1 APPENDIX - NEARSHORE RESEARCH AND MONITORING

2 Despite tremendous advances over the last decade in understanding Oregon's nearshore
3 species and habitats, as well as advances in ODFW's program capacity to conduct
4 nearshore research and monitoring, there is still a need to enhance and augment existing
5 nearshore programs. Nearshore resources are still poorly understood, relative to the
6 state's other natural resources. Yet, the demands for information and data for conservation
7 and management purposes continue to grow. Biological, physical, and socioeconomic
8 data collected from research and monitoring efforts are central to effective wildlife
9 conservation and management programs, and provide the information needed for effective
10 outreach and education. The conservation values of a well-informed public help drive
11 policy and management decisions that ensure a heathy ecosystem.

12 ODFW's current marine research and monitoring program capacity is diverse and obtains
13 data on a range of ecological, fishery and socio-economic questions. The broad suite of
14 research and monitoring projects currently conducted by ODFW help support
15 management decisions and also provide a better understanding of the nearshore
16 environment's inhabitants and their habitats. This chapter includes information on existing
17 ODFW research and monitoring efforts (to provide context) and some detail on additional
18 research and monitoring needs. This chapter provides a foundation for many of the
19 Nearshore Recommendations found in the Nearshore ecoregion.

20 EXISTING ODFW RESEARCH AND MONITORING CAPACITY

21 The list below highlights existing ODFW research and monitoring efforts, along with specific
22 project goals and outcomes.

23 **Shellfish and Estuary Habitat**

24 The shellfish program conducts research, monitoring and management of marine and
25 estuarine shellfish species, along with the habitats these species utilize. This includes
26 surveys for multiple species of sport and commercially harvested shellfish including bay
27 clams, Dungeness crab, red rock crab, red sea urchins, razor clams, and the invasive
28 European green crab. The shellfish program conducts shoreline creel surveys to monitor
29 the levels of sport harvest. Data from these creel surveys are coupled with counts of the
30 sport harvesters to develop estimates of the overall effort expended by the recreational
31 shellfishers. The ODFW shellfish program also collects measurements of the biological
32 characteristics of the clams and crab. Information generated by the monitoring work is

33 used to gauge the level of seasonal harvest activity and periodically evaluate the need for
34 any modifications of the shellfish harvest regulations. The Shellfish and Estuarine
35 Assessment of Coastal Oregon (SEACOR) program conducts clam population
36 assessments and estuarine habitat studies throughout estuaries along the Oregon coast.
37 Data collected through this project is used to better manage the commercial and
38 recreational clam fisheries, along with informing shellfish stock assessments and tracking
39 estuarine habitat changes. Since its inception in 2008, the SEACOR project has collected
40 data from six major estuaries, with the goal of assessing every major estuary and bay along
41 the Oregon coast. SEACOR has also digitized historical habitat survey information
42 including native eelgrass as a component of developing predictive capabilities for shellfish
43 resources within Oregon estuaries.

44 **Marine Mammals - Pinnipeds**

45 The marine mammal program conducts research and monitors pinnipeds to address
46 conservation and management concerns relevant to Oregon. This work is done
47 cooperatively with federal, state, tribal and academic cooperators. Examples include
48 analysis of fecal and stomach samples to study pinniped diets; design- and model-based
49 estimation of prey consumption, with an emphasis on salmonids, lamprey, sturgeon and
50 other species of conservation concern; population surveys to support marine mammal
51 stock assessments; and capture and marking of pinnipeds to study survival rates,
52 movements, disease, and individual foraging behavior. The program also provides support
53 to solve problems and develop policy with regards to marine mammals in Oregon. This
54 work includes participation in the Oregon Marine Mammal Stranding Network and
55 Involvement in new and emerging issues related to sea otters, marine mammal health, and
56 southern resident killer whales.

57 **Fishery Sustainability Research**

58 Fishery-related research supports fishery management and assessment of fish stock
59 health. Over the past decades, this program's research has led the way towards
60 understanding and reducing bycatch. One notable example is with the pink shrimp fishery
61 where and the reduction of eulachon bycatch (listed as a threatened species under the
62 federal Endangered Species Act). This work was instrumental both in allowing the
63 continuation of this important fishery while addressing conservation concerns for
64 eulachon, and in contributing toward certification of the Oregon pink shrimp fishery by the
65 Marine Stewardship Council as a sustainable fishery. Additionally, this program conducted
66 extensive research to understand the effects of barotrauma on rockfish and how to reduce
67 barotrauma-related mortality in rockfish. The research resulted in the development and

68 acceptance of rockfish descender devices. Fishery managers use the survival rates to
69 improve estimates of fishing impacts on sensitive species such as yelloweye rockfish.
70 These improved estimates meant increased fishing opportunities for anglers, while still
71 addressing the conservation concerns for the sensitive species.

