

Project Proposal 8

Introduction and Background:

I am interested in human interactions with surrounding non-human environmental (biological) systems. I love to spend time in the wilderness, partly due to the rejuvenation one feels when connected with “nature,” since most human day-to-day life is now fairly removed from actual natural processes. Unfortunately, as much as you can preach and practice the “leave no trace” ethic, any foray into a relatively untouched place will probably have a lasting (and potentially negative) impact on the biota. The most controlled entry points and transportation conduits through the wilderness are officially sanctioned trails, so only the impact of recreational hiking trails will be examined in this study.

There is a rather large existing collection of literature regarding human recreational activities and their ecological interactions, consisting mostly of case studies looking at forest ecology of particular trail systems or protected park areas.^{1,2,3,4} However, my research shows that there is a lack of studies looking at the direct impacts of repeated “minimally-invasive” foot-traffic on plant species biodiversity, specifically. One re-occurring theme in the literature on general ecological disturbances, as I propose hiking can be an example of, is the Intermediate Disturbance Theory (IDT). It has been developed since the 1970’s to help explain how disturbances to certain systems can alter the influence of competition and predation on species richness and diversity by not allowing a dominant (competitor or predator) species to force the other species to extinction.^{5,6} The effects of recreational hiking on ecological communities will be examined in order to see if the IDT helps to explain the human impact.

Questions and Goals:

Within the broader realm of hiking trails in National Parks, I will be focusing on an area of particular familiarity and interest to me: North Cascades National Park (NCNP), in Washington State. My question is, how do the most heavily-traveled, recreational hiking trails influence the species diversity and richness of plots immediately adjacent to the trails, when compared with the species diversity and richness of plots isolated from any type of human interaction?

Contrary to my original thinking that plant species diversity will be significantly lower along recreational trail boundaries and inside of plots immediately adjacent to trails as a result of the negative impact of trampling, increased erosion, and associated unnatural factors propagated onto the system by hikers, my research leads me to a different hypothesis. The IDT leads me to predict that perhaps trails with certain, intermediate, levels of activity will actually provide the conditions necessary for increased diversity and richness.

Methodological Approach:

In order to assess this question, it is assumed that the proper data will be available, or at least attainable from existing GIS data sets, as there will be no primary gathering of site observations as a part of the project. If data is available, geographically isolated plots will serve as the control for the type and amount of plant diversity present at a series of altitudes and regions of NCNP. Plots immediately adjacent to heavily traveled recreational trails will be the study group for which the diversity and richness observations will be contrasted.

Basic ecological models based on competition and predation are known as equilibrium models because species eventually reach stable levels over time based on species interaction. The models based on IDT are considered to be non-equilibrium models because the disturbances have the assumed effect of never allowing the system to reach equilibrium where one species dominates, and thus the potential for increased diversity exists.^{5,6} If the human

hiker factor is treated as a