National and State Economic Values of Cattle Ranching and Farming Based Ecosystem Services in the U.S.

B-1338 | MAY 2019

University of Wyoming | College of Agriculture and Natural Resources

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Sustainable Rangelands Roundtable Publication No. 5

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Editor: Steve Miller, University of Wyoming Extension. Design and layout: Tanya Engel, University of Wyoming Extension.

Issued in furtherance of extension work, acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. University of Wyoming, Laramie, Wyoming 82071. The University of Wyoming is an affirmative action/equal employment institution.

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National and State Economic Values of Cattle Ranching and Farming Based Ecosystem Services in the U.S.

INTRODUCTION

The 2012 Census of Agriculture estimated there are nearly 620,000 agricultural operations classified as beef cattle ranches and farms in the U.S. (USDA 2014). These ranch operations use 337 million acres of land to produce $33.9 billion in gross revenue from the production associated with 20.4 million head of beef cows. Of the 337 million acres, 257 million are classified as permanent pasture and rangeland. The total investment in buildings, land, machinery, and equipment for cattle ranches in the U.S. is an estimated $523.4 billion (USDA 2014).

The economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching and farming. Beef cattle ranching also provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching and farming include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space (Maczko and Hidinger 2008). Past valuation of ecosystem services in rangeland systems estimated total values to be about twice that of economic output (Costanza et al., 2014); however, ecosystem services either are irreplaceable or difficult to replace with human-made services (Avise 2002, Salles 2011).

The work presented here is intended to document the value of select ecosystem services associated with the conservation of land use for beef cattle production. It also provides quantitative information for use in public policy and planning, such as assessments of potential land use change. A summary of the economic value of beef cattle ranching and farming-based ecosystem services for each state, and an estimate of the total values for the U.S., are presented below; however, note that all figures are conservative, representing just three of the myriad of ecosystem services provided in association with beef production. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits (MEA 2005). Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife-related recreation from pasture and rangeland used for U.S. beef cattle production. This study assumes the ecosystem services considered are constant across space. Costanza et al. (2014) also used this approach and argued the appropriateness of this method for assessing land use-change scenarios over large areas. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per-acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per-acre value estimates were translated into ecosystem service estimates for beef cattle ranching and farming based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Numbers may be subject to rounding.

U.S. AND INDIVIDUAL STATE REPORTS

Following the above overview, this document presents individual reports on the value of ecosystem services for the U.S. and each individual state (excluding Alaska and Hawaii). Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef. These results represent a conservative estimate of the value of ecosystem services since data limitations precluded valuation of all ecosystem services associated with beef cattle production.

The Economic Value of Beef Cattle Ranching and Farming Based Ecosystem Services – U.S.

INTRODUCTION

The 2012 Census of Agriculture classified nearly 620,000 agricultural operations in the U.S. as beef cattle ranches and farms (USDA, 2014). These ranches and farms managed 337 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one in every five acres of non-metro, non-urban land in the nation and supported more than 20.4 million head of beef cows in 2012. The production from these ranches and farms generated $33.9 billion of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches and farms in the U.S. was estimated to be $523.4 billion. U.S. beef cattle ranches and farms also employed over 1.9 million workers including operators, hired labor, and family labor in 2012.

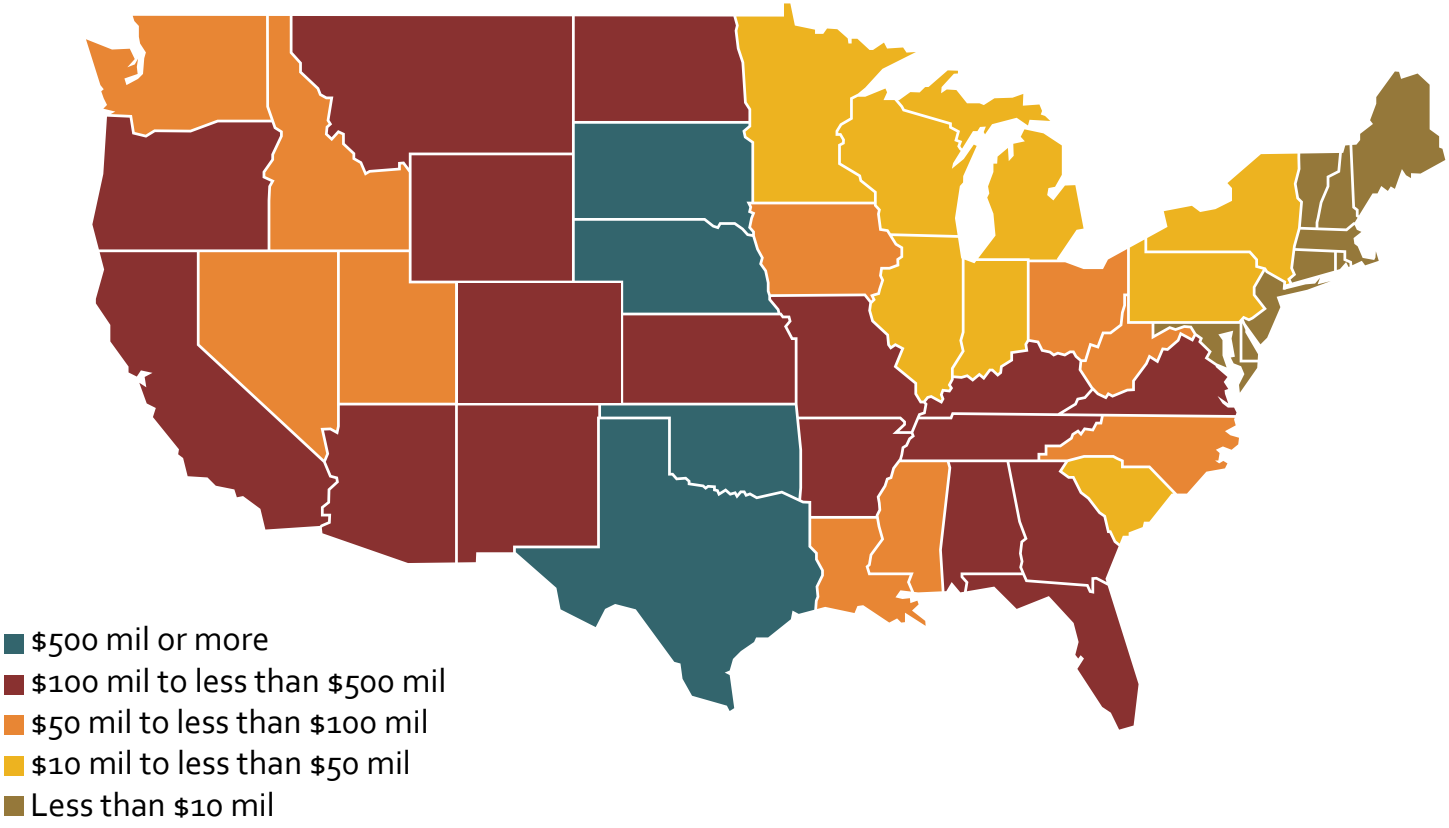
However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching and farming. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching and farming include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of U.S. beef cattle ranching and farming based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in

TOTAL ECOSYSTEM SERVICES VALUE PROVIDED ANNUALLY



the U.S. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in the U.S. since they only consider beef production on agricultural operations classified as beef cattle ranches and farms. While this represents 70 percent of the beef cows in the nation, there is another 30 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranching operations.

RESULTS

Table 1 summarizes the value of U.S. beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in the U.S. are estimated to be $12.43, $7.14, and $38.11 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $57.67 per acre of pasture and rangeland. Applying this per acre value to the 257 million acres of pasture and rangeland used by ranching operations in the U.S. for beef production results in an estimated $14.8 billion in total ecosystem services provided annually. This represents an ecosystem services value of $726.01 per beef cow or $0.86 per pound of retail beef. In summary, beef cattle ranching and farming in the U.S. is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF U.S. BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$12.43	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$7.14	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	281,884,000	(USFWS)
Economic Value Per Day	$94.93	(USFWS)
Hunting Economic Value	$26,759,214,671	
Fresh Water Fishing Days	443,223,000	(USFWS)
Economic Value Per Day	$52.50	(USFWS)
Fishing Economic Value	$23,268,809,061	
Wildlife Watching Days	335,625,000	(USFWS)
Economic Value Per Day	$38.83	(USFWS)
Watching Economic Value	$13,033,980,583	
Total Wildlife Value	$63,062,004,315	
Habitat Acres	1,654,690,539	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$38.11	
Total Value Per Acre	$57.67	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	256,861,597	(2012 Census of Ag)
Total Value Per Acre	$57.67	
Cattle Ranching Economic Value	$14,813,875,051	
Cattle Ranching Economic Value	$14,813,875,051	
Beef Cows	20,404,406	(2012 Census of Ag)
Economic Value Per Beef Cow	$726.01	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.86	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Alabama

INTRODUCTION

The 2012 Census of Agriculture classified 17,698 agricultural operations in Alabama as beef cattle ranches (USDA, 2014). These ranches managed 3.3 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented nearly one out of every five acres of non-metro, non-urban land in the state and supported more than 564,300 head of beef cows in 2012. The production from these ranches generated $384.1 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Alabama was estimated to be $9.1 billion. Alabama beef cattle ranches also employed more than 52,000 workers including operators, hired labor, and family labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Alabama beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Alabama. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Alabama since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 78 percent of the beef cows in Alabama, there is another 22 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-beef cattle ranch operations.

RESULTS

Table 1 summarizes the value of Alabama beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Alabama are estimated to be $22.86, $16.53, and $69.82 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $109.21 per acre of pasture and rangeland. Applying this per acre value to the 1.5 million acres of pasture and rangeland used by beef cattle ranches in Alabama for beef production results in an estimated $162.4 million in total ecosystem services provided annually. This represents an ecosystem services value of $287.85 per beef cow or $0.34 per pound of retail beef. In summary, beef cattle ranching in Alabama is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF ALABAMA BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$22.86	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$16.53	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	10,548,000	(USFWS)
Economic Value Per Day	$99.24	(USFWS)
Hunting Economic Value	$1,046,834,951	
Fresh Water Fishing Days	9,741,000	(USFWS)
Economic Value Per Day	$19.42	(USFWS)
Fishing Economic Value	$189,145,631	
Wildlife Watching Days	1,525,000	(USFWS)
Economic Value Per Day	$50.53	(USFWS) (a)
Watching Economic Value	$77,056,404	
Total Wildlife Value	$1,313,036,987	
Habitat Acres	18,806,504	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$69.82	
Total Value Per Acre	$109.21	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	1,487,506	(2012 Census of Ag)
Total Value Per Acre	$109.21	
Cattle Ranching Economic Value	$162,454,195	
Cattle Ranching Economic Value	$162,454,195	
Beef Cows	564,373	(2012 Census of Ag)
Economic Value Per Beef Cow	$287.85	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.34	

(a) Based on 2006 data adjusted to 2016$

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Arkansas

INTRODUCTION

The 2012 Census of Agriculture classified 22,009 agricultural operations in Arkansas as beef cattle ranches (USDA, 2014). These ranches managed 5.3 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented more than one out of every five acres of non-metro, non-urban land in the state and supported nearly 662,100 head of beef cows in 2012. The production from these ranches generated $721.7 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Arkansas was estimated to be $11.9 billion. Arkansas beef cattle ranches also employed more than 65,000 workers including operators, hired labor, and family labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Arkansas beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Arkansas. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services, as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Arkansas since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 81 percent of the beef cows in Arkansas, there is another 19 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-beef cattle ranch operations.

RESULTS

Table 1 summarizes the value of Arkansas beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Arkansas are estimated to be $17.89, $13.79, and $47.44 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $79.12 per acre of pasture and rangeland. Applying this per acre value to the 2.3 million acres of pasture and rangeland used by beef cattle ranches in Arkansas for beef production results in an estimated $181.1 million in total ecosystem services provided annually. This represents an ecosystem services value of $273.57 per beef cow or $0.33 per pound of retail beef. In summary, beef cattle ranching in Arkansas is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF ARKANSAS BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$17.89	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$13.79	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	10,967,000	(USFWS)
Economic Value Per Day	$46.39	(USFWS)
Hunting Economic Value	$508,717,368	
Fresh Water Fishing Days	15,622,000	(USFWS)
Economic Value Per Day	$39.91	(USFWS)
Fishing Economic Value	$623,531,823	
Wildlife Watching Days	1,427,000	(USFWS)
Economic Value Per Day	$34.52	(USFWS)
Watching Economic Value	$49,259,978	
Total Wildlife Value	$1,181,509,169	
Habitat Acres	24,907,234	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$47.44	
Total Value Per Acre	$79.12	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	2,289,276	(2012 Census of Ag)
Total Value Per Acre	$79.12	
Cattle Ranching Economic Value	$181,129,413	
Cattle Ranching Economic Value	$181,129,413	
Beef Cows	662,099	(2012 Census of Ag)
Economic Value Per Beef Cow	$273.57	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.33	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Arizona

INTRODUCTION

The 2012 Census of Agriculture classified 4,201 agricultural operations in Arizona as beef cattle ranches (USDA, 2014). These ranches managed 7.7 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every ten acres of non-urban land in the state and supported more than 182,600 head of beef cows in 2012. The production from these ranches generated $162.4 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Arizona was estimated to be $5.1 billion. Arizona beef cattle ranches also employed more than 17,000 workers including operators, hired labor, and family labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Arizona beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Arizona. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching-based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services, as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Arizona since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 92 percent of the beef cows in Arizona, there is another 8 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-beef cattle ranch operations.

