

## **Tracking shifts in the vulnerability and resiliency of commercial fishing vessel crew and hired captains in New England and the Mid-Atlantic**

Matthew Cutler, Ph.D.\*

Northeast Fisheries Science Center  
National Oceanic and Atmospheric Administration  
Woods Hole, Massachusetts, USA

Angela Silva, M.A.

ECS Federal Inc.

*In support of:*

NOAA Fisheries, Northeast Fisheries Science Center, Social Sciences Branch  
28 Tarzwell Dr. Narragansett, RI, USA

Lauren Gentile, Ph.D.

Climate Science and Impacts Branch  
U.S. Environmental Protection Agency  
Washington, D.C., USA

Lisa Colburn, Ph.D.

Northeast Fisheries Science Center  
National Oceanic and Atmospheric Administration  
Woods Hole, Massachusetts, USA

\*Corresponding Author: [matthew.cutler@noaa.gov](mailto:matthew.cutler@noaa.gov)

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

1 Title: Tracking shifts in the vulnerability and resiliency of commercial fishing vessel crew and  
2 hired captains in New England and the Mid-Atlantic

4 Abstract:

5 Commercial fisheries are important to the social, cultural, and economic well-being of coastal  
6 communities throughout the New England and Mid-Atlantic regions of the United States.  
7 Fishing vessel crew and hired captains comprise a significant portion of fishing industry  
8 employment, yet very few studies have inquired about the social and demographic characteristics  
9 of the individuals who make up this segment of the industry. Moreover, virtually no data exists  
10 that tracks the characteristics of crew and hired captains over time in order to capture trends in  
11 socio-demographics, employment, and fishing practices, among other factors. This study is a  
12 follow-up to a baseline survey conducted in 2012 by the National Oceanic and Atmospheric  
13 Administration's (NOAA) Northeast Fisheries Science Center (NEFSC). During late 2018 and  
14 early 2019, NEFSC staff conducted interviews with commercial fishing vessel crew and hired  
15 captains at ports from Maine to North Carolina. Interviewers asked respondents questions  
16 regarding their demographic background, the availability of work, and fishing trip  
17 characteristics, among other topics of interest related to employment in commercial fishing.  
18 Results indicate an increasing fragility of fishing communities in the region related to the aging  
19 of fishing crews and low levels of new individuals entering into the occupation, in addition to  
20 other social and economic vulnerabilities of commercial crews and hired captains.

22 Keywords: commercial fishermen, commercial fishing industry, vulnerability, resilience

1  
2  
3  
4 24 1. Introduction

5  
6 25 Commercial fisheries are socio-economically and culturally important to many  
7  
8  
9 26 communities throughout the New England and Mid-Atlantic regions of the United States. In  
10  
11 27 2017, commercial landings of all fish species in these two regions were valued at over \$1.8  
12  
13 28 billion in total revenue<sup>1</sup>. According to the most recent Fisheries Economics of the United States  
14  
15 29 report (FEUS) published by the National Oceanic and Atmospheric Administration (NOAA),  
16  
17 30 commercial fisheries in New England and the Mid-Atlantic provide nearly 140,000 jobs and  
18  
19 31 contribute more than \$3.7 billion in value to the gross domestic product of the two regions  
20  
21 32 combined (NMFS 2018a). New England, in particular, boasts the highest value port in the nation,  
22  
23 33 New Bedford, MA, which in 2020 had landings worth approximately \$377 million (NMFS  
24  
25 34 2021a). Economic value, however, is not the only indicator, nor is it even sufficient, for  
26  
27 35 characterizing the dependence of communities on commercial fishing activities. Communities  
28  
29 36 may have ports with relatively low economic value compared to others in the region or the  
30  
31 37 nation, but still have a substantial number of individuals, businesses, and organizations that are  
32  
33 38 highly dependent upon commercial fisheries for their livelihoods and well-being. For example,  
34  
35 39 according to NOAA Fisheries' Community Social Vulnerability Indicators (CSVIs)<sup>2</sup>, Stonington  
36  
37 40 and Portland, ME both rank highly in commercial fishing engagement, but Stonington is also  
38  
39 41 very highly reliant on commercial fishing for sustaining its local economy due to its small  
40  
41 42 population size and rural character. Portland has a larger population size with a more diverse  
42  
43 43 economy and ranks low in reliance on commercial fishing activities.

44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56 \_\_\_\_\_  
57 <sup>1</sup> This figure comes from the latest data made publicly available by the National Marine Fisheries Service (NMFS).  
58 Statistics by region were queried at <https://foss.nmfs.noaa.gov/apexfoss/f?p=215:200:::>

59 <sup>2</sup> The Community Social Vulnerability Indicators (CSVIs) developed by NOAA Fisheries include indices of  
60 commercial fishing engagement and reliance that measure communities' relative levels of activity in and  
61 dependence upon the commercial fishing industry (Jepson and Colburn 2013).  
62  
63  
64  
65

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

44 As important as place-based metrics of commercial fishing dependence can be, there is  
45 also a critical need for more information about the social and economic characteristics of the  
46 individuals who participate in the industry. Econometric and geospatial representations of the  
47 commercial fishing industry are not sufficient to capture the full extent of the human dimensions  
48 of the fishing industry. For example, very little data exists on even basic socioeconomic  
49 information about commercial fishing vessel crews and hired captains (hereafter referred to as  
50 commercial crews). Only a handful of region-specific studies have been conducted (Henry and  
51 Olson 2014; Russell et al. 2014; Himes-Cornell et al. 2015; Steiner et al. 2018), and there are no  
52 federal requirements for crew licensing or a registry of crew information.

53 Following up on a baseline survey of commercial crew and hired captains conducted in  
54 2012 (Henry and Olson 2014), this study utilizes data from the second wave of the survey  
55 collected in 2018 and 2019 by social scientists at the NOAA Fisheries Northeast Fisheries  
56 Science Center (NEFSC) (Silva et al. 2021). This study is especially important given the  
57 requirement by the Magnuson-Stevens Fishery Conservation and Management Act (MSA) to  
58 consider the potential social, economic, and community impacts of fisheries management  
59 actions. The MSA National Standard 8 holds that management measures must, “take into  
60 account the importance of fishery resources to fishing communities by utilizing economic and  
61 social data... in order to: 1) Provide for the sustained participation of such communities; and 2)  
62 To the extent practicable, minimize adverse economic impacts on such communities,” (50 CFR §  
63 600.345(a)). The “fishing community” as defined by National Standard 8 includes, “fishing  
64 vessel owners, operators, and crew... that are based in such communities,” and is characterized  
65 by, “social or economic groups whose members reside in a specific location and share a common  
66 dependency on commercial, recreational, or subsistence fishing or on directly related fisheries-

1  
2  
3  
4 67 dependent services and industries,” (50 CFR § 600.345(b)). This research provides crucial data  
5  
6 68 that fills this specific need for information, namely the characteristics of fishing vessel crews that  
7  
8  
9 69 are based in commercial fishing communities. Data collected as part of this effort have been  
10  
11 70 used to inform social impact assessments of past fisheries management actions and will continue  
12  
13  
14 71 to be an important component to the policymaking process (NEFMC 2014; NEFMC 2016a;  
15  
16 72 NEFMC 2016b; NEFMC 2017; NEFMC 2020). This study contributes necessary information  
17  
18  
19 73 that has high practical utility in the fisheries policymaking setting, as well as novel data adding  
20  
21 74 to a growing body of literature on the social vulnerabilities of commercial fishing communities  
22  
23  
24 75 in the United States.  
25  
26 76

## 27 28 77 2. Review of Literature 29 30

31 78 Although commercial fishing vessel crews comprise perhaps the largest proportion of  
32  
33 79 commercial fishing employment in the United States, very little data exists on even basic  
34  
35  
36 80 demographic information for individuals in the occupation. The dearth of information about crew  
37  
38 81 is especially problematic because crew are particularly vulnerable to disruptions in employment  
39  
40  
41 82 and earning potential due to the multiple and interacting forces of fisheries management policy  
42  
43 83 change, environmental change, and broader social and economic transformations. For example,  
44  
45 84 results from a study of crew wages and well-being in the aftermath of the implementation of the  
46  
47  
48 85 West Coast Groundfish Trawl Catch Share Program revealed that crew job and pay satisfaction  
49  
50  
51 86 decreased despite evidence of modest increases in wages after the program went into place  
52  
53 87 (Steiner et al. 2018). These kinds of studies are rare and there are only a handful of routine  
54  
55 88 collections of data by the federal government on industry participants, which are generally  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

89 limited to only vessel owners or permit holders and even then may not include social information  
90 such as demographic or attitudinal characteristics (Cutler et al. 2017; NMFS 2021b).

