725 Front Street
Suite 201
Santa Cruz, CA 95060

Ocean Conservancy

831.854.4630 Telephone
831.425.5604 Facsimilie
www.oceanconservancy.org

California Air Resources Board
California Environmental Protection Agency
State of California

Re: 2030 Climate Change Draft Scoping Plan Update

July 8, 2016

Dear California Air Resources Board Members;

Thank you for the opportunity to comment on the 2030 Draft Scoping Plan Update (Plan). We applaud the Board for including in the Plan a focus on Natural and Working Lands, including wetland, riparian, estuarine, coastal, and ocean habitats. Investments in California's coast and ocean can play a critical role in reducing the state's greenhouse gas (GHG) emissions and combating climate change, and can also produce a range of co-benefits that will help ensure oceans continue to provide the services upon which all Californians depend.

The Plan, along with the associated Discussion Paper on California's Climate Change Vision and Goals for Natural and Working Lands (Discussion Paper) released for the March 23rd 2016 public workshop, recognizes the importance of ocean and coastal habitat to California's climate change strategy. In this letter, we offer additional support for the importance of this focal area, and provide several recommendations and comments on the Plan.

We greatly appreciate the state's efforts on climate change, and support the most ambitious actions recommended in the concepts in an effort to limit global warming below 2 degrees C. We note, however, that even this goal is increasingly considered inadequate, as evidenced by the aspirational limit of 1.5 degrees C at the Paris climate talks. For the ocean in particular, a lower limit is critical to preventing the worst consequences of climate change, including sea level rise and storm surges, species shifts due to increasing temperatures, habitat loss, and synergistic effects among them.[1] We urge the ARB to include reference to this aspirational limit and to encourage the most stringent, efficient, and fastest means of achieving greenhouse gas reductions.

For this reason, Ocean Conservancy commends the current inclusion of ocean and coastal habitats in the Plan, and recommends even greater recognition of their importance in the overall strategy for using the inherent capacities of natural and working lands to increase carbon storage and mitigation and provide

[1] Hansen, J., et al. 2016. Ice melt, sea level rise and superstorms: Evidence from paleoclimate data, climate modeling, and modern observations that 2 C global warming could be dangerous. *Atmospheric Chemistry and Physics*, *16*(6): 3761-3812; Gattuso, J.P. et al. 2015. Contrasting futures for ocean and society from different anthropogenic CO2 emissions scenarios. *Science* 349 (6423): aac4722.

economic and environmental co-benefits. For example, we recommend that the ARB specify "coastal habitats" whenever different habitat types are mentioned. We also recommend four key strategies for better incorporating natural and working lands, and in particular, coastal and ocean ecosystems, into the State's climate change strategy through the Plan.

These are:

1. **Protect and restore near-shore habitat and ecosystems;**
2. **Restore offshore marine food webs to utilize food web dynamics as a carbon management tool;**
3. **Advance seaweed aquaculture as a mechanism to remove CO2 from the ocean, while providing jobs and biofuels to benefit all Californians; and**
4. **Create an "Ocean Carbon Strategy Workgroup" to identify, advance and test new, science-based ocean initiatives to mitigate and adapt to climate change.**

Ocean Conservancy concludes that there are a number of investments the State can make in our coast and ocean to reduce, mitigate and/or sequester carbon that advances California's AB 32 goals, positions the State to combat climate change more broadly, and maximize co-benefits to our natural resources.[2]

Background

Investments in California's coast and ocean could play a critical role in reducing the state's greenhouse gas (GHG) emissions and combating climate change. As a critical complement to land-based investments, AB 32 auction revenue could also produce a range of co-benefits that will ensure the coasts and ocean continue to provide the services upon which all Californians depend, consistent with the spirit of California's Global Warming Solutions Act of 2006.[3]