RESULTS

Table 1 summarizes the value of Arizona beef cattle ranching based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Arizona are estimated to be $2.29, $2.13, and $18.00 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $22.42 per acre of pasture and rangeland. Applying this per acre value to the 6.4 million acres of pasture and rangeland used for beef production by beef cattle ranches in Arizona results in an estimated $144.3 million in total ecosystem services provided annually. This represents an ecosystem services value of $794.57 per beef cow or $0.95 per pound of retail beef. In summary, beef cattle ranching in Arizona is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF ARIZONA BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$2.29	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$2.13	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	2,634,000	(USFWS)
Economic Value Per Day	$137.49	(USFWS) (a)
Hunting Economic Value	$362,136,310	
Fresh Water Fishing Days	4,825,000	(USFWS)
Economic Value Per Day	$85.22	(USFWS)
Fishing Economic Value	$411,192,017	
Wildlife Watching Days	11,907,000	(USFWS)
Economic Value Per Day	$44.23	(USFWS)
Watching Economic Value	$526,631,068	
Total Wildlife Value	$1,299,959,395	
Habitat Acres	72,230,980	(EPS - NonUrban)
Wildlife Value Per Acre	$18.00	
Total Value Per Acre	$22.42	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	6,438,044	(2012 Census of Ag)
Total Value Per Acre	$22.42	
Cattle Ranching Economic Value	$144,328,795	
Cattle Ranching Economic Value	$144,328,795	
Beef Cows	181,643	(2012 Census of Ag)
Economic Value Per Beef Cow	$794.57	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.95	

(a) Based on 2006 data adjusted to 2016$

The Economic Value of Beef Cattle Ranching Based Ecosystem Services – California

INTRODUCTION

The 2012 Census of Agriculture classified 11,767 agricultural operations in California as beef cattle ranches (USDA, 2014). These ranches managed 10.5 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every nine acres of non-urban land in the state and supported nearly 472,800 head of beef cows in 2012. The production from these ranches generated $1.5 billion of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in California was estimated to be $23.5 billion. California beef cattle ranches also employed more than 42,500 workers including operators, hired labor, and family labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of California beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in California. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in California since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 81 percent of the beef cows in California, there is another 19 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-beef cattle ranch operations.

RESULTS

Table 1 summarizes the value of California beef cattle ranching based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in California are estimated to be $11.93, $10.66, and $29.15 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $51.75 per acre of pasture and rangeland. Applying this per acre value to the 8.8 million acres of pasture and rangeland used by beef cattle ranches in California for beef production results in an estimated $457.2 million in total ecosystem services provided annually. This represents an ecosystem services value of $967.14 per beef cow or $1.15 per pound of retail beef. In summary, beef cattle ranching in California is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF CALIFORNIA BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$11.93	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$10.66	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	6,731,000	(USFWS)
Economic Value Per Day	$154.26	(USFWS)
Hunting Economic Value	$1,038,331,176	
Fresh Water Fishing Days	17,382,000	(USFWS)
Economic Value Per Day	$42.07	(USFWS)
Fishing Economic Value	$731,281,553	
Wildlife Watching Days	27,352,000	(USFWS)
Economic Value Per Day	$36.68	(USFWS)
Watching Economic Value	$1,003,201,726	
Total Wildlife Value	$2,772,814,455	
Habitat Acres	95,107,146	(EPS - Total Non-Urban)
Wildlife Value Per Acre	$29.15	
Total Value Per Acre	$51.75	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	8,836,126	(2012 Census of Ag)
Total Value Per Acre	$51.75	
Cattle Ranching Economic Value	$457,234,603	
Cattle Ranching Economic Value	$457,234,603	
Beef Cows	472,769	(2012 Census of Ag)
Economic Value Per Beef Cow	$967.14	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$1.15	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Colorado

INTRODUCTION

The 2012 Census of Agriculture classified 10,528 agricultural operations in Colorado as beef cattle ranches (USDA, 2014). These ranches managed 14.5 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every three and one-half acres of non-metro, non-urban land in the state and supported more than 510,000 head of beef cows in 2012. The production from these ranches generated $990.8 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Colorado was estimated to be $14.7 billion. Colorado beef cattle ranches also employed more than 37,500 workers including operators, hired labor, and family labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Colorado beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Colorado. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Colorado since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 75 percent of the beef cows in Colorado, there is another 25 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-beef cattle ranch operations.

RESULTS

Table 1 summarizes the value of Colorado beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Colorado are estimated to be $5.57, $4.32, and $18.07 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $27.95 per acre of pasture and rangeland. Applying this per acre value to the 12.1 million acres of pasture and rangeland used by beef cattle ranches in Colorado for beef production results in an estimated $338.1 million in ecosystem services provided annually. This represents an ecosystem services value of $662.91 per beef cow or $0.79 per pound of retail beef. In summary, beef cattle ranching in Colorado is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF COLORADO BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$5.57	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$4.32	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	2,184,000	(USFWS)
Economic Value Per Day	$67.96	(USFWS)
Hunting Economic Value	$148,427,184	
Fresh Water Fishing Days	8,433,000	(USFWS)
Economic Value Per Day	$66.88	(USFWS)
Fishing Economic Value	$564,019,417	
Wildlife Watching Days	6,937,000	(USFWS)
Economic Value Per Day	$30.20	(USFWS)
Watching Economic Value	$209,531,823	
Total Wildlife Value	$921,978,425	
Habitat Acres	51,025,734	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$18.07	
Total Value Per Acre	$27.95	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	12,096,221	(2012 Census of Ag)
Total Value Per Acre	$27.95	
Cattle Ranching Economic Value	$338,113,187	
Cattle Ranching Economic Value	$338,113,187	
Beef Cows	510,047	(2012 Census of Ag)
Economic Value Per Beef Cow	$662.91	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.79	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Connecticut

INTRODUCTION

The 2012 Census of Agriculture classified 693 agricultural operations in Connecticut as beef cattle ranches (USDA, 2014). These ranches managed 34,668 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 82 acres of non-urban land in the state and supported nearly 4,000 head of beef cows in 2012. The production from these ranches generated $3.1 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Connecticut was estimated to be $384.8 million. Connecticut beef cattle ranches also employed more than 2,000 workers including operators, hired labor, and family labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Connecticut beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Connecticut. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Connecticut since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 49 percent of the beef cows in Connecticut, there is another 51 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-beef cattle ranch operations.

RESULTS

Table 1 summarizes the value of Connecticut beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Connecticut are estimated to be $25.60, $16.78, and $202.22 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $244.60 per acre of pasture and rangeland. Applying this per acre value to the nearly 8,000 acres of pasture and rangeland used by beef cattle ranches in Connecticut for beef production results in an estimated $1.9 million in ecosystem services provided annually. This represents an ecosystem services value of $488.89 per beef cow or $0.58 of ecosystem services per pound of retail beef. In summary, beef cattle ranching in Connecticut makes an economic contribution not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF CONNECTICUT BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$25.60	(NASS Pastureland Rental Rate)(a)
Ecosystem Services (Per Acre)	$16.78	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	1,011,000	(USFWS)
Economic Value Per Day	$204.96	(USFWS)
Hunting Economic Value	$207,216,828	
Fresh Water Fishing Days	3,518,000	(USFWS)
Economic Value Per Day	$32.36	(USFWS)
Fishing Economic Value	$113,851,133	
Wildlife Watching Days	8,964,000	(USFWS)
Economic Value Per Day	$28.05	(USFWS)
Watching Economic Value	$251,417,476	
Total Wildlife Value	$572,485,437	
Habitat Acres	2,830,954	(EPS - Total NonUrban)
Wildlife Value Per Acre	$202.22	
Total Value Per Acre	$244.60	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	7,907	(2012 Census of Ag)
Total Value Per Acre	$244.60	
Cattle Ranching Economic Value	$1,934,066	
Cattle Ranching Economic Value	$1,934,066	
Beef Cows	3,956	(2012 Census of Ag)
Economic Value Per Beef Cow	$488.89	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.58	

(a) Based on average for Maine and Vermont

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Delaware

INTRODUCTION

The 2012 Census of Agriculture classified 137 agricultural operations in Delaware as beef cattle ranches (USDA, 2014). These ranches managed 4,704 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 250 acres of non-urban land in the state and supported nearly 900 head of beef cows in 2012. Delaware beef cattle ranches also employed more than 500 workers including operators, hired labor, and family labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Delaware beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Delaware. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services, as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Delaware since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 23 percent of the beef cows in Delaware, there is another 77 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Delaware beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Delaware are estimated to be $35.79, $29.62, and $73.36 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $138.76 per acre of pasture and rangeland. Applying this per acre value to the 956 acres of pasture and rangeland used by beef cattle ranches in Delaware for beef production results in an estimated $132,655 in ecosystem services provided annually. This represents an ecosystem services value of $150.74 per beef cow or $0.18 per pound of retail beef. In summary, beef cattle ranching in Delaware makes an economic contribution not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF DELAWARE BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$35.79	(NASS Pastureland Rental Rate)(a)
Ecosystem Services (Per Acre)	$29.62	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	380,000	(USFWS)
Economic Value Per Day	$72.28	(USFWS) (a)
Hunting Economic Value	$27,464,941	
Fresh Water Fishing Days	655,000	(USFWS)
Economic Value Per Day	$15.10	(USFWS)
Fishing Economic Value	$9,892,125	
Wildlife Watching Days	1,573,000	(USFWS)
Economic Value Per Day	$31.28	(USFWS)
Watching Economic Value	$49,209,277	
Total Wildlife Value	$86,566,343	
Habitat Acres	1,180,021	(EPS - Total NonUrban)
Wildlife Value Per Acre	$73.36	
Total Value Per Acre	$138.76	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	956	(2012 Census of Ag)
Total Value Per Acre	$138.76	
Cattle Ranching Economic Value	$132,655	
Cattle Ranching Economic Value	$132,655	
Beef Cows	880	(2012 Census of Ag)
Economic Value Per Beef Cow	$150.74	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.18	

(a) Based on average for New Jersey

The Economic Value of Beef Cattle Ranching Based Ecosystem Services – Florida

INTRODUCTION

The 2012 Census of Agriculture classified 17,351 agricultural operations in Florida as beef cattle ranches (USDA, 2014). These ranches managed 4.7 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every seven acres of non-urban land in the state and supported nearly 788,800 head of beef cows in 2012. The production from these ranches generated $442.2 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Florida was estimated to be $20.5 billion. Florida beef cattle ranches also employed more than 54,000 workers including operators, hired labor, and family labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Florida beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Florida. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services, as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Florida since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 80 percent of the beef cows in Florida, there is another 20 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Florida beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Florida are estimated to be $15.41, $13.30 and $56.54 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $85.25 per acre of pasture and rangeland. Applying this per acre value to the 2.7 million acres of pasture and rangeland used by beef cattle ranches in Florida for beef production results in an estimated $228.1 million in ecosystem services provided annually. This represents an ecosystem services value of $289.25 per beef cow or $0.34 per pound of retail beef. In summary, beef cattle ranching in Florida is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF FLORIDA BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$15.41	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$13.30	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	5,252,000	(USFWS)
Economic Value Per Day	$65.80	(USFWS)
Hunting Economic Value	$345,600,863	
Fresh Water Fishing Days	25,729,000	(USFWS)
Economic Value Per Day	$38.83	(USFWS)
Fishing Economic Value	$999,184,466	
Wildlife Watching Days	16,786,000	(USFWS)
Economic Value Per Day	$35.60	(USFWS)
Watching Economic Value	$597,559,871	
Total Wildlife Value	$1,942,345,200	
Habitat Acres	34,350,900	(EPS - NonUrban)
Wildlife Value Per Acre	$56.54	
Total Value Per Acre	$85.25	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	2,676,248	(2012 Census of Ag)
Total Value Per Acre	$85.25	
Cattle Ranching Economic Value	$228,153,081	
Cattle Ranching Economic Value	$228,153,081	
Beef Cows	788,767	(2012 Census of Ag)
Economic Value Per Beef Cow	$289.25	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.34	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Georgia

INTRODUCTION

The 2012 Census of Agriculture classified nearly 12,858 agricultural operations in Georgia as beef cattle ranches (USDA, 2014). These ranches managed 1.9 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 11 acres of non-metro, non-urban land in the state and supported more than 296,800 head of beef cows in 2012. The production from these ranches generated $313.0 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Georgia was estimated to be $7.4 billion. Georgia beef cattle ranches also employed more than 36,500 workers including operators, hired labor, and family labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Georgia beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Georgia. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Georgia since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 67 percent of the beef cows in Georgia, there is another 37 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Georgia beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Georgia are estimated to be $28.83, $22.30, and $124.43 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $175.56 per acre of pasture and rangeland. Applying this per acre value to the more than 742,000 acres of pasture and rangeland used by beef cattle ranches in Georgia for beef production results in an estimated $130.3 million in total ecosystem services provided annually. This represents an ecosystem services value of $439.10 per beef cow or $0.52 per pound of retail beef. In summary, beef cattle ranching in Georgia is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF GEORGIA BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$28.83	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$22.30	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	8,920,000	(USFWS)
Economic Value Per Day	$60.41	(USFWS)
Hunting Economic Value	$538,856,526	
Fresh Water Fishing Days	8,106,000	(USFWS)
Economic Value Per Day	$42.07	(USFWS)
Fishing Economic Value	$341,029,126	
Wildlife Watching Days	34,309,000	(USFWS)
Economic Value Per Day	$51.70	(USFWS) (a)
Watching Economic Value	$1,773,908,343	
Total Wildlife Value	$2,653,793,996	
Habitat Acres	21,328,056	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$124.43	
Total Value Per Acre	$175.56	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	742,425	(2012 Census of Ag)
Total Value Per Acre	$175.56	
Cattle Ranching Economic Value	$130,336,617	
Cattle Ranching Economic Value	$130,336,617	
Beef Cows	296,826	(2012 Census of Ag)
Economic Value Per Beef Cow	$439.10	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.52	