72 Fishery managers require information on the population status of harvested species to
73 make well-informed management decisions. While the federal government conducts stock
74 assessments on federally managed species, including many ocean fishery species that
75 have been included in the SGCN list, there remain several state-managed species for
76 which there is incomplete knowledge of population status. ODFW's fishery-related
77 research program develops species life history information such as population age
78 composition and age of female fish maturity for poorly understood species, including both
79 federally and state managed species. They also work to understand how fish move and use
80 Oregon's nearshore waters. Federal stock assessment scientists use this information to
81 improve their understanding of population status. The fishery-related research program
82 conducted the first statewide survey using a combination of a scientific fish finder and
83 visual survey tools to directly survey the population of nearshore the semi-pelagic rockfish
84 species in a fishery-independent survey, something that many stock assessors have called
85 for as critical need to improve stock assessments. Work is ongoing to develop methods for
86 other important nearshore stocks. The group is also working on understanding how fish
87 respond to ocean change and how these understandings can promote adaptive
88 management. These studies will help ODFW develop more consistent, accurate and
89 sustainable harvest recommendations.

90 **Fishery Monitoring**

91 Fishery monitoring and sampling are integral in generating data and information to meet the
92 needs of resource managers and ensuring sustainable fisheries. Approximately 40 percent
93 of the ODFW Marine Resource Program's budget is devoted to a sophisticated sampling
94 program that monitors both commercial and sport fisheries along the Oregon coast. These
95 programs collect information on groundfish, halibut, salmon, albacore tuna, clam, crab,
96 squid, and shrimp fisheries, including catch composition and biological data. Fishery data
97 processing and quality control are also significant components of the fishery monitoring
98 program. The information collected via this program is used to monitor progress toward

99   quotas, to inform stock assessments, and to assist in the development of management
100 recommendations for the best use of Oregon's fishery resources.

101 **Nearshore Ecology**

102 The Nearshore Ecology Program focuses on marine conservation and nearshore habitat
103 research through two teams. The Marine Reserves team conducts ecological monitoring at
104 the reserves and comparison areas; social science research to understand how people
105 use, relate to and value Oregon's Marine Reserves; and communication and outreach. The
106 Marine Habitat team focuses on understanding nearshore habitats more broadly,
107 researches seafloor communities, and contributes to policy development that supports
108 sustainability and conservation. The Nearshore Ecology Program is interdisciplinary.
109 Though ecological study is central, the program also features a social scientist, a
110 communications and engagement specialist, and an economist. These three additional
111 arms of this program enable the science to address a wide range of concerns and be
112 understood across diverse audiences.

113 *Marine Reserves Ecological and Social Science*

114   The Oregon Legislature passed two foundational marine reserves bills, House Bill
115   3013 in 2009 and Senate Bill 1510 in 2012. These statutes provided instructions to
116   state agencies and laid out requirements for the planning, siting, designation, and
117   implementation of the marine reserve sites, which are areas in coastal waters
118   dedicated to conservation and scientific research. In 2012, Senate Bill 1510
119   completed the designation of five marine reserve sites and required a ten-year
120   assessment and report on the Oregon Marine Reserves due to the Oregon
121   Legislature. Since then, the ODFW Marine Reserves team has monitored the effects
122   of marine reserves on the marine environment and on people. The **2022 synthesis**
123   **report** details many research findings of the reserves' first ten years and was used to
124   evaluate marine reserves as a management tool. In 2024, HB 4132 was passed in
125   response to Oregon State University's decadal review of the Marine Reserves and
126   tasked the Marine Reserves team with developing an adaptive management plan,
127   among other recommendations for future improvements.

128   The Marine Reserves team leads ecological and social science research. Ecological
129   research focuses on monitoring habitats, biodiversity, and oceanography over time,
130   with the goal to determine ongoing effects of closure to fishing and other extractive
131   activities in the marine reserves. Human dimensions monitoring focuses on
132   determining social, cultural, and economic changes for ocean users and

133	communities that result from marine reserves implementation. In addition to
134	providing insight on the specific effects of marine reserves, these monitoring efforts
135	are proving to be a vital resource in improving the general understanding of Oregon's
136	nearshore environment, coastal economy, and ocean users.

