMO GloBallast Partnerships, London, UK. GloBallast Monograph No. 22.

[64] Port of Los Angeles Cost Share Agreement Accessed June 22, 2015 at http://www.portoflosangeles.org/Board/2013/June%202013/060613_Item_6.pdf

[65] Baseline Survey of the Port of Darwin Accessed June 22, 2015 at http://lrm.nt.gov.au/__data/assets/pdf_file/0006/14298/podsrptver6a.pdf

[66] Port of Los Angeles Cost Share Agreement Accessed June 22, 2015 at http://www.portoflosangeles.org/Board/2013/June%202013/060613_Item_6.pdf

4.1.6 Risk assessments

Risk assessments are essential components in the implementation of a ballast water management strategy on a national scale. Assessments aid in the identification of high risk trading routes and identification of ballast water sources that require higher levels of vessel monitoring and management. Risk assessments can be conducted for routes of particular vessels or to assess the risk of particular ports based on the type and frequency of shipping vessels. Risk assessments for vessels allow states to grant exemptions for the movement of ships between specified ports. Risk assessments for ports allow for identification of types of vessels that require high levels of monitoring.

Standardized methods of ballast water risk assessment have been developed by the IMO[67]. These assessments use semi-quantitative approaches that identify the most at risk ballast tank discharges. Risk assessments for commercial shipping ports require the establishment and operation of information management systems. Guidelines for the development and operation of these systems has been developed by the IMO[6869]. It is recommended that risk assessments be developed for the major shipping ports in New Providence, Grand Bahama and Abaco.

Estimated cost of port risk assessment: $44,000

Development of database and GIS system ($8,000 per port):	$ 24,000
Training of personnel in up keeping system:	$ 10,000
Software	$ 10,000
Total:	$ 44,000

4.2 COMPLIANCE RELATED COSTS AS A FLAG STATE

The Bahamas Maritime Authority (BMA) will be responsible for the compliance of vessels registered to The Bahamas to the BWM Convention. The BMA

[67] Guidelines for Risk Assessment under Regulation A-4 of the BWM Convention. http://globallast.imo.org/wp-content/uploads/2015/01/G7-GUIDELINES-FOR-RISK-ASSESSMENT-UNDER-REGULATION-A-4-OF-THE-BWM-CONVENTION.pdf

[68] IMO Guidance On Risk Assessment In Relation To Bioinvasions. http://bch.cbd.int/database/attachment/?id=2985

[69]GlobBallast.2013. GloBallast Monograph 21: Identifying Risks from Organisms in Ships' Ballast Water. http://globallast.imo.org/wpcontent/uploads/2014/11/Mono21_english.pdf

Inspections and Surveys department is currently responsible for ensuring that registered ships meet statutory requirements detailed in international Conventions and Codes[70]. Surveys and certifications are conducted by Recognised Organizations on behalf of the BMA while BMA keeps an overview of all issued certifications. BMA operates an annual inspection programme that ensures the good management of ships and verifies the results of surveys and inspections conducted by Recognized Organizations.

For compliance with the BWM Convention, this current practice can be maintained with Recognized Organizations responsible for verifying compliance of registered ships and BMA reviewing certification during its annual inspection. However, clear guidelines and specifications need to be provided to Recognized Organizations to ensure that requirements are met.

It is recommended that an expert in BWM be contracted to work along with BMA to develop the compliance measures needed for the following categories:

4.2.1 Establishing procedures for BWM Certificate issuance

BMA will need to establish procedures for BWM certificate issuance through Recognized Organizations. As these procedures are already in place for compliance with other international Conventions, this process should be well defined.

4.2.2 Approval of BWM plans for ships

All ships of 400gt and above will be required to have a ship-specific BWM plan[71]. The plan is required to assist the ship in complying with regulations, identify the BWM Officer and include training on BWM operational practices. It is the responsibility of flag states that register ships to inspect and approve these BWM plans. BMA will need to communicate to Recognized Organizations requirements for approval of BWM plans for ships.

4.2.3 Type approval of BWM systems

[70] BMA. Inspections and Surveys. Accessed June 23, 2015 at: http://www.bahamasmaritime.com/index.php?page=17

[71] IMO. 2004. International Convention for the Control and Management of Ships' Ballast Water and Sediments.