91       Accessibility is one of the reasons it is difficult to track crew. Vessel owners and permit  
92 holders submit contact information as part of their registration or permit applications, making  
93 them more easily reachable and traceable over time (Clay et al. 2014; Cutler et al. 2017). By  
94 contrast, there are only a handful of state crew licensing programs and no contact database or  
95 registry of crew exists on the national or federal level (Macinko 2010; Pollnac et al. 2015).  
96 Therefore, methods to sample crew often require key informants, snowball sampling techniques,  
97 and walk-up “intercept” strategies for in-person interviews at the work site (e.g., ports where  
98 commercial fishing vessels are docked). These challenging sampling techniques may not enable  
99 random selection or representativeness by any particular category, such as demographic  
100 background, geographic location, or target fishery. Due to these challenges related to sampling  
101 and participant availability, it is even more critical to collect information on crew as regularly as  
102 possible in order to capture changes to the industry that are not reflected in federally-mandated  
103 vessel, permit, catch, and landings data.

104       One of the most critical factors to track over time is the age structure of commercial  
105 fishing crew employment. Crew age can be an indicator of the health of the industry overall  
106 because an older population of crew may signal that few young and new individuals have entered  
107 the occupation. There is extensive literature that has documented the phenomenon of an aging  
108 commercial fishing industry across the U.S., known as the “graying of the fleet,” (PFMC 2013;  
109 Russell et al. 2014; Donkersloot and Carothers 2016; Cramer et al. 2018; Johnson and Mazur  
110 2018). While graying of the fleet has been well documented in regions throughout the U.S., less  
111 is understood about specific factors that may contribute to this phenomenon. Some have found

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

evidence suggesting that fisheries management policies may influence the age structure of commercial fishing crews due to the consolidation of fishing fleets under new management regimes (Russell et al. 2014). Small-scale fishing businesses have been an important point of entry for young and new fishers (Andreatta & Parlier 2010), but business costs related to changes in fisheries management have resulted in fewer small-scale operations and thus fewer new crew participants in the industry overall (Rosvold 2006). For example, the transition to a catch share system in the Northeast Multispecies (also referred to as groundfish) Fishery Management Plan (FMP) led to substantial consolidation of the active fishing fleet. Between 2007 and 2015, the number of active vessels and vessel affiliations<sup>3</sup> earning revenue from groundfish declined by about 51% from 485 to 240 (Murphy et al. 2018). This coincided with an “overall negative trend in employment indicators in the period from 2007 to 2015 (Murphy et al. 2018),” which suggests that the availability of crew positions and earning opportunities for existing crew declined during the transition period as well. With reductions in employment and earning opportunities, there may have been fewer new and young entrants to the industry in recent years. This study helps address this critical gap in information on the age structure of commercial fishing crews in the New England and Mid-Atlantic U.S.

Educational attainment is another important potential source of social vulnerability among crew that is rarely tracked, yet can influence the social and economic mobility of those in the industry. This is especially critical given the potential for job displacement due to environmental, economic, and fishery management disruptions. Very few studies have assessed the level of educational attainment among commercial fishing crews in the U.S. A 2012 study of occupational risk perceptions among Maine commercial fishing vessel captains found that nearly

---

<sup>3</sup> “Vessel affiliations” refers to “the number of networks of vessels connected through one or more common vessel owners (Murphy et al. 2018).

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

134 70% had no college or technical training (Davis 2012). Similarly, the baseline survey wave for  
135 the current study found that about 76% of crew and hired captains sampled in the New England  
136 and Mid-Atlantic U.S. had not pursued education beyond the high school or equivalent level  
137 (Henry and Olson 2014). Post-secondary education, including college and professional degrees,  
138 is closely associated with increased income and lower unemployment. According to data from  
139 the 2015 Current Population Survey from the U.S. Bureau of Labor Statistics, individuals with  
140 professional degrees had three times the median weekly earnings and one-fifth the  
141 unemployment rate of those with less than a high school education (Vilorio 2016). Commercial  
142 crews have relatively high earnings compared to the portion of the general population with a  
143 similar level of educational attainment (Henry and Olson 2014; Vilorio 2016). However, their  
144 employment remains vulnerable to socioeconomic and environmental change and they may not  
145 be well situated to find employment in another occupation with similar earning potential to  
146 commercial fishing given their level of education. Therefore, tracking educational attainment  
147 over time among commercial fishing crews is critical to understand potential vulnerabilities to  
148 environmental or fisheries management changes.

149         Intergenerational involvement among families can be another important background  
150 characteristic among commercial fishing industry participants. Some of those involved in  
151 commercial fishing enter the industry because past generations of their families have been  
152 involved. This is not limited to working on a fishing vessel and may include immediate and  
153 extended family members working in shore-side support services, such as seafood dealers and  
154 auctions or bookkeeping and accounting. Indeed, the 2012 survey wave of the present study  
155 found that over half of crew and hired captains sampled reported having family involved in  
156 fishing, with a mean of about two generations in the industry (Henry and Olson 2014). However,



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

157 recent evidence suggests these familial linkages have weakened over time due to a confluence of  
158 fisheries management changes and the departure of youth from fishing communities, particularly  
159 those in rural or remote areas (Kitner 2006; Messick 2015; Donkersloot and Carothers 2016;  
160 Russell et al. 2014). There has also been evidence from the UK to suggest that intergenerational  
161 involvement likely varies by geographic location, where some fishing communities may be more  
162 likely to have families that assimilate their youth into the industry as an extension of local social  
163 and cultural milieus (Ota and Just 2008). Regardless of geographic variation, however, it is  
164 important to assess family involvement among commercial fishing crews in the New England  
165 and Mid-Atlantic regions because this can be a critical conduit for the entry of young and new  
166 fishers.

167           Finally, very few studies have attempted to investigate the extent of health insurance  
168 coverage among commercial fishing crews. This is especially problematic due to the extremely  
169 dangerous nature of commercial fishing and the chronic conditions, such as drug and alcohol  
170 abuse, cardiovascular illnesses, and excessive sun exposure that can arise from work-related  
171 stressors. According to the National Institute for Occupational Safety and Health (NIOSH), the  
172 fatality rate for the occupation of commercial fishing is 29 times higher than the national average  
173 (NIOSH 2019). There have also been dozens of studies since the mid-twentieth century that have  
174 documented various health risks, risk factors, and possible interventions to reduce risk and  
175 improve safety (NIOSH 2017). While the health implications of commercial fishing are well  
176 understood, little is known about access to health care and sources of health insurance coverage  
177 for commercial crews. The baseline 2012 study found that 41% of crew reported having no  
178 health insurance coverage in the past year, and the overwhelming majority of those who *did* have  
179 insurance reported purchasing a private plan receiving it from a spouse's or partner's plan, or

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

180 being on a federal or state program (Henry and Olson 2014). This study contributes important  
181 new information on the current state of health insurance coverage among commercial crews in  
182 New England and the Mid-Atlantic, which is critical to understanding social vulnerability among  
183 fishing industry participants and communities.

184 By investigating the demographic characteristics of commercial fishing crews in New  
185 England and the Mid-Atlantic, this research aims to address multiple questions about the  
186 structure and character of commercial fishing employment in the region. First, what are the  
187 current social and economic characteristics of commercial crews in New England and the Mid-  
188 Atlantic U.S.? Second, how have these characteristics changed over time? Third, has there been a  
189 “graying of the fleet,” as previous research has suggested in this and other regions? Finally, what  
190 are the potential vulnerabilities to change (i.e., social, economic, or environmental change)  
191 stemming from the social and economic conditions of commercial crews in New England and  
192 Mid-Atlantic regions? In answering these questions, this study fills multiple gaps in the extant  
193 literature and provides critical new information to support key stakeholders, including fisheries  
194 managers, scientists, and industry organizations, and non-profits.