| 137 | *Marine Habitat* |

138	The Marine Habitat team (also known as the Marine Habitat Project) conducts
139	numerous ecological research projects focused on marine species-habitat
140	relationships. This work helps provide a scientific understanding of the nearshore
141	ecosystem for both fishery and non-fishery species. The team conducted some of
142	the first detailed mapping efforts for Oregon's nearshore habitat using multibeam
143	sonar surveys that gather high-resolution data on seafloor depth and
144	characteristics. This effort has since been expanded through collaboration with
145	Oregon State University and others, which has resulted in detailed seafloor habitat
146	maps for a large majority of the rocky reef areas within Oregon Territorial Sea and
147	adjacent federal waters. This spatial data provides the foundational knowledge of
148	seafloor habitats in the nearshore and enables subsequent applications to resource
149	management. The Marine Habitat team has developed methods to model the
150	habitat associations of key nearshore species. The team has also expanded its
151	remotely operated vehicle video survey data to coast-wide abundance estimates for
152	nearshore rocky reef-associated fish to inform stock assessments for nearshore
153	demersal fish stocks. Additionally, the Marine Habitat team has been instrumental
154	in documenting and monitoring the ecological consequences of nearshore hypoxic
155	zones off of Oregon. This team has also led research efforts on aerial surveys of kelp
156	forests, trawl impacts on soft bottom habitats and annual monitoring of rocky reef
157	biological communities.

158 RESEARCH AND MONITORING NEEDS

159	The subsequent section highlights significant data gaps for the nearshore ecosystem and
160	gives examples of research needed to fill these gaps. While not comprehensive, these
161	examples – if addressed and the data gaps filled – would provide a much deeper
162	understanding of nearshore ecosystem function and status.

| 163 | General information needs include baseline data on the distribution and abundance of |
| 164 | nearshore species and habitats, data on inter-species and species-habitat associations to |

165 understand the nuances of nearshore ecosystem function, and issue-specific data on the
166 effects human activities on nearshore resources.

167 In particular, the effects of climate change, ocean acidification, and hypoxia on species
168 and their habitats need to be understood and considered in conservation decisions.
169 Universities, government agencies and private entities have begun developing programs to
170 observe and monitor the symptoms of climate change. Future needs include designing
171 further studies that can identify and quantify the impacts of those symptoms on species,
172 habitats, and ecosystem function; to explore what changes in nearshore resource
173 distribution, abundance, and interactions we can expect with changing climate patterns
174 anticipated in years to come.

175 **Species Data**

176 Information on the presence, abundance, and location of some nearshore species and
177 biological communities is needed. While we understand the types of species present in
178 the nearshore area and have limited abundance information on some, we lack the
179 following important information for many species:

180 • invertebrate and fish community structure of nearshore reefs, and variation in
181 communities among reefs
182 • identification of indicator species that can be tracked to monitor the health of the
183 system and impacts of climate change
184 • absolute abundance measures or fishery-independent relative abundance
185 measures for key managed species, and/or indicators of changes in abundance
186 (important for fished species such as nearshore rockfish, cabezon, and greenling,
187 etc.)
188 • movements undertaken by nearshore species

189 Specific types of research that can help fill these data gaps include:

190 • surveys for marine fish, invertebrates, and algae, which are independent of fisheries
191 and at coastwide or other appropriate scales
192 • periodic and consistent long-term monitoring of organisms at selected indicator
193 sites, such as the ecosystem monitoring currently conducted in marine reserves
194 and nearby comparison areas by ODFW's Marine Reserves Program, and the
195 selection of specific sites and organisms most likely to demonstrate impacts of
196 climate change, ocean acidification, and hypoxia
197 • developing and testing abundance measures or population trend indicators for
198 selected species and monitoring those species over time

Habitat Data

Habitat data include structure and composition of the seafloor, estuary bottoms, and rocky and sandy shore substrates; oceanographic patterns and process (see Oceanographic Data below); and biological communities present (see Species Data above). Our knowledge of nearshore subtidal habitat is improving. We now have considerably more detailed seafloor maps for roughly half of Oregon's Territorial Sea than we had a decade ago; however, much remains to be mapped in detail. Researchers have only begun to understand which characteristics of habitats are most important in addressing the needs of particular species or communities. Types of research that can help fill these data gaps include:

- examining the relationships between species/communities and habitats to determine the most important habitat features to survey
- large-scale, coastwide survey of seafloor structure and composition employing modern ocean survey methodologies
- detailed surveys of selected areas to support studies of species-habitat relationships
- update and refine the coastwide rocky habitat resource inventory using information from ongoing scientific research and monitoring

Oceanographic Data

Marine organisms are intimately tied to the physical/chemical properties and movements of the ocean waters in which they live. In order to understand the nearshore system, we need more information on:

- large and small scale processes determining local water properties
- water movement and circulation patterns on large and small scales of time and space
- natural variation in oceanographic conditions over short and long time scales
- models with proven predictive ability on short and long time scales
- how local Oregon ocean conditions are tied to global ocean and climate conditions, and how global processes such as climate change, ocean acidification, and hypoxia are likely to affect local conditions in Oregon's nearshore waters

Researchers at universities and other research institutions continue to make significant progress toward understanding nearshore oceanographic patterns and ecological processes in the waters off Oregon. Continuation of this research is essential to gaining a better understanding of the nearshore ecosystem.

