NARRAGANSETT BAY WATERSHED ECONOMY

The ebb and flow of natural capital

TOURISM

BEACH USE

MARITIME TRADE

AQUACULTURE

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NARRAGANSETT BAY WATERSHED ECONOMY

The ebb and flow of natural capital

Executive Summary

What is the watershed?

The Narragansett Bay watershed (NBW) is the land area that drains into the Narragansett Bay, including rivers and streams that eventually flow into it. The NBW covers over 1,700 square miles of land, 60% in Massachusetts (MA) and 40% in Rhode Island (RI), and 420 miles of coastline. Between RI and MA, 105 towns and cities are partially or entirely located in the watershed. Almost two million people reside within its borders.

Why study the economy of the watershed?

Business and industry sectors across the watershed provide immense economic benefit to the area, including providing thousands of jobs, generating billions in revenue and expenditure, and paying millions in wages. Many of these economic sectors rely on a healthy watershed ecosystem and its natural resources (natural capital), such as clean water for fishing, aquaculture, and recreation. These resources, however, are under threat from a multitude of forces, such as climate change and expanding development. While water pollution has been greatly reduced in recent decades, this trend is not guaranteed to continue. Understanding the potential economic impacts of these threats is therefore critical to informing and improving decision-making policy regarding the management and protection of the watershed's environment. The Narragansett Bay Estuary Project (NBEP) has done considerable work on the current state of the watershed as well as potential future threats that may impact its health – this report complements their findings by focusing on the economy of the watershed whose future prospects rely on its natural capital.

Watersheds of the Narragansett Bay
Source: Watershed Counts Annual Report, 2014

What are the objectives of this study?

The goal of this report is to synthesize existing data to provide a comprehensive overview of the NBW economy in one document. This report aims to:

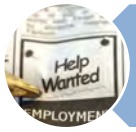
- **Identify** key industries that contribute to the economy of the watershed and rely on its natural capital.
- **Quantify** the economic impact of these industries by calculating: the number of establishments, size of workforce, and total wages for each sector using data from the Bureau of Labor Statistics, the Bureau of Economic Analysis, and various state-level reports.
- **Assess** future opportunities and threats for each industry, mainly as they relate to climate change and its impacts.
- **Provide** a comprehensive overview of the watershed's economy through an overall economic status report, as well as a detailed history of the watershed and information on its geography and demographics.

What are the major findings?

We identified 13 key sectors in the watershed that provide considerable economic benefit and rely on the watershed's natural capital: agriculture; aquaculture and shellfishing; beach use; commercial fishing; the defense industry; forestry; hunting; ports, transportation and maritime trade; recreational boating; recreational fishing; research and education; tourism; and wildlife viewing. These industries vary in size, contribution, and their utilization of the watershed and its resources, although all make an important contribution. The impact for each sector was determined by scaling county-level data for RI and MA according to their population and/or land-share that falls within the NBW. All values are in 2016 dollars unless otherwise stated.

13 key industries

$14+ billion in revenue and expenditure



97,000+ full and part-time jobs

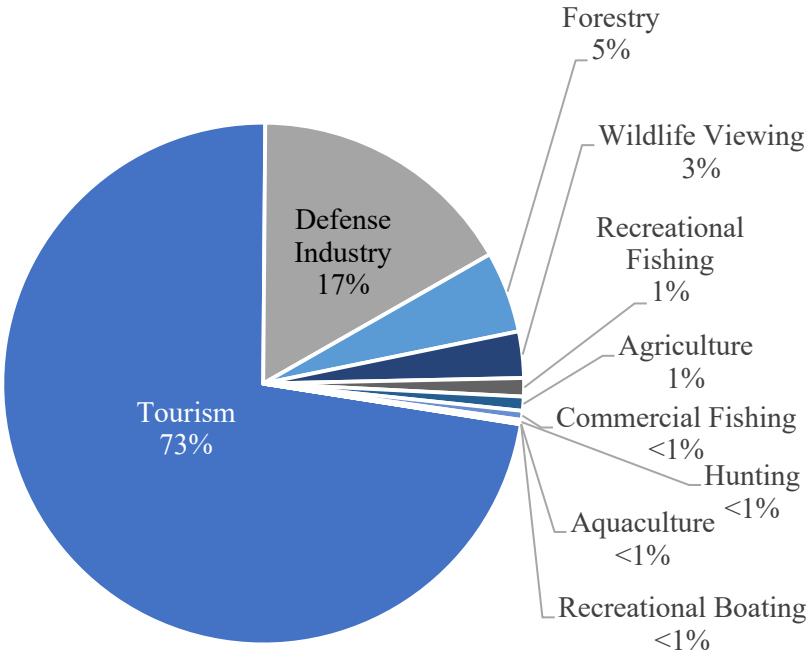
Cumulatively, there are approximately 97,000+ full- and part-time jobs in these sectors. Aggregation of regional value estimates from various sources estimates the combined revenue and expenditure of these industries at approximately $14 billion. Data sources for these aggregate estimates are listed in the Appendix of the Executive Summary.

Tourism and the defense industry have the largest contribution to expenditure/revenue (73% and 17% respectively) and employment (62% and 18%). Historically, tourism has been imperative in the watershed's economy over the past century, starting with the "summer cottages" of the wealthy elite in Newport's Gilded Age and expanding to wider audiences with public beaches and scenic venues like Rocky Point, RI. Tourism employs an estimated 60,000 people: it is the 5th highest employing industry in RI, and from 2010-2015, employment grew almost 3%, higher than the average employment growth in the state. Additionally, in RI alone, tourists

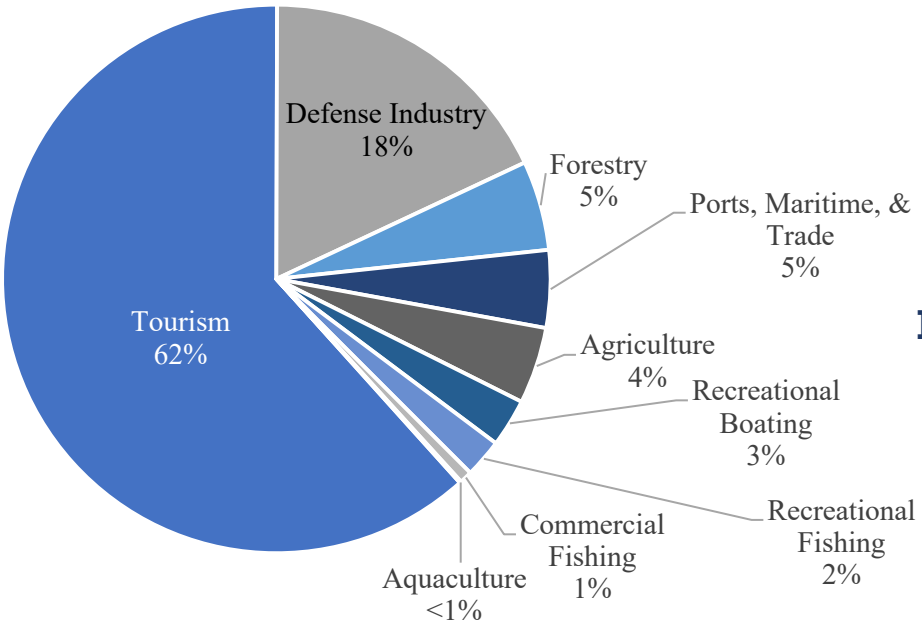
spent over $6 billion in 2015, and we estimate that the seasonal tax effect related to tourism was over $5.4 million in 2015 in the watershed. Tourism also ties into almost every other sector in this report, such as beach use and recreational boating, so its impact may be even larger than what we estimate.