### 196 3. Research Methods

197 This study relies on data from the second wave of a survey of commercial crews and  
198 hired captains in New England and Mid-Atlantic commercial fisheries conducted by social  
199 scientists at the NOAA NEFSC in 2018 (Silva et al. 2021). An overall sample size was  
200 calculated from estimates of employment in commercial fishing in the New England and Mid-  
201 Atlantic regions. There are no employment databases, registries, or other documentation of crew  
202 information to provide a sampling frame. Instead, estimates of employment in commercial

1  
2  
3  
4 203 fishing in New England and the Mid-Atlantic provided an approximation of the sampling frame  
5  
6 204 from which to calculate an appropriate sample size (Steinback and Thunberg 2006). The  
7  
8  
9 205 employment estimates come from data available through the software and data package  
10  
11 206 IMPLAN<sup>4</sup>. IMPLAN derives estimates of employment from three sources of 2014 data (the most  
12  
13  
14 207 recent available data): 1) Census County Business Patterns (CBP), 2) Bureau of Labor Statistics  
15  
16 208 (BLS) Covered Employment and Wages (CEW), and 3) Bureau of Economic Analysis (BEA)  
17  
18  
19 209 Regional Economic Accounts (REA). A target sample of 452 respondents was calculated using  
20  
21 210 Cochran's (1977) formula for categorical data with a 20% buffer to accommodate nonresponse  
22  
23  
24 211 due to the logistical challenges of the intercept method. This sample size calculation was based  
25  
26 212 on an estimated 21,616 individuals employed in commercial fishing in New England and the  
27  
28  
29 213 Mid-Atlantic.

30  
31 214         Since there is no database of contact information (i.e., phone, mail, or email address) for  
32  
33 215 commercial crew, an intercept strategy was the primary data collection method for both survey  
34  
35  
36 216 waves (Miller et al. 1997). Under the intercept approach, crew and hired captains were  
37  
38 217 approached and interviewed by trained staff on the docks and vessels at major commercial  
39  
40  
41 218 fishing ports throughout New England and the Mid-Atlantic. To establish a list of ports to visit  
42  
43 219 for intercepts, a quasi-random sample of fishing ports was selected from the universe of ports in  
44  
45  
46 220 the New England and Mid-Atlantic states. In order to ensure that the most active ports were  
47  
48 221 selected, a probability proportional to size (PPS) sampling method was used to add weight in the  
49  
50  
51 222 selection process to ports with more fishing activity. Under the PPS approach, a port's  
52  
53 223 probability of being selected into the sample is related to the "size" of the port, with larger ports  
54  
55 224 being more likely to be selected into the sample. The PPS approach was necessary to ensure that

---

59  
60  
61  
62  
63  
64  
65  
<sup>4</sup> Minnesota IMPLAN Group, 2014 IMPLAN System (data and software), 1725 Tower Drive West Suite 140,  
Stillwater, MN 55082 [www.implan.com](http://www.implan.com).

1  
2  
3  
4 225 selected ports were more active and thus, more likely to result in completed crew surveys. Port  
5  
6  
7 226 size was assessed using a commercial fishing engagement index from the 2014 Community  
8  
9 227 Social Vulnerability Indicators (see Jepsen and Colburn 2013). This index is reported by  
10  
11 228 community and is generated from a principal component factor analysis of variables associated  
12  
13  
14 229 with fishing activity. The “community level” here refers to data at the level of Census  
15  
16 230 Designated Place (CDP) or County Subdivision (MCD) nested within a set of counties  
17  
18  
19 231 designated as “coastal” by their connection to the ocean through a coastline, river, bay, or  
20  
21 232 estuary. The variables used to determine commercial fishing engagement included the number of  
22  
23  
24 233 commercial fishing permits, dealers with landings, the value of landings, and the total landings in  
25  
26 234 pounds. A sample of fifty CDPs and MCDs containing moderately and highly engaged ports  
27  
28  
29 235 throughout New England and the Mid-Atlantic was drawn using the PPS method. The 2012  
30  
31 236 wave included an additional level of sampling stratified by fishery, but the 2018 wave  
32  
33 237 discontinued the stratified approach due to a combination of logistical challenges, cost  
34  
35  
36 238 considerations, and a failure of the 2012 survey to achieve the desired response rates using the  
37  
38 239 stratified sampling approach by fishery.

40  
41 240 The 2018 survey began in the late summer of 2018 and lasted through the spring of 2019.  
42  
43 241 Respondents were asked a variety of questions regarding their demographic background and  
44  
45 242 commercial fishing activities and the full survey questionnaire is provided in the Supplementary  
46  
47  
48 243 Materials. This study utilizes survey questions asking respondents about their sociodemographic  
49  
50  
51 244 background, personal and family history in commercial fishing, fishing characteristics, and their  
52  
53 245 views about the future of the commercial fishing industry. Demographic background questions  
54  
55 246 included respondents’ age, income from fishing, educational attainment, race and ethnicity, and  
56  
57  
58 247 health insurance coverage status. Questions about respondents’ personal histories in commercial  
59  
60  
61  
62  
63  
64  
65

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

248 fishing included how many years they had been involved in commercial fishing themselves, how  
249 many years they have worked for their current vessel, and how they found employment on their  
250 current vessel. Questions regarding family histories in the industry included whether or not any  
251 family members are involved in commercial fishing and how many generations of their families  
252 have been involved in commercial fishing. Questions about fishing characteristics included target  
253 species or primary fishery in terms of income, homeport (i.e., the port where their primary vessel  
254 is docked or moored), and primary landing port (i.e., the port where their primary vessel lands  
255 most of its catch). Finally, questions about respondents' views of the future of commercial  
256 fishing included whether or not they would advise young people to enter commercial fishing and  
257 whether or not they themselves would enter into commercial fishing if they had their lives to live  
258 over again. These questions, originally developed by Pollnac and Poggie as part of a series of  
259 measures of job satisfaction, have been utilized and validated across a sizable literature on job  
260 satisfaction and well-being of commercial fishermen (Pollnac and Poggie 1988; Pollnac and  
261 Poggie 2006; Bavinck et al. 2012; Pollnac et al. 2014; Seara et al. 2017a; Seara et al. 2017b).

## 4. Results

### 4.1. Ports and Fisheries

Crew were interviewed at twenty-two ports during the 2012 survey and thirty-four ports during the 2018 survey. The largest proportion (~21%) of interviews took place in New Bedford, MA, in 2018, an eleven percent increase from the 2012 survey. While this is a substantial shift in the location of crew interviews, it is likely to be an artifact of the change in sampling design from a mixed design taking into account fishery representation to an approach favoring ports with larger levels of engagement in commercial fishing activities.

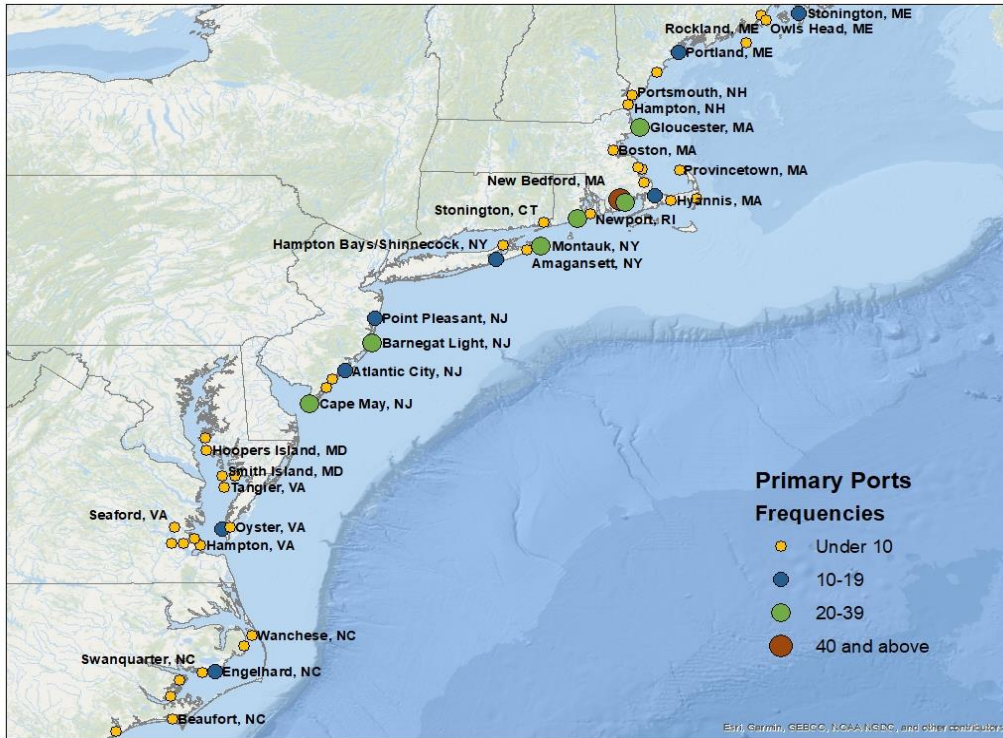
1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

271 Self-reported primary port and landing port variables may provide a better sense of the  
272 geographic distribution of crew employment and any potential shifts over time. Figure 1 shows  
273 the communities that crew respondents identified as their primary ports, or the ports where their  
274 primary vessel docks or is moored in the past year. Figure 2 shows the communities that crew  
275 respondents identified as their landing ports, or the ports where their primary vessel lands most  
276 of its catch in the past year. Self-reported primary and landing ports are distinct from intercept  
277 port, or the place where crew were interviewed, but most often the intercept port was also their  
278 self-reported primary and landing port. A table showing frequency of interviews by intercept port  
279 is included in the Supplementary Materials. According to the 2018 survey data, the largest  
280 percentage of crew reported New Bedford, MA, as their primary port (20%) and primary landing  
281 port (24%). However, no other port represented more than seven percent of the sample in terms  
282 of self-reported primary port or landing port. In addition, despite a pocket of concentration in  
283 employment and landings in New Bedford, there was a high degree of geographic variation  
284 among the large majority of crew surveyed in 2018.

