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Valuing the Economic Benefits of Conservation Land in Downeast Maine

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A technical report prepared for:

DOWNEAST CONSERVATION NETWORK

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1. Introduction

Natural ecosystems provide numerous goods and services that contribute to both human well-being and the economy (Costanza et al. 1997, Daily 1997, Troy & Wilson 2006, Braat & deGroot 2012). This "natural capital" is essential to life and includes such market goods as drinking water, timber, agricultural products, fish, and shellfish. It also includes services provided by ecosystems that are not measured in the marketplace, such as recreation area, flood mitigation, carbon sequestration, and critical wildlife habitat.

The term "ecosystem services" was first adopted by Ehrlich and Ehrlich in 1981 to describe these ecosystem products that provide benefits to humans. In 2003, the Millennium Ecosystem Assessment (MEA 2005) further advanced the concept of ecosystem services, proposing a classification system dividing ecosystem services into four categories: provisioning (e.g. timber, water, crops), regulating (e.g. flood mitigation, climate regulation), cultural (e.g. recreational, educational, spiritual or aesthetic benefits) and supporting (e.g. nutrient cycling, soil formation). Ecosystem services occur at different spatial scales, and there is variation in how they impact human welfare (Troy 2012). For example, carbon sequestration benefits individuals on a global scale whereas blueberry harvests benefit local residents. In addition to benefits accruing to individuals, ecosystem services also benefit the local economy both directly and indirectly; direct benefits typically come from provisioning services, while indirect economic benefits may arise from cultural services (e.g., through visitor spending effects offered by eco-tourism, or employment provided by land preservation efforts).

This report uses an ecosystem services approach to calculate the economic value of conservation lands in Downeast Maine, an area composed of Hancock and Washington Counties.

This region, roughly bordered by the Atlantic Ocean, the Penobscot River, and Canada, includes extensive coastline, thousands of acres of forestland, areas of agricultural land, mountains, lakes, rivers, and wetlands. The area is known for its recreational and aesthetic resources, and productive offshore areas. Employment centers range from the tourism-dominated area of Bar Harbor in Hancock County, adjacent to Acadia National Park, to the Baileyville tissue mill and Woodland pulp mill area in Washington County. Overall, it remains one of the least developed areas of Maine.

Natural ecosystems are under tremendous pressure to be converted to other uses, and the Downeast region of Maine is no exception. Shifts in ownership, land use change, fragmentation, and climate change are all major factors affecting the future of the region's ecosystems. In response to increasing pressure or risk of development, and to preserve the production of ecosystem services from these lands, private and public entities have worked to place land under conservation. Across the Downeast region, 19.6% was held in some type of conservation status in June 2017 as defined by this study.

There are varying public perceptions of conservation land. Local communities are often resistant to establishing land use limitations such as the deed restrictions accompanying conservation easements and fear potential loss of property tax income for their town (Korngold 2007). This perception that the lost tax revenue exceeds the value of the conserved land has frequently placed conservationists and residents at odds. However, in a 2018 report of conserved lands owned by nonprofits in Maine, the state's Joint Standing Committee on Agriculture, Conservation and Forestry found that private land trusts provide a wide range of public benefits, including protecting resources critical to the state economy. They concluded that Maine's land trusts offer a wide range of benefits to the general public that municipal and state governments

would otherwise need to provide, including access to recreational fishing and hunting, snowmobiling, hiking and camping, and more. In addition, the Standing Committee report indicated that the bulk of private lands conserved in Maine are enrolled in Maine's Tree Growth Tax program, which provides municipalities with a 90% reimbursement of this lost tax revenue (Maine Revised Statutes Title 36, section 578).

The Downeast Conservation Network (DCN) is a coalition of organizations and agencies that connects conservation, research, education, and people in Downeast Maine. In an effort to better understand the value of conservation land in the region, DCN contacted researchers at the University of Maine to initiate a project that would more comprehensively assess the economic contributions of these lands to the surrounding communities. To our knowledge, this is the first such economic valuation of conserved lands conducted specifically for the Downeast Maine region.

The primary goal of this study was to map and value conservation lands in Downeast Maine by applying established, replicable methodology that will have practical applications for land managers and policy makers. This technical report first presents a GIS mapping of the study area, including classifying and mapping of land use and land cover, identification and mapping of conserved lands in the study area, and maps of key socio-demographic variables. Next, an economic valuation of ecosystem services provided by these conserved lands was performed. This included benefit transfer valuation of non-market ecosystem services, direct valuation of market-based ecosystem services, and calculations of visitor spending effects and employment contributions to the local economy. Finally, a communication and outreach strategy for successful sharing the results of this study with a range of stakeholders is provided.

2. Methodology

2.1 Valuing Ecosystem Services

Throughout the 20th century, efforts primarily applied market methodologies to determine the value of certain ecosystem services that were traded in the marketplace. Direct market approaches use data from actual markets, with prices reflecting individual preferences (Kumar 2010). Many provisioning services (such as timber harvests) can be valued by applying direct market valuation approaches, which include market price-based approaches, cost-based approaches (e.g., estimating the cost if an ecosystem service needed to be re-created), and production function-based approaches (which determines how an ecosystem service contributes to the value of a commodity that is traded in the marketplace). In this study, direct market valuation was used for ecosystem services with available prices.

Reliance on direct market valuation excludes non-market ecosystem services, essentially assigning them a dollar value of zero (Braat & deGroot 2012; Dupras et al. 2015; Richardson et al. 2015). Capturing the value of non-market ecosystem services was an important goal of this analysis. Over the past decade, research in the valuation of non-market ecosystem services has expanded exponentially, as the demand for this information by policy-makers and land managers has grown.

To determine the economic value of non-market goods and services, different methodologies are applied based on what is being measured. Common tools include revealed and stated preference approaches. Revealed preference approaches look at actual choices of consumers in the marketplace that can be used to infer the value of the good in question. For example, the hedonic pricing method evaluates prices in the housing market to determine the value people place on living near environmental attributes; the travel-cost model uses the time

and money spent to participating in recreational activities as an indication of their value. To capture the value derived from visitor spending as a result of visitations to conservation lands Downeast, a modified Visitor Spending Effects approach was used (Cline et al. 2011). Visitor Spending Effects (VSE) are the direct and ripple effects of visitors' spending money on employment and business activity in gateway economies surrounding parks (Koontz et al. 2017).

For non-market goods and services without such indirect prices, a stated preference approach is required to estimate their value. Stated preference approaches use surveys to query respondents about their willingness to pay (WTP) for an ecosystem service, or their willingness to accept compensation (WTA) for the loss of one.

Primary research methods such as the ones described here are the ideal for valuation of ecosystem services. However, conducting primary research is often very time-consuming and cost-prohibitive. Benefit transfer (also known as "value" transfer) has become a preferred secondary method for practical application, as it is relatively inexpensive, can be conducted in a timely manner, and is less data-intensive (Troy & Wilson 2006; Plummer 2009; TEEB 2012). Additionally, the process is transparent (Andrew et al. 2015; Koschke et al 2012) and a wide range of spatial indicators exist to apply in the mapping process (Andrew et al. 2015; Bagstad et al. 2012).

Benefit transfer is the process of identifying ecosystem valuation data from primary research (conducted at the primary "study" site) and *transferring* the value to a secondary or "policy" site (Plummer 2009). Benefit transfer uses land cover as a proxy for ecosystem services and applies a value estimate per acre to areas with the same land cover. It is essential to ensure a close match between the study and policy sites, in terms of ecology, geography, demographics, and socioeconomics to prevent a lack of correspondence, a potential source of error when

applying this method (Plummer 2009). Spatially explicit value transfer methods have been applied around the globe, including studies of the state of Maine (Troy 2012), New Hampshire (Trust for Public Land 2014) and Montreal, Canada (Dupras et al. 2015).

2.2 Stakeholder input

Relevant stakeholder identification is a critical part of ecosystem valuation (Hein et al. 2006; TEEB 2012). The process is inherently value-laden, as the significance of ecosystem services depends on who is benefitting from them. When conducting an ecosystem valuation, a stakeholder is "any group or individual who can affect or is affected by the ecosystem's services" (Hein et al. 2006, p. 213). Inclusion of stakeholders is essential in valuation to maximize the legitimacy (fairness), salience (relevance), and credibility (believability) of the work.

Stakeholder identification was initiated by meeting with members of the Downeast Conservation Network. As recommended by Darvill and Lindo (2015), stakeholders with a wide range of ecosystem service applications and needs were included. Representatives from local land trusts, statewide and federal conservation organizations working in Maine, regional economic councils, government agencies, and the Passamaquoddy Indian Nation were asked to share what, if anything, they would like this study to answer or address regarding conservation land in the Downeast Maine region, and to determine which ecosystem goods and services were of priority interest for further exploration and economic valuation.

2.3 Mapping

A wide range of ecosystem service mapping methods exist, and they vary significantly in their complexity and data requirements (Martinez-Harms and Balvanera 2012; Andrew et al. 2015). Land use/land cover data (LULC) has become a frequently applied proxy for mapping ecosystem services (Seppelt et al. 2011; Andrew et al. 2015). LULC maps are widely available,

are offered at different scales, provide detailed information and are user-friendly. Each land cover type can be associated with a unique set of ecosystem goods and services. The LULC classification is also a direct input into the benefits transfer valuation methodology. Working under the guidance of the University of Maine at Machias Geospatial Information Lab, directed by Dr. Tora Johnson, a spatially-explicit benefits transfer mapping process was conducted for this study using ArcGIS software (ArcMap 10.4.1).

For this project, LULC data from the USGS National Land Cover Database (NLCD) was applied to create a land cover typology of the study area. To further refine the map, the LULC layer was augmented by overlaying 1) public beaches on conserved lands, derived from a search of Google Maps, and 2) areas of cultivated blueberries greater than 40 acres, derived from an in-house analysis of satellite imagery.

To create an up-to-date layer of conserved lands in the Downeast Maine region, the State of Maine conserved lands layer was downloaded from the Maine Office of GIS (MEGIS) as a starting point. The file is at a 1:24,000 scale, and includes conserved lands for Maine held in federal, state, municipal and nonprofit ownership/easements. During the spring of 2017, conserved land holders in the study region were contacted individually to request permission to use their current conserved land shapefiles for this project. Participating organizations included The Nature Conservancy, Maine Coast Heritage Trust, Downeast Salmon Federation, Blue Hill Heritage Trust, and Crabtree Neck Conservancy. Newly conserved lands and missing parcels that did not appear on the State of Maine's conserved land layer were added.

Demographic and socioeconomic data for Hancock and Washington Counties were obtained from the US Census Bureau's Decennial Census (2000) and American Community Survey (2016) products. County-subdivision level data, roughly equivalent to the township level,

from 2000 and 2016[1] was downloaded from the American Fact Finder website. This information provided important input data for the benefits transfer methodology, as well as maps that display the human context of ecosystem service use.

3. Results

3.1 Identification of ecosystem services

Conversations were held with 12 individuals representing 8 organizations (nonprofit, municipal, state and federal) in March of 2017. Meetings were conducted in person and by telephone. Individuals represented local land trusts, statewide and federal conservation organizations working in Maine, regional economic councils, government agencies, and the Passamaquoddy Indian Nation. Ecosystem services of relevance to the region and those identified through conversations were used to guide which values would be represented in the valuation process. The stakeholder generated priority ecosystem services for analysis are detailed in Table 3-1 (next page). Final ecosystem service values calculated were limited to appropriate data availability for the benefits transfer methodology.

[1] The 2016 ACS includes data from a five-year survey period for low population areas such as these. The margins of error for the data are not mapped, but can be quite large for low population areas; caution is recommended in interpreting the values displayed.

Table 3-1. Stakeholder-identified priority ecosystem services.

Stakeholder group (# reps)	**Priority Ecosystem Services**
Local land trust representative (3)	Wildlife habitat, Recreation, Tourism, Healthy lifestyle, Salt marsh health, Preserving land for future, Water quality, Soil retention, Access, Economic activity
State government representative (3)	Rockweed harvesting
Regional conservation organization representative (2)	Fish habitat, Fish passage, Clean water, Value of angling
Federal government representative (1)	Wildlife & waterfowl habitat, Wildlife tourism
Regional economic council representative (1)	Healthy riparian zones and fisheries, Tourism
Tribal representative (1)	Fish & wildlife habitat, Fish passage, Clean water, Access to resources

3.2 The Downeast region: Conservation Lands and Land Use/Land Cover

Lands in conservation have had use restrictions placed on them “in perpetuity”, primarily restrictions on development. For the purposes of this research, conserved lands include both public and private landowners. Public lands held in conservation include lands owned by the National Park Service (NPS), US Fish and Wildlife Service (USFWS), and the Maine Bureau of Parks and Lands; examples include Acadia National Park, Moosehorn National Wildlife Refuge, Quoddy Head State Park, Roque Bluffs State Park, and Lamoine State Park. Other conserved lands include privately held conservation easements on private lands and lands under private fee ownership by nonprofit land trusts and other conservation organizations. Conservation easements do not necessarily preclude active natural resources management, such as timber harvest.

A total of 702,654 acres has been conserved in the Downeast Maine region as of June 2017 (Table 3-2). Of the total land in the two-county area, 19.6% is held in some type of

conservation status as defined by this study. Hancock County has 12.5% of its 1,500,800 acres in conserved land, while Washington County has double that at 25% (of 2,085,120 acres).

Table 3-2. Conservation land by county.

