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- 188 A market price of US\$6 per kg was used for 2000 and 2015. Although declines in productivity (and associated harvest) would tend to reduce supply and could lead to price increases, overfishing of reefs will also result in catches of smaller and less valuable fish, which would tend to offset any increase in price.
- 189 Fishing costs vary widely between the U.S. and developing countries within the region, ranging between 20 and 90 percent. Kearney and Centaur (Kearney and Centaur. 1984. "Economic Impact of the Commercial Fishing Industry in the Gulf of Mexico and South Atlantic Regions." *Final Report 8318 to the Gulf and South Atlantic Fisheries Development Foundation, Inc*) suggest returns in U.S. fisheries ranging between 11 and 36 percent. Pomeroy (*Economic Analysis for the Siting of Marine Protected Areas: A Case Study in the British Virgin Islands*, unpublished) found returns of about 80 percent in the British Virgin Islands. We chose 50 percent net return as an average for the region.
- 190 World Travel and Tourism Council (WTTC), *Caribbean Travel & Tourism - A World of Opportunity: The 2003 Travel & Tourism Economic Research* (London, UK: WTTC, 2003). International tourism receipts contribute more than 10 percent of GDP in Caribbean countries overall.
- 191 Pattullo (1996).
- 192 Tourism receipt data from CTO (2002) and Development Data Group, The World Bank, *World Development Indicators 2002* (Washington, D.C.: The World Bank, 2002); data on the value of the tourism economy from WTTC (2003).
- 193 WTTC (2003).
- 194 Pendleton (1994).
- 195 E. Green and R. Donnelly. 2003. "Recreational Scuba Diving in the Caribbean Marine Protected Areas: Do the Users Pay?" *Ambio* 32 (2): 140-144. This study focused on diving outside of the United States. As much of the diving in Florida is in marine protected areas (MPAs), the statistic seems valid for the broader region.
- 196 Based on data in Green and Donnelly (2003); G. M. Johns, V.R. Leeworthy, F. W. Bell, and M. A. Bonn, *Socioeconomic Study of Reefs in Southeast Florida: Final Report* (Hazen and Sawyer, Florida State University, and National Oceanic and Atmospheric Administration, 2001). Online at <http://marineconomics.noaa.gov>.
- 197 Diving outside of the United States generated an estimated \$4.1 billion in 2000, which is 17 percent of total international tourism receipts, excluding the United States. (See Appendix A, Table A4.)
- 198 Cline Group 1997. "Diving Industry Consumer Study." Online at <http://www.cline-group.net/diving>.
- 199 Visitor expenditure for 2000 derived from Table 55 in CTO (2002), p. 101.
- 200 CTO (2002), p. 101; supported by Cline Group (1997).
- 201 The estimate of numbers of divers in the region and associated gross revenue is based on integration and cross-tabulation of several data sources. Two market survey reports provided detailed information on divers from the United States: Cline Group. 1995. "Diving Manufacturer and Travel Industry Retailer Study" and Cline Group. 1997. "Diving Industry Consumer Study". Both online at <http://www.cline-group.net/diving>. These data were supplemented with information from personal communication with William R. Cline (November, 2003); CTO (2002); Pattullo (1996); Green and Donnelly (2003); Johns et al (2001).
- 202 Ibid.
- 203 Ibid.
- 204 Johns et al. (2001). (4.5 million person days of scuba diving in South Florida contributed an estimated US\$625 million in expenditures and 16,000 jobs. 4.2 million person days of snorkeling contributed an estimated US\$340 million in expenditures and 7,400 jobs.)
- 205 Net benefits from tourism and the multiplier used were adapted from H. Cesar, P. Beukering and G. Berdt Romilly, *Mainstreaming Economic Valuation in Decision Making: Coral Reef Examples in Selected CARICOM-Countries* (Arnhem, The Netherlands: World Bank and ARCADIS Euroconsult, 2003) Their analysis used "value added of direct expenditures" of 25–40 percent and a multiplier of 25 percent.
- 206 PADI certifies most of the world's scuba divers. During the 1990s, dive certification increased at an average of 7 percent a year. Online at <http://www.padi.com/english/common/padi/statistics/3.asp>.
- 207 Burke et al. (2000).
- 208 H. Berg et al. 1998. "Environmental Economics of Coral Reef Destruction in Sri Lanka," in *Ambio* 27 (8): 627–634.
- 209 G. Chambers. 1997. "Beach Changes in the Eastern Caribbean Islands: Hurricane Impacts and Implications for Climate Change." *Journal of Coastal Research Special Issue* 24:29–47.
- 210 Ibid.
- 211 Shorelines—World Vector Shoreline (E.A. Soluri and V.A. Woodson. 1990. "World Vector Shoreline". *International Hydrographic Review*, LXVII(1)) and NIMA. 1997. "VMAP National boundaries". Land areas of 100 hectares minimum were identified, and the associated shoreline was converted into a GRID for the analysis. Coral Reefs— See Appendix B for data sources.
- 212 To estimate the economic value of the shoreline protection services provided along these coastlines, we relied on earlier studies (H. Cesar, ed., *Collected Essays on the Economics of Coral Reefs* (Kalmar, Sweden: CORDIO, 2000); Cesar, Burke, and Pet-Soede (2003)) and estimates of past expenditures for artificial replacement of this protection (Berg (1998); S.J. Williams, K. Dodd, and K.K. Gohn. 1995. "Coast in Crisis." *US Geological Survey Circular* 1075; Herman Cesar, personal communication). These estimates ranged from about US\$50,000 to US\$800,000 or more for each km of coastline protected by coral reefs.
- 213 Assumptions of the degree of loss of shoreline protection function provided by coral reefs were made by the Reefs at Risk project based upon input from project partners. Information from the literature on this topic is quite limited. Reefs under low threat are assumed to provide 100 percent of their current coastal protection service; reefs under medium and high threat are assumed to provide 90 percent and 80 percent of current service, respectively.
- 214 Shoreline segments were assigned the threat category of the nearest reef. About two-thirds (67 percent) of shoreline areas were near high-threat reefs, 18 percent were near medium-threat reefs, and 16 percent were near low-threat reefs. Shoreline near high- and medium-threat reefs (a total of 84 percent) were assumed to experience a reduction in shoreline protection services. The estimate of loss in coastal protection function is based on cross-tabulation of estimates of level of development along a given shoreline area and threat estimate of the nearest coral reef.
- 215 A. Bruckner. 2002. "Life-Saving Products from Coral Reefs." *Issues in Science and Technology* 18 (3): 39-44.
- 216 Cesar, Burke, and Pet-Soede (2003).
- 217 E. Chivian, C. Roberts, and A. Bernstein. 2003. "The Threat to Cone Snails." Letter to *Science* 302, p.391.
- 218 Cesar, Burke, and Pet-Soede (2003).