Revenue and Expenditure by Sector

Total annual revenue:
$13,847,936,340
(2016 dollars)



Defense, like tourism, also has deep historical ties to the watershed, especially in Newport, RI. Dating back to times of the American Revolution, it has remained an important defense hub throughout the centuries. It is currently home to the Naval Undersea Warfare Center (NUWC) Division Newport, a leading underwater weapon testing and development institution, as well as the Naval War College. It is also home to Electric Boat General Dynamics, which manufactures Virginia Class submarines for



Employment by Sector

Total employment:
97,298

the US Navy. As of 2013, the defense sector employed 17,500 individuals, 40% of whom were in the private defense sector, with wages of over $1.1 billion. It is also one of the highest paying sectors in RI, with a private sector salary of $74,500, a Department of Defense (DoD) salary of $97,000, and a NUWC salary of $114,000. In comparison, the average salary for manufacturing was $53,000 and for leisure and hospitality it was $19,000. This same year, the defense sector also had an output of over $2.3 billion, which made up 4% of RI's total GDP. There was also $736 million in DoD contracts issued to 200+ firms through 4,768 transactions.

Meanwhile, although the remaining eleven industries do not have nearly the same impact as tourism and defense, they still provide significant value to communities in the watershed:

- **Agriculture:** employed over 2,600 people on 4,600 farms with $121 million valued in crops and livestock in 2012.
- **Aquaculture:** had 36 farms with $2.8 million in sales in 2016 (an increase in sales of 40-fold since 1995).
- **Beach use:** accommodated 20 million annual beach visitors in RI in spite of 28 combined beach closure days recorded in 2016.
- **Commercial fishing:** had 155 establishments with $85 million in wages and an annual landing value of $150 million in 2016.
- **Forestry:** had $55 million in wages in RI in 2013 and $170 million in MA in 2006.
- **Hunting:** had 26,000 active participants (19% from out-of-state) and $32 million in revenue in 2011.
- **Ports, transportation, and maritime trade:** over 200 companies and 11,000 employees are involved in the Quonset Business Park, and the Port of Davisville is a top ten automobile importer in the country (2015). Between 1994-2014, ProvPort generated 1,700 jobs and had an economic output of approximately $122 million.
- **Recreational boating:** in 2012, there were 56,000 registered recreational boats, and in 2011 there was $201 million in spending, supporting 2,700 jobs and $150 million in wages.
- **Recreational fishing:** in 2011, there were 221,600 recreational anglers who spent $136 million, supporting 2,200 jobs and $86 million in wages. Almost half of these anglers were from out-of-state.
- **Research and education:** in recent years, Rhode Island's universities and colleges received five large National Science Fund (NSF) grants for research based on NBW totaling $57 million.
- **Wildlife viewing:** in 2011, 172,000 wildlife viewers spent $400 million and a combined two million days viewing.

Potential threats from Climate Change

Current data suggests, however, that the effects of climate change, including sea level rise, increased air and water temperature, and changing precipitation patterns will have considerable impacts on these sectors by the year 2100.

How do I navigate this report?

This report consists of the following sections:

- **Introduction and Methodology**: outlines the motivation of this report, its scope, purpose, and objectives and the methodology used to calculate watershed statistics.
- **History, Demographics and Geography, and Economic Overview:** provide a history of the watershed, its land uses, its population and settlements, and its economy, as well as current sociodemographic statistics and trends and how they have shifted over time.
- **Sector reports:** each section provides in-depth analysis of the history of the industry in the watershed, its current status and trends, data sources covered, and future opportunities and threats relating to climate change.

Climate Change and Affected Sectors

9.8 ft sea-level rise	5-10° F air temperature rise
• Beach use • Defense • Ports and maritime • Research and education	• Agriculture • Forestry • Hunting • Wildlife viewing
3.6-5.4° F water temperature rise	**1-3 in. increase annual rainfall**
• Aquaculture • Beach use • Commercial fishing • Recreational fishing • Recreational boating • Tourism	• Aquaculture • Agriculture • Beach use • Commercial fishing • Recreational boating • Recreational fishing

Agriculture

Recent Trends

Despite declines over the past century, agriculture continues to be an important and growing contributor to the economy of the NBW. According to the US Department of Agriculture (USDA):

- **Crop production dominates agricultural sector in the NBW:** of 2000 farms selling agricultural products in 2012, a majority (1,176) of these farms were in MA, while 791 were in RI. MA also had more farmland—approximately 70,000 acres—while RI had about 14,000 acres. These farms produced goods, both crops and livestock, with a combined market value of $121 million in 2012 (2016 dollars). Crops comprised a majority of this value compared to livestock, which only accounted for 19% of market value in RI and 16% in MA.
- **The number of farms is increasing:** from 1997 to 2012, the number of farms increased by 44% to an estimated 4,600 farms (see graph). Despite this increase, however, the total acreage of agricultural land has remained relatively the same at ~28,000 acres.
- **Employment in farms is growing:** farms employed over 4,400 people in the watershed (1,700 in RI and 2,700 in MA). Of this 4,400, 1,700 were proprietors and 2,700 were classified as other employees. Although farming remains a small percentage of total employment in the watershed, it is growing rapidly: between 2001 and 2015, farming employment in RI increased at three times the growth rate of total employment in the state.
- **These estimates of the impact of agriculture may be underestimates:** a state-level study in 2015 found that USDA figures were underestimates of the scope of agriculture in RI. They found that 4,500 people worked in the agricultural sector, 2.6 times higher than the USDA's reported employment of 1,700. They also found that agricultural sales were $239 million, four times higher than what USDA reported. Under this assumption, the market value of agricultural products in RI would be $142 million and $321 in MA in 2012 based on the adjusted previously stated USDA figures.

Future Outlook

Urbanization and suburbanization potentially threaten the future of agriculture by reducing available land for farming: from 2001 to 2011, there was an 8.5% increase in urban land in the NBW. For example, cranberry farming (a significant portion of agricultural activity in the MA portion of the watershed) is experiencing considerable development pressure. More recently, open spaces such as farmland are under pressure as targets for renewable energy projects like large solar farms. The greatest threats and opportunities to agriculture may arise from the effects of climate change. Average summer air temperature is expected to increase 7° F in the next century. This change would make the climate of the NBW akin to that of modern-day Georgia or South Carolina. Additionally, precipitation, especially rainfall, is expected to increase up to three inches during this time. This warmer climate and increased rainfall may provide challenges for current agricultural practices in the NBW, but also new opportunities, such as the introduction of different crops.

Aquaculture

Recent Trends

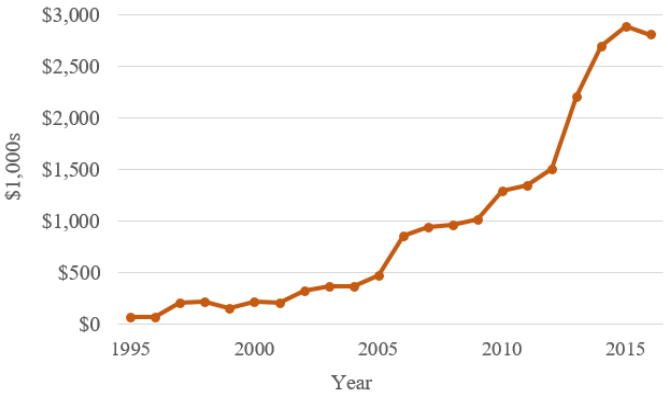
Owing to its unique geology, the NBW provides an ideal environment for shellfish cultivation, primarily of eastern oysters and blue mussels. This report focuses solely on the aquaculture farms in RI, as aquaculture in MA is mostly outside of the NBW.