	Total area (acres)	**Acres held in conservation**	**% of County**
Hancock	1,500,800	187,002	12.5%
Washington	2,085,120	515,653	25%
Total	**3,585,920**	**702,654**	**19.6%**

There is an approximate 60/40 ratio between lands held under conservation easements and those purchased through fee simple acquisition. A very small percent of lands (less than one-half of one percent) were held in some other type of arrangement, including deed restrictions, leases, management transfer agreements, or restricted areas. In a few cases, the type was not indicated, and these were listed as unknown. (Table 3-3, next page).

There is also an approximate 60/40 ratio between public and private ownership of conservation lands in the region (Table 3-3). A detailed list of landowners and public units of conservation lands, along with socio-economic data for the two counties, is included in the appendix.

Table 3-3. Conservation lands by conservation status and ownership.

Conservation Type	**Total Acres**	**% held in each type**	**Washington County**	**Hancock County**
Fee simple acquisition	298,182	42.44	151,865	146,317
Conservation easement	400,919	57.06	360,779	40,141
Unknown/Other	3,553	<1	3,009	544
Total	**702,654**	**99.5**	**515,613**	**187,002**
Ownership Type	**Total Acres**	**% held in each type**	**Washington County**	**Hancock County**
Public	281,888	40.12	145,756	136,132
Private	420,653	59.86	369,851	50,802
Unknown	113	<1	45	68
Total	**702,654**	**99.98**	**515,652**	**187,002**

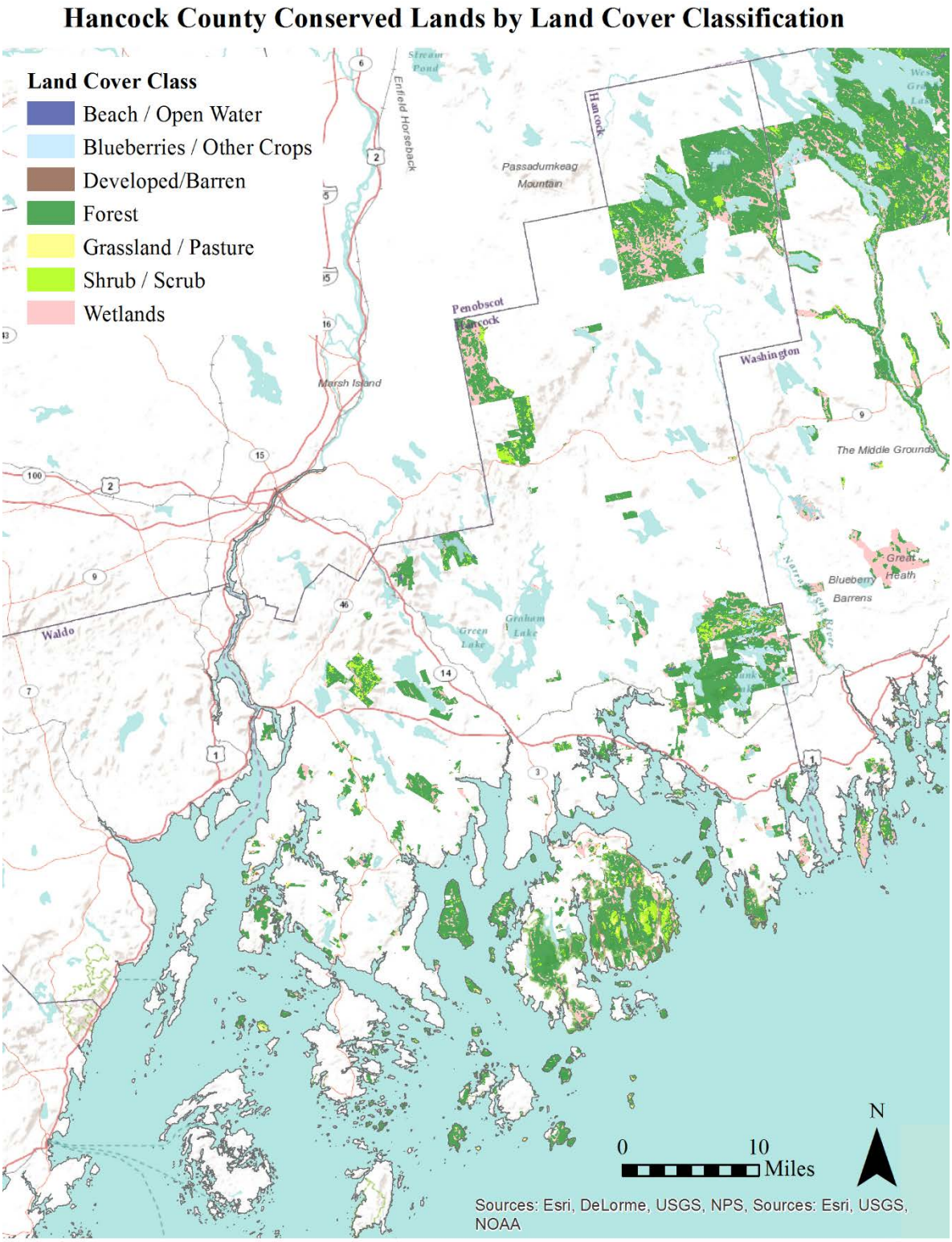
The majority of Downeast conserved lands are forestland (72.4%). The breakdown of conservation lands by land use/land cover status is detailed in Table 3-4 (next page). Acres may not sum completely due to rounding. A map of land cover class for conserved lands for each county follows (Hancock County in Figure 3-1 and Washington County in Figure 3-2). Figures 3-3 and 3-4 display conserved lands by ownership type for Hancock County and Washington County, respectively. The next two maps show conservation lands by conservation type for Hancock (Figure 3-5) and Washington (Figure 3-6) Counties.

Table 3-4. Conservation land by land use/land cover type.

Land Cover Classification	# Acres Conserved	% Conserved Area	Washington County	Hancock County
Barren Land (Rock, Sand, Clay)	1,860	0.26%	940	920
Beach (sandy)	30	<1%	17.5	12.5
Blueberry Barrens >40 acres	3,594	0.51%	1,731	1,864
Cultivated Crops	579	0.082%	305	275
Developed	7,708	1.1%	4,233	3,475
Forest[2]	508,498	72.4%	371,225	137,243
Grassland / herbaceous	6,972	0.99%	4,358	2,614
Open Water	10,000	1.42%	6,205	3,795
Pasture / Hay	986	0.14%	430	556
Shrub/Scrub	32,684	4.65%	23,260	9,424
Wetlands[3]	129,743	18.47%	102,918	26,825
TOTAL	**702,654**	**99.9%**		

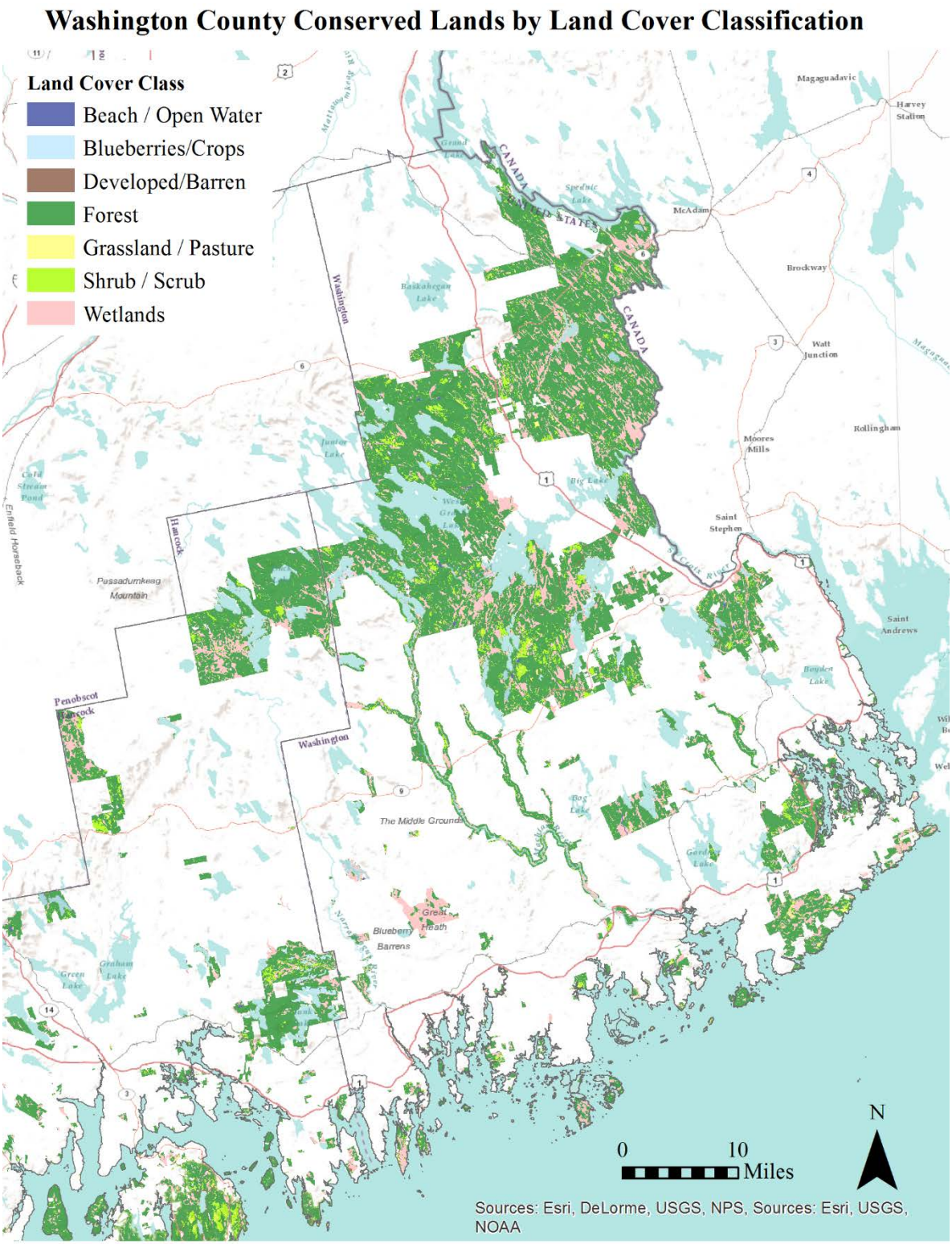
[2] Forestland includes deciduous forests, 80,204.63 acres; evergreen or conifer forests, 210,436.98 acres; and mixed woods, 217,856.64 acres. By county these totals are: 60,987 acres deciduous, 133,906 acres evergreen, and 176,362 acres mixed for Washington County and 19,218 acres deciduous, 76,531 acres evergreen, and 41,494 acres mixed wood for Hancock County.

[3] Wetlands include both emergent herbaceous (19,771 acres) and woody (109,972 acres).



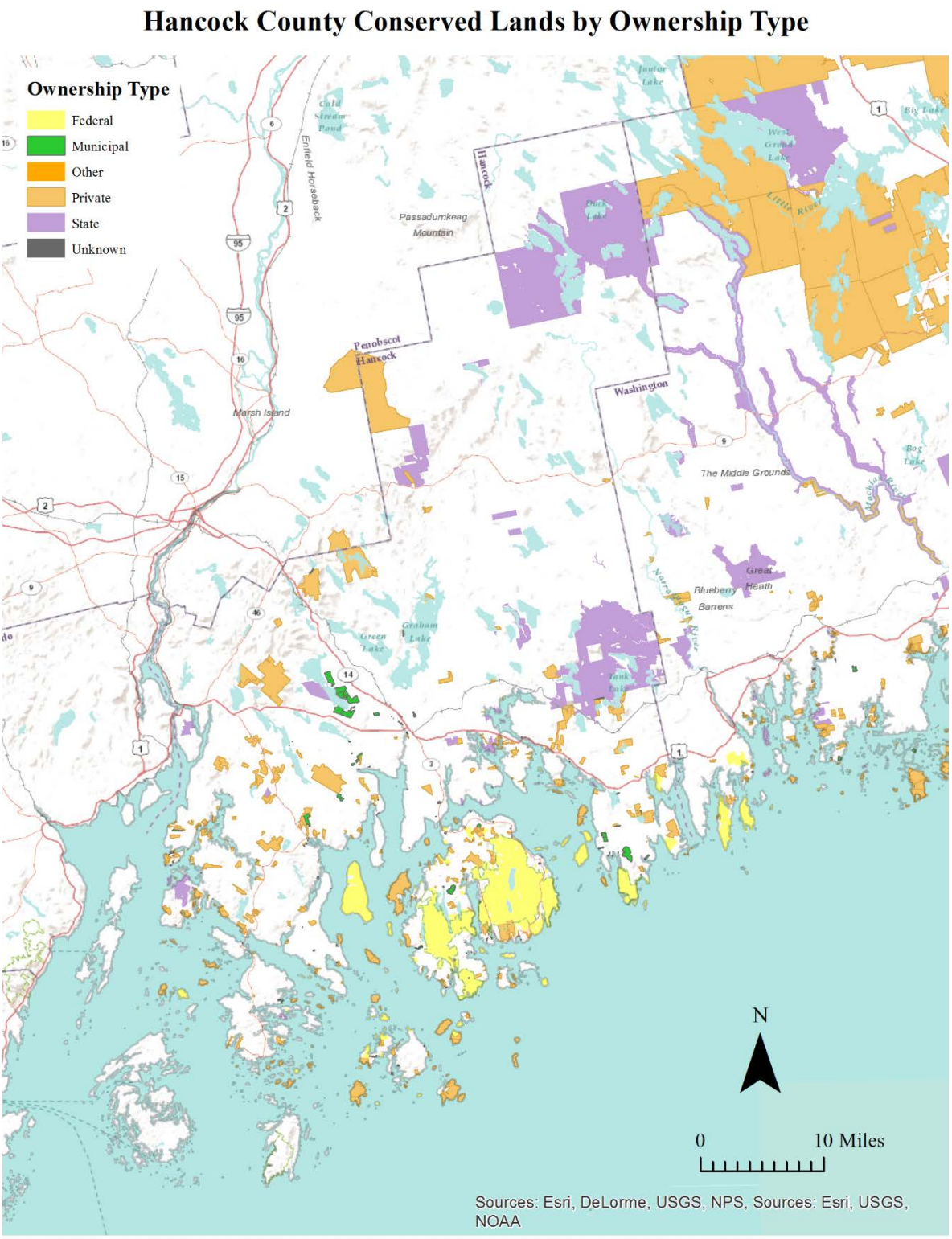
Sources: Conserved lands data from MEGIS and regional conservation organizations. Land cover data from NLCD 2011.

