

Appendix B:

Ecosystem Service Valuation (ECONorthwest, 2012)

Forests and woodlands provide air quality benefits from purification and pollutant removal. The table below shows the kilograms of pollutant removal by forests and woodland per acre, per year and the economic value of those pollutants in avoided health care costs.

Annual Quantity and Value of Pollutant Removal by Forests and Woodlands (2011\$)

Pollutant	Annual Kilograms Removed per Acre	Annual Value per Ton	Annual Value per Acre
CO	2.03	\$1,403	\$3
NO ²	3.65	\$4,039–\$9,875	\$15–\$36
O ³	14.57	\$2,019–\$9,875	\$29–\$144
PM ¹⁰	10.53	\$6,593	\$69
SO ²	2.83	\$2,418–\$9,546	\$7–\$27

Source: ECONorthwest, 2012

The table below provides estimated values for key ecosystem services that wetlands provide. The table presents values associated with wetlands that were assumed to provide only a single type of service. The range of values associated with single-service wetlands is about \$2–\$9,669 per acre per year. In many cases wetlands provide multiple services; however, the values cannot simply be added up and an estimate for multiple services was not made.

The next set of rows estimates the values associated with ecosystem services provided by both native and restored wetlands. The way the ecosystem services are combined in this section combine more of the single-services into larger categories. For example, recreation can include fishing, bird hunting, bird watching, amenity, etc. The values in the second set of rows are additive.

Value of Ecosystem Services Associated with Wetlands (2011\$/Acre/Year)

Single-Service Wetlands		
Single-Service Wetland Type	Mean Value	Range of Values
Flood	\$676	\$153-\$3,007
Quality	\$718	\$2,177-\$2,372
Quantity	\$219	\$10-\$4,425
Recreational Fishing	\$614	\$163-\$2,310
Commercial Fishing	\$1,339	\$186-\$9,669
Bird Hunting	\$120	\$43-\$339
Bird Watching	\$2,086	\$909-\$4,788
Amenity	\$5	\$2-\$24
Habitat	\$527	\$163-\$1,688
Storm	\$408	\$19-\$8,850
Ecosystem Service	Native Wetlands	Restored Wetlands

Gas regulation	\$128	\$93
Disturbance regulation	\$15,300	\$15,300
Water supply	\$1,424	\$1,424
Nutrient cycling	\$7,706	\$5,780
Commodities	\$2,907	\$2,907
Biodiversity	\$185	\$163
Recreation	\$1,744	\$1,744
Total	\$29,394	\$27,410

Source: Woodward, R., and Y. Wui. 2001. "The Economic Value of Wetland Services: A Meta-Analysis." *Ecological Economics* 37: 257-270; Dodds, W. K. Wilson, R. Rehmeier, et al. 2008. "Comparing Ecosystem Goods and Services Provided by Restored and Native Lands." *BioScience* 58(9):837-845.

Shrublands and grasslands provide air quality benefits from purification and pollutant removal. The table below shows the annual per acre pollutant removal by shrublands and grasslands and a range of economic values of those pollutants in avoided health care costs.

Annual Quantity and Value of Pollutant Removal by Shrubland and Grassland (2011\$)

Pollutant	Annual Kilograms Removed per Acre	Annual Value per Ton	Annual Value per Acre
CO	0.79	\$0—\$1,403	\$1
NO ²	1.45	\$4,039—\$9,875	\$6—\$14
O ³	6.05	\$2,019—\$9,875	\$12—\$60
PM ¹⁰	4.34	\$0—\$6,593	\$29
SO ²	1.18	\$2,418—\$9,546	\$3—\$11

Source: ECONorthwest

Economic research has shown that people place a considerable value on the continued survival of sensitive species, such as those listed as threatened or endangered. Such studies also suggest that the value associated with protecting threatened, endangered, and rare species ranges from an annual payment of \$11 per household to a one-time payment of nearly \$400 per household.

Willingness to Pay to Protect Threatened, Endangered, and Rare Species

Studies Reporting Annual Values		
	Average Value	Range of Values
Bald eagle	\$43.51	\$23.43-\$50.21
Owl	\$72.52	\$43.51-\$145.05
Salmon/Steelhead	\$90.38	\$11.16-\$155.09
Whooping Crane	\$62.48	\$49.09-\$76.99
Woodpecker	\$17.85	\$14.50-\$22.32
Studies Reporting Lump Sum Values		
	Average Value	Range of Values
Arctic grayling	\$25.66	\$22.32-\$29.01
Bald eagle	\$331.38	\$273.36-\$390.52
Falcon	\$35.70	-

Source: ECONorthwest, 2012 (taken from Richardson and Loomis,. 2009)

It is important to note that willingness to pay a different measure than estimating the economic value associated with maintaining individual species and biodiversity. For example, the courts have interpreted Congress to say that the value of threatened and endangered species is incalculable (TVA v. Hill).