(a) Based on 2006 data adjusted to 2016$

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Iowa

INTRODUCTION

The 2012 Census of Agriculture classified 9,697 agricultural operations in Iowa as beef cattle ranches (USDA, 2014). These ranches managed 1.6 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 17 acres of non-metro, non-urban land in the state and supported nearly 284,700 head of beef cows in 2012. The production from these ranches generated $1.3 billion of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Iowa was estimated to be $8.4 billion. Iowa beef cattle ranches also employed more than 28,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Iowa beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Iowa. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Iowa since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 32 percent of the beef cows in Iowa, there is another 68 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Iowa beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Iowa are estimated to be $53.68, $37.97, and $20.65 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $112.30 per acre of pasture and rangeland. Applying this per acre value to the 528,440 acres of pasture and rangeland used by beef cattle ranches in Iowa for beef production results in an estimated $59.3 million in total ecosystem services provided annually. This represents an ecosystem services value of $208.44 per beef cow or $0.25 per pound of retail beef. In summary, beef cattle ranching in Iowa is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF IOWA BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$53.68	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$37.97	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	4,240,000	(USFWS)
Economic Value Per Day	$69.04	(USFWS)
Hunting Economic Value	$292,729,234	
Fresh Water Fishing Days	5,978,000	(USFWS)
Economic Value Per Day	$33.44	(USFWS)
Fishing Economic Value	$199,911,543	
Wildlife Watching Days	2,547,000	(USFWS)
Economic Value Per Day	$30.20	(USFWS)
Watching Economic Value	$76,932,039	
Total Wildlife Value	$569,572,816	
Habitat Acres	27,581,701	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$20.65	
Total Value Per Acre	$112.30	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	528,440	(2012 Census of Ag)
Total Value Per Acre	$112.30	
Cattle Ranching Economic Value	$59,342,594	
Cattle Ranching Economic Value	$59,342,594	
Beef Cows	284,694	(2012 Census of Ag)
Economic Value Per Beef Cow	$208.44	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.25	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Idaho

INTRODUCTION

The 2012 Census of Agriculture classified 7,505 agricultural operations in Idaho as beef cattle ranches (USDA, 2014). These ranches managed 3.4 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 12 acres of non-metro, non-urban land in the state and supported more than 345,400 head of beef cows in 2012. The production from these ranches generated $880.4 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Idaho was estimated to be $6.2 billion. Idaho beef cattle ranches also employed more than 27,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Idaho beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Idaho. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Idaho since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 71 percent of the beef cows in Idaho, there is another 29 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Idaho beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Idaho are estimated to be $11.93, $10.71, and $13.57 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $36.21 per acre of pasture and rangeland. Applying this per acre value to the 2.5 million acres of pasture and rangeland used by beef cattle ranches in Idaho for beef production results in an estimated $89.8 million in total ecosystem services provided annually. This represents an ecosystem services value of $260.05 per beef cow or $0.31 of ecosystem services per pound of retail beef. In summary, beef cattle ranching in Idaho is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF IDAHO BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$11.93	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$10.71	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	3,227,000	(USFWS)
Economic Value Per Day	$66.98	(USFWS) (a)
Hunting Economic Value	$216,144,536	
Fresh Water Fishing Days	5,507,000	(USFWS)
Economic Value Per Day	$33.44	(USFWS)
Fishing Economic Value	$184,160,734	
Wildlife Watching Days	3,757,000	(USFWS)
Economic Value Per Day	$37.76	(USFWS)
Watching Economic Value	$141,850,054	
Total Wildlife Value	$542,155,323	
Habitat Acres	39,943,645	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$13.57	
Total Value Per Acre	$36.21	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	2,481,133	(2012 Census of Ag)
Total Value Per Acre	$36.21	
Cattle Ranching Economic Value	$89,833,820	
Cattle Ranching Economic Value	$89,833,820	
Beef Cows	345,445	(2012 Census of Ag)
Economic Value Per Beef Cow	$260.05	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.31	

(a) Based on 2006 data adjusted to 2016$

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Illinois

INTRODUCTION

The 2012 Census of Agriculture classified 6,600 agricultural operations in Illinois as beef cattle ranches (USDA, 2014). These ranches managed 692,254 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 31 acres of non-metro, non-urban land in the state and supported more than 114,200 head of beef cows in 2012. The production from these ranches generated $297.8 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Illinois was estimated to be $4.0 billion. Illinois beef cattle ranches also employed more than 18,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Illinois beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Illinois. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Illinois since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 32 percent of the beef cows in Illinois, there is another 68 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Illinois beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Illinois are estimated to be $37.77, $24.60, and $80.35 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $142.73 per acre of pasture and rangeland. Applying this per acre value to the 220,732 acres of pasture and rangeland used by beef cattle ranches in Illinois for beef production results in an estimated $31.5 million in total ecosystem services provided annually. This represents an ecosystem services value of $275.81 per beef cow or $0.33 per pound of retail beef. In summary, beef cattle ranching in Illinois is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF ILLINOIS BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$37.77	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$24.60	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	7,836,000	(USFWS)
Economic Value Per Day	$112.19	(USFWS)
Hunting Economic Value	$879,119,741	
Fresh Water Fishing Days	12,312,000	(USFWS)
Economic Value Per Day	$49.62	(USFWS)
Fishing Economic Value	$610,951,456	
Wildlife Watching Days	6,434,000	(USFWS)
Economic Value Per Day	$36.68	(USFWS)
Watching Economic Value	$235,982,740	
Total Wildlife Value	$1,726,053,937	
Habitat Acres	21,481,541	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$80.35	
Total Value Per Acre	$142.73	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	220,732	(2012 Census of Ag)
Total Value Per Acre	$142.73	
Cattle Ranching Economic Value	$31,504,398	
Cattle Ranching Economic Value	$31,504,398	
Beef Cows	114,224	(2012 Census of Ag)
Economic Value Per Beef Cow	$275.81	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.33	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Indiana

INTRODUCTION

The 2012 Census of Agriculture classified 8,394 agricultural operations in Indiana as beef cattle ranches (USDA, 2014). These ranches managed 571,619 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 21 acres of non-metro, non-urban land in the state and supported nearly 84,900 head of beef cows in 2012. The production from these ranches generated $290.9 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Indiana was estimated to be $3.1 billion. Indiana beef cattle ranches also employed more than 25,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Indiana beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Indiana. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Indiana since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 46 percent of the beef cows in Indiana, there is another 54 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Indiana beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Indiana are estimated to be $38.77, $25.98, and $189.98 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $254.72 per acre of pasture and rangeland. Applying this per acre value to the 175,847 acres of pasture and rangeland used by beef cattle ranches in Indiana for beef production results in an estimated $44.8 million in total ecosystem services provided annually. This represents an ecosystem services value of $527.72 per beef cow or $0.63 per pound of retail beef. In summary, beef cattle ranching in Indiana is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF INDIANA BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$38.77	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$25.98	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	10,863,000	(USFWS)
Economic Value Per Day	$120.82	(USFWS)
Hunting Economic Value	$1,312,466,019	
Fresh Water Fishing Days	19,324,000	(USFWS)
Economic Value Per Day	$47.46	(USFWS)
Fishing Economic Value	$917,212,513	
Wildlife Watching Days	2,924,000	(USFWS)
Economic Value Per Day	$28.05	(USFWS)
Watching Economic Value	$82,010,787	
Total Wildlife Value	$2,311,689,320	
Habitat Acres	12,168,361	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$189.98	
Total Value Per Acre	$254.72	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	175,847	(2012 Census of Ag)
Total Value Per Acre	$254.72	
Cattle Ranching Economic Value	$44,791,687	
Cattle Ranching Economic Value	$44,791,687	
Beef Cows	84,878	(2012 Census of Ag)
Economic Value Per Beef Cow	$527.72	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.63	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Kansas

INTRODUCTION

The 2012 Census of Agriculture classified 15,991 agricultural operations in Kansas as beef cattle ranches (USDA, 2014). These ranches managed 10.4 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every four acres of non-metro, non-urban land in the state and supported more than 630,100 head of beef cows in 2012. The production from these ranches generated $2.5 billion of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Kansas was estimated to be $15.5 billion. Kansas beef cattle ranches also employed nearly 48,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Kansas beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Kansas. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Kansas since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 50 percent of the beef cows in Kansas, there is another 50 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Kansas beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Kansas are estimated to be $18.89, $13.53, and $14.29 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $46.71 per acre of pasture and rangeland. Applying this per acre value to the 7.0 million acres of pasture and rangeland used for beef production by beef cattle ranches in Kansas results in an estimated $328.7 million in total ecosystem services provided annually. This represents an ecosystem services value of $521.69 per beef cow or $0.62 per pound of retail beef. In summary, beef cattle ranching in Kansas is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF KANSAS BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$18.89	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$13.53	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	5,209,000	(USFWS)
Economic Value Per Day	$70.12	(USFWS)
Hunting Economic Value	$365,248,112	
Fresh Water Fishing Days	4,163,000	(USFWS)
Economic Value Per Day	$59.33	(USFWS)
Fishing Economic Value	$246,995,685	
Wildlife Watching Days	1,019,000	(USFWS)
Economic Value Per Day	$20.50	(USFWS)
Watching Economic Value	$20,885,653	
Total Wildlife Value	$633,129,450	
Habitat Acres	44,315,917	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$14.29	
Total Value Per Acre	$46.71	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	7,038,339	(2012 Census of Ag)
Total Value Per Acre	$46.71	
Cattle Ranching Economic Value	$328,735,692	
Cattle Ranching Economic Value	$328,735,692	
Beef Cows	630,140	(2012 Census of Ag)
Economic Value Per Beef Cow	$521.69	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.62	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Kentucky

INTRODUCTION

The 2012 Census of Agriculture classified 30,041 agricultural operations in Kentucky as beef cattle ranches (USDA, 2014). These ranches managed 4.6 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every four acres of non-metro, non-urban land in the state and supported nearly 715,500 head of beef cows in 2012. The production from these ranches generated $975.3 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Kentucky was estimated to be $13.7 billion. Kentucky beef cattle ranches also employed more than 91,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Kentucky beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Kentucky. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Kentucky since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 73 percent of the beef cows in Kentucky, there is another 27 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Kentucky beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Kentucky are estimated to be $24.85, $21.28, and $57.09 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $103.23 per acre of pasture and rangeland. Applying this per acre value to the 1.9 million acres of pasture and rangeland used by beef cattle ranches in Kentucky for beef production results in an estimated $197.6 million in total ecosystem services provided annually. This represents an ecosystem services value of $276.18 per beef cow or $0.33 per pound of retail beef. In summary, beef cattle ranching in Kentucky is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF KENTUCKY BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$24.85	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$21.28	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	12,222,000	(USFWS)
Economic Value Per Day	$64.72	(USFWS)
Hunting Economic Value	$791,067,961	
Fresh Water Fishing Days	10,245,000	(USFWS)
Economic Value Per Day	$18.34	(USFWS)
Fishing Economic Value	$187,880,259	
Wildlife Watching Days	2,890,000	(USFWS)
Economic Value Per Day	$34.52	(USFWS)
Watching Economic Value	$99,762,675	
Total Wildlife Value	$1,078,710,895	
Habitat Acres	18,894,069	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$57.09	
Total Value Per Acre	$103.23	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	1,914,193	(2012 Census of Ag)
Total Value Per Acre	$103.23	
Cattle Ranching Economic Value	$197,597,800	
Cattle Ranching Economic Value	$197,597,800	
Beef Cows	715,465	(2012 Census of Ag)
Economic Value Per Beef Cow	$276.18	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.33	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Louisiana

INTRODUCTION

The 2012 Census of Agriculture classified 11,218 agricultural operations in Louisiana as beef cattle ranches (USDA, 2014). These ranches managed 2.1 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 14 acres of non-urban land in the state and supported nearly 347,000 head of beef cows in 2012. The production from these ranches generated $248.5 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Louisiana was estimated to be $6.6 billion. Louisiana beef cattle ranches also employed more than 34,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Louisiana beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Louisiana. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Louisiana since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 80 percent of the beef cows in Louisiana, there is another 20 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Louisiana beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Louisiana are estimated to be $16.90, $13.16, and $33.98 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $64.04 per acre of pasture and rangeland. Applying this per acre value to the 1.2 million acres of pasture and rangeland used by beef cattle ranches in Louisiana for beef production results in an estimated $79.6 million in total ecosystem services provided annually. This represents an ecosystem services value of $229.45 per beef cow or $0.27 per pound of retail beef. In summary, beef cattle ranching in Louisiana is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF LOUISIANA BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$16.90	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$13.16	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	5,222,000	(USFWS)
Economic Value Per Day	$52.86	(USFWS)
Hunting Economic Value	$276,028,047	
Fresh Water Fishing Days	16,665,000	(USFWS)
Economic Value Per Day	$31.28	(USFWS)
Fishing Economic Value	$521,343,042	
Wildlife Watching Days	4,916,000	(USFWS)
Economic Value Per Day	$41.13	(USFWS) (a)
Watching Economic Value	$202,185,664	
Total Wildlife Value	$999,556,753	
Habitat Acres	29,413,829	(EPS - NonUrban)
Wildlife Value Per Acre	$33.98	
Total Value Per Acre	$64.04	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	1,243,228	(2012 Census of Ag)
Total Value Per Acre	$64.04	
Cattle Ranching Economic Value	$79,615,992	
Cattle Ranching Economic Value	$79,615,992	
Beef Cows	346,983	(2012 Census of Ag)
Economic Value Per Beef Cow	$229.45	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.27	