Figure 3-1. Conserved lands in Hancock County by LULC.



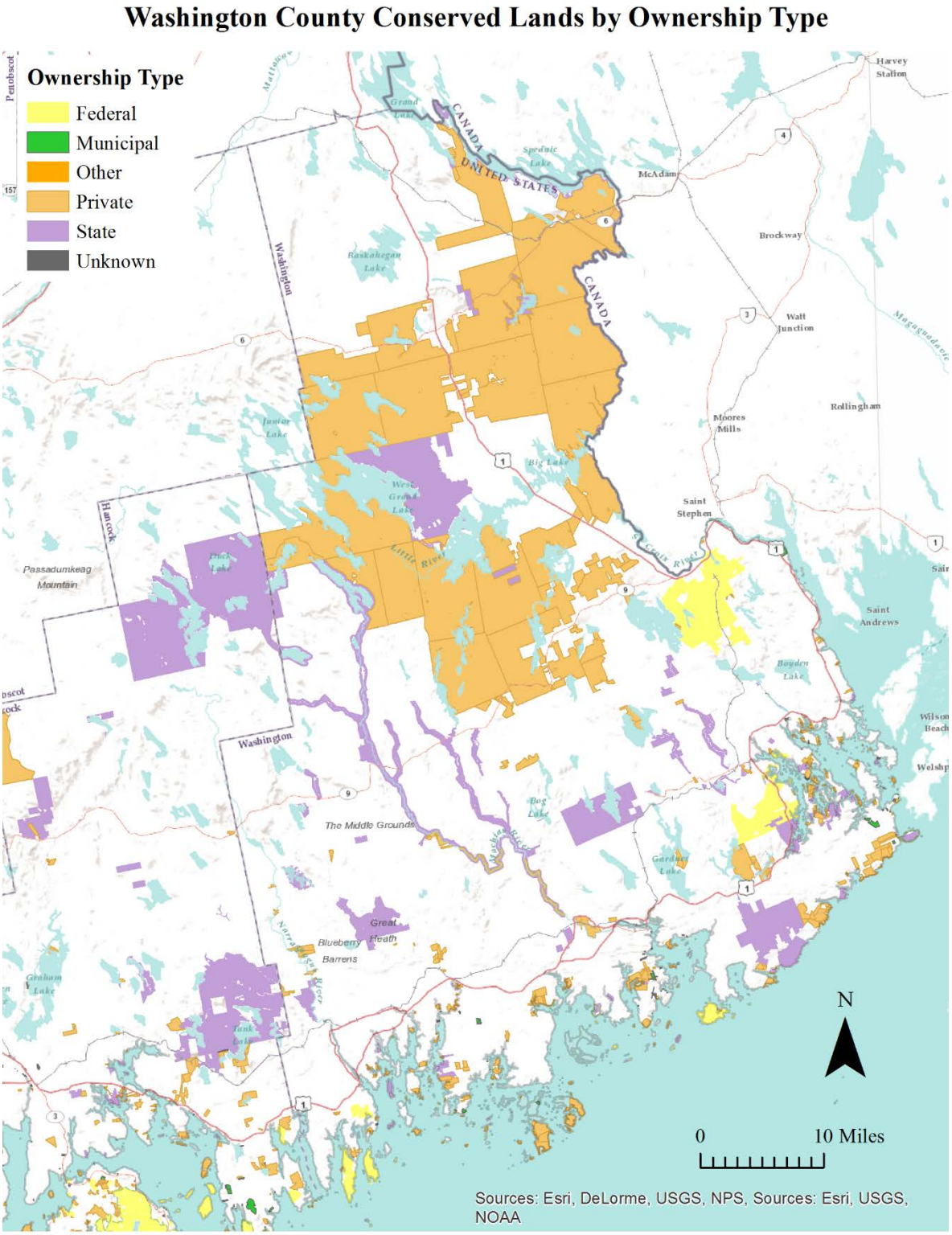
Sources: Conserved lands data from MEGIS and regional conservation organizations. Land cover data from NLCD 2011.

Figure 3-2. Conserved lands in Washington County by LULC.



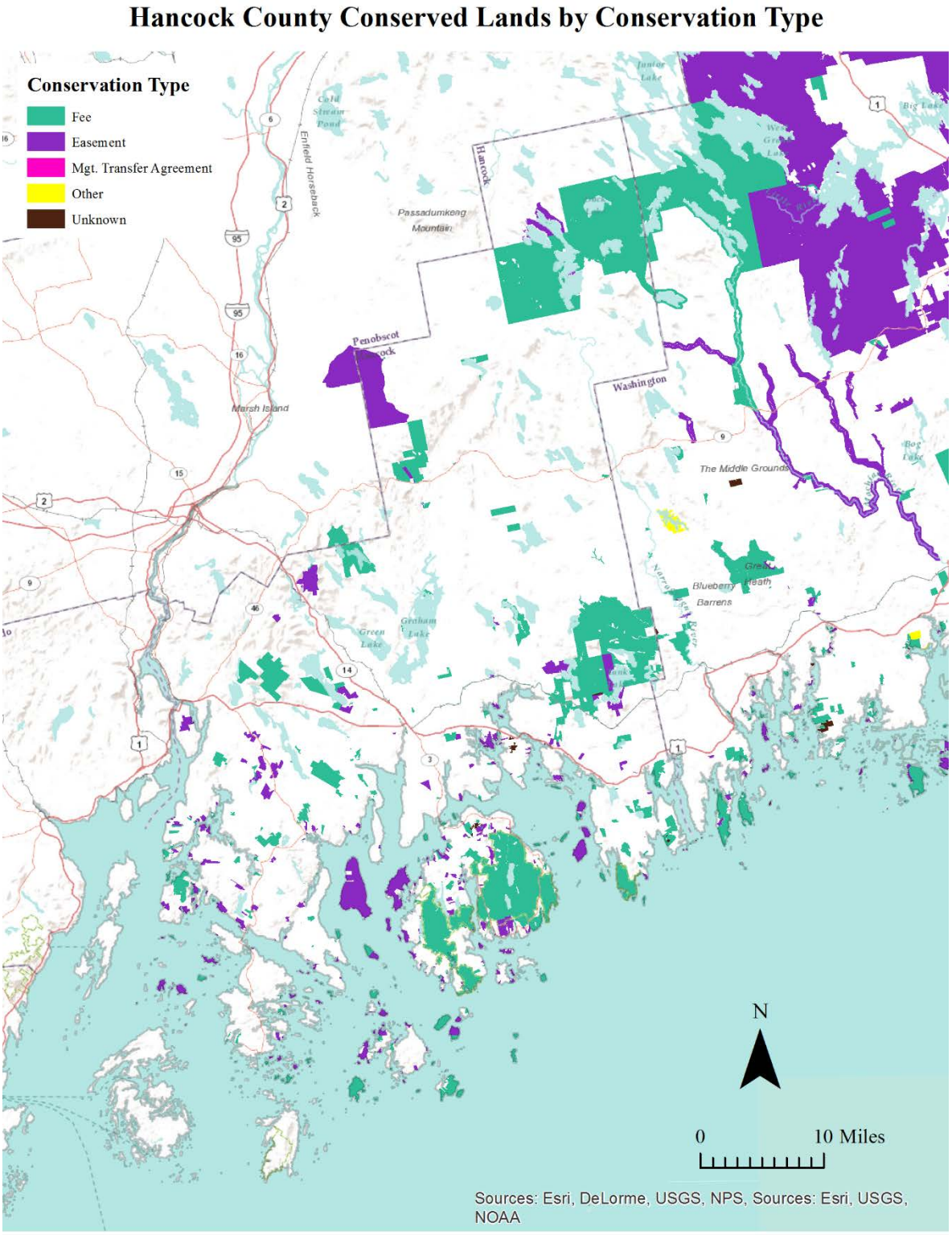
Sources: Conserved lands data from MEGIS and regional conservation organizations; Land use/land cover from NLCD 2011.

Figure 3-3. Conserved lands in Hancock County by owner type.



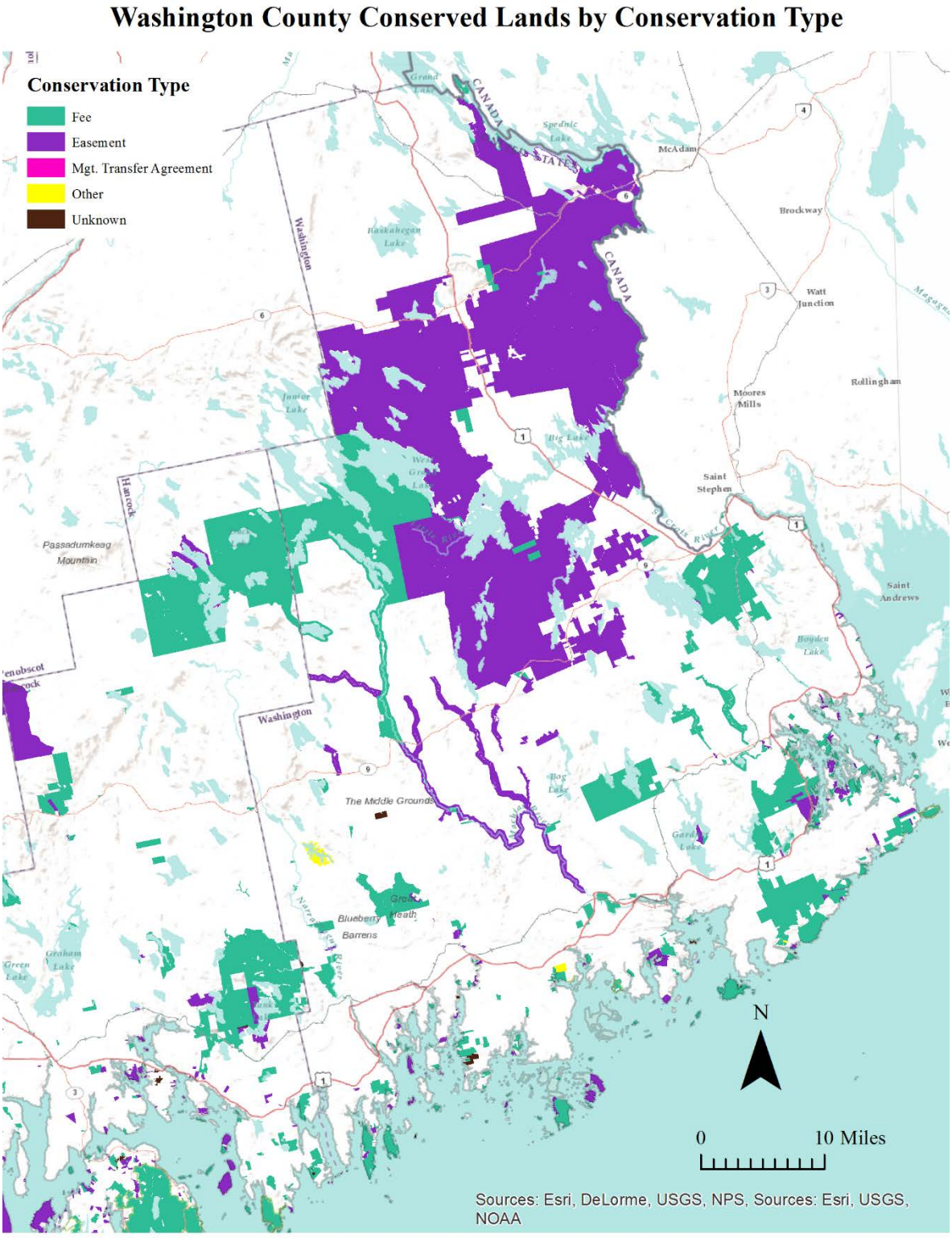
Sources: Conserved lands data from MEGIS and regional conservation organizations; Land use/land cover from NLCD 2011.

Figure 3-4. Conserved lands in Washington County by owner type.



Sources: Conserved lands data from MEGIS and regional conservation organizations; Land use/land cover from NLCD 2011.

Figure 3-5. Conserved lands by conservation type, Hancock County.



Sources: Conserved lands data from MEGIS and regional conservation organizations; Land use/land cover from NLCD 2011.

Figure 3-6. Conservation lands by conservation type, Washington County.

