Environmental Organizations' Joint Scoping Comments for the Humboldt Wind Energy Area Environmental Assessment

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1. Introduction

The following comments are submitted on behalf of Defenders of Wildlife, Natural Resources Defense Council, National Audubon Society, Ocean Conservation Research, Redwood Region Audubon, Sierra Club California, Humboldt Baykeeper, Surfrider Foundation, CA North Coast Chapter of The Wildlife Society, Environmental Information Protection C enter (EPIC), and Whale and Dolphin Conservation in response to the Bureau of Ocean Management's (BOEM) July 28, 2021 announcement and July 22, 2021 memo (Memo)[1] advising that a Wind Energy Area (WEA) for the Humboldt Call Area has been identified and advising that BOEM will conduct an environmental review pursuant to the National Environmental Policy Act (NEPA) to assess the potential environmental impacts associated with leasing some or all of the WEA. These comments are submitted on behalf of our organizations' millions of members in California.

Together, our organizations have long advocated for policies and actions to bring offshore wind projects to scale in an environmentally protective manner. We understand that developing renewable energy is pivotal for California to avoid the worst consequences of climate change, achieve a zero-carbon energy future, maintain our thriving economy, healthy communities, and our national role as an environmental leader.[2] Responsible development of offshore wind energy:

1. avoids, minimizes, mitigates, and monitors adverse impacts on marine and coastal habitats and the wildlife that rely on them;
2. reduces negative impacts on other ocean uses;
3. includes robust consultation with Native American tribes and communities;
4. meaningfully engages state and local governments and stakeholders from the outset;
5. includes comprehensive efforts to avoid negative impacts to environmental justice communities; and
6. uses the best available scientific and technological data to ensure science-based and stakeholder-informed decision making.

<u>Improving offshore wind planning</u>

As BOEM pursues offshore wind energy development on the Pacific Coast, BOEM has a responsibility pursuant to the administration's renewable energy goals to ensure its offshore wind permitting/leasing process is successful in addition to being in compliance with applicable environmental laws. This success depends on a development process that includes robust upfront planning and stakeholder engagement and sets a high environmental standard for this new ocean use technology. Our organizations have asserted repeatedly that a state and/or federal planning process that reflects environmental and other concerns will have the dual benefit of protecting biodiversity in the project area and mitigating the concerns of stakeholders in affected coastal communities.

We believe that BOEM, working in partnership with the state or independently, should

[1] BOEM 3799 Humboldt Area ID Memo (July 22, 2021)

[2] Audubon's science at https://climate.audubon.org finds that climate change may drive 389 species of North American birds to extinction if we cannot limit warming below 3 degrees Celsius. Bateman BL, Wilsey C, Taylor L, Wu J, LeBaron GS, Langham G. 2020. North American birds require mitigation and adaptation to reduce vulnerability to climate change. Conservation Science and Practice 2:e242.

facilitate an inclusive and transparent planning process with ocean-users and coastal stakeholders to identify least conflict lease areas. Identifying viable development sites will enable federal and state agencies to evaluate offshore wind energy projects more efficiently across the entire outer continental shelf (OCS) offshore California, rather than on an ad hoc basis.

Under the current process, leases are awarded for site assessment and characterization, and allow the developer to submit a construction and operations plan to the agency for approval. We acknowledge and agree that the issuance of any lease resulting from this sale would not constitute an approval of project-specific plans to develop offshore wind energy. These plans, if submitted by the lessee, would be subject to subsequent environmental, technical, and public review before a decision to advance the project development. However, while a lease is not a promise that a project will be constructed, any eventual development cannot occur without a lease. Having thorough environmental review conducted before leasing will help identify concerns before developers invest in site assessment work, and shapes development plans. Stakeholder engagement based on thorough review is more educated, which also advises the project development.

The San Joaquin Valley Least Conflict Solar Analysis[3] is an example of the value of a collaborative and orderly planning process that identified renewable energy development areas with least conflict with stakeholder values, and close to existing transmission. This project planning can serve as a tool for developers and a model for energy planning by state agencies. The six-month process continues to lead to environmentally sound and more efficient permitting and transmission planning of solar PV projects in the Central Valley of California.

The State of California has already stated the value of utilizing a landscape-level planning process to advance offshore wind energy development. The 2021 SB 100 Joint Agency Report states:

> *"The benefits of using landscape-level approaches for renewable energy and transmission planning include early identification and resolution of large issues or barriers to development, coordinated agency permitting processes, increased transparency in decision making, increased collaboration, avoidance of impacts, and more rapid development of environmentally responsible renewable energy projects."*[4]

It is crucial to California's renewable energy future, as well as to the future of the fledgling floating wind energy industry, that care be taken upfront to prioritize avoiding the most environmentally sensitive areas and adopt minimization/mitigation measures to ensure the first projects enjoy the greatest chances of success. Careful consideration of *how* we achieve this zero-carbon future is vital for protecting California's internationally treasured wildlife, landscapes, marine ecosystems, diverse habitats, and cultural resources. Some of the organizations that signed this letter are currently developing additional recommendations regarding how BOEM could improve their planning process in this regard and will share them

[3] https://sjvp.databasin.org/pages/least-conflict/
[4] https://efiling.energy.ca.gov/GetDocument.aspx?tn=237167&DocumentContentId=70349 at pg. 112

separately since they are outside the scope of this comment letter.

Robust monitoring, mitigation and adaptive management

For floating offshore wind to minimize harm to local ecosystems and move smoothly through the permitting process, it is imperative that all offshore wind energy development activities move forward with strong science-based protective measures in place to avoid, minimize, mitigate, and monitor impacts on coastal and marine habitats and wildlife. To achieve these desirable outcomes, BOEM must undertake robust planning to identify areas for offshore wind energy development and adopt measures to protect our most vulnerable threatened and endangered species during all stages of development, from site characterization and assessment, through construction and operations and decommissioning.

Monitoring before, during, and after- construction is essential to learning about the impacts of floating offshore wind development and for adaptive management and mitigation. Given the uncertainty of offshore wind energy impacts, BOEM's environmental analysis should be designed to improve our future understanding of impacts by providing sufficient baseline data to effectively assess wind farm development impacts in a Before After Control Impact (BACI) design strategy. These BACI surveys should be designed for long-term review and regularly sampled during the life of the wind farm and through its decommissioning.

In addition, given the uncertainty associated with impacts from floating turbine technology, we urge BOEM to consider phasing development of offshore wind projects in the Humboldt Bay WEA such that development can adapt and incorporate new information through construction, operation, and repowering/decommissioning.

Below we provide our recommendations to BOEM on what environmental factors should be included in its environmental analysis before, during, and after- construction to ensure informed consideration of leasing activities. Any new offshore wind energy development will have impacts on the environment. Recognizing that even the most conservation-oriented siting and operating decisions are unlikely to avoid all wildlife and habitat impacts, we offer preliminary minimization, mitigation, and monitoring recommendations to inform the environmental analysis. This preliminary list is not exhaustive, and we anticipate recommending further mitigation measures that are tailored to the location, scale, and other project specifics.

2. Summary of Project

Location

The Humboldt WEA is located off the northern California coast and begins 21 miles offshore the City of Eureka in Humboldt County, California. The area is approximately 28 miles in length from north to south and approximately 14 miles in width from east to west with the minimum depth at the eastern boundary being approximately 500 meters (m) extending out to 1100 m along the western boundary. BOEM has designated the entire ~206 square miles (132,369 acres) as a WEA.

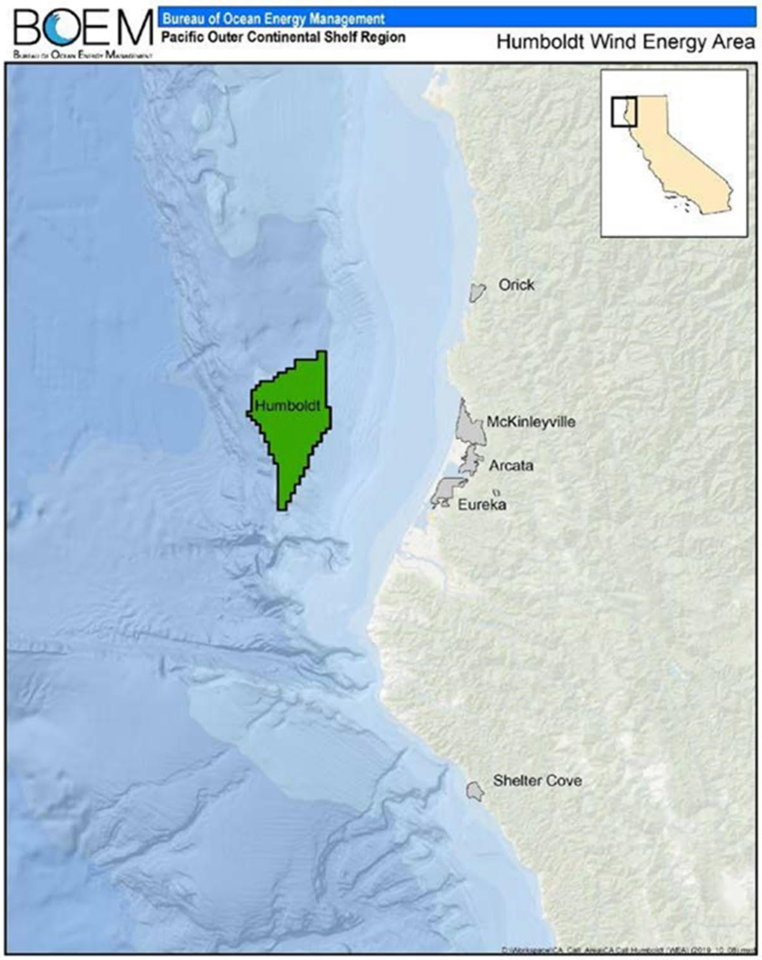

Figure 1. BOEM designated Humboldt WEA

Humboldt Wind Energy Area History

In September 2018, BOEM received an unsolicited lease request for offshore wind energy development from the Redwood Coast Energy Authority. In response to the unsolicited lease request, BOEM issued a Call for Information and Nominations in October 2018. BOEM received interest from ten developers who identified specific portions of the Call Area for obtaining commercial leases for wind energy projects.

Wind Energy Area and Environmental Review

The WEA encompasses the entire ~206 sq. mi. Call Area. BOEM has designated the WEA in anticipation of conducting one or more lease sales for offshore wind energy development. BOEM estimates an installed capacity of 1,605 MW with up to 8,435,880 MWh/year of power production.[5] An installed capacity of 1,605 MW could potentially result in a grid of an estimated 107 turbines with associated anchoring cabling and transmission cables and facilities spread across the WEA.[6]

[5] BOEM 3799 Humboldt Area ID Memo (July 22, 2021) pg. 2

[6] Based on 15 MW turbines

3. NEPA Requirements

NEPA is the nation's keystone environmental law, passed by Congress to "encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man." NEPA has two primary aims: "First, it places upon an agency the obligation to consider every significant aspect of the environmental impact of a proposed action. Second, it ensures that the agency will inform the public that it has indeed considered environmental concerns in its decision-making process."

For over half a century, NEPA has ensured that federal decision-making is based on a thorough consideration of its environmental impacts. NEPA requires all federal agencies to prepare a "detailed statement" for every "major federal action significantly affecting the quality of the human environment." 42 U.S.C. § 4332(C). Under NEPA, agencies must take "a 'hard look' at the possible effects of the proposed action."[7]

Public scoping is a critical first step in the NEPA process, used to determine the range of issues to be addressed in their environmental review and which issues are of greatest concern to the public. The scoping process requires the agency to "invite the participation of likely affected Federal, State, Tribal, and local agencies and governments, the proponent of the action, and other likely affected or interested persons" as well as involve the public. The ability of the public and other stakeholders to shape the scope of critical issues analyzed in the many stages of environmental review is critical to ensuring proper consideration of all appropriate impacts and alternatives.

It is important to note that in July 2020, the Council on Environmental Quality ("CEQ") published a final rule revising long-standing NEPA regulations. These regulations went into effect on September 14, 2020. Pursuant to President Biden's Executive Order 13990, these rules are being reviewed for possible repeal or replacement. Additionally, Interior Secretary Haaland issued a Secretarial Order stating that the 2020 rule will not be applied "in a manner that would change the application level of NEPA that would have been applied to a proposed action before the 2020 Rule went into effect on September 14, 2020."

<u>Cumulative Effects</u>

In determining the scope of the required NEPA analysis, an agency must consider not only the proposed action, but also three types of related actions—"connected actions," "similar actions," and "cumulative actions."[8] "Cumulative actions" are those "which when viewed with other proposed actions have cumulatively significant impacts."[9] NEPA's hard look "requires analysis of the combined impact that may result from…[the same activities occurring] over or near the same

[7] Wilderness Soc. v. U.S. Forest Serv., 850 F.Supp.2d 1144, 1154 (D. Idaho 2012).
[8] 40 C.F.R. § 1508.25(a) (repealed 2020).
[9] *Id*. § 1508.25(a)(2).

geographic area."[10] The cumulative impact analysis must be more than perfunctory; it must provide a "useful analysis of the cumulative impacts of past, present, and future projects."[11]

BOEM must include an analysis of cumulative impacts, as defined under the former 40 C.F.R. § 1508.7:

> *Cumulative impact* is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

<u>Alternative Analysis</u>

NEPA documents are required to have a statement of purpose and need for the proposed action.[12] Courts regularly have held that the statement of purpose and need should be defined to reflect the objective, general need for the proposed activity rather than the specific, narrow course of action preferred by the applicant or agency.[13] The statement of purpose and need must not be defined too restrictively, and may not be so narrowly defined as to reflect BOEM's preferred course of action rather than its underlying basic need and purpose.[14]

In turn, the purpose and need statement sets the stage for the agency's analysis of project alternatives. The NEPA process is intended to "inform decision makers and the public of the reasonable alternatives that would avoid or minimize adverse impacts or enhance the quality of the human environment."[15] The alternatives analysis is the heart of the environmental review process and is intended to provide a clear basis for choice among options by the decisionmaker and the public by rigorously exploring and objectively evaluating all reasonable alternatives to the proposed action.[16] The agency's review of alternatives must "serve as the means of assessing the environmental impact of proposed agency actions, rather than justifying decisions already made."[17] The alternatives analysis is the linchpin of the entire impact statement, and it is essential to the NEPA process that the decisionmaker be provided with a detailed and careful analysis of the relative environmental merits and demerits of the proposed action and possible alternatives."[18]

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[10] *Nat'l Audubon Soc'y v. U.S. Dep't of Navy*, 422 F.3d 174, 197 (4th Cir. 2005) (finding the Navy's cumulative impacts analysis for an airfield in eastern North Carolina insufficient and ultimately finding the challenged EIS unlawful).
[11] *Muckleshoot Indian Tribe v. U.S. Forest Serv.*, 177 F.3d 800, 810 (9th Cir. 1999) (citing *City of Carmel-by-the-Sea v. U.S. DOT*, 123 F.3d 1142, 1160 (9th Cir. 1997)).
[12] Id. § 1502.13.
[13] See, e.g., Citizens Against Burlington, Inc. v. Busey, 938 F.2d 190, 196 (D.C. Cir. 1991) ("[A]n agency may not define the objectives of its action in terms so unreasonably narrow that only one alternative from among the environmentally benign ones in the agency's power would accomplish the goals of the agency's action, and the EIS would become a foreordained formality"), cert. denied, 502 U.S. 994 (1991).
[14] *Id.*
[15] 40 C.F.R. § 1502.1 (repealed 2020).
[16] *Id.* § 1502.14(a)
[17] *Id.* § 1502.2(g).
[18] *NRDC v. Callaway*, 524 F.2d 79, 92 (2d Cir. 1975).

BOEM must carefully consider a full range of diverse and reasonable alternatives, including all necessary mitigation and monitoring of environmental impacts. Consideration of a just a simple no-action and a single action alternative in its analysis is insufficient, BOEM must evaluate a true range of diverse and reasonable alternatives.

4. Environmental Setting

Although the legislatively defined OCS is determined only by the distance from the coastline, the habitats located within these waters are varied and complex, with the diverse communities being shaped by a combination of depth and local geologic and oceanographic conditions.

The WEA is situated in the California Current System (CCS) and located adjacent to the coastal (200 m) Davidson Current which carries warmer, more saline water from the south into the cooler, fresher water travelling from the north in the CCS. The mixing of these different water masses makes the WEA highly dynamic and productive and an ecologically important pelagic habitat for many fish species, marine mammals, and seabirds.

The WEA is located between two submarine canyons, Trinidad Canyon, approximately 8.6 nm to the northwest, and Eel Canyon, approximately 4.9 nm to the south. Submarine canyons are well documented to serve as habitats, nurseries, forage areas, refugia, and carbon sequestration and storage areas.[19] It is unknown how development in proximity to these canyons may affect the canyons' ecosystem functions and services they provide. The important connection between banks, canyons and seamounts and oceanic productivity must not be overlooked in demarcating areas of special interest for California's coastal pelagic species (CPS) and highly migratory species (HMS) relative to the WEA.

The wind velocities above the ocean surface along the California coast can range from 1.6 to 31.2 ft/second at a reference height of 328 ft above sea level.[20] Per measurement from the National Oceanic and Atmospheric Administration (NOAA) weather buoy 46022, summer wind patterns are from the north/northwest with average peak wind speeds between 10.5 to 14 knots and up to 45.1 knots.[21] These winds move surface waters away from the coastline and are the primary drivers of upwelling, which brings deep, colder waters to the surface to replace warmer surface waters that have been advected offshore and contributes nutrient-rich surface waters that support biological productivity.[22]

[19] Fernandez-Arcaya, U., Ramirez-Llodra, E., Aguzzi, J., Allcock, A. L., Davies, J. S., Dissanayake, A., ... & Van den Beld, I. M. (2017). Ecological role of submarine canyons and need for canyon conservation: a review. *Frontiers in Marine Science*, *4*, 5.
[20] Musial, W., Beiter, P., Tegen, S., & Smith, A. (2016). *Potential offshore wind energy areas in California: An assessment of locations, technology, and costs* (No. NREL/TP-5000-67414). National Renewable Energy Lab.(NREL), Golden, CO (United States).
[21] National Data Buoy Center. 2019. Data for station 46022, Eel River—17NM WNW of Eureka, California. National Oceanic and Atmospheric Administration. https://www.ndbc.noaa.gov/station_page. php?station=46022
[22] Checkley, D. M., and J. A. Barth. 2009. Patterns and processes in the California Current System. Progress in Oceanography 83:49–64. https://doi.org/10.1016/j.pocean.2009.07.028

5. Ecological Considerations

The complexity and importance of California's marine ecosystem is well-documented and includes ecological areas of global significance. The California coast is home to hundreds of species and unique populations that are not found anywhere else on the planet. The overlap of "oceanographic processes in the region fosters the transport of materials, such as nutrients and fish and invertebrate larvae between the marine islands and coastal habitats and are primary food sources that support biological communities."[23]

6. Benthic Habitat and Species

Benthic habitat is classified primarily based on physical substrate and depth with the continental shelf being defined generally as extending out to 200 m isobath.[24] In California, the geological shelf extends offshore to the shelf break, a steep change in slope, which occurs at 130 m. The WEA is located well offshore of the continental shelf 200 m isobath on the lower continental slope ranging in depth from 500 - 1200 m. The habitats in these deeper regions of the continental slope off California are made up primarily of soft-bottom habitat with the dominant sediment type thought to be mud.[25] Recent work by Yoklavich et al. 2016[26] with an Autonomous Underwater Vehicle characterized 21,352 m^2 of seafloor habitat approximately 50 km to the north and south of the WEA at a depth of 695 - 1169 m. They found soft mud sediments (85%) and some mixed rock (12%) and observed 13,758 (20 species) corals, 2549 (8 species) sponges and 5580 (18 species) fishes.

The seemingly featureless continental slope habitat is, in fact, an extremely rich ecosystem that supports infaunal and microbial communities that play an important role in nutrient cycling and CO_2 exchange.[27] The microbial ecology of the continental slope oxidizes methane and sequesters carbon into marine sediments helping to mitigate climate change caused by these greenhouse gases.[28,29] Researchers are only just beginning to understand these microbial communities and their critical role in the global carbon cycle. Currently, there is not a comprehensive understanding of how these communities may react to localized and wide-spread disturbances to the deep-sea benthos. Nutrient cycling is also an important component of these communities which convert critical nutrients like nitrogen and phosphorus into biologically usable forms which support the growth and reproduction of marine organisms.[30]

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[23] *A Biogeographic Assessment of the Channel Islands National Marine Sanctuary: A Review of Boundary Expansion Concepts for NOAA's National Marine Sanctuary Program*, NOAA Technical Memorandum NOS NCCOS 21, November 2005. Available at: https://repository.library.noaa.gov/view/noaa/2161

[24] Allen, M.J. 2006. Continental Shelf and Upper Slope. In: All LG, Pondella DJ, Horn MH (eds). The Ecology of Marine Fishes: California and Adjacent Waters. University of California Press. Berkeley, CA; p. 167-202. ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/JournalArticles/488_continental_shelf.pdf

[25] Surpless, K. D., Ward, R. B., & Graham, S. A. (2009). Evolution and stratigraphic architecture of marine slope gully complexes: Monterey Formation (Miocene), Gaviota Beach, California. *Marine and Petroleum Geology*, *26*(2), 269-288.

[26] Yoklavich, M. M., Clarke, M. E., Laidig, T. E., Fruh, E. L., Krigsman, L., Anderson, J., & Romsos, C. (2016). A characterization of deep-sea coral and sponge communities in areas of high bycatch in bottom trawls off northern California.

[27] Thurber, A. R., Sweetman, A. K., Narayanaswamy, B. E., Jones, D. O., Ingels, J., & Hansman, R. L. (2014). Ecosystem function and services provided by the deep sea. *Biogeosciences*, *11*(14), 3941-3963. https://doi.org/10.5194/bg-11-3941-2014.

[28] Wallmann, K., Pinero, E., Burwicz, E., Haeckel, M., Hensen, C., Dale, A., & Ruepke, L. (2012). The global inventory of methane hydrate in marine sediments: A theoretical approach. *Energies*, Vol. 5. https://doi.org/10.3390/en5072449

[29] Orcutt, B. N., Sylvan, J. B., Knab, N. J., & Edwards, K. J. (2011). Microbial Ecology of the Dark Ocean above, at, and below the Seafloor. *Microbiology and Molecular Biology Reviews*, *75*(2). https://doi.org/10.1128/mmbr.00039-10

[30] Bristow, L. A., Mohr, W., Ahmerkamp, S., & Kuypers, M. M. M. (2017). Nutrients that limit growth in the ocean. *Current Biology*, Vol. 27. https://doi.org/10.1016/j.cub.2017.03.030

The slope ecosystem also supports habitat forming macro-invertebrates like sponges and corals that, in turn, support commercially important species of groundfish. Biogenic three-dimensional structures created by living organisms like sponges, sea pens, gorgonians and other types of coral support high densities and diversity of fishes and other marine life.[31] NOAA's National Deep-Sea Coral and Sponge Database, comprising data from 1842 to the present day, identifies coral and sponge resources within the Humboldt WEA.[32] These resources have slow growth rates and are long-lived species that provide habitat for a range of other species including important commercial species like deep-living rockfishes and thornyheads. As an example, Black corals (Order Antipatharia) are extremely slow growing and long lived and have been aged to 174 years old in California, though likely live much longer as some species of black coral in other areas have been aged to over 1000 years old.[33]

[31] Buhl-Mortensen, L., Vanreusel, A., Gooday, A. J., Levin, L. A., Priede, I. G., Buhl-Mortensen, P., Raes, M. (2010). Biological structures as a source of habitat heterogeneity and biodiversity on the deep ocean margins. *Marine Ecology*, *31*(1).

[32] NOAA National Deep-Sea Coral and Sponge Database 1842 – present [Internet]. National Oceanic and Atmospheric Administration [cited 2019 Jan 9]. Available from: https://catalog.data.gov/dataset/noaa-national-deep-sea-coral-and-sponge-database-1842-present. Information is based on observations from trawl surveys, by-catch data and other scientific surveys

[33] Love, M. S., Yoklavich, M. M., Black, B. A., & Andrews, A. H. (2007). Age of black coral (Antipathes dendrochristos) colonies, with notes on associated invertebrate species. *Bulletin of Marine Science*, *80*(2), 391-399.

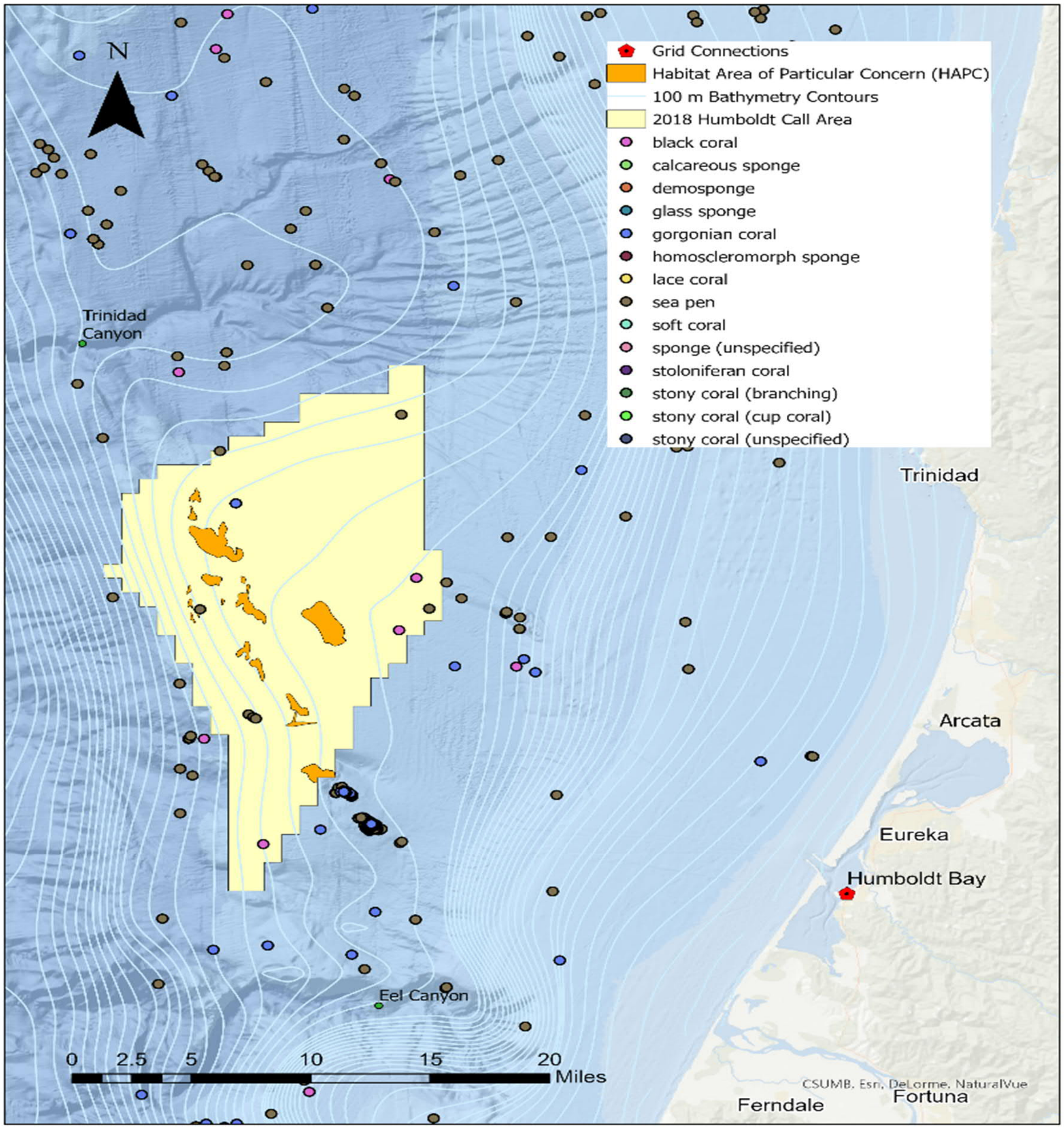

Figure 2. Bureau of Ocean Energy Management Humboldt Wind Energy Area showing overlap with Habitat Areas of particular concern and points showing individual coral and sponge locations from the NOAA Deep Sea Corals Research and Technology Program National Database

Table 1. Common Name Category points which indicate the location of a coral or sponge individual from the NOAA Deep Sea Corals Research and Technology Program National Database that overlap with the Humboldt WEA for Wind Power Development on OCS

Common Name Category	Count
black coral	3
glass sponge	5
gorgonian coral	1
sea pen	7
soft coral	1
sponge (unspecified)	2
Grand Total	**19**

Figure 3. Photos of deep slope benthic habitat and communities from Yoklavich et al. 2016

<u>Impacts to Benthic Habitat and Species</u>

Impacts to the benthic ecosystem will occur from all types of floating offshore wind energy platforms (semi-submersible, spar-buoy, tension leg), moorings (taut-leg, catenary, semi-taut) and anchoring systems (drag-embedded, driven pile, suction pile, gravity anchor), yet would vary based on the mooring and anchor system used. Research indicates that mooring lines do not remain in the same place, particularly in high sea states.[34] Models have indicated that mooring lines move across the seafloor, thereby affecting benthic habitat, in direct relation to increasing wave height. For example, in an experiment with 6 m waves, more than 60 square miles of

[34] Krivtsov, V., & Linfoot, B. (2012). [Disruption to benthic habitats by moorings of wave energy installations: A modelling case study and implications for overall ecosystem functioning.](#) *Ecological Modelling*, *245*, 121-124.

benthic habitat were affected.[35] At offshore wind farms, the interaction between turbine foundations and local hydrodynamics affect sediment characteristics by reducing flow and preventing the re-suspension of finer sediments and sand around a device.[36] [37] A taut-leg mooring system coupled with suction pile anchors is expected to have the smallest benthic footprint and should be assessed for deployment in the WEA.