(a) Based on 2007 data

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Massachusetts

INTRODUCTION

The 2012 Census of Agriculture classified 620 agricultural operations in Massachusetts as beef cattle ranches (USDA, 2014). These ranches managed 36,952 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 115 acres of non-urban land in the state and supported more than 2,700 head of beef cows in 2012. The production from these ranches generated $3.8 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Massachusetts was estimated to be $362.6 million. Massachusetts beef cattle ranches also employed more than 1,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Massachusetts beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Massachusetts. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Massachusetts since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 44 percent of the beef cows in Massachusetts, there is another 56 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Massachusetts beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Massachusetts are estimated to be $26.84, $23.91, and $205.02 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $255.77 per acre of pasture and rangeland. Applying this per acre value to the 10,398 acres of pasture and rangeland used by beef cattle ranches in Massachusetts for beef production results in an estimated $2.7 million in total ecosystem services provided annually. This represents an ecosystem services value of $966.74 per beef cow or $1.15 per pound of retail beef. In summary, beef cattle ranching in Massachusetts is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF MASSACHUSETTS BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$26.84	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$23.91	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	1,062,000	(USFWS)
Economic Value Per Day	$192.71	(USFWS) (a)
Hunting Economic Value	$204,662,750	
Fresh Water Fishing Days	4,499,000	(USFWS)
Economic Value Per Day	$30.20	(USFWS)
Fishing Economic Value	$135,892,125	
Wildlife Watching Days	10,546,000	(USFWS)
Economic Value Per Day	$50.70	(USFWS)
Watching Economic Value	$534,694,714	
Total Wildlife Value	$875,249,589	
Habitat Acres	4,269,114	(EPS - NonUrban)
Wildlife Value Per Acre	$205.02	
Total Value Per Acre	$255.77	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	10,398	(2012 Census of Ag)
Total Value Per Acre	$255.77	
Cattle Ranching Economic Value	$2,659,494	
Cattle Ranching Economic Value	$2,659,494	
Beef Cows	2,751	(2012 Census of Ag)
Economic Value Per Beef Cow	$966.74	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$1.15	

(a) Based on 2006 data adjusted to 2016$

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Maryland

INTRODUCTION

The 2012 Census of Agriculture classified 1,649 agricultural operations in Maryland as beef cattle ranches (USDA, 2014). These ranches managed 150,619 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 37 acres of non-urban land in the state and supported nearly 19,000 head of beef cows in 2012. The production from these ranches generated $36.7 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Maryland was estimated to be $1.0 billion. Maryland beef cattle ranches also employed more than 5,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Maryland beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Maryland. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Maryland since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 48 percent of the beef cows in Maryland, there is another 52 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Maryland beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Maryland are estimated to be $39.76, $29.52, and $88.35 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $157.63 per acre of pasture and rangeland. Applying this per acre value to the 46,129 acres of pasture and rangeland used by beef cattle ranches in Maryland for beef production results in an estimated $7.3 million in total ecosystem services provided annually. This represents an ecosystem services value of $382.87 per beef cow or $0.46 per pound of retail beef. In summary, beef cattle ranching in Maryland is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF MARYLAND BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$39.76	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$29.52	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	1,032,000	(USFWS)
Economic Value Per Day	$222.22	(USFWS)
Hunting Economic Value	$229,333,333	
Fresh Water Fishing Days	3,160,000	(USFWS)
Economic Value Per Day	$36.68	(USFWS)
Fishing Economic Value	$115,900,755	
Wildlife Watching Days	4,458,000	(USFWS)
Economic Value Per Day	$33.44	(USFWS)
Watching Economic Value	$149,080,906	
Total Wildlife Value	$494,314,995	
Habitat Acres	5,594,836	(EPS - NonUrban)
Wildlife Value Per Acre	$88.35	
Total Value Per Acre	$157.63	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	46,129	(2012 Census of Ag)
Total Value Per Acre	$157.63	
Cattle Ranching Economic Value	$7,271,517	
Cattle Ranching Economic Value	$7,271,517	
Beef Cows	18,992	(2012 Census of Ag)
Economic Value Per Beef Cow	$382.87	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.46	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Maine

INTRODUCTION

The 2012 Census of Agriculture classified 950 agricultural operations in Maine as beef cattle ranches (USDA, 2014). These ranches managed 101,954 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 164 acres of non-metro, non-urban land in the state and supported nearly 4,900 head of beef cows in 2012. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Maine was estimated to be $308.7 million. Maine beef cattle ranches also employed more than 3,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Maine beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Maine. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Maine since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 47 percent of the beef cows in Maine, there is another 53 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Maine beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Maine are estimated to be $25.60, $17.72, and $37.91 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $81.28 per acre of pasture and rangeland. Applying this per acre value to the 15,416 acres of pasture and rangeland used by beef cattle ranches in Maine for beef production results in an estimated $1.2 million in total ecosystem services provided annually. This represents an ecosystem services value of $256.02 per beef cow or $0.30 per pound of retail beef. In summary, beef cattle ranching in Maine is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF MAINE BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$25.60	(NASS Pastureland Rental Rate)(a)
Ecosystem Services (Per Acre)	$17.77	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	2,523,000	(USFWS)
Economic Value Per Day	$69.04	(USFWS)
Hunting Economic Value	$174,187,702	
Fresh Water Fishing Days	3,223,000	(USFWS)
Economic Value Per Day	$42.07	(USFWS)
Fishing Economic Value	$135,595,469	
Wildlife Watching Days	7,334,000	(USFWS)
Economic Value Per Day	$44.23	(USFWS)
Watching Economic Value	$324,373,247	
Total Wildlife Value	$634,156,419	
Habitat Acres	16,727,443	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$37.91	
Total Value Per Acre	$81.28	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	15,416	(2012 Census of Ag)
Total Value Per Acre	$81.28	
Cattle Ranching Economic Value	$1,252,960	
Cattle Ranching Economic Value	$1,252,960	
Beef Cows	4,894	(2012 Census of Ag)
Economic Value Per Beef Cow	$256.02	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.30	

(a) Based on the average for Massachusetts and Vermont

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Michigan

INTRODUCTION

The 2012 Census of Agriculture classified 6,042 agricultural operations in Michigan as beef cattle ranches (USDA, 2014). These ranches managed 621,452 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 43 acres of non-metro, non-urban land in the state and supported more than 52,500 head of beef cows in 2012. The production from these ranches generated $236.8 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Michigan was estimated to be $2.6 billion. Michigan beef cattle ranches also employed more than 19,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Michigan beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Michigan. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Michigan since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 49 percent of the beef cows in Michigan, there is another 51 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Michigan beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Michigan are estimated to be $27.83, $15.57, and $54.59 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $97.99 per acre of pasture and rangeland. Applying this per acre value to the 124,347 acres of pasture and rangeland used by beef cattle ranches in Michigan for beef production results in an estimated $12.2 million in total ecosystem services provided annually. This represents an ecosystem services value of $231.96 per beef cow or $0.28 per pound of retail beef. In summary, beef cattle ranching in Michigan is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF MICHIGAN BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$27.83	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$15.57	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	11,020,000	(USFWS)
Economic Value Per Day	$64.72	(USFWS)
Hunting Economic Value	$713,268,608	
Fresh Water Fishing Days	20,961,000	(USFWS)
Economic Value Per Day	$18.34	(USFWS)
Fishing Economic Value	$384,398,058	
Wildlife Watching Days	10,343,000	(USFWS)
Economic Value Per Day	$34.52	(USFWS)
Watching Economic Value	$357,039,914	
Total Wildlife Value	$1,454,706,580	
Habitat Acres	26,648,733	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$54.59	
Total Value Per Acre	$97.99	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	124,347	(2012 Census of Ag)
Total Value Per Acre	$97.99	
Cattle Ranching Economic Value	$12,184,606	
Cattle Ranching Economic Value	$12,184,606	
Beef Cows	52,529	(2012 Census of Ag)
Economic Value Per Beef Cow	$231.96	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.28	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Minnesota

INTRODUCTION

The 2012 Census of Agriculture classified 8,083 agricultural operations in Minnesota as beef cattle ranches (USDA, 2014). These ranches managed 1.4 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 28 acres of non-metro, non-urban land in the state and supported more than 142,400 head of beef cows in 2012. The production from these ranches generated $604.9 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Minnesota was estimated to be $4.7 billion. Minnesota beef cattle ranches also employed more than 24,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Minnesota beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Minnesota. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Minnesota since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 40 percent of the beef cows in Minnesota, there is another 60 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Minnesota beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Minnesota are estimated to be $29.82, $16.46, and $66.59 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $112.88 per acre of pasture and rangeland. Applying this per acre value to the 361,306 acres of pasture and rangeland used by beef cattle ranches in Minnesota for beef production results in an estimated $40.8 million in total ecosystem services provided annually. This represents an ecosystem services value of $286.36 per beef cow or $0.34 of ecosystem services per pound of retail beef. In summary, beef cattle ranching in Minnesota is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF MINNESOTA BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$29.82	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$16.46	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	5,589,000	(USFWS)
Economic Value Per Day	$176.91	(USFWS)
Hunting Economic Value	$988,776,699	
Fresh Water Fishing Days	20,768,000	(USFWS)
Economic Value Per Day	$61.49	(USFWS)
Fishing Economic Value	$1,276,996,764	
Wildlife Watching Days	6,974,000	(USFWS)
Economic Value Per Day	$46.39	(USFWS)
Watching Economic Value	$323,497,303	
Total Wildlife Value	$2,589,270,766	
Habitat Acres	38,883,086	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$66.59	
Total Value Per Acre	$112.88	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	361,306	(2012 Census of Ag)
Total Value Per Acre	$112.88	
Cattle Ranching Economic Value	$40,783,024	
Cattle Ranching Economic Value	$40,783,024	
Beef Cows	142,417	(2012 Census of Ag)
Economic Value Per Beef Cow	$286.36	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.34	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Missouri

INTRODUCTION

The 2012 Census of Agriculture classified 40,724 agricultural operations in Missouri as beef cattle ranches (USDA, 2014). These ranches managed 9.8 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every three acres of non-metro, non-urban land in the state and supported more than 1.2 million head of beef cows in 2012. The production from these ranches generated $1.7 billion of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Missouri was estimated to be $23.8 billion. Missouri beef cattle ranches also employed more than 119,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Missouri beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Missouri. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Missouri since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 73 percent of the beef cows in Missouri, there is another 27 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Missouri beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Missouri are estimated to be $30.82, $20.24, and $52.36 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $103.42 per acre of pasture and rangeland. Applying this per acre value to the 4.6 million acres of pasture and rangeland used by beef cattle ranches in Missouri for beef production results in an estimated $472.3 million in total ecosystem services provided annually. This represents an ecosystem services value of $382.32 per beef cow or $0.46 per pound of retail beef. In summary, beef cattle ranching in Missouri is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF MISSOURI BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$30.82	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$20.24	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	10,087,000	(USFWS)
Economic Value Per Day	$69.04	(USFWS)
Hunting Economic Value	$696,405,609	
Fresh Water Fishing Days	14,865,000	(USFWS)
Economic Value Per Day	$44.23	(USFWS)
Fishing Economic Value	$657,459,547	
Wildlife Watching Days	8,200,000	(USFWS)
Economic Value Per Day	$40.99	(USFWS)
Watching Economic Value	$336,138,080	
Total Wildlife Value	$1,690,003,236	
Habitat Acres	32,276,928	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$52.36	
Total Value Per Acre	$103.42	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	4,566,830	(2012 Census of Ag)
Total Value Per Acre	$103.42	
Cattle Ranching Economic Value	$472,287,677	
Cattle Ranching Economic Value	$472,287,677	
Beef Cows	1,235,315	(2012 Census of Ag)
Economic Value Per Beef Cow	$382.32	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.46	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Mississippi

INTRODUCTION

The 2012 Census of Agriculture classified 13,041 agricultural operations in Mississippi as beef cattle ranches (USDA, 2014). These ranches managed 2.4 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 10 acres of non-metro, non-urban land in the state and supported more than 383,400 head of beef cows in 2012. The production from these ranches generated $301.6 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Mississippi was estimated to be $6.4 billion. Mississippi beef cattle ranches also employed more than 38,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Mississippi beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Mississippi. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Mississippi since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 77 percent of the beef cows in Mississippi, there is another 23 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Mississippi beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Mississippi are estimated to be $17.89, $14.04, and $52.30 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $84.24 per acre of pasture and rangeland. Applying this per acre value to the 1.1 million acres of pasture and rangeland used by beef cattle ranches in Mississippi for beef production results in an estimated $89.6 million in total ecosystem services provided annually. This represents an ecosystem services value of $233.58 per beef cow or $0.28 per pound of retail beef. In summary, beef cattle ranching in Mississippi is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF MISSISSIPPI BEEF CATTLE RANCHING AND FARMING ECOSYTEM SERVICES