285 Results of the data give insight into the transboundary nature of the commercial fishing  
286 fleets in the Northeast. In 2018, 20% of the sample reported different primary and landing ports  
287 from intercept, as well as differences between their primary and landing port. Additionally,  
288 almost all of the differences were ports located in different states. Examples of the most common  
289 reported differences between primary and landing ports were Cape May, NJ and New Bedford,  
290 MA, Portland, ME and Gloucester, MA, New Bedford, MA and Newport News, VA, and Point  
291 Judith, RI and Point Pleasant, NJ. Understanding these vessel patterns will be pertinent to  
292 understanding changing conditions on fisheries (i.e., climate shifts and upcoming offshore wind  
293 development in the region).

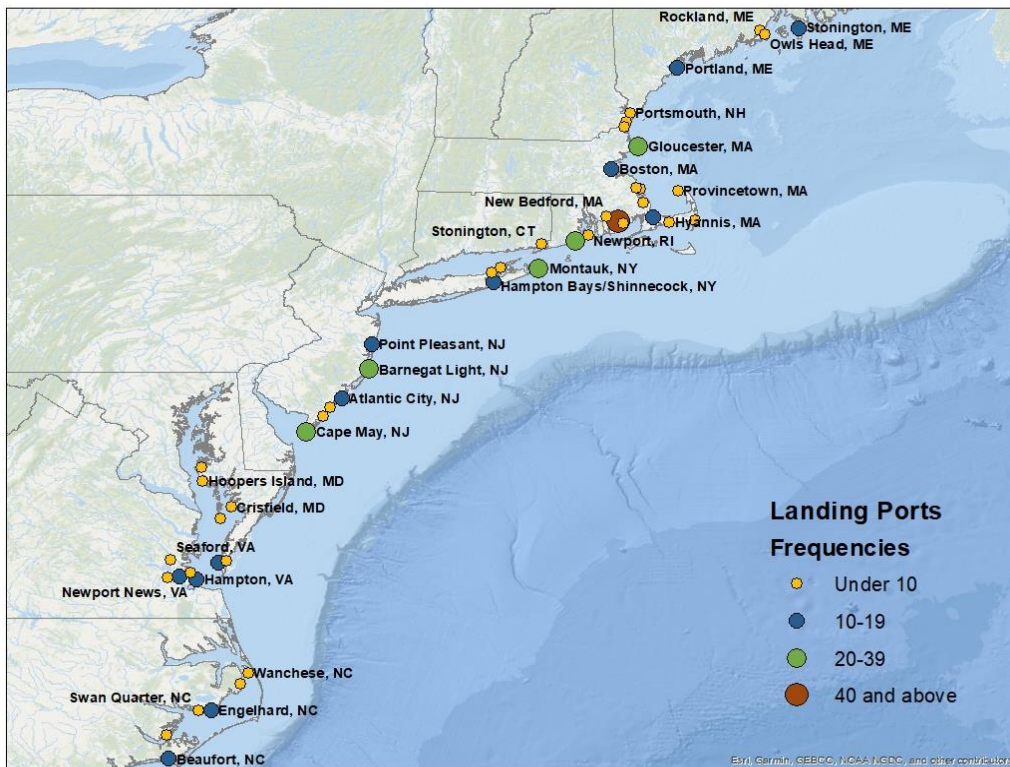
1  
2  
3  
4 294  
5 295  
6

Figure 1. Communities that Crew Identified as their Primary Ports in 2018. .



296  
297  
298

Figure 2. Communities that Crew Identified as their Landing Ports in 2018.



299  
300  
301  
302  
303  
304  
305

1  
2  
3  
4 300  
5 301 Respondents were also asked which fisheries or species their primary vessel targeted in  
6  
7  
8 302 the past year and, among those, which was the primary fishery or species in terms of generating  
9  
10 303 income. The majority of respondents to the 2012 survey identified either scallop (28%),  
11  
12 304 groundfish (20%), or lobster (20%) as their primary fishery in terms of income. Two of those  
13  
14 305 three fisheries – scallop and lobster – remained among the top three fisheries that crew identified  
15  
16 306 as their primary fisheries in the 2018 survey. Groundfish, on the other hand, dropped  
17  
18 307 substantially from 20% to only 7% of crew respondents having identified the fishery as their  
19  
20 308 primary source of income in 2018, which was a statistically significant difference ( $\chi^2 = 35.33$ ,  
21  
22 309  $p < .001$ ). Squid had surpassed groundfish as the third most common primary fishery (~8% of  
23  
24 310 respondents). While slightly fewer crew reported lobster as their primary fishery in 2018 versus  
25  
26 311 2012 (18% versus 20%, respectively), somewhat more crew identified scallop as their primary  
27  
28 312 fishery, up 4% from 2012 to 32% of respondents in 2018. Though the sampling methodology  
29  
30 313 may have had some influence on what fisheries were represented, these shifts among primary  
31  
32 314 fisheries reported by crew between 2012 and 2018 are potentially reflective of change among the  
33  
34 315 dominant fisheries in the region, which may be linked to changes in fisheries management, ocean  
35  
36 316 and climate conditions, and economic circumstances, which requires additional study.

#### 317 4.2. Socioeconomic Characteristics of Crew

318 Among the most basic, yet critical information about commercial fishing vessel crews is  
319 their socioeconomic characteristics. By tracking socioeconomic characteristics of fishing crews  
320 over time, we can better understand who is entering or exiting the industry and how they might  
321 be situated within the broader socioeconomic structure of their communities, regions, and the  
322 United States as a whole. As part of both the 2012 and 2018 surveys, crew respondents were  
323 asked several demographic questions about their background and socioeconomic status,



324 including their age, race and ethnicity, annual income from fishing, and educational attainment.  
 325 Additionally, crew respondents were asked whether they had health insurance coverage in the  
 326 past year and, if so, what the source of that coverage had been. Statistical results for comparisons  
 327 of crew demographics across survey waves are reported in Table 1.

Table 1. Crew Demographics by Survey Wave  
 Frequencies, Percentages, and Pearson's Chi-Squared Test Statistics

		2012	2018
		N (%)	N (%)
Age** ( $\chi^2=14.10$ )	18-24	63 (18%)	53 (11%)
	25-34	93 (26%)	151 (32%)
	35-44	94 (26%)	99 (21%)
	45-54	70 (20%)	104 (22%)
	55 or older	39 (11%)	71 (15%)
Income*** ( $\chi^2=95.89$ )	Less than \$30,000	81 (23%)	43 (9%)
	\$30,000 - \$59,999	122 (34%)	93 (19%)
	\$60,000 - \$89,999	61 (17%)	93 (19%)
	\$90,000 - \$119,999	31 (9%)	73 (15%)
	\$120,000 or more	25 (7%)	130 (27%)
	Don't know/No answer	39 (11%)	46 (10%)
Education ( $\chi^2=4.30$ )	Less than high school	60 (17%)	65 (14%)
	High school or GED	211 (59%)	300 (63%)
	Associate's/2-year	48 (13%)	54 (11%)
	Bachelor's/4-year	30 (8%)	50 (10%)
	Graduate degree	3 (1%)	3 (1%)
	Don't know/No answer	7 (2%)	6 (1%)
Health Insurance ( $\chi^2=0.00$ ) Source of insurance*** ( $\chi^2=20.43$ )	Insured	202 (56%)	277 (58%)
	From Vessel Owner	9 (3%)	3 (1%)
	From Another Employer	3 (1%)	1 (<1%)
	From Spouse/Partner	55 (15%)	48 (10%)
	Private Insurance	82 (23%)	129 (27%)
	Federal/State Insurance	38 (11%)	64 (13%)
	Other	15 (4%)	32 (7%)
	Don't know/No answer	5 (1%)	1 (<1%)
Not Insured	147 (41%)	200 (42%)	
Don't know/No answer	10 (3%)	1 (<1%)	
Race* ( $\chi^2=17.08$ )	White	306 (85%)	423 (89%)
	Black	10 (3%)	6 (1%)
	American Indian/Alaska Native	8 (2%)	1 (<1%)
	Asian	0 (0%)	5 (1%)
	Native Hawaiian/Pacific Islander	0 (0%)	1 (<1%)
Hispanic Ethnicity ( $\chi^2=2.18$ )	Other	18 (5%)	21 (4%)
	Multiracial	11 (3%)	9 (2%)
	Don't know/No answer	6 (2%)	12 (3%)
	Hispanic (discrete)	34 (9%)	32 (7%)
Total		359 (100%)	478 (100%)