Recent funding by the Ocean Protection Council has supported a range of analyses and reports on the different aspects of the build out and potential impacts conducted by the Schatz Energy Research Center at Humboldt State University.[38] There are significant data gaps related to the benthic community throughout the Humboldt WEA and along potential paths for the inshore cable routes that will be utilized to connect the offshore wind farms to the electrical grid. Results from EXPRESS cruises in the Humboldt WEA specifically designed to address these data gaps should be released by the end of 2021 and will help to further characterize existing conditions and some remaining data gaps.[39]

The WEA does not overlap with any state marine protected areas or with any currently designated federal marine protected areas. However, connections to the grid will proceed through state waters, and should avoid existing state marine protected areas (e.g., South Humboldt Bay State Marine Recreational Management Area) and other key environmentally important and sensitive habitats. Additional comprehensive analysis of the route and impact of the grid connection will be required to identify and minimize impacts to the nearshore habitats and the multitude of species that use them. Nearshore waters are already highly impacted, and the addition of wind farm-associated stressors merit a cautious approach to energy development in these waters.

Additional reports in the California North Coast Offshore Wind Studies collection[40] provide details on a few potential landfall options and on subsea transmission cables from Humboldt to the San Francisco Bay[41] which could be used to transfer energy to load centers in the Bay Area. Porter and Phillips 2020[42] identify landfall options that will require the export power cable to travel through Humboldt Bay. Both trenchless, where the cable would be installed via horizontal drilling below the substrate, and trenched options are discussed in the report. Humboldt Bay has

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[35] Krivtsov, V., & Linfoot, B. (2012). [Disruption to benthic habitats by moorings of wave energy installations: A modelling case study and implications for overall ecosystem functioning.](#) *Ecological Modelling*, *245*, 121-124.
[36] Coates, D. A., Deschutter, Y., Vincx, M., and Vanaverbeke, J. (2014). [Enrichment and shifts in macrobenthic assemblages in an offshore wind farm area in the Belgian part of the North Sea.](#) *Marine Environmental Research.* 95:1 12.
[37]Chen, L., Lam, W. H., & Shamsuddin, A. H. (2013, June). [Potential scour for marine current turbines based on experience of offshore wind turbine.](#) In *IOP Conference Series: Earth and Environmental Science* (Vol. 16, No. 1, p. 012057). IOP Publishing.
[38] Ocean Protection Council, “Staff Recommendation North Coast Offshore Wind Feasibility Analysis -October 25, 2018”, accessed August 4, 2021, https://opc.ca.gov/webmaster/ftp/pdf/agenda_items/20181025/Item7c_North-Coast-Offshore-Wind-Feasibility-Analysis_FINAL.pdf
[39] https://www.usgs.gov/centers/pcmsc/science/express-expanding-pacific-research-and-exploration-submerged-systems?qt-science_center_objects=0#qt-science_center_objects
[40] Schatz Energy Center, “Publications – California North Coast Offshore Wind Studies”, accessed August 4, 2021, http://schatzcenter.org/publications/
[41] H.T. Harvey & Associates, “Feasibility of Potential Subsea Cable Corridor Scenarios’. *in* M. Severy, Z. Alva, G. Chapman, M. Cheli, T. Garcia, C. Ortega, N. Salas, A. Younes, J. Zoellick, & A. Jacobson (Eds.) California North Coast Offshore Wind Studies. Humboldt, CA: Schatz Energy Research Center, 2020, http://schatzcenter.org/pubs/2020-OSW-R14.pdf.
[42] Porter, A., and Phillips, S., “Export Cable Landfall’, *in* M. Severy, Z. Alva, G. Chapman, M. Cheli, T. Garcia, C. Ortega, N. Salas, A. Younes, J. Zoellick, & A. Jacobson (Eds.) California North Coast Offshore Wind Studies. Humboldt, CA, Schatz Energy Research Center, 2020, http://schatzcenter.org/pubs/2020-OSW-R18.pdf.

over 30% of the eelgrass meadows remaining in California[43] and the terrestrial areas on both the north and south spit contain sensitive habitats including snowy plover nesting sites on the south spit. Both proposed cable runs would impact eelgrass if a trenched option were selected. It is critical to protect the state's remaining eelgrass and to avoid impacts to other sensitive habitats.

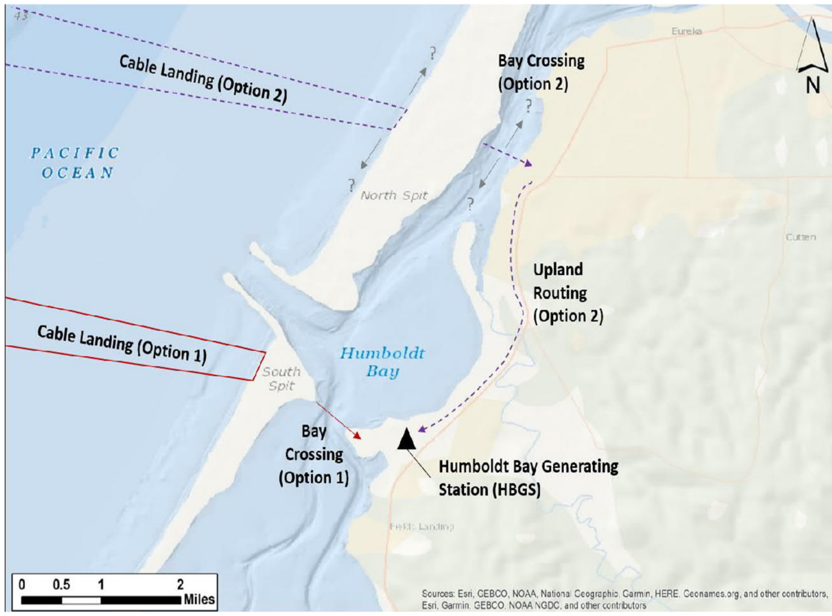

Figure 4. From Porter and Philips 2020, alignment Options 1 and 2 for cable landfall. Note that no specific Ocean Cable Landfall or Bay Crossing alignments were developed for Option 2, and the routes shown are conceptual.

<u>Required Analysis for Benthic Ecosystem</u>

BOEM's environmental analysis should identify and address data gaps for benthic habitats and species that could be potentially affected by the offshore wind project. There are some data available that describe the general type of benthic habitats in the WEA. However, BOEM's environmental analysis should include thorough benthic surveys within the WEA to identify areas with high levels of diversity and density of species to inform appropriate sites for offshore wind energy development. This analysis should include detailed ground truthing of current mapping, and mapping in areas where data gaps exist for the substrate and their biological communities. In addition, updated biological surveys may be needed in certain areas to ensure the offshore wind energy development sites are selected to minimize impacts to benthic communities.

These surveys will enable the drafting and implementation of robust avoidance, minimization, and mitigation measures to protect the benthic ecosystem. EXPRESS Cruise Data publications are forthcoming and will be critical to informing siting decisions and to evaluate potential impacts to the benthic communities for the Humboldt WEA. New technologies such as rapid deploy landers

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[43] Whelan A. Gilkerson and Keith W. Merkel, "Humboldt Bay Eelgrass Comprehensive Management Plan. Prepared for Humboldt Bay Harbor, Recreation and Conservation District", 2014, accessed, August 4, 2021. https://humboldtbay.org/sites/humboldtbay2.org/files/documents/Humboldt%20Bay%20Eelgrass%20Management%20Plan_10-10-17.pdf.

and autonomous underwater vehicles, and improvements to towed camera sleds will make this work highly feasible.

The Pacific Fisheries Management Council (PFMC) has designated several Habitat Areas of Particular Concern (HAPC), subsets of essential fish habitat (EFH) that have a particularly important ecological role in fish life cycles or are especially sensitive, rare, or vulnerable (Figures 5 and 6). HAPC fulfill important ecological functions and/or are especially vulnerable to degradation and designation by NOAA and the PFMC notes conservation priority status

There is some overlap of the Humboldt WEA and HAPC (Figure 5) and Humboldt Bay itself is designated as HAPC. We recommend that BOEM prioritize collection of fine-scale benthic habitat mapping within HAPCs before leasing these areas given the increased likelihood for conflict and environmental harm. Finer scale mapping will ensure that the necessary data is on hand to advise decision-making for any contemplated development within the HAPC.

In addition, it is critical that comprehensive pre-installation and continued monitoring at proposed offshore wind farms is implemented to assess impacts on not just the individual species present but also the biophysical processes which encompass abiotic and biotic conditions including the chemical, biological, physical, and ecological components. This type of monitoring will allow for assessment of impacts from installation and operation of offshore wind farms. Traditional oceanographic sampling of the water column including instrumentation to sample water movement and chemical components (e.g., NO_2, NO_3, CO_2, P) in spatiotemporal conjunction with benthic biological sampling will be needed to accurately assess ecosystem conditions pre- and post-installation.

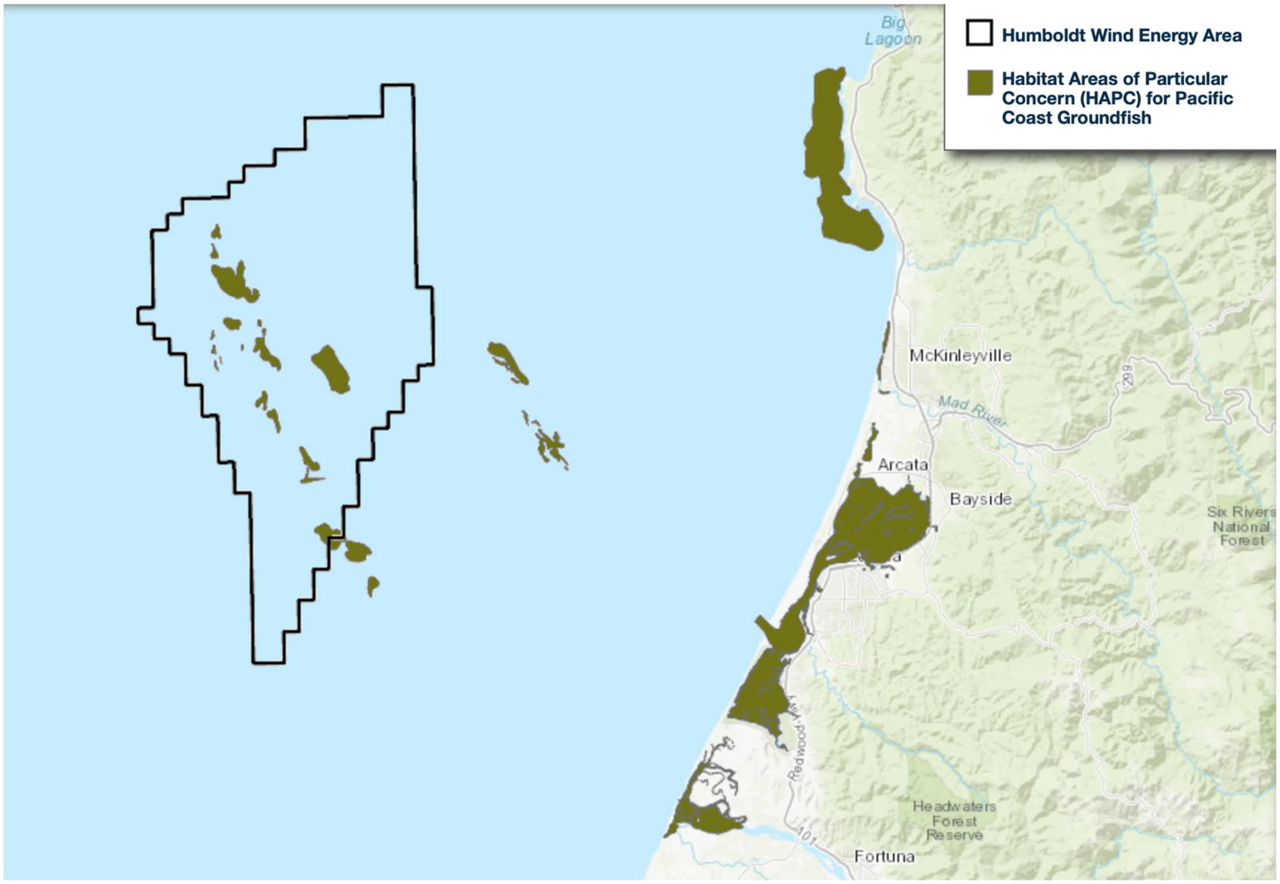

Figure 5. HAPC overlap with Humboldt WEA and Humboldt Bay. DataBasin.

<u>Recommended monitoring for benthic habitats and species</u>

BOEM should require lessees to conduct ongoing monitoring for impacts from site characterization and assessment, construction, operation and management (O&M), and decommissioning activities of offshore wind energy, essentially through the life of the project. Impacts could include, but are not limited to, scouring, changes to species diversity and density, and ecosystem disruption. Adaptive management actions must be implemented to reduce adverse impacts.

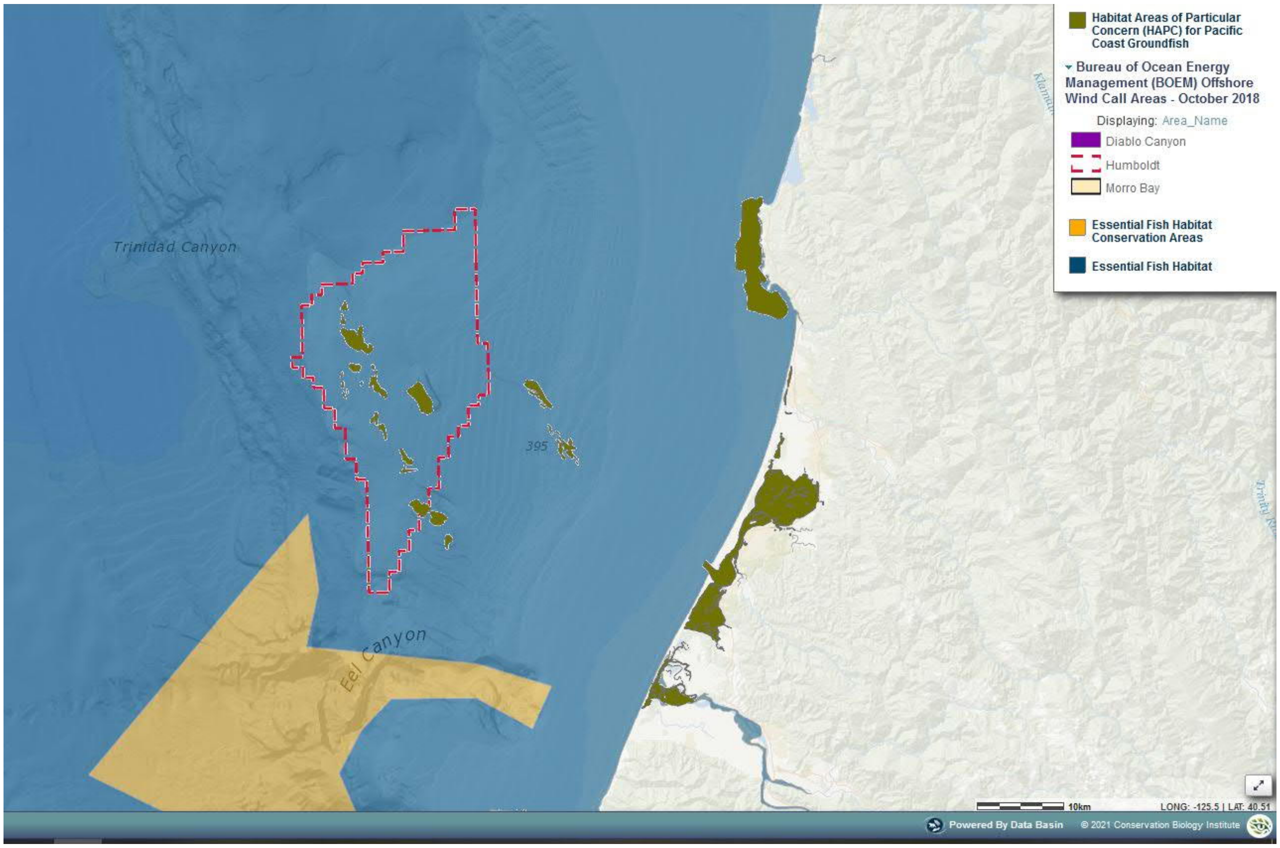

Figure 6. Humboldt WEA in red outline and Essential Fish Habitat Conservation Area (EFH CA) and the Pacific Fisheries Management Council Habitat Areas of Particular Concern (HAPC) for Groundfish.

7. Fish habitat and species

Along the California coastline, abiotic habitat varies greatly between seasons and years, and is also strongly impacted by weather phenomena such as El Niño/La Niña cycles and the Pacific Decadal Oscillation. These fluctuations often determine prey abundance of CPS and HMS species along the California coast, the most well-known example of which is the changing abundance of sardine and anchovy species.

The habitat features of CPS/HMS are mobile (fronts, upwelling, downwelling etc.) which means CPS and HMS often appear in different areas from year-to-year depending on abiotic habitat conditions (temperature, productivity etc.). By comparison, benthic/demersal species (i.e., groundfish species) which are more closely tied to fixed habitat structures generally experience lower levels of abiotic habitat variability. As it is easier to define fixed habitat areas for Groundfish species than for CPS and HMS, much of the California coast has been designated EFH for sheepshead, sturgeon, and skate. It must, however, be noted that benthic habitat is important for some CPS during certain stages of their life cycle. For example, market squid need benthic substrate to attach their egg cases to (usually in much shallower, coastal water than the WEA itself) and which would be impacted by the installation and maintenance of transmission lines.

Current HAPC types (estuaries, canopy kelp, seagrass, rocky reefs and “areas of interest”[44]) do not include a specific pelagic classification. The canopy kelp and seagrass could be construed as shallow pelagic habitat and such habitats do not exist in the WEA as they only occur close to the coast. However, they could be impacted by installation and maintenance of transmission lines, depending on cable siting decisions.[45,46] The important connection between banks, canyons and seamounts and oceanic productivity must not be overlooked in demarcating areas of special interest for California’s CPS and HMS relative to the WEA.

Coastal pelagic fishes (CPS)

CPS are generally not affiliated with fixed seafloor habitat features/types like many benthic/demersal species.[47] Instead, they are generally associated with prey abundance which commonly correlates with water temperatures and/or productivity. The distribution of EFH for CPS is therefore largely based upon a thermal range within the geographic area where a CPS species is present at any life stage – i.e., where the CPS has occurred historically during periods of similar environmental conditions. EFH for these species is therefore derived from distributional (presence/absence) data, oceanographic data (e.g., sea surface temperatures) and relationships between oceanographic variables.[48] Sea surface temperature is an important determinant of primary productivity/phytoplankton growth which in turn is closely linked to zooplankton production.[49] Zooplankton is the primary food source of many CPS and is therefore linked to resident CPS populations along the US West coast.[50]

[44] This includes submarine features such as banks, seamounts, and canyons
[45] https://inport.nmfs.noaa.gov/inport/item/39359
[46] *https://catalog.data.gov/dataset/seagrass-distribution-off-california*
[47] Note: although many shark species are classified as demersal and HMS, they are often wide-ranging foragers.
[48] https://www.westcoast.fisheries.noaa.gov/publications/habitat/essential_fish_habitat/coastal_pelagic_appendix_d.pdf
[49] Hays et al. Climate change and marine plankton. TREE. 2005. https://doi.org/10.1016/j.tree.2005.03.004
[50] Ware and Thomson, Bottom-up ecosystem trophic dynamics determine fish production in the Northeast Pacific, Science, 2005.

Table 2 Coastal Pelagic Species (CPS) present in the Humboldt WEA. Data based on relative, approximate extractions from PFMC stock assessment reports [51]

Species name		General distribution	Presence in Humboldt WEA (2016)	Important forage species	Notes
Common	Scientific				
Pacific sardine[52]	*Sardinops sagax*	Mexico to Alaska	Low	Yes	Appear seasonally in north
Pacific (chub) mackerel[53]	*Scomber japonicus*	Mexico to Alaska	Low	Yes	Most abundant south of Point Conception
Northern anchovy[54]	*Engraulis mordax*	Mexico to British Columbia	Low	Yes	N, central, & S subpopulations
Jack mackerel[55]	*Trachurus symmetricus*	Mexico to Alaska	High	Yes (only smaller Y1-Y2 individuals)	Most abundant in S California. Offshore late spring to early fall
Market Squid	*Doryteuthis opalescens*	Mexico to Alaska	High	Yes	Most abundant between Baja and Monterey Bay

Predicted average abundances of CPS species and their distributions are highly dynamic (based on the water temperature and planktonic productivity) and show annual variation. Therefore, labeling areas as high versus low abundance is not entirely reliable as the predictability of species distributions deteriorates under changing/novel environmental conditions in the CCS.[56] This is now more relevant as climate change-induced sea surface temperature anomalies have significant impacts on the distribution of CPS[57] and such changes are predicted to become more frequent.[58,59] With these large-scale changes in global oceanography , it is also likely that the distribution of CPS will change in response.

51 https://www.pcouncil.org/background-coastal-pelagic-species/
52 https://www.pcouncil.org/documents/2020/03/agenda-item-d-3-attachment-1-stock-assessment-report-executive-summary-assessment-of-the-pacific-sardine-resource-in-2019-for-u-s-management-in-2019-20-full-document-electronic-only.pdf/
53 https://www.pcouncil.org/documents/2019/06/appendix-b-pacific-mackerel-stock-assessment-june-2019.pdf/
54 https://www.pcouncil.org/documents/1978/03/northern-anchovy-fishery-final-environmental-impact-statement-and-fishery-management-plan.pdf/
55 https://www.pcouncil.org/documents/2019/06/appendix-b-pacific-mackerel-stock-assessment-june-2019.pdf/
56 Muhling, B. A., Brodie, S., Smith, J. A., Tommasi, D., Gaitan, C. F., Hazen, E. L., & Brodeur, R. D. (2020). Predictability of species distributions deteriorates under novel environmental conditions in the California Current System. *Frontiers in Marine Science*, *7*, 589. https://doi.org/10.3389/fmars.2020.00589
57 Cavole, L. M., Demko, A. M., Diner, R. E., Giddings, A., Koester, I., Pagniello, C. M., & Franks, P. J. (2016). Biological impacts of the 2013–2015 warm-water anomaly in the Northeast Pacific: winners, losers, and the future. *Oceanography*, *29*(2), 273-285.
58 Miyama, T., Minobe, S., & Goto, H. (2021). Marine Heatwave of Sea Surface Temperature of the Oyashio Region in Summer in 2010–2016. *Frontiers in Marine Science*. https://doi.org/10.3389/fmars.2020.576240
59 Oliver, E. C., Donat, M. G., Burrows, M. T., Moore, P. J., Smale, D. A., Alexander, L. V., & Wernberg, T. (2018). Longer and more frequent marine heatwaves over the past century. *Nature communications*, *9*(1), 1-12.

Highly Migratory Species (HMS)
Like CPS, HMS are generally not affiliated to fixed seafloor habitat features/types like many benthic demersal species.[60] Sea surface temperature is an important determinant of primary productivity/phytoplankton growth which in turn is closely linked to zooplankton production[61] and the distribution of CPS which often form a prey source for HMS.[62] Of the HMS of commercial interest in the CCS (Table 3), distributional prediction data is available for Common Thresher Sharks (*Alopias vulpinus*) and Blue Sharks (*Prionace glauca*).

Table 3. Commercially caught, Highly Migratory Species (HMS) present off the California coast
**Others may also include Opah (Lampris guttatus) and Basking (Cetorhinus maximus), Megamouth (Megachasma pelagios) and Great White (Carcharadon carcharias) sharks.*

Group	Species name		US West Coast US distribution		
	Common	Scientific	Juvenile	Adults	Adult SST range
Sharks	Common Thresher	*Alopias vulpinus*	Occur within 2 to 3 miles of the coast of Santa Barbara county through to Monterey Bay. Near surface waters.	Range extends north to Columbia River mouth	13 to 25°C
	Blue Shark	*Prionace glauca*	Oceanic waters – Mexico to Alaska		8 to 21°C
Tunas	Albacore	*Thunnus alalunga*	Oceanic waters – Mexico to Alaska		15 to 19°C
	Northern Bluefin	*Thunnus orientalis*	Mexico to Canada	No regular habitat inside US West coast EEZ	17 to 23°C
	Broadbill swordfish	*Xiphias gladius*	Mexico to Oregon	Southern and Central California	25 to 29°C

Groundfish
Groundfish species are those that live in close association with the seafloor so that their distribution is generally determined by seafloor habitats and in some cases, specific benthic features. The association between groundfish and non-mobile/stable habitat means it is easier to make predictions about their distribution compared to CPS and HMS whose habitat features are consistently dynamic.

[60] Note: although many shark species are classified as demersal and HMS, they are often wide-ranging foragers.
[61] Hays, G. C., Richardson, A. J., & Robinson, C. (2005). Climate change and marine plankton. *Trends in ecology & evolution*, *20*(6), 337-344. https://doi.org/10.1016/j.tree.2005.03.004
[62] Preti, A. (2020). *Trophic ecology of nine top predators in the California Current* (Doctoral dissertation, University of Aberdeen).

Table 4 Distance between the Humboldt WEA and groundfish species predicted ranges (offshore limit)

Distances are in miles.

Humboldt WEA	Cowcod Rockfish		California Skate	Scorpionfish
	Juvenile	Adult		
	7.7	4.3	2.17	NA

Salmon

Two salmon species are predominant in the CCS: Chinook and coho.[63] Several populations of both species are listed as threatened or endangered under the Endangered Species Act (ESA). Salmon can migrate ~3,000 miles in the ocean, and while there is a lack of detailed information on the offshore movement of salmon that could potentially overlap with the WEA, salmon originating in California rivers tend to have a more southerly ocean distribution and stay off the coast of California and Oregon as juveniles and adults.[64]

Impacts to fisheries

The inter-array mooring cables and anchors used to secure the floating turbine platforms are likely to cause benthic disturbance particularly during the construction phase but also during standard operation and maintenance due to wave and current scouring action. The installation and maintenance of transmission lines will cause benthic disturbance resulting in increased sedimentation which can adversely impact fish populations. Increased sedimentation may also cause the release of seabed sediment contaminants which could impact benthic spawning habitat quality of some fish species.[65]

Activities from all phases of offshore wind development including site characterization and assessment, construction, operations, and decommissioning will generate increased levels of underwater and above ground noise within the WEA and along export/transmission cable routes and at port facilities. Noise generation sources include site characterization and assessment activities, construction, operation, and decommissioning, noise generated from survey equipment, installation and operation of floating turbine systems and transmission lines, increased vessel traffic, and resonance from mooring cables and water currents.

