

## 7. ECONOMIC VALUATION

The marine economy in Massachusetts is constantly evolving as it adapts to changing demands for products and services, and supply of natural resources. Over one third of the population in Massachusetts lives along the 1500 km (932 mile) coastline and this serves as a driver that is exerting pressure on coastal and ocean ecosystem health and services. The marine economic sectors in Massachusetts include Commercial Seafood, Transportation, Coastal Tourism and Recreation, Marine Science and Technology, and Marine-related Construction and Infrastructure.

An economic valuation of the marine environment is based on the marine services it provides. Ecosystem services are defined as all benefits that humans receive from ecosystems (Daly 1997). The benefits of marine ecosystems, which include open ocean, coastal environment, and estuaries, can be direct (*e.g.*, food production) or indirect, through the functioning of ecosystem processes that produce the direct services. Ecosystem services are critical to the function of coastal systems and contribute significantly to human well-being, representing a significant portion of the total economic value of the marine environment. According to Agardy *et al.* (2005), the best available data indicates that marketed and non-marketed marine ecosystem services have substantial economic value.

The total economic value (TEV) of marine ecosystem services is the sum of the values of direct use resources, indirect use resources, and nonuse resources. Non-use resource value is made up of option value, existence value, and bequest value. Goods and services may be valued for potential future benefits which constitute an option value (a person's willingness-to-pay to have that resource available in the future). The concept of option value is rather controversial as it can refer to use and/or non-use resource valuation. Existence value reflects benefits from simply knowing that a certain good or service exists. People may be willing to pay for protection of species' habitats, even those located in remote, hard to access areas that they may never visit. Bequest value refers to benefits derived from ensuring that certain goods will be preserved for future generations. For example, people concerned with future damages from global warming may be willing to pay to reduce them, despite the fact that the vast majority of the damage is expected to affect the earth long after they are gone.

The Millennium Ecosystem Assessment (Agardy *et al.* 2005) classifies marine ecosystem services into four categories:

Provisioning - include food, water, minerals, and pharmaceuticals. More than a billion people worldwide rely on fish as their main source of protein. Fisheries and associated industries employ 38 million people directly, and support 162 million indirectly;

Regulating - benefits accrued from regulation of ecosystem processes, climate regulation, flood regulation, disease regulation. Coastal wetlands play an important role in water quality regulation by capturing and filtering sediments and organic wastes in transit from inland regions to the ocean.

42 Cultural - include recreational, aesthetic, and spiritual benefits. Coastal tourism is the fastest-growing  
43 sector of the global tourism industry, and is a major part of the economies of many small island  
44 developing nations. The cultures and traditions of many coastal peoples are intimately tied to the  
45 marine ecosystems on which they depend.

46  
47 Supporting - include photosynthesis and nutrient cycling, which support other ecosystems. Coastal  
48 habitats such as seagrass beds and mangroves are important nursery areas for fishes and invertebrates  
49 that support coastal communities and commercial and recreational fisheries.

50

## 51 **ECONOMIC IMPACT OF THE MARINE ECONOMY IN MASSACHUSETTS**

52 The maritime economy generated \$14.8 billion in Massachusetts in 2004, including \$6.1 billion in  
53 secondary output impacts (jobs created in the rest of the state through functioning of the maritime  
54 economy) (Donahue Institute 2006).

55

56 The coastal tourism and recreation sector is the largest of the marine-related business, making up  
57 70% of marine business and employing 79% of people in marine-related businesses. However, it also  
58 offers the lowest wages. The marine science and technology sector, on the other hand, is one of the  
59 smallest businesses but has the highest wages (MOTT 2007). Marine economy employment has a  
60 moderate impact on job creation, with a multiplier effect of 1.47 (*i.e.*, one job generates 0.47 jobs).  
61 Marine transportation and marine science and technology have the highest multiplier effects--2.83  
62 and 2.27, respectively.