\* -  $p<.05$ , \*\* -  $p<.01$ , \*\*\* -  $p<.001$

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

328 The sustainability of the commercial fishing industry in New England and the Mid-Atlantic  
329 regions relies in some measure upon how well the industry can attract young, new entrants into  
330 the occupation of commercial fishing. Crew surveyed in 2018 were significantly older on  
331 average, statistically, than those who were surveyed in 2012, with mean age increasing from 38  
332 in 2012 to 40 in 2018 ( $t = 2.25, p < .01$ ). This shift was driven by significant changes in age cohort  
333 representation. There was a 7% drop among those 18 to 24 years old between 2012 and 2018,  
334 accompanied by a corresponding 7% increase among those 45 years old or older over that same  
335 period. About half of all crew (52%) were between 25 and 44 years old in 2018, which was  
336 unchanged from 2012. These trends in aging among commercial crews provide further evidence  
337 for a “graying of the fleet” in New England and the Mid-Atlantic overall akin to what has been  
338 documented recently among Maine’s lobster fleet (Johnson and Mazur 2018) and in the U.S.  
339 Northwest and Alaska (Russell et al. 2014; Donkersloot and Carothers 2016).

340  
341 The large majority of crew in both survey waves identified as non-Hispanic white (85%  
342 in 2012 and 89% in 2018). Although this suggests there is little racial and ethnic diversity among  
343 commercial fishing crews in New England and the Mid-Atlantic, there was some variation  
344 geographically by port. For example, in one of the most racially and ethnically diverse ports in  
345 the sample, about one-quarter of crew and hired captains in New Bedford, MA, in 2018  
346 identified as non-white (24%), either as black/African-American (1%), Asian (4%), some other  
347 race (15%), or multiracial (4%). Additionally, 16% of crew and hired captains in New Bedford in  
348 2018 identified as Hispanic, Latino, or Spanish origin. There are a number of important caveats  
349 to consider prior to interpreting these results. First, many non-white, first generation and migrant  
350 crew may have been uncomfortable responding to interviews or information collections,

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

351 especially ones officially sponsored by an agency of the federal government, given the role of  
352 immigration enforcement among other departments and agencies. Some individuals walked away  
353 or actively avoided contact with approaching survey interviewers, especially at ports with larger  
354 non-white populations such as New Bedford, MA. Second, only the 2012 survey instrument was  
355 translated into Spanish and Portuguese due to budget and time constraints in 2018, and none of  
356 the interviewers in 2018 were multilingual. Despite the translation of the 2012 survey  
357 instrument, however, the overwhelming majority of respondents completed the survey in English  
358 (98%) and identified English as the primary language spoken in their homes (89%).

359           About three-quarters of crews reported having a high school education or less. While  
360 higher education is generally not required to earn a position aboard a commercial fishing vessel,  
361 a college degree can be a prerequisite for employment in many other sectors of the economy,  
362 including professional occupations that pay salaries that can match or exceed the relatively high  
363 incomes of some commercial fishing crews. Notably, educational attainment among commercial  
364 crews in New England and the Mid-Atlantic is much lower than the general U.S. adult  
365 population. According to the U.S. Census Bureau, about 28% percent of people 25 years or older  
366 had only a high school education or less in 2019 (U.S. Census Bureau 2020), versus 59% of crew  
367 overall in 2018. Given this disparity in educational attainment, commercial crews in New  
368 England and the Mid-Atlantic may be more vulnerable to unemployment or poverty should they  
369 lose the ability to earn income from fishing.

370           Despite being “one of the most dangerous occupations in the United States” (NIOSH  
371 2019), a substantial proportion of commercial fishing vessel crew in New England and the Mid-  
372 Atlantic did not have health insurance coverage during their employment. About 42% of crew  
373 respondents in 2018 reported that they did not have health insurance in the past year. This was

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

374 virtually unchanged from 2012, in which 41% of crew reported having no insurance. Sources of  
375 health insurance coverage shifted somewhat between 2012 and 2018. The percentage of crew  
376 who received health insurance from a spouse or partner dropped by about 9% from 26% to 17%.  
377 On the other hand, crew with private insurance plans increased by 5% from 39% in 2012 to 46%  
378 in 2018. Likewise, crew with coverage through federal or state plans increased by 5% from about  
379 18% in 2012 to 23% in 2018. Importantly, the percentage commercial crews in New England  
380 and the Mid-Atlantic without health insurance coverage is far higher than the rate of uninsured at  
381 the national level. According to American Community Survey (ACS) data, about 8.5% of  
382 Americans did not have health insurance in 2018 (Berchick et al., 2019).

#### 4.3. Participation in the Commercial Fishing Industry

385 Respondents to both the 2012 and 2018 surveys were asked about their individual and  
386 family history of involvement in the commercial fishing industry. This information can provide  
387 insight into multiple changing dynamics of the industry, such as the recruitment of new entrants  
388 into the profession or the preservation of culture and tradition among fishing families and  
389 communities. Questions about family participation in the industry included whether they had  
390 family members currently involved in the industry and the number of generations of their family  
391 involved in the industry. Regarding their own individual histories within the industry, crew  
392 respondents were asked how many years they had been employed in any capacity in the industry,  
393 their first position in the industry, and the number of different vessel owners they had been  
394 employed by in the past year. By tracking these characteristics over time, it is possible to  
395 illuminate generational shifts and help to predict the future of employment in this sector of the  
396 New England and Mid-Atlantic regions' economies.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

397 Most crew had family involved in the commercial fishing industry in 2018. Similarly, the  
398 majority of crew (60%) reported having two or more generations of their families involved in the  
399 commercial fishing industry, which was a slight increase from 54% in 2012 (Table 2). These  
400 data suggest that commercial fishing is rooted in family as a career path shared across  
401 generations for most crew employed in New England and the Mid-Atlantic. To add to the depth  
402 of involvement among those currently in the occupation, there was also substantial individual  
403 tenure in the industry among crew surveyed. Crew respondents reported a mean of 19 years  
404 employed in the commercial fishing industry in 2018, which did not change from the 2012  
405 survey wave. While there had not been a substantial change in crew tenure over time, a mean of  
406 nearly 20 years of experience among crew over the seven-year period suggests that there may  
407 have been few new entrants to the industry in the region. The percentage of those employed for  
408 less than five years in the industry decreased slightly (about 2%) from 2012 to 2018, while the  
409 percentage of those who had been employed in the industry for more than 30 years increased by  
410 nearly the same amount (Table 2). Taken together, these indicators provide evidence that the  
411 occupation of commercial fishing may be in decline in New England and the Mid-Atlantic, at  
412 least insofar as the number of new entrants to the industry continues to remain very low.  
413 Additionally, although about 60% of crew have worked for less than 5 years on their current  
414 vessels and this remained the case from 2012 to 2018, the path to employment for crew changed  
415 significantly over time. The plurality of crew in 2012, nearly 40%, reported that they were hired  
416 by their current vessel based on previous work with that same vessel, whereas the largest  
417 proportion of crew in 2018 (43%) reported having been hired by their current vessel through  
418 word of mouth (Table 2).

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

419           Although the demographic and fishery participation variables outlined above indicate  
420 potential vulnerabilities in the commercial fishing industry in New England and the Mid-  
421 Atlantic, additional survey questions on crews' attitudes about the future of the industry lend  
422 some evidence to the potential resiliency of the industry and its participants. Crew respondents  
423 were also asked whether or not they would advise young people to enter the industry and  
424 whether or not they would choose to enter commercial fishing again if they had their life to live  
425 over again (Table 3). While just over half, or 56%, of respondents in 2018 said they would  
426 advise young people to enter the industry, this percentage is up considerably from only 46% in  
427 2012. However, substantially more crew in 2018 (15%) versus 2012 (4%) responded that they  
428 "don't know" if they would advise young people to enter the industry. Despite seemingly greater  
429 optimism among current crew about the prospects for future generations, there is also increased  
430 uncertainty as to whether commercial fishing would be a wise choice of career for young people  
431 who might be interested in the occupation.