3.3 Value of conserved lands

3.3.1 Market ecosystem services: blueberries, timber, and carbon

In 2016, the yield per acre for wild blueberries in Maine was 4,400 lbs, and the average price was $0.27/lb. Assigning these averages to the total acreage of blueberry fields identified on conserved lands Downeast, adjusted for 2017 dollars, yielded a total value of $4,441,694.

Annual timber harvest values from conservation lands were estimated in the following way. U.S. Forest Service Forest Inventory and Analysis data was used to calculate change in standing biomass over a five-year period. It was assumed that the reductions in stock were due to harvests, and that the harvested amount was evenly split between pulpwood and sawlogs, as well as across all species types reported in the Maine Stumpage Report for Washington and Hancock County. The value obtained was divided by five to calculate an annual harvest value of $28/acre/year from forests on Downeast conservation land. This translates to about $17.5 million annually in harvest revenue for the area.

These figures may be overestimates; they are based on interpolating volumes from FIA plots that represent a large area on the ground. Using FIA data was necessary as we were not able to determine the percent of acres actually harvested over the most recent time period. However, The Maine Land Trust Network (MLTN 2017) reports that working forestlands comprise more than 85% of the total acreage held by private land trusts in the state; these lands are not restricted from harvest as a condition of the conservation easement.

The value of carbon is a new market, with active carbon markets providing a dollar value for each ton of carbon sequestered in forests. Our study applies Sohngen and Mendelsohn's approach (2003) for calculating a carbon "rental value," which accounts for the impermanence of carbon stored in forests. This rental value is equal to the interest earned from selling one ton of

stored carbon at the current price ($36 per ton of CO2), less any capital gains from changes in that price. Carbon stock, the average biomass per acre, was estimated using standing volume estimates derived from FIA data. Total biomass estimates were used to derive annual carbon stock (measured in metric tons carbon dioxide equivalent). A rental value of 3% was then directly applied to the carbon stock. The average forest carbon value in the region was $80/acre/year for a total annual value across all forestland of over $42 million. Given the coarse nature of the FIA input data used in both timber harvest and carbon value calculations, only a two-county summary value was calculated.

3.3.2 Visitor spending

The visitor spending approach used in this analysis began with known visitor spending (VS) calculated for two NPS units in the region, Acadia National Park and St. Croix International Historic Site, as benchmark values. VS data for Acadia National Park and St. Croix Island International Historic Site were obtained from the National Park Service for 2017 (Cullinane et al. 2018), and represent the top two tiers of potential visitor quality. Values for the remaining conserved lands were extrapolated and scaled down by 30% each per designation (derived from the percentage difference between the available data from Acadia and St. Croix Island). Each designation is based on visitor willingness to pay (WTP) for the respective site quality. National Parks have the highest perceived quality and therefore hold the highest value per visitor, with privately conserved, inland properties holding the lowest value per visitor. This hypothetical relationship between VS estimates and property type is shown in Figure 3-2. As Cline et al. (2011) point out, this graph essentially reflects the supply curve as represented by visitors to the conserved lands. To complete the valuation calculation of total visitor spending effect, VS per visitor is multiplied by the number of visitors to each property.

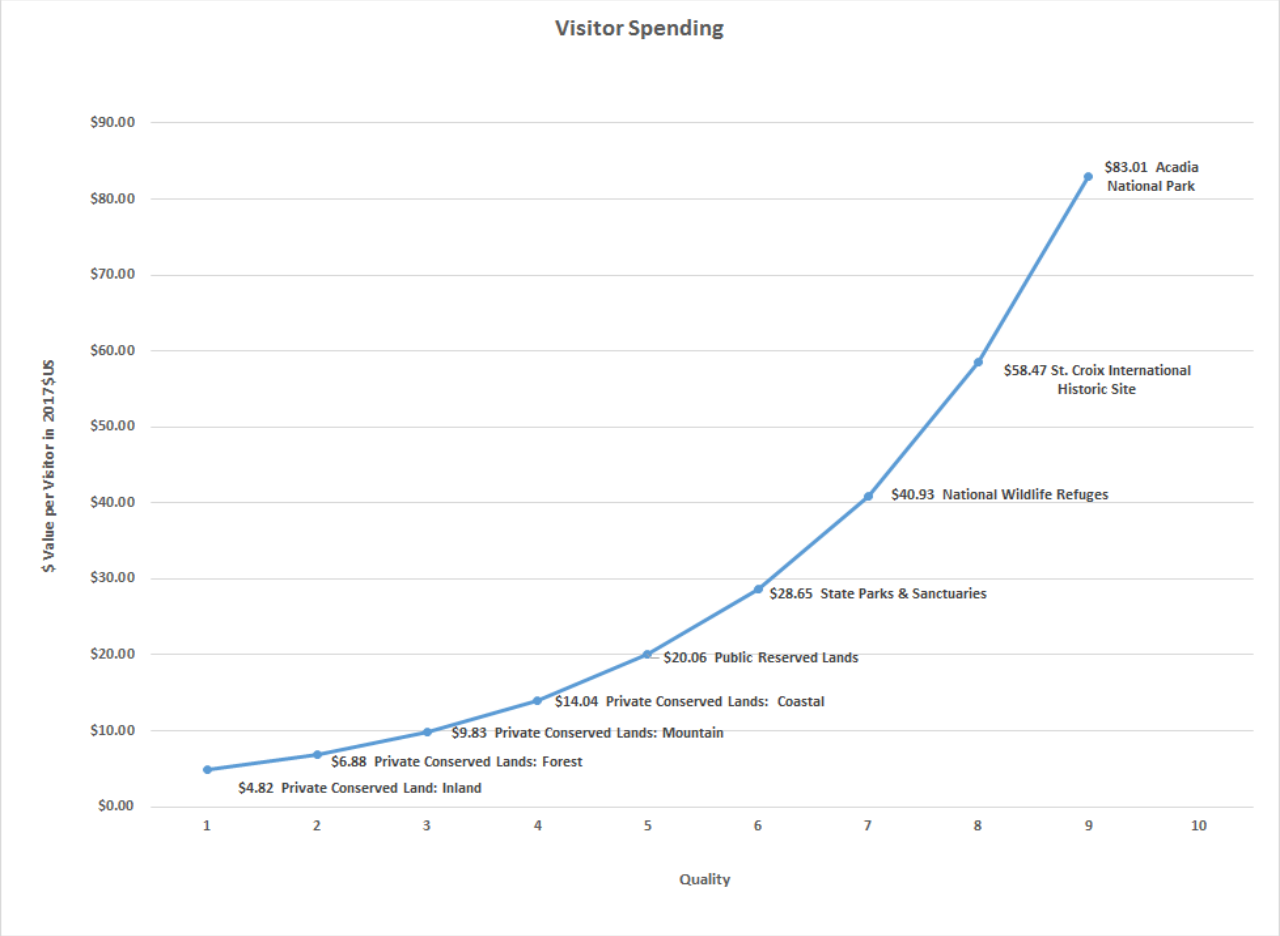


Figure 3-7. Relationship between property type and visitor spending.

Visitor spending effects for the study area totaled $304,427,778 in 2017. This is a conservative estimate, as private conserved lands, and many state public lands, are free and open access, and do not track visitor numbers. For these properties, a true value of visitor spending provided by private conserved lands could not be calculated; conservative estimates of visitor numbers were applied instead. Acadia National Park represents the majority of these spending effects at $291,304,586 in 2017. Total visitor spending effects for conserved lands outside of Acadia was calculated as $13,123,192 for 2017. Estimates per unit are shown in Table 3-5. In all, Hancock County visitor spending effects are estimated at $296,963,195 and Washington County

at $7,464,585; some lands appear in both counties and so are not broken out by county (see Table 3-5).

Table 3-5. Visitation and visitor spending amounts used in VSE calculations.

Property	2017 Visitors	VS ($2017)	Total	County
Acadia Nat'l Park	3,509,271	$83.01	$291,304,586	Hancock
St. Croix Island Int'l Historic Site	13,856*	$61.83**	$856,716	Washington
Moosehorn Nat'l Wildlife Refuge	54,920	$40.93	$2,247,876	Washington
Cross Island Nat'l Wildlife Refuge	1,100	$40.93	$45,023	Washington
Petit Manan Nat'l Wildlife Refuge	84,300	$40.93	$3,450,399	Hancock
Holbrook Island Sanctuary	10,237	$28.65	$293,290	Hancock
Lamoine State Park	52,224	$28.65	$1,496,218	Hancock
Quoddy Head State Park	102,435	$28.65	$2,934,763	Washington
Roque Bluffs State Park	23,013	$28.65	$659,322	Washington
Cobscook Bay State Park	14,861	$28.65	$425,768	Washington
Shackford Head State Park	~ 500	$28.65	$14,325	Washington
Ft. O'Brien State Historic Site	~ 500	$24.54	$12,270	Washington
Donnell Pond Public Reserved Land	~ 10,000	$20.06	$200,600	Hancock
Duck Lake Public Reserved Land	~ 500	$20.06	$10,300	Hancock
Cutler Coast Public Reserved Land	~ 1,000	$20.06	$20,060	Washington
Great Heath Public Reserved Land	~ 500	$20.06	$10,300	Washington
Machias River Corridor	~ 500	$20.06	$10,300	Washington
Rocky Lake Public Reserved Area	~ 1,000	$20.06	$20,060	Washington
Downeast Sunrise Trail	~ 10,000	$20.06	$200,600	both
Private Conserved Lands: Coastal	~ 10,000	$14.04	$140,400	both
Private Conserved Lands: Mountain	~ 100	$9.83	$983	both
Private Conserved Lands: Forest	~ 10,000	$6.88	$68,800	both
Private Conserved Lands: Other Inland	~ 1,000	$4.82	$4,820	both
TOTAL			**$304,427,779**	

3.3.3 Direct employment

Estimating the indirect employment effects of conserved lands[4] or the relationship between conservation, in-migration, and employment was outside the scope of this study, but an attempt was made to capture the direct conservation industry employment. Employment and salary information for local land trusts in the Downeast region were obtained by searching Guidestar.org for organizational I-990 tax return documents. For state and federally protected properties, this information was provided by personal communication with various agencies. Estimates for regional employment by statewide and national conservation organizations were included where available. Overall, the estimate of employment impact was calculated as the wages accruing to employees of conservation lands; where only employment was available, the average wage in the industry was used to calculate an industry-wide total. Given the overlap of many conservation organizations in activities in both counties, county-specific breakdowns were not available.

Since a significant proportion of employment information could not be obtained, these values are conservative and represent the lower bound limits of actual employment and wage totals. It also does not include the indirect effect of additional jobs generated outside of these organizations, such as in associated recreational employment (sporting outfits, guides, etc.), or jobs in the "restoration economy" which includes a variety of industries that participate in environmental conservation, mitigation, and restoration.

[4] The most common method to generate estimates of economic impact from various activities is through the use of input-output models such as IMPLAN, which calculate both the direct and indirect or induced effects of economic activities. However, these models perform best at the state level or possibly the county for export-heavy economic activities; it was not possible to separate out the economic activity resulting from just conservation lands within specific counties using these models. Instead, we focus on direct impacts, where measureable.

3.3.4 Non-market ecosystem services

Three publicly-available, national valuation databases were queried to acquire proxy values by land cover type and ecosystem service. These included the Environmental Valuation Research Inventory (EVRI), Oregon State (OSU) Recreation Database, and the USGS Benefit Transfer Toolkit. Primary studies were reviewed to locate valuation data from similar geographic and socioeconomic study sites for transfer to the policy site. Studies selected for value transfer were from similar regions in New England, Canada and Minnesota. These original valuation studies included various cost-benefit analysis methodologies, such as contingent pricing, travel-cost method, and hedonic pricing.

Using the results from the databases that most closely matched the policy site, an average value was obtained for each ecosystem service provided by the land cover classifications in the study area. Once a suitable selection of studies was identified, a unit value was derived for each ecosystem service, providing a dollar estimate on a per-unit basis (e.g. per household/year, per licensed angler/season). This constant value was then multiplied by the amount of units at the policy site. For those transfer values presented in a per acre basis, the land cover area was multiplied by the per acre proxy value. Land cover types then received a total per-acre dollar value for the ecosystem services provided. All values were converted to 2017 dollars.

Initial stakeholder ecosystem services of interest were compared against available studies that met the criteria for appropriateness for benefits transfer. Ecosystem services, the land cover they are represented by, and input values used in the calculations are detailed in Table 3-6. Units represent the unit of analysis of the primary study. For example, some benefits are calculated as accruing to the users (e.g., hunters), while some to the area residents (people or households). Some are calculated per unit of land (acre). Acadia National Park was included to capture the

Table 3-6. Land cover types, associated ecosystem services, and values used.

Ecosystem Service	**Unit (annual)**	**Value/unit (2017$)**
Land Cover type: Open Water		
Recreation - access to area with migratory fish	Resident household	$31.07
Recreational fishing: fresh & salt	Angler	$589.67
Recreation - non-motorized boating	User	$49.49
Recreation - water quality	User	$279.03
Wildlife Habitat - migratory fish spawning habitat	Household	$0.89
Land Cover Type: Forests		
Carbon sequestration	Ton of CO_2	$36
Recreation - camping	Users	$14.82
Recreation - deer hunting	Acre	$46.04
Recreation - moose hunting	Hunter	$1,301.21
Recreation - black bear hunting	Hunter	481.88
Timber production	Acre	$28
Water supply	Acre	$26.82
Land Cover Types: Scrub/Shrub, Grassland/Herbaceous, Pasture/Hay, Cultivated Crops		
Carbon sequestration	Ton of CO_2	$36
Recreation – deer hunting	Acre	$46.04
Wild blueberry production	$/acre	$1,188
Land Cover Type: Wetlands		
Carbon sequestration	Ton of CO_2	$36
Clean water	Resident	$130.69
Recreation – deer hunting	Acre	$46.04
Land Cover Type: Beaches		
Recreation – access	User	$5.09
Special Land Cover: Acadia National Park		
Recreation access	Resident household	$135.30
Science and educational value	Resident household	$133.02

benefits that it provides to local residents, as opposed to visitors, who were captured in the visitor spending effects calculation.