IMO has developed Guidelines for Approval of Ballast Water Management Systems aimed at helping Administrators to assess whether ballast water management systems meet standards established in the BWM Convention[72]. Recognized Organizations will be responsible for approval of BWM systems with BMA checking compliance during annual inspections.

4.2.4 Surveys of BWM systems

Recognized Organizations will be responsible for surveying BWM systems onboard vessels. Guidelines developed by the IMO provide methodology for conducting surveys of BWM systems[73].

4.2.5 Approval of exemption applications

BMA approves all exemptions from statutory requirements and thus will be responsible for BWM exemption applications[74]. A clear procedure for exemptions needs to be developed by BMA.

For Sections 4.2.1-4.2.5 that cover compliance measures, the services of a BWM Convention expert should be retained to work along with BMA and Recognized Organizations.

Estimated cost for development of compliance measures: $5,000

Expert in BWM Convention	$5,000

4.2.6 Training of Inspectors

Both BMA inspectors and Recognized Organizations will need to be trained on approving BWM plans for ships, BWM systems and surveys and BW exemptions. A series of workshops will need to be held as well as making training materials available

[72] IMO, Guidelines for Approval of Ballast Water Management Systems. http://globallast.imo.org/wp-content/uploads/2015/01/G8-GUIDELINES-FOR-APPROVAL-OF-BALLAST-WATER-MANAGEMENT-SYSTEMS.pdf

[73] IMO, Guidelines for Approval of Ballast Water Management Systems. http://globallast.imo.org/wp-content/uploads/2015/01/G8-GUIDELINES-FOR-APPROVAL-OF-BALLAST-WATER-MANAGEMENT-SYSTEMS.pdf

[74] BMA Inspections and Surveys. http://www.bahamasmaritime.com/index.php?page=17

online. Recognized Organizations for BMA are located all around the world making the availability of online training a necessity.

Estimated cost for training of inspectors: $40,000

Development of training workshops and online material specific to Bahamian requirements	$10,000
Training workshops (3 @ $10,000 each)	$30,000
Total:	$40,000

4.3 COMPLIANCE RELATED COSTS AS A PORT STATE

The Bahamas Port Department and Department of Environmental Health Services will be responsible for assuring compliance of vessels with the BWM Convention at ports within the nation. A training workshop on port state control for the BWM Convention was held in The Bahamas in August 2013 and facilitated by RAC/ REMPEITC-Caribe. The workshop focused on disseminating information about compliance, monitoring and enforcement aspects of port state control and was attended by a number of stakeholders. Continued training can be built upon this initial workshop to increase the capacity of The Bahamas as a port state. It is recommended that an expert in the BWM Convention work along with the Port Department to develop compliance related materials as detailed in the following sections.

4.3.1 Compliance and monitoring enforcement

As a port state, The Bahamas is responsible for[75]:

1. Inspecting ships for adherence with BWM Certificates, completing and storing inspection reports
2. Sampling ballast water from ships that do not comply with BWM Certificates
3. Prohibiting the discharge of ballast water from ships that pose a threat to environment, human health, property or resources
4. Warning, detaining or excluding ships in violation of the BWM Convention

[75] IMO, Guidelines for Port State Control under the BWM Convention, http://www.imo.org/en/OurWork/Environment/BallastWaterManagement/Documents/MEPC.252(67).pdf

4.3.2 Inspection of ships

As a port state, The Bahamas is responsible for inspecting ships for compliance with the BWM Convention. A four stage inspection of ships required to carry the BWM Certificate is defined by the IMO[76]. In the first stage, inspection of BWM documentation and verification of a qualified BWM Officer on board the ship is conducted. In the second stage, the operation of the BW management system is checked. In the third stage, sampling of ballast water takes place to ensure that ballast water meets standards. In the fourth stage, detailed analysis of ballast water takes place. It is only required to move from the first stage to the other stages if there are clear grounds that indicate the condition of the ship or its equipment does not correspond to details indicated on the BWM Certificate. When this occurs, inspection becomes more detailed.

To complete obligations as a port state, a detailed inspection methodology needs to be developed for the Bahamian context and training is needed for Port Department Officers and Environmental Health Services Operators. It is anticipated that Environmental Health Services Operators will be responsible for any ballast water sampling.