432  
433  
434  
435  
436  
437  
438  
439  
440  
441

Table 2. Participation in the Commercial Fishing Industry by Survey Wave  
 Frequencies, Percentages, and Pearson's Chi-Squared Test Statistics

		2012	2018
		N (%)	N (%)
Family involved in commercial fishing ( $\chi^2=2.81$ )	Yes	194 (54%)	286 (60%)
	No	165 (46%)	192 (40%)
Number of generations in commercial fishing ( $\chi^2=7.28$ )	First generation	162 (45%)	194 (41%)
	Second generation	69 (19%)	87 (18%)
	Third generation	62 (17%)	98 (21%)
	Fourth gen. or greater	63 (18%)	99 (21%)
	Don't know/No answer	3 (1%)	0 (0%)
Number of years in commercial fishing** ( $\chi^2=13.10$ )	Less than 5 years	66 (18%)	77 (16%)
	5 to 15 years	100 (28%)	168 (35%)
	16 to 29 years	109 (30%)	110 (23%)
	30 years or more	81 (23%)	123 (26%)
	Don't know/No answer	3 (1%)	0 (0%)
Number of years on current vessel ( $\chi^2=3.70$ )	Less than 5 years	209 (58%)	289 (60%)
	5 to 15 years	114 (32%)	148 (31%)
	16 to 29 years	26 (7%)	36 (8%)
	30 years or more	10 (3%)	5 (1%)
Path to employment on current vessel ( $\chi^2=218.07***$ )	Word of mouth	74 (21%)	204 (43%)
	Referred by friend	78 (22%)	123 (26%)
	Related to owner	36 (10%)	56 (12%)
	Related to crew	9 (3%)	21 (4%)
	Previous work	139 (39%)	23 (5%)
	Advertisement	1 (<1%)	2 (<1%)
	Other	22 (6%)	49 (10%)
<b>Total</b>		<b>359 (100%)</b>	<b>478 (100%)</b>

\* -  $p < .05$ , \*\* -  $p < .01$ , \*\*\* -  $p < .001$

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41 442  
42  
43 443  
44  
45 444  
46  
47  
48 445  
49  
50 446  
51  
52  
53 447  
54  
55 448  
56  
57  
58 449  
59  
60  
61  
62  
63  
64  
65

Table 3. Views on the Future of Commercial Fishing by Survey Wave  
 Frequencies, Percentages, and Pearson's Chi-Squared Test Statistics

		2012	2018
		N (100%)	N (100%)
Would you advise a young person to enter fishing?*** ( $\chi^2=57.47$ )	Yes	166 (46%)	266 (56%)
	No	177 (49%)	136 (28%)
	Unsure	14 (4%)	76 (16%)
	No Answer	2 (1%)	0 (0%)
Would you still be a commercial fisherman if you had your life to live over?*** ( $\chi^2=11.78$ )	Yes	264 (74%)	372 (78%)
	No	70 (20%)	58 (12%)
	Unsure	24 (7%)	48 (10%)
	No Answer	1 (<1%)	0 (0%)

\* -  $p < .05$ , \*\* -  $p < .01$ , \*\*\* -  $p < .001$

450

## 451 5. Discussion

452 The results of this study revealed several important new insights into the current social  
 453 and economic conditions of commercial fishing vessel crews and hired captains in New England  
 454 and the Mid-Atlantic U.S. regions. Comparisons of the 2012 and 2018 survey data provide  
 455 evidence to support the hypothesis that there has been a “graying of the fleet” in the region. The  
 456 mean age of respondents increased significantly from 2012 to 2018, which expands on the results  
 457 of recent research on the graying of the Maine lobster fleet (Johnson and Mazur 2018). In  
 458 addition to an aging fleet, this study also revealed that relatively few new individuals are entering  
 459 the occupation of commercial fishing in the region. About half of the respondents in 2018 had  
 460 been employed in the industry for more than fifteen years and only one in six had less than five  
 461 years of experience, a significant change from the 2012 survey results, when about 18% had less  
 462 than five years in the industry. Not only is the fleet aging in New England and the Mid-Atlantic  
 463 regions, there are also fewer new entrants to the industry. These results suggest a challenging  
 464 future for the industry in the region as commercial fishing vessels struggle to hire and retain new  
 465 and young members to their crews. Similar trends have been documented in the Pacific  
 466 Northwest region where a combination of factors, including financial barriers to entry, a lack of



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

467 fishing expertise among the youth, and perceptions about overregulation leading to reduced  
468 profits, also contribute to the aging workforce (Russell et al. 2014; Cramer et al. 2018).

469 To add to the issue of an aging fleet, evidence from this study also suggests a shift in the  
470 region's industry away from small-scale fishing businesses, due in part to the consolidation of  
471 fishing fleets. Crew respondents were much less likely to report having worked for their current  
472 vessels or vessel owner previously while at the same time much more likely to report having  
473 found the current employment through word of mouth. Additionally, crew respondents reported  
474 working on their current vessels for five years or less, but had worked on average for nearly 20  
475 years in the industry overall. These results highlight the volatility in employment for commercial  
476 fishing crews as it appears they often move from vessel to vessel in order to sustain their  
477 incomes over time. The movement of crew between vessels or out of the fishing industry  
478 altogether may be influenced by a number of interrelated factors, including fishery consolidation,  
479 management restrictions, opportunities in higher value fisheries, or changing ocean conditions  
480 (St. Martin 2007; Abbott et al. 2010; Lazrus et al. 2011; Carothers and Chambers 2012; Colburn  
481 et al. 206; Murphy et al. 2018). While this study is not able to unpack the reasons for crew  
482 movement between vessels or fisheries, more research is needed to understand what factors  
483 influence crew mobility within and across fisheries and to what extent this affects their  
484 vulnerability or capacity for resilience in the face of management or environmental change.

485 Other potential vulnerabilities for commercial fishing crews may stem from their  
486 socioeconomic circumstances. Crews are highly unlikely to have educational attainment beyond  
487 high school and a substantial proportion do not have health insurance coverage. As opportunities  
488 for employment on fishing vessels decline, crews may find it difficult to obtain employment in  
489 other sectors that might require college or technical degrees (Hackett et al. 2015). This highlights

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

490 the need for transitional education and training to provide individuals with occupational  
491 mobility. For example, aquaculture could be one pathway for commercial fishers to maintain  
492 employment related to the oceans or the seafood industry; training programs could be introduced  
493 wherever feasible. This could be challenging, however, as there may be substantial resistance to  
494 the development of aquaculture both from industry stakeholders and coastal communities  
495 (Whitmarsh and Palmieri 2009; Sinner et al. 2020).

496         There is a significant need to understand the racial and ethnic dynamics of commercial  
497 fishing crew in the Northeast and nationally. Executive Orders 12898 and 14008 direct federal  
498 agencies to incorporate considerations of environmental justice into their missions by developing  
499 programs, policies, and activities to address the disproportionately high and adverse human  
500 health, environmental, climate-related and other cumulative impacts on disadvantaged  
501 communities (E.O. 12898; E.O. 14008). While NOAA Fisheries has national indicator data at the  
502 coastal community level (NOAA Fisheries 2021), individual-level data on fishing community  
503 and industry members is limited. As noted in the results section of this paper, collecting this  
504 information is challenging. Further research should be designed with the capacity to collect this  
505 sensitive information and consider unique methods of reaching and engaging with disadvantaged  
506 communities.

507         Commercial crews in New England and the Mid-Atlantic may also be particularly  
508 vulnerable given the reported lack of health insurance coverage, especially in an occupation as  
509 hazardous as commercial fishing (Davis 2011; Lincoln et al. 2021). More than 40% of crew  
510 respondents reported having no health insurance during the 2017-2018 fishing year, which is in  
511 stark contrast to only about 9% uninsured among the total employed U.S. population in 2017  
512 (Berchick et al. 2019). Although this research was not able to unpack the issues that might

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

513 influence health insurance coverage, it could be due in part to the affordability of private  
514 insurance plans given that vessels typically do not offer health insurance coverage to crews.  
515 Nearly half of the crew respondents who had insurance in 2018 reported that they had purchased  
516 private insurance coverage. There may be a variety of other reasons for the lack of insurance  
517 among crews, but this finding clearly highlights the need for a deeper understanding of the  
518 factors that influence such a high rate of being uninsured among this particularly high-risk  
519 population.