In 2016, there were:

- 28+ aquaculture farms in the NBW
- 2.2 million oysters and 27,000 lbs. of mussels sold
- $2.8 million in estimated sales
- Value of sales up 4,000% since 1995

Top products:
Eastern oysters and blue mussels

- **Rhode Island defies the national trend of aquaculture decline:** in the U.S. from 2005 to 2013, the number of saltwater aquaculture farms declined by 27% and acreage fell by 34%. During the same time, the number of aquaculture farms in RI increased by 91% and acreage grew by 90%. The value of sales in this time increased 489% in RI compared to a national average of 26%. Including non-NBW areas, the number of farms in RI increased from 13 in 2000 to 70 in 2016, and acreage increased from 30 to 275 acres. Of these 70 farms, an estimated 28 farms were within the NBW. This increasing trend is in part due to improved water quality in the Bay (NBEP 2017).



Value of Aquaculture Sales in the NBW, 1995-2016 (in 2016 dollars)
Source: CRMC Annual Reports, 1995-2016

- **Aquaculture revenues are expanding:** in 1995, there were $67,000 in sales (2016 dollars) in the NBW portion of RI alone. By 2016, this figure increased 40-fold, with over $2.8 million in sales (2016 dollars) (see graph).

- **More than just oysters:** in 2016, NBW farms produced 2.2 million oysters and 27,000 lbs. of mussels. Since 2016, nine farms have expanded to also grow sugar kelp and this number is expected to increase. Currently, no farms produce fish.

Future Outlook

Shellfish in the NBW have a history of being affected by environmental pollutants, which has led to the closure of shellfish farms at various points in history. However, overall area open to shellfishing has increased in recent years due to improvement of water quality, specifically in the upper portion of the Bay. These improvements are threatened as climate change brings extreme precipitation, heat, and droughts, leading to increased stress on our oceans. Such conditions are exacerbated by increased development and more impervious surfaces, which causes polluted runoff into local waters, increasing the likelihood of toxic algal blooms which can affect shellfish. In 2016, RI experienced its first harmful algal bloom in history, which reoccurred in 2017. Outbreaks of Pseudo-nitzchia species, some of which produce domoic acid, a neurotoxin, can affect oysters, resulting in shellfishing area closures. While aquaculture has skyrocketed since 1996, this additional pressure will require farmers to consider innovative and adaptive strategies to continue the industry's growth in the region.

Beach Use

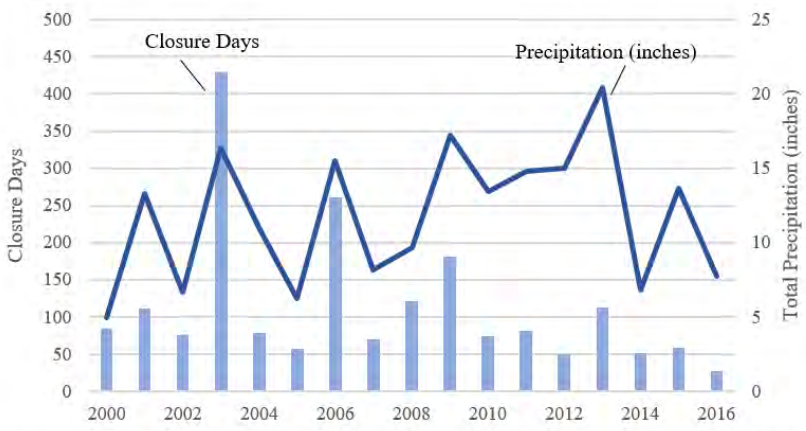
Recent Trends

In 2016, there were:

- 100+ marine and freshwater beaches
- $2.5 million revenue at three beaches
- 3.3 million visitors at four beaches
- 28 beach closure days for all beaches

RI: approximately 20 million beach visits per year

- **Beach attendance is growing:** on average, there are 20 million visits a year to RI's 70+ beaches, 37 of which are saltwater. Attendance has increased at many beaches – statistics available for Scarborough, Fort Adams, and Goddard Park illustrate that attendance has increased 56% from 2010 to 2015, to a total of 2.5 million visitors. In Bristol, Eastons, and Sachuset beaches, this visitation generated $2.5 million in revenue in 2015 from beach passes and parking fees. Although not all beaches charge for use or parking, this figure illustrates their important contribution to the economy.
- **Beach closures matter:** beach closures peaked in 2003 with 429 combined closure days for saltwater beaches. In 2016, the number of closures dropped to 28 days (see graph). Beach closures are typically due to levels of bacterial contamination in the water that exceed safe health standards, usually induced by precipitation carrying these pollutants from human settlements into the water – these closures can be indicative of overall water health in the Bay. Proper waste management that prevents rainfall runoff is key to preventing closures. For example, programs since 2009 to abate combined sewer overflow reduced the number of beach closure days by properly handling waste.
- **Visitors also contribute to the local economy:** through activities associated with beach use, such as dining, shopping, event rentals, and hotel stays (for more information, see "Tourism" fact sheet).



Saltwater Beach Closure Days and Precipitation in the NBW, 2000-2016

Sources: MADPH, 2001-2016; RIDOH, 2017

Future Outlook

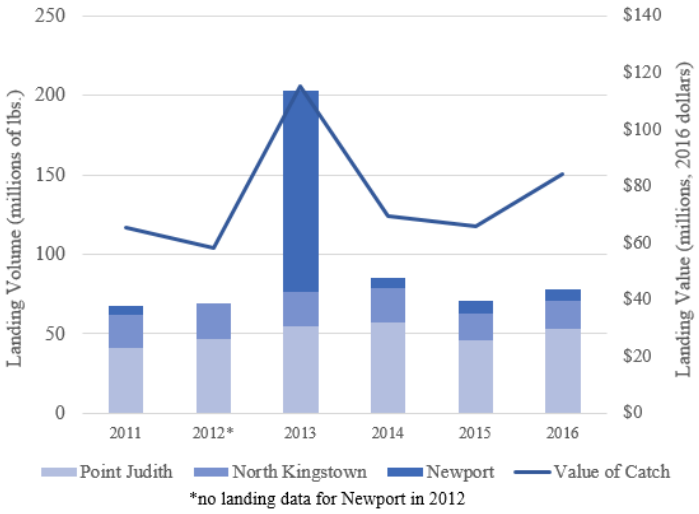
In 2016, the State of Rhode Island reduced beach pass prices by roughly half to promote tourism and increase beach accessibility. Although visitation rates may increase in the future, NBW beaches remain under threat from bacterial contamination, which is exacerbated by the effects of human development and climate change. The beaches are already vulnerable: currently 14 of the 37 saltwater beaches in the area are considered of "high concern" (1.5+ closures a year) for water contamination. Future predictions of precipitation increases and warmer water temperatures, as well as continuing influxes of human population, may elevate risks of ocean water contamination. Furthermore, sea level is forecasted to rise nearly ten feet by 2100, submerging many beaches or rendering them inaccessible. Action to preserve water quality and the overall maintenance of these beaches is imperative to ensure their continuing contribution to the watershed's economy.

Commercial Fishing

Recent Trends

- **The industry has remained relatively constant over the past few years:** Point Judith is the most productive port, with landings of 53.4 million pounds in 2016, yielding $56 million in value (see graph). Newport had 7 million pounds valued at $8 million, while North Kingstown had 18 million pounds valued at $14 million. Data for all three ports is available beginning in 2011 – as seen from the graph, catch value and volume remain relatively constant with yearly fluctuations.

- **Ports in the NBW are nationally ranked:** In 2016, Point Judith, North Kingstown and Newport ranked 18th, 34th, and 75th for landing volume out of the top 131 landings in coastal states in the U.S. For landing value, in 2016 they ranked 15th, 74th, and 92nd nationally. All three ports rose in rank for landing value since 2015. For comparison, in 1981, Newport ranked 11th and Point Judith ranked 17th of 98 in landing volume for all coastal ports.