Beaches were not a separate category in the LULC classification and are not common throughout the study region. However, they represent a unique recreational opportunity, and one that is valued and provided on conservation lands. To calculate the benefit of beaches on conserved lands, public beaches were identified and mapped using local knowledge and Google Earth. Visitation was estimated for each. Thirteen beaches were identified on conserved lands in the study region (Table 3-7).

Table 3-7. Beaches used in valuation calculation.

Beach	**Est. # Visitors**	**Value**	**County**
Lamoine State Park	52,000	$264,680	Hancock
Town of Lamoine	3,600	$18,324	Hancock
Sand Beach, Acadia National Park	100,000	$509,000	Hancock
Roque Bluffs State Park Beach	23,000	$117,070	Washington
Jasper Beach, Machiasport	3,600	$18,324	Washington
Jones Beach, Lubec	3,600	$18,324	Washington
Marlboro Beach, Lamoine	3,600	$18,324	Hancock
Seal Harbor Beach, Mt Desert	3,600	$18,324	Hancock
Causeway Beach, Deer Isle	3,600	$18,324	Hancock
Reach Beach, Deer Isle	3,600	$18,324	Hancock
Sand Beach, Swan’s Island	1,000	$5,090	Hancock
Star Beach, Swan’s Island	1,000	$5,090	Hancock
Joyce Beach, Swan’s Island	1,000	$5,090	Hancock
Total		**$1,034,288**	

A summary of the values associated with non-market ecosystem services on conservation lands in the Downeast region is summarized in Table 3-8.

Table 3-8. Summary of non-market ecosystem service values on conservation lands.

ECOSYSTEM SERVICE	VALUE (2017 $USD/yr)	Hancock County	Washington County
Recreation, all types	$57,852,801	$39,873,910	$17,978,905
Science and Education	$5,029,885	$3,158,959	$1,870,926
Beach Access	$1,034,288	$880,570	$153,718
Clean water (water purification)	$11,292,662	$7,120,383	$4,172,278
Water supply (water provisioning)	$5,519,072	$4,029,482	$1,489,591
Wildlife Habitat provision	$33,654	$21,136	$12,518

3.4 Summary of results

Our analysis attempted to calculate as many of the known values that conservation lands provide to the Downeast region as possible, using a methodology that is backed by research. Our analysis is conservative in that only the most appropriate studies were selected for the benefits transfer and when lacking input values, lower bound estimates were used. In addition, we did not incorporate the indirect or induced effects of market-based values as is commonly done. These represent only direct values. Overall, direct market values were used for blueberries, timber, and carbon values on conservation lands; indirect market values for visitor spending effects; and non-market valuation (benefits transfer) used for recreation, science and education, beach access, clean water, water supply, and wildlife habitat provision. In addition, we included the direct payroll for employees of conservation lands and organizations in the region. The overall summary of each of these values is in Table 3-9. Caution should be used when combining values from different methodologies, as not all are based on market prices, and represent a combination

of willingness to pay and willingness to accept compensation values, which are not necessarily equivalent.

Table 3-9. Summary of economic values on conserved lands in Downeast Maine.

Economic Value	Value in 2017	Hancock County	Washington County
Ecosystem Services: Direct Market Estimation Methods			
Blueberry Harvest	$4,441,694	$2,138,685	$2,303,009
Timber Harvest	$17,500,000	N/A	N/A
Carbon sequestration by forests	$42,189,413	N/A	N/A
Visitor spending	$304,427,778	$296,963,195	$7,464,585
Conservation Employment	$13,903,184	N/A	N/A
Ecosystem Services: Benefits Transfer Methodology			
Recreation, all types	$57,852,801	$39,873,910	$17,978,905
Science and Education	$5,029,885	$3,158,958	$1,870,926
Beach Access	$1,034,288	$880,570	$153,718
Clean water (water purification)	$11,292,662	$7,120,383	$4,172,278
Water supply (water provisioning)	$5,519,072	$4,029,482	$1,489,591
Wildlife Habitat provision	$33,654	$21,136	$12,518

Acadia National Park in Hancock County dominates the visitor spending effects and employment totals calculated in the study region. According to the NPS, in 2017 Acadia had 3.5 million visitors who spent approximately $284 million in local gateway communities. These expenditures supported a total of 4,160 jobs, $108 million in labor income, $185 million in value added, and $339 million in economic output in areas surrounding the park (NPS 2017). Employment sectors that were directly affected by included camping, gas, groceries, hotels, recreation industries, restaurants, retail and transportation.

This study found that Acadia National Park represented the majority (96%) of the visitor spending effects calculated for Downeast conserved lands at over $291 million in 2017. Employment at Acadia National Park in 2017 provided full- and part-time jobs for 278 people, representing wages and benefits totaling over $10 million. This represents 63% of the jobs calculated for Downeast conservation lands, and 71% of the wages and benefits.

These figures are an upper-bound estimate, however, as Acadia National Park tracks the visitor numbers needed for spending effects calculations and was able to provide up to date employment information. Similar data for private conserved lands, and many state and locally-owned public lands were not available, and therefore those parcels received a minimum value or a conservative estimate in the calculations for visitor spending effects and employment.

Other values, such as wildlife habitat and some types of recreation (e.g., deer hunting) where the unit of value analysis was per acre, are not as dominated by the presence of Acadia National Park. However, many of these benefits are calculated per household or per resident; the higher population in Hancock County is reflected in many of the county-level breakdowns. This is consistent with the ecosystem services framework, which views the benefits provided by ecosystems in terms of their value to humans.

4. Communication of the results

An integral part of this project is to facilitate the operationalization of the results for effective natural resource governance in the Downeast Maine region. It is important to consider the various decision demands that will be placed on these ecosystem services valuation results, and the subsequent format of presentations that should be provided. Elements of dignity theory, trust theory, post-structuralism and other relevant frameworks are applied in these recommendations. All science is value-laden, and when uncertainty is high, related policy-

making is often value-driven as well (Johnson 2015). Socio-cultural and economic influences can lead different stakeholders to attach different values to various ecosystem services (Hein et al. 2006). Here, best practices are proposed for prevailing over barriers and achieving a shared understanding of contentious issues among stakeholders leading to effective governance.

4.1 Communication and Outreach Strategies

- Conduct collaborative planning and form transdisciplinary partnerships that are self-organized, and bridge boundaries across different ways of knowing.

- Maximize strategies that emphasize dialogue and interaction between diverse constituents. Minimize use of tools applying one-way information sharing flows (e.g. public opinion polls, focus groups, surveys, public hearings).

- Ensure that decision-makers play an active role in ecosystem services research so as to increase its application and use.

- Create facilitator-led, stakeholder-driven, agreed-upon procedures and rules for communicating during the process to ensure fairness and transparency.

- Create opportunities for stakeholders to share information in a structured environment. For example - host a formal interactive group dialogue about project goals and objectives. Determine how goals interpreted by different members. Ascertain what constituents personally hope for regarding outcomes. Co-contribute to the creation of project documents and materials.

- Plan “informal interactions” that highlight shared interests, such as field trips. The goal is to achieve consensus. Create opportunities for stakeholders to talk, share ideas, communicate opinions, and ask questions; this increases learning and builds confidence in others’ abilities to perform their jobs with skill and competence.

- Have conversations to develop a mutual understanding of goals.

- Where there is values conflict, provide choices of alternative courses of action that can accommodate multiple [potentially competing] perspectives. Providing choices allows stakeholders the opportunity to make a decision based on their own values, priorities, and ideals.

- Align scale of governance with scale of resources; have many small centers of governance.

- Create tight information feedback loops, which can facilitate governance by allowing close observation and involvement by stakeholders. One way to promote information feedback loops is through a series of facilitator-led public discussions.

- Maps and other information should be presented at a scale appropriate to stakeholder decision-making needs.

- It is critical that the language used to communicate ecosystem services information be framed differently for various stakeholder audiences, speaking in the voice of the intended recipient and avoiding unfamiliar jargon. Frame the discussion around current, local vulnerabilities and priorities, and avoid framing communications around polarizing issues.

- Apply boundary spanners, which may include individuals, objects, organizations, or tools & methods. Boundary spanners may serve several functions, including information sharing, compromise negotiation, and facilitating trust. Two frequently recommended boundary objects are maps and scenarios.

- When introducing the results of this study to the community, the Downeast Conservation Network might consider creating a transdisciplinary working group to serve as a liaison in presenting the information during early phases of discussions. Working group members should represent the diverse range of stakeholders in the region, and include professionals from various fields who are able to interpret the various scientific concepts.

4.2 Comparison with other studies

Comparing the results from this study to others can validate the amounts calculated here. Results of our study indicate that conservation land in Downeast Maine provide a total of over $463 million per year if you take into account both market and non-market values, including the more than $300 million of visitor spending in the region. Based on our estimate of 702,654 acres of conserved land in the study area, this equates to an average value of $652/ac/yr. If values associated with visitor spending are ignored, then this estimate reduces to about $200/ac/yr. This latter value is closer to the methods and categories used in other ecosystem service valuation

studies conducted elsewhere, and thus more comparable. As a majority of the conserved land in Downeast Maine is forested, we focus on a comparison here with other studies that featured that ecosystem.

Many studies have used similar benefits transfer methods to estimate the value of ecosystem services at the global (e.g., Costanza et al 2014; de Groot et al 2012) and regional scale (e.g., Troy, 2012). For example, Troy (2012) used a benefits transfer approach based on values taken from studies in temperate areas of central and eastern North America, northern Europe, and New Zealand to estimate the value of non-market ecosystem services for the entire state of Maine.

Global studies estimate that temperate forests provide ecosystem services that value $194 to $1,463 (in 2016 USD)[5] per acre per year, with more recent studies citing figures closer to the higher end (e.g., Costanza et al. 2014). In terms of the value of ecosystem services in Maine, Troy (2012) estimates that the 17 million acres of forests in Maine provide an average value of about $482/ac/year, but that this value can vary between $120 and $3,217/ac/year depending on the type and location of the forest. At the regional level, Daigneault and Strong (2019) estimated that the per acre annual value of forest ecosystem services in the more than 200,000 acre Sebago Lake Watershed ranged from $270-1,970/ac/year depending on the benefit transfer values used, with a 'moderate' ecosystem service valuation approach providing a value of about $870/ac/yr.

As another source of comparison, Sills et al. (2017) compiled a list of studies of forest ecosystem services across the southern US and found that the annual value of ecosystem services generated by an average acre of forest land ranged from $151/ acre/year in Florida to

[5] All figures converted to 2016 USD for consistency.

$1,709/acre/year in Georgia. This wide variation values reflects both methodological and study scope differences as well as differences in the value of forests across the states. For example, the Florida study focused on the value of "the components of forests that are directly enjoyed, consumed, or used to produce specific, measurable human benefits," while the Georgia study used the more general concept of "ecosystem services as the things nature provides that are of direct benefit to humans."

In all of these studies, each research group made different choices about which services to include, regardless of geographic scope. In some cases, e.g,. Troy (2012) Moore et al (2011), the study only included estimates of the non-use value of forests (e.g., aesthetic and cultural benefits), while others also included market values (e.g., provision of fuel and fiber). However, all studies estimated the value of forests for protecting water quality, regulating water flow, regulating climate change via carbon sequestration, and providing wildlife habitat or biodiversity.

The goal of this study was to present the most defensible estimate of the value of conservation lands. As such, only the most applicable primary sites were selected for benefits transfer, and only those ecosystem services that were both available from appropriate primary study sites and of interest to stakeholders were considered. The conservative nature of the estimates in this study can be seen by comparing the per acre values to others reported in the literature (Table 4-1, next page).

Table 4-1. Summary of forest ecosystem service valuation studies.

Study	Ecosystem	Region	Value, 2016$/ac
This study	All	Downeast ME	$652
This study	All, non-market	Downeast ME	$199
deGroot et al, 2012	Temperate forests	Global	$1,405
deGroot et al, 2012	Woodlands	Global	$741
Costanza et al, 1997	Temperate/Boreal	Global	$194
Costanza et al, 2014	Temperate/Boreal	Global	$1,463
Troy, 2012	Streamside forest	Maine	$1,425
	Harvested forests	Maine	$120 - $313
	Non-urban forest	Maine	$482
	Suburban forest	Maine	$3,217
	All forests	Maine	$480
Daigneault and Strong, 2019	All forests	Sebago Lake	$870
Escobedo and Timilsina, 2012	FSP[6] lands	Florida	$151
Moore et al, 2011	Private forests	Georgia	$1,709
Paul, 2011	All forests	Virginia	$880
Simpson et al, 2013	All forests	Texas	$1,489

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[6] Forest Stewardship Program

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7. Appendix tables and maps

Organizations holding units of conservation lands are listed in Table 7-1 (private owners) and Table 7-2 (public owners).

Table 7-1. Organizations holding private lands in conservation in Downeast Maine.