520           Despite the social vulnerabilities of commercial fishing crew in New England and the  
521 Mid-Atlantic, this study indicates the potential for resilience as well. Survey results revealed that  
522 most crew would advise young individuals to enter into fishing as an occupation and that they  
523 would be commercial fishers if they could begin their lives again. Prior research utilizing these  
524 measures of job satisfaction found that more restrictive fisheries regulations negatively affected  
525 willingness among fishermen to advise young people to enter into the occupation of commercial  
526 fishing (Pollnac et al. 2015; Seara et al. 2016). Although many challenges face the industry in the  
527 New England and the Mid-Atlantic regions, there is substantial optimism among current crews  
528 that the occupation of commercial fishing will remain a viable and worthwhile endeavor for the  
529 next generation. However, there was also considerable uncertainty about whether they would  
530 advise young people to enter the occupation, suggesting that there are concerns for what the  
531 future may hold for the region’s industry among those who are currently involved in it.

532  
533 6. Conclusion

534           The results of this study reveal important potential vulnerabilities among commercial  
535 fishing crew in the New England and Mid-Atlantic regions. It is evident that commercial crews

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

536 are aging and there are fewer new entrants to the industry, which will affect the long-term  
537 viability of many fishing businesses throughout the Northeast. Regional fisheries management  
538 councils, state, and federal agencies should evaluate the impact of future policies that might  
539 exacerbate these individual- and community-level vulnerabilities. As mentioned earlier, National  
540 Standard 8 of the MSA requires that fisheries management take into account, and minimize to  
541 the extent practicable, the adverse consequences of new rules on fishing communities and  
542 community members, and specifically calls for the use of “social data” in doing so (50 CFR §  
543 600.345(a)). The results of this study can inform the social impact assessments of fisheries  
544 management policies by illuminating vulnerabilities related to the socioeconomic characteristics  
545 of fishing community members.

546           In addition to improving the quality of social impact assessments of fisheries  
547 management policies, this study can also contribute useful socioeconomic information to support  
548 the broader implementation of the NOAA Fisheries Ecosystem-Based Fisheries Management  
549 (EBFM) Policy (NMFS 2018b). NOAA Fisheries defines EBFM as “a systematic approach to  
550 fisheries management in a geographically specified area that... recognizes the physical,  
551 biological, economic, and social interactions among the affected fishery-related components of  
552 the ecosystem, including humans...” (NMFS 2018b). The socioeconomic conditions of  
553 commercial crews and hired captains are crucial to the sustainability of the human component of  
554 the fisheries ecosystem. The results of this study can inform EBFM programs and initiatives by  
555 improving their ability to understand and identify vulnerabilities within fishing communities and  
556 develop ecosystem-level planning strategies that take into account the human dimensions of  
557 fisheries.

558

1  
2  
3  
4 559  
5  
6  
7 560  
8  
9 561  
10  
11  
12 562  
13  
14 563  
15  
16  
17 564  
18  
19 565  
20  
21 566  
22  
23  
24 567  
25  
26 568  
27  
28  
29 569  
30  
31 570  
32  
33  
34 571  
35  
36 572  
37  
38 573  
39  
40  
41 574  
42  
43 575  
44  
45  
46 576  
47  
48 577  
49  
50  
51 578  
52  
53 579  
54  
55 580  
56  
57  
58 581  
59  
60  
61  
62  
63  
64  
65

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

582 References

583 Abbott, J. K., Garber-Yonts, B., & Wilen, J. E. 2010. "Employment and remuneration effects of  
584 IFQs in the Bering Sea/Aleutian Islands crab fisheries." *Marine Resource Economics*.  
585 25(4): 333-354.

586 Andreatta, S. and Parlier, A., 2010. "The political ecology of small-scale commercial fishermen  
587 in Carteret County, North Carolina." *Human Organization*. 180-191.

588 Bavinck, M., Pollnac, R., Monnereau, I., & Failler, P. 2012. "Introduction to the special issue on  
589 job satisfaction in fisheries in the global south." *Social indicators research*. 109(1): 1-10.

590 Berchick, Edward R., Jessica C. Barnett, and Rachel D. Upton. 2019. Current Population  
591 Reports, P60- 267(RV), Health Insurance Coverage in the United States: 2018, U.S.  
592 Government Printing Office, Washington, DC.

593 Carothers, C., & Chambers, C. 2012. "Fisheries privatization and the remaking of fishery  
594 systems." *Environment and Society*. 3(1): 39-59.

595 Colburn, L. L., Jepson, M., Weng, C., Seara, T., Weiss, J., & Hare, J. A. 2016. "Indicators of  
596 climate change and social vulnerability in fishing dependent communities along the  
597 Eastern and Gulf Coasts of the United States." *Marine Policy*. 74: 323-333.

598 Cochran, W.G. 1977. *Sampling Techniques*. 3<sup>rd</sup> ed. New York, NY. John Wiley & Sons.

599 Cramer, L.A., Flathers, C., Caracciolo, D., Russell, S.M. and Conway, F., 2018. "Graying of the  
600 fleet: Perceived impacts on coastal resilience and local policy." *Marine Policy*. 96:27-35.

601 Clay, P. M., Kitts, A., & da Silva, P. P. 2014. "Measuring the social and economic performance  
602 of catch share programs: definition of metrics and application to the US Northeast Region  
603 groundfish fishery." *Marine Policy*. 44, 27-36.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

604 Cutler, M., Murphy, T. and Vasta, M., 2017. An overview of the survey on the socioeconomic  
605 aspects of commercial fishing vessel owners in the northeast and Mid-Atlantic. National  
606 Marine Fisheries Service (NMFS). U.S. Dept. of Commerce, NOAA Tech. Memo.  
607 NMFS-NE-240, 29 p.

608 Davis, M. E. 2011. "Occupational safety and regulatory compliance in US commercial fishing."  
609 *Archives of environmental & occupational health*. 66(4): 209-216.

610 Davis, M. E. 2012. "Perceptions of occupational risk by US commercial fishermen." *Marine*  
611 *Policy*. 36(1): 28-33.

612 Donkersloot, R. and Carothers, C., 2016. "The graying of the Alaskan fishing fleet."  
613 *Environment: Science and policy for sustainable development*. 58(3): 30-42.

614 Executive Order 12898. Federal actions to address environmental justice in minority populations  
615 and low-income populations Fed Reg 59:FR7629.

616 Executive Order 14008. Tackling the Climate Crisis at Home and Abroad. Federal Register (86  
617 FR 7619, February 1, 2021).Hackett, S., Pitchon, A., & Hansen, D. 2015. "Economic  
618 attributes of stayers and leavers in four California fisheries." *CalCOFI Reports*. 56: 1-10.

619 Henry, A. E., & Olson, J. A. 2014. An overview of the survey on the socio-economic aspects of  
620 commercial fishing crew in the Northeast. National Marine Fisheries Service (NMFS).  
621 U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-NE-230, 42 p.

622 Himes-Cornell, A. H., Kasperski, S., Kent, K., Maguire, C. M., Downs, M. A., Weidlich, S., &  
623 Russell, S. M. 2015. Social baseline of the Gulf of Alaska groundfish trawl fishery:  
624 results of the 2014 social survey. National Marine Fisheries Service (NMFS). U.S.  
625 Dept. of Commerce, NOAA Tech. Memo. NMFS-AFSC-306, 510 p.Jepson, M. and  
626 Colburn, L. 2013. Development of Social Indicators of Fishing Community Vulnerability

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

627 and Resilience in the U.S. Southeast and Northeast Regions. National Marine Fisheries  
628 Service (NMFS). U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-F/SPO-129, 64 p.  
629 Johnson, T.R. and Mazur, M.D., 2018. "A mixed method approach to understanding the graying  
630 of Maine's lobster fleet." *Bulletin of Marine Science*. 94(3): 1185-1199.  
631 Kitner, K.R., 2006. "Beeliners, pinkies, and kitties: Mobility and marginalization in the South  
632 Atlantic snapper grouper fishery." *Human Organization*. 65(3): 294-306.  
633 Lazrus, H. M., J. A. Sepez, R. G. Felthoven, and J. C. Lee. 2011. Post-rationalization  
634 restructuring of commercial crew member opportunities in Bering Sea and Aleutian  
635 Island crab fisheries. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-217, 62 p.  
636 Lincoln, J. M., Carruth, A., Cherry, D., Kincl, L., & Syron, L. N. 2021. "Occupational Health  
637 Research in the Commercial Fishing Industry." *Journal of agromedicine*. 26(1): 28-30.  
638 Macinko, S., 2010. "Fisheries 'rationalization' and crew: Workplace dynamics and  
639 compensation, what can we learn." *NPRB Project*, 725, pp.3-3.  
640 Messick, J. 2015. "Study examines decline in young rural Alaska fishermen." *Alaska Dispatch*  
641 *News*. Retrieved June 11, 2015:  
642 <http://www.adn.com/article/20150321/studyexaminesdeclineyoungruralalaskafishermen>  
643 Miller, K. W., Wilder, L. B., Stillman, F. A., & Becker, D. M. 1997. "The feasibility of a street-  
644 intercept survey method in an African-American community." *American journal of*  
645 *public health*. 87(4): 655-658.  
646 Murphy, T., Ardini, G., Vasta, M., Kitts, A.W., Demarest, C.K., Walden, J. and Caless, D., 2018.  
647 "2015 Final Report on the Performance of the Northeast Multispecies (Groundfish)  
648 Fishery (May 2007–April 2016)." National Marine Fisheries Service (NMFS). 2018.