Fish are able to detect vibration through their lateral line and inner ear and many species are known to be able to discriminate between sounds. Many species use acoustic signals to attract mates to spawn.[66] Pile driving activities have been shown to negatively impact fish physiology

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[63] Bellinger, M. R., Banks, M. A., Bates, S. J., Crandall, E. D., Garza, J. C., Sylvia, G., & Lawson, P. W. (2015). Geo-referenced, abundance calibrated ocean distribution of Chinook Salmon (Oncorhynchus tshawytscha) stocks across the West Coast of North America. *PLoS One*, *10*(7), e0131276. https://doi.org/10.1371/journal.pone.0131276

[64] Weitkamp, L.A. (2010). Marine Distributions of Chinook Salmon from the West Coast of North America Determined by Coded Wire Tag Recoveries. *Transactions of the American Fisheries Society*, 139 (1), 147-170:

[65] van Berkel, J., Burchard, H., Christensen, A., Mortensen, L. O., Petersen, O. S., & Thomsen, F. (2020). The effects of offshore wind farms on hydrodynamics and implications for fishes. *Oceanography*, *33*(4), 108-117.

[66] Hawkins, A. D., & Amorim, M. C. P. (2000). Spawning sounds of the male haddock, Melanogrammus aeglefinus. *Environmental Biology of Fishes*, *59*(1), 29-41. https://doi.org/10.1023/A:1007615517287

(causing abnormal heart rates and ear trauma) while also affecting behavior.[67] To date, there is no data on the acoustic impacts of the O&M of floating wind farms on fish behavior or physiology.

The generation of Electromagnetic Fields (EMFs) is of concern for fish species in close proximity with wind farms. Studies have shown that some fish species are magneto-sensitive and use geomagnetic field information for orientation purposes.[68] EMF effects can alter the ability to detect or respond to natural magnetic signatures, potentially altering fish survival, reproductive success, and migratory patterns. Long-lived slow reproducing elasmobranch species (sharks, rays, skates etc.) are of particular concern.[69,70,71,72] EMF deterrents have been successfully tested as depredation-mitigation devices in fisheries to reduce shark bycatch[73] which highlights the potential for offshore windfarm EMF has to alter shark behavior.

Additionally, the area between the WEA and the coast which has been designated as critical habitat for the ESA-listed green sturgeon (*Acipenser medirostris*) would be affected by the routing of transmission lines.

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[67] Thomsen, F., Lüdemann, K., Kafemann, R., & Piper, W. (2006). Effects of offshore wind farm noise on marine mammals and fish. *Biola, Hamburg, Germany on behalf of COWRIE Ltd*, *62*, 1-62.

[68] Öhman, M. C., Sigray, P., & Westerberg, H. (2007). Offshore windmills and the effects of electromagnetic fields on fish. *AMBIO: A journal of the Human Environment*, *36*(8), 630-633.

[69] Normandeau Associates Inc., Exponent Inc., Timothy Tricas, and Andrew Gill. 2011. "Effects of EMFs from Undersea Power Cables on Elasmobranchs and Other Marine Species." U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Regulation, and Enforcement, Pacific OCS Region, Camarillo, CA. OCS Study BOEMRE 2011-09; // Gill, A.B., Bartlett, Thomsen, F. 2012. Potential interactions between diadromous fishes of U.K. conservation importance and the electromagnetic fields and subsea noise from marine renewable energy developments. Journal of Fish Biology 81(2):664 695.

[70] Woodruff, D.L., V.I. Cullinan, A.E. Copping, and K.E. Marshall. 2013. Effects of Electromagnetic Fields on Fish and Invertebrates: Task 2.1.3: Effects on Aquatic Organisms: Fiscal Year 2012 Progress Report: Environmental Effects of Marine and Hydrokinetic Energy. PNNL-22154. Pacific Northwest National Laboratory (PNNL), Richland, WA (US); Gill, A.B., I. Gloyne-Phillips, J.A. Kimber, P. Sigray. 2014. Marine renewable energy, electromagnetic fields and EM-sensitive animals. In: Humanity and the Sea: marine renewable energy and the interactions with the environment. Eds. M. Shields and A. Payne.

[71] Kimber, J. A., Sims, D. W., Bellamy, P. H., & Gill, A. B. (2014). Elasmobranch cognitive ability: using electroreceptive foraging behaviour to demonstrate learning, habituation and memory in a benthic shark. *Animal cognition*, *17*(1), 55-65. 1-11.

[72] Halvorsen, M. B., Casper, B. M., Woodley, C. M., Carlson, T. J., & Popper, A. N. (2012). Threshold for onset of injury in Chinook salmon from exposure to impulsive pile driving sounds. *PLoS One*, *7*(6), e38968.

[73] Robbins, W. D., Peddemors, V. M., & Kennelly, S. J. (2011). Assessment of permanent magnets and electropositive metals to reduce the line-based capture of Galapagos sharks, Carcharhinus galapagensis. *Fisheries Research*, *109*(1), 100-106.

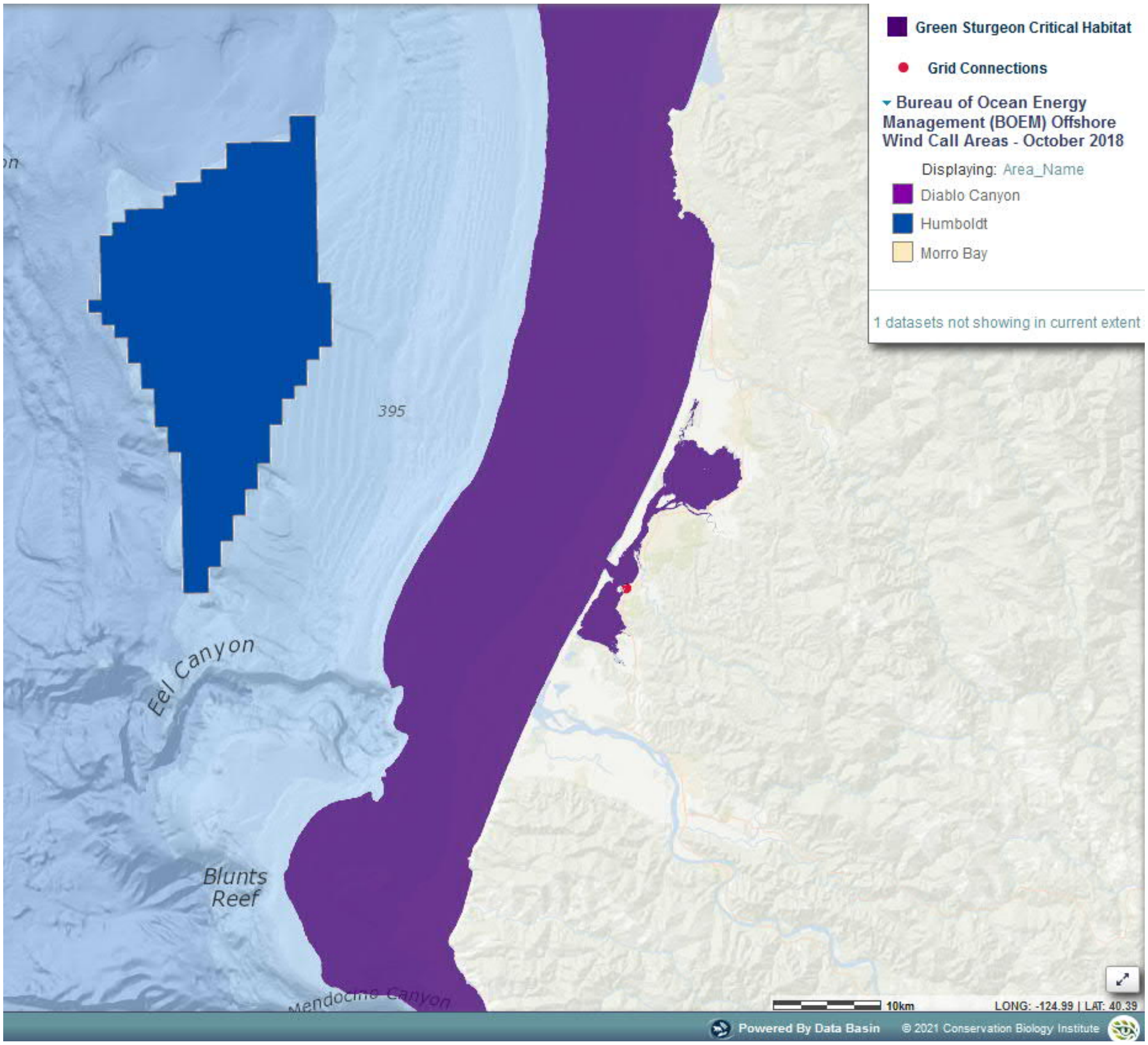

Figure 7. Humboldt WEA, grid connections, and green sturgeon critical habitat

Pollution impacts to fisheries

Offshore wind farm site characterization and assessment, construction and maintenance activities and associated vessel traffic can be a source of maritime pollution including trash, petrochemical spills, lost gear, and biowaste. Anti-fouling agents used to deter and/or kill marine growth on the mooring structures are a notable source of continued toxic chemical pollution. These biocidal agents which over time leach into water need to be reapplied periodically and can be lethal to pelagic fish.[74]

Entanglement impacts to fisheries

The presence of mooring cables and floating platforms in the WEA could pose a significant risk of entanglement of migratory fish through secondary entanglement. The many mooring lines and

[74] Amara, I., Miled, W., Slama, R. B., & Ladhari, N. (2018). Antifouling processes and toxicity effects of antifouling paints on marine environment. A review. *Environmental toxicology and pharmacology*, *57*, 115-130.

inter-array cables associated with an offshore wind development could cause marine debris to become entangled on the mooring lines and inter-array cables. This is of particular concern because discarded (ghost) fishing gear has a wide and/or long area by which to become attached to marine structures.[75] This Abandoned, Lost, or otherwise Discarded Fishing Gear (ALDFG) continues to entangle marine prey and predator species with deadly consequences. Fish and other smaller species caught in the abandoned gear can serve as a bait source for larger predators causing more unintended catch and death of these predators. For example, if a school of CPS becomes caught in an abandoned fishing net snagged on a wind turbine platform or mooring line, these CPS then act as bait for larger fish and eventually larger HMS that come to feed on these fish get caught by the nets. It is likely that with increased biofouling, there will be an increased risk of fishing gear entanglement as the wind farm structures become increasingly textured with marine life.[76]

Wind energy development will undoubtedly result in some change to the environment of the ~206 square miles of marine space of the Humboldt WEA though the precise scope and nature is difficult to predict. Changes in fish behavior in response to development of the Humboldt WEA are unpredictable and will likely vary with specific species. Any significant changes in fish behavior may cause alterations to aggregations, spawning events, and migration patterns. This may lead to increased energy expenditure of affected species from increased search for conspecifics and/or prey items and could also influence the ecological community structure of the WEA if ecologically important species avoid the area altogether. For example, the importance of apex predators such as sharks in maintaining food web structures has been noted in certain systems.[77] Reduced CPS abundance in the WEA could therefore have a dramatic impact on marine mammal and bird populations, many of which prey heavily on forage fish species.[78,79]

Required Analysis for Fisheries

BOEM has acknowledged that there are deficiencies in current fish and fishing data. It would therefore be beneficial, if possible (given data privacy issues), to combine logbook data, catch records and Automatic Identification System/Vessel Monitoring System data to give spatially explicit estimates of fish abundance and presence though at the least, a more thorough review of catch records is needed.

It will be useful to verify the migratory periods and any persistent or seasonally occurring oceanic habitat features associated with fish species of commercial interest and/or ecological importance that occur within the Humboldt WEA. If significant impacts from wind energy development are found, then knowledge of the timing and location of these habitat features may be used to reduce certain impacts. (For example,

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[75] http://www.fao.org/tempref/docrep/fao/011/i0620e/i0620e.pdf

[76] https://www.tandfonline.com/doi/abs/10.1080/08927014.2017.1317755

[77] Bornatowski, H., Navia, A. F., Braga, R. R., Abilhoa, V., & Corrêa, M. F. M. (2014). Ecological importance of sharks and rays in a structural foodweb analysis in southern Brazil. *ICES Journal of Marine Science*, *71*(7), 1586-1592.

[78] https://oceana.org/sites/default/files/reports/Forage_Fish_OCEANA_2011_final.pdf

[79] Cury, P. M., Boyd, I. L., Bonhommeau, S., Anker-Nilssen, T., Crawford, R. J., Furness, R. W., & Sydeman, W. J. (2011). Global seabird response to forage fish depletion—one-third for the birds. *Science*, *334*(6063), 1703-1706.; Smith, A. D., Brown, C. J., Bulman, C. M., Fulton, E. A., Johnson, P., Kaplan, I. C., & Tam, J. (2011). Impacts of fishing low–trophic level species on marine ecosystems. *Science*, *333*(6046), 1147-1150.; Lenfest Forage Fish Task Force, Little Fish Big Impact, 2013

by adopting temporal closures to vessel traffic and/or cessations in offshore wind development activity during important fish-related events (spawning, migration, aggregation etc.)). NOAA could apply a similar concept as a Biologically Important Area for cetacean species (BIA) to designate key habitat for CPS and HMS to help guide wind farm siting decisions, although the difficulty of defining habitat for pelagic species is noted above. New and better methods of stock assessments will be invaluable and should be targeted at species of importance related to windfarm development.

Acoustic and EMF effects and thresholds for fish species of interest/particular concern need to be established and compared to the levels of each that may occur when wind facilities are being built and when they are operational (and compared to background/ambient noise. It would be best to conduct these studies by running laboratory-based experiments before the wind facility is established. If time and/or budgets are limited, an effective approach to understanding these impacts would be to group functionally/biologically similar species and test individuals from each group. (For example, one small CPS (sardine or anchovy), one common shark species, one rockfish, and one benthic species.)

BOEM's environmental analysis should also consider the potential for unforeseen synergistic and cumulative adverse impacts of dramatic scale-up of floating wind farm technology. Synergies may include but are not limited to benthic disturbances, changes in fishing activities, and climate change impacts acting together, with the latter likely having significant impacts on coastal upwelling systems like the CCS.[80] A recent high-resolution modeling study[81] demonstrated that future climate change will lead to increased upwelling intensity along the CCS.

Recommended mitigation for fisheries

As referenced above, to preserve ecosystem functions that sustain the West Coast's valuable commercial fisheries, BOEM should avoid advancing leasing for the portions of the Humboldt WEA that overlap with HAPC until thorough benthic surveys of HAPC are conducted. In addition, we recommend that BOEM consider the following technologies and strategies to mitigate impacts to fisheries:

- Use of wave dampening technologies to reduce turbine movement and seafloor scour from anchors, mooring lines, transmission facilities and other wind farm infrastructure for the life of the project.
- Installation of radio-frequency identification (RFID) micro-chips on all survey equipment/ buoy components/ trawl nets to track and retrieve them when lost (as is being done by Adriatic countries to protect marine wildlife), to avoid contributing to marine debris.[82]
- Frequent and regular surveys of mooring lines and inter-array cables for derelict fishing gear or marine debris, noting that the potential for ensnarement of these materials around offshore wind structures will increase if biofouling increases over time. The

[80] Bakun, A., Black, B. A., Bograd, S. J., Garcia-Reyes, M., Miller, A. J., Rykaczewski, R. R., & Sydeman, W. J. (2015). Anticipated effects of climate change on coastal upwelling ecosystems. *Current Climate Change Reports*, *1*(2), 85-93.
[81] Xiu, P., Chai, F., Curchitser, E. N., & Castruccio, F. S. (2018). Future changes in coastal upwelling ecosystems with global warming: The case of the California Current System. *Scientific reports*, *8*(1), 1-9.
[82] ADRINET: Adriatic Network for Marine Ecosystem. https://adrinet.italy-albania-montenegro.eu/

frequency and type of monitoring, and how derelict gear would be removed should be included in all environmental assessments.

- Use of non-toxic alternatives as deterrents of marine growth on windfarm infrastructure components. Such alternatives could include wire-walker[83] cleaning devices for cables and manual cleaning of turbine bases, the application of long-lasting non-toxic chemical coatings and incorporation of non-toxic chemicals, or metal/plastic coverings into the design of underwater components of the infrastructure, etc. Avoid the use of biocides on any component of the wind project infrastructure.
- Refrainment of significant noise-producing activities such as construction, maintenance, and decommissioning activities during periods of significant ecological importance as identified by best available science.
- Use of acoustic dampening devices/attenuation technologies to minimize noise from wind farm site characterization and assessment, O&M, and decommissioning, including vessel noise[84] for the life of the project.
- Use of electromagnetic shielding technologies and/or insulations on transmission cables and turbine platforms if shown to be feasible, and If the developer is unable to demonstrably reduce electromagnetic impacts through measures such as insulation, burying, coating, etc., require suspension/curtailment of operation during ecologically important times (e.g., migrations, spawning etc.) as identified by best available science for the life of the project.

8. Marine Mammals and Sea Turtles

The CCS boasts the presence of an extensive diversity and density of large marine species including marine mammals and sea turtles.[85] This diversity and abundance of large marine species creates unique challenges for floating offshore wind energy development and offshore development activities. Large baleen whales including blue (*Balaenoptera musculus*), gray (*Eschrichtius robustus*), humpback (*Megaptera novaeangliae*), fin (*Balaenoptera physalus*), minke (*Balaenoptera acutorostrata*), sei (*Balaenoptera borealis*), and North Pacific right (*Eubalaena japonica*) whales inhabit the area. Additionally, the CCS boasts populations of sperm and killer whales, multiple species of beaked whales, several dolphin species, and pinnipeds. Many species or distinct populations are protected under the Endangered Species Act and all are covered by the Marine Mammal Protection Act (MMPA).

Critical Considerations for Cetaceans

The overlap of the Humboldt WEA with specific cetacean habitat is described below, yet there are several important environmental considerations that apply to cetaceans broadly. As BOEM proceeds toward an intended 2022 lease sale, the agency should consider the following: (1) there are limitations of NOAA's Biologically Important Areas (BIAs) as a primary data source for cetacean habitat; (2) offshore wind energy developments are likely to overlap with critical prey

[83] e.g. http://delmarocean.com/wirewalker/ - but adapted for cleaning of cables
[84] De Robertis, A., & Handegard, N. O. (2013). Fish avoidance of research vessels and the efficacy of noise-reduced vessels: a review. *ICES Journal of Marine Science*, *70*(1), 34-45.
[85] Block, B.A., Jonsen, I.D., Jorgensen, S.J., Winship, A.J., Shaffer, S.A., Bograd, S.J., et al. (2011). Tracking apex marine predator movements in a dynamic ocean. *Nature* 475(7354), 86-90.

resources, particularly krill; (3) there is a need to understand how climate change will influence dynamic marine habitat and how other stressors on cetaceans will change as a result.

BIAs and their current limitations

There are a variety of BIA designations, comprising reproductive areas, feeding areas, migratory corridors, and areas in which small and resident populations are concentrated. NOAA identifies BIAs through an expert consultation process with scientists, using available data sources, including boat-based and aerial survey data, tracking data, and expert opinion.[86] BIAs offer a necessary complement to habitat-based density models (e.g., NOAA CetMap); in addition to high density areas, BIAs may capture areas of critical importance to the survival of a species or stock where density of individuals may be low. However, while BIAs articulate key areas of importance, BIA designations are not comprehensive and are intended to be periodically reviewed and updated to reflect the best available scientific information.[87] In fact, West Coast BIAs are currently undergoing review, a process that may yield new or revised BIAs for a number of species, including humpback, gray, fin, and blue whales. The process is expected to be complete in December 2021.[88] We caution that BOEM and other agencies should not rely on BIAs as the sole indicator of habitat importance for species; rather, determinations about the importance of habitat should factor in multiple data sources, many of which are outlined herein.

For each cetacean species, we discuss currently designated BIAs and highlight relevant data sources that provide insight into additional habitats and movements that should be factored into responsible offshore wind development off the West Coast.

Overlap with prey resources

The CCS includes vitally important foraging habitat for cetaceans. For many CCS cetaceans, particularly large baleen whales including blue, humpback, and fin whales, krill is a particularly important resource.[89] It is therefore critical to understand the distribution of both cetacean prey (i.e., krill) and cetaceans when evaluating the potential impacts of offshore wind energy developments. The variation in krill distribution and the ability to predict these distributions suggests that offshore wind development and operations activities could be tailored to minimize disruptions to feeding whales during periods of high krill density (e.g., via seasonal restrictions on certain activities).

Climate change impacts

Climate change impacts, such as marine heat waves, may cause temporary or permanent shifts in habitat for cetaceans and possibly increase their presence in the Humboldt WEA. Predicted density of fin and humpback whales remained high or slightly higher in Humboldt during an anomalously warm year (2014) when the spatial extent of habitat was reduced, whereas blue

[86] Calambokidis, John, et al. "4. Biologically Important Areas for Selected Cetaceans within US Waters-West Coast Region." Aquatic Mammals 41, no. 1 (2015): 39.

[87] Van Parijs, S. M. (2015). Letter of Introduction to the Biologically Important Areas issue. In S. M. Van Parijs, C. Curtice, & M. C. Ferguson (Eds.), Biologically Important Areas for cetaceans within U.S. waters (p. 1). Aquatic Mammals (Special Issue), 41(1). 128 pp.

[88] See https://oceannoise.noaa.gov/biologically-important-areas

[89] Irvine, L. M., Mate, B. R., Winsor, M. H., Palacios, D. M., Bograd, S. J., Costa, D. P., & Bailey, H. (2014). Spatial and temporal occurrence of blue whales off the US West Coast, with implications for management. *PLoS One*, *9*(7), e102959.https://doi.org/10.1371/journal.pone.0102959

whale density decreased. In addition, warm temperate water odontocetes and, counterintuitively, several cool temperate water odontocete species increased in abundance, and a number of other cool temperate water odontocetes decreased. In fact, for fin and humpback whales, densities were predicted to be slightly higher in Humboldt during this warmer period (Figures 8 and 9).[90] This implies that climate change impacts, including increased ocean temperatures, may change and, in many cases, increase the relative density of cetaceans in this region. This underscores the importance of consulting climate change models to ensure responsible siting, mitigation, and monitoring in the Humboldt WEA.

In addition to climate change being a critical factor in considering timing of site assessment and construction activities, it may also cause the intensification of other stressors on whale populations, contributing to cumulative impacts. For example, a 2021 study on blue and humpback whales in the Gulf of the Farallones area found that the whales have been arriving earlier to the area, resulting in greater overlap with fisheries and increased entanglements beginning in 2014.[91] These overlaps were especially intensified in 2016 during the 2014-2016 heat wave due in part to delayed opening of the Dungeness crab fishery, concurrent with a shift in habitat use closer to shore by blue and humpback whales, resulting in a record high number of humpback whale entanglements in 2016.[92] The habitat compression caused by this marine heatwave increased whale presence closer to shore in 2015 and 2016, likely in response to the more available forage fish prey.[93]

Prey-switching by humpback whales in response to variations in ocean conditions is important to consider in offshore wind development, as whales may vary their distribution and foraging behavior between years, requiring adaptability in mitigation measures. These insights will be critical to understanding the appropriate timing for both construction and monitoring of offshore wind developments, particularly during anomalous years with marine heat waves and other climate driven changes that may affect the distribution of both marine mammals and human activities. Below, species-specific climate impacts are discussed, based on best available scientific information.

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[90] Becker, Elizabeth A., et al. “Predicting Cetacean Abundance and Distribution in a Changing Climate.” Edited by Maria Beger. Diversity and Distributions 25, no. 4 (April 2019): 626–43. https://doi.org/10.1111/ddi.12867
[91] Ingman, Kaytlin, et al. “Modeling Changes in Baleen Whale Seasonal Abundance, Timing of Migration, and Environmental Variables to Explain the Sudden Rise in Entanglements in California.” Edited by Songhai Li. PLOS ONE 16, no. 4 (April 15, 2021): e0248557. https://doi.org/10.1371/journal.pone.0248557.
[92] Santora, Jarrod A., et al. “Habitat Compression and Ecosystem Shifts as Potential Links between Marine Heatwave and Record Whale Entanglements.” Nature Communications 11, no. 1 (December 2020): 536. https://doi.org/10.1038/s41467-019-14215-w.
[93] Id. and Fleming, A. H., Clark, C. T., Calambokidis, J. & Barlow, J. Humpback whale diets respond to variance in ocean climate and ecosystem conditions in the California Current. Glob. Chang. Biol. 22, 1214–1224 (2016).

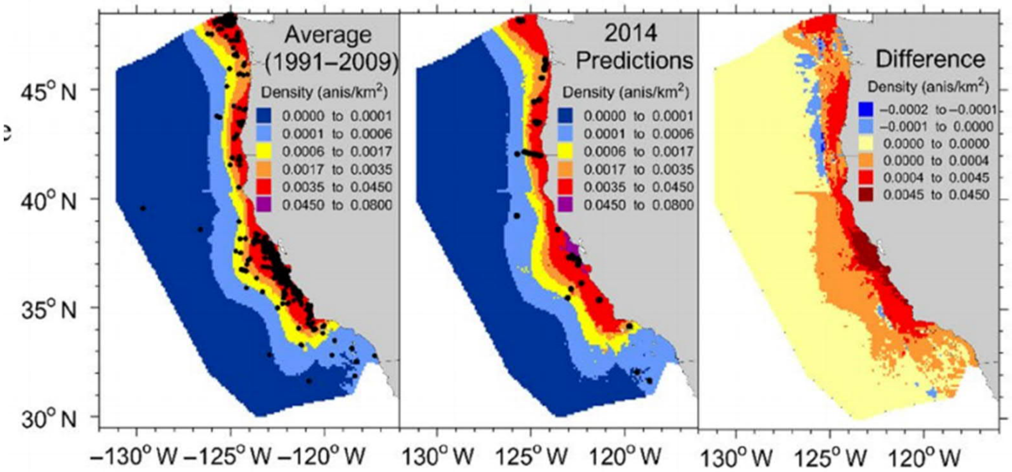

Figure 8. Humpback whale density. Predicted humpback whale density average from 1991-2009; predictions for 2014, and the difference between the average and 2014. [94]

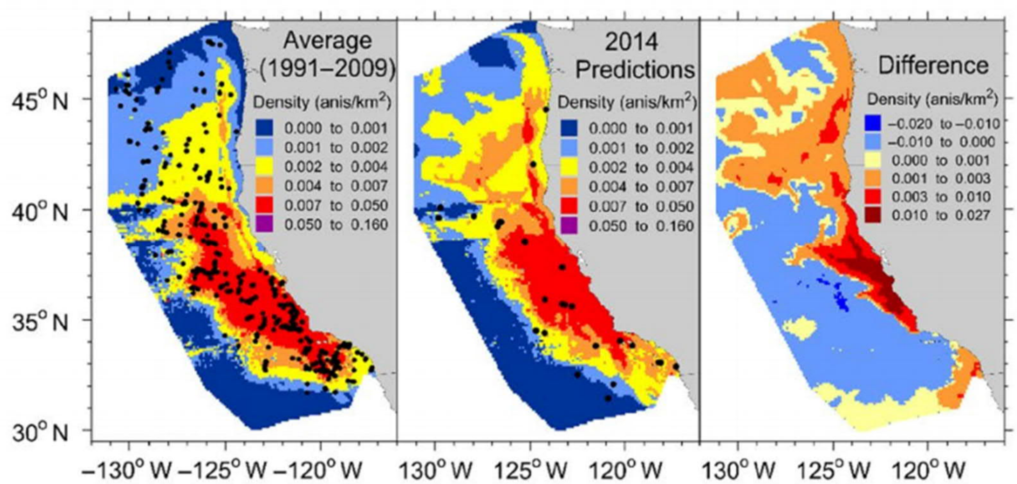

Figure 9. Fin whale density. Predicted fin whale density average from 1991-2009; predictions for 2014, and the difference between the average and 2014.[95]

Species-Specific Impacts and Overlap with Humboldt

As discussed above, NOAA is currently undertaking a review process that may yield new or revised BIAs for a number of species discussed below, including humpback, gray, fin, and blue whales. The process is expected to be completed in December 2021.[96] Accordingly, BOEM should incorporate those updated BIAs into its analysis.