Over 90% of the Earth's carbon dioxide passes through the oceans,[4] making oceans a critical part of the global carbon cycle. Vast amounts of carbon are stored in a number of ocean habitats, including sea grass beds, kelp forests, coastal peat bogs, and tidal, freshwater and brackish wetlands. Rates of carbon sequestration and storage in these coastal ecosystems are comparable to - and often higher than - the rates in carbon-rich terrestrial ecosystems such as tropical rainforests or freshwater peat lands. Unlike most terrestrial ecosystems, which reach soil carbon equilibrium within decades, deposition of CO2 in the sediments of coastal ecosystems can continue over millennia, as the root systems of sea grasses, especially, sequester CO2 belowground. Duarte et al. (2013) confirmed the important role of "blue carbon," stating that the "…conservation, restoration and use of vegetated coastal habitats in eco-engineering solutions for coastal protection provide a promising strategy, delivering significant capacity for climate change mitigation and adaption."[5]

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[2] As stipulated by AB 1532 (Perez, 2012), auction revenue must only be used to mitigate greenhouse gas emissions as well as to the extent feasible, maximize environmental benefits, foster job creation for California workers, and lessen the impacts and effects of climate change. Specifically AB 1532 authorizes "*funding to reduce greenhouse gas emissions associated with … natural resource conservation and management…*" and "*funding in research, development, and deployment of innovative technologies, measures, and practices related to programs and projects funded pursuant to this part.*"

[3] Assembly Bill No. 32 (2006), Chapter 488, Section 1, Division 25.5, Part 1, Chapter 2, Section 38501(h).

[4] U.N. Environment Program (UNEP), From Mangroves to Sea grass – Carbon Capture and Storage in Nature's Way, Nick Nuttall. http://www.unep.org/climatechange/ClimateChangeConferences/COP18/News/UNmovestopreserveecosystemsthatlockawaycar.aspx.

[5] Duarte, C.M., Losada, I.J., Hendriks, I.E., Mazarrasa, I. and Marbà, N., 2013. The role of coastal plant communities for climate change mitigation and adaptation. *Nature Climate Change*, *3*(11), pp.961-968.

As noted in the Plan, "policies that support [the natural and working lands sector] can reduce emissions and sequester carbon, while also providing ecosystem benefits such as better water quality, increased water yield, soil health, reduced erosion and habitat connectivity" (p. 20). Ocean and coastal systems in particular provide a range of important benefits for society.[6]

Among the important co-benefits investments in coastal and ocean habitat protection and restoration can provide are:

- protection from sea level rise and increasing storm intensity;
- amelioration of ocean acidification;
- increased survival of juvenile fish of commercial and recreational importance through protection of nursery habitats;
- protection of wild species and preservation of open space;
- ensuring access for outdoor recreation and wildlife viewing and tourism;
- establishing "natural laboratories" for improved scientific understanding of climate impacts on oceans;
- promoting "green jobs," consistent with the State's move to a low-carbon economy; and
- fostering novel strategies to confront climate change in California through new, multidisciplinary research and development.

These carbon sequestration benefits and economic and environmental co-benefits will only accrue if we maintain the health and vitality of these environments and work aggressively to restore damaged habitats to recover the services that have been lost. Indeed, at the global level, halting the destruction and degradation of these "blue carbon" sinks could supply at least 10% of the reduction needed to keep atmospheric concentrations of carbon dioxide below 450 parts per million. New research is exploring the benefits of re-"forestation" of ocean habitats,[7] and the protection of blue carbon is widely acknowledged as critical to mitigating climate change.[8]

At the same time, yearly global rates of loss from two to seven percent for mangroves, sea grass beds and salt marshes – driven largely by conversion, coastal development and over-harvesting – are among the highest of any ecosystem on the planet. As a result, between 300 and 900 million tons of CO2 are added to the atmosphere globally from degraded and converted coastal wetlands each year.[9] California is a prime contributor to this global challenge. The state has lost 91% of its historical salt marshes and more than 2.5 billion cubic meters of freshwater wetlands have been lost in the Sacramento-San Joaquin

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[6] Ruckelshaus, M., et al. 2013. Securing ocean benefits for society in the face of climate change. *Marine Policy*, *40*, pp.154-159; Chan, F., et al. 2016. The West Coast Ocean Acidification and Hypoxia Science Panel: Major findings, recommendations, and actions. California Ocean Science Trust, Oakland, California. April 2016.