Estimated costs for inspections: $25,000

Expert to develop inspection protocols	$5,000
-in collaboration with Port Department	
Training workshops for Port Department Officers	$20,000
-4 @ $5,000 each	

4.3.3 Sampling

The Port Department will be responsible for sampling ballast water during inspection of ships if required. The IMO has developed guidelines for ballast water sampling to provide states with practical and technical guidance to determine

[76] IMO, Guidelines for Port State Control Under the BWM Convention, http://www.imo.org/en/OurWork/Environment/BallastWaterManagement/Documents/MEPC.252(67).pdf

whether vessels are in compliance with the BWM Convention[77]. The guidelines provide general recommendations for ballast water sampling by port state control authorities. Sampling requirements are different depending on whether vessels comply with regulation D-1 or D-2 of the BWM Convention. Regulation D-1 requires exchange of ballast water while Regulation D-2 requires treatment of ballast water. For both regulations, sampling the ballast water on arriving ships provides evidence of compliance. Samples should be fully processed in a timely manner so as not to unduly delay ships. While the process of collecting the samples is relatively straightforward and detailed in IMO guidelines, there is currently very limited laboratory capacity to test sampled water and provide results in a timely manner in The Bahamas.

Currently, developments in rapid on-board compliance testing are being developed in European markets[78]. Methods for on-board sampling and analysis have been developed and tested successfully. This would be an ideal solution to allow port state officers to test ballast water compliance onboard the vessel rather than transporting water samples to an off-site laboratory[79]. The on-vessel tests require the use of safety measures including lab glasses, special gloves, and lab coat. Training workshops of theory and practical exercises of have proven to be sufficient to allow personnel without technical and/or scientific backgrounds to learn how to conduct onboard sampling and testing.

Estimated sampling costs: $52,000

Training workshop on ballast water sampling	$ 40,000
- (1 week, expert trainer, travel for personnel from Grand Bahama, Abaco)	
Sampling kits for ports (3 @ $4,000 each)	$ 12,000
- safety measures, chemicals, etc.	

[77] IMO, Guidelines for Ballast Water Sampling, http://globallast.imo.org/wp-content/uploads/2015/01/G2-GUIDELINES-FOR-BALLAST-WATER-SAMPLING.pdf

[78] SGS Institut Fresenius. 2014. Effective New Technologies for the Assessment of Compliance with the Ballast Water Management Convention. http://www.bsh.de/en/Marine_data/Environmental_protection/Ballastwater/compliance_control/SGS_20141211BSH_final_report.pdf

[79] The ATP method, PAM method and the FDA method can be executed on-board ships with the ATP and PAM methods taking just a few minutes to produce results while the FDA method requires up to one hour for results. The FISH method detects bacteria species and must be conducted in a land-based lab that takes 15 hours for results.

Total: $ 52,000

4.3.4 Sediment reception facilities

Article 5 of the BWM Convention states that ports and terminals where cleaning or repair of ballast water tanks takes place should have adequate reception facilities for the reception of sediments. The IMO has developed guidelines for sediment reception facilities for the use by port states[80].

Currently, the Grand Bahama Shipyard and the Freeport Harbour Company are the only locations in The Bahamas that provide for cleaning or repair of ballast water tanks. Government operated ports do not provide these services. The Grand Bahama Shipyard partnered with Hyde Marine in 2014 to install two chemical free ballast water treatment systems for vessels docking at the yard[81]. The system uses filtration and ultraviolet disinfection to treat ships' ballast water.

There has been some research into the viability of using existing port waste reception facilities as ballast water sediment reception facilities. Research has shown that this may be a viable and cost-effective approach[82]. There is an existing port reception facility in Freeport, Grand Bahama operated by Morgan Oil Marine that provides for the disposal of oily bilge water[83] that may have the possibility to accommodate ballast water sediment.

As there are already facilities for ballast water treatment at the locations that provide for cleaning or repair of ballast water tanks, there are not costs associated with this measure at this time.