Annual Landings and Value, 2011-2016
Source: NOEP

In 2015, there were:

1500 commercial vessels

155 commercial fishing establishments

In 2016, there were:

77 million lbs. of fish/shellfish

$78 million catch value

- **Despite national ranking, the NBW falls behind in national trends:** in the U.S., from 2006 to 2015, landing volume increased 2% while annual landing value increased by 30%. Conversely, data from Point Judith and Newport indicate that landing volume decreased 3% and landing value fell by 34%.

Future Outlook

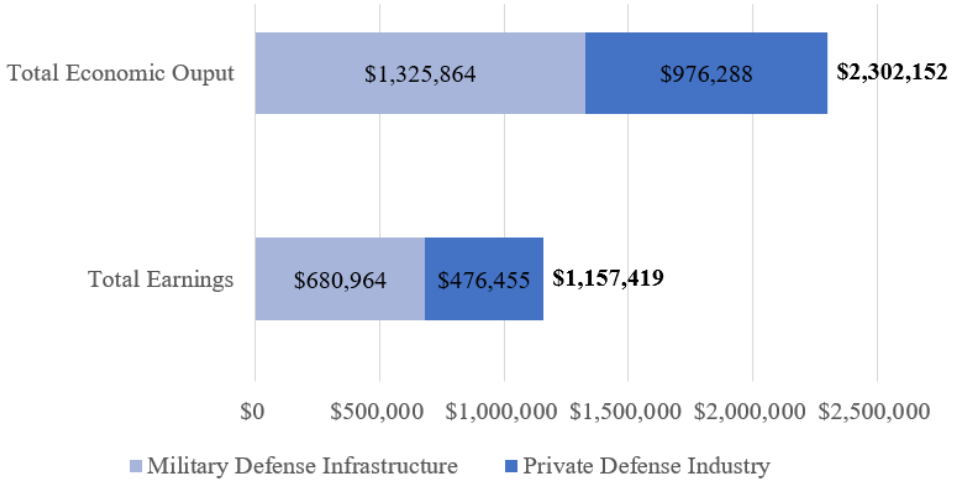
Commercial fishing is currently threatened by declining stocks as a result of overfishing, water pollution, and loss of habitat. In the future, climate change may exacerbate many stressors on fish populations, including changes in ocean pH and salinity and an increase in water temperature. In the coming century, water temperature will rise an estimated 3.6 to 5.4° F. Species composition will shift – population of warm water species like scup and summer flounder, two top grossing species in NBW commercial fishing, are likely to increase, while populations of cool-cold water species, like American lobster, are likely to decline. Together, these shifting ocean conditions and species diversity will likely impact commercial fishing, and adaptation to these changes will be key for the commercial fishing industry moving forward.

Defense Sector

Recent Trends

Data were obtained from *The Economic Impact of the Rhode Island Defense Sector* (Tebaldi, 2014)*:*

- **The defense sector contributes significantly to the local economy:** in 2013, the sector supported 17,500 jobs, which generated over $1.1 billion in wages and $2.3 billion in economic output (2016 dollars) (see graph). This includes both private contracts (37% of jobs) and military defense infrastructure employees (63% of jobs). In the same year, the defense sector contributed $2.3 billion, or roughly 4%, to the state's GDP – 42% of this contribution was from the private sector while 58% from military defense infrastructure.
- **Defense is the highest paying industry in Rhode Island:** in 2013, private sector employees earned an average of $74,500 annually, civilian employees working for the U.S. Department of Defense (DoD) earned an average of $97,000 annually, and NUWC employees earned $114,000. This is considerably higher than other critical industries in the state such as manufacturing (average full-time wage of $53,000) and leisure and hospitality ($19,000).



Total Economic Output and Earnings by RI Private and Military Defense Industries in 2013
Source: Tebaldi, 2014

- **The private defense industry is growing**: in 2013 alone, the DoD engaged in 4,768 transactions with over 200 private contractors in RI, awarding over $736 million in contracts. Currently, the private sector is growing at a faster rate than its public counterpart.

Future Outlook

Given the close proximity of infrastructure to the coastline, rising sea levels pose a major threat to the defense industry in the NBW due to climate change – one study of 18 coastal Naval installations in the U.S. predicts that flooding incidents will increase at least tenfold at most locations by 2050. The National Oceanic and Atmospheric Association predicts that sea level rise in the Northeast Atlantic will be higher than the global average, with an increase of up to 9.8 feet by 2100. Even just a one-foot rise in sea level would impact key infrastructure and buildings such as the Naval War College in Newport. Additionally, increasing frequency and intensity of storm events also pose flooding threats. These changes will likely necessitate the adaptation of defense sector infrastructure looking forward.

Forestry

Recent Trends

- **Extractive forestry generates millions in sales:** the sale of forest-based products in the RI portion of the NBW generated almost $500 million (2016 dollars) in 2013 and accounted for 3,000 jobs with $55 million in wages. Major outputs included wood products, furniture, and paper manufacturing (see graph). In the MA portion of the NBW, the forest sector employed over 2,000 people with over $170 million (2016 dollars) in wages in 2006.
- **Most forests are privately owned:** in 2013, 74% of forests in RI were owned privately, 16% state-owned, and 10% municipal-owned. In MA, 65% were owned privately, 19% state, 14% municipally, and 3% federally, with nearly 120,000 acres permanently protected.
- **Other industries rely on healthy forests:** hunting and wildlife viewing, for example, utilize forests. Recreational activities like hiking, rock climbing, and leaf peeping are very popular for residents and tourists – the economic impact of these industries were not calculated in these state-level studies.

In NBW RI in 2013, there were:

$55 million in wages* (2016 dollars)

3,000 jobs in the forestry sector

In NBW MA in 2006, there were:

$170 million in wages* (2016 dollars)

2,000 jobs in the forestry sector

*Sectors: forestry/logging, wood products, pulp/paper

Estimated Value of Forest-Based Manufacturing Sales in RI Portion of the NBW, 2013 (in 2016 dollars)
Source: North East State Foresters Association, 2015

- **Forests provide key ecosystem services:** forests filter and clean the air and water, provide habitats for numerous plant and animal species, sequester carbon, help prevent flooding, and provide myriad other direct and indirect benefits.

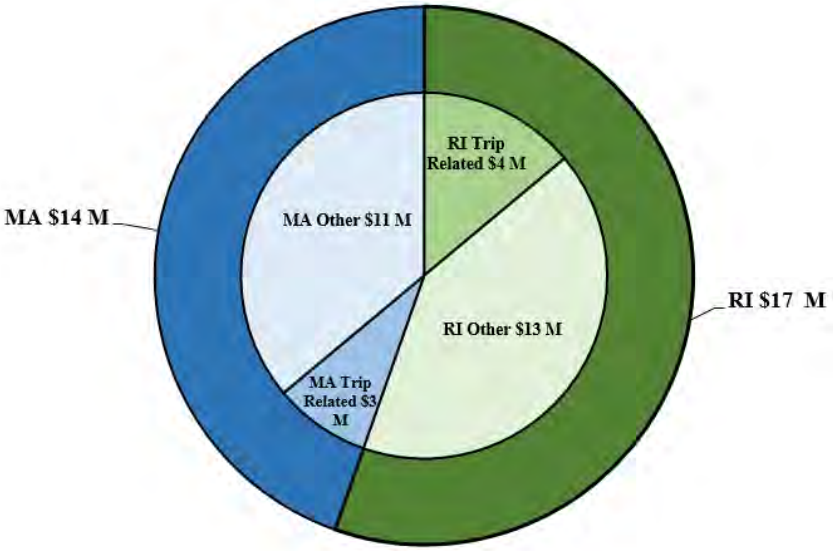
Future Outlook

Forest coverage is under threat from sprawling urban and suburban development. Forest fragmentation is an increasing concern that impacts the functions and benefits provided by forests – although overall forest coverage may be relatively constant, forests are broken into smaller patches by roads and development. Fragmenting forests impacts their ability to provide important ecosystem services like water filtration and wildlife habitats. Additionally, climate change will affect the composition and health of forests in the NBW. The temperature in the NBW is expected to increase an average of 7° F in the next century, leading to summer temperatures akin to that of modern-day Georgia or South Carolina. Precipitation patterns will also change, with increased rainfall expected. Species composition will likely shift further north as temperatures increase: northern hardwood species like maple and birch will likely decline, while species like oak and hickory take their place. This changing composition of forests may affect production of forest-based goods, and adaptation to these changes will be necessary for the continued success of the forestry industry in the NBW.