[7] Associated Press, 7/4/16, Slowing ocean acidification with kelp. *New York Times* (online edition), http://www.nytimes.com/2016/07/05/science/fighting-ocean-acidification-through-kelp.html?rref=collection%2Ftimestopic%2FOceans&action=click&contentCollection=science&region=stream&module=stream_unit&version=latest&contentPlacement=2&pgtype=collection&_r=1, accessed 7/7/16.

[8] NOAA Habitat Conservation, National Marine Fisheries Service, Coastal blue carbon. Web page, http://www.habitat.noaa.gov/coastalbluecarbon.html, accessed 7/7/16.

[9] Estimating Global "Blue Carbon" Emissions from Conversion and Degradation of Vegetated Coastal Ecosystems, Murray et al., 2011, http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0043542.

Delta. Ocean Conservancy is therefore highly supportive of the riparian, floodplain, and coastal wetland restoration goals presented in Figure 1 of the Discussion Paper (p. 5), but encourage an even greater acknowledgement of the importance of coastal and ocean "blue carbon" habitat protection and restoration.

This goal has strong statewide support as evidenced by its inclusion in the West Coast Ocean Acidification and Hypoxia (OAH) Science Panel Report,[10] the likely convening of an OST-SAT workgroup on eelgrass,[11] and the introduction in the 2016 California Legislative Session of two bills that support eelgrass and other ocean and coastal habitat protection and restoration for carbon sequestration and mitigation, as well as mitigation of ocean acidification and other co-benefits like storm surge protection.

Beyond the coast, open water marine habitats may also have a key role to play in carbon sequestration. Wilmers et al. (2012) found that sea otters, acting as keystone species, can accelerate carbon sequestration in kelp forests by controlling sea urchins.[12] While sea otters have returned to California waters, their current abundance is a fraction of their historical number, indicating kelp forests may have a larger role to play in combating climate change than they have in the recent past. More generally, these findings suggest that large marine predators, through their impacts on marine food web structure, may be more important than previously thought in influencing carbon sequestration. In addition, it is increasingly recognized that ocean biota itself plays an important role in the carbon cycle in transport and sequestration. This, along with better quantification of the carbon capture and sequestration benefits of riparian, wetland, estuarine, coastal, and ocean habitats, is an important area for new scientific research of the type recommended in the Plan (p. 13).

Potential Investment Strategies

Strategy 1: Protect and restore near-shore habitat and ecosystems

Data[13] on the carbon sequestration potential of California's tidal wetlands show that salt marshes, estuarine forests, and potentially freshwater tidal marshes play a critical role in sequestering carbon. Carbon accumulation rates can approach 1000 gm C m^{-2} yr^{-1} in wetland soils because of high rates of plant productivity and low rates of decomposition in these ecosystems. Tidal wetlands store carbon belowground and have low methane emissions, making their restoration a promising technique for reducing greenhouse gas emissions. In addition, the eligibility of wetland restoration projects for carbon credit offsets will both reduce greenhouse gas emissions and provide a significant new funding source for habitat restoration that will facilitate adaptation of vulnerable coastal areas to impacts of future climate change, including sea level rise and more intense storm surges. **We commend the Plan's inclusion of natural and working lands restoration goals, but urge the Board to specify that coastal and ocean habitats should be specifically mentioned and included in restoration, protection, and preservation policies in the Natural and Working Lands sections of the four concepts presented**.

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[10] Chan, F., et al. 2016. The West Coast Ocean Acidification and Hypoxia Science Panel: Major findings, recommendations, and actions. California Ocean Science Trust, Oakland, California. April 2016.