63

64 The linkages among the various economic sectors affect the amount of revenue generated within the  
65 local economy. Output impact is defined as the dollar value of the total production of a particular  
66 industry (Donahue Institute 2006). Based on data from the U.S. Bureau of Census, the U.S. Bureau  
67 of Economic Analysis and the U.S. Bureau of Labor Statistics, the Donahue Institute calculated that  
68 the marine industry in Massachusetts brings in an input of 152,441 employees and generates an  
69 output of \$14.8 billion, with a multiplier effect of 1.70 in 2004.

70

## 71 **EMPLOYMENT**

72 Thirty-seven percent of the workforce in Massachusetts is employed in maritime sectors which are of  
73 special value to the coastal communities that depend on these industries. In 2004, the gross state  
74 product (GSP) of the coastal economy was \$117 billion, or 37% of the GSP for all of Massachusetts  
75 (Donahue Institute 2006). Over 78% of employees in marine related industries are employed in the  
76 coastal tourism and recreation sector, followed by marine-related construction and infrastructure  
77 (10%) and commercial seafood (7%).

78

79 In the past, the marine-related construction and the commercial seafood sectors contributed  
80 relatively more to the Commonwealth's workforce. However, a decrease in demand by the U.S.  
81 Navy, improvements in productivity of the offshore oil and gas industry, as well as an increase in  
82 shipping efficiency and productivity to meet cargo demands have resulted in a reduction in the  
83 shipbuilding industry, formerly a major employer in New England. Over the last decades there has  
84 also been a tendency for the U.S. maritime economy to shift away from extractive sectors, such as

85 the mineral industry and commercial fishing, toward the service/tourism industry (Colgan 2003). The  
86 service industry operates at lower wages and the shift to these lower-paying jobs presents an  
87 economic challenge to coastal states. Further, increasing residential and commercial development has  
88 caused an increase in real estate value as well as increasing pressure on rapidly diminishing  
89 undeveloped land and natural ecosystems, thereby placing maritime jobs in jeopardy. The transition  
90 from traditional maritime to recreational industries, together with a concomitant increase in property  
91 values, may be the cause of additional pressure on development of coastal lands (MOMTF 2004).

92

### 93 **TRANSPORTATION**

94 Although transportation is not the largest sector in the marine industry in Massachusetts, it is an  
95 important contributor to the economy and includes transportation of foreign and domestic freight,  
96 passengers, towing and tugboat services, as well as marine pipeline and gas transmission. In 2004, just  
97 over 2000 individuals were employed in marine transportation in Massachusetts. This sector  
98 generated \$529 million, almost 50% from secondary output impacts (Donahue Institute 2006).  
99 Marine transportation contributed only 3% of the total marine industry employment in  
100 Massachusetts. About 75% came from passenger transportation (41%) and scenic and sightseeing  
101 transportation (35%). Despite the low input to the marine industry economy in Massachusetts,  
102 marine transportation has the highest multiplier (2.83) within the marine industry (Donahue Institute  
103 2006)

104

105 There are seven major customs ports in Massachusetts: Boston, Gloucester, Salem, New Bedford,  
106 Fall River, Plymouth, and Provincetown. Exports and imports increased state-wide between 1997  
107 and 2004. However, port calls and port capacity have decreased between 2002 and 2004. This could  
108 have been the reason for the decline in foreign container imports by 50% since 1997. While port  
109 capacity in Boston decreased, general cargo capacity increased by 600%. As for the other ports,  
110 variations in weight and value also occurred, with decreases by 90% for Fall River and Gloucester.  
111 New Bedford saw a decrease in trade by weight by 50% and an increase in value of 500% (Donahue  
112 Institute 2006). Marine Transportation may be impacted by changes in transportation costs as well as  
113 channel depth. Channel depth limits growth in volume and weight traded. As vessels are becoming  
114 larger to transport greater volumes, navigational channel depth becomes a determining factor that  
115 has economic impacts (as discussed in the Transportation section of Chapter 6 Human Uses).