Forage Production (Per Acre)	$17.89	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$14.04	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	9,105,000	(USFWS)
Economic Value Per Day	$70.12	(USFWS)
Hunting Economic Value	$638,430,421	
Fresh Water Fishing Days	7,751,000	(USFWS)
Economic Value Per Day	$32.36	(USFWS)
Fishing Economic Value	$250,841,424	
Wildlife Watching Days	3,946,000	(USFWS)
Economic Value Per Day	$87.38	(USFWS)
Watching Economic Value	$344,796,117	
Total Wildlife Value	$1,234,067,961	
Habitat Acres	23,594,268	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$52.30	
Total Value Per Acre	$84.24	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	1,063,259	(2012 Census of Ag)
Total Value Per Acre	$84.24	
Cattle Ranching Economic Value	$89,565,410	
Cattle Ranching Economic Value	$89,565,410	
Beef Cows	383,448	(2012 Census of Ag)
Economic Value Per Beef Cow	$233.58	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.28	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Montana

INTRODUCTION

The 2012 Census of Agriculture classified 8,703 agricultural operations in Montana as beef cattle ranches (USDA, 2014). These ranches managed 30.4 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every three acres of non-metro, non-urban land in the state and supported more than 1.1 million head of beef cows in 2012. The production from these ranches generated $1.8 billion of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Montana was estimated to be $22.5 billion. Montana beef cattle ranches also employed more than 33,000 workers including operators, hired labor, and family labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Montana beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Montana. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Montana since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 80 percent of the beef cows in Montana, there is another 20 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Montana beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Montana are estimated to be $6.26, $4.95, and $5.74 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $16.95 per acre of pasture and rangeland. Applying this per acre value to the 25.9 million acres of pasture and rangeland used by beef cattle ranches in Montana for beef production results in an estimated $438.2 million in total ecosystem services provided annually. This represents an ecosystem services value of $382.19 per beef cow or $0.45 per pound of retail beef. In summary, beef cattle ranching in Montana is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF MONTANA BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$6.26	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$4.95	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	2,493,000	(USFWS)
Economic Value Per Day	$137.00	(USFWS)
Hunting Economic Value	$341,543,689	
Fresh Water Fishing Days	2,450,000	(USFWS)
Economic Value Per Day	$47.46	(USFWS)
Fishing Economic Value	$116,289,105	
Wildlife Watching Days	1,395,000	(USFWS)
Economic Value Per Day	$29.13	(USFWS)
Watching Economic Value	$40,631,068	
Total Wildlife Value	$498,463,862	
Habitat Acres	86,898,751	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$5.74	
Total Value Per Acre	$16.95	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	25,857,102	(2012 Census of Ag)
Total Value Per Acre	$16.95	
Cattle Ranching Economic Value	$438,229,473	
Cattle Ranching Economic Value	$438,229,473	
Beef Cows	1,146,621	(2012 Census of Ag)
Economic Value Per Beef Cow	$382.19	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.45	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - North Carolina

INTRODUCTION

The 2012 Census of Agriculture classified 13,909 agricultural operations in North Carolina as beef cattle ranches (USDA, 2014). These ranches managed 1.3 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 23 acres of non-urban land in the state and supported nearly 215,000 head of beef cows in 2012. The production from these ranches generated $257.4 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in North Carolina was estimated to be $7.4 billion. North Carolina beef cattle ranches also employed more than 39,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of North Carolina beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in North Carolina. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in North Carolina since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 62 percent of the beef cows in North Carolina, there is another 38 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of North Carolina beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in North Carolina are estimated to be $25.84, $23.35, and $72.10 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $121.29 per acre of pasture and rangeland. Applying this per acre value to the 554,431 acres of pasture and rangeland used by beef cattle ranches in North Carolina for beef production results in an estimated $67.2 million in total ecosystem services provided annually. This represents an ecosystem services value of $312.84 per beef cow or $0.37 per pound of retail beef. In summary, beef cattle ranching in North Carolina is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF NORTH CAROLINA BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$25.84	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$23.35	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	7,608,000	(USFWS)
Economic Value Per Day	$76.59	(USFWS)
Hunting Economic Value	$582,705,502	
Fresh Water Fishing Days	15,764,000	(USFWS)
Economic Value Per Day	$80.91	(USFWS)
Fishing Economic Value	$1,275,404,531	
Wildlife Watching Days	9,275,000	(USFWS)
Economic Value Per Day	$39.91	(USFWS)
Watching Economic Value	$370,199,569	
Total Wildlife Value	$2,228,309,601	
Habitat Acres	30,906,725	(EPS - NonUrban)
Wildlife Value Per Acre	$72.10	
Total Value Per Acre	$121.29	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	554,431	(2012 Census of Ag)
Total Value Per Acre	$121.29	
Cattle Ranching Economic Value	$67,247,373	
Cattle Ranching Economic Value	$67,247,373	
Beef Cows	214,957	(2012 Census of Ag)
Economic Value Per Beef Cow	$312.84	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.37	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - North Dakota

INTRODUCTION

The 2012 Census of Agriculture classified 4,949 agricultural operations in North Dakota as beef cattle ranches (USDA, 2014). These ranches managed 6.1 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every six acres of non-metro, non-urban land in the state and supported nearly 429,800 head of beef cows in 2012. The production from these ranches generated $790.2 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in North Dakota was estimated to be $5.4 billion. North Dakota beef cattle ranches also employed more than 15,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of North Dakota beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in North Dakota. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in North Dakota since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 49 percent of the beef cows in North Dakota, there is another 51 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of North Dakota beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in North Dakota are estimated to be $16.90, $10.53, and $4.42 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $31.86 per acre of pasture and rangeland. Applying this per acre value to the 4.2 million acres of pasture and rangeland used by beef cattle ranches in North Dakota for beef production results in an estimated $134.9 million in total ecosystem services provided annually. This represents an ecosystem services value of $313.88 per beef cow or $0.37 per pound of retail beef. In summary, beef cattle ranching in North Dakota is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF NORTH DAKOTA BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$16.90	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$10.53	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	1,344,000	(USFWS) (a)
Economic Value Per Day	$78.73	(USFWS) (b)
Hunting Economic Value	$105,814,336	
Fresh Water Fishing Days	953,000	(USFWS) (a)
Economic Value Per Day	$59.93	(USFWS) (b)
Fishing Economic Value	$57,112,808	
Wildlife Watching Days	264,000	(USFWS) (a)
Economic Value Per Day	$47.87	(USFWS) (b)
Watching Economic Value	$12,638,298	
Total Wildlife Value	$175,565,442	
Habitat Acres	39,685,796	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$4.42	
Total Value Per Acre	$31.86	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	4,234,308	(2012 Census of Ag)
Total Value Per Acre	$31.86	
Cattle Ranching Economic Value	$134,894,400	
Cattle Ranching Economic Value	$134,894,400	
Beef Cows	429,760	(2012 Census of Ag)
Economic Value Per Beef Cow	$313.88	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.37	

(a) 2006 data

(b) Based on 2006 data adjusted to 2016 dollars

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Nebraska

INTRODUCTION

The 2012 Census of Agriculture classified 11,788 agricultural operations in Nebraska as beef cattle ranches (USDA, 2014). These ranches managed 16.2 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every three acres of non-metro, non-urban land in the state and supported more than 955,800 head of beef cows in 2012. The production from these ranches generated $2.4 billion of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Nebraska was estimated to be $15.8 billion. Nebraska beef cattle ranches also employed nearly 36,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Nebraska beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Nebraska. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Nebraska since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 55 percent of the beef cows in Nebraska, there is another 45 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Nebraska beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Nebraska are estimated to be $24.35, $11.96, and $7.01 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $43.33 per acre of pasture and rangeland. Applying this per acre value to the 13.6 million acres of pasture and rangeland used by beef cattle ranches in Nebraska for beef production results in an estimated $588.9 million in total ecosystem services provided annually. This represents an ecosystem services value of $616.13 per beef cow or $0.73 per pound of retail beef. In summary, beef cattle ranching in Nebraska is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF NEBRASKA BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$24.35	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$11.96	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	1,554,000	(USFWS)
Economic Value Per Day	$81.98	(USFWS)
Hunting Economic Value	$127,404,531	
Fresh Water Fishing Days	2,595,000	(USFWS)
Economic Value Per Day	$48.54	(USFWS)
Fishing Economic Value	$125,970,874	
Wildlife Watching Days	2,361,000	(USFWS)
Economic Value Per Day	$26.97	(USFWS)
Watching Economic Value	$63,673,139	
Total Wildlife Value	$317,048,544	
Habitat Acres	45,231,272	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$7.01	
Total Value Per Acre	$43.33	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	13,592,498	(2012 Census of Ag)
Total Value Per Acre	$43.33	
Cattle Ranching Economic Value	$588,909,608	
Cattle Ranching Economic Value	$588,909,608	
Beef Cows	955,813	(2012 Census of Ag)
Economic Value Per Beef Cow	$616.13	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.73	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - New Hampshire

INTRODUCTION

The 2012 Census of Agriculture classified 383 agricultural operations in New Hampshire as beef cattle ranches (USDA, 2014). The land excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. from these ranches supported more than 1,600 head of beef cows in 2012. The production from these ranches generated $3.7 million of gross revenue. New Hampshire beef cattle ranches also employed more than 1,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of New Hampshire beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in New Hampshire. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in New Hampshire since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 41 percent of the beef cows in New Hampshire, there is another 59 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of New Hampshire beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in New Hampshire are estimated to be $25.60, $17.77, and $81.11 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $124.47 per acre of pasture and rangeland. Applying this per acre value to the 4,597 acres of pasture and rangeland used by beef cattle ranches in New Hampshire for beef production results in an estimated $572,200 in total ecosystem services provided annually. This represents an ecosystem services value of $343.25 per beef cow or $0.41 per pound of retail beef. In summary, beef cattle ranching in New Hampshire is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF NEW HAMPSHIRE BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$25.60	(NASS Pastureland Rental Rate)(a)
Ecosystem Services (Per Acre)	$17.77	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	1,359,000	(USFWS)
Economic Value Per Day	$62.00	(USFWS)
Hunting Economic Value	$84,258,000	
Fresh Water Fishing Days	3,606,000	(USFWS)
Economic Value Per Day	$43.00	(USFWS)
Fishing Economic Value	$155,058,000	
Wildlife Watching Days	1,896,000	(USFWS)
Economic Value Per Day	$71.00	(USFWS)
Watching Economic Value	$134,616,000	
Total Wildlife Value	$373,932,000	
Habitat Acres	4,610,357	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$81.11	
Total Value Per Acre	$124.47	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	4,597	(2012 Census of Ag)
Total Value Per Acre	$124.47	
Cattle Ranching Economic Value	$572,200	
Cattle Ranching Economic Value	$572,200	
Beef Cows	1,667	(2012 Census of Ag)
Economic Value Per Beef Cow	$343.25	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.41	

(a) Based on the average for Massachusetts and Vermont

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - New Jersey

INTRODUCTION

The 2012 Census of Agriculture classified 701 agricultural operations in New Jersey as beef cattle ranches (USDA, 2014). These ranches managed 32,742 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 100 acres of non-urban land in the state and supported more than 4,000 head of beef cows in 2012. The production from these ranches generated $5.1 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in New Jersey was estimated to be $549.2 million. New Jersey beef cattle ranches also employed more than 2,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of New Jersey beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in New Jersey. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in New Jersey since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 42 percent of the beef cows in New Jersey, there is another 58 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of New Jersey beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in New Jersey are estimated to be $35.79, $27.24, and $176.09 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $239.11 per acre of pasture and rangeland. Applying this per acre value to the 9,312 acres of pasture and rangeland used by beef cattle ranches in New Jersey for beef production results in an estimated $2.2 million in total ecosystem services provided annually. This represents an ecosystem services value of $552.10 per beef cow or $0.66 per pound of retail beef. In summary, beef cattle ranching in New Jersey is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF NEW JERSEY BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$35.79	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$27.24	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	2,400,000	(USFWS)
Economic Value Per Day	$72.28	(USFWS)
Hunting Economic Value	$173,462,783	
Fresh Water Fishing Days	2,680,000	(USFWS)
Economic Value Per Day	$20.50	(USFWS)
Fishing Economic Value	$54,929,881	
Wildlife Watching Days	6,210,000	(USFWS)
Economic Value Per Day	$56.09	(USFWS)
Watching Economic Value	$348,349,515	
Total Wildlife Value	$576,742,179	
Habitat Acres	3,275,274	(EPS - NonUrban)
Wildlife Value Per Acre	$176.09	
Total Value Per Acre	$239.11	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	9,312	(2012 Census of Ag)
Total Value Per Acre	$239.11	
Cattle Ranching Economic Value	$2,226,603	
Cattle Ranching Economic Value	$2,226,603	
Beef Cows	4,033	(2012 Census of Ag)
Economic Value Per Beef Cow	$552.10	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.66	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - New Mexico