[11] Discussion, Ocean Protection Council Science Advisory Team Workshop, April 18, 2016, Oakland, CA.

[12] Wilmers, C. C., Estes, J. A., Edwards, M., Laidre, K. L. and B. Konar. Do trophic cascades affect the storage and flux of atmospheric carbon? An analysis of sea otters and kelp forests. Front. Ecol. Environ. 2012. DOI: 10.1890/11076.

[13] Crooks, S. 2009. Carbon sequestration in tidal wetlands – white paper. Prepared for Resources Legacy Fund. 8pp.

The State Coastal Conservancy has legal authority to undertake projects and award grants for projects that address existing and future climate change impacts, as clarified through SB 1066 (Lieu, 2012), and in the third grant round in 2015 awarded almost $2m to 11 "climate ready" project grants. The three grant rounds so far have funded projects related to sea level rise (vulnerability assessments and planning, managed retreat), greenhouse gas reduction, green infrastructure, water catchment and storage, habitat conservation, and regional climate collaboratives.[14] These grants are an important step in helping California's coastal communities prepare for climate change while also improving carbon sequestration, and **we encourage ongoing support to the Coastal Conservancy for projects like those listed in the Discussion Paper and others, including**:

- Reversing carbon losses from the Sacramento-San Joaquin Delta, currently estimated at 13 mt of carbon per year, equivalent to 3% of California's GHG emissions[15], with a special emphasis on changing hydrology and sediment conditions.

- Funding efforts to restore an additional 75,000 – 100,000 acres of tidal wetlands in the San Francisco Bay area[16], including the Redwood City salt ponds. Other notable projects include Ormond Beach, Ballona, Southern California, Dutch Slough, and South San Diego Bay Wetlands Projects. Estuary mitigation projects associated with development, or projects that would otherwise occur, are not eligible to receive AB 32 funding. Wildlife conservation and flood control co-benefits should be central goals of these projects. Based on the South Bay Salt Pond Restoration Project alone, 20 mt of annual carbon sequestration could result.[17]

In addition, a vital tool to address new strategies for habitat protection and restoration as well as climate mitigation and adaptation will be California's network of marine protected areas (MPAs) and areas of special biological significance (ASBS). These areas provide unique opportunities to detect and improve our understanding of the effects of climate change and ocean acidification on marine ecosystems and fisheries and the role of management and private-sector strategies to confront the threat of climate change. MPAs can thus help resource managers and policy makers better assess and address this critical threat to the state's fishery and marine conservation goals, as laid out in state laws such as the Marine Life Management Act and the Marine Life Protection Act.

Strategy 2: Restore offshore marine food webs to utilize food web dynamics as a carbon management tool.

Healthy ecosystems can sequester more carbon than perturbed ecosystems, providing additional justification for protection and restoration of healthy ocean and coastal ecosystems as a climate change mitigation strategy. These effects occur both through food web dynamics, where additional carbon sequestration occurs because of healthier, more robust, and more active blue carbon systems provided in a healthy ecosystem with a fully-functioning food web (for example, via the relationship between otters, urchins, and kelp), as well as through the role of biota more broadly in the ocean carbon pump. The role

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[14] State of California Coastal Conservancy. Coastal Conservancy Awards 11 Climate Ready Project Grants. Web page, http://scc.ca.gov/2015/06/29/coastal-conservancy-awards-11-climate-ready-project-grants/. Accessed 7/7/16; State of California Coastal Conservancy. http://scc.ca.gov/webmaster/brochures/ClimateReady_Brochure.pdf.

[15] Brown, S. 2005. Global climate change and California. Staff paper: Fuels and Transportation Division, California Energy Commission. 33 pp.

[16] Doherty, A. 2009. How can restoration of California's wetlands help with climate change? Paper presented to the Ocean Protection Council. 6 pp.