1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

649 Fisheries Economics of the United States, 2016. U.S. Dept. of Commerce, NOAA Tech.  
650 Memo. NMFS-F/SPO-187a, 243 p.

651 NEFMC (New England Fisheries Management Council) 2014. Framework Adjustment 8 to the  
652 Monkfish FMP. 179 p.

653 NEFMC (New England Fisheries Management Council) 2016a. Framework Adjustment 9 to the  
654 Monkfish FMP. 319 p.

655 NEFMC (New England Fisheries Management Council) 2016b. Framework Adjustment 55 to  
656 the Northeast Multispecies FMP. 381 p.

657 NEFMC (New England Fisheries Management Council) 2017. Framework Adjustment 10 to the  
658 Monkfish FMP. 218 p.

659 NEFMC (New England Fisheries Management Council) 2020. Amendment 23 to the  
660 Northeast Multispecies FMP. 616 p.

661 NIOSH (National Institute of Occupational Safety and Health). 2017. “List of Journal Articles on  
662 Occupational Safety in the Fishing Industry: 1954- 2012.” Washington, D.C.: National  
663 Institute for Occupational Safety and Health. Retrieved April 2, 2020  
664 ([https://www.cdc.gov/niosh/topics/fishing/pdfs/Fishing\\_Safety\\_Bibliography\\_1954-](https://www.cdc.gov/niosh/topics/fishing/pdfs/Fishing_Safety_Bibliography_1954-2012.pdf)  
665 [2012.pdf](https://www.cdc.gov/niosh/topics/fishing/pdfs/Fishing_Safety_Bibliography_1954-2012.pdf))

666 NIOSH (National Institute of Occupational Safety and Health) 2019. “Commercial Fishing  
667 Safety.” Washington, D.C.: National Institute for Occupational Safety and Health.  
668 Retrieved April 2, 2020 (<https://www.cdc.gov/niosh/topics/fishing/default.html>).

669 NMFS (National Marine Fisheries Service). 2018a. Fisheries Economics of the United States,  
670 2016. U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-F/SPO-187, 243 p.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

671 NMFS (National Marine Fisheries Service). 2018b. Ecosystem-Based Fisheries Management  
672 Policy of the National Marine Fisheries Service National Oceanic and Atmospheric  
673 Administration. U.S. Dept. of Commerce. NMFS Policy 01-120, 9 p.

674 NMFS (National Marine Fisheries Service). 2021a. "Annual commercial landing statistics."  
675 Retrieved December 10, 2021  
676 (<https://www.fisheries.noaa.gov/foss/f?p=215:200:9304033833641:Mail:NO:::>).

677 NMFS (National Marine Fisheries Service). 2021b. "Northeast Socioeconomic Data Products."  
678 Retrieved December 10, 2021 (<https://www.fisheries.noaa.gov/new-england-mid-atlantic/socioeconomics/northeast-socioeconomic-data-products>).

680 NOAA Fisheries. 2021. Social Indicators for Coastal Communities. Accessed 30 Dec 2021.  
681 [https://www.fisheries.noaa.gov/national/socioeconomics/social-indicators-coastal-](https://www.fisheries.noaa.gov/national/socioeconomics/social-indicators-coastal-communities)  
682 communities.

683 Ota, Y., & Just, R. 2008. "Fleet sizes, fishing effort and the 'hidden' factors behind statistics: an  
684 anthropological study of small-scale fisheries in UK." *Marine Policy*. 32(3): 301-308.

685 PFMC (Pacific Fisheries Management Council). 2013. "Ecosystem Initiatives Appendix to the  
686 Pacific Coast Fishery Ecosystem Plan." Pacific Fishery Management Council. Portland,  
687 OR.

688 Pollnac, R. B., & Poggie Jr, J. J. 1988. "The structure of job satisfaction among New England  
689 fishermen and its application to fisheries management policy." *American Anthropologist*.  
690 90(4): 888-901.

691 Pollnac, R. B., & Poggie, Jr, J. J. 2006. "Job satisfaction in the fishery in two southeast Alaskan  
692 towns." *Human organization*. 65(3): 329-339.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

693 Pollnac, R.B., Seara, T. and Colburn, L.L., 2015. "Aspects of fishery management, job  
694 satisfaction, and well-being among commercial fishermen in the northeast region of the  
695 United States." *Society & Natural Resources*. 28(1): 75-92.

696 Rosvold, E. 2006. "Graying of the Fleet: Community Impacts from Asset Transfers." In P.  
697 Cullenberg (Ed.). *Alaska's Fishing Communities: Harvesting the Future*. 67-72.  
698 Anchorage.

699 Russell SM, Sparks K, Arias-Arthur A, Varney A. 2014. The Pacific groundfish fishery social  
700 study: an initial theme based report. US Department of Commerce, NWFSC, Seattle,  
701 WA. 78 p.

702 Seara, T., Pollnac, R. B., & Poggie, J. J. 2017a. "Changes in job satisfaction through time in two  
703 major New England fishing ports." *Journal of Happiness Studies*. 18(6): 1625-1640.

704 Seara, T., Pollnac, R. B., Poggie, J. J., Garcia-Quijano, C., Monnereau, I., & Ruiz, V. 2017b.  
705 "Fishing as therapy: Impacts on job satisfaction and implications for fishery  
706 management." *Ocean & Coastal Management*. 141: 1-9.

707 Silva, A., Gentile, L.E., Cutler, M.J., and Colburn L.L. 2021. A Comparison of Waves I  
708 (2012/2013) and II (2018/2019) of the Survey on the Socio-Economic Aspects of  
709 Commercial Fishing Crew in the Northeast U.S. National Marine Fisheries Service  
710 (NMFS). U.S. Dept. of Commerce, NOAA Tech. Memo. NMFS-NE-274, 64 p.

711 Sinner, J., Newton, M., Barclay, J., Baines, J., Farrelly, T., Edwards, P., & Tipa, G. 2020.  
712 "Measuring social licence: What and who determines public acceptability of aquaculture  
713 in New Zealand?." *Aquaculture*. 521: 734973.

714 St Martin, K. 2007. "The difference that class makes: neoliberalization and non- capitalism in  
715 the fishing industry of New England." *Antipode*. 39(3): 527-549.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
26  
27  
28  
29  
30  
31  
32  
33  
34  
35  
36  
37  
38  
39  
40  
41  
42  
43  
44  
45  
46  
47  
48  
49  
50  
51  
52  
53  
54  
55  
56  
57  
58  
59  
60  
61  
62  
63  
64  
65

716 Steinback, S.R. and Thunberg, E.M., 2006. Northeast region commercial fishing input-output  
717 model. National Marine Fisheries Service (NMFS). U.S. Dept. of Commerce, NOAA  
718 Tech. Memo. NMFS-NE-188, 54 p.

719 Steiner, E., Russell, S., Vizek, A., & Warlick, A. 2018. "Crew in the West Coast groundfish  
720 catch share program: Changes in compensation and job satisfaction. Coastal  
721 Management." 46(6): 656-676.

722 U.S. Census Bureau. 2020. "U.S. Census Bureau Releases New Educational Attainment Data."  
723 Release Number CB20-TPS.09. [https://www.census.gov/newsroom/press-](https://www.census.gov/newsroom/press-releases/2020/educational-attainment.html)  
724 [releases/2020/educational-attainment.html](https://www.census.gov/newsroom/press-releases/2020/educational-attainment.html).

725 Vilorio, D. 2016. "Education Matters." *Career Outlook*. U.S. Bureau of Labor Statistics, March  
726 2016.

727 Whitmarsh, D., & Palmieri, M. G. 2009. "Social acceptability of marine aquaculture: The use of  
728 survey-based methods for eliciting public and stakeholder preferences." *Marine Policy*.  
729 33(3): 452-457.

730



[Click here to access/download](#)

**Supplementary Material**

Supplementary Material\_121021.docx