Organization	**County**	**Type**
Blue Hill Heritage Trust	Hancock	Local land trust, nonprofit
Crabtree Neck Land Trust	Hancock	Local land trust, nonprofit
Frenchmans Bay Conservancy	Hancock	Local land trust, nonprofit
Great Pond Mtn. Conservation Trust	Hancock	Local land trust, nonprofit
Island Heritage Trust	Hancock	Local land trust, nonprofit
Islesboro Islands Trust	Hancock	Local land trust, nonprofit
Maine Audubon	Washington & Hancock	State chapter of national nonprofit
Maine Coast Heritage Trust	Washington & Hancock	Statewide nonprofit organization
Maine Farmland Trust	Washington & Hancock	Statewide nonprofit organization
Maine Island Trail Association	Washington & Hancock	Statewide nonprofit organization
ME Woodland Owners (SWOAM)	Washington & Hancock	Statewide nonprofit organization
New England Forestry Foundation	Washington & Hancock	Regional nonprofit organization
Northeast Wilderness Trust	Washington & Hancock	Regional nonprofit organization
The Conservation Fund	Washington & Hancock	National nonprofit organization
The Nature Conservancy of Maine	Washington & Hancock	State chapter of national nonprofit
Forest Society of Maine	Washington & Hancock	Statewide nonprofit organization
Downeast Lakes Land Trust	Washington	Local land trust, nonprofit
Downeast Salmon Federation	Washington	Local conservation org., nonprofit
Downeast Coastal Conservancy	Washington	Local land trust, nonprofit
Pleasant River Wildlife Foundation	Washington	Local land trust, nonprofit
Woodie Wheaton Land Trust	Washington	Local land trust, nonprofit

Table 7-2. Federal and state units in conservation in Downeast Maine.

Property	**County**
Cobscook Bay State Park	Washington
Shackford Head State Park	Washington
Ft. O'Brien State Historic Site	Washington
Quoddy Head State Park	Washington
Roque Bluffs State Park	Washington
Cross Island National Wildlife Refuge	Washington
Saint Croix Island International Historic Site	Washington
Moosehorn National Wildlife Refuge	Washington
Holbrook Island Sanctuary	Hancock
Lamoine State Park	Hancock
Acadia National Park	Hancock
Donnell Pond Public Reserved Land	Hancock
Duck Lake Public Reserved Land	Hancock
Petit Manan National Wildlife Refuge	Hancock
Downeast Sunrise Trail	Washington & Hancock

Selected socio-economic characteristics by county are detailed in Table 7-3. These data were compiled from the 2010 Decennial Census for population and the 2012 – 2016 American Communities Survey Census Bureau product for the remainder. The decennial census product is a 100% count of the population, and so is accurate. The ACS is a sample of the population with a survey frame that moves slightly over five years of observations for low population areas, and as such, has very high margins of error. Employment by industry for each county, also from the US Census Bureau, is included in Table 7-4. Maps of these data follow (Figures 7-1 – 7-9).

Table 7-3. Select socio-economic data for Downeast Maine.

Socio-economic variable	Washington	Hancock
Population in 2000	33,941	51,791
Population in 2016	31,925	54,483
Change in population	-2,016	+2,692
Percent change in population	-5.94%	5.20%
Households, 2016	14,065	23,748
Percent, adults over 25, at least a High School Diploma, 2016	88.5%	88.42%
Percent, adults over 25, at least a Bachelor's Degree, 2016	19.9%	28%
Labor Force Participation Rate, 2016	52.85%	57.47%
Unemployment, 2016	8.01%	5.2%
Median Household Income (unadjusted), 2000	$27,979	$34,293
Median Household Income, 2016	$40,448	$47,603
Percent of population in poverty (Poverty Rate), 2016	15.84%	11.72%
Child Poverty Rate, 2016	17%	16.43%
Housing Units, 2016	23,075	40,469
Percent of housing units occupied, 2016	60.95%	58.68%
Percent of housing units, vacant for seasonal use, 2016	26.88%	33.96%
Median House Value, 2016	$109,167	$200,334

Table 7-4. Employment by industry for Downeast Maine Counties.

Industry	Washington	Hancock
Educational Services, Healthcare, Social Assist.	27.2%	26.7%
Arts, Entertainment, Recreation, Accommodations, Food Service	6.8%	11%
Public Administration	6.7%	3.1%
Agriculture, Forestry, Fishing, Hunting, Mining	12.2%	5.6%
Construction	6%	8.4%
Manufacturing	8.8%	5.6%
Wholesale trade	2.5%	1.5%
Retail trade	11.6%	12.9%
Transportation and warehousing, utilities	4%	3.5%
Information services	.5%	1.6%
Fire	4.1%	4.2%
Professional / Management	4.9%	10.7%
Other	4.7%	5.1%

Another component of conservation lands in Downeast Maine are those lands enrolled in Maine's Working Waterfront Access Protection Program. While compiling an estimate of the value of these lands was beyond the scope of this project, a list of the six properties enrolled as of 2017 is included in Table A-5. Combined, these properties encompass 4.84 acres within the two Downeast Counties. Although small in size, they provide critical access for traditional fisheries in areas threatened by waterfront development that may restrict or eliminate access to water.

Table 7-5. Working Waterfront conserved lands.

Working Waterfront Property	**Town**	**County**	**Acres**
David Wharf	Tremont	Hancock	0.6
The Wharf on Johnson Bay	Lubec	Washington	1.0
Moosabec Mussel	Jonesport	Washington	0.8
Quoddy Bay Lobster	Eastport	Washington	0.94
Great Wass Lobster & Bait Co.	Beals	Washington	1.0
Beals Town Landing	Beals	Washington	0.5

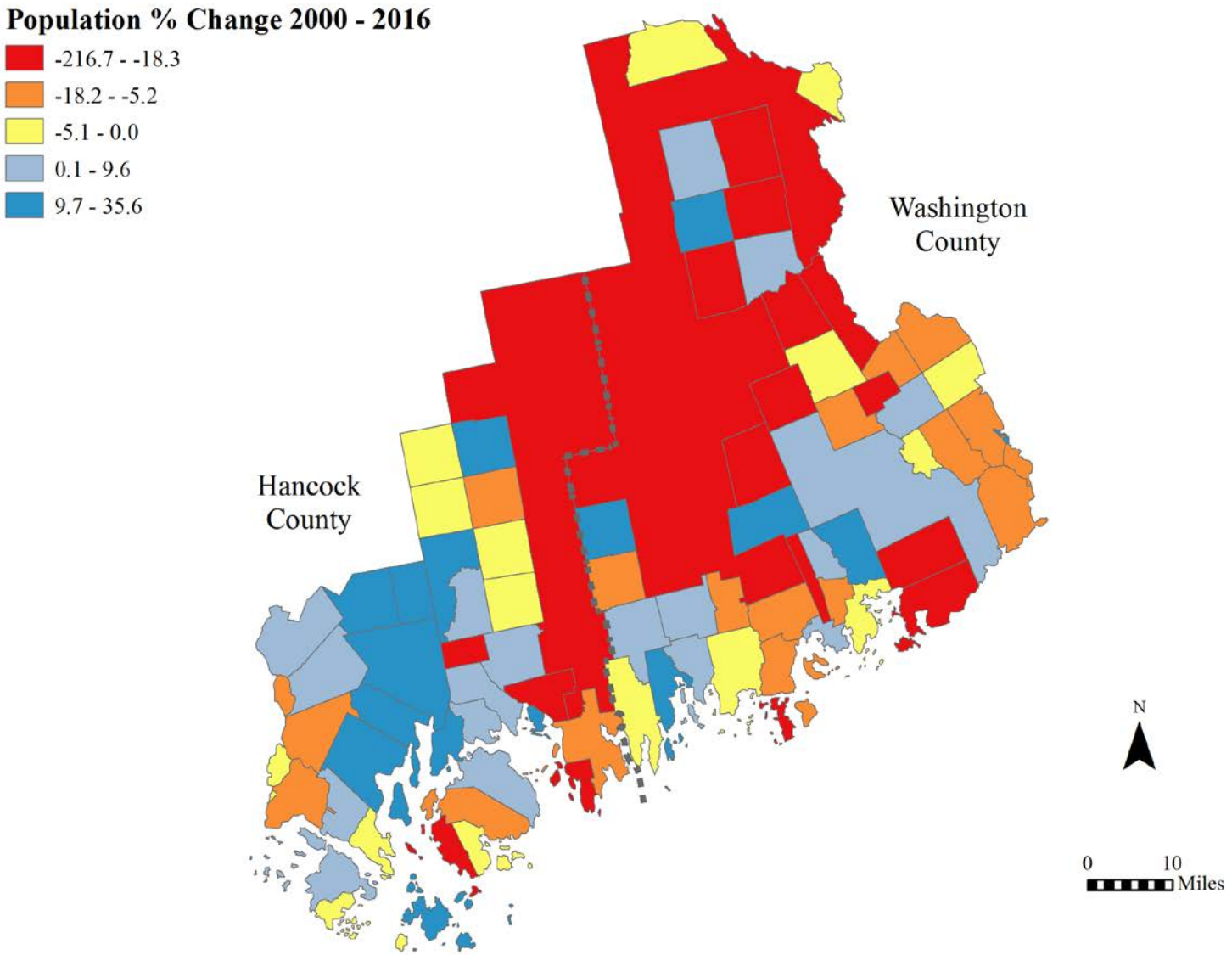

Figure 7-1. Population change in Downeast Maine, 2000-2016. Source: US Census Bureau ACS.

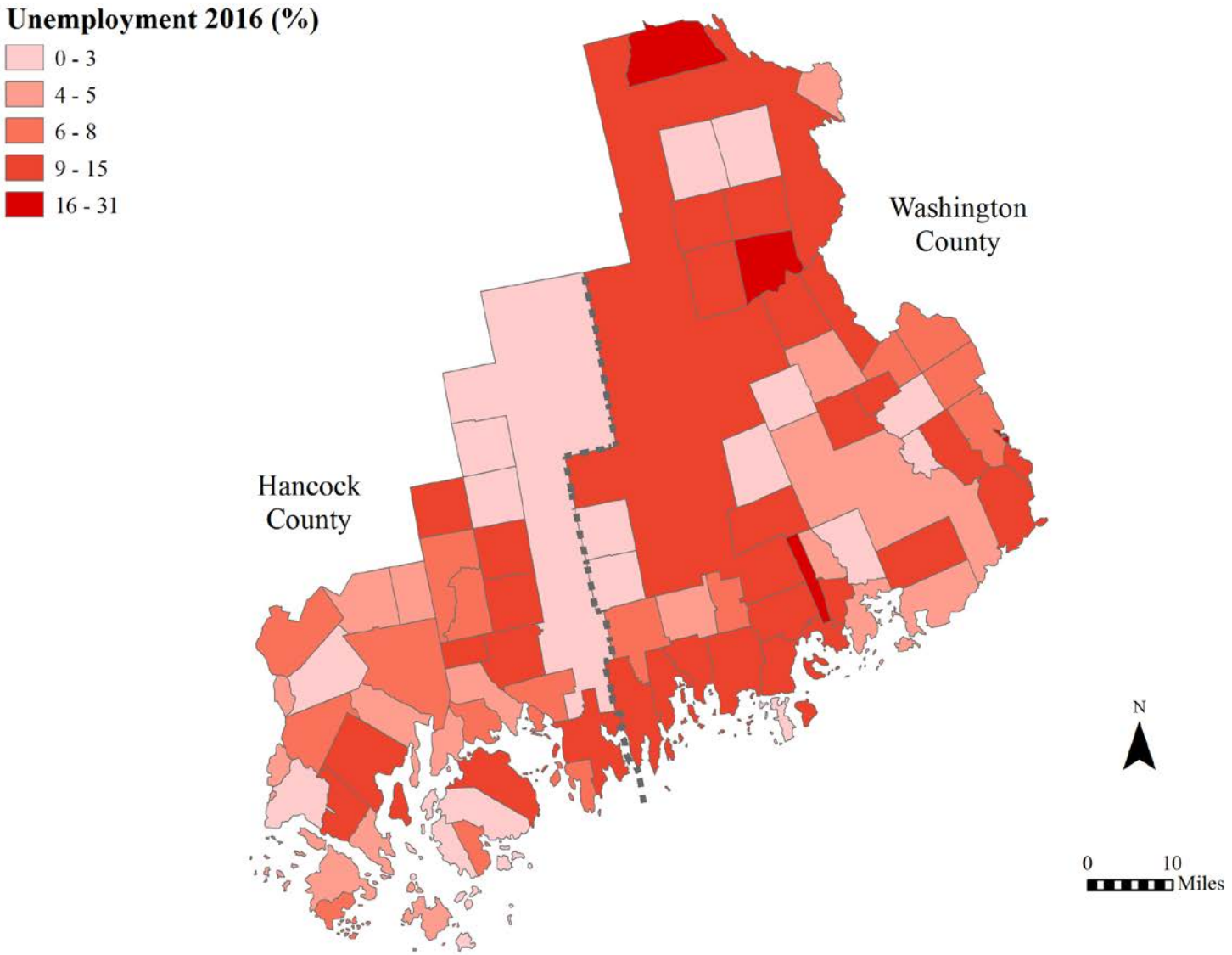

Figure 7-2. Unemployment rate, 2016. Source: US Census Bureau ACS.