[17] Atwater, B. F., S. G. Conard, J. N. Dowden, C. W. Hedel, R. L. MacDonald, and W. Savage. 1979. History, landforms, and vegetation of the estuary's tidal marshes. Pages 347-385 in T. J. Conomos, editor. San Francisco Bay: The urbanized estuary. Pacific Division, American Association for the Advancement of Science, San Francisco, CA.

of biota in the terrestrial carbon cycle is becoming increasingly well-recognized.[18] Similar dynamics are at play in the ocean, where marine mammals, large carnivores, and microbial interactions sequester substantial amounts of carbon in the surface ocean, deep ocean, and, more permanently, in ocean sediments.[19] For example, whales, both through their feeding cycles and in death, move nutrients throughout the ocean system and increase carbon sequestration in the ocean.[20]

For California in particular, Wilmers et al. (2012) highlighted the pressing global importance of developing habitat use strategies as a mechanism to sequester carbon. [21] Using the example of sea otters in the eastern Pacific, these researchers showed that sea otters can increase carbon storage in kelp forests by an order of magnitude (10x) compared to regions where sea otters are absent. Storage in live plants, combined with transport to the deep sea of even modest amounts of decaying algal biomass, can contribute substantially to additional carbon sequestration.

Sea otters live in shallow coastal waters along the entire west coast, with a range from Alaska down to Baja California. Because of strong federal and state protections, sea otters have recovered from near extinction due to hunting at the turn of the century but their recovery has stalled over the last few years[22]. Scientists conclude otters now suffer from a range of diffuse threats including predation by white sharks, water pollution, and disease linked to storm water runoff. **A substantial increase in investment in sea otter recovery and protection could result in increases in carbon storage as well as contribute to the goal of delisting of this iconic – and critically important – keystone predator.**

Strategy 3: Advance seaweed aquaculture as a mechanism to remove CO2 from the ocean, while providing jobs and biofuels to benefit all Californians.

Marine agronomy – the farming of seaweeds in the ocean – has the potential to contribute to the State's greenhouse gas emission goals as well as improve water quality, create jobs, and produce biofuels to reduce our reliance on fossil fuels. Like all plants, marine seaweeds absorb carbon dioxide and use photosynthesis to grow, while producing oxygen as a metabolic byproduct. There is a growing recognition[23] that ocean plants can play a key role in absorbing carbon directly, ameliorating the associated problem of ocean acidification,[24] and improving water quality by absorbing nutrients and reducing low oxygen associated with hypoxia and dead zones.

California could direct AB 32 revenue to state agencies, such as the Department of Fish and Wildlife, to advance new seaweed aquaculture facilities in specific coast and ocean waters that could benefit from algal culture. Alternatively, the state's existing shellfish farms could be incentivized to diversify their culture to include seaweeds, both as a means to sequester carbon pursuant to AB 32 and to reduce local acidification. In doing so, however, **the state should ensure that decisions about existing and future aquaculture facilities are made within the context of a well-planned and coordinated spatial**

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[18] Schmitz, O.J., et al. 2014. Animating the carbon cycle. *Ecosystems*, *17*(2), pp.344-359.

[19] Atwood, T.B., et al. 2015. Predators help protect carbon stocks in blue carbon ecosystems. *Nature Climate Change*, *5*(12), pp.1038-1045; Siegel, D., et al. 2015. Export Processes in the Ocean from Remote Sensing (EXPORTS): A science plan for a NASA field campaign. http://cce.nasa.gov/cce/pdfs/EXPORTS_Science_Plan_May18_2015_final.pdf.

[20] Roman, J., et al. 2014. Whales as marine ecosystem engineers. *Frontiers in Ecology and the Environment*, *12*(7), pp.377-385.

[21] Wilmers, C. C., Estes, J. A., Edwards, M., Laidre, K. L. and B. Konar. Do trophic cascades affect the storage and flux of atmospheric carbon? An analysis of sea otters and kelp forests. Front. Ecol. Environ. 2012. Doi: 10.1890/11076.