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[94] Becker, Elizabeth A., et al. "Predicting Cetacean Abundance and Distribution in a Changing Climate." Edited by Maria Beger. Diversity and Distributions 25, no. 4 (April 2019): 626–43. https://doi.org/10.1111/ddi.12867.

[95] Id., Becker, Elizabeth A., et al. "Predicting Cetacean Abundance and Distribution in a Changing Climate." Edited by Maria Beger. Diversity and Distributions 25, no. 4 (April 2019): 626–43. https://doi.org/10.1111/ddi.12867.

[96] See https://oceannoise.noaa.gov/biologically-important-areas

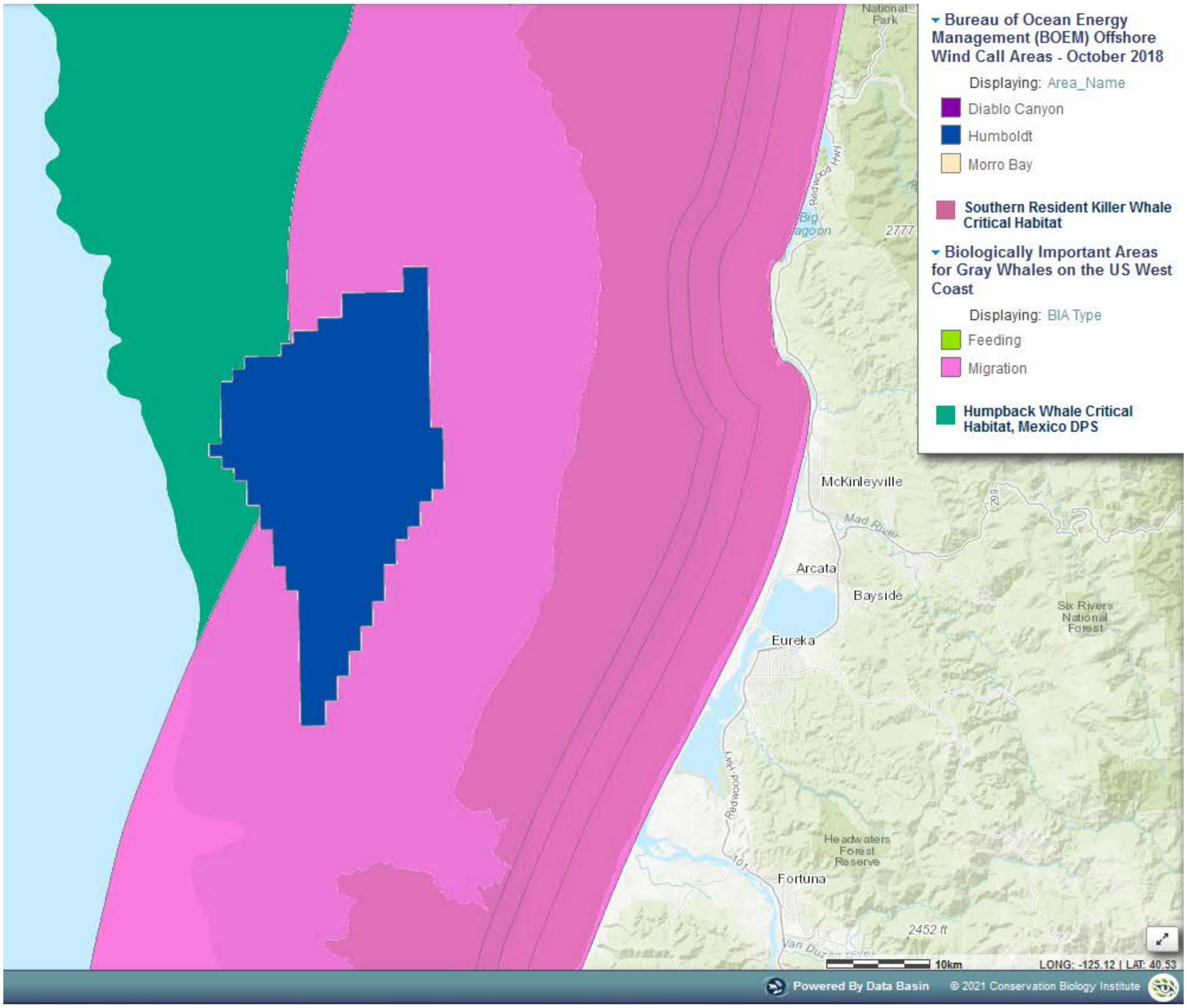

Figure 10. Humboldt WEA and designated critical habitat for Humpback and Southern Resident killer whales and gray whale BIA

Blue Whales

Blue whales are listed as "endangered" under the ESA and are "depleted" under the MMPA.[97] While blue whales and other vulnerable species have shown initial promising signs of recovery after the whaling era, many populations have stopped increasing and now face increasing threats from human impacts and activities in the ocean. Data through 2018 for the Eastern North Pacific (ENP) population models its abundance as 1,767 individuals, with numbers largely stable since the 1990s with a possible slight increase, although there is a sampling bias.[98]

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97 http://www.fisheries.noaa.gov/pr/species/mammals/whales/blue-whale.html

98 Calambokidis, J., & Barlow, J. (2020). Updated abundance estimates for blue and humpback whales along the U.S. West Coast using data through 2018. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-SWFSC-634. 20 pp.

Blue whales are found primarily on the continental shelf, and have greater probability of occurring in waters off California than offshore Washington or Oregon.[99] Blue whales' foraging habitat shifts depending on large scale oceanographic conditions (i.e., Pacific Decadal Oscillation) as the whales follow krill populations.[100] Satellite telemetry tracks of tagged ENP blue whales established the "overall" and "core" home ranges of the ENP population, both of which overlap with the Humboldt WEA.[101] Future shifts in feeding habitat may occur due to climate change – these potential shifts require further research.

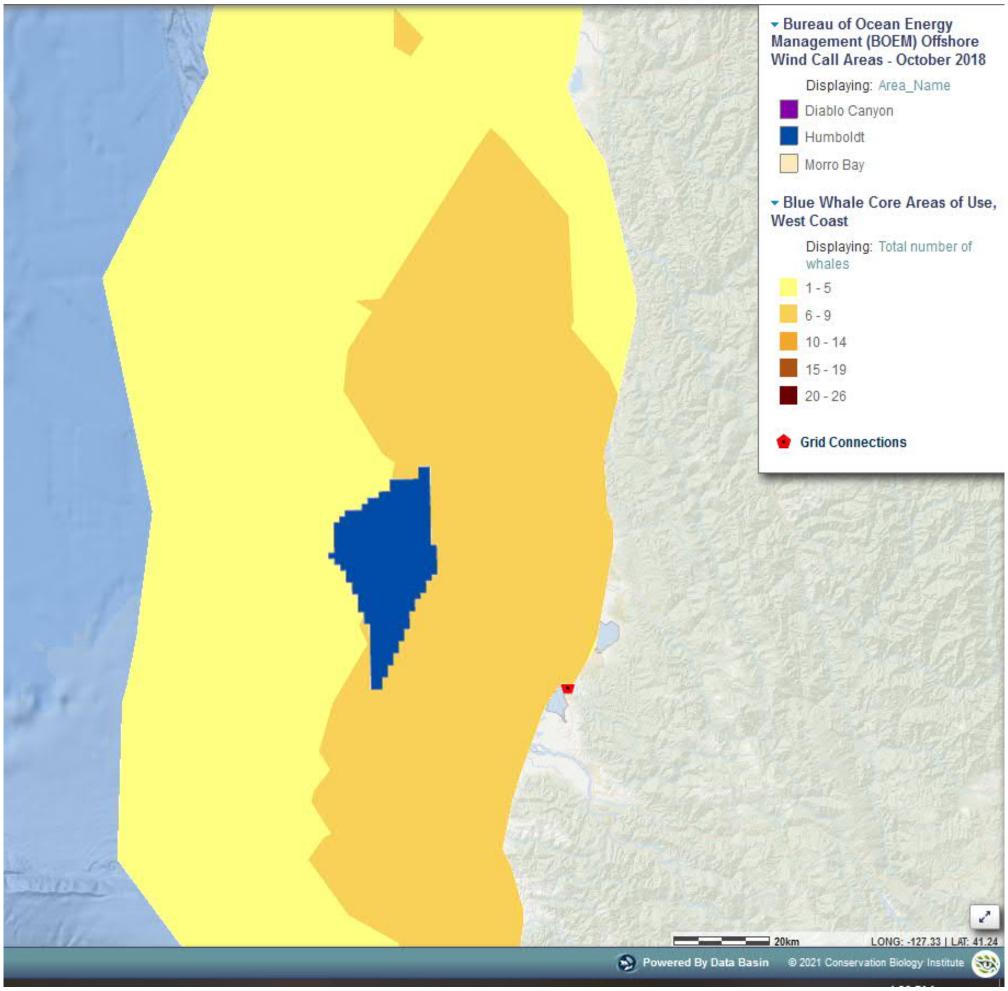

Figure 11. Blue whale use of the Humboldt WEA.

[99] Croll, D.A., Marinovic, B., Benson, S., Chavez, F.P., Black, N., Ternullo, R., et al. (2005). From wind to whales: trophic links in a coastal upwelling system. *Marine Ecology Progress Series* 289, 117-130.; Keiper, C., Calambokidis, J., Ford, G., Casey, J., Miller, C., and Kieckhefer, T.R. (2011). "Risk assessment of vessel traffic on endangered blue and humpback whales in the Gulf of the Farallones and Cordell Bank National Marine Sanctuaries". (Bolinas, CA: Oikonos.).

[100] Calambokidis, J., Steiger, G.H., Curtice, C., Harrison, J., Ferguson, M.C., Becker, E., DeAngelis, M., Van Parijs, S.M. (2015). Biologically Important Areas for Selected Cetaceans Within U.S. Waters – West Coast Region. *Aquatic Mammals, 41(1)*, 39-53. DOI 10.1578/AM.41.1.2015.39

[101] Irvine, L.M., Mate, B.R., Winsor, M.H., Palacios, D.M., Bograd, S.J., Costa, D.P., et al. (2014). Spatial and temporal occurrence of blue whales off the US West Coast, with implications for management. *PLoS One* 9(7), e102959.

Gray Whales

The WEA overlaps with BIAs for gray whale migration. Pacific gray whales are currently experiencing an ongoing Unusual Mortality Event (UME) due to unconfirmed causes, though poor body condition likely resulting from starvation has been observed over the course of the UME. The ENP population, while not listed under the ESA, has declined by an estimated 24% since 2016, currently numbering approximately 20,580 individuals.[102] The Western North Pacific (WNP) population is listed as endangered, and individuals have been documented along the migration route of the ENP population.[103]

While gray whales typically follow migration corridors close to shore (within 5.4 nm), it is important to note that gray whale BIAs also include a 25.4 nm buffer zone.[104] The buffer represents the potential path of some individuals that move farther offshore during annual southbound migration which occurs from October through March (peak December through March) and the northbound migration occurs from January through July (peak April through July).[105] This buffer overlaps with more than half of the footprint of the WEA and thus requires additional consideration of new data on migration and movement patterns of gray whales to better understand their utilization of the WEA.

The WEA also overlaps with the feeding range of the Pacific Coast Feeding Group (PCFG) of gray whales, a small group that may be a demographically independent unit of the ENP population, with an estimated 232 individuals.[106] The PCFG is highly vulnerable to impacts relative to the larger ENP population and thus must be treated as a separate management unit.

Humpback Whales

The entire WEA is within the recently designated Critical Habitat for the ESA-listed Central America and Mexico Distinct Population Segments (DPS) of humpback whales. [107] Together, the populations are considered the "CA/OR/WA stock" under the MMPA and have an estimated abundance of 4,973 individuals. [108]NMFS has also identified the Central America DPS as a

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[102] Stewart, J.D. & Weller, D.W. (2021). Abundance of eastern North Pacific gray whales 2019/2020. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-639.https://doi.org/10.25923/bmam-pe91
[103] Mate, B.R., Ilyashenko, V.Y., Bradford, A.L., Vertyankin, V.V., Tsidulko, G.A., Rozhnov, V.V., & Irvine, L.M. (2015) Critically endangered western gray whales migrate to the eastern North Pacific. Biol. Lett.11 (4), http://doi.org/10.1098/rsbl.2015.0071
[104] Calambokidis, J., Steiger, G.H., Curtice, C., Harrison, J., Ferguson, M.C., Becker, E., DeAngelis, M., Van Parijs, S.M. (2015). Biologically Important Areas for Selected Cetaceans Within U.S. Waters – West Coast Region. Aquatic Mammals, 41(1), 39-53. DOI 10.1578/AM.41.1.2015.39
[105] *Id.*
[106] Calambokidis, J., Laake, J. and Perez, A.. (2019).. Updated Analysis of abundance and population structure of season gray whales in the Pacific Northwest, 1996-2017. Final Report to NOAA, Seattle, Washington. pp. 1-72; Lang, A.R., Calambokidis, J., Scordino, J., Pease, V.L., Klimek, A., Burkanov, V.N., et al. (2014). Assessment of genetic feeding structure among eastern North Pacific gray whales on their feeding grounds. Marine Mammal Science, 30(4), 1473-1493. https://doi.org/10.1111/mms.12129; Frasier, T., Koroscil, S.M., White, B., & Darling, J. (2011). Assessment of population substructure in relation to summer feeding ground use in the eastern North Pacific gray whale. Endangered Species Research, 14, 39-48,https://doi.org/10.3354/ESR00340
[107] NOAA Office of Protected Species. "ESA Section 4(b)(2) Report In Support of the Final Designation of Critical Habitat for the Mexico, Central America, and Western North Pacific Distinct Population Segments of Humpback Whales (*Megaptera novaeangliae*)." (2020)
[108] Calambokidis, J. & Barlow, J. (2020). Updated abundance estimates for blue and humpback whales along the U.S. West Coast using data through 2018, U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-634.

demographically independent population ("DIP") under the MMPA, distinguishing it further from the CA/OR/WA stock.[109]

Critical Habitat is defined under the ESA (16 U.S.C. Section 1532(5)(A)(i) as an area with "physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection." Additionally, there are two established humpback whale feeding BIAs that occur within 27 nm to the north and 76 nm to the south of the WEA.

The WEA Area is within Unit 14 of critical habitat for both DPSs and borders Unit 15. Both areas are considered to have a high conservation value for each population.[110] NOAA's Office of Protected Resources states that "habitat units receiving a higher conservation value rating by Critical Habitat Review Team (CHRT) members are ones considered to be used by a relatively larger percentage of the DPS and contain higher quality feeding habitat."[111] Of these ratings, 'High' indicates habitats that are "important to the conservation of the DPS".[112] Further, NOAA's Southwest Fisheries Science Center (SWFSC) density models predict the WEA to overlap with regions of high or moderate density for humpback whales in the summer and fall.[113]

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[109] Martien, K. et al. (2019). "The DIP Delineation Handbook: A Guide to Using Multiple Lines of Evidence to Delineate Demographically Independent Populations of Marine Mammals." U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-622 at 33-34.

[110] NOAA Office of Protected Species. "ESA Section 4(b)(2) Report In Support of the Final Designation of Critical Habitat for the Mexico, Central America, and Western North Pacific Distinct Population Segments of Humpback Whales (*Megaptera novaeangliae*)." (2020)

[111] Id.

[112] These areas were determined after review of available scientific data by the Critical Habitat Review Team, which consists of biologists with expertise in humpback whales from NMFS and NOS.

[113] Becker E.A., Forney K.A., Fiedler P.C., Barlow J., Chivers S.J., Edwards C.A., Moore A.M., & Redfern J.V. (2016). Moving Towards Dynamic Ocean Management: How Well Do Modeled Ocean Products Predict Species Distributions? *Remote Sensing, 8(2)*:149. https://doi.org/10.3390/rs8020149

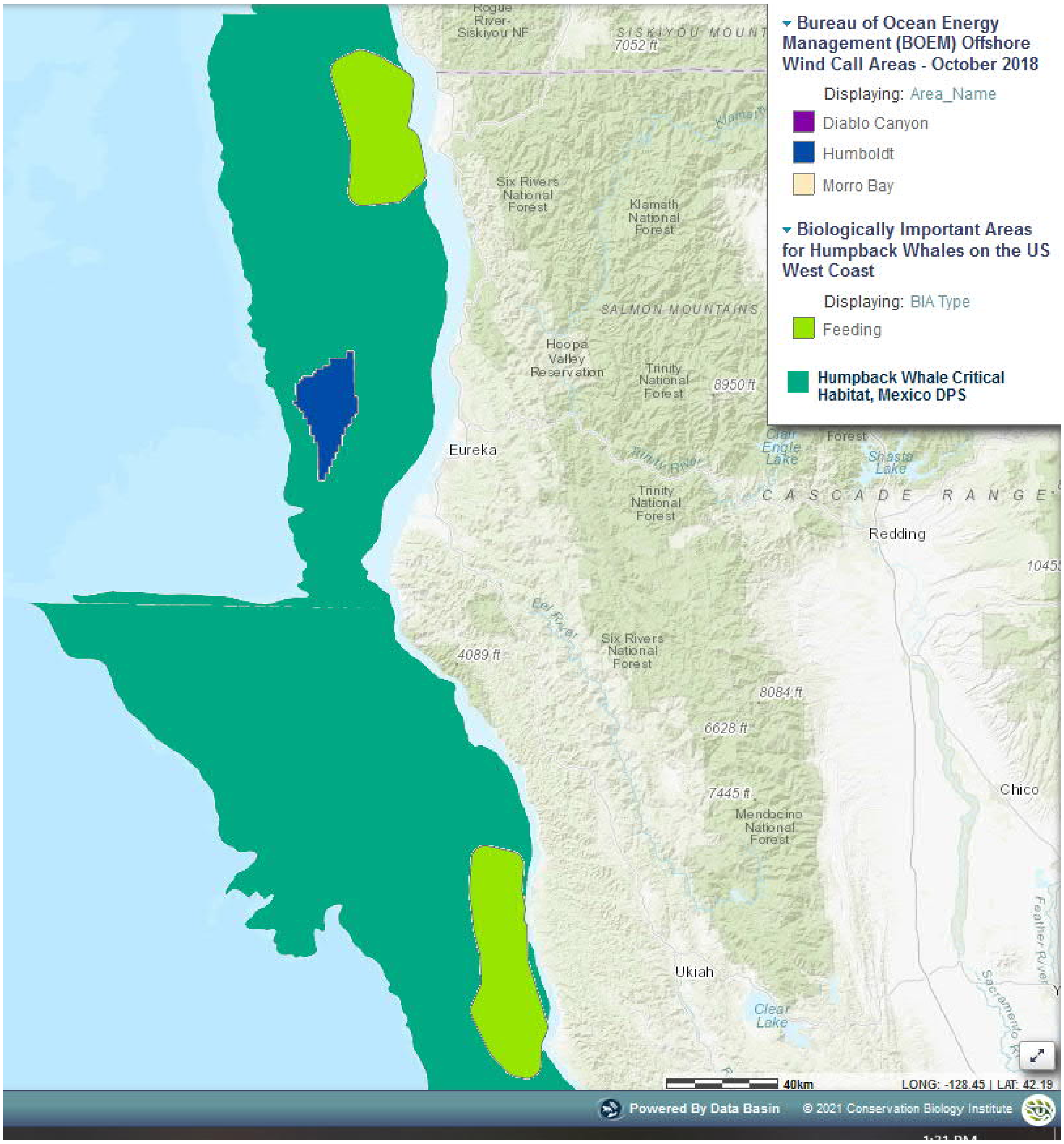

Figure 12. Humpback whale Critical Habitat and feeding BIAs.

Southern Resident Killer Whales

The Southern Resident killer whale (SRKW) DPS is highly endangered, with only 73 individuals remaining in the population as of September 20, 2021.[114] These are fish-obligate whales that rely almost exclusively on salmon as their primary source of food.[115] The Humboldt WEA is located ~5.4 nm to the west of the critical habitat designated in 2021, which includes waters from the 6m to 200m isobath from the Washington/Canada border to Point Sur, California. The area from the CA/OR border to Cape Mendocino is "Area 4: Northern California Coast Area", with prey as

114 Population data from Center for Whale Research. See https://www.whaleresearch.com/orca-population.

115 Hanson, M.B., Emmons, C.K., Ford, M.J., Everett, M., Parsons, K., Park, L.K., et al. (2021) Endangered predators and endangered prey: Seasonal diet of Southern Resident killer whales. PLoS ONE 16(3): e0247031. https://doi.org/10.1371/journal.pone.0247031

the primary essential feature of this area. [116] Transmission lines necessary for offshore wind energy development in the WEA would traverse this critical habitat located between the WEA and the coast, as would vessels transiting to the project area.

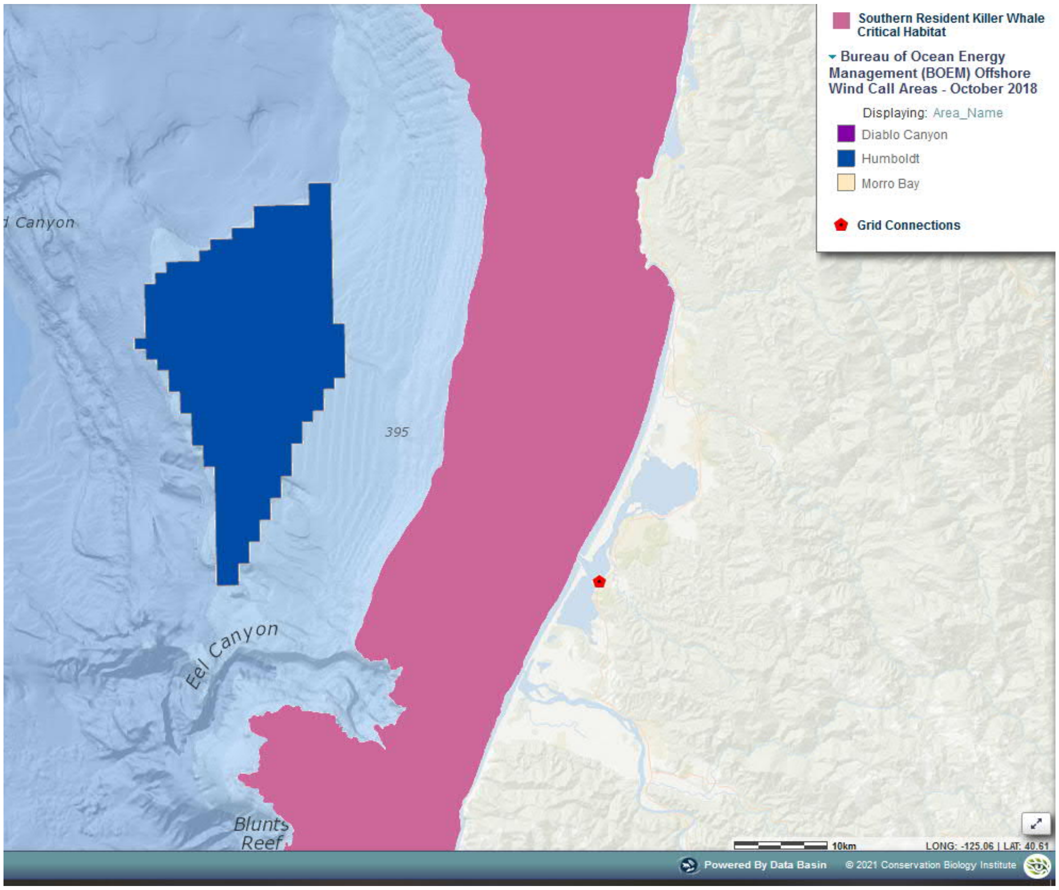

Figure 13. Southern Resident killer whale Critical Habitat

Approximately 50% of the available fall Chinook in Area 4 come from rivers in Northern California (Klamath and Central Valley).[117] Chinook salmon comprise the primary diet of the SRKWs year-round, as they travel between different regions to target seasonal concentrations of prey. K and L pods of the SRKW population have been recorded using the area January-April, and have been seen south of Area 4 in October.[118] While the SRKWs primarily use the area in the winter and early spring, it is possible they may be present at any time of year.[119] Biological Opinions for any wind energy area would need to assess the potential for jeopardy to the SRKWs as well as their

[116] NMFS. "Revision of the Critical Habitat Designation for Southern Resident Killer Whales Final Biological Report (to Accompany the Final Rule)," 2021. https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/critical-habitat-southern-resident-killer-whales.
[117] *Id*.
[118] *Id*.
[119] *Id.* and Hanson, M.B., Ward, E.J., Emmons, C.K., & Holt, M.M. (2018). Modeling the occurrence of endangered killer whales near a U.S. Navy Training Range in Washington State using satellite-tag locations to improve acoustic detection data. Prepared for: U.S. Navy, U.S. Pacific Fleet, Pearl Harbor, HI. Prepared by: National Oceanic and Atmospheric Administration, Northwest Fisheries Science Center under MIPR N00070-17-MP-4C419. 33 p

critical habitat and may require additional measures to mitigate impacts.[120] Noise and vessel traffic are major threats to SRKW and both would require mitigation during offshore wind construction, O&M, and decommissioning.

Fin Whales

Fin whales occur in both pelagic and coastal waters where they feed primarily on krill and fish. Fin whales are listed as endangered, and the CA/OR/WA stock is estimated to have a minimum population abundance of 8,127 individuals.[121] Current research suggests that only some fin whales migrate long distances, with parts of the population remaining resident in warmer waters of Southern California.[122] This variability in fin whale movements makes defining their BIAs difficult, thus none have yet been designated. Satellite tagging-based habitat suitability models suggest the Humboldt WEA falls in a low density or low-moderate habitat suitability region.[123] Shifts in feeding habitat may, however, occur due to climate change.

Minke Whales

Minke whales in California are usually sighted on the continental shelf.[124] Populations in coastal California waters are thought to be resident populations that establish home ranges although individuals in Alaska migrate to warmer waters for breeding.[125] The population size, status, and individual movements of minke whales in California are unknown, making assessment of any range overlap with the WEA and impacts from offshore wind energy development difficult.

North Pacific Right Whales

North Pacific right whales are one of the rarest of all large whale species and among the rarest of all marine mammal species.[126] There are fewer than 500 remaining in the North Pacific and likely around 30 individuals in the Eastern North Pacific population.[127] Potential overlap of North Pacific right whale habitat with the WEA is unknown. Very limited information exists on the distribution of North Pacific right whales. At least four sightings of North Pacific right whales from the eastern population occurred in Washington (one of which occurred since 1990), twelve

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120 NMFS. "Revision of the Critical Habitat Designation for Southern Resident Killer Whales Final Biological Report (to Accompany the Final Rule)," 2021. https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/critical-habitat-southern-resident-killer-whales.

121 Carretta, J.V., Oleson, E.M., Forney, K.A., Muto, M.M., Weller, D.W., Lang, A.R., Baker, J., Hanson, M.B., Orr, A.J., Barlow, J., Moore, J.E., & Brownell Jr., R.L. (2021). U.S. Pacific Marine Mammal Stock Assessments: 2020, Fin whale: CA/OR/WA Stock. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-646.