Hunting

Recent Trends

- **Hunting generates millions in revenue:** in 2011, 26,000 active hunters in the NBW generated $32 million in revenue, $7 million from trip related expenses and $25 million from equipment/other expenses (2016 dollars) (see graph). On average, these individuals spent $1,300 a year on hunting, including purchases such as firearms, ammunition, specialized clothing, permits, guides, etc. Aside from the economic benefits of hunting, it also aids in population control of animals like deer and coyote which threaten other wildlife species or damage ecosystems due to overpopulation.
- **Four of five hunters are from the NBW:** 81% of hunters in the survey live in the NBW, while the remaining 19% are tourists, indicating additional economic impact related to tourism (see "Tourism" fact sheet for more information). On average, most of these hunters reside in urban areas, are white males between 45-66 and hunted on private lands.
- **Hunting is gaining popularity:** the number of hunters increased 21% from 2001. This increase in popularity indicates a positive outlook for the continued economic impact of hunting in the NBW.



Hunting Expenditure Broken Down by State and Type of Expense in 2011 (2016 dollars)
Source: NFWS, 2013

Future Outlook

Hunting relies heavily on the availability of healthy ecosystems for wildlife, mainly forests and open space. Currently, the effects of urban and suburbanization are placing strains on these resources: from 2001 to 2011, the forest coverage in the NBW decreased 4.3%. Additionally, 17% of open space in the watershed is not protected, leaving it vulnerable to development. Climate change will also have an impact on wildlife diversity and species composition in the watershed. For example, two species that are popular game in the watershed – white-tailed deer and the wild turkey – will be vulnerable to habitat relocation as temperatures increase in the area, causing them to migrate further north to remain in climates similar to that of the modern-day watershed. By 2080, it is predicted that the wild turkey will lose 87% of its current wintertime range due to increasing temperatures as a result of climate change. Additionally, warming temperatures will likely lead to increases in other wildlife, including invasive species. Measure to protect the existing habitats of these species is imperative to maintaining healthy populations and ensuring the future of hunting in the NBW.

Ports, Transportation, and Maritime Trade

Recent Trends

- **Maritime trade continues its legacy as a strong contributor to the watershed's economy:** in 2015, the Quonset Business Park housed over 200 companies that employed over 11,000 people. From 1994-2014, ProvPort directly employed a total of 13,000 individuals and generated $15 million in tax revenue. A 2014 projection predicted a rise in employment of 5,500 between 2014 - 2020, with outputs expected to increase to $2.3 billion (2014 dollars). As of 2015, the port employs 1,700 individuals.
- **More broadly, maritime trade sector in RI make up 4.7% of firms in RI economy:** Sproul and Michaud (2018) reported that the maritime-trade industry is comprised of 1,712 firms that generate $2.65 billion in annual gross sales and employ 13,337 people which encompasses individuals working outside of direct employment of the ports (see "Tourism" section for more details).

- **The NBW is nationally ranked in automobile imports:** in 2015, the Port of Davisville imported 269,000 automobiles, both new and used, making it a top 10 automobile importer in the country. This is a 27% increase from 2014 and the sixth consecutive year of rise in auto imports.
- **Ports at Galilee and Newport**: while these ports contribute to the watershed's economy, they are not involved in maritime trade. Galilee mainly houses charter fishing boats, tours, and the Block Island Ferry. Newport mainly deals with tourism through its docking of cruise ships. For more information about the economic value of related sectors, see the "Tourism," "Recreational Boating," and "Recreational Fishing" fact sheets.

Future Outlook

In 2016, voters approved $50 million in support for the modernization of infrastructure at the Port of Davisville and another $20 million for the acquisition of land to expand ProvPort. This growth, however, may be impacted by the effects of climate change. The National Oceanic and Atmospheric Association predicts sea-level rise to be more intense in the Northeast Atlantic region, with an expected rise of 9.8 feet by 2100. This rise in sea-level will undoubtedly impact coastal structures and port infrastructure. This may prove to be a challenge for existing structures, but also an opportunity to use the incoming funds to ensure structures can withstand impacts of sea level rise and more severe storms. Adaptation will be necessary to continue growth of maritime trade in the NBW, an industry which has ample room to grow.

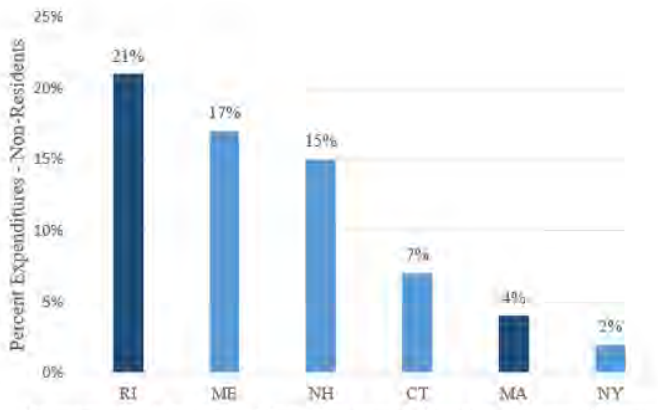
Recreational Boating

Recent Trends

In 2012, the NBW had:

- 56,000 licensed recreational boats
- 97,000 boating trips taken
- $201 million in boater spending
- 27,000 year-round jobs supported
- $150 million in wages

- **Recreational boating contributes millions to the watershed's economy:** in 2012, there were over 56,000 recreational boats registered in the NBW, with 63% in RI and 37% in MA, which took over 97,000 trips that year. Boaters spent over $650 million (2016 dollars) on expenditures such as food and lodging ($510 million in MA and $140 million in RI). This spending helped to provide over 2,700 jobs with over $150 million in annual wages.
- **Recreational boating draws in tourists:** in 2012, 21% of expenditure in RI came from nonresident recreational boaters. This is the highest nonresident spending percentage in all of New England. In MA, this figure was much lower at 4% (see graph).
- **Fishing is the most popular activity associated with recreational boating:** an average of 43% of boaters in MA and 34% of boaters in RI fish when they are on the water. Thus, the recreational boating industry has important ties to the recreational fishing industry, which also has a significant impact on the economy (see "Recreational Fishing").
- **Our numbers are conservative estimates:** a state-level study of just Rhode Island found that manufacturers, service providers, professional services, construction and transportation enterprises associated with recreational boating, as well as sole proprietors and out-of-state boaters, spent over $1 billion (2016 dollars) in the state in 2012. This supported 6,300 jobs with wages of over $291 million. Therefore, the above estimates may be conservative assumptions of the impact of recreational boating on the NBW's economy.