4.3.5 Communication of requirements

The Port Department is responsible for communicating requirements regarding ballast water to vessels that affect the waters of The Bahamas. Information about (i)the location and terms of use of areas designated for ballast water exchange,

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[80] IMO, Guidelines or Sediment Reception Facilities, http://globallast.imo.org/wp-content/uploads/2015/01/G1-GUIDELINES-FOR-SEDIMENT-RECEPTION-FACILITIES.pdf
[81] Grand Bahama Shipyard Marketing, 2014. http://grandbahamashipyard.com/2014/07/1721/
[82] Adaptation of Port Waste Reception Facilities to Ballast Water Treatment System: Turkish Port Perspective. PSP Volume 23 No 11a. 2014
[83] GISIS: Port Reception Facilities, The Bahamas. https://gisis.imo.org/Public/PRF/SearchResults.aspx?search=port

(ii)warnings concerning ballast water uptake in the event of emergency, (iii)availability, location and capacities of reception facilities and (iv)any other measures specific to the nation must be communicated to ships. As there is already an established system of communicating other requirements to vessels, this process should be streamlined.

4.3.6. Designation of areas for BW exchange

Exchange of ballast water is an important component of preventing the invasion of marine aquatic organisms. The IMO has developed guidelines on designation of areas for ballast water exchange[84]. This process requires adherence to rights and obligations of the state under international law as well as consultation with adjacent states to identify, assess and designate potential ballast water exchange areas.

The designation of areas for ballast water exchange will need to take into account the membership of The Bahamas in the ballast water program for the wider Caribbean region and work along with other states to develop appropriate areas. This designation will require risk analysis, environmental assessment and the development of legal commitments. This process has been completed in other states and offer guidelines and best practices that can be applied in the Bahamian context[85]. Following the identification of appropriate areas by an expert, final recommendations and input from other states can be facilitated through the wider Caribbean region ballast water group.

Estimated costs for designation of BW exchange areas: $5,000

Expert report:	$ 5,000
Collaboration with other states:	in kind
- through wider Caribbean region ballast water group	

[84] IMO, Guidelines on Designation of Areas for Ballast Water Exchange, http://globallast.imo.org/wp-content/uploads/2015/01/G14-GUIDELINES-ON-DESIGNATION-OF-AREAS-FOR-BALLAST-WATER-EXCHANGE.pdf

[85] Knight et al., 2007. Designated Exchange Areas Project- Providing informed decisions on the discharge of ballast water in Australia. http://www.lib.washington.edu/msd/norestriction/b67512513.pdf

4.4 INDUSTRY OBLIGATIONS

4.4.1 Training of crewmembers

Shipping companies are responsible for training their crewmembers on how to uptake, treat and discharge ballast water. This training can be incorporated into existing training of crewmembers and should be a streamlined process. Shipping companies will need to ensure that appropriate expertise is sourced to train crewmembers.

Estimated cost per vessel: $2,000

4.4.2 BWM Plans

Ships are required to have BWM plans in the working language of the crew of the ship. The IMP has developed guidelines for the development of ballast water management plans[86]. Shipping companies will be responsible for developing BWM plans for each vessel.

Estimated cost for BWM plan per vessel: $3,000

4.4.3 BWM Record Books

Ships are required to keep a record book on uptake and discharge of ballast water[87]. The BMA has already developed a BW record book that is available to registered vessels[88]. The BW record book is available for a nominal fee of $16[89].

Estimated cost of BW Record Book per year per vessel: $16

4.4.4 BWM System

The IMO has developed guidelines for approval of ballast water management systems primarily for use by Administrators responsible for inspecting vessels but

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[86] IMO, Guidelines for Ballast Water Management and Development of Ballast Water Management Plans (G4), http://www.imo.org/blast/blastDataHelper.asp?data_id=15730&filename=127(53).pdf
[87] IMO. 2004. International Convention for the Control and Management of Ships' Ballast Water and Sediments.
[88] BMA, Information Bulletin No. 152: BMA Publications. http://www.bahamasmaritime.com/downloads/bulletins/152bulltn.pdf
[89] BMA, Publications Order Form, Accessed June 23, 2015 at: http://bahamasmaritime.com/includes/tng/pub/tNG_download4.php?page=88&KT_download1=a0b25d7f8637b8a24fde663c0442221f

also appropriate for use by ship-owners on the evaluation procedures for ballast water management systems[90]. Shipping companies will need to ensure that they select appropriate BWM systems and that they are installed and operated correctly. BW treatment systems range from US$175,000 to US$3 million, dependent on the size of the ship[91]. However, technical advances are leading to lower prices. If a vessel obtains an exemption then there would be no associated costs for ballast water management via a treatment system.