116

### 117 **COASTAL TOURISM AND RECREATION**

118 The tourism and recreation sector employed 125,800 individuals in 2006. The sector comprises three  
119 subsectors: food, entertainment and recreation, and accommodations. Seventy-three percent of the  
120 people employed in this sector are in food service, 15% are in jobs related to accommodations, and  
121 11% are in the entertainment and recreation sector. Although the tourism and recreation sector is the  
122 largest in the marine industry in terms of the number of establishments, number of employees, and  
123 total wages paid, the average salary is the lowest of all sectors. Altogether, \$14.2 billion were  
124 generated in this sector in 2006, an increase of 8.6% over 2005. This represented 2% of all U.S. direct  
125 expenditures (\$699.9 billion). Fifty-four percent of the visitors were from New England and 20%  
126 from the mid-Atlantic States. The 1.7 million international visitors were mainly from Canada, the

127 UK, and Germany and accounted for 11.4% of money spent by visitors, indicating an increase of  
128 16.6% over 2005 (MOTT 2007).

129

130 The top industries that benefited from tourists were transportation (43.7%), accommodation  
131 (22.6%), food (19.0%), and entertainment and recreation (6.1%). Sixty-nine percent of visitors  
132 traveled by car (MOTT 2007). This sector has the lowest employment multiplier effect of the marine  
133 industry (1.32), generating insignificant amounts of additional demand for goods and services within  
134 the state. However, due to its extensive size, the number of jobs it creates is over 70% of total jobs in  
135 the marine industry and the total output generated is the highest of all sectors (\$8.72 billion) in the  
136 state (Donahue Institute 2006).

137

138 Activities associated with this sector include recreational boating, saltwater angling, wildlife watching,  
139 and beach visits. At least 20% of visitors to Massachusetts visit Cape Cod and the Islands, second  
140 only to Boston. Cape Cod has many coastal resources that make it attractive to visitors, mainly its  
141 beaches and bays. The main activities in which Massachusetts residents participate are swimming  
142 (44%), coastal viewing (34%), boating (19%), and diving (3%). Whale watching is a popular activity as  
143 a result of the proximity of Stellwagen Bank, with annual revenue of about \$25 million (\$21 million  
144 in 1996).

145

146 In 2007 12,875,568 recreational vessels were registered in the U.S. including motor boats, sail boats,  
147 canoes and kayaks, and rowboats. According to the Massachusetts Marine Trades Association, the  
148 total number of recreational vessels registered in Massachusetts is close to 186,000. The total number  
149 of motor boats in the U.S. is 11,966,627 (USCG 2007). Massachusetts ranks 29<sup>th</sup> with 145,496 motor  
150 boats registered in 2007, down from 148,640 in 2006 (USCG 2007). During the summer, as many as  
151 195,000 residents go boating during the weekend (in fresh and salt water). Boat owners in this state  
152 spend \$192,917,000 per year on new boats, engines, trailers, and accessories (MMTA 2008). The  
153 Donahue Institute study projected that recreational boat ownership has an employment multiplier of  
154 1.37 and a spending multiplier of 1.33. The net effect on local communities from peripheral spending  
155 was \$1,338,750,000 in 2007 (MMTA 2008).

156

157 An important aspect of recreational boating is the number of businesses and trades associated with it,  
158 including boat yards, marinas, boat manufacturing, sales and transportation, canvas makers, charters  
159 and excursions, dock management, harbor masters, marine surveyors and yacht brokers. In 2005, the  
160 Urban Harbors Institute conducted a study of marine trades in the south coast of Massachusetts. The  
161 study indicated that 77% of those surveyed were concerned about the lack of qualified engineers and  
162 that this was having a significant impact on marine businesses.

163

164 There are 64 marinas and about 25,000 permitted public slips and moorings used for recreational  
165 boating along the coastline of Massachusetts. In addition, there are an estimated 10,000 privately  
166 maintained slips, moorings, and docks.