Percentage Share of Non-Resident Boater Expenditures in Northeast Region (2012)

Source: 2012 Northeast Recreational Boat Survey

Future Outlook

Given that recreational boating often includes activities like fishing, swimming, clamming, and sightseeing, the industry is sensitive to changes in the environment that may arise because of climate change and human developments, specifically as they relate to water quality. These include declining water clarity, rising water temperatures, and increasing pollution from human populations and development. Increased water temperature can also lead to increased occurrences of algal blooms, which impair or even close recreational waterbodies. Currently, 85% of studied estuarine waters, 40% of freshwater streams and rivers, and 80% of lakes and ponds are acceptable for recreational use in the NBW – maintaining proper water quality will help ensure these waterbodies stay safe for boaters. Additionally, rising sea level may reshape the current systems of docks and moorings, requiring changes and investments in more resilient infrastructure. Adaptation to these changes, as well as measures to protect water quality, are key in supporting the future of recreational boating in the NBW.

Recreational Fishing

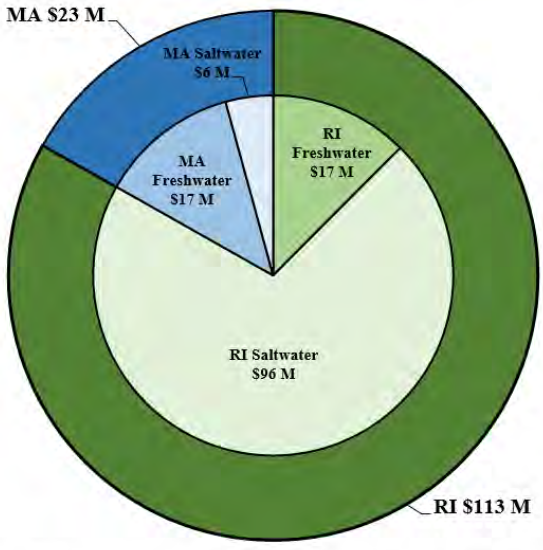
Recent Trends

In 2011, the National Fish and Wildlife Service (NFWS) published the *National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* and the American Sportfishing Association (ASA) published its own findings. Comparing the data, we found:

- **Fishermen spend millions in the NBW:** the NFWS data shows that fishermen spent $136 million (2016 dollars) in the NBW in 2011. Most of this was spending by saltwater fishermen ($103 million) compared to that by freshwater fishermen ($33 million), and most was in RI ($113 million) compared to MA ($23 million) (see graph). On average, fishermen spent $556 annually. This includes both long and short-term expenditure on items such as fishing gear, bait, gasoline, and licenses.
- **Recreational fishing supports jobs:** ASA data indicate that fishermen generated $158 million in retail sales in 2011 in the NBW. This supported 2,200 jobs and $86 million in salaries and wages. It also generated $20 million in federal tax revenue and $18 million in state and local tax revenue (2016 dollars).

In 2011, there were:

- 221,000 total anglers
- 97,000 out-of-state anglers
- $147 million in related spending
- 2,000 jobs supported
- $86 million in wages



NBW Recreational Fishing Expenditure Broken Down by State and Fresh/Saltwater Spending in 2011 (2016 dollars)

Source: NFWS, 2013

- **Recreational fishing attracts tourists:** only 41% of saltwater anglers in RI and 67% of saltwater anglers in MA were residents, a high proportion are tourists that visit the NBW to fish. Recreational fishing, especially in saltwater, is a popular activity that draws in tourists and the related economic benefit of tourism (see fact sheet "Tourism" for more information). The average saltwater angler spends 9.6 days per year on the water. Cumulatively, that's over one million trips and 1.4 million cumulative days spent fishing and bringing visitors to the region.

Future Outlook

Effects of climate change—sea level rise as well as warmer ocean temperatures, changes in salinity, pH, and oxygen levels—will play an important role in shaping recreational fishing in the NBW. The warmer temperatures may cause a species shift, as current species migrate into cooler waters and warmer-water species take their place. Additionally, recreational fishing is affected by water quality – issues such as growing populations and increased rainfall from climate change increases runoff into local surface water. Warmer waters also create environments for harmful algal blooms such as cyanobacteria, commonly known as "blue green algae," which can lead to illness in humans. Currently, 85% of studied estuarine waters, 80% of lakes and ponds, and 40% of freshwater streams and rivers in the NBW are considered "acceptable" for recreational use. These numbers are likely to be affected by the anticipated changes in water quality and effects of climate change.

Research and Education

Recent Trends

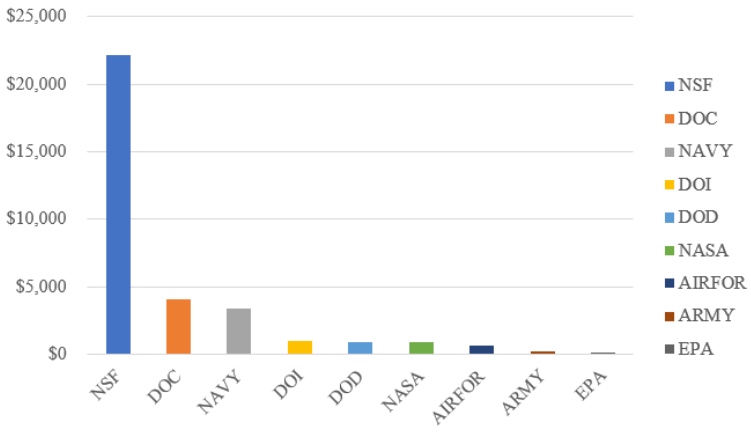
The NBW has provided researchers with an ideal environment to study a broad range of marine related subjects, ranging from the impact of climate change on coastal ecosystems to the effectiveness of marine technology. In addition, there are numerous non-profit groups, such as Mass Audubon and Save The Bay, that engage the community through activities like public school visits and hands-on site work, or Watershed Watch, a citizen science group that monitors water quality. There are also government-funded organizations, such as the Narragansett Bay Estuary Project, which carry out extensive research and community outreach on the Bay.

In recent years, scientific research in the NBW have generated:

- 5 multi-million dollar NSF grants to RI institutions
- $341 million in grants at URI from 2007-2016
- Top contributors: NSF, Department of Commerce, U.S. Navy

- **NBW academic institutions attract considerable grant money from the National Science Foundation (NSF):** in recent years, the NSF has distributed five major grants to RI institutions through its Established Program to Stimulate Competitive Research (EPSCoR) program. These grants ranged from $6-20 million, focusing on marine life science, coastal ecosystems and climate change, water quality, and the impact of dams. These projects involved collaboration from academic institutions across the state, such as Brown University, the Rhode Island School of Design, and URI.

- **URI is a major recipient of grants in the NBW:** from FY 2007 to 2016, URI received over $341 million (2016 dollars) in grants from the NSF, the Department of Commerce (DOC), the U.S. Navy, the Department of the Interior (DOI), NASA, the U.S. Airforce, the U.S. Army, and the Environmental Protection Agency. The top agencies were NSF ($185 million), the DOC ($59 million), and the Navy ($37 million).



URI Grant Sources FY2007-2016
Source: URI, Division of Research and Economic Development Annual Report FY2016

- **Non-profits have cultivated considerable networks in the community:** for example, Clean Ocean Access, conducted over 6,000 hours of outreach through 87 events as a single organization, reaching over 4,000 students from 2013 to 2017 in RI.

Future Outlook

With climate change impacting many aspects of coastal and marine ecosystems, the NBW is likely to continue to be a testbed to understand how ecosystems change, and how society and the economy adapt to changes. Compromised water quality as a result of increased precipitation, heavy storms, and increased stormwater is another pressing issue in the NBW. Ongoing work of academic institutions, government organizations, and non-profits will ideally continue to contribute valuable insight in supporting the health of marine ecosystems.