Estimated cost of ballast water management, per vessel: $0 -$3,000,000

Ballast water treatment system	$0 - $3,000,000
- (dependent upon size of vessel and exemption statues)	

4.5 ADDITIONAL COSTS

4.5.1 Port biological monitoring programmes

IMO recommends that follow up surveys of port biological conditions be conducted every 3-5 years following the initial port biological baseline study[92]. This monitoring would be similar to initial surveys but reduced in both scope and scale.

Estimated costs of port monitoring, every 5 years: $450,000

Monitoring (every 3-5 years, $150,000 each for 3 ports)	$450,000

4.5.2 Port BWM plan development

Each port in the archipelago that berths vessels with ballast water needs to develop a port specific BWM plan. A basic port BWM plan that is applicable to the Bahamian context can be developed that can then be adapted to specific ports within the nation.

[90] IMO, Guidelines for Approval of Ballast Water Management Systems, http://globallast.imo.org/wp-content/uploads/2015/01/G8-GUIDELINES-FOR-APPROVAL-OF-BALLAST-WATER-MANAGEMENT-SYSTEMS.pdf

[91] McQuilling, Ballast Water Treatment Costs, Accessed June 23, 2015 at: http://gcaptain.com/ballast-water-treatment-costs/#.VYhpEvlViko

[92] IMO, Guidelines for Port Biological Baseline Studies, http://globallast.imo.org/wp-content/uploads/2015/01/Mono22.pdf

Estimated cost for port BWM plans: $15,000

Expert to develop basic port BWM plan	$ 5,000
Workshop to facilitate development of port specific plans	$ 10,000
Total:	$ 15,000

5
Funding Mechanisms

To defray some of the costs associated with implementation of the BWM Convention, there are a number of potential sources of funding that can be approached by the Ministry of Transportation and Aviation as detailed in Table 4.

TABLE 4: POTENTIAL SOURCES OF FUNDING

Funding Type	Potential Sources
Private sector stakeholders	• Nassau Container Port; • Freeport Container Port; • Freeport Harbour Company; • Grand Bahama Shipyard • BMA Recognized Organizations
Public sector stakeholders	• Ministry of Tourism; • Ministry of Agriculture, Marine Resources and Local Government; • Ministry of Environment and Housing
Multilateral Donors	• IMO Integrated Technical Cooperation Programme; • UN agencies and programmes; • World Bank; • Inter-American Development Bank; • Caribbean Development Bank

In addition to funding partnerships, there can also be defrayment of costs through the charging of fees as detailed in Table 5.

TABLE 5: POTENTIAL FEE SYSTEMS[93]

Type of fee system	Structure of fees
Direct fee	Payment on delivery of services
Contract	Contract between ships calling the same port frequently and the service provider
Port Dues	Costs added to existing port dues/charges
Fixed fee	Costs added as a surcharge to port dues/charges
Combined	Each ship pays a fixed fee plus an extra charge dependent on service rendered
Non-compliance fee	Significant charge if ship does not comply with BWM Convention

[93] GloBallast, 2010. Economic Assessments for Ballast Water Management: A Guideline. http://globallast.imo.org/wp-content/uploads/2014/11/Mono19_English.pdf

6
Synthesis of Findings

Given the fragmented nature of studies valuing marine and coastal resources of The Bahamas, it is difficult to form a comprehensive total economic value. There are significant knowledge gaps concerning ecosystem services, option, existence, altruistic and bequest values. The values that are provided, particularly for ecosystem services, represent but a small fraction of the total value for these resources. However, while available data is incomplete, it is clear to see that marine and coastal resources are a significantly valuable commodity for the nation. Table 6 provides a synthesis of available information on the value of these resources.