122 Calambokidis, J., Steiger, G.H., Curtice, C., Harrison, J., Ferguson, M.C., Becker, E., DeAngelis, M., Van Parijs, S.M. (2015). Biologically Important Areas for Selected Cetaceans Within U.S. Waters – West Coast Region. Aquatic Mammals, 41(1), 39-53. DOI 10.1578/AM.41.1.2015.39

123 Scales, K.L., Schorr, G.S., Hazen, E.L., Bograd, S.J., Miller, P.I., Andrews, R.D., et al. (2017). Should I stay or should I go? Modelling year-round habitat suitability and drivers of residency for fin whales in the California Current. *Diversity and Distributions* 23(10), 1204-1215; Becker E.A., Forney K.A., Fiedler P.C., Barlow J., Chivers S.J., Edwards C.A., Moore A.M., & Redfern J.V. (2016). Moving Towards Dynamic Ocean Management: How Well Do Modeled Ocean Products Predict Species Distributions? *Remote Sensing, 8(2)*:149. https://doi.org/10.3390/rs8020149

124 Carretta, J.V., A.R., Forney, Oleson, E., Weller, D. W., Lang, K. A., Baker, J., et al. (2017). U.S. Pacific Marine Mammal Stock Assessments: 2016. US Department of Commerce, NOAA Technical Memorandum, NMFS-SWFSC-577.

125 https://www.fisheries.noaa.gov/species/minke-whale

126 https://www.fisheries.noaa.gov/species/north-pacific-right-whale

127 Wright D.L., Castellote, M., Berchok, C.L., Ponirakis, D., Crance J.L., Clapham, P.J. (2018) Acoustic detection of North Pacific right whales in a high-traffic Aleutian Pass, 2009-2015. *Endang Species Res 37*:77-90. https://doi.org/10.3354/esr00915.

in California waters since 1950, and two off British Columbia in 2013.[128] Recent sightings include two separate pairs of North Pacific right whales in Alaskan waters, one of which was seen early in 2021 off British Columbia.[129] There have been two sightings offshore La Jolla, three in the Channel Islands, one each off Piedras Blancas, Big Sur, and Half Moon Bay, and four in the San Francisco vicinity. Thus, there is evidence of their migration through California waters to reach breeding grounds in Southern California or Mexico in the summer months;[130] however, the exact number of these whales that utilize this migratory route is unconfirmed,[131] and none were sighted in the vicinity of the Humboldt WEA.[132] Regardless, their highly vulnerable status and potential for North Pacific right whales to occur in the area require a robust monitoring and mitigation plan.

Other Cetacean and Pinniped Species

In addition to the species listed above, many other marine mammals utilize the deep waters around the continental shelf off California and are likely to overlap with the Humboldt WEA or be impacted by site assessment, cable-laying, and vessel activities. Other ESA-listed marine mammals found in this area include sei whales, sperm whales and Guadalupe fur seals.

Very little is known about sei whales, including a worldwide population estimate. They are typically observed in deeper waters and have an unpredictable distribution.[133] Sei whales can often be confused with blue and fin whales and they face similar threats including vessel strikes, entanglement, noise, and shifts in prey distribution.

Small cetaceans in the CCE may be present year-round, including two additional types of orcas (Transient and Offshore), bottlenose dolphins, common dolphins, harbor porpoises Dall's porpoises, Risso's dolphins, Pacific white-sided dolphins, short-finned pilot whales, and northern right whale dolphins.[134]

Guadalupe fur seals are listed as threatened and juveniles travel long distances from the species' breeding ground on Guadalupe Island off the coast of Mexico, and regularly strand on coasts from Northern California to Washington State.[135] A UME was declared for Guadalupe fur seals in 2015 and is still ongoing.[136]

[128] Ford, J.K.B., Pilkington, J.F., Gisborne, B. et al. Recent observations of critically endangered North Pacific right whales (*Eubalaena japonica*) off the west coast of Canada. Mar Biodivers Rec 9, 50 (2016). https://doi.org/10.1186/s41200-016-0036-3

[129] NOAA Fisheries. Sept 9, 2021. "Four Endangered North Pacific Right Whales Spotted in the Gulf of Alaska." https://www.fisheries.noaa.gov/feature-story/four-endangered-north-pacific-right-whales-spotted-gulf-alaska

[130] Crance, J.L, Berchok, C.L., Wright,, D.L., and Clapham, P. (2018). Can their Pacific cousins be saved? The plight of the North Pacific right whales and a comparison of two very different populations. Poster presentation. North Atlantic Right Whale Consortium 2018 Annual Meeting, New Bedford, MA, USA, 7-8 November, 2018.

[131] https://www.fisheries.noaa.gov/species/north-pacific-right-whale

[132] National Marine Fisheries Service. 2013. Recovery plan for the North Pacific right whale (*Eubalaena japonica*). National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD; Brownell Jr, R.L., and Clapham, P.J. (2001). Conservation status of North Pacific right whales. *Journal of Cetacean Research and Management* (2), 269-286.

[133] *See* NOAA Fisheries species directory: Sei whale. https://www.fisheries.noaa.gov/species/sei-whale

[134] NOAA Fisheries species directory, marine mammals: https://www.fisheries.noaa.gov/species-directory/marine-mammals

[135] NOAA Fisheries species directory: Guadalupe fur seal. https://www.fisheries.noaa.gov/species/guadalupe-fur-seal

[136] NOAA Fisheries 2015–2021 Guadalupe Fur Seal Unusual Mortality Event in California, Oregon and Washington: https://www.fisheries.noaa.gov/national/marine-life-distress/2015-2021-guadalupe-fur-seal-unusual-mortality-event-california

Other species of pinnipeds likely to overlap with the WEA include northern elephant seals and northern fur seals, both of which seasonally travel through and forage in deeper waters.[137] Further, as BOEM works with state agencies to permit the infrastructure to bring offshore wind power to shore, they should evaluate the importance of fragile coastal habitat to other marine mammal species.

Leatherback Sea Turtles

The Humboldt WEA does not fall within the Critical Habitat for the ESA-listed leatherback sea turtles designated.[138] However, the WEA overlaps with high density areas that were identified from habitat modeling approaches.[139]

Impacts to Marine Mammals and Sea Turtles

There is little data on how marine mammals respond to new disturbances within their habitats including the permanent introduction of physical structures, increased human activity, and vessel traffic. If enough large static objects are placed in the marine environment, larger marine mammals may avoid the area altogether, keeping them from important feeding, mating, rearing, or resting habitats, or from vital movement and migratory corridors.[140]

<u>Impacts to Marine Mammals</u>

Marine Mammals – Collision

There is no current evidence that large marine mammals are at risk of colliding with turbine platforms, mooring lines, or draped power cables associated with offshore wind energy infrastructure (OWEI), or any other existing infrastructure associated with the offshore petrochemical industry—the closest parallel to marine renewables moorings[141]—although the petrochemical industry platforms are typically much larger and are situated in an industrial noise field that whales may avoid. However, floating wind turbines of this scale have not yet been developed in important habitats for large baleen whales and so the potential impacts to naïve animals are unknown.

While fixed submerged structures are likely to pose little collision risk, cables, chains, power lines, and components that move freely on the surface or in the water column (i.e., the mooring lines and cables of floating turbines) may pose a collision risk.[142]

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137 NOAA Fisheries species directory, marine mammals: https://www.fisheries.noaa.gov/species-directory/marine-mammals
138 https://www.westcoast.fisheries.noaa.gov/maps_data/endangered_species_act_critical_habitat.html
139 Eguchi, T., Benson, S.R., Foley, D.G., and Forney, K.A. (2017). Predicting overlap between drift gillnet fishing and leatherback turtle habitat in the California Current Ecosystem. *Fisheries Oceanography* 26(1), 17-33.
140 Malcolm, I., Godfrey, J., and Youngson, A. 2010. Review of Migratory Routes and Behaviour of Atlantic Salmon, Sea Trout and European Eel in Scotland's Coastal Environment: Implications for the Development of Marine Renewables. Report published by Marine Scotland Science, Caithness, UK. Pp. 77.
141 Andrea E. Copping, Luke Hanna, Jonathan Whiting, Nichole Sather. (2016). What do we know about environmental effects of marine renewable energy devices? the state of the science in 2016 White paper/lit review. https://tethys.pnnl.gov/sites/default/files/publications/Copping-et-al-2016-METS.pdf.
142 Wilson, B., Batty, R.S., Daunt, F., and Carter, C. 2007. Collision risks between marine renewable energy devices and mammals, fish, and diving birds. Report to the Scottish Executive, Scottish Association for Marine Science, Oban, Scotland, PA37 1QA; Inger *et al.* 2009.

This would particularly be the case with rorquals and humpbacks that lunge feed on aggregations of small fish and invertebrates down to 300m. Lunge feeding involves their acceleration up to 6m. sec^{-1} (~20 kph^{-1} or ~13 mph, the equivalent velocity of a human runner), opening their jaws up to 90 degrees from their body,[143]capturing their body-weight in food-laden water, closing their jaws, and expelling the water through their baleen.[144] Executing lunge feeding maneuvers amidst a web of mooring and inter-array cables poses a number of potential threats. Midwater structures serve as fish aggregating devices for pelagic forage fish that these lunge feeders prefer by these lunge-feeders[145] So mooring lines and cables have the potential to damage the baleen upon collision with a feeding whale that may result in permanent impairment of the animal's ability to feed.[146]

Collisions with ships are a leading cause of baleen whale mortality on the West Coast.[147] Increased vessel traffic associated with all phases of offshore wind energy development poses an increased ship strike risk for marine mammals, particularly baleen whales. The risk of serious injury and mortality from vessel collisions increases significantly with vessel speeds of 10 knots or greater.[148]

Primary and secondary entanglement

The potential for wildlife to become entangled with mooring lines and dynamic inter-array cables is one of the key differences between fixed foundations and floating offshore wind technology. Floating offshore wind farms have an extensive network of mooring lines and inter-array cables that connect turbines to one another and to the floating substation, and export cables that transport electricity from the offshore substation to transmission grid/onshore service platforms. The inter-array power cables connecting turbines are likely to have curvature and will sit roughly 100 m below the surface.

Entanglement risk takes two forms: "primary entanglement" where wildlife becomes entangled directly in the mooring lines and cables; and "secondary entanglement" where abandoned, lost, or discarded fishing gear or other marine debris gets caught on mooring lines and subsequently entangles species.

Entanglement and entrapment may cause death by drowning or starvation or may lead to serious injuries and sublethal impacts that can compromise an animal's health and impair its ability to reproduce. Entrapment can be defined as physically trapping an animal or causing

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143 Goldbogen, J. A., Calambokidis, J., Shadwick, R. E., Oleson, E. M., McDonald, M. A., & Hildebrand, J. A. (2006). Kinematics of foraging dives and lunge-feeding in fin whales. Journal of Experimental Biology. 209(7): 1231–1244

144 Fossette, S.; Abrahms, B.; Hazen, E. L.; Bograd, S. J.; Zilliacus, K. M.; Calambokidis, J.; Burrows, J. A.; Goldbogen, J. A.; Harvey, J. T.; Marinovic, B.; Tershy, B.; Croll, D. A. (2017). Resource partitioning facilitates coexistence in sympatric cetaceans in the California Current. Ecology and Evolution. 7 (1): 9085–9097. doi:10.1002/ece3.3409.

145 Workman, Ian K.; Landry, Jr., André M.; Watson, Jr., John W.; Blackwell, John W. A. Midwater Fish Attraction Device Study Conducted from Hydrolab. University of Miami - Rosenstiel School of Marine and Atmospheric Science. Bulletin of Marine Science, Volume 37, Number 1, July 1985, pp. 377-386(10).

146 Id.

147 Rockwood, R. C., Calambokidis, J., & Jahncke, J. (2017). High mortality of blue, humpback and fin whales from modeling of vessel collisions on the US West Coast suggests population impacts and insufficient protection. *PloS one*, *12*(8), e0183052.

148 Conn, P. B., & Silber, G. K. (2013). Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. *Ecosphere, 4*(4), 1-16.

confusion in or around a set of mooring lines.[149] In planning for commercial-scale offshore wind energy development in federal waters offshore California, it is important to note that several marine mammal populations off the West Coast, including blue whales and humpback whales, are at increased risk from human activities, including entanglement[150], and cannot withstand additional entanglement risk.

Primary Entanglement

It is possible that marine mammal species will be able to detect the large diameter mooring lines, either through echolocation, vibrations detected through vibrissae (in the case of pinnipeds), or basic acoustic detection (hearing) as lines and cables produce noise in proportion to current flow.[151] Scientists also suggest that the risk of primary entanglement is low given that the cables and mooring lines are relatively taut and likely to be of a large enough diameter to preclude entanglement of even a large whale.[152] Additionally, the mooring lines have less curvature and are made of more rigid material than fishing lines, resulting in little to no risk of loop creation and subsequent entanglement.[153]

Catenary moorings are the most slack of the various anchoring options, and thus pose the greatest potential risk of primary entanglement, but entanglements have not been reported for oil platforms with similar configurations.[154] In waters offshore Scotland, where there is the only commercial-scale floating offshore wind development, there are killer whales, long-finned pilot whales, sperm whales, fin whales, and minke whales, as well as pinnipeds.[155] No primary entanglement of marine mammals in mooring lines, cables, or related gear has been reported for floating turbines in Scotland since operation began in October 2017. However, large migratory populations of baleen whales are not present in the North Sea, so results from Europe cannot be generalized to U.S. West Coast where baleen whales occur in high densities, and where foraging patterns (e.g., humpback whales lunge-feeding in mid-water columns) differ from species in the North Sea. Further, surveys of inter-array and mooring lines are conducted annually and biennially, so there is incomplete information about the frequency of entanglement or gear ensnarement.

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[149] https://www.fisheries.noaa.gov/west-coast/science-data/pacmapps-pacific-marine-assessment-program-protected-species

[150] Saez, L., D. Lawson, and M. DeAngelis. 2021. Large whale entanglements off the U.S. West Coast, from 1982-2017. NOAA Tech. Memo. NMFS-OPR-63A, 50 p.; NMFS (2020) 2019 Blue Whale (Balaenoptera musculus musculus): Eastern North Pacific Stock (https://media.fisheries.noaa.gov/dammigration/2019_sars_bluewhale_enp.pdf);NMFS (2020) 2019 Humpback Whale (Megaptera novaeangliae): California/Oregon/Washington Stock (https://media.fisheries.noaa.gov/dam-migration/2019_sars_humpbackwhale_cawaor.pdf)

[151] https://www.fisheries.noaa.gov/west-coast/science-data/pacmapps-pacific-marine-assessment-program-protected-species

[152] Bailey, H., Brookes, K. L., & Thompson, P. M. (2014). Assessing environmental impacts of offshore wind farms: Lessons learned and recommendations for the future. Aquatic Biosystems, 10, 8; Benjamins, S., Harnois, V., Smith, H. C. M., Johanning, L., Greenhill, L., Carter, C., & Wilson, B. (2014). *Understanding the potential for marine megafauna entanglement risk from renewable marine energy developments*.

[153] Benjamins *et al.*, (2014) *id*.

[154] Harnois, V., Smith, H. C. M., Benjamins, S., & Johanning, L. (2015). Assessment of entanglement risk to marine megafauna due to offshore renewable energy mooring systems. *International Journal of Marine Energy*, *11*, 27–49. https://doi.org/10.1016/j.ijome.2015.04.001

[155] Gillham, K., & Baxter, J. (2009). Whales, Dolphins & Porpoises: Naturally Scottish (p. 58). Scottish Natural Heritage. https://www.nature.scot/sites/default/files/2017-07/Naturally%20Scottish%20-%20Whales%2C%20Dolphins%20and%20Porpoises.pdf

There is currently no information available to entirely discount primary entanglement as a threat. It is possible that baleen whales may be at the greatest risk of primary entanglement because of their large body size and open mouth foraging behavior.[156]

Secondary Entanglement

Entanglement in abandoned, lost, or discarded fishing gear and other marine debris is a leading threat to many marine wildlife species, often causing serious injury or death. When these materials become ensnared in mooring lines and cables of floating offshore wind farms, secondary entanglement could pose a significant risk and have population-level impacts, particularly on endangered species.

Marine mammals, diving seabirds, sea turtles, elasmobranchs, and fishes are vulnerable to secondary entanglement if the underwater infrastructure accumulates derelict fishing gear, such as nets and hooks or lines, or plastic pollutants.[157] Fish and other animals caught in the abandoned gear can serve as a bait for other, larger predators thus placing these predators at risk of secondary entanglement. The high densities of large baleen whales in the WEA, as well as endangered and threatened sea turtles, seabirds, sharks, and large pelagic fish makes this a serious concern.

Large whales already entangled in fishing gear often drag long ropes and heavy traps in their wake that could, in turn, become caught around the mooring lines and cables associated with floating offshore wind energy developments. This alternative form of secondary entanglement may represent a significant risk to species present in WEA that are already experiencing a high mortality from entanglements.

Marine mammals - noise

Detrimental impacts of noise on marine wildlife are of significant concern when considering offshore wind energy development, given the crucial importance of sound to marine wildlife and the large environmental footprint of anthropogenic noise. Underwater noise may also result in habitat loss and displacement of marine mammals from the area. A benefit of floating wind technology is the reduced noise produced during the development of a floating wind turbine array relative to pile-driven turbines in shallower waters. However, pre-construction site assessment and characterization activities employing high resolution geophysical surveys will likely be necessary and, after an offshore wind farm becomes operational, active turbines will produce low levels of underwater noise. Associated maintenance activities will also last over the lifetime of the wind farm, including noise from increased traffic of service vessels transiting between ports and the wind farm areas and operating within the wind farm area.

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[156] Gillham, K., & Baxter, J. (2009). Whales, Dolphins & Porpoises: Naturally Scottish (p. 58). Scottish Natural Heritage. https://www.nature.scot/sites/default/files/2017-07/Naturally%20Scottish%20-%20Whales%2C%20Dolphins%20and%20Porpoises.pdf

[157] Hardesty, B.D., Good, T.P. and Wilcox, C., 2015. Novel methods, new results and science-based solutions to tackle marine debris impacts on wildlife. *Ocean & Coastal Management*, *115*, pp.4-9; Benjamins *et al.* (2014), "Understanding the Potential for Marine Megafauna Entanglement Risk from Marine Renewable Energy Developments." Scottish Natural Heritage Commissioned Report No. 791

High resolution geophysical surveys are used in the initial stages of offshore wind energy development for engineering and siting decisions and during construction to inform micro-siting of turbines. The resulting maps help offshore wind developers determine available options for cable routes, mooring conditions, foundation type, and turbine layout. Some of the sound waves used in geophysical surveys overlap with the same frequencies that marine mammal hearing. While not as loud as the seismic airgun surveys used for oil and gas exploration, exposure to noise from geophysical surveys used for offshore wind can damage the hearing and sensory abilities of some species, cause stress and negative health effects, disrupt vital behaviors, or displace marine mammals from habitat. For vulnerable species, displacement from preferred feeding and breeding areas or known migratory paths can be especially concerning. As multiple HRG surveys may occur at the same time as other sources of noise, cumulative impacts of these activities are a serious concern. As with all increased vessel traffic, survey vessels also pose a risk of collision to marine mammals.

Sounds produced by floating offshore wind energy structures will be predominantly lower frequency sounds below ~1 kHz. However, noise from operation will be largely dependent on wind speed. Measurement of noise from the floating turbine Hywind near Utsira Nord site is approximately 166 dB re 1µPa at 1 m from the sound source under local wind conditions, which is 46 dB above NOAA exposure guidelines for "Level B" harassment guidelines for continuous noise exposure. This would mean that the "Level B" harassment threshold would be exceeded within 200 m of the noise source.

As there is a correlation between turbine size and radiated noise, and whether the generator is direct or gear-box driven, the sizes and types of turbines will be important in determining occasional and cumulative impacts from the turbines. Other factors include how loud the operating noise is underwater, installation and service vessel noises, and low frequency pulses generated by the turbine blades passing by the mast. Understanding these noise factors will be critical to determining how various taxa would be impacted and by how much. For example, species that are sensitive to lower frequencies might be able to detect turbines from several kilometers away if the ambient noise levels are below the radiated noise level from a given turbine. Thus, it will be crucial to understand ambient noise across seasons before the installation of turbines to accurately understand and mitigate potential impacts, and what mitigations will need to be employed in the design and installation of the turbines (such as direct drive or acoustically decoupling the turbine from the mast). Noise assessment must also be done in the context of a field of turbines, and the noise contribution of multiple turbines to the area's marine soundscape.

Perhaps the greatest concern regarding noise impacts on marine mammals from operational floating wind technology is the potential to mask sounds made by marine mammals for communication, locating prey, and navigation. Risks may include changes in marine mammals' behavior for hunting, swimming, rearing, mating, resting, and avoiding underwater threats, as well as changes in migratory patterns if sufficient noise is generated. Importantly, as the scale of projects increases, the cumulative impacts of underwater sound will likely increase and cause additional masking and other effects at greater distances from the source. While low-level operational noise is considered to have a low impact on marine mammals due to the low-intensity of the noise, low-level continuous noise is known to induce stress in mysticetes, compromising fitness and breeding success.[158] These low levels may also result in habitat displacement for some sensitive species. For example, changes of behavior were observed for harbor porpoises at two wind farms in Denmark during their operation and the number of these marine mammals was found to be reduced within the development area.[159] Thus the potential for habitat displacement over the long term remains an area of needed research.

Very little is known about sea turtle hearing and potential noise impacts. It has been determined that sea turtle hearing sensitivity overlaps with the frequencies and source levels produced by many anthropogenic sources; however, more research is needed to determine the potential physiological and behavioral impacts of these noise sources on sea turtles.

It is important to consider the construction, operational, and decommissioning noise from floating turbine systems, the increase in vessel traffic in areas with new turbine structures, and potential resonance from mooring cables and water currents/movement. Offshore wind developments may alter fish habitat if fishes are attracted to a device by its physical presence or the sound emanating from it. Many pelagic fish species are able to detect acoustical particle motion through their lateral line and inner ear, and many species use acoustic signals to attract mates to spawn. Potential impacts to commercial fisheries, including forage fishes, that provide critical resources to seabirds and shorebirds must also be taken into consideration. To date, no studies have examined the acoustic impacts of floating turbine structures operations and maintenance on fish behavior or physiology. It is important to note that there is currently incomplete knowledge of background noise and acoustic turbine effects on fishes.

While the impacts of underwater noise on diving seabirds have not been emphasized in the past, underwater noise from increased vessel traffic as well as turbine installation and operation also poses a potential threat to diving birds occurring within and around Humboldt WEA. As described above in the habitat loss section, loons[160] and alcids[161] have been known to avoid areas up to 16 and eight (8) km away, respectively, from offshore turbine arrays during operation and construction. Common Murre, which are predicted to be of high displacement vulnerability, and likely occur near Humboldt WEA, are sensitive to underwater noise.[162] It is important for BOEM to consider this impact in its decision making and assess potential direct and indirect physiological impacts to diving birds from underwater noise associated with offshore wind construction and operation within the CCS moving forward.

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[158] Rosalind M. Rolland, Susan E. Parks, Kathleen E. Hunt, Manuel Castellote, Peter J. Corkeron, Douglas P. Nowacek, Samuel K. Wasser and Scott D. Kraus (2012) "Evidence that ship noise increases stress in right whales" Proc. R. Soc. B doi:10.1098/rspb.2011.2429

[159] Thomsen, F., Lüdemann, K., Kafemann, R. & Piper, W. (2006) Effects of offshore wind farm noise on marine mammals and fish. COWRIE Report.

[160] Mendel B, Schwemmer P, Peschko V, Müller S, Schwemmer H, Mercker M, Garthe S. 2019. Operational offshore wind farms and associated ship traffic cause profound changes in distribution patterns of Loons (Gavia spp.). Journal of Environmental Management 231:429–438.

[161] Peschko V, Mendel B, Müller S, Markones N, Mercker M, Garthe S. 2020. Effects of offshore windfarms on seabird abundance: Strong effects in spring and in the breeding season. Marine Environmental Research:105157.

[162] Anderson Hansen K, Hernandez A, Mooney TA, Rasmussen MH, Sørensen K, Wahlberg M. 2020. The common murre (Uria aalge), an auk seabird, reacts to underwater sound. The Journal of the Acoustical Society of America 147:4069–4074.

Required Analysis for Whales and Sea Turtles

There is a need for additional surveys and data collection, such as aerial and boat-based studies, on marine mammal distribution on the North Coast. Given the nascence of floating offshore wind technology globally, there is a need for empirical assessments of wildlife impacts from floating wind turbines.

BOEM's environmental analysis must include basic data on the distribution, critical habitat, and presence and migration patterns of large whale species, including North Pacific right whales and minke whales to enable assessment of potential impacts from offshore wind energy development.

BOEM's environmental analysis must include baseline data on noise levels within and adjacent to the WEA, vessel traffic routes, and transmission corridors to shore and provide for 'control' sites for future monitoring. It is critical to understand sound propagation at varying distances from lease sites in specific areas, and across different frequencies[163] to assess potential impacts. BOEM's environmental analysis must also address impacts of noise from operational use of turbines on marine mammal prey species such as krill and small schooling fish.

All activities associated with offshore wind, from siting and installation through operation and decommissioning will be accompanied by noise, posing adverse impacts for whales and other marine mammals. It is critical to immediately begin monitoring the soundscapes of the WEA to provide a spatiotemporal understanding of the density and activity of marine life across all taxa – from marine arthropods to fishes, reptiles, and marine mammals.

These passive acoustic surveys need to be broad-band, recording between 4 Hz to 100kHz to capture all acoustic niche species anticipated in the area – from blue whales to harbor porpoises. These surveys will also capture anthropogenic noise sources including vessel traffic and surveying equipment - from impulse signals used for geological characterization, to scanning sonars used for seafloor profiling. Additionally, they will provide acoustic data that would reveal interactions between marine life and the anthropogenic noise sources to which they are being subjected.

While there is already considerable anthropogenic noise in the sea due to shipping traffic,[164] robust baselining of the proposed wind farm areas would reveal the acoustical changes to the habitat as a consequence of the development, deployment, and operation of the turbines, and the associated ongoing support and maintenance of the equipment.

In addition to robust acoustical baselining, biological transects of the seafloor should be made to map the various habitats of the area. This would inform site selection that avoids wildlife

[163] Bailey, H., K. L. Brookes, and P. M. Thompson. "Assessing Environmental Impacts of Offshore Wind Farms: Lessons Learned and Recommendations for the Future." *Aquatic Biosystems* 10 (2014): 8.

[164] Ross, D. 1976. Mechanics of underwater noise (Pergamon Press, New York). Ross predicted that noise from global shipping would increase 2dB per decade, starting in 1964. By the late 1990's his model was confirmed, and named "The Ross prediction." Using that prediction, noise density in the ocean is 12dB – or 20 times louder in 2021 than in 1964. This does not account for regional differences such as the shipping lanes that run adjacent to the Humboldt OSW area.

conflicts, for example, steer away from areas where the gray whales might feed on amphipods, or where there are large aggregations of demersal fish.

Examining health and fitness across all taxa would also provide significant value given the interdependence of life in these large areas.Only an ecosystem-based approach will give us some clarity on the impacts of transforming so much of it. For example, it is well known in the bioacoustics field that chronic shipping noise elevates stress in mysticetes,[165] but it is less known that chronic noise is also a stress factor for bivalves[166] and arthropods.[167] Bioirrigation is how much the organism moves water in and out of the sediment by its actions. A study by Solan et. al (2016)[168] found that chronic shipping and construction noise disrupted the burrowing and bioirrigation activities of the North Sea Langoustine.[169] This discovery is alarming because the langoustine "fluffs up" the sediment of the North Sea, providing habitat for burrowing worms, amphipods, crabs, and other marine invertebrates and laying the foundation of the area's trophic pyramid. Compromising the habitability of this will affect all marine life dependent upon it.[170]

From the above arguments, baselining is need in the following areas associated with contemplated wind energy projects:

- Broadband baseline soundscape recordings across all four seasons.
- Continuous, ongoing broadband soundscape recordings of the areas of contemplated development.
- Area benthic transects and sea bottom sampling identifying biological activity and benthic habitat
- Health and fitness monitoring of marine life.