Wildlife Viewing

Recent Trends

In 2011, there were:

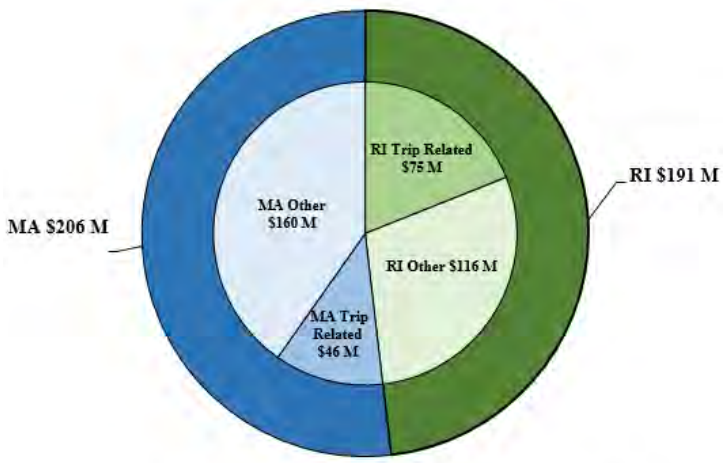
172,000 viewers visiting

2 million combined viewing days

$400 million in related spending

RI alone is home to over 800 different wildlife species

- **Wildlife viewing is in the NBW is a $400 million-dollar industry (2016 dollars):** expenditures include purchases toward lodging, equipment, transportation, and other expenses. Approximately $121 million of this was from food, lodging, and transportation, while the other $276 million was equipment and related costs. On average, each viewer spent $592 (2016 dollars) (see graph).
- **Wildlife watching draws in out-of-state visitors:** there are two types of wildlife viewers: around-the-home (<1 mile from residence) and away-from-home (1+ mile from residence). More than half of away-from-home wildlife viewers were from out of state. For residents of RI and MA, around-the-home wildlife viewing was six times more popular than away-from-home viewing. Expenses of trips that necessitate traveling away from one's residence were not included in this report.



Wildlife Viewing Expenditure in RI and MA in 2011 (2016 dollars)
Source: NFWS, 2013

- **Who's watching wildlife:** almost all wildlife viewers are white and from urban areas. More than half are female and between 45-64 years old with 4+ years of college. Most have an income below $100,000. On average, they spend 23 days a year watching wildlife.
- **State Parks generate jobs and revenue:** In RI alone, Sproul (2017) finds that 22 State Parks, many of which fall within NBW, were responsible for $312 million of economic impact and 3,709 jobs in 2016. Revenues and jobs are generated through visitors' spending at parks, beaches, bikeways and camping grounds. Similar statistics for MA were not available at the time of this study.

Future Outlook

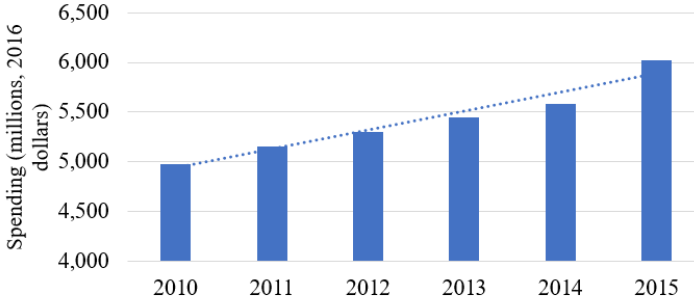
Biodiversity is changing, due in part to climate change and increasing human developments – warmer air and water temperatures pushes some species out while drawing others in. Air temperature is expected to rise 7° F, while water temperature will rise between 3.6 and 5.4° F by the next century. These changes will affect species diversity, with new species migrating in and others moving away. Habitat loss or preservation also plays a key role in species diversity. Mass Audubon estimates that between 2005-2013, 13 acres of land were developed every day, culminating at 38,000 acres of lost forest. In recent decades, RI and MA have passed legislation to preserve fields, forests, and open space through tax incentives–such conservation efforts are vital to maintaining species diversity and preventing habitat loss, thereby supporting the future of wildlife viewing in the NBW.

Tourism

Recent Trends

The size of the tourism industry is difficult to measure precisely, since tourism transects numerous other industries. This report measured in three ways: data from two industries closely related to tourism from the Bureau of Labor Statistics, seasonal tax revenue from the Rhode Island (RI) Department of Revenue, and two 2015 reports from Tourism Economics and the Research Department of the U.S Travel Association.

- **Tourism creates jobs:** industries closely related to tourism (arts/entertainment/recreation sector and accommodation/food services sector) were selected to serve as proxies for the tourism sector. In 2015, in counties within the NBW, the Bureau of Labor Statistics estimates that there were over 5,500 businesses employing over 91,000 people with wages over $1.8 billion (2016 dollars). While not all of these establishments deal with tourism, these figures highlight the broad scope of businesses that interact with the tourism sector.
- **Tourism generates seasonal tax revenue**: assuming that tourism peaks in the summer, its seasonal effect was calculated on two taxes closely related to tourism in RI – the hotel tax and the meal and beverage tax. In 2015, $5.4 million (2016 dollars) in revenue was due to this seasonal effect, and it can be related to tourism.
- **Tourist spending stimulates the economy:** the journal *Tourism Economics* estimated that in 2015, the expenditure of tourists in RI was an estimated $6 billion (2016 dollars) (see graph), supporting nearly 80,500 jobs directly related to tourism in RI (60,000 specifically in the watershed) and accounting for 13% of employment in the state (Figure 1).
- **Tourism also makes its mark in the MA portion of the NBW:** In domestic tourism, the four MA counties in the NBW accounted for $2.9 billion, or 17% of total domestic tourism spending.



Tourist Expenditure in RI 2010-2015
Source: Tourism Economics, 2015

- **Arts and culture contribute to tourism and the local economy:** according to BEA data, there were 15,900 employees in RI and 19,400 in MA the Arts and Culture sector in the NBW in 2015, with almost $1 billion and $1.7 billion in wages respectively.

Future Outlook

The future of tourism is at risk from the effects of climate change, including submersion of infrastructure by storm surges and sea level rise. Additionally, many sectors related to tourism rely on a healthy environment, such as beach use and recreational fishing, yet they are under stress from the effects of climate change. These include threats to water quality arising from increasing water temperatures, which may lead to increased algal and bacterial outbreaks. Human development may exacerbate these effects – for example, increasing impervious cover from expanding human settlements leads to more pollutants running off into the water.

References

Beutel, D. (2015). *Aquaculture in Rhode Island: 2015 Annual Status Report*. Wakefield, RI: Coastal Resources Management Council (CRMC). Retrieved from http://www.crmc.state.ri.us/aquaculture/aquareport15.pdf.

Beutel, D. (2016). *Aquaculture in Rhode Island: 2016 Annual Status Report.* Wakefield, RI: Coastal Resources Management Council (CRMC). Retrieved from http://www.crmc.state.ri.us/aquaculture/aquareport16.pdf.

Bureau of Economic Analysis (BEA). (n.d.) Retrieved from https://bea.gov/index.htm.

Bureau of Labor Statistics (BLS). (n.d.). *Quarterly Census of Employment and Wages.* Retrieved from https://www.bls.gov/cew/home.htm.

de la Cretaz, A. Fletcher, L., Gregory, P., VanDoren, W., & Barten, P. (2010). An Assessment of the Forest Resources of Massachusetts. Boston: Massachusetts Department of Conservation and Recreation, National Association of State Foresters. Retrieved from http://www.mass.gov/eea/docs/dcr/stewardship/forestry/assessment-of-forest-resources.pdf

National Ocean Economics Program (NOEP). (n.d.). *Commercial Fishing Port Landings History for Point Judith, Rhode Island.* Retrieved from http://www.oceaneconomics.org/LMR/portHist.aspx?port=RIPJ.