167

168 **COMMERCIAL AND RECREATIONAL SEAFOOD**

169 Massachusetts has always been a leading state in the fisheries sector. The commercial seafood sector  
170 comprises commercial fishing, seafood processing, and wholesale industries and employs 11,270  
171 people in Massachusetts. Since the Fishery Conservation and Management Act extended the nation's  
172 Exclusive Economic Zone to 37 km (20 nautical miles) in 1976, landing values have gone up from  
173 \$239 million to \$377 million in 1987, down to \$210 million in 1998 and back up to \$296 million in  
174 2004. A gross state product of \$1.6 billion was generated in 2004 (Donahue Institute 2006).

175  
176 The commercial fishing industry in Massachusetts is one of the most valuable in the U.S. Scallops,  
177 lobsters, and groundfish species are responsible for the highest revenue. Commercial and recreational  
178 fishing in Massachusetts employ over 80,000 and contribute \$2 billion to the economy, including fish  
179 sales (25%) and fishing support services (12%), including fuel, bait, ice, food, insurance, mortgage).  
180 In Massachusetts 157,992 tonnes (174,156 tons) worth \$437,048,000 and 137,443 tonnes (151,505  
181 tons) worth \$417,495,000 were landed in 2006 and 2007 respectively (Van Voorhees 2007). The top  
182 seaports in 2007 were New Bedford (122 million kg or 268 million lb), Gloucester (21.2 million kg or  
183 46.8 million lb) and Provincetown-Chatham (8.26 million kg or 18.2 million lb).

184  
185 Scallops and lobsters constitute the highest value of shellfish landings. Scallops in particular, have  
186 allowed the port of New Bedford to prosper in comparison to other Massachusetts ports. Between  
187 1995 and 1999, the value of lobster was higher than scallops, but by 2004 the number of scallops  
188 landed soared to yield \$133 million in 2004 versus \$50 million for lobster. In 2004, the total value of  
189 scallops and lobster was more than 50% of total landing, compared to \$16 million for cod, mainly  
190 due to the amount of scallops caught and fishery regulations restricting cod catches (Donahue  
191 Institute 2006). A total of 12,915 commercial and recreational permits were issued for lobsters  
192 statewide in 2005, a decrease of 2.5% from 2004. Total landings went down slightly from 5,349,986  
193 kg (11,784,110 lb) in 2004 to 5,175,551 kg (11,399,893 lb) in 2005, but value increased from  
194 \$53,028,494 to \$57,227,464 over the same years (Dean *et al.* 2007).

195  
196 Decreasing fish stocks and increasing restrictions have caused the Massachusetts fishing industry to  
197 suffer and the effects are felt mostly by fishing communities. Ports such as Gloucester, where  
198 commercial fishing is the primary economic activity, are affected the hardest. Various industries  
199 directly and indirectly associated with fishing are affected, and this increase in pressure causes a shift  
200 in the economic base of the community. This not only affects the economy directly, through loss of  
201 market value, but also through loss of important cultural resources.

202  
203 One sector that is affected by decreasing fish stocks and fish landings is fish processing. Employment  
204 in the fish processing sector declined as the number of plants decreased from 144 in 1976 to 50 in  
205 2003. At the same time, employment in the seafood wholesale sector increased from 868 in 1976 to  
206 2,779 in 2000, though there has been a decline over the past few years. In 2004, less than 50% of the  
207 11,270 people were employed in fishing but they gained more than half the wages - mainly  
208 commercial fishermen versus workers in retail and aquaculture. The economic output indicated \$1  
209 billion in fresh, frozen, and canned fish sales to supermarkets, food services, and restaurants,  
210 generating \$329 million and \$307 million in indirect and induced effects respectively (Georgianna  
211 2000). Since 1980, per capita consumption of seafood rose from 5.7 kg (12.5 lb) to 7.5 kg (16.6 lb)

212 though the value has remained constant since 1998. Moreover seafood prices have increased less  
213 than for other food products, which could impact income and employment.

