Scientific evidence on the effect of people on beaches

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An issue has come up repeatedly in the discussion about the proposed sale to the Land Bank of beach access on the west side. Proponents maintain that the probable increase in foot traffic over present usage is unlikely to cause environmental harm. Opponents maintain the opposite. Neither side has presented data to support their argument. We have researched the literature on the effects of human traffic ("trampling") on rocky shorelines and found numerous experimental studies in the peer-reviewed scientific literature on this issue. The publicly available portion of the beach is a rocky shoreline. These studies have been conducted around the world and as close to home as California, Oregon, and even Cattle Point on San Juan Island. They generally conclude that both the density and diversity of plants and animals declines with even light human traffic, that the damage increases in proportion to the amount of trampling, and that recovery is slow or does not occur if trampling does not cease.

A relevant trampling study was conducted at San Juan County Park, the findings and conclusions of which reinforce our concerns about probable environmental damage that would occur:

> "Trampling reduced cover of [the dominant algae] to 30% of its original value within 6 weeks, and cover remained lower in trampled than control quadrats throughout the 'recovery' period... 4 weeks after trampling ended, bare space had more than doubled where previously trampled, particularly at mid and low tidal elevations. These negative impacts of trampling on canopy algae are consistent with numerous studies throughout the world."
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> "Parks and reserves...become popular recreational destinations, leading to increased recreational pressure... Trampling, or foot traffic, will occur with all forms of intertidal access... 85% [of the visitors surveyed] reported that they had walked along the intertidal shoreline." [1]

More studies:

> "[F]oliose algae were susceptible to trampling, and suffered significant declines shortly after trampling started... Barnacles were crushed and removed by trampling... Overall, trampling can shift community composition to an alternate state dominated by low profile algae, and fewer mussels." [2]

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1 C. Jenkins, A. Olson, J. L. Ruesink , and M. E. Haas. 2002. Watch Your Step: Impacts of Trampling on a Rocky Shoreline of San Juan Island, Washington. Puget Sound Water Quality Action Team. 2002. Proceedings of the 2001 Puget Sound Research Conference. T. Droscher, editor. Puget Sound Water Quality Action Team. Olympia, Washington.

2 Brosnan DM, Crumrine LL (1994) Effects of human trampling on marine rocky shore communities. Journal of Experimental Marine Biology and Ecology 177:79– 97 [Oregon]

"Trampling by visitors could result in replacement of [an algal] mat species assemblage with 'bare' rock... 20% of the biomass of individual plants being removed by a single footstep.

"[T]rampling should be considered as a disturbance capable of directly and indirectly influencing intertidal populations on rocky shores." [3]

"As few as 10 tramples reduced [algal] cover by up to 25% after a single tide. Progressively greater reductions occurred at higher trampling intensities, with >90% of the [algal] canopy removed at 200 tramples." [4]

"[D]ensities [of various invertebrates] declined with increasing trampling...and were reduced to 50% of control values at the highest trampling intensity... Given...their vulnerability to low levels of trampling by humans, we conclude that the effective management of marine protected areas may necessitate total exclusion of humans in some cases." [5]

"Significant differences were detected in taxonomic richness, density, and assemblage structure of macroinvertebrates between heavily visited and pristine shores, suggesting that macroinvertebrates were adversely affected by visitors' impact at heavily visited shores...macroinvertebrates were adversely affected by human activities in subtropical rocky shore." [6]

"The density of all species was reduced in the more heavily visited intertidal area." [7]

"[A] general pattern of higher density and diversity [of algae and invertebrates] occurred at the less trampled sites..." [8]

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3 Povey A, Keough MJ (1991) Effects of trampling on plant and animal populations on rocky shores. Oikos 61:355–368.

4 Schiel DR, Taylor DI (1999) Effects of trampling on a rocky intertidal algal assemblage in southern New Zealand. Journal of Experimental Marine Biology and Ecology 235:213–235

5 Brown PJ, Taylor RB (1999) Effects of trampling by humans on animals inhabiting coralline algal turf in the rocky intertidal Journal of Experimental Marine Biology and Ecology 235:45–53

6 Fatemeh Aghajan Pour, Mohammad Reza Shokri,, Behrooz Abtahi. 2013. Visitor impact on rocky shore communities of Qeshm Island, the Persian Gulf, Iran. Environmental Monitoring and Assessment

185:1859–1871.

7 Loana Addessi 1994. Human Disturbance and Long-Term Changes on a Rocky Intertidal Community. Ecological Applications 4: 786–797

8 K.A. Beauchamp, M.M. Gowing. 1982. A quantitative assessment of human trampling effects on a rocky intertidal community. Marine Environmental Research 7: 279-293

"[L]oss of biomass did increase with treatment level... Percent cover decreased differentially with treatment level, ranging from 10 percent cover in a 100-step plot up to 85 percent loss in a 200-step plot." [9]

"Mussel bed cover, with the associated higher number of species within, decreased with increased human trampling, while the frequency of bare rock areas increased." [10]

"[A]t high levels of trampling, Hormosira was almost eliminated within 2 yr, and at two intermediate levels of trampling, cover was reduced from >90 to 60–70%, where it remained for 4 yr." [11]

"Bare space increased in trampled plots as compared to pre-impact levels... Trampled plots exhibited shifts in invertebrate community composition and significant declines in the abundances and richness of invertebrate taxa...to manage visitor impacts on rocky shore communities, 'no-access' zones may be as important as 'no-take' zones." [12]

9 Kolleen Irvine. 2007. Influence of Trampling Intensity versus Hydration State on Loss of Biomass from the Intertidal Rockweed, Fucus gardneri. Coastal Management 33:471-481. [Done at cattle point. UW School of Marine Affairs.]

10 Van De Werfhorst, Laurie C.; Pearse, John S. 2007. Trampling in the rocky intertidal of central California: a follow-up study. Bulletin of Marine Science, Volume 81, pp. 245-254

11 Keough, M. J., & Quinn, G. P. (1998). Effects of periodic disturbances from trampling on rocky intertidal algal beds. Ecological Applications, 8, 141–161.

12 TM Huff . 2011. Effects of human trampling on macro- and meiofauna communities associated with intertidal algal turfs and implications for management of protected areas on rocky shores (Southern California). Marine Ecology, 2011 Volume 32, Pages 335–345