INTRODUCTION

The 2012 Census of Agriculture classified 8,989 agricultural operations in New Mexico as beef cattle ranches (USDA, 2014). These ranches managed 29.1 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every two acres of non-metro, non-urban land in the state and supported more than 403,000 head of beef cows in 2012. The production from these ranches generated $546.8 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in New Mexico was estimated to be $10.3 billion. New Mexico beef cattle ranches also employed more than 30,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of New Mexico beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in New Mexico. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in New Mexico since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 87 percent of the beef cows in New Mexico, there is another 13 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of New Mexico beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in New Mexico are estimated to be $3.18, $2.21, and $6.98 respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $12.37 per acre of pasture and rangeland. Applying this per acre value to the 27.0 million acres of pasture and rangeland used by beef cattle ranches in New Mexico for beef production results in an estimated $334.5 million in total ecosystem services provided annually. This represents an ecosystem services value of $830.08 per beef cow or $0.99 per pound of retail beef. In summary, beef cattle ranching in New Mexico is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF NEW MEXICO BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$3.18	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$2.21	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	927,000	(USFWS)
Economic Value Per Day	$105.72	(USFWS)
Hunting Economic Value	$98,000,000	
Fresh Water Fishing Days	3,899,000	(USFWS)
Economic Value Per Day	$39.91	(USFWS)
Fishing Economic Value	$155,623,517	
Wildlife Watching Days	5,962,000	(USFWS)
Economic Value Per Day	$32.36	(USFWS)
Watching Economic Value	$192,944,984	
Total Wildlife Value	$446,568,501	
Habitat Acres	64,009,451	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$6.98	
Total Value Per Acre	$12.37	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	27,038,643	(2012 Census of Ag)
Total Value Per Acre	$12.37	
Cattle Ranching Economic Value	$334,529,671	
Cattle Ranching Economic Value	$334,529,671	
Beef Cows	403,008	(2012 Census of Ag)
Economic Value Per Beef Cow	$830.08	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.99	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Nevada

INTRODUCTION

The 2012 Census of Agriculture classified 1,242 agricultural operations in Nevada as beef cattle ranches (USDA, 2014). These ranches managed 3.6 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 17 acres of non-metro, non-urban land in the state and supported more than 185,600 head of beef cows in 2012. The production from these ranches generated $233.2 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Nevada was estimated to be $2.3 billion. Nevada beef cattle ranches also employed nearly 5,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Nevada beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Nevada. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Nevada since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 84 percent of the beef cows in Nevada, there is another 16 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Nevada beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Nevada are estimated to be $16.00, $1.97, and $3.74 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $21.71 per acre of pasture and rangeland. Applying this per acre value to the 3.0 million acres of pasture and rangeland used by beef cattle ranches in Nevada for beef production results in an estimated $66.2 million in total ecosystem services provided annually. This represents an ecosystem services value of $356.81 per beef cow or $0.42 of ecosystem services per pound of retail beef. In summary, beef cattle ranching in Nevada is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF NEVADA BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$16.00	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$1.97	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	748,000	(USFWS)
Economic Value Per Day	$110.37	(USFWS) (a)
Hunting Economic Value	$82,558,511	
Fresh Water Fishing Days	1,400,000	(USFWS)
Economic Value Per Day	$61.49	(USFWS)
Fishing Economic Value	$86,084,142	
Wildlife Watching Days	1,619,000	(USFWS)
Economic Value Per Day	$36.68	(USFWS)
Watching Economic Value	$59,380,798	
Total Wildlife Value	$228,023,451	
Habitat Acres	61,027,279	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$3.74	
Total Value Per Acre	$21.71	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	3,050,480	(2012 Census of Ag)
Total Value Per Acre	$21.71	
Cattle Ranching Economic Value	$66,228,215	
Cattle Ranching Economic Value	$66,228,215	
Beef Cows	185,613	(2012 Census of Ag)
Economic Value Per Beef Cow	$356.81	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.42	

(a) Based on 2001 data adjusted to 2016$

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - New York

INTRODUCTION

The 2012 Census of Agriculture classified 4,453 agricultural operations in New York as beef cattle ranches (USDA, 2014). These ranches managed 643,027 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 43 acres of non-urban land in the state and supported nearly 42,800 head of beef cows in 2012. The production from these ranches generated $213.5 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in New York was estimated to be $1.8 billion. New York beef cattle ranches also employed more than 13,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of New York beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in New York. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in New York since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 50 percent of the beef cows in New York, there is another 50 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of New York beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in New York are estimated to be $22.86, $16.96, and $165.84 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $205.66 per acre of pasture and rangeland. Applying this per acre value to the 136,185 acres of pasture and rangeland used by beef cattle ranches in New York for beef production results in an estimated $28.0 million in total ecosystem services provided annually. This represents an ecosystem services value of $654.87 per beef cow or $0.78 of ecosystem services per pound of retail beef. In summary, beef cattle ranching in New York is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF NEW YORK BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$22.86	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$16.96	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	18,433,000	(USFWS)
Economic Value Per Day	$147.79	(USFWS)
Hunting Economic Value	$2,724,186,624	
Fresh Water Fishing Days	19,200,000	(USFWS)
Economic Value Per Day	$62.57	(USFWS)
Fishing Economic Value	$1,201,294,498	
Wildlife Watching Days	22,814,000	(USFWS)
Economic Value Per Day	$29.13	(USFWS)
Watching Economic Value	$664,485,437	
Total Wildlife Value	$4,589,966,559	
Habitat Acres	27,676,876	(EPS - NonUrban)
Wildlife Value Per Acre	$165.84	
Total Value Per Acre	$205.66	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	136,185	(2012 Census of Ag)
Total Value Per Acre	$205.66	
Cattle Ranching Economic Value	$28,007,962	
Cattle Ranching Economic Value	$28,007,962	
Beef Cows	42,769	(2012 Census of Ag)
Economic Value Per Beef Cow	$654.87	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.78	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Ohio

INTRODUCTION

The 2012 Census of Agriculture classified 11,445 agricultural operations in Ohio as beef cattle ranches (USDA, 2014). These ranches managed 1.1 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 23 acres of non-urban land in the state and supported nearly 141,600 head of beef cows in 2012. The production from these ranches generated $332.5 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Ohio was estimated to be $4.9 billion. Ohio beef cattle ranches also employed more than 35,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Ohio beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Ohio. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Ohio since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 51 percent of the beef cows in Ohio, there is another 49 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Ohio beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Ohio are estimated to be $24.85, $19.72, and $92.40 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $136.97 per acre of pasture and rangeland. Applying this per acre value to the 384,140 acres of pasture and rangeland used by beef cattle ranches in Ohio for beef production results in an estimated $52.6 million in total ecosystem services provided annually. This represents an ecosystem services value of $371.61 per beef cow or $0.44 per pound of retail beef. In summary, beef cattle ranching in Ohio is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF OHIO BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$24.85	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$19.72	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	8,967,000	(USFWS)
Economic Value Per Day	$46.39	(USFWS)
Hunting Economic Value	$415,944,984	
Fresh Water Fishing Days	14,040,000	(USFWS)
Economic Value Per Day	$121.90	(USFWS)
Fishing Economic Value	$1,711,456,311	
Wildlife Watching Days	6,251,000	(USFWS)
Economic Value Per Day	$34.52	(USFWS)
Watching Economic Value	$215,784,250	
Total Wildlife Value	$2,343,185,545	
Habitat Acres	25,357,960	(EPS - NonUrban)
Wildlife Value Per Acre	$92.40	
Total Value Per Acre	$136.97	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	384,140	(2012 Census of Ag)
Total Value Per Acre	$136.97	
Cattle Ranching Economic Value	$52,616,656	
Cattle Ranching Economic Value	$52,616,656	
Beef Cows	141,590	(2012 Census of Ag)
Economic Value Per Beef Cow	$371.61	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.44	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Oklahoma

INTRODUCTION

The 2012 Census of Agriculture classified 40,939 agricultural operations in Oklahoma as beef cattle ranches (USDA, 2014). These ranches managed 18.7 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every two acres of non-metro, non-urban land in the state and supported more than 1.3 million head of beef cows in 2012. The production from these ranches generated $2.4 billion of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Oklahoma was estimated to be $26.9 billion. Oklahoma beef cattle ranches also employed more than 127,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Oklahoma beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Oklahoma. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Oklahoma since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 79 percent of the beef cows in Oklahoma, there is another 21 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Oklahoma beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Oklahoma are estimated to be $12.92, $9.83, and $23.51 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $46.26 per acre of pasture and rangeland. Applying this per acre value to the 13.1 million acres of pasture and rangeland used by beef cattle ranches in Oklahoma for beef production results in an estimated $606.3 million in total ecosystem services provided annually. This represents an ecosystem services value of $457.60 per beef cow or $0.54 per pound of retail beef. In summary, beef cattle ranching in Oklahoma is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF OKLAHOMA BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$12.92	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$9.83	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	4,968,000	(USFWS)
Economic Value Per Day	$60.41	(USFWS)
Hunting Economic Value	$300,116,505	
Fresh Water Fishing Days	8,499,000	(USFWS)
Economic Value Per Day	$49.62	(USFWS)
Fishing Economic Value	$421,741,100	
Wildlife Watching Days	3,084,000	(USFWS)
Economic Value Per Day	$28.05	(USFWS)
Watching Economic Value	$86,498,382	
Total Wildlife Value	$808,355,987	
Habitat Acres	34,387,098	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$23.51	
Total Value Per Acre	$46.26	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	13,106,864	(2012 Census of Ag)
Total Value Per Acre	$46.26	
Cattle Ranching Economic Value	$606,281,432	
Cattle Ranching Economic Value	$606,281,432	
Beef Cows	1,324,911	(2012 Census of Ag)
Economic Value Per Beef Cow	$457.60	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.54	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Oregon

INTRODUCTION

The 2012 Census of Agriculture classified 11,420 agricultural operations in Oregon as beef cattle ranches (USDA, 2014). These ranches managed 8.2 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every six acres of non-metro, non-urban land in the state and supported more than 418,100 head of beef cows in 2012. The production from these ranches generated $643.4 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Oregon was estimated to be $9.8 billion. Oregon beef cattle ranches also employed more than 38,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Oregon beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Oregon. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Oregon since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 83 percent of the beef cows in Oregon, there is another 17 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Oregon beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Oregon are estimated to be $10.93, $9.37, and $20.86 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $41.17 per acre of pasture and rangeland. Applying this per acre value to the 6.2 million acres of pasture and rangeland used by beef cattle ranches in Oregon for beef production results in an estimated $254.4 million in total ecosystem services provided annually. This represents an ecosystem services value of $608.44 per beef cow or $0.72 per pound of retail beef. In summary, beef cattle ranching in Oregon is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF OREGON BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$10.93	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$9.37	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	2,205,000	(USFWS)
Economic Value Per Day	$99.24	(USFWS)
Hunting Economic Value	$218,834,951	
Fresh Water Fishing Days	5,201,000	(USFWS)
Economic Value Per Day	$74.43	(USFWS)
Fishing Economic Value	$387,129,450	
Wildlife Watching Days	7,268,000	(USFWS)
Economic Value Per Day	$55.02	(USFWS)
Watching Economic Value	$399,857,605	
Total Wildlife Value	$1,005,822,006	
Habitat Acres	48,208,878	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$20.86	
Total Value Per Acre	$41.17	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	6,180,019	(2012 Census of Ag)
Total Value Per Acre	$41.17	
Cattle Ranching Economic Value	$254,401,432	
Cattle Ranching Economic Value	$254,401,432	
Beef Cows	418,123	(2012 Census of Ag)
Economic Value Per Beef Cow	$608.44	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.72	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Pennsylvania

INTRODUCTION

The 2012 Census of Agriculture classified 7,665 agricultural operations in Pennsylvania as beef cattle ranches (USDA, 2014). These ranches managed 798,211 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 34 acres of non-urban land in the state and supported nearly 60,800 head of beef cows in 2012. The production from these ranches generated $343.6 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Pennsylvania was estimated to be $4.3 billion. Pennsylvania beef cattle ranches also employed more than 24,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Pennsylvania beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Pennsylvania. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Pennsylvania since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 41 percent of the beef cows in Pennsylvania, there is another 59 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Pennsylvania beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Pennsylvania are estimated to be $43.74, $32.16, and $53.94 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $129.85 per acre of pasture and rangeland. Applying this per acre value to the 182,023 acres of pasture and rangeland used by beef cattle ranches in Pennsylvania for beef production results in an estimated $23.6 million in total ecosystem services provided annually. This represents an ecosystem services value of $388.84 per beef cow or $0.46 per pound of retail beef. In summary, beef cattle ranching in Pennsylvania is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF PENNSYLVANIA BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$43.74	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$32.16	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	18,247,000	(USFWS)
Economic Value Per Day	$55.02	(USFWS)
Hunting Economic Value	$1,003,880,259	
Fresh Water Fishing Days	8,906,000	(USFWS)
Economic Value Per Day	$35.60	(USFWS)
Fishing Economic Value	$317,042,071	
Wildlife Watching Days	9,554,000	(USFWS)
Economic Value Per Day	$17.26	(USFWS)
Watching Economic Value	$164,901,834	
Total Wildlife Value	$1,485,824,164	
Habitat Acres	27,544,310	(EPS - NonUrban)
Wildlife Value Per Acre	$53.94	
Total Value Per Acre	$129.85	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	182,023	(2012 Census of Ag)
Total Value Per Acre	$129.85	
Cattle Ranching Economic Value	$23,634,872	
Cattle Ranching Economic Value	$23,634,872	
Beef Cows	60,783	(2012 Census of Ag)
Economic Value Per Beef Cow	$388.84	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.46	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Rhode Island