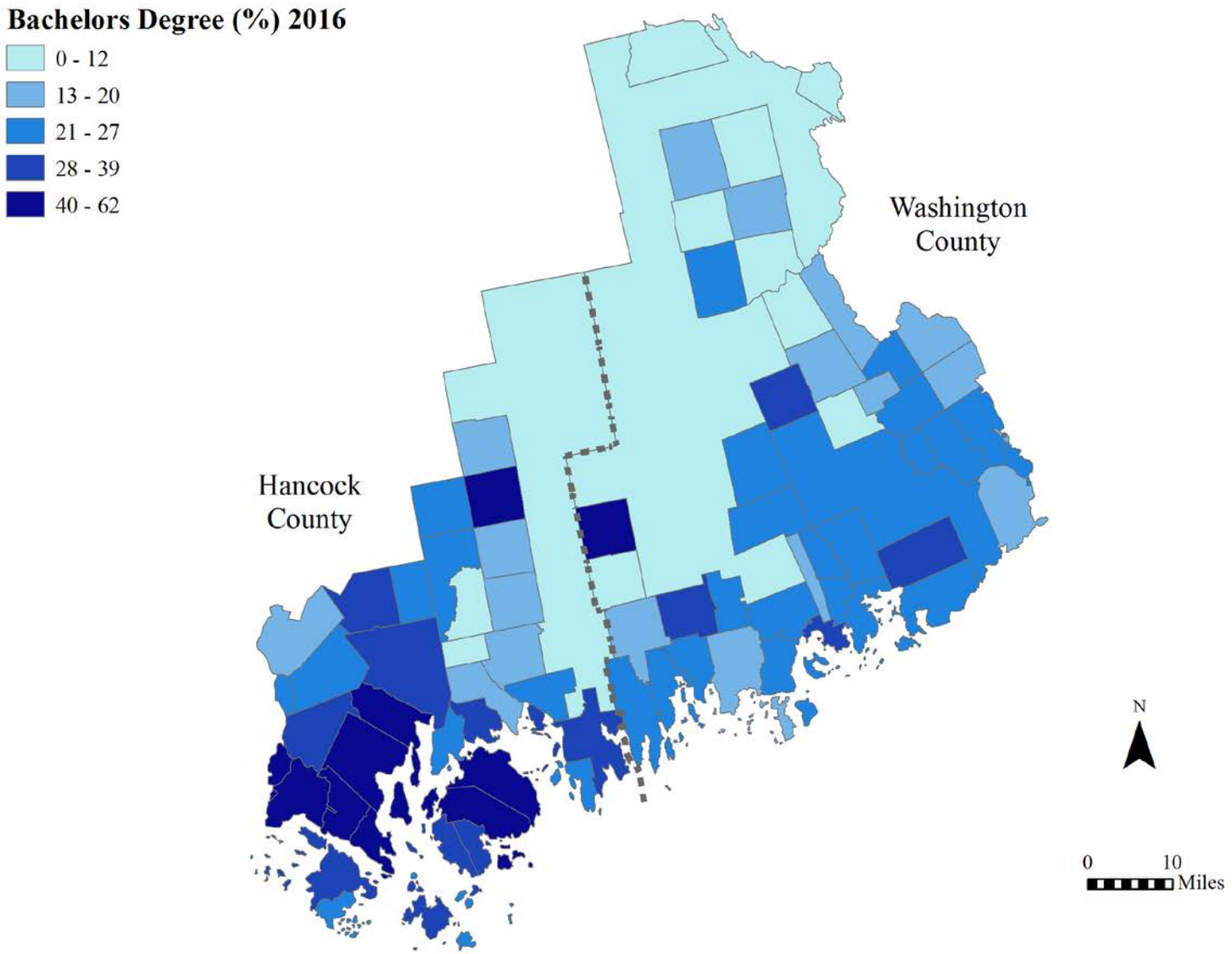

Figure 7-3. Bachelors degree or greater attainment by adults, 2016. Source: US Census Bureau ACS.

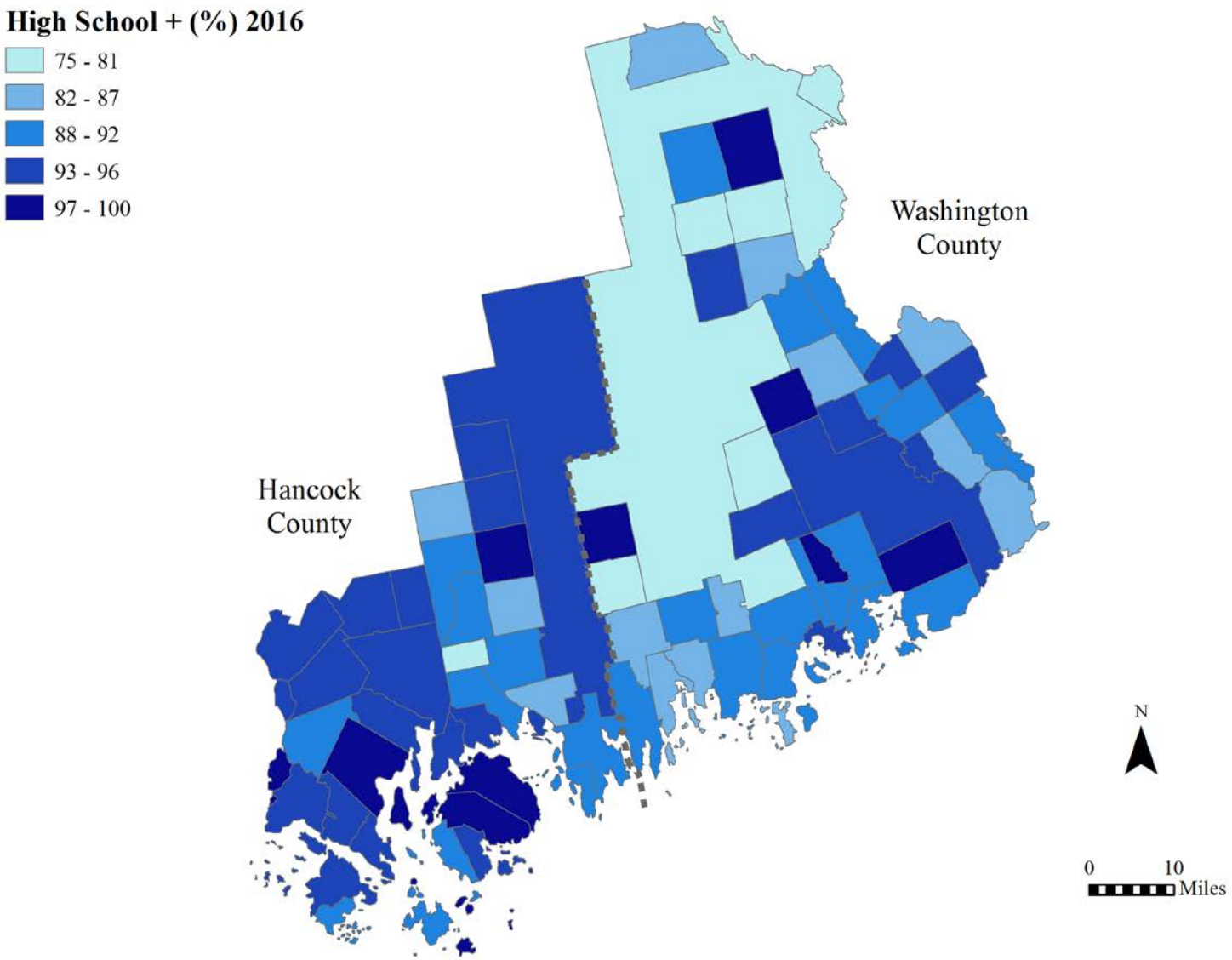

Figure 7-4. High school diploma or greater attainment by adults, 2016. Source: US Census Bureau ACS.

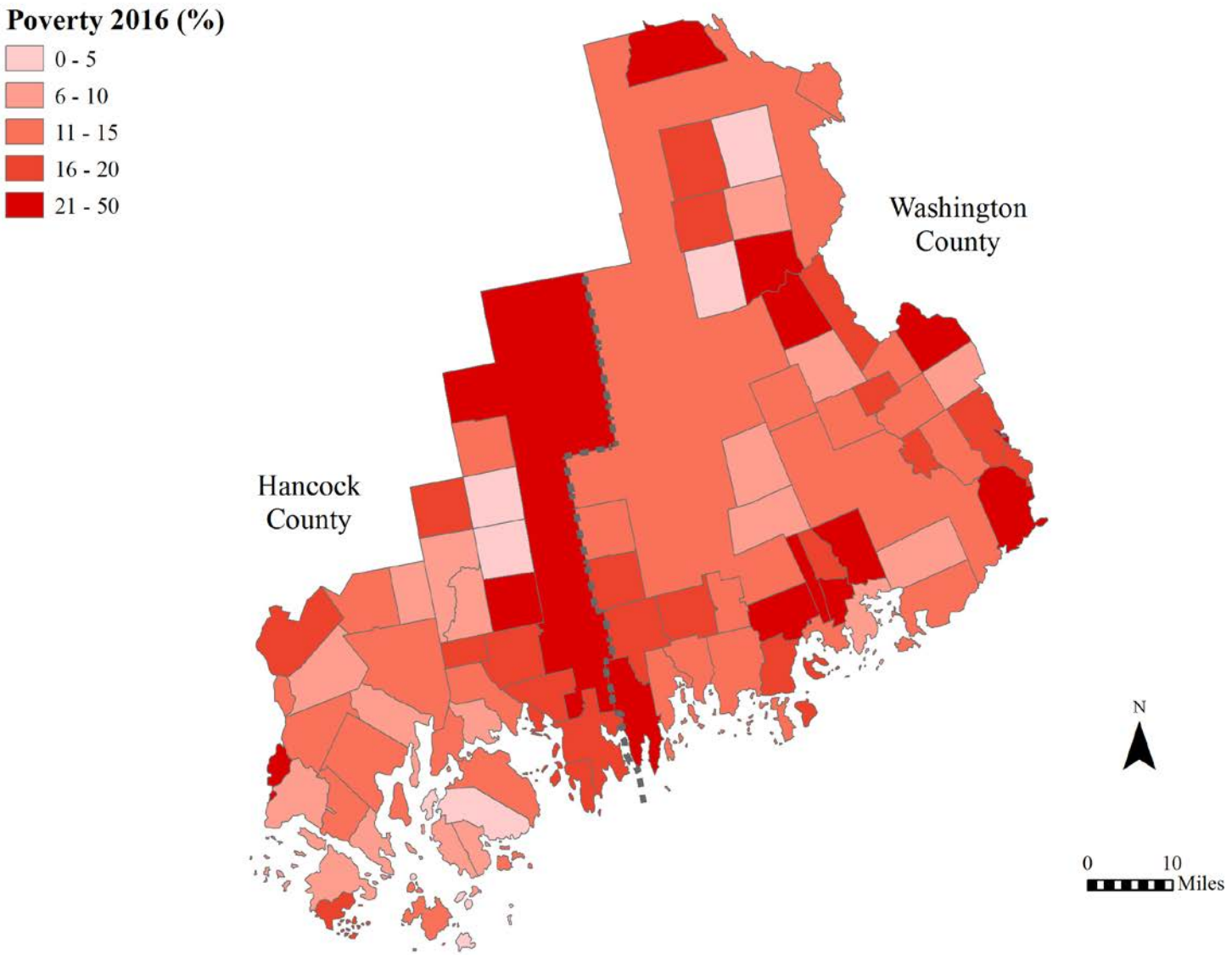

Figure 7-5. Poverty rate, 2016. Source: US Census Bureau ACS.

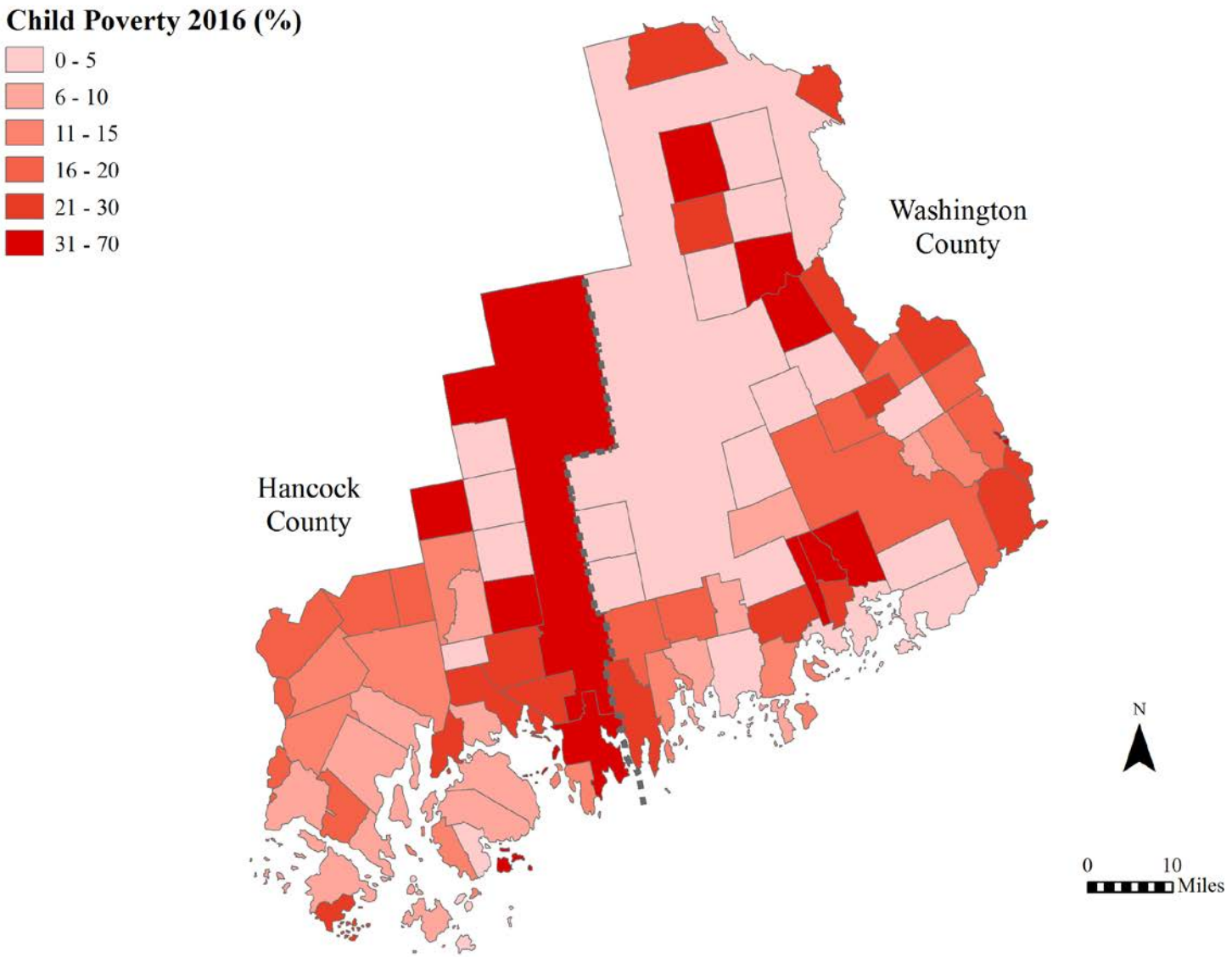

Figure 7-6. Child poverty rate, 2016. Source: US Census Bureau ACS.