TABLE 6: COASTAL AND MARINE RESOURCES: ECONOMIC VALUE AND PERSONS EMPLOYED

Type of Value	Sector/Resource	Value (B$)	# of Persons Employed	Notes
Direct Use	Shipping	$245,000,000	11,500	2014 GVA; see Section 3.1.1
	Coastal Tourism	$922,000,000	80,000	2014 GVA; see Section 3.1.2
	Fisheries	$ 80,000,000	9,300	2014 GVA; see Section 3.1.3
	Aquaculture	-	-	No current value but expected to increase significantly in future; see Section 3.1.4
	Marine Resources	-	-	No current value but expected to increase significantly in future; see Section 3.1.5
Indirect Use	Ecosystem Services (Only captured for Andros, Exuma and part of Grand Bahama)	$347,000,000	-	Per year value; Will be significantly higher if all of The Bahamas is valued; see Section 3.2
Option				No studies found; see Section 3.3
Existence, Altruistic and Bequest		$31,500,000		see Section 3.4
Total		**$1,625,500,000**	**100,800**	**Will be significantly higher if value of all resources is accounted for**

The costs associated with enacting the BWM Convention can be categorized in a number of ways. Some are one-time costs associated with developing a BWM strategy, others will be ongoing costs and costs will be distributed amongst different groups. In addition, some of the actions are essential in enacting the BWM Convention while others are not mandatory. Table 7 synthesizes the costs of enacting the BWM Convention that will be the responsibility of the Government of The Bahamas. Table 8 synthesizes the costs of adhering to BWM Convention for ship owners.

TABLE 7: COSTS OF ENACTING BWM CONVENTION FOR THE GOVERNMENT OF THE BAHAMAS

Category	Activity	One-Time Cost	On-Going Annual Cost	Notes
Preparatory Costs	Introductory Training Workshops (4)	$20,000		see Section 4.1.1
	Stakeholder Meetings (4)	$20,000		See Section 4.1.1
	National Meetings		$1,000	See Section 4.1.2
	Regional Meetings		$20,000	See Section 4.1.2
	Legislative and Policy Reform	$5,000		See Section 4.1.3
	Legislative review and implementation			In kind through AG Office; see section 4.1.4
	Port biological baseline surveys	$1,500,000		May be cost shared with private entities; see section 4.1.5
	Risk assessments	$44,000		See section 4.1.6
Flag State Compliance Costs	Development of compliance measures	$5,000		See Sections 4.2.1-4.2.5
	Training of inspectors	$40,000		May be cost shared with Recognized Organizations; See Section 4.2.6
Port State Compliance Costs				
	Training for inspections	25,000		See Section 4.3.2
	Training for sampling	$52,000		See Section 4.3.3

	Sediment reception facilities			Not required; See Section 4.3.4
	Designation of BW exchange areas	$5,000		See Section 4.3.6
Other Costs	Port biological monitoring		90,000	$450,000 every 5 years; See Section 4.5.1
	Port BWM plans	$15,000		See Section 4.5.2
Total		**$1,731,000**	**$111,000**	

TABLE 8: COSTS OF ENACTING BWM CONVENTION FOR SHIP OWNERS

Activity	**Costs**	**Notes**
Training crewmembers	$2,000	See Section 4.4.1
BWM Plan	$3,000	See Section 4.4.2
BWM record book	$16	See Section 4.4.3
BWM System	$0-$3,000,000	Dependent on type and size of vessel; See Section 4.4.4
Total	**$5,016 - $3,005,016**	Per vessel

In conclusion, the value of marine and coastal resources at risk to marine invasive species transported through ships' ballast water was found to be approximately $1.6 Billion per year. Please note that this figure does not include the economic value of all resources as there is a lack of valuation of all natural resources for The Bahamas. A complete valuation of all coastal and marine resources would provide a significantly higher figure. In order to enact the BWM Convention, the Government of The Bahamas will need approximately $1.7 Million in one-time costs with on-going costs of approximately $111,000 annually. For ship owners, costs for enacting the BWM Convention range from approximately $5,000 to $3 million dependent on the type and size of the vessel. Based on the compiled values, it is clear that the economic value of resources at risk to invasive marine species far exceeds the costs of enacting the BWM Convention that would aid in preventing damages to the coastal and marine resources of The Bahamas. It is therefore in the best interests of the nation to strongly consider enacting the BWM Convention and drawing upon sources detailed in Section 5 to fund an effective ballast water management strategy for the nation.