Recommended Mitigation for Whales and Sea Turtles

BOEM should adopt regulatory measures to limit the vessel speeds of offshore wind project-associated vessels to 10 knots or less within any WEA and along primary transit routes except in limited circumstances where the best available scientific information demonstrates that whales or sea turtles do not use the habitat or transit the area.

Projects may develop, in consultation with NOAA, an "Adaptive Plan" that modifies these vessel speed restrictions. However, the monitoring methods that inform the Adaptive Plan must follow a scientific study design and be proven effective using vessels traveling at 10

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[165] Rosalind M. Rolland, Susan E. Parks, Kathleen E. Hunt, Manuel Castellote, Peter J. Corkeron, Douglas P. Nowacek, Samuel K. Wasser and Scott D. Kraus. 2012 "Evidence that ship noise increases stress in right whales" Proc. R. Soc. B

[166] Charifi M, Sow M, Ciret P, Benomar S, Massabuau J-C (2017) The sense of hearing in the Pacific oyster, Magallana gigas. PLoS ONE 12(10): e0185353. https://doi.org/10.1371/journal.pone.0185353

[167] Pine MK, Jeffs AG, Radford CA (2012) Turbine Sound May Influence the Metamorphosis Behavior of Estuarine Crab Megalopae. PLoS ONE 7(12):e51790. doi:10.1371/journal.pone.0051790

[168] Solan, M., Hauton, C., Godbold, J. et al. Anthropogenic sources of underwater sound can modify how sediment-dwelling invertebrates mediate ecosystem properties. Sci Rep 6, 20540 (2016). https://doi.org/10.1038/srep20540

[169] University of Southampton News, (5 February 2016) Man -made underwater sound may have wider ecosystem effects than previously thought.. https://www.southampton.ac.uk/news/2016/01/underwater-sound-biodiversity-study.page

[170] Decrease in bioirrigation would also decrease carbon sequestration and nutrient recycling, with the potential consequence of the sediment becoming anoxic.

knots or less. If the resulting Adaptive Plan is scientifically proven to be equally or more effective than a 10-knot speed restriction, the Adaptive Plan could be used as an alternative to the 10-knot speed restriction.

Prior to the initiation of any activity related to offshore wind energy development, all associated personnel working offshore should be required to attend worker education/training conducted by a qualified biologist on observing, identifying, and avoiding sensitive biological resources (e.g., whales) and on pollution control.

In addition, we recommend the following mitigation measures for vessels:

- maintain a vigilant watch for and separation distance of 500 m for Southern Resident killer whales and North Pacific right whales, maintain a separation distance of 100 m for other large whale species and sea turtles
- carry dedicated observers to maintain a watch for marine mammals and turtles to maintain distance and avoid potential interactions
- all vessels responsible for crew transport (i.e., service operating vessels) should use automated thermal detection systems or similar detection technology to assist monitoring efforts while vessels are in transit (in addition to observers, and not exceeding a speed of 10 knots).

9. Birds

Marine birds and mammals comprise an important community of meso- and upper-trophic-level predators within the northern CCS). The NCCS is located within one of the world's four major eastern boundary currents and is characterized by an abundant and diverse marine ecosystem fueled seasonally by wind-driven upwelling which supplies nutrient-rich water to abundant phytoplankton inhabiting the surface euphotic zone. The oceanographic conditions throughout the NCCS fluctuate according to well-described seasonal, inter-annual, and decadal cycles. Such oceanographic variability can influence patterns in the distribution, abundance, and habitat use among marine birds and mammals.[171]

National Audubon Society's climate science identifies 389 species of birds likely to become extinct under a warming scenario of 3 degrees Celsius above pre-industrial levels. Audubon's analysis found 78% of waterbirds vulnerable to extinction under more severe warming scenarios.[172] While climate mitigation will reduce risks to birds from range loss, a majority of species are facing multiple pressures to their populations, which are compounded by a changing climate.[173] Seabirds offshore California experience population-level impacts from overfishing and habitat loss, factors which are exacerbated by warming temperatures and rising sea-level,

[171] Adams, J., J. Felis, J. W. Mason, and J. Y. Takekawa. 2014. Pacific Continental Shelf Environmental Assessment (PaCSEA): aerial seabird and marine mammal surveys off northern California, Oregon, and Washington, 2011-2012. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Pacific OCS Region, Camarillo, CA. OCS Study BOEM 2014-003. 266 pages
[172] Bateman B.L., Wilsey C., Taylor L., Wu J., LeBaron G.S., Langham G. (2020) North American birds require mitigation and adaptation to reduce vulnerability to climate change. Conservation Science and Practice 2:e242.
[173] Bateman BL, Taylor L, Wilsey C, Wu J, LeBaron GS, Langham G. 2020. Risk to North American birds from climate change-related threats. Conservation Science and Practice 2:e243.

respectively. Cassin's Auklet, as an example, experienced a massive mortality event following a severe heat wave resulting in trophic collapse.[174] Brown Pelicans, like many seabirds, face at least five challenging factors in addition to climate change, including loss of breeding habitat, invasive predators, diminished forage fish availability, pesticides, and bycatch.[175] Considering the number of compounding threats to avian conservation, it will be crucial to reduce additional pressure on these vulnerable populations.

The pelagic seabirds attracted to these abundant foraging grounds include ESA-listed species like Short-tailed Albatross, as well as Scripps's Murrelet, which is under listing consideration. Shorebirds breeding along Alaska's Arctic tundra, take migratory pathways which cross over the NCCS during their southbound migration in the fall. While trans-oceanic migrating shorebirds and songbirds typically fly above the rotor swept zone (RSZ), they are more likely to encounter the turbines during periods of inclement weather. Arctic nesters are experiencing extreme pressure on their breeding grounds, so extra care must be taken to limit additional external pressure to their populations. Alcids, gulls, terns, pelicans, and cormorants which breed along California's coastal beaches and islands also forage offshore along the shelf break to provision themselves and their chicks. The ESA-listed Marbled Murrelet breeds in coastal forests near the Humboldt WEA and generally forages inshore of the WEA, in areas that will be transited by project vessel traffic.

Avian species may experience impacts of floating wind turbines to their populations via three main mechanisms: 1) displacement or loss of habitat, 2) barrier effects which can have energetic costs if birds reroute daily movements to foraging grounds or seasonal migratory movements, 3) direct mortality through collision. Studies from other wind areas suggest that alcids and waterfowl may be among taxa more sensitive to displacement effects[176] but such studies have not evaluated projects in a location comparable to the Humboldt WEA in terms of geographic location, distance offshore, or turbine design. Any seabirds occurring in the area, including albatrosses, shearwaters, petrels, storm-petrels, terns, gulls, pelicans, and cormorants can be sensitive to collision. In addition, nocturnal migrants and shorebird migrants are sensitive to barrier impacts and collision. Diving birds, like alcids and loons, are also sensitive to potential impacts from secondary entanglement and underwater noise from construction and operations activities.

Seabirds, in general, tend to live a long time, breed less frequently, and produce few chicks annually, meaning that population trajectories are highly sensitive to changes in adult survival. Laysan, Short-tailed, and Black-footed Albatross, on the more extreme end of this life history strategy, do not begin reproducing until seven years after hatching, frequently skip years for breeding, lay only a single egg in a season,[177] and are known to survive up to least 70 years.[178] Thus, similar to other long- lived taxa such as marine mammals and some fish groups, increased

[174] Jones T et al. 2018. Massive Mortality of a Planktivorous Seabird in Response to a Marine Heatwave. Geophysical Research Letters 45:3193–3202.
[175] Bateman BL, Taylor L, Wilsey C, Wu J, LeBaron GS, Langham G. 2020. Risk to North American birds from climate change-related threats. Conservation Science and Practice 2:e243.
[176]
[177] Rice DW, Kenyon KW. 1962. Breeding Cycles and Behavior of Laysan and Black-Footed Albatrosses. The Auk 79:517–567.
[178] https://medium.com/usfwspacificislands/worlds-oldest-known-banded-wild-bird-hatches-chick-at-midway-atoll-2708a0b3f2c0

mortality of adults from human impacts can lead to population decline. Almost 30 percent of the world's seabird species are globally threatened, and the majority of populations are in decline.[179] A study by Paleczny *et al.* (2015) demonstrated a 70 percent decline in the world's monitored seabirds, with the most prominent declines in pelagic seabirds.[180] The rapidly-deteriorating status of the world's seabirds has led to calls for urgent policy changes to address the major threats to seabirds, which include fisheries bycatch, habitat loss, invasive species, contamination, and climate change.[181]

Over 75 species of seabirds frequent the CCS, including year-round residents, seasonal residents, or long- distance migrators *en route* to breeding or wintering grounds. While many species exploit waters close to shore, many prefer to forage in offshore waters at or beyond the continental shelf[182] following concentrations of prey that can often occur far offshore along the CCS,[183] generating hotspots of seabird activity along the CCS.[184] Scripps's Murrelet (previously a form of Xantus's Murrelet), occur from Baja California to as far north as Vancouver Island, British Columbia.[185] Many of the pelagic seabirds concentrate around the Pacific shelf break and slope. BOEM's own PaCSEA surveys along the northern CCS, also showed that Northern Fulmars in particular frequently occur in the vicinity of the Humboldt WEA, typically over outer-shelf (1.82 ± 0.88 birds per square km) and slope waters (1.64 ± 0.34 birds per square km).[186] Sooty shearwater, an abundant yet declining species, winters in high numbers throughout the CCS, with foraging flocks of hundreds of thousands of individuals extending up to several kilometers.[187] While Sooty Shearwater is the most abundant species in the summer, Common Murre dominates the CCS avian community year-round, with "instantaneous" populations exceeding one million individuals across hotspots from northern California through Washington.[188] Upwards of 800 Pacific Loons per hour can migrate off the northern California coast in the fall, on average.[189] Species nesting offshore northern California like Cassin's Auklet, as well as winter residents like the marine shorebird phalaropes, have similarly occurred offshore central and northern California in populations exceeding one million individuals.[190] Brant, which rely heavily on Humboldt Bay as a critical stopover site during spring migration,[191] will fly through the shelf on their migratory routes, and may occur in flocks of up to 100 individuals as far as 90

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179 IUCN (2019)
180 Paleczny et al. (2015), "Population Trend of the World's Monitored Seabirds, 1950-2010."
181 McCauley et al. (2015), "Marine Defaunation: Animal Loss in the Global Ocean."
182 Allen, Pondella, and Horn (2006), The Ecology of Marine Fishes: California and Adjacent Waters. California's Continental Shelf ranges from 0.27 nm to 97.2 nm offshore.
183 Ainley et al. (2015), "Seabird Flight Behavior and Height in Response to Altered Wind Strength and Direction."
184 Nur et al. (2011), "Where the Wild Things Are : Predicting Hotspots of Seabird Aggregations in the California Current System"
185 Karnovsky NJ et al. 2005. At-sea distribution, abundance and habitat affinities of Xantus's Murrelets:16.
186 Adams, J., J. Felis, J. W. Mason, and J. Y. Takekawa. 2014. Pacific Continental Shelf Environmental Assessment (PaCSEA): aerial seabird and marine mammal surveys off northern California, Oregon, and Washington, 2011-2012. U.S. Dept. of the Interior, Bureau of Ocean Energy Management, Pacific OCS Region, Camarillo, CA. OCS Study BOEM 2014-003. 266 pages. Table 10; Figure 34.
187 Briggs, K.T., W.M. Breck Tyler, D.B. Lewis, and D.R. Carlson. 1987. Bird Communities at Sea Off California 1975 to 1983. Studies in Avian Biology No. 11. The Cooper Ornithological Society. 74 pp.
188 Briggs et al, 1987, Bird Communities at Sea off California: 1975-1983, Institute of Marine Sciences, University of California, Santa Cruz, CA, Studies in Avian Biology No. 11, a publication of the Cooper Ornithological Society.
189 Palmer, R.S. 1962. Handbook of North American birds, vol. 1. Loons through flamingos. Yale Univ. Press, New Haven, CT.
190 Briggs et al, 1987, Bird Communities at Sea off California: 1975-1983, Institute of Marine Sciences, University of California, Santa Cruz, CA, Studies in Avian Biology No. 11, a publication of the Cooper Ornithological Society.
191 Lee DE, Black JM, Moore JE, Sedinger JS. 2007. AGE-SPECIFIC STOPOVER ECOLOGY OF BLACK BRANT AT HUMBOLDT BAY, CALIFORNIA. The Wilson Journal of Ornithology 119:9–22.

km from shore.[192] The sheer abundance of individuals in no way minimizes the potential impact of wind development to these species, and instead demonstrates the significant impact that offshore wind development off Humboldt and along the Pacific OCS could have to these populations globally if measures are not in places to adequately minimize impacts to the avian community within the CCE. Additionally, a number of the species which occur in numbers within the Humboldt WEA, like Black-footed Albatross and the federally endangered Short-tailed Albatross, are facing compounding impacts from invasive species, decreases in foraging fish, as well as bycatch and entanglement risks.[193]

Impacts to Birds and Required Analysis

BOEM has already committed resources to a key study designed to characterize avian distribution along the CCS and inform responsible offshore wind development. The results of the long-awaited Data Synthesis and High-resolution Predictive Modeling of Marine Bird Spatial Distributions on the Pacific OCS[194] will be critical to consider if BOEM intends to proceed with leasing and successfully developing the Humboldt WEA in a responsible manner. BOEM should prioritize completing and publishing results from this study and factor research findings into its decision-making regarding the leasing of the Humboldt WEA.

Habitat Loss and Barrier Effects

Offshore wind projects have the potential to harm birds through disturbance and habitat loss or damage.[195] Disturbance to birds can occur during wind farm construction and continue due to post-construction operations and maintenance (O&M) activities. These disturbances may lead directly to expulsion and thus loss of territory for certain species of birds. Murrelets, known to rely heavily on waters offshore the northern California coast are predicted to be particularly vulnerable to displacement effects.[196] Research at Horns Rev wind project offshore Denmark found significant changes in the distributions of divers, common scoter, and common guillemot/razorbills following construction, and avoided not only the wind farm but also the two and four km zones around the wind farm.[197] At other windfarms, alcids, kittiwakes,[198] and loons[199] avoided areas up to 16 and 8 km away, respectively, from offshore wind turbine arrays

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192 Briggs et al, 1987, Bird Communities at Sea off California: 1975-1983, Institute of Marine Sciences, University of California, Santa Cruz, CA, Studies in Avian Biology No. 11, a publication of the Cooper Ornithological Society.

193 Guy TJ et al. 2013. Overlap of North Pacific albatrosses with the U.S. west coast groundfish and shrimp fisheries. Fisheries Research 147:222–234.

194 https://opendata.boem.gov/BOEM-ESP-Ongoing-Study-Profiles-2021-FYQ2/BOEM-ESP-PC-15-01.pdf

195 Snyder B, Kaiser MJ. Ecological and economic cost-benefit analysis of offshore wind energy. Renewable Energy 2009;34(6):1567e78; Sun X, Huang D, Guoqing W. The current state of offshore wind energy technology development. Energy 2012; 41:298-312.

196 Kelsey EC, Felis JJ, Czapanskiy M, Pereksta DM, Adams J. 2018. Collision and displacement vulnerability to offshore wind energy infrastructure among marine birds of the Pacific Outer Continental Shelf. Journal of Environmental Management 227:229–247.

197 Petersen IK, Christensen TK, Kahlert J, Desholm M, Fox AD. Final results of bird studies at the offshore wind farms at Nysted and Horns Rev, Denmark. Denmark: Report to Dong Energy and Vattenfall A/S, National Environmental Research Institute; 2006.
http://www.folkecenter.net/mediafiles/folkecenter/pdf/Final_results_of_bird_studies_at_the_offshore_wind_farms_at_Nysted_and_Horns_Rev_Denmark.pdf.

198 Peschko V, Mendel B, Müller S, Markones N, Mercker M, Garthe S. 2020. Effects of offshore windfarms on seabird abundance: Strong effects in spring and in the breeding season. Marine Environmental Research:105157.

199 Mendel B, Schwemmer P, Peschko V, Müller S, Schwemmer H, Mercker M, Garthe S. 2019. Operational offshore wind farms and associated ship traffic cause profound changes in distribution patterns of Loons (Gavia spp.). Journal of Environmental Management 231:429–438.

during operation and construction.

Some bird species are known to actively change course to travel around perimeters of windfarms and/or avoid the area in response to increased ship traffic. This avoidance can lead to increased energetic costs when traveling to and from breeding/foraging sites[200] and result in a functional loss of habitat.[201] This would be especially true for offshore wind developments built within primary foraging areas or along the migration and commuting routes.

Displacement impacts to birds are not limited to the area around the turbine array. Loons,[202] alcids, and some sea ducks, all of which occur within the Humboldt WEA, are particularly vulnerable to impacts from vessel traffic.[203] These impacts are especially pronounced from traffic outside of designated shipping lanes, which is the case for site characterization activities.[204] Regular disturbance from Project and Site Assessment data collection vessel traffic can decrease energy reserves for birds by reducing food intake and increasing energy costs. Species with the shortest flight initiation distances (i.e. most responsive to vessel traffic like loons, alcids, and sea ducks) also tend to be those species with the largest wing loadings compared to other marine birds,[205] meaning the birds that are more likely to expend extra energy in response to vessels also waste more energy with each take off relative to birds with lower wing loadings.[206] Additionally, increased vessel traffic can ultimately result in a loss of habitat for affected marine birds if they are regularly disturbed from important foraging grounds. Furthermore, terns and other pelagic seabirds occurring within the CCS are attracted to wakes and turbulence created from objects like vessels and turbine platforms in the marine environment.[207] Diverting from fruitful foraging grounds to investigate artificially created marine turbulence, creates an ecological trap for these individuals by which they expend critical energy.

Collision Risk

Collision is one of the primary concerns for direct impacts to birds from wind turbines. Loss et al. (2013) estimates that the average annual mortality rate for birds from turbines onshore is 3.58 birds/MW (95% C.I.=3.05-4.68).[208] Recent research by Huso et al. (2021) confirmed that the rate of collision is dependent on MW, and therefore not expected to decrease with increased turbine

[200] Drewitt and Langston (2006), "Assessing the Impacts of Wind Farms on Birds"; Masden et al. (2010), "Barriers to Movement: Modelling Energetic Costs of Avoiding Marine Wind Farms amongst Breeding Seabirds"; Masden et al. (2009), "Barriers to Movement: Impacts of Wind Farms on Migrating Birds."

[201] Furness, Wade, and Masden (2013), "Assessing Vulnerability of Marine Bird Populations to Offshore Wind Farms"; Dierschke, Furness, and Garthe (2016), "Seabirds and Offshore Wind Farms in European Waters : Avoidance and Attraction."

[202] Mendel B, Schwemmer P, Peschko V, Müller S, Schwemmer H, Mercker M, Garthe S. 2019. Operational offshore wind farms and associated ship traffic cause profound changes in distribution patterns of Loons (Gavia spp.). Journal of Environmental Management 231:429–438.

[203] Fliessbach KL, Borkenhagen K, Guse N, Markones N, Schwemmer P, Garthe S. 2019. A Ship Traffic Disturbance Vulnerability Index for Northwest European Seabirds as a Tool for Marine Spatial Planning. Frontiers in Marine Science 6:192.

[204] Schwemmer P, Mendel B, Sonntag N, Dierschke V, Garthe S. 2011. Effects of ship traffic on seabirds in offshore waters: implications for marine conservation and spatial planning. Ecological Applications 21:1851–1860.

[205] Crawford H. Greenwalt. 1962. Dimensional relationships for flying animals. Smithsonian miscellaneous collections 144.

[206] Fliessbach KL, Borkenhagen K, Guse N, Markones N, Schwemmer P, Garthe S. 2019. A Ship Traffic Disturbance Vulnerability Index for Northwest European Seabirds as a Tool for Marine Spatial Planning. Frontiers in Marine Science 6:192.

[207] Lieber L, Langrock R, Nimmo-Smith WAM. 2021. A bird's-eye view on turbulence: seabird foraging associations with evolving surface flow features. Proceedings of the Royal Society B: Biological Sciences 288:rspb.2021.0592, 20210592.

[208] Scott R. Loss et al., *Estimates of bird collision mortality at wind facilities in the contiguous United States*, BIOLOGICAL CONSERVATION (Dec. 2013).

size.[209] While these impacts can be estimated at onshore wind facilities through carcass surveys, there are no reliable methods for measuring rates of collision in the offshore environment. In general, it is thought that the species most vulnerable to collision risk are those whose distributions overlap with wind farms, that do not avoid wind farms, that have a greater percentage of flight time within the rotor sweep zone, and that fly at night when visual acuity is poorer.[210] BOEM's own research on collision vulnerability[211] is a great first step to evaluate which avian populations may be at greatest risk of collision impacts from the Humboldt WEA, and which areas should be avoided for development. However, many of the species which occur along the CCS are unique to the region and have never been observed around operating wind farms. Additionally, floating technology poses new challenges, including variable height that occur from pitch and yaw of the turbines, which may interact with avian behavior to affect collision risk.

We expect BOEM to require two different types of tools to assess potential impacts from offshore wind energy development within the Humboldt WEA: 1) tools to predict risk to avian species from collision, and 2) tools to measure realized collision rates within WEA post-construction and during operations.

Here, we focus on considerations BOEM must take in predicting potential risk to avian species with the Humboldt WEA under consideration. However, we urge BOEM to develop a program to monitor observed collisions within offshore wind developments. This requirement should be clearly advertised to potential lease holders within the sale notice to create a more certain regulatory environment and ensure a successful and efficient build out of offshore wind within the CCS.

BOEM must consider a full picture of migratory pathways for land birds and seabirds. This could be realized with the addition of satellite tracking information from Movebank and the National Aeronautics and Space Administration's Icarus project for larger bodied shorebirds, additional research and tagging of priority bird species using radio and satellite telemetry technology as appropriate, and an expansion of the radio telemetry receiver network in the offshore environment. BOEM should use the data currently available to calculate the risk to these migratory birds, especially in regard to modern turbine height, and provide for tracking these migratory birds during the life of projects within the WEA and over all the cumulative projects in the Pacific OCS.

Additionally, BOEM should outline its plan to implement collision detection and minimization measures during the operation of potential projects within the WEA and other planning areas. Under the ESA and MBTA, developers are responsible for any take of migratory birds and ESA-listed species. However, without appropriate monitoring for collision detection, large collision events could have serious population-level impacts to migratory land birds and seabirds without

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[209] Huso M, Conkling T, Dalthorp D, Davis M, Smith H, Fesnock A, Katzner T. 2021. Relative energy production determines effect of repowering on wildlife mortality at wind energy facilities. Journal of Applied Ecology:1365-2664.13853.

[210] Kelsey et al. (2018), "Collision and Displacement Vulnerability to Offshore Wind Energy Infrastructure among Marine Birds of the Pacific Outer Continental Shelf"; Adams et al. (2016), "Collision and Displacement Vulnerability among Marine Birds of the California Current System Associated with Offshore Wind Energy Infrastructure."

[211] Id.

recourse. This is not an acceptable outcome, and BOEM must communicate a plan to address this concern.

We expect that offshore wind energy development in California will incorporate a variety of technologies to minimize collision risks and measure collision impacts to birds, including aircraft detection lighting systems (ADLS), smart curtailment, deterrent technology, and collision detection. At a basic level, we expect BOEM to require developers to use FAA-compliant ADLS on turbines to diminish attraction of nocturnal migrants in the marine environment. This technology is well developed and has been adopted across land-based wind facilities.[212] This has been a standard mitigation strategy identified in BOEM's environmental impact statements for offshore wind facilities to date. We commend this step by BOEM and look forward to seeing mitigation strategies grow and evolve as technology allows.

Blanket seasonal curtailment strategies are likely not economically viable for offshore wind energy industry. However, reasonably tailored smart curtailment strategies might be necessary for responsibly operated offshore wind farms in the CCS. Developments in radar science and research into the environmental cues driving migration timing and dynamics across the CCS make it possible to predict migration events and specific periods when collision risk might be highest. Developments in collision detection technology will also likely provide a mechanism for smart curtailment based on the proximity of individual birds to the turbines. This type of automated curtailment system has resulted in significant decreases in collision mortality events within land-based wind farms where it has been deployed, and we ask that BOEM play a significant role in further developing this technology and testing its effectiveness for the species and harsh marine environment.[213]

BOEM's collision risk analysis should include all species that occur within a 20-km radius of the area under consideration for development and that trigger conservation obligations.

Collision Risk for Seabirds

In reviewing the Humboldt WEA and designating areas for leasing, BOEM must adequately assess collision risk and impacts to seabirds. This must include an analysis, using the most current available science, of flight heights (averages and ranges), avoidance rates, and other relevant avian flight behavior at the very least. BOEM must also consider the range of turbine specifications that could influence collision risk, including air gap, total rotor swept zone, and turbine height. We know from studies of oil and gas (O&G) platforms that gulls, shearwater, storm-petrel, and peregrine falcons are attracted to platforms in the marine environment, which further heightens their potential collision risk with turbines.[214] Nocturnal migrants and foraging seabirds alike are attracted to lights associated with offshore O&G infrastructure, which has led

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212 https://detect-inc.com/aircraft-detection-lighting-systems/

213 McClure CJW, Rolek BW, Dunn L, McCabe JD, Martinson L, Katzner T. 2021. Eagle fatalities are reduced by automated curtailment of wind turbines. Journal of Applied Ecology 58:446–452.

214 Ronconi RA, Allard KA, Taylor PD. 2015. Bird interactions with offshore oil and gas platforms: Review of impacts and monitoring techniques. Journal of Environmental Management 147:34–45.

to an estimated 200,000 collision-induced mortalities per year in the Gulf of Mexico where such offshore infrastructure is prevalent.[215]

BOEM should start with its own analysis of the vulnerability of over 80 species of birds that could come into contact with the wind turbine generators ("WTG") in the cumulative OCS Wind Development Areas ("WDA") within the CCS in the foreseeable future and incorporate this analysis into its decision-making regarding the designation of lease areas within the WEA.[216] BOEM must be transparent in presenting the high level of uncertainty in the results, including high and low estimates for population-level cumulative impacts. Much of the high uncertainty in these models is a result of highly variable concentrations of seabirds throughout the year. BOEM should be explicit about these seasonally higher risks and not rely on annual averages. Many tubenoses, for example, congregate outside the breeding season near upwellings and other locations of high productivity. Such concentrated flocks, if occurring within the turbine array, could produce significantly large collision events, even if such events are relatively rare. BOEM should consider this variability of large concentrations of birds even in short periods of time in its analysis of seasonal abundance when calculating risk to birds.

Furthermore, seabirds that use upwellings and ocean turbulence as ecological cues to locate important foraging areas offshore, can be attracted to the wakes created by offshore wind energy infrastructure. Turbine platforms can mimic the cues birds rely on, even when foraging fish are not present, creating an ecological trap by which these birds both expend energy foraging in an unfruitful environment and potentially expose individuals to higher collision risk.[217]

Collision Risk for Land Bird Migrants

Marine birds are not the only avian group at risk of collision from OWED in the CCS. Many species of land birds breeding in Alaska cross over the shelf break offshore before stopping over on the coast of California. Whimbrel, designated by USFWS as a bird of conservation concern,[218] may fly nonstop more than 8,000 km over the Pacific Ocean before making landfall.[219] Unlike the migratory altitudes estimated for many land birds based on radar studies, Whimbrel are known to regularly fly within the RSZ for oversea flights (median = 133 m above sea level).[220] Black

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[215] Russell, R.W. 2005. Interactions between migrating birds and offshore oil and gas platforms in the northern Gulf of Mexico: Final Report. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, LA. OCS Study MMS 2005-009. 348 pp.

[216] Adams et al. (2016), "Collision and Displacement Vulnerability among Marine Birds of the California Current System Associated with Offshore Wind Energy Infrastructure."

[217] Lieber L, Langrock R, Nimmo-Smith WAM. 2021. A bird's-eye view on turbulence: seabird foraging associations with evolving surface flow features. Proceedings of the Royal Society B: Biological Sciences 288:rspb.2021.0592, 20210592.