233 **Ecosystem Data**

234 This includes the data types described above, stitched together to provide an
235 understanding of the interactions and dependencies among species and the relationships
236 between species and their habitats, to provide insight into the functioning of the nearshore
237 ecosystem. This is a growing field and still data-poor; information needed to improve this
238 understanding includes:

239 • habitat characteristics that determine community structure
240 • relationships among species, habitats, and oceanographic variables
241 • how ocean currents affect larval transport and consequently the genetic structure
242   of populations
243 • connectivity and relationship between estuary and ocean populations
244 • factors affecting primary and secondary production
245 • factors affecting reproduction, recruitment, and natural mortality
246 • food web relationships and predator-prey dynamics
247 • natural variability of these and other factors
248 • climate change impacts on species and habitats related to:

249   o sea level rise effects
250   o warming ocean temperatures
251   o altered weather patterns
252   o changes in circulation patterns
253   o changes in species range distribution related to temperature or food
254   requirements
255   o upwelling and nutrient availability for primary production
256   o changes in food web dynamics

257 • ocean acidification and hypoxia
258 • effects of introduced non-native and invasive species

259 Most of these represent large scientific questions that cannot be addressed with individual
260 research projects. Understanding these variables has, and will continue, to occur
261 incrementally over time. The best way to ensure progress is to continue building Oregon's
262 research infrastructure and increasing the emphasis on nearshore research. Recent
263 ecosystem modeling efforts have provided insights but still need data both to make
264 predictions and to validate the accuracy of those predictions.

265 **Human Dimensions**

266 Human presence and activities are integral parts of Oregon's nearshore ecosystem.
267 Human dimensions – or socioeconomic – information can be used to understand how
268 coastal communities, economies, and nearshore resources are interrelated and might be

269   affected by various management actions. Basic economic data concerning commercial
270   fisheries are developed regularly; however, there is less information on recreational
271   fisheries, natural resource contributions to the tourist industry, and the economic
272   consequences of management actions. These and other studies are needed to ensure
273   managers address human dimensions factors in decision-making.

274   The best way to ensure continued progress in marine and coastal resource management is
275   to build upon and expand Oregon's human dimensions research. While recent efforts, such
276   as the Marine Reserves Human Dimensions Program, have provided valuable insights (see
277   **2022 synthesis report**), there is still a significant need for broader and deeper research to
278   fully understand the social, cultural, and economic dynamics affecting Oregon's coastal
279   communities and ocean users.

280   It is important for this research to draw on a diverse set of disciplines including economics,
281   sociology, anthropology, social psychology, and political science, to examine how people
282   interact with and are affected by coastal and marine systems. There are strong
283   opportunities to expand Human Dimension research through new partnerships with
284   academic institutions, private sector experts, and community organizations.

285   By collaborating across sectors, Oregon can generate more robust, area-specific data
286   while maintaining a broad enough research scope to address statewide marine and coastal
287   management challenges. A well-designed, interdisciplinary Human Dimension research
288   framework will help ensure that decision-making is informed by a clear understanding of
289   the values, needs, and priorities of ocean users, communities of place, communities of
290   interest, and the broader public.

291   **Human Development & Impacts**

292   Several existing and emerging human uses of the nearshore environment will require
293   special studies to understand their effects on nearshore resources and to develop
294   appropriate management measures. Existing human development uses of the nearshore
295   include maritime infrastructure, shoreline armoring, dredging and dredge material
296   disposal, and other marine and/or estuarine construction projects. Examples of possible
297   emerging uses include wave and wind energy development, methane hydrate mining,
298   marine algae harvest, and aquaculture. There has been considerable interest in renewable
299   energy projects off the Oregon coast over the last two decades, with an interest in finding
300   solutions to our nation's energy needs. While the benefit of efficient alternative energy is
301   clear, more research and monitoring (once projects are built) is needed to understand the
302   potential and/or realized impacts of such development. Ballast water from shipping,
303   aquaculture and recreational boating have contributed to the introduction of non-native
304   and invasive species to Oregon's nearshore. Once established in Oregon, these species are
305   difficult to remove, so prevention of introductions is a preferable approach. An important
306   data need is how best to effectively prevent or mitigate the effects of such species
307   introductions.

308 CONCLUSION

309 As demonstrated above, there are considerably more data gaps than can be filled by any
310 one group or organization. Research and monitoring must be prioritized to address the
311 most pressing needs first. It also is important to develop conservation, research and
312 monitoring partnerships with the commercial and recreational fishing industries, other
313 state and federal agencies, universities, and appropriate non-governmental organizations
314 to maximize the effectiveness and efficiency of the work. ODFW continues to work with
315 partners to address conservation, research, and monitoring needs for SGCN.

316