214  
215 Over the past 15 years, recreational fishing has expanded to be the second most valuable in the U.S.,  
216 especially for striped bass. Marine anglers in Massachusetts spent \$850 million in 1998 (Steinback and  
217 Gentner 2001). Fifty-five percent of 1 million people who participated in marine recreational fishing  
218 in 2002 were Massachusetts residents. In 2006, 7,049,258 kg (15,527,000 lb) were caught but this  
219 number decrease slightly in 2007 when 6,096,312 kg (13,428,000 lb) were caught. The number of  
220 anglers in Massachusetts who are residents exceed the number that are from out of state. In total,  
221 there were 1,267 and 1,308 anglers in Massachusetts in 2006 and 2007 respectively (Van Voorhees  
222 2007). The amount of lobster landing decreased by 1.5% from 2004 to 2005 for recreational permits  
223 (Dean *et al.* 2007).

224

## 225 **AQUACULTURE**

226 Aquaculture is the smallest sector in the seafood industry, employing 267 individuals in 2004 and  
227 accounting for less than 3% of the seafood catch in Massachusetts. The industry depends mainly on  
228 hard shell clams and oysters, while soft shell steamers, razor and surf clams, bay and sea scallops, and  
229 blue mussels are gathered for a lesser demand. Although it is a relatively small industry compared to  
230 Maine and Connecticut, aquaculture in Massachusetts generated \$3.6 million in 2002. Eighty percent  
231 of aquaculture takes places on Cape Cod, with the South and North Shores experiencing the greatest  
232 increase since 2000. Aquaculture of finfish and shellfish generated 375 million tonnes (413 million  
233 tons) worth \$1,115,115,000 in 2005 and 360 million tonnes (397 million tons) worth \$1,244,145,000  
234 in 2006 (Van Voorhees 2007).

235

## 236 **MARINE SCIENCE AND TECHNOLOGY**

237 This industry includes the construction of marine instruments, research and environmental services  
238 and employs about 5,000 people – 59% in marine engineering and technical services, 29% in  
239 production of instrumentation and 10% in ship and boat building and repair. Moreover, 1,530  
240 individuals worked in academic programs in marine science research institutions in 2004. The main  
241 uses are mapping projects, monitoring, and surveying for offshore drilling. Users include industries  
242 such as commercial fishing, maritime shipping and transportation, environmental services, education,  
243 and research. In 2004, the annual production output for this sector in Massachusetts was \$1.2 billion.

244

245 Massachusetts is considered one of the top ten states with a high concentration of the marine science  
246 and technology industry (Barrow *et al.* 2005). All the components of this sector play a key role in  
247 several marine activities and industries. Marine instrument and equipment includes instruments for  
248 use in oceanographic and geophysical research and remote sensing activities. Electronic  
249 instrumentation and platforms used in ship navigation, underwater research, and communications are  
250 also important. Other subsectors include design of software and systems to run navigational  
251 equipment and conduct monitoring; marine engineering and consulting groups; suppliers of marine  
252 materials such as paint, engines, machinery and riggings; onshore marine activities; shipbuilding and  
253 design; research; and education. The study conducted by Barrow *et al.* (2005) estimated employment

254 in Massachusetts in this sector to be 22,396 jobs with a total annual impact of \$2.9 billion (1% of the  
255 GSP).

256

## 257 **MARINE-RELATED CONSTRUCTION AND INFRASTRUCTURE**

258 This sector is the second largest marine industry component in Massachusetts and includes heavy  
259 construction such as coastal and offshore infrastructure, administration of management programs,  
260 and real estate development. This sector generates only 10% of employment but wages are twice the  
261 industry average. Seventy-seven percent of the 15,000 people employed within this sector are  
262 involved in housing construction, while 23% are employed in marine-related development. Almost  
263 12,000 jobs were created from secondary impacts in 2004. The sector employment multiplier is 1.82,  
264 and 1.56 for output. In total, \$2.8 billion was generated from this sector in 2004.

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