[218] U.S. Fish and Wildlife Service. 2021. Birds of Conservation Concern 2021. United States Department of the Interior, U.S. Fish and Wildlife Service, Migratory Birds, Falls Church, Virginia. https://www.fws.gov/migratorybirds/pdf/management/birds-of-conservation-concern-2021.pdf

[219] Shiloh Schulte, personal communication, August 14, 2021; Ruthrauff DR, Harwood CM, Tibbitts TL, Warnock N, Gill RE. 2021. Diverse patterns of migratory timing, site use, and site fidelity by Alaska-breeding Whimbrels. Journal of Field Ornithology 92:156–172.

[220] Galtbalt B, Lilleyman A, Coleman JT, Cheng C, Ma Z, Rogers DI, Woodworth BK, Fuller RA, Garnett ST, Klaassen M. 2021. Far eastern curlew and whimbrel prefer flying low - wind support and good visibility appear only secondary factors in determining migratory flight altitude. Movement Ecology 9:32.

Brant have been identified as a species that could be impacted during their oversea migration along the Pacific coast.[221]

BOEM must consider collision risks to land bird migrants. Migration events are relatively infrequent, and therefore, survey efforts like PaCSEA and PacMAPPS are not appropriate for characterizing collision risk to land bird migrants. In general, efforts to evaluate collision risk should rely on a combination of radar, telemetry, survey, and acoustic monitoring, and should not be based on a single technology alone.

Studies to document and characterize land bird migration patterns should prioritize satellite telemetry, paired with altimeters/pressure sensors, for larger bodied birds, as this is the best method for gathering fine scale movement data and flight altitude.[222]

When incorporating radio telemetry methods for avian species too small for satellite transmitters that provide geo-location data, receiving stations need to be installed in the offshore environment in such a way that avian movement patterns in and around the WEA can be adequately assessed prior to and following construction. BOEM must follow the monitoring protocols for automated radio telemetry that the agency is currently developing in partnership with USFWS and the Regional Wildlife Science Entity.[223] We applaud this interagency effort to develop robust, scientifically sound monitoring protocols and to test the feasibility of floating receiving stations. Metocean buoys, outfitted with telemetry, acoustic, and marine radar technology, should be deployed in the WEA prior to leasing, so that baseline data can be collected and paired with post-construction data to evaluate observed impacts from the Project's development and operation. BOEM needs to help financially support the efforts to further this technology, adopt these methods into regional monitoring protocols for offshore wind development, and ensure the success of this technology moving forward.

Acoustic monitoring alone is especially inappropriate to characterize the community of land bird migrants within the WEA. Evidence indicates that Empidonax flycatchers and vireos, two of the most abundant nocturnal migrant groups, do not emit nocturnal flight calls, and therefore, would not be accounted for using acoustic monitoring. Additionally, acoustic monitoring does not adequately assess flux, a necessary value for assessing collision risk and estimating population-level impacts.

It is imperative that BOEM supports further tracking efforts, and we recommend the construction and maintenance of telemetry receiving towers throughout the offshore environment to inform risk analyses. It is important to note that the VHF transmitters widely deployed along the coast have a limited lifespan. New solar-powered ultra-high frequency

[221] https://www.boem.gov/sites/default/files/documents/regions/pacific-ocs-region/environmental-analysis/PC-20-01-profile_0.pdf

[222] Péron G, Calabrese JM, Duriez O, Fleming CH, García-Jiménez R, Johnston A, Lambertucci SA, Safi K, Shepard ELC. 2020. The challenges of estimating the distribution of flight heights from telemetry or altimetry data. Animal Biotelemetry 8:5; Thaxter CB, Ross-Smith VH, Cook SCP. (n.d.). How high do birds fly? A review of current datasets and an appraisal of current methodologies for collecting flight height data: Literature review:66.

[223] Stakeholder Workshop: Scientific Research Framework to Understand the Effects of Offshore Wind Energy Development on Birds and Bats in the Eastern United States. (n.d.).:86.

transmitters, which include on-board battery support for transmitting at night, should be the future focus for incorporating this technology.

Collision Risk Models

We expect that BOEM will apply CRMs to evaluate potential avian impacts from developing the Humboldt WEA and use this information to determine the areas within the WEA to offer for leasing. While limited, CRMs are one of the only tools available to hypothesize potential impacts to birds from collision in the offshore environment. As such, CRMs provide a mechanism for testing outcomes (e.g., observed collision rates) against the model predictions (e.g., expected collision rates), and BOEM must address the need to collect the data necessary to test these hypotheses.

BOEM's decision should be based in part on a CRM-driven analysis for all species of conservation obligation which may occur within 20 km of the Project footprint and for which a current CRM would be appropriate, even if the species has not been documented within the footprint of the Project. This should include a recent stochastic derivation of the Band model, such as the McGregor (2018) version.[224]

BOEM must be transparent in its CRM application. These models are extremely sensitive to the input parameter values, such as avoidance rate. A study by Cook et al. (2014) found that estimations of avoidance and collision risk from Band models were highly sensitive to the flux rate (total number of birds passing through the wind farm), corpse detection rate, rotor speed, and bird speed. Factors such as weather (i.e., wind speed and visibility) and habitat use would also affect the accuracy of these estimates, as such factors would greatly influence avian flight patterns and behavior.[225]

In addition to CRMs being extremely sensitive to avoidance rates used, "avoidance rate" is complex with multiple components,[226] and the term has been defined differently across previous studies and CRMs. BOEM's analysis must provide, clearly define, and justify the CRM models and the inputs and choice of input parameter values used in order to best inform public comment and create a transparent decision process. Providing CRM results without transparency to the inputs and analytical process would never be acceptable from a scientific perspective and, therefore, should not be acceptable from BOEM. Providing inputs would show whether BOEM followed the guidance provided by Band in assessing collision risk. These details regarding inputs should include, but not be limited to, avoidance behavior, flight height, flight activity, flux rate, corpse detection rate, rotor speed, bird speed, and collision risk, as well as seasonal and daily conditions that might influence avian flight height. [227] CRM analyses should also evaluate the sensitivity of the models across a range of variable input parameter values. For example, we know that CRMs are very sensitive to the avoidance rate, particularly when very high avoidance

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[224] R.M. McGregor et al., A Stochastic Collision Risk Model for Seabirds in Flight, MARINE SCOTLAND (Apr. 6, 2018), https://tethys.pnnl.gov/sites/default/files/publications/McGregor-2018-Stochastic.pdf .

[225] Aonghais S.C.P. Cook et al., The avoidance rates of collision between birds and offshore turbines, SCOTTISH MARINE & FRESHWATER SCI. (Jan. 2014).

[226] Cook ASCP, Humphreys EM, Bennet F, Masden EA, Burton NHK. 2018. Quantifying avian avoidance of offshore wind turbines: Current evidence and key knowledge gaps. Marine Environmental Research 140:278–288.

[227] Bill Band, Using a collision risk model to assess bird collision risks for offshore windfarms, STRATEGIC ORNITHOLOGICAL SUPPORT SERV. (Mar. 1, 2012).

rates such as 90 to 95 percent or more are used. Given the lack of avoidance data for the avian species involved, for the current turbine styles and sizes, and for the offshore continental shelf location of the Humboldt WEA, collision risk and impact assessments should not assume very high avoidance rates. At a minimum, CRMs should provide impact estimates based on a broad range of assumed avoidance rates, to show the sensitivity of collision impact estimates to model assumptions regarding those rates.

Current efforts underway at the Schatz Energy Research Center to develop a 3D CRM for pelagic seabirds in the CCS could help to better estimate how seabird flight heights affect collision risk. [228] This new derivation of the Band model should be applied, once available, in BOEM's assessments of avian impacts for offshore wind developments, as they will be better able to incorporate variation in input parameters.

Moreover, collision risk models provide a starting point, not an end point, from which to predict cumulative, population-level impacts across wind farms in the Pacific OCS. Collision risk models are not found to be reliable in predicting mortality:

> *Siting and permitting decisions for many European offshore wind facilities are informed by collision risk models, which have been created to predict the number of avian collisions for offshore wind energy facilities. However, these models are highly sensitive to uncertainties in input data. The few empirical studies at land-based wind facilities that have compared model-estimated collision risk to actual mortality rates found only a weak relationship between the two, and due to logistical difficulties, the accuracy of these models has not been evaluated in the offshore environment.*[229]

BOEM should pursue studies to not only verify CRM utility in the offshore environment across the range of weather and oceanographic conditions occurring in the Humboldt WEA but should also move toward viable collision detection requirements for leases within the WEA, and any future offshore wind developments.

Birds – Entanglement

Underwater mooring lines may pose an entanglement risk for diving seabirds if the underwater infrastructure accumulates derelict fishing gear, such as nets and hooks/lines.[230] Fishing gear is the number one cause of underwater entanglement for birds, with diving and plunging birds like sea ducks, loons, grebes pelicans, and alcids being at greatest risk.[231]

As discussed for marine mammals, it is important to scientifically evaluate "snagging risk" of derelict fishing gear on cables within proposed mooring systems for floating turbines. OWEI

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[228] Shatz Energy Rsch. Ctr., Seabird Distribution in 3D: Assessing Risk from Offshore Wind Energy Generation, HUMBOLDT ST. UNIV. (Apr. 16, 2020), https://schatzcenter.org/2020/04/seabird3dstudy/

[229] Taber D. Allison et al., Impacts to wildlife of wind energy siting and operation in the United States, ISSUES IN ECOLOGY (2019).

[230] Benjamins et al. (2014), "Understanding the Potential for Marine Megafauna Entanglement Risk from Marine Renewable Energy Developments." Scottish Natural Heritage Commissioned Report No. 791

[231] Ryan PG. 2018. Entanglement of birds in plastics and other synthetic materials. Marine Pollution Bulletin 135:159–164; Good TP, June JA, Etnier MA, Broadhurst G. 2010. Derelict fishing nets in Puget Sound and the Northwest Straits: Patterns and threats to marine fauna. Marine Pollution Bulletin 60:39–50.

developers could, for example, follow the recommendations outlined in Benjamins *et al*. (2014) to conduct a qualitative risk assessment that would facilitate risk management and the development of mitigation strategies in early development of OWEI.[232]

Noise

Underwater noise from increased vessel traffic as well as turbine installation and operation could pose a potential threat to diving seabirds occurring within and around the WEA. As described further in this letter, loons[233] and alcids[234] have been known to avoid areas up to 16 and 8 km away, respectively, from offshore turbine arrays during operation and construction. The Common Murre, which is predicted to be of high displacement vulnerability, and likely occur near the WEA, is sensitive to underwater noise.[235] BOEM must assess potential direct and indirect physiological impacts to diving birds from underwater noise associated with offshore wind farm construction and operation within the CCS.

Species of Concern and Conservation Obligation

BOEM must consider the full range of potential impacts on all bird species known to forage or rest in or near the Project, or migrate through the area, including those species protected under the Migratory Bird Treaty Act ("MBTA") and the ESA, as well as species of birds covered under obligations for conservation of birds under the Fish and Wildlife Conservation Act as amended in 1988,[236] Executive Order 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*,[237] the North American Waterbird Conservation Plan[238] the U.S. Shorebird Conservation Plan,[239] the Memorandum of Understanding ("MOU") between the U.S. Minerals Management Service and the U.S. Fish and Wildlife Service ("USFWS") regarding implementation of Executive Order 13186,[240] the United Nations Convention on the Conservation of Migratory Species of Wild Animals ("CMS")[241] and BOEM, DOI, USFWS, and NOAA's membership in the IUCN[242] (hereinafter collectively referred to as the "conservation obligations").

As we have commented to BOEM before, we are aware that the DOI and the USFWS are now

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232 Benjamins et al. (2014), "Understanding the Potential for Marine Megafauna Entanglement Risk from Marine Renewable Energy Developments." Scottish Natural Heritage Commissioned Report No. 791

233 Mendel B, Schwemmer P, Peschko V, Müller S, Schwemmer H, Mercker M, Garthe S. 2019. Operational offshore wind farms and associated ship traffic cause profound changes in distribution patterns of Loons (Gavia spp.). Journal of Environmental Management 231:429–438.

234 Peschko V, Mendel B, Müller S, Markones N, Mercker M, Garthe S. 2020. Effects of offshore windfarms on seabird abundance: Strong effects in spring and in the breeding season. Marine Environmental Research:105157.

235 Anderson Hansen K, Hernandez A, Mooney TA, Rasmussen MH, Sørensen K, Wahlberg M. 2020. The common murre (Uria aalge), an auk seabird, reacts to underwater sound. The Journal of the Acoustical Society of America 147:4069–4074.

236 16 U.S.C. 2901-2911 (1988).

237 Exec. Order No. 13,186, *Responsibilities of Federal Agencies to Protect Migratory Birds* (Jan. 10, 2001).

238 James A. Kushlan et al., WATERBIRD CONSERVATION FOR THE AMERICAS: NORTH AMERICAN WATERBIRD CONSERVATION PLAN, VERSION 1 (2002), https://www.fws.gov/migratorybirds/pdf/management/northamericawaterbirdconservationplan.pdf.

239 Stephen Brown et al., UNITED STATES SHOREBIRD CONSERVATION PLAN, MANOMET CTR. CONSERVATION SCI. (2001), https://www.shorebirdplan.org/wp-content/uploads/2013/01/USShorebirdPlan2Ed.pdf.

240 Memorandum of Understanding Between the Department of the Interior U.S. Minerals Management Service and the Department of the Interior U.S. Fish and Wildlife Service Regarding Implementation of Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds" (June 4, 2009), https://www.boem.gov/sites/default/files/renewable-energy-program/MMS-FWS MBTA MOU 6-4-09.pdf [hereinafter "DOI MOU"].

241 Convention on the Conservation of Migratory Species of Wild Animals, Convention Text (June 23, 1979), https://www.cms.int/en/convention-text.

242 IUCN, IUCN Members (last visited July 25, 2021), https://www.iucn.org/about/members/iucn-members.

relying on a new rule[243] which codifies an illegal interpretation of the MBTA and limits its scope to the purposeful take of birds.[244] Our organizations strongly oppose this rule as contrary to the plain language and intent of the law, and we urge BOEM to continue to implement its MBTA responsibilities as all previous administrations have done in the past, with explicit recognition that incidental take is prohibited. This would also be consistent with the memorandum of understanding that BOEM signed with USFWS in 2009 to protect migratory bird populations.[245] If DOI's new interpretation changes BOEM's analysis and associated requirements for impacts to migratory birds in any way, a detailed description and explanation of such changes must be included in the Draft EIS. We note that several signatories of these comments, together with many other organizations and states, successfully challenged DOI's unlawful reinterpretation of the MBTA in court[246] and we expect BOEM and USFWS to respect the court's ruling.

The MBTA states that, "[u]nless and except as permitted by regulations…it shall be unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill…any migratory bird."[247] For decades, the DOI has interpreted the MBTA to encompass "incidental takes" of migratory birds, including from wind turbines. It was not until the 2017 Jorjani Opinion M-37050 that the DOI limited the MBTA's legal scope to only include actions that purposely take migratory birds.[248] However, on August 11, 2020, the U.S. District Court for the Southern District of New York found that "the Jorjani Opinion's interpretation runs counter to the purpose of the MBTA to protect migratory bird populations."[249] The Court found that the statute's unambiguous text makes clear that killing a migratory bird "by any means or in any manner," regardless of how, is covered by the statute.[250] As such, the District Court struck down the Jorjani Opinion as unlawful, restoring the MBTA's protections for migratory birds from incidental takes.[251] The unlawful reinterpretation does not relieve BOEM or USFWS from their obligations for conservation of birds under the aforementioned federal laws, Executive Order and MOU, as well as the MBTA.

At a minimum, BOEM should carefully consider impacts to the following priority species, which are likely to use the WEA, to fulfill BOEM's conservation obligations:

- Marbled Murrelet, Short-tailed Albatross, and California Least Tern are protected under the Endangered Species Act
- Scripps's Murrelet were petitioned for listing under the ESA in 2002.
- Ashy Storm-Petrel classified by IUCN as Endangered

[243] 50 C.F.R. § 10 (2021).
[244] Memorandum M-37050: The Migratory Bird Treaty Act Does Not Prohibit Incidental Take, U.S. DEP'T OF INTERIOR (DOI) (Dec. 22, 2017), https://www.doi.gov/sites/doi.gov/files/uploads/m-37050.pdf [hereinafter "2017 MBTA Interpretation"]. While USFWS has proposed to revoke the illegal rule, until that revocation has been effected we are concerned that the agencies may rely on it to exclude key protections for migratory birds.
[245] See DOI MOU. Memorandum of Understanding Between the Department of the Interior U.S. Minerals Management Service and the Department of the Interior U.S. Fish and Wildlife Service Regarding Implementation of Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds" (June 4, 2009), https://www.boem.gov/sites/default/files/renewable-energy-program/MMS-FWS MBTA MOU 6-4-09.pdf
[246] Nat'l Audubon Soc'y v. U.S. DOI, No. 18-cv-08084 (S.D.N.Y 2019).
[247] 16 U.S.C. § 703 (1918).
[248] 2017 MBTA Interpretation.
[249] NRDC v. U.S. DOI, 2020 WL 4605235, at *6 (S.D.N.Y. Aug. 11, 2020).
[250] *Id.* at 28.
[251] *Id.* at 42-44.

- Ashy Storm-petrel, Marbled Murrelet, Western Grebe, Clark's Grebe, Black-footed Albatross, Laysan Albatross, Cassin's Auklet, and Brant are some of the marine birds occurring in the Pacific OCS listed as USFWS Birds of Conservation Concern under the Fish & Wildlife Conservation Act, 1988 amendment.[252]
- Whimbrel aretrans-Pacific migrating shorebirds and USFWS Birds of Conservation Concern[253] with documented migratory paths through the Pacific OCS,[254] and should therefore be prioritized for studies concerning risks to landbird migrants.
- Black-legged Kittiwake, Short-tailed Albatross, Scripps's Murrelet, and Leach's Storm-petrel are classified by the IUCN as Vulnerable.
- Sooty Shearwater, Black-footed Albatross, Laysan Albatross, Cassin's Auklet, and Semipalmated Sandpiper are classified by IUCN as Near Threatened.
- Semipalmated Sandpiper are classified by the CMS as Endangered.

Many of the species which may migrate through the Project area are protected under California state regulations in addition to the federal ESA and the MBTA. BOEM should consider impacts to species protected under California's endangered species laws, as well as the species of greatest conservation need designated under California's State Wildlife Action Plan.

BOEM must additionally consider species prioritized for conservation by avian expert partners, including the Pacific Flyway Shorebird Initiative, Partners in Flight, and the North American Waterbird Plan. Along with ESA-listing and IUCN Red List status, the species included on these initiative priority lists are of high national and international conservation concern. Their priority status by these entities highlights their vulnerability and is further indicative of the need for enhanced mitigation and conservation measures to ensure their survival.

We provide additional information regarding some species of particular concern within the Humboldt WEA:

Short-tailed Albatross: Both the Black-footed Albatross and federally endangered Short-tailed Albatross rely heavily on the waters offshore northern California and within the Humboldt WEA, mostly utilizing the shelf-break domain (201-1000 m).[255] Given that these species also face overlapping risks from long-line fishing gear entanglement, it will be important to mitigate potential additional or interacting risks from offshore wind development.
Pacific Brant: Alaska Division of Fish and Game lists Pacific Brant as a species of greatest conservation need with high biological vulnerability.[256] The Pacific Brant actually refers to two disjunct breeding populations, Black Brant and Western High Arctic Brant, sharing common staging and wintering grounds.[257] The Audubon Humboldt Bay IBA and adjacent offshore area

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[252] U.S. FISH & WILDLIFE SERV. (FWS), BIRDS OF CONSERVATION CONCERN 2021: MIGRATORY BIRD PROGRAM (2021), available at http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
[253]U.S. FISH & WILDLIFE SERV. (FWS), BIRDS OF CONSERVATION CONCERN 2021: MIGRATORY BIRD PROGRAM (2021), available at http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
[254] Frank A. La Sorte & Daniel Fink, Projected changes in prevailing winds for transatlantic migratory birds under global warming, J. ANIMAL ECOLOGY (Dec. 14, 2016).
[255] Guy TJ et al. 2013. Overlap of North Pacific albatrosses with the U.S. west coast groundfish and shrimp fisheries. Fisheries Research 147:222–234.
[256] https://accs.uaa.alaska.edu/wp-content/uploads/branta_bernicla_nigricans.pdf
[257] Lewis, T. L., D. H. Ward, J. S. Sedinger, A. Reed, and D. V. Derksen. 2013. Brant (Branta bernicla), version 2.0. In Rodewald, P. G., ed. Birds of North America. Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bna.337

serves as a critical stopover site for Brandt during their northbound migration between January and April, especially for younger birds. While the number of birds stopping over at Humboldt Bay varies annually, capture-mark recapture efforts suggest between 28 and 58% of the population utilize this IBA.[258] These individuals are not restricted to the Bay, with flocks of up to 100 individuals occurring up to 90 km from shore.[259] Given the reliance of this species on the region, special care must be taken to mitigate impacts to this species from development of the Humboldt WEA.

Sooty Shearwaters: IUCN classifies Sooty Shearwaters as near threatened due to declining population trajectories. The Humboldt WEA hosts high numbers of sooty shearwaters in spring and summer.[260]

Marbled Murrelets: Marbled Murrelets are listed as Threatened under the federal Endangered Species Act and as Endangered by the state of California. They breed in coniferous forests in California from the Oregon border to Santa Cruz County and also occur in waters off Humboldt county primarily in fall. Marbled Murrelets are considered vulnerable to displacement from OSW development, so BOEM must carefully consider impacts to this species from construction activities and vessel traffic, especially nearshore. Nearly 75-90% of California's entire population nest within the Redwood National and State Parks of Northern California,[261] so it is absolutely critical that BOEM, lease holders, and OWEI developers adhere to guidelines to mitigate impacts to this species.[262]

Recommended Monitoring and Mitigation for Birds

Avian species may experience impacts to their populations from floating wind turbines via three main mechanisms: 1) displacement or loss of habitat, 2) barrier effects which can have energetic costs if birds reroute daily movements to foraging grounds or seasonal migratory movements, 3) direct mortality through collision. We expect BOEM to deploy two different types of tools to assess potential impacts from offshore wind development within Morro Bay 399: 1) those which predict risk to avian species from collision and displacement, and 2) those which measure realized impacts to birds from collision and displacement within Morro Bay 399 during construction and operation. Ideally, BOEM will employ baseline monitoring, as soon as possible, that will not only characterize avian risk and use of areas under consideration for offshore wind development but can also be paired with during and post-construction monitoring to assess realized impacts. We highlight here some of the key monitoring and mitigation needs, but also urge BOEM to:

1. Follow guidance many of the groups signing this letter have previously provided to the agency, all of which are relevant for leasing across U.S. marine environments, including guidance provided by

[258] Lee DE, Black JM, Moore JE, Sedinger JS. 2007. AGE-SPECIFIC STOPOVER ECOLOGY OF BLACK BRANT AT HUMBOLDT BAY, CALIFORNIA. The Wilson Journal of Ornithology 119:9–22.

[259] Briggs KT, Tyler WB, Lewis DB, Carlson DR. 1987. Bird Communities at Sea Off California: 1975 to 1983. The Cooper Ornithological Society.

[260] Briggs KT, Chu EW. 1986. Sooty Shearwaters off California: Distribution, Abundance and Habitat Use. The Condor 88:355–364.

[261] Marbled Murrelet - Redwood National and State Parks (U.S. National Park Service). Available from https://www.nps.gov/redw/learn/nature/marbled-murrelet.htm (accessed September 7, 2021).

[262] Mitigation strategies prepared for the Humboldt Wind, LLC suggest that Marbled Murrelet impacts are temporary and fails to incorporate impacts from underwater noise and increase vessel traffic that will occur over the life of the project; Golightly R, Schneider S, Terrill SB. 2019. Compensatory Mitigation Strategy for Marbled Murrelets Impacted by Operation of the Humboldt Wind Project. Prepared by H. T. Harvey & Associates.

   a. Atlantic Marine Bird Cooperative,[263]
   b. NYSERDA's E-TWG,[264] and
   c. Avian Considerations recommendations provided to BOEM on October 23, 2020[265]

2. Engage experts, like the Pacific Seabird Group, in developing a monitoring and mitigation framework to adequately address potential impacts to seabirds along the CCS.

Furthermore, BOEM is currently engaged in two studies which are meant to inform decision-making regarding leasing along the CCS. It is imperative that BOEM use the results of these studies, among others, in its decisions regarding Morro Bay 399 and any future developments along the CCS.

Monitoring--General
We suggest that BOEM clearly outline monitoring requirements and coordinate with other stakeholders, including future project developers, state agencies, and regional science entities, to support the development of a regional monitoring plan for birds and other wildlife.

Monitoring for adverse effects requires multiple modes of evaluation in a coordinated framework pre- and post-construction. Radar, vessel and aerial surveys, acoustic monitoring, and telemetry are all complimentary tools that provide data necessary for evaluating impacts, though none of these tools provides the full picture when used alone.

Monitoring--scope
BOEM's collision and displacement risk analyses should include information of avian distribution and occurrence for all species that occur within a 20 km radius of the area under consideration for development and that trigger conservation obligations.[266]

Annual and seasonal variations in avian movement are also not well captured during a limited survey period. Surveys should be repeated frequently enough to cover within and between seasonal and annual variation in avian distribution, so that changes in distribution caused by offshore wind development can be discerned from other sources.

Migration events are relatively infrequent, and therefore, survey efforts like PaCSEA[267] and PacMAPPS[268] are not appropriate for characterizing collision risk to land bird migrants. In general, understanding collision risk will require a combination of radar, telemetry, survey, and acoustic monitoring, and should not be based on a single technology alone. Studies to document

[263] Available at https://atlanticmarinebirds.org/recommendations-on-boem-avian-survey-guidelines-ambc-marine-spatial-planning-working-group/
[264] Aonghais Cook, Kate Williams, Edward Jenkins, Julia Gulka, Jillian Liner. 2021. Bird Workgroup Report for State of the Science Workshop on Wildlife and Offshore Wind Energy 2020: Cumulative Impacts. Page 37. Report to the New York State Energy Research and Development Authority (NYSERDA). Albany, NY. Available from https://www.nyetwg.com/2020-workgroups (accessed September 15, 2021).
[265] Available at https://drive.google.com/file/d/1qAY23mGxDLLKyEr9x6wJ_cSv6AOBiPQG/view?usp=sharing
[266] See bird species of conservation concern above.
[267] https://pubs.er.usgs.gov/publication/70100431
[268] https://www.fisheries.noaa.gov/west-coast/science-data/pacmapps-pacific-marine-assessment-program-protected-species

and characterize land bird migration patterns should prioritize satellite telemetry, paired with altimeters/pressure sensors, for larger bodied birds, as this is the best method for gathering fine scale movement data and flight altitude.[269]

Monitoring--Telemetry

BOEM must consider a full picture of migratory pathways for land birds and seabirds. This could be realized with the addition of satellite tracking information from Move bank and the National Aeronautics and Space Administration's Icarus project for larger bodied shorebirds, additional research and tagging of priority bird species using radio and satellite telemetry technology as appropriate, and an expansion of the radio telemetry receiver network in the offshore environment. BOEM should use the data currently available to calculate the risk to these migratory birds, especially in regard to modern turbine height, and provide for tracking focal species of these migratory birds during the life of projects within Humboldt Bay WEA and over all the cumulative projects in the Pacific OCS.

When incorporating radio telemetry methods, receiving stations need to be installed in the offshore environment in such a way that avian movement in and around the wind energy development areas can be adequately assessed prior to and following construction. BOEM must follow the monitoring protocols for automated radio telemetry that the agency is currently developing in partnership with USFWS and the Regional Wildlife Science Entity.[270] We applaud this interagency effort to develop robust, scientifically sound monitoring protocols and to test the feasibility of floating receiving stations. Metocean buoys, outfitted with telemetry, acoustic, and marine radar technology, should be deployed in wind energy areas prior to leasing, so that baseline data can be collected and paired with post-construction data to evaluate observed impacts from the Project's development and operation. BOEM needs to help financially support the efforts to further this technology, adopt these methods into regional monitoring protocols for offshore wind development, and ensure the success of this technology moving forward. It is important to note that the very-high frequency transmitters widely deployed along the coast have a limited lifespan. New solar-powered ultra-high frequency transmitters, which include on-board battery support for transmitting at night, should be the future focus for incorporating this technology.