[22] http://www.usgs.gov/newsroom/article.asp?ID=3369

[23] http://marineagronomy.org/

[24] http://oceanacidification.net/

planning process. The state should look to work closely with the West Coast Regional Planning Body and the West Coast Governors' Alliance in any such effort.

Finally, direct investments could be made in California companies, private-public partnerships, or government projects designed to advance innovative techniques to grow both macro and microalgae for biofuels, with the "co-benefit" of carbon sequestration. For example, recent research by Moreira and Pires (2016) suggests that algal aquaculture could be an effective "negative emission technology."[25] In addition, several experiments with 3-dimensional farming systems that joinshellfish and algae aquaculture are being brought to commercial scale in different locations globally.[26] While shown to be effective on a small scale, **these innovative concepts require resources to be tested at scales relevant to AB 32.**

Strategy 4: Create an "Ocean Carbon Strategy Workgroup" to identify, advance and test new, science-based ocean initiatives to mitigate and adapt to climate change.

In 2012 Rau and colleagues published a provocative paper that argued that the historically unprecedented threats to the marine environment posed by increasing atmospheric carbon dioxide require that new conservation strategies be developed for a high carbon dioxide world.[27] They argued that unconventional, interventionist methods were likely to be needed to ensure healthy oceans in the future. Beyond adapting to climate change, Rau and his colleagues advocated that new testable ideas are needed to determine how oceans themselves can be used to combat (i.e., mitigate) climate change. Their call for identifying such approaches and evaluating their cost, safety and effectiveness is consistent with the goal of AB 32 to fund research and deploy innovative technologies consistent with meeting the State's climate goals.

At present, there is no formal structure anywhere in the world to bring together the science, government, public policy and private sector interests needed to devise options for combatting climate change with a focus on oceans, rigorously vet those with scientific merit, and develop policies and strategies to test the resultant ideas at relevant scales (Greg Rau, personal communication, November 13, 2012). **Using AB 32 revenue, the Ocean Protection Council could initiate and support a new "Ocean Carbon Strategy Workgroup"** to achieve these goals. Such a workgroup is consistent with OPC's charge to implement the California Ocean Protection Act (COPA) and the OPC Strategic Plan, which includes climate change amongst the areas of primary focus. Indeed, California (through the OPC) has already been at the forefront of convening new science on climate change with an ocean focus, with the West Coast Ocean Acidification and Hypoxia panel and upcoming work for further research in some of the areas identified by the panel's report. A new Ocean Carbon Strategy Workgroup could build off of this ground-breaking, climate-related work done by the WCOAH Panel to provide similarly forward-looking, practicable solutions for climate change mitigation.

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[25] Moreira, D. and Pires, J.C., 2016. Atmospheric CO 2 capture by algae: negative carbon dioxide emission path. *Bioresource technology*, *215*, pp.371-379.

[26] http://greenwave.org/3d-ocean-farming/

[27] Rau, G. H., McLe, E. L. and Ove Hoegh-Guldberg. 2012. The need for new ocean conservation strategies in a high-carbon dioxide world. Nature Climate Change. DOI: 10.1038/NCLIMATE1555. pp. 1-5.

Conclusion

By incorporating these four strategies and goals – ecosystem protection and restoration, healthy marine food webs, well-planned and managed algae production for carbon sequestration and other benefits, and a focus on research and testing of new, science-based ocean initiatives to mitigate and adapt to climate change – the ARB Draft Scoping Plan Update can provide a framework for the state to further its position as a global leader on climate change. These investments in California's coast and ocean could play a critical role in both mitigation of and adaptation to climate change both in California and globally, and could also result in economic and environmental co-benefits, ensuring that our ocean and coasts continue to provide the services upon which all Californians depend.

Ocean Conservancy strongly encourages the ARB to incorporate these suggestions as it moves forward on this important work.

Thank you very much for your consideration.

Very truly yours,

George H. Leonard, Ph.D.
Chief Scientist

Anna M. Zivian, Ph.D.
Senior Research Fellow