INTRODUCTION

The 2012 Census of Agriculture classified 154 agricultural operations in Rhode Island as beef cattle ranches (USDA, 2014). These ranches managed 7,016 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 88 acres of non-urban land in the state and supported more than 400 head of beef cows in 2012. The production from these ranches generated $894,000 of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Rhode Island was estimated to be $119.7 million. Rhode Island beef cattle ranches also employed more than 400 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Rhode Island beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Rhode Island. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Rhode Island since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 29 percent of the beef cows in Rhode Island, there is another 71 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Rhode Island beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Rhode Island are estimated to be $25.60, $19.74, and $169.59 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $214.93 per acre of pasture and rangeland. Applying this per acre value to the 1,548 acres of pasture and rangeland used by beef cattle ranches in Rhode Island for beef production results in an estimated $332,705 in total ecosystem services provided annually. This represents an ecosystem services value of $801.70 per beef cow or $0.95 per pound of retail beef. In summary, beef cattle ranching in Rhode Island is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF RHODE ISLAND BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$25.60	(NASS Pastureland Rental Rate)(a)
Ecosystem Services (Per Acre)	$19.74	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	419,000	(USFWS)
Economic Value Per Day	$105.72	(USFWS)
Hunting Economic Value	$44,295,577	
Fresh Water Fishing Days	739,000	(USFWS)
Economic Value Per Day	$15.10	(USFWS)
Fishing Economic Value	$11,160,734	
Wildlife Watching Days	1,230,000	(USFWS)
Economic Value Per Day	$39.91	(USFWS)
Watching Economic Value	$49,093,851	
Total Wildlife Value	$104,550,162	
Habitat Acres	616,502	(EPS - NonUrban)
Wildlife Value Per Acre	$169.59	
Total Value Per Acre	$214.93	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	1,548	(2012 Census of Ag)
Total Value Per Acre	$214.93	
Cattle Ranching Economic Value	$332,705	
Cattle Ranching Economic Value	$332,705	
Beef Cows	415	(2012 Census of Ag) (b)
Economic Value Per Beef Cow	$801.70	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.95	

(a) Based on the average for Massachusetts and Vermont

(b) Based on ratio of total cows and heifers calved to total beef cows

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - South Carolina

INTRODUCTION

The 2012 Census of Agriculture classified 5,851 agricultural operations in South Carolina as beef cattle ranches (USDA, 2014). These ranches managed 826,232 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 23 acres of non-urban land in the state and supported more than 114,100 head of beef cows in 2012. The production from these ranches generated $76.4 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in South Carolina was estimated to be $3.0 billion. South Carolina beef cattle ranches also employed more than 16,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of South Carolina beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in South Carolina. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in South Carolina since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 68 percent of the beef cows in South Carolina, there is another 32 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of South Carolina beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in South Carolina are estimated to be $18.89, $16.24, and $33.27 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $68.39 per acre of pasture and rangeland. Applying this per acre value to the 324,418 acres of pasture and rangeland used by beef cattle ranches in South Carolina for beef production results in an estimated $22.2 million in total ecosystem services provided annually. This represents an ecosystem services value of $194.44 per beef cow or $0.23 per pound of retail beef. In summary, beef cattle ranching in South Carolina is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF SOUTH CAROLINA BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$18.89	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$16.24	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	4,353,000	(USFWS)
Economic Value Per Day	$37.76	(USFWS)
Hunting Economic Value	$164,352,751	
Fresh Water Fishing Days	9,221,000	(USFWS)
Economic Value Per Day	$30.20	(USFWS)
Fishing Economic Value	$278,519,957	
Wildlife Watching Days	4,254,000	(USFWS)
Economic Value Per Day	$47.46	(USFWS)
Watching Economic Value	$201,915,858	
Total Wildlife Value	$644,788,565	
Habitat Acres	19,383,269	(EPS - NonUrban)
Wildlife Value Per Acre	$33.27	
Total Value Per Acre	$68.39	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	324,418	(2012 Census of Ag)
Total Value Per Acre	$68.39	
Cattle Ranching Economic Value	$22,186,106	
Cattle Ranching Economic Value	$22,186,106	
Beef Cows	114,101	(2012 Census of Ag)
Economic Value Per Beef Cow	$194.44	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.23	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - South Dakota

INTRODUCTION

The 2012 Census of Agriculture classified 8,288 agricultural operations in South Dakota as beef cattle ranches (USDA, 2014). These ranches managed 16.5 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every three acres of non-metro, non-urban land in the state and supported nearly 930,200 head of beef cows in 2012. The production from these ranches generated $1.9 billion of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in South Dakota was estimated to be $15.4 billion. South Dakota beef cattle ranches also employed more than 27,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of South Dakota beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in South Dakota. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in South Dakota since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 58 percent of the beef cows in South Dakota, there is another 42 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of South Dakota beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in South Dakota are estimated to be $24.85, $9.22, and $11.73 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $45.81 per acre of pasture and rangeland. Applying this per acre value to the 13.0 million acres of pasture and rangeland used by beef cattle ranches in South Dakota for beef production results in an estimated $596.2 million in total ecosystem services provided annually. This represents an ecosystem services value of $640.97 per beef cow or $0.76 per pound of retail beef. In summary, beef cattle ranching in South Dakota is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF SOUTH DAKOTA BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$24.85	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$9.22	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	3,742,000	(USFWS)
Economic Value Per Day	$76.59	(USFWS)
Hunting Economic Value	$286,604,099	
Fresh Water Fishing Days	4,069,000	(USFWS)
Economic Value Per Day	$32.36	(USFWS)
Fishing Economic Value	$131,682,848	
Wildlife Watching Days	1,559,000	(USFWS)
Economic Value Per Day	$50.53	(USFWS) (a)
Watching Economic Value	$78,774,383	
Total Wildlife Value	$497,061,330	
Habitat Acres	42,375,712	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$11.73	
Total Value Per Acre	$45.81	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	13,016,616	(2012 Census of Ag)
Total Value Per Acre	$45.81	
Cattle Ranching Economic Value	$596,228,513	
Cattle Ranching Economic Value	$596,228,513	
Beef Cows	930,191	(2012 Census of Ag)
Economic Value Per Beef Cow	$640.97	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.76	

(a) Based on 2006 data adjusted to 2016$

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Tennessee

INTRODUCTION

The 2012 Census of Agriculture classified 34,457 agricultural operations in Tennessee as beef cattle ranches (USDA, 2014). These ranches managed 5.0 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every three acres of non-metro, non-urban land in the state and supported more than 760,100 head of beef cows in 2012. The production from these ranches generated $693.5 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Tennessee was estimated to be $19.6 billion. Tennessee beef cattle ranches also employed more than 101,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Tennessee beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Tennessee. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Tennessee since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 87 percent of the beef cows in Tennessee, there is another 13 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Tennessee beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Tennessee are estimated to be $19.88, $16.11, and $105.32 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $141.31 per acre of pasture and rangeland. Applying this per acre value to the 2.2 million acres of pasture and rangeland used by beef cattle ranches in Tennessee for beef production results in an estimated $306.4 million in total ecosystem services provided annually. This represents an ecosystem services value of $403.10 per beef cow or $0.48 per pound of retail beef. In summary, beef cattle ranching in Tennessee is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF TENNESSEE BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$19.88	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$16.11	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	9,846,000	(USFWS)
Economic Value Per Day	$89.31	(USFWS) (a)
Hunting Economic Value	$879,313,749	
Fresh Water Fishing Days	16,957,000	(USFWS)
Economic Value Per Day	$43.48	(USFWS) (a)
Fishing Economic Value	$737,260,870	
Wildlife Watching Days	6,424	(USFWS)
Economic Value Per Day	$25.89	(USFWS)
Watching Economic Value	$166,317	
Total Wildlife Value	$1,616,740,935	
Habitat Acres	15,350,478	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$105.32	
Total Value Per Acre	$141.31	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	2,168,359	(2012 Census of Ag)
Total Value Per Acre	$141.31	
Cattle Ranching Economic Value	$306,408,261	
Cattle Ranching Economic Value	$306,408,261	
Beef Cows	760,126	(2012 Census of Ag)
Economic Value Per Beef Cow	$403.10	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.48	

(a) Based on 2006 data adjusted to 2016$

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Texas

INTRODUCTION

The 2012 Census of Agriculture classified more than 127,726 agricultural operations in Texas as beef cattle ranches (USDA, 2014). These ranches managed 78.3 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented two out of every three acres of non-metro, non-urban land in the state and supported 3.6 million head of beef cows in 2012. The production from these ranches generated $4.3 billion of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Texas was estimated to be $129.2 billion. Texas beef cattle ranches also employed more than 393,000 workers including operators, hired labor, and family labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Texas beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Texas. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Texas since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 82 percent of the beef cows in Texas, there is another 18 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Texas beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Texas are estimated to be $6.56, $5.47, and $36.62 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $48.65 per acre of pasture and rangeland. Applying this per acre value to the 65.6 million acres of pasture and rangeland used by beef cattle ranches in Texas for beef production results in an estimated $3.2 billion in total ecosystem services provided annually. This represents an ecosystem services value of $892.22 per beef cow or $1.06 per pound of retail beef. In summary, beef cattle ranching in Texas is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1.VALUE OF TEXAS BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$6.56	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$5.47	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	20,372,000	(USFWS)
Economic Value Per Day	$103.56	(USFWS)
Hunting Economic Value	$2,109,721,683	
Fresh Water Fishing Days	22,616,000	(USFWS)
Economic Value Per Day	$79.83	(USFWS)
Fishing Economic Value	$1,805,376,483	
Wildlife Watching Days	11,840,000	(USFWS)
Economic Value Per Day	$37.76	(USFWS)
Watching Economic Value	$447,033,441	
Total Wildlife Value	$4,362,131,607	
Habitat Acres	119,129,581	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$36.62	
Total Value Per Acre	$48.65	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	65,593,996	(2012 Census of Ag)
Total Value Per Acre	$48.65	
Cattle Ranching Economic Value	$3,190,872,065	
Cattle Ranching Economic Value	$3,190,872,065	
Beef Cows	3,576,336	(2012 Census of Ag)
Economic Value Per Beef Cow	$892.22	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$1.06	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Utah

INTRODUCTION

The 2012 Census of Agriculture classified 5,231 agricultural operations in Utah as beef cattle ranches (USDA, 2014). These ranches managed 3.3 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 11 acres of non-metro, non-urban land in the state and supported nearly 267,400 head of beef cows in 2012. The production from these ranches generated $292.3 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Utah was estimated to be $5.5 billion. Utah beef cattle ranches also employed close to 20,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Utah beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Utah. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching-based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Utah since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 69 percent of the beef cows in Utah, there is another 31 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Utah beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Utah are estimated to be $4.77, $4.97, and $24.90 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $34.64 per acre of pasture and rangeland. Applying this per acre value to the 2.7 million acres of pasture and rangeland used by beef cattle ranches in Utah for beef production results in an estimated $93.0 million in total ecosystem services provided annually. This represents an ecosystem services value of $347.86 per beef cow or $0.41 per pound of retail beef. In summary, beef cattle ranching in Utah is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1.VALUE OF UTAH BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$4.77	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$4.97	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	2,720,000	(USFWS)
Economic Value Per Day	$130.53	(USFWS)
Hunting Economic Value	$355,037,756	
Fresh Water Fishing Days	5,979,000	(USFWS)
Economic Value Per Day	$66.88	(USFWS)
Fishing Economic Value	$399,889,968	
Wildlife Watching Days	5,169,000	(USFWS)
Economic Value Per Day	$35.60	(USFWS)
Watching Economic Value	$184,009,709	
Total Wildlife Value	$938,937,433	
Habitat Acres	37,712,616	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$24.90	
Total Value Per Acre	$34.64	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	2,685,305	(2012 Census of Ag)
Total Value Per Acre	$34.64	
Cattle Ranching Economic Value	$93,015,192	
Cattle Ranching Economic Value	$93,015,192	
Beef Cows	267,394	(2012 Census of Ag)
Economic Value Per Beef Cow	$347.86	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.41	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Virginia

INTRODUCTION

The 2012 Census of Agriculture classified 18,149 agricultural operations in Virginia as beef cattle ranches (USDA, 2014). These ranches managed 3.7 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every six acres of non-urban land in the state and supported nearly 511,200 head of beef cows in 2012. The production from these ranches generated $643.7 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Virginia was estimated to be $15.8 billion. Virginia beef cattle ranches also employed more than 55,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Virginia beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Virginia. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Virginia since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 78 percent of the beef cows in Virginia, there is another 22 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Virginia beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Virginia are estimated to be $19.88, $15.54, and $53.31 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $88.73 per acre of pasture and rangeland. Applying this per acre value to the 1.6 million acres of pasture and rangeland used by beef cattle ranches in Virginia for beef production results in an estimated $144.9 million in total ecosystem services provided annually. This represents an ecosystem services value of $283.46 per beef cow or $0.34 per pound of retail beef. In summary, beef cattle ranching in Virginia is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1.VALUE OF VIRGINIA BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$19.88	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$15.54	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	10,060,000	(USFWS)
Economic Value Per Day	$57.17	(USFWS)
Hunting Economic Value	$575,167,206	
Fresh Water Fishing Days	7,904,000	(USFWS)
Economic Value Per Day	$34.52	(USFWS)
Fishing Economic Value	$272,845,739	
Wildlife Watching Days	4,552,000	(USFWS)
Economic Value Per Day	$71.20	(USFWS)
Watching Economic Value	$324,090,615	
Total Wildlife Value	$1,172,103,560	
Habitat Acres	21,986,296	(EPS - NonUrban)
Wildlife Value Per Acre	$53.31	
Total Value Per Acre	$88.73	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	1,633,083	(2012 Census of Ag)
Total Value Per Acre	$88.73	
Cattle Ranching Economic Value	$144,899,851	
Cattle Ranching Economic Value	$144,899,851	
Beef Cows	511,179	(2012 Census of Ag)
Economic Value Per Beef Cow	$283.46	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.34	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Vermont

INTRODUCTION

The 2012 Census of Agriculture classified 862 agricultural operations in Vermont as beef cattle ranches (USDA, 2014). These ranches managed 114,307 acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 45 acres of non-metro, non-urban land in the state and supported more than 5,100 head of beef cows in 2012. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Vermont was estimated to be $435.8 million. Vermont beef cattle ranches also employed more than 2,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Vermont beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Vermont. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Vermont since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 45 percent of the beef cows in Vermont, there is another 55 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Vermont beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Vermont are estimated to be $24.35, $16.06, and $51.45 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $91.86 per acre of pasture and rangeland. Applying this per acre value to the 21,606 acres of pasture and rangeland used by beef cattle ranches in Vermont for beef production results in an estimated $2.0 million in total ecosystem services provided annually. This represents an ecosystem services value of $386.30 per beef cow or $0.46 per pound of retail beef. In summary, beef cattle ranching in Vermont is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1.VALUE OF VERMONT BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$24.35	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$16.06	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	1,584,000	(USFWS)
Economic Value Per Day	$85.22	(USFWS)
Hunting Economic Value	$134,990,291	
Fresh Water Fishing Days	2,215,000	(USFWS)
Economic Value Per Day	$29.13	(USFWS)
Fishing Economic Value	$64,514,563	
Wildlife Watching Days	2,602,000	(USFWS)
Economic Value Per Day	$25.89	(USFWS)
Watching Economic Value	$67,365,696	
Total Wildlife Value	$266,870,550	
Habitat Acres	5,187,255	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$51.45	
Total Value Per Acre	$91.86	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	21,606	(2012 Census of Ag)
Total Value Per Acre	$91.86	
Cattle Ranching Economic Value	$1,984,805	
Cattle Ranching Economic Value	$1,984,805	
Beef Cows	5,138	(2012 Census of Ag)
Economic Value Per Beef Cow	$386.30	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.46	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Washington

INTRODUCTION

The 2012 Census of Agriculture classified 9,008 agricultural operations in Washington as beef cattle ranches (USDA, 2014). These ranches managed 2.3 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 18 acres of non-urban land in the state and supported nearly 145,200 head of beef cows in 2012. The production from these ranches generated $253.7 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Washington was estimated to be $5.5 billion. Washington beef cattle ranches also employed nearly 29,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Washington beef cattle ranching based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Washington. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching-based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Washington since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 68 percent of the beef cows in Washington, there is another 32 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Washington beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Washington are estimated to be $7.95, $10.14, and $24.07 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $42.17 per acre of pasture and rangeland. Applying this per acre value to the 1.6 million acres of pasture and rangeland used by beef cattle ranches in Washington for beef production results in an estimated $69.1 million in total ecosystem services provided annually. This represents an ecosystem services value of $476.02 per beef cow or $0.57 per pound of retail beef. In summary, beef cattle ranching in Washington is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1.VALUE OF WASHINGTON BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$7.95	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$10.14	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	2,547,000	(USFWS)
Economic Value Per Day	$37.76	(USFWS)
Hunting Economic Value	$96,165,049	
Fresh Water Fishing Days	10,940,000	(USFWS)
Economic Value Per Day	$46.39	(USFWS)
Fishing Economic Value	$507,464,941	
Wildlife Watching Days	9,641,000	(USFWS)
Economic Value Per Day	$44.23	(USFWS)
Watching Economic Value	$426,408,846	
Total Wildlife Value	$1,030,038,835	
Habitat Acres	42,785,090	(EPS - NonUrban)
Wildlife Value Per Acre	$24.07	
Total Value Per Acre	$42.17	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	1,638,702	(2012 Census of Ag)
Total Value Per Acre	$42.17	
Cattle Ranching Economic Value	$69,100,799	
Cattle Ranching Economic Value	$69,100,799	
Beef Cows	145,163	(2012 Census of Ag)
Economic Value Per Beef Cow	$476.02	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.57	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Wisconsin

INTRODUCTION

The 2012 Census of Agriculture classified 10,241 agricultural operations in Wisconsin as beef cattle ranches (USDA, 2014). These ranches managed 1.2 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every 20 acres of non-metro, non-urban land in the state and supported more than 107,900 head of beef cows in 2012. The production from these ranches generated $657.8 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Wisconsin was estimated to be $5.1 billion. Wisconsin beef cattle ranches also employed more than 31,500 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Wisconsin beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Wisconsin. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching-based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Wisconsin since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 43 percent of the beef cows in Wisconsin, there is another 57 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Wisconsin beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Wisconsin are estimated to be $39.76, $22.78, and $62.81 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $125.35 per acre of pasture and rangeland. Applying this per acre value to the 252,354 acres of pasture and rangeland used by beef cattle ranches in Wisconsin for beef production results in an estimated $31.6 million in total ecosystem services provided annually. This represents an ecosystem services value of $293.14 per beef cow or $0.35 per pound of retail beef. In summary, beef cattle ranching in Wisconsin is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1.VALUE OF WISCONSIN BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$39.76	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$22.78	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	12,177,000	(USFWS)
Economic Value Per Day	$53.94	(USFWS)
Hunting Economic Value	$656,796,117	
Fresh Water Fishing Days	19,950,000	(USFWS)
Economic Value Per Day	$34.52	(USFWS)
Fishing Economic Value	$688,673,139	
Wildlife Watching Days	6,080,000	(USFWS)
Economic Value Per Day	$33.44	(USFWS)
Watching Economic Value	$203,322,546	
Total Wildlife Value	$1,548,791,802	
Habitat Acres	24,658,488	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$62.81	
Total Value Per Acre	$125.35	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	252,354	(2012 Census of Ag)
Total Value Per Acre	$125.35	
Cattle Ranching Economic Value	$31,633,620	
Cattle Ranching Economic Value	$31,633,620	
Beef Cows	107,913	(2012 Census of Ag)
Economic Value Per Beef Cow	$293.14	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.35	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - West Virginia

INTRODUCTION

The 2012 Census of Agriculture classified 9,430 agricultural operations in West Virginia as beef cattle ranches (USDA, 2014). These ranches managed 2.0 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one out of every five acres of non-metro, non-urban land in the state and supported nearly 157,100 head of beef cows in 2012. The production from these ranches generated $202.1 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in West Virginia was estimated to be $5.0 billion. West Virginia beef cattle ranches also employed more than 29,000 workers including operators, hired labor, and unpaid labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of West Virginia beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in West Virginia. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching-based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in West Virginia since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 82 percent of the beef cows in West Virginia, there is another 18 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of West Virginia beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in West Virginia are estimated to be $12.43, $8.25, and $58.51 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $79.18 per acre of pasture and rangeland. Applying this per acre value to the 770,410 acres of pasture and rangeland used by beef cattle ranches in West Virginia for beef production results in an estimated $61.0 million in total ecosystem services provided annually. This represents an ecosystem services value of $388.31 per beef cow or $0.46 per pound of retail beef. In summary, beef cattle ranching in West Virginia is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1.VALUE OF WEST VIRGINIA BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$12.43	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$8.25	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	3,166,000	(USFWS)
Economic Value Per Day	$50.70	(USFWS)
Hunting Economic Value	$160,519,957	
Fresh Water Fishing Days	4,521,000	(USFWS)
Economic Value Per Day	$40.99	(USFWS)
Fishing Economic Value	$185,326,861	
Wildlife Watching Days	3,648,000	(USFWS)
Economic Value Per Day	$67.96	(USFWS)
Watching Economic Value	$247,922,330	
Total Wildlife Value	$593,769,148	
Habitat Acres	10,148,647	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$58.51	
Total Value Per Acre	$79.18	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	770,410	(2012 Census of Ag)
Total Value Per Acre	$79.18	
Cattle Ranching Economic Value	$60,999,661	
Cattle Ranching Economic Value	$60,999,661	
Beef Cows	157,089	(2012 Census of Ag)
Economic Value Per Beef Cow	$388.31	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.46	

The Economic Value of Beef Cattle Ranching Based Ecosystem Services - Wyoming

INTRODUCTION

The 2012 Census of Agriculture classified 4,365 agricultural operations in Wyoming as beef cattle ranches (USDA, 2014). These ranches managed 20.8 million acres of land, excluding grazing lands used under government permits if leased on a per Animal Unit Month basis. This land represented about one in every three acres of non-metro, non-urban land in the state and supported more than 573,800 head of beef cows in 2012. The production from these ranches generated $899.5 million of gross revenue. The value of land, buildings, machinery, and equipment associated with beef cattle ranches in Wyoming was estimated to be $12.6 billion. Wyoming beef cattle ranches also employed more than 17,000 workers including operators, hired labor, and family labor in 2012.

However, the economic value of beef cattle production is just one component of the suite of values derived from beef cattle ranching. Beef cattle ranching provides a flow of ecosystem services that may not be available from alternative land uses. Additional economic values associated with beef cattle ranching include ecosystem goods and services such as recreation opportunities, wildlife habitat, and preservation of open space. The purpose of this report is to summarize, to the extent possible, the economic value of Wyoming beef cattle ranching-based ecosystem services. This project was funded by the National Cattlemen's Beef Association as a contractor for the Beef Checkoff Program and is part of a project looking at ecosystem services from beef cattle ranching across the U.S.

METHODOLOGY

Ecosystem services are typically grouped into four broad categories: 1) provisioning, such as production of food and water; 2) regulating, such as control of climate and disease; 3) supporting, such as nutrient cycles and crop pollination; and 4) cultural, such as spiritual and recreation benefits. Pogue et al. (2018) found that beef cattle ranching in Canada's prairie provinces had a positive influence on eight ecosystem services including biodiversity, habitat maintenance, cultural heritage, food production, non-food production, air quality regulations, soil quality regulation, and recreation and tourism. Comprehensively quantifying the economic values of all of these attributes is difficult because many of these ecosystem service attributes are not traded in a formal market; however, building on the work by Rashford et al. (2013), estimating the economic value of several major aspects of beef cattle ranching-based ecosystem services is possible using readily available data.

Specifically, this report provides estimates of the ecosystem service values of forage production, general ecosystem services such as open space, and wildlife recreation from pasture and rangeland used for beef cattle production in Wyoming. Forage production values are based on National Agricultural Statistics Service (NASS) pasture rental rate data (NASS, 2017). General ecosystem services values are based on the United States Department of Agriculture's (USDA) Farm Service Agency Conservation Reserve Program (CRP) – Grasslands annual rental payments to program participants for maintaining ecosystem functions on grasslands (FSA, 2018). Wildlife recreation values are based on U.S. Fish and Wildlife Service (USFWS) estimates of hunting days, fresh water fishing days (excluding Great Lakes fishing), and wildlife watching days for individual states (USFWS, 2014). These recreation use estimates were combined with USFWS estimates of net economic values for wildlife-related recreation (USFWS, 2016) to estimate the ecosystem values of wildlife recreation on a per acre basis. The estimates of net economic values represent statewide average value to participants from wildlife-related recreation. The combined per acre value estimates from above were translated into ecosystem service estimates for beef cattle ranching based on the acres of pasture and rangeland used in beef cattle production. All dollar amounts are expressed in 2016 dollars. Results are presented in terms of the total value of ecosystem services as well as values per beef cow and per pound of retail beef.

The following results represent a conservative estimate of the value of ecosystem services from beef production in Wyoming since they only consider beef production on agricultural operations classified as beef cattle ranches. While this represents 86 percent of the beef cows in Wyoming, there is another 14 percent of beef cows found on a variety of other types of agricultural operations. Unfortunately, data limitations precluded the valuation of the ecosystem services from the beef production on these non-cattle ranch operations.

RESULTS

Table 1 summarizes the value of Wyoming beef cattle ranching-based ecosystem services. The per acre economic values of ecosystem services in terms of forage production, general ecosystem services, and wildlife recreation from pasture and rangeland in Wyoming are estimated to be $4.77, $3.83, and $13.25 per acre, respectively. Combining these three values yields an estimated total economic value of ecosystem services for beef cattle ranching of $21.85 per acre of pasture and rangeland. Applying this per acre value to the 19.2 million acres of pasture and rangeland used by beef cattle ranches in Wyoming for beef production results in an estimated $420.5 million in total ecosystem services provided annually. This represents an ecosystem services value of $732.80 per beef cow or $0.87 per pound of retail beef. In summary, beef cattle ranching in Wyoming is economically important not only from a beef production standpoint but also from the provision of ecosystem services.

TABLE 1. VALUE OF WYOMING BEEF CATTLE RANCHING ECOSYTEM SERVICES

Forage Production (Per Acre)	$4.77	(NASS Pastureland Rental Rate)
Ecosystem Services (Per Acre)	$3.83	(CRP - Grassland Reserve Rental Rate)
Wildlife		
Hunting Days	1,726,000	(USFWS)
Economic Value Per Day	$171.52	(USFWS)
Hunting Economic Value	$296,045,307	
Fresh Water Fishing Days	3,123,000	(USFWS)
Economic Value Per Day	$75.51	(USFWS)
Fishing Economic Value	$235,825,243	
Wildlife Watching Days	3,125,000	(USFWS)
Economic Value Per Day	$73.35	(USFWS)
Watching Economic Value	$229,234,088	
Total Wildlife Value	$761,104,639	
Habitat Acres	57,426,117	(EPS - NonMetro & NonUrban)
Wildlife Value Per Acre	$13.25	
Total Value Per Acre	$21.85	
Beef Cattle Ranching (NAICS 1121110)		
Pasture & Rangeland (Acres)	19,244,065	(2012 Census of Ag)
Total Value Per Acre	$21.85	
Cattle Ranching Economic Value	$420,499,165	
Cattle Ranching Economic Value	$420,499,165	
Beef Cows	573,823	(2012 Census of Ag)
Economic Value Per Beef Cow	$732.80	
LBS of Beef Production Per Cow	840	(LMIC)
Economic Value Per LBS of Beef	$0.87	

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