Acoustic monitoring is especially inappropriate on its own to characterize the community of land bird migrants within wind energy areas. Evidence indicates that Empidonax flycatchers and vireos, two of the most abundant nocturnal migrant groups, do not emit nocturnal flight calls, and therefore, would not be accounted for using acoustic monitoring. Additionally, acoustic monitoring does not adequately assess flux, a necessary value for assessing collision risk and estimating population-level impacts.

Monitoring--Collision Detection

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[269] Péron G, Calabrese JM, Duriez O, Fleming CH, García-Jiménez R, Johnston A, Lambertucci SA, Safi K, Shepard ELC. 2020. The challenges of estimating the distribution of flight heights from telemetry or altimetry data. Animal Biotelemetry 8:5; Thaxter CB, Ross-Smith VH, Cook SCP. (n.d.). How high do birds fly? A review of current datasets and an appraisal of current methodologies for collecting flight height data: Literature review:66.

[270] Stakeholder Workshop: Scientific Research Framework to Understand the Effects of Offshore Wind Energy Development on Birds and Bats in the Eastern United States. (n.d.).:86.

Additionally, BOEM should outline requirements for the implementation of collision detection and minimization measures during the operation of potential projects within Morro Bay 399 and other planning areas. Under the ESA and MBTA, developers are responsible for any take of migratory birds and ESA-listed species. However, without appropriate monitoring for collision detection, large collision events could have serious population-level impacts to migratory land birds and seabirds without recourse. This is not an acceptable outcome, and BOEM must have a plan to address this concern.

Post-construction fatality monitoring onshore is a key component of Tier 4 of the FWS Land-Based Wind Energy Guidelines.[271] Many wind projects onshore conduct post-construction monitoring, especially on public lands managed by the Department of Interior's Bureau of Land Management. Developers survey for carcasses around a radius from the turbines, under an a priori protocol, to determine avian mortality rates. The data are adjusted for searcher efficiency, carcass persistence, and other sources of bias.

This practice is entirely impractical at sea for obvious reasons, however, that does not relieve BOEM from requiring post-construction fatality monitoring—an obligation that the onshore wind industry has committed to and is required to fulfill. There is ongoing, rapid development of imaging and bird strike technologies used in the European Union and the United Kingdom, and technologies are also being developed in the United States. Grant funding from the Department of Energy (DOE) Office of Energy Efficiency and Renewable Energy, state energy agencies, and others supports technical and economic advancement of offshore and onshore wind. The DOE Wind Energy Technologies Office invests in energy science research and development activities that enable the innovations needed to advance wind systems, reduce the cost of electricity, and accelerate the deployment of wind power.

DOE has recently funded development of collision detection technology from the Albertani Lab[272] at Oregon State University and WT Bird from WEST, Inc.[273] Similar technologies are being tested at Block Island Wind Project and other offshore locations in the European Union and United Kingdom and are making rapid gains in being effective, officially verified, commercially available, and affordable at scale in the near future, possibly prior to any construction and operation within Humboldt WEA.[274] However, these technologies must be fully integrated into turbine design before they can be deployed. DOE is currently evaluating the development status of these integrated systems based on their readiness for offshore wind deployment.[275] BOEM must support the development of these technologies and must drive turbine developers to integrate these systems into their turbine designs. We cannot wait on offshore wind project

[271] U.S. Fish and Wildlife Service. 2012. U.S. Fish and Wildlife Service land-based wind energy guidelines. OMB Control No, 10180148. U.S. Department of Interior, Fish and Wildlife Service, Hadley, MA. Available from https://www.fws.gov/ecologicalservices/es-library/pdfs/WEG_final.pdf.
[272] Clocker K, Hu C, Roadman J, Albertani R, Johnston ML. 2021. Autonomous Sensor System for Wind Turbine Blade Collision Detection. IEEE Sensors Journal:1–1.
[273] Verhoef JP, Eecen PJ, Nijdam RJ, Korterink H, Scholtens HH. 2003. WT-Bird A Low Cost Solution for Detecting Bird Collisions:46.
[274] Dirksen S. 2017. Review of methods and techniques for field validation of collision rates and avoidance amongst birds and bats at offshore wind turbines. Sjoerd Dirksen Ecology.
[275] Brown-Saracino J. 2018. State of the Science: Technologies and Approaches for Monitoring Bird and Bat Collisions Offshore. https://www.briloon.org/uploads/BRI_Documents/Wildlife_and_Renewable_Energy/NYSERDA_workshop_JocelynBrown-Saracino.pdf.

developers to drive the market, BOEM must require this type of collision monitoring and work with the industry to support the development of these technologies to make deploying them a reality.

The incorporation of these new monitoring technologies, and hopefully a standardized technology, should be a required element in the post-construction monitoring plan for the Project. BOEM should standardize the methodology for using these new technologies across all projects in the Pacific OCS to incorporate mortality data, and possibly displacement data, into ongoing cumulative effects analyses and adaptive management strategies, to validate collision risk models, and to measure impacts on ESA-listed species and other species of conservation obligation by augmenting tracking data with data from on-site detection technology.

In previous NEPA documents for Atlantic offshore wind development, BOEM has suggested that mortality monitoring rely on carcass monitoring around the base of the offshore wind turbines. This is contrary to the standard protocol for post-construction monitoring at onshore wind projects, where a radius from the turbine is prescribed as the search area and includes where birds may be propelled or thrown from the actual turbine structure and blades after collision. The offshore structures anticipated to be installed have very little available structure on which a dead or injured bird could land. Defining the structure as a search area, if it means the turbine base or nacelle (since no injured or dead birds could be found on the blades), is woefully inadequate. Only updated technology will detect bird strikes or mortalities in the appropriate range established by onshore post-construction mortality studies.

Collision Mitigation

We expect that offshore wind in California will incorporate a variety of technologies to minimize collision risks and measure collision impacts to birds, including aircraft detection lighting systems (ADLS), smart curtailment, deterrent technology, and collision detection.[276]

At a basic level, we expect BOEM to require that developers use Federal Aviation Administration-compliant ADLS on turbines to diminish attraction effects by nocturnal migrants in the marine environment. This technology is well developed and has been adopted across land-based wind facilities.[277] This has been a standard mitigation strategy identified in BOEM's environmental impact statements for offshore wind facilities in the Atlantic to date. We commend this step by BOEM and look forward to seeing mitigation strategies grow and evolve as technology allows.

While we acknowledge that blanket seasonal curtailment strategies are likely untenable for an economically viable and successful offshore wind industry, reasonably tailored, smart curtailment strategies will likely be necessary for responsibly operated offshore wind in the CCS. Developments in radar science make it easier to predict migration timing and various research into the timing and environmental cues driving migration dynamics across the CCS make it possible to predict specific periods when collision risk might be highest. Developments in collision detection technology will also likely provide a mechanism for smart curtailment based

[276] Cook ASCP et al. 2011. Identifying a range of options to prevent or reduce avian collision with offshore wind farms using a UK-based case study. BTO Research Report No. 580. British Trust for Ornithology, The Nunnery, Thetford, Norfolk.
[277] https://detect-inc.com/aircraft-detection-lighting-systems/

on the proximity of individual birds to the turbines. This type of automated curtailment system has resulted in significant decreases in collision mortality events within land-based wind farms where it has been deployed.[278]

Collision Risk Models

While limited, CRMs are one of the only tools available to hypothesize potential impacts to birds from collision in the offshore environment. As such, CRMs provide a mechanism for testing outcomes (e.g., observed collision rates) against the model predictions (e.g., expected collision rates), and BOEM must ensure the necessary data is collected to test these hypotheses.

BOEM's permitting decisions should be based, in part, on a CRM-driven analysis for all species of conservation obligation which may occur within 20 km of the Project footprint and for which a current CRM would be appropriate, even if the species has not been documented within the footprint of the Project. This should include a recent stochastic derivation of the Band model, such as the McGregor (2018) version.[279]
BOEM's analysis must provide the inputs used in order to best inform public comment and create a transparent decision process. Providing CRM results without transparency to the inputs and analytical process would never be acceptable from a scientific perspective and, therefore, would not be acceptable from BOEM. Providing inputs would show whether BOEM followed the guidance provided by Band in assessing collision risk. These details regarding inputs should include, but not be limited to, avoidance behavior, flight height, flight activity, flux rate, corpse detection rate, rotor speed, bird speed, and collision risk, as well as seasonal and daily conditions that might influence avian flight height. [280]

The current efforts underway at the Shatz Energy Research Center to develop a 3-D CRM for pelagic seabirds in the CCS could help inform these conditional flight heights.[281] This new derivation of the Band model should be applied, once available, in BOEM's assessments of avian impacts for future offshore wind developments, as they will be better able to incorporate variation in input parameters.

Moreover, CRMs provide a starting point, not an end point, from which to predict cumulative, population-level impacts across wind farms in the OCS. Collision risk models are not found to be reliable in predicting mortality:

> Siting and permitting decisions for many European offshore wind facilities are informed by collision risk models, which have been created to predict the number of avian collisions for offshore wind energy facilities. However, these models are highly sensitive to uncertainties in input data. The few empirical

[278] McClure CJW, Rolek BW, Dunn L, McCabe JD, Martinson L, Katzner T. 2021. Eagle fatalities are reduced by automated curtailment of wind turbines. Journal of Applied Ecology 58:446–452.
[279] R.M. McGregor et al., A Stochastic Collision Risk Model for Seabirds in Flight, MARINE SCOTLAND (Apr. 6, 2018), https://tethys.pnnl.gov/sites/default/files/publications/McGregor-2018-Stochastic.pdf .
[280] Bill Band, Using a collision risk model to assess bird collision risks for offshore windfarms, STRATEGIC ORNITHOLOGICAL SUPPORT SERV. (Mar. 1, 2012).
[281] Shatz Energy Rsch. Ctr., Seabird Distribution in 3D: Assessing Risk from Offshore Wind Energy Generation, HUMBOLDT ST. UNIV. (Apr. 16, 2020), https://schatzcenter.org/2020/04/seabird3dstudy/

> studies at land- based wind facilities that have compared model-estimated collision risk to actual mortality rates found only a weak relationship between the two, and due to logistical difficulties, the accuracy of these models has not been evaluated in the offshore environment.[282]

BOEM should pursue studies to not only verify CRM utility in the offshore environment but must also move toward viable collision detection requirements for leases within Morro Bay 399 and any future offshore wind developments.

Compensatory Mitigation

Given the importance of the CCS as a biodiversity hotspot, and an invaluable habitat for seabirds, BOEM should consider a mitigation framework which incorporates advanced conservation measures that appropriately compensate for the loss of adult seabirds. Given the life history of seabirds, as discussed above, these populations are highly sensitive to the loss of adults, and even non-breeding subadults. Supporting greater chick and egg survival will not necessarily compensate for decreases in adult survival.[283] Therefore, it's imperative that BOEM consult with experts like the Pacific Seabird Group to develop conservation strategies that will compensate for any potential population level impacts to avian species within the CCS. Such strategies may include but are not limited to nesting colony restoration and management, removal of invasive species, forage fish restoration and management, marine debris mitigation, or other strategies which will soften potential population-level impacts from offshore wind.

Both direct and indirect impacts can have population-level consequences, as discussed above, and therefore should both be considered in developing compensatory conservation measures.

Until BOEM can effectively document the level of take from collision, displacement, barrier effects, and secondary entanglement, BOEM should take a conservative approach and provide conservation strategies that compensate for highest estimates of loss.

10. Bats

Few data exist on bats in California offshore environment, although research has shown that bat fatalities are common at land-based wind facilities[284] with the potential for cumulative impacts to cause population-level declines.[285] How bats use the offshore environment is not well understood, although a report prepared by Peterson et al. (2016) for DOE found bats to be present at all surveyed locations in the Mid-Atlantic, Gulf of Maine, and Great Lakes, with bats detected up to   70.2 nm from the mainland in the Mid-Atlantic.[286]

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[282] Taber D. Allison et al., Impacts to wildlife of wind energy siting and operation in the United States, ISSUES IN ECOLOGY (2019).

[283] Felton SK, Hostetter NJ, Pollock KH, Simons TR. 2017. Managing American Oystercatcher (Haematopus palliatus) population growth by targeting nesting season vital rates. Waterbirds 40:44–54.

[284] Edward B. Arnett & Erin F. Baerwald. *Impacts of wind energy development on bats: Implications for conservation*, *in* BAT EVOLUTION, ECOLOGY, & CONSERVATION, 435-56 (Rick A. Adams & Scott C. Pedersen eds., 2013).

[285] Winifred F Frick et al., *Fatalities at wind turbines may threaten population viability of a migratory bat*, BIOLOGICAL CONSERVATION (May 2017); ELEC. POWER RSCH. INST. (EPRI), *Population-level risk to hoary bats amid continued wind energy development: Assessing fatality reduction targets under broad uncertainty* (Mar. 27, 2020).

[286] Trevor S. Peterson et al., *Long-Term Bat Monitoring on Islands, Offshore Structures, and Coastal Sites in the Gulf of Maine, Mid-Atlantic, and Great Lakes—Final Report*, U.S. DEP'T OF ENERGY (DOE) (Jan. 15, 2016).

The Southeast Farallon Island (SEFI) is the one place in North America where tree bats have been regularly observed during fall migration. SEFI is a small rocky island located more than 20 miles offshore from Point Reyes, California. Hoary bats (*Lasiurus cinereus*) have been observed on SEFI for over 50 years.[287]

They are also long-time well-known visitors to Humboldt Redwoods State Park and surrounds.[288] The regular appearance of Hoary bats on SEFI clearly demonstrates their ability to travel long distances offshore. If and until proven otherwise, it must be assumed that Hoary bats and potentially other migratory bats spend time within the WEA.

Impacts to Bats

More than half a million bats are likely killed at land-based wind turbines every year in the US and Canada.[289] Fatal collisions of bats with land-based wind turbines[290] mostly at low wind speeds on warm nights during migration are now well-documented.[291] Migratory tree-roosting bat species seem to be particularly attracted to WTGs on land. [292] Some of these bats have also been recorded altering course towards turbines.[293] This attraction to turbines could be from bats perceiving WTGs as potential roosting sites, using the structures for navigational purposes while migrating,[294] mistaking smooth turbine surfaces for water, foraging prey that congregate near lighted turbines/structures that attract insect prey,[295] or could be due to an as yet unknown reason.

Required Impact Analysis for Bats

Better understanding of bat presence and behavior in the WEA is needed to afford them protection from potential impacts from offshore wind energy-related activities. Lack of knowledge on the precise spatiotemporal movements of specific bat species cannot and must not be used to draw any conclusions on their potential presence in the WEA. Given the fact that hoary bats regularly travel to SEFI, BOEM's environmental analysis must consider impacts to all

[287] Cryan, P. M., & Brown, A. C. (2007). Migration of bats past a remote island offers clues toward the problem of bat fatalities at wind turbines. *Biological Conservation*, *139*(1–2), 1–11. https://doi.org/10.1016/j.biocon.2007.05.019

[288] Salganek, Autumn Roost Selection by Male Hoary Bats (*Lasiurus Cinereus*) In Northern California. (December 2019)

[289] Hayes, Mark A. "Bats Killed in Large Numbers at United States Wind Energy Facilities." *BioScience*, vol. 63, no. 12 (2013): 975–79. https://doi.org/10.1525/bio.2013.63.12.10

[290] Rollins, K. E., D. K. Meyerholz, G. D. Johnson, A. P. Capparella, and S. S. Loew. 2012. "A Forensic Investigation Into the Etiology of Bat Mortality at a Wind Farm: Barotrauma or Traumatic Injury?" *Veterinary Pathology,* vol. 49, no. 2 (2012): 362–71. https://pubmed.ncbi.nlm.nih.gov/22291071/

[291] Arnett, Edward, Manuela Huso, Michael Schirmacher, and John Hayes. "Altering Turbine Speed Reduces Bat Mortality at Wind-Energy Facilities." *Frontiers in Ecology and the Environment,* vol. 9, no. 4 (2011): 209–14. https://doi.org/10.1890/100103

[292] Hoary bats, eastern red bats, and silver-haired bats represent 38%, 22%, and 18% of all bat fatalities at wind turbines in the United States and Canada, respectively. Arnett, Edward B., and Erin F. Baerwald. "Impacts of Wind Energy Development on Bats: Implications for Conservation." *Bat Evolution, Ecology, and Conservation*, (2013): 435–56. https://doi.org/10.1007/978-1-4614-7397-8_21

[293] Cryan, Paul M., P. Marcos Gorresen, Cris D. Hein, Michael R. Schirmacher, Robert H. Diehl, Manuela M. Huso, David T. S. Hayman, *et al*. "Behavior of Bats at Wind Turbines." Proceedings of the National Academy of Sciences of the United States of America, vol. 111, no. 42: 15126-15131. https://doi.org/10.1073/pnas.1406672111

[294] South Fork Wind Farm and South Fork Export Cable Project Draft Environmental Impact Statement, Table H-36, 86 Fed. Reg. 1520 (Posted January 4, 2021).

[295] BOEM, 2021, South Fork Wind Farm and South Fork Export Cable - Development and Operation Biological Assessment, at pg. 45.

bat species with a presence, however limited, in this region. BOEM must be deliberate and conservative in its assessment of risk to all bat species to avoid, minimize, and mitigate adverse offshore wind energy-related impacts to the only flying mammals remaining on the planet.

We make the following recommendations for BOEM's consideration at all steps of offshore wind energy development including site characterization and assessment, pre-, during, and post-construction operation, maintenance, and decommissioning phases:

- Given the paucity of data on bat populations, BOEM must consider the relative risk to bats posed by OSW projects compared to terrestrial wind power projects.[296]
- BOEM must consider the evidence of impacts to both tree-roosting bats and cave-dwelling bats from terrestrial wind power projects in evaluating leasing and development in the WEA.
- BOEM must ensure that its analyses and decisions are informed by the most current and emerging science and technologies.
- BOEM must employ the best available scientific methods in real-time detection and continued monitoring using data sources like Motus Wildlife Tracking System[297] to establish pre-construction baseline data, fill in gaps in data, and develop methods to assess impacts to bats during the OSW development process.
- BOEM must consult with the USFWS and California Department of Fish and Wildlife (CDFW) on offshore wind energy-related impacts to listed/potentially listed bat species in developing and implementing protocols to avoid, minimize, and mitigate such impacts.
- BOEM must support and invest in scientific and technological research to:
    - develop methods and technologies for monitoring, risk assessment, direct detection of collisions, and quantification of mortalities of bats in the offshore environment.[298] Adaptive management to avoid and minimize impacts relies on monitoring, but traditional fatality assessments (which rely on searching for carcasses around turbines) are not feasible at offshore sites. As such, many dead or injured bats would most likely go undetected, either falling into the water or becoming prey to marine scavengers or predators.
    - continue developing mitigation strategies for land-based wind energy projects and evaluate the efficacy of their application to offshore wind. Differences in turbine height and environmental surroundings between land-based and offshore farms increase the uncertainty about how bat behavior and impacts from land-based wind energy will translate to offshore wind development. Offshore wind turbines are larger than land-based ones and research onshore has shown that bat mortality increases with tower height,[299] meaning that development approaches that favor fewer, larger turbines may be detrimental to bats.

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[296] NYSERDA workgroup
[297] Bird Studies Canada. 2018. "Motus Wildlife Tracking System." 2018. https://motus.org/
[298] NYSERDA bats
[299] Barclay, R. M.R., E.F. Baerwald, and J.C. Gruver. "Variation in Bat and Bird Fatalities at Wind Energy Facilities: Assessing the Effects of Rotor Size and Tower Height." *Canadian Journal of Zoology,* vol. 85, no. 3 (2007): 381–87. https://doi.org/10.1139/Z07-011; Rydell, J, Lothar Bach, Marie-Jo Dubourg-Savage, Martin Green, Luisa Rodrigues, and Anders Hedenström. "Bat Mortality at Wind Turbines in Northwestern Europe." *Acta Chiropterologica,* vol. 12, no. 2 (2010): 261–74. https://doi.org/10.3161/150811010X537846

- o improve acoustic monitoring to distinguish between calls of different species.[300]

Recommended Mitigation and Monitoring for Bats

BOEM must consider all available science and technology-based recommendations/guidance in the conservation of all bat populations. NYSERDA's Birds and Bats Study[301] recommends several mitigation measures, which could be used singly or combined and used in tandem to effectively avoid or reduce potential adverse impacts to bats from OSW projects:

- Bat deterrent technologies being developed for land-based turbines could be evaluated for deployment or modified for use in the offshore environment to minimize bat impacts. Some of these technologies include turbine coatings (to counteract any attraction to smooth surfaces which might be perceived as water),[302] ultraviolet lighting (which many bat species can see),[303] ultrasonic noise emitters (to effectively "jam" bats' radars and make wind facilities unappealing to bats),[304] acoustic monitoring at the height of turbine nacelles,[305] autodetection, targeted tagging, and use of thermal imaging technology to detect collisions. Additionally, supplementary field surveys shall be conducted in the RWF area to collect baseline information on the presence and activity levels of specific bat species.
- Feathering turbine blades at high-risk periods for bats, known as targeted or smart operational curtailment, should be explored for use in the offshore environment to minimize bat fatalities from WTG collisions. This approach has proven to be effective in reducing bat fatalities at land-based wind facilities and has achieved a greater than 90% reduction in some cases.[306,307]
- Increasing cut-in speed of turbines has been shown to reduce overall bat fatalities by 36% including those of eastern red bats, although there were no reductions in fatalities of

[300] Peterson *et al*. 2016.

[301] Ecology and Environment Engineering, P.C. "New York State Offshore Wind Master Plan Birds and Bats Study: Final Report." Prepared for: New York State Energy Research and Development Authority. NYSERDA Report 17-25d, 2017. Hereafter "NYSERDA BBS."

[302] Texturizing Wind Turbine Towers to Reduce Bat Mortality DE-EE0007033, https://www.energy.gov/sites/prod/files/2019/05/f63/TCU%20-%20M17%20-%20Hale-Bennett.pdf

[303] NREL Wind Research, Technology Development and Innovation Research Projects https://www.nrel.gov/wind/technology-development-innovation-projects.html

[304] https://www.osti.gov/biblio/1484770; Weaver, S. P., Hein, C. D., Simpson, T. R., Evans, J. W., & Castro-Arellano, I. (2020). Ultrasonic acoustic deterrents significantly reduce bat fatalities at wind turbines. Global Ecology and Conservation, e01099. https://doi.org/10.1016/j.gecco.2020.e01099; Arnett, E. B., Hein, C. D., Schirmacher, M. R., Huso, M. M. P., & Szewczak, J. M. (2013). Evaluating the Effectiveness of an Ultrasonic Acoustic Deterrent for Reducing Bat Fatalities at Wind Turbines. PLoS ONE, 8(6), e65794. https://doi.org/10.1371/journal.pone.0065794

[305] Peterson *et al*.'s (2016) survey work did not conduct acoustic monitoring at nacelle height; no acoustic monitor was mounted higher than 45m and more than half were at 10m or less. These low altitude surveys may not adequately assess risk at nacelle height. Eastern red bats have been detected offshore of New Jersey, Delaware, and Virginia flying at heights in excess of 200m. Hatch, Shaylyn K., Emily E. Connelly, Timothy J. Divoll, Iain J. Stenhouse, and Kathryn A. Williams. 2013. "Offshore Observations of Eastern Red Bats (Lasiurus Borealis) in the Mid-Atlantic United States Using Multiple Survey Methods." Justin David Brown, ed. *PLoS ONE,* vol. 8, no. 12 (2013): e83803. https://doi.org/10.1371/journal.pone.0083803

[306] Arnett, E. B., Huso, M. M., Schirmacher, M. R., & Hayes, J. P. "Altering turbine speed reduces bat mortality at wind-energy facilities." *Frontiers in Ecology and the Environment*, vol. 9, no. 4 (2011): 209–214. https://doi.org/10.1890/100103

[307] Borssele Wind Farm in the Netherlands is the first proposed offshore wind farm in Europe with a bat mitigation requirement for migratory bats. One proposed mitigation measure is targeted operational curtailment. https://www.rvo.nl/sites/default/files/2015/09/33953992.pdf

either hoary or silver-haired bats.[308] This strategy could be evaluated for application in offshore wind projects to reduce bat collisions. A higher cut-in speed could translate to greater reductions in bat mortality.[309] In Europe, WTGs in the North Sea have operational curtailment between August 15 and October 1 to reduce impacts on the Nathusius's pipistrelle (*Pipistrellus nathusii*) during their summer/autumn migration.[310] If monitoring efforts reveal that offshore wind related activities are significantly impacting bat populations, a similar strategy could be explored for use, targeting warm, slow wind speed nights during seasonal migration when bat activity is highest.[311] Bat activity levels offshore could be used as a proxy for their risk from offshore wind.[312]

11. Conclusion

We urge BOEM to incorporate the recommendations in these comments in its preparation of the environmental analysis for the Humboldt Wind Energy Area. We also urge BOEM to undertake the broader suite of actions outlined in these comments to ensure that the U.S. offshore wind energy industry as a whole advance in a responsible and sustainable manner.

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[308] Good, Rhett E, Andy Merrill, Sandra Simon, Kevin Murray, and Kimberly Bay. "Bat Monitoring Studies at the Fowler Ridge Wind Farm, Benton County, Indiana. Final Report: April 1 – October 31, 2011." Prepared for Fowler Ridge Wind Farm, Fowler, Indiana, 2012. https://tethys.pnnl.gov/sites/default/files/publications/Good%20et%20al.%202012_Fowler%20Report.pdf. As a caveat, as turbine technology advances and turbines become efficient at lower wind speeds, the manufacturer's cut-in speed will decrease, thereby limiting reductions in bat fatalities from feathering only to the manufacturer's cut-in speed.

[309] Although it varies considerably by facility, for land-based wind, a 50% reduction in bat fatalities is associated with a ~1% decrease in energy production and a 90% reduction in bat fatalities is associated with a ~3.5% decrease in energy production, although similar reductions with less energy loss may be possible with more targeted operational curtailment. Good, R.E., Merrill, A., Simon, S., Murray, K. and Bay, K. "Bat Monitoring Studies at the Fowler Ridge Wind Farm, Benton County, Indiana. Final Report: April 1 – October 31, 2011." Prepared for Fowler Ridge Wind Farm, Fowler, Indiana, 2012.; Arnett, E.B., Johnson, G.D., Erickson, W.P., and Hein, C.D. "A Synthesis of Operational Mitigation Studies to Reduce Bat Fatalities at Wind Energy Facilities in North America." A report submitted to the National Renewable Energy Laboratory. Bat Conservation International. Austin, Texas, 2013.; Arnett, E. B., Huso, M.M., Schirmacher, M.R., & Hayes, J.P. "Altering turbine speed reduces bat mortality at wind-energy facilities." *Frontiers in Ecology and the Environment*, vol. *9,* no. 4 (2011): 209–214.; Tidhar, D., Sonnenberg, M., & Young, D. *2012 "*Post-construction Carcass Monitoring Study for the Beech Ridge Wind Farm Greenbrier County, West Virginia. FINAL REPORT." Prepared by Western EcoSystems Technology, Inc. for Beech Ridge Wind Farm, Beech Ridge Energy, LLC, 2013; Ostridge, C. and Framer, C. "Understanding the costs of bat curtailment." Presentation at AWEA Siting Conference. 20 Mar. 2018.

[310] South Fork Wind Farm and South Fork Export Cable Project Draft Environmental Impact Statement, Table H-36, 86 Fed. Reg. 1520 (Posted January 4, 2021).

[311] *See* Peterson *et al*. (2016). In their study, the majority of bat activity in the Gulf of Maine and the Mid-Atlantic occurred below 10 m/s average nightly wind speed and above ~7^{o}C.

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