National Ocean Economics Program (NOEP). (n.d.). *Commercial Fishing Port Landings History for North Kingstown, Rhode Island.* Retrieved from http://www.oceaneconomics.org/LMR/portHist.aspx?port=RINK.

National Ocean Economics Program (NOEP). (n.d.). *Commercial Fishing Port Landings History for Newport, Rhode Island.* Retrieved from http://www.oceaneconomics.org/LMR/portHist.aspx?port=RINE.

North East State Foresters Association. (2015). The Economic Importance of Rhode Island's Forest Based Economy 2015. Retrieved from http://www.dem.ri.gov/programs/forestry/documents/econimp15.pdf

Research Department of the U.S Travel Association. (2015, October). The Economic Impact of Travel on Massachusetts Counties. Retrieved from http://archives.lib.state.ma.us/bitstream/handle/2452/734827/ocn995850430-2014.pdf?sequence=1&isAllowed=y.

Rhode Island Department of Labor and Training: Labor Market Information. (n.d.). *Current Employment Statics*. Retrieved from http://www.dlt.ri.gov/lmi/ces.htm.

Southwick Associates. (2013). *Sportfishing in America: An Economic Force for Conservation. Produced for the American Sportfishing Association (ASA) under a U.S. Fish and Wildlife Service (USFWS) Sport Fish Restoration grant (F12AP00137, VA M-26-R) awarded by the Association of Fish and Wildlife Agencies (AFWA), 2012.* Retrieved from http://asafishing.org/uploads/2011_ASASportfishing_in_America_Report_January_2013.pdf.

Starbuck, K & Lipsky, A. (2013). *2012 Northeast Recreational Boater Survey: A Socioeconomic and Spatial Characterization of Recreational Boating in Coastal and Ocean Waters of the Northeast United States.* Retrieved from http://www.trpa.org/wp-content/uploads/2012-Seaplan-NE-boater-survey.pdf.

Telbadi, E. (2014). *The Economic Impact of the Rhode Island Defense Sector.* http://www.rilin.state.ri.us/Reports/2014%20-%20Defense%20Report%20%20-%20Final%20-%2007072014.pdf.

Tourism Economics. (2015). *The Economic Impact of Tourism in Rhode Island: 2015 Analysis*. Prepared for the Blackstone Valley Tourism Council. Retrieved from blackstonevalleytourismcouncil.org/tourism2015.ppt.

U.S. Fish and Wildlife Service (USFWS), U.S. Department of the Interior, U.S. Department of Commerce, & U.S. Census Bureau. (2013). *2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation – Rhode Island.* Retrieved from https://www.census.gov/prod/2013pubs/fhw11-ri.pdf.

United States Department of Agriculture, National Agricultural Statistics Service (USDA NASS). (2014). *2012 Census of Agriculture.* Retrieved from https://www.nass.usda.gov/Statistics_by_State/Rhode_Island/Publications/2012_Census_Report/index.php.

[1] Source: MA - US Travel Assoc., 2015

[2] Source: RI - Travel Economics, 2015

[3] Source: Tebaldi, 2014

[4] Source: NESFA 2015

[5] Source: USFWS 2013

[6] Source: USDA, 2012 Census of Agriculture

[7] Source: NOEP, 2016

[8] Source: CRMC Annual Report, 2016

[9] Source: Starbuck & Lipsky

[10] Source: Azure Giroux Personal Communications

[11] Sources: de la Cretaz, 2010

[12] Source: RIDL, 2012 (Planning Decisions, 2014)

[13] Source: BEA, 2015

[14] Source: Southwick Associates, 2013

[15] Source: BLS

Appendix

Table A1: Revenue and Expenditure by Sector

Sector	Revenue	Explanation
Tourism	$10,057,163,000	MA - direct expenditure scaled NBW-MA portion from tourism in 2014 (~$1M),[1] RI - scaled NBW-RI from 2015 RI "visitor industry" (~$4B) and "traveler economy" (~$6B) expenditures.[2]
Defense Industry	$2,302,152,000	2013 combined military defense and private defense infrastructure. Not scaled for NBW-RI population/land area. RI only.[3]
Forestry	$697,667,000	2013 sales for total forest products in NBW-RI scaled. RI only.[4]
Wildlife Viewing	$397,736,000	2011 expenditure of wildlife viewers scaled for state NBW-RI/MA.[5]
Recreational Fishing	$157,776,900	NBW-RI/MA scaled retail sales from recreational fishers in 2011.[5]
Agriculture	$120,867,000	Scaled data for RI/MA watershed area. Total market value crops (~$100M) and livestock (~$20M) in 2012.[6]
Commercial Fishing	$77,400,000	NOEP data landing market values for 3 ports in RI 2016 - Narragansett, Point Judith, North Kingstown NOT SCALED.[7]
Hunting	$31,607,000	2013 expenditures of hunters in NBW-RI/MA scaled (includes trip related expenses (~$7.2M) and equipment/other spending (~$24.5M)).[5]
Aquaculture	$2,809,440	Scaled for NBW-RI farm gate value of aquacultural products in 2016. RI only.[8]
Recreational Boating	$2,758,000	2012 boater economic impact scaled for NBW-RI/MA[9]
Beach Use	$2,519,000	Beach revenue for 3 marine beaches (Bristol, Eastons, Sachuest/Third) in NBW in 2015 for 100-day season.[10]
Ports, Maritime, & Trade	--	No comparable data
Research and Education	--	No comparable data

The total revenue for the RI portion of the tourism sector (approximately $10 billion) was compiled using three sources. In RI, tourism is comprised of spending by "visitors" and "travelers". Visitors are from outside 50 miles of RI, while travelers are inside 50 miles.

- Visitor spending from the RI portion of the watershed (~$4 billion for all of RI, scaled 89% for watershed portion of state ~ $3.6 billion)
- Traveler spending for the RI portion of the watershed (~$6 billion for all of RI, scaled 89% for watershed portion of state ~ $5.4 billion)
- Tourism direct expenditure in MA scaled for the watershed portion of the state (~$1 billion)

Table A2: Employment by Sector

Sector	Employment	Explanation
Tourism	60,042	MA - 2014 scaled MA-NBW employment directly from tourism (6,941),[1] RI - scaled NBW-RI combined employment 2015 from "touists" and "visitors" (53,101).[2]
Defense Industry	17,497	2013 employment combined military defense and private defense infrastructure, NOT SCALED, ONLY FOR RI.[3]
Forestry	5,135	RI - 2013 employment statistics scaled for NBW-RI, [11] MA - 2006 employment statistics scaled for NBW-MA.[4]
Ports, Maritime, & Trade	4,445	RIDL classified as employment in RI relating to maritime trade - scaled 88.9% for RI pop. In NBW (originally 5,000).[12]
Agriculture	4,401	BEA 2015 agricultural employment data scaled by population in NBW-RI/MA. This includes employment for farm proprietors (owners) employment (1,726) and other farm employment (2,675).[13]
Recreational Boating	2,758	2012 year-round jobs supported by recreational boating from report, scaled for NBW-RI/MA population.[9]
Recreational Fishing	2,208	2011 jobs supported by recreational fishing from report, scaled NBW-RI/MA.[14]
Commercial Fishing	722	BLS commercial fishing scaled for NBW-RI/MA population as of 2015, under NAICS code "fishing"[15]
Beach Use	372	We only have employment data for 6 beaches (Bristol, City Park/Oakland, Conimicut, Eastons, Narragansett, and Sachuest/Third for the 100-Day 2015 season.[10]
Aquaculture	90	Employment from 2015 CRMC aquaculture report scaled for NBW population (only RI).[8]
Hunting	--	NO COMPARABLE DATA
Research and Education	--	NO COMPARABLE DATA
Wildlife Viewing	--	NO COMPARABLE DATA

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