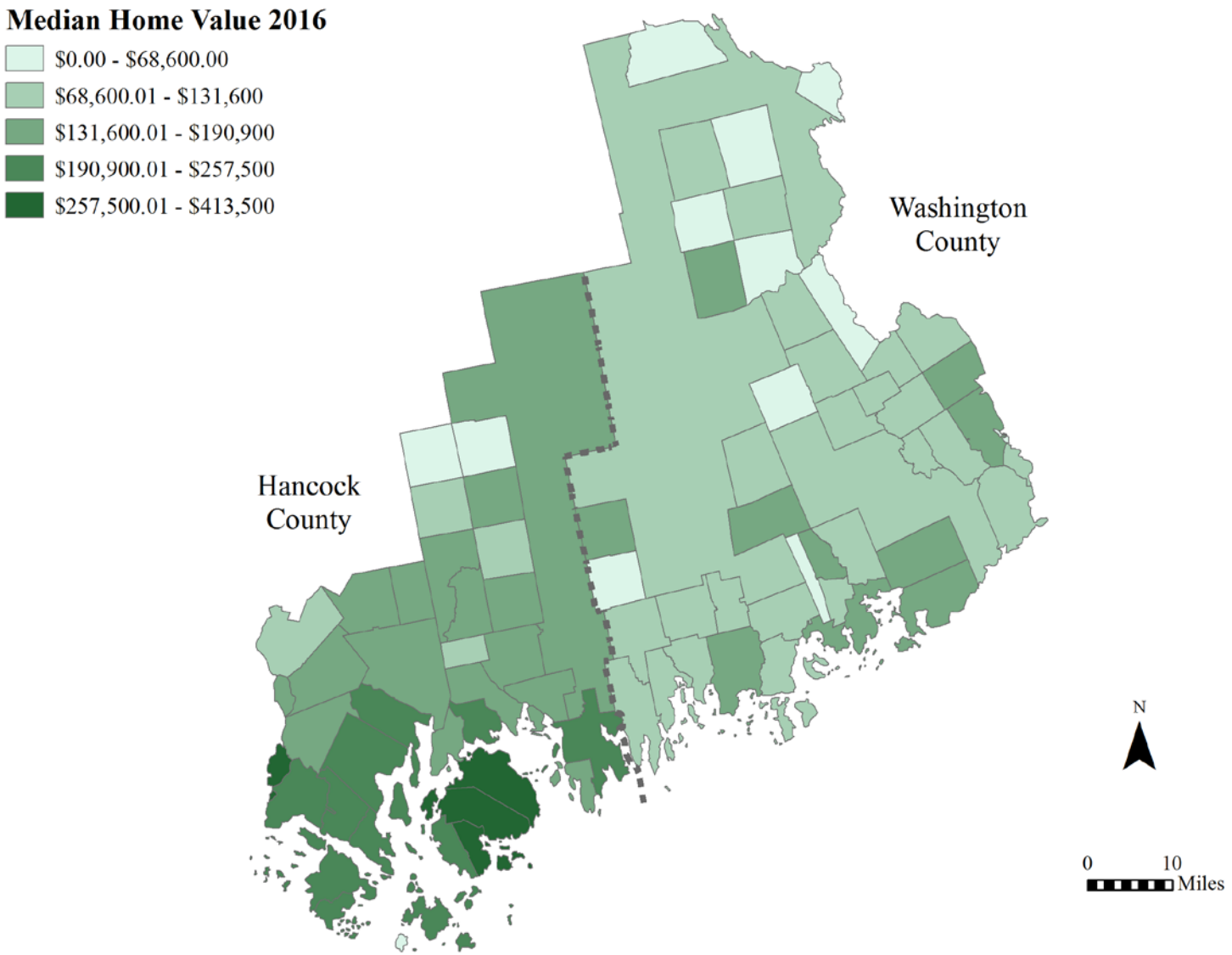

Figure 7-7. Median Home Value, 2016. Source: US Census Bureau ACS.

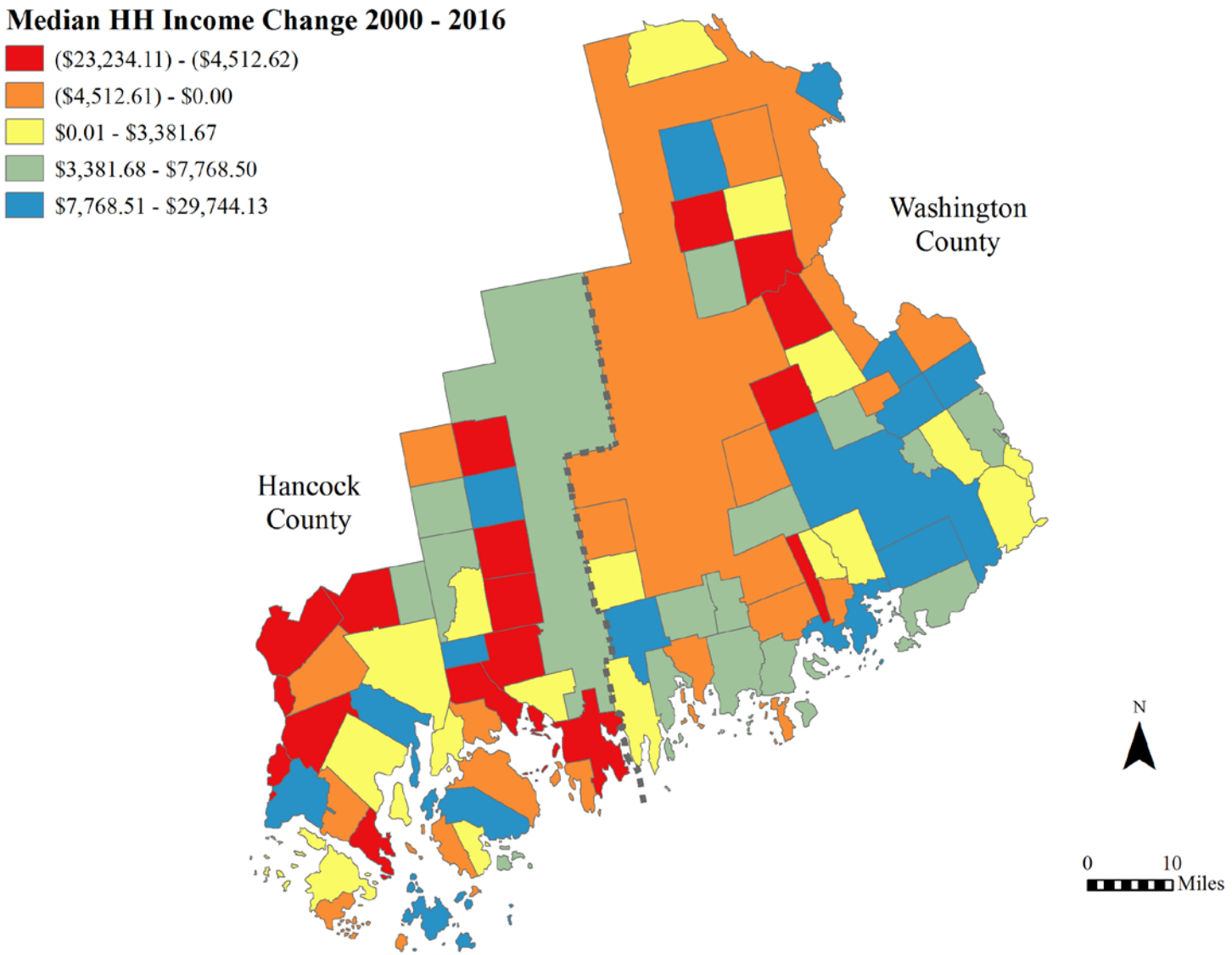

Figure 7-8. Median Household Income Change, 2000-2016. Source: US Census Bureau ACS.

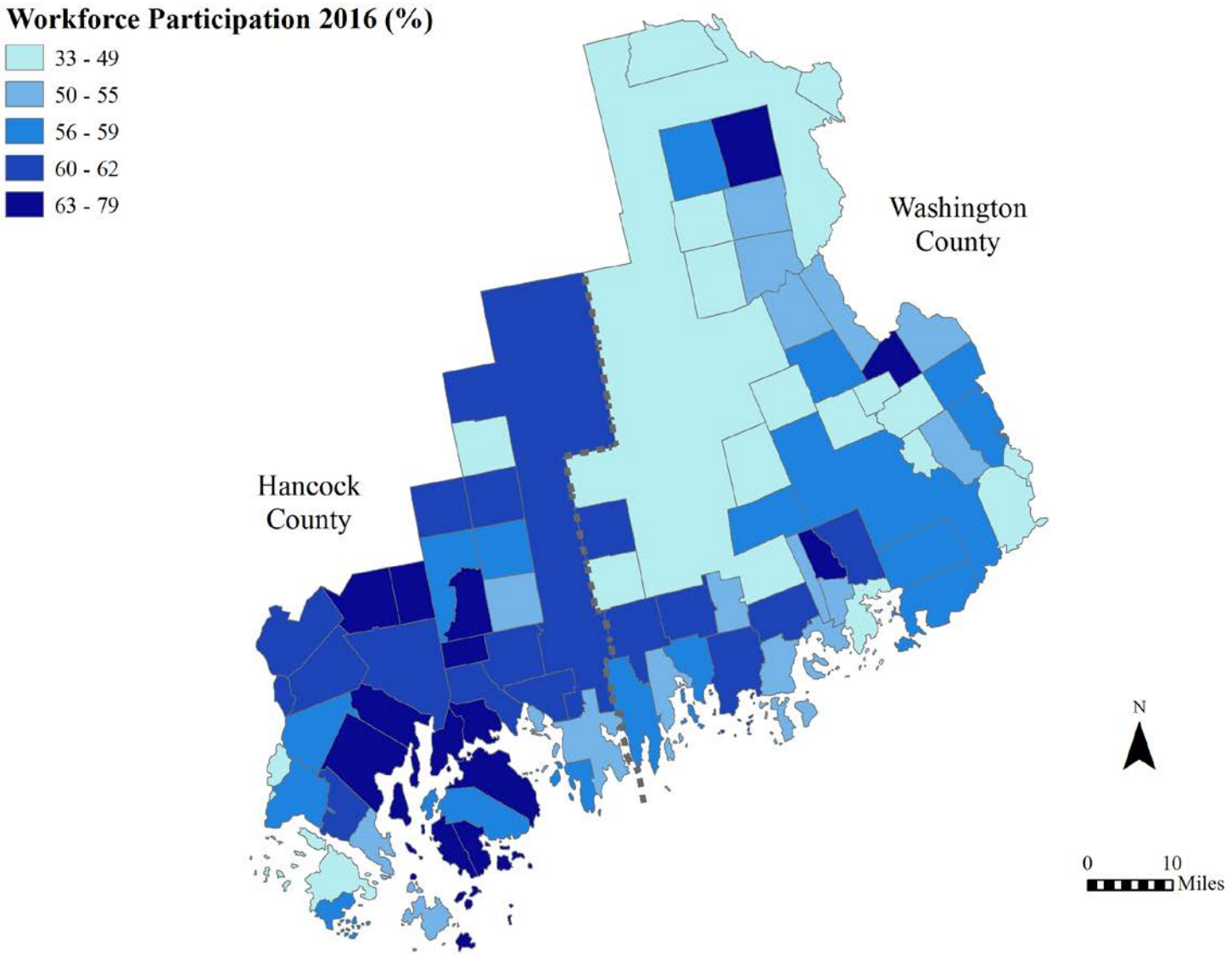

Figure 7-9. Workforce participation rate, 2016. Source: US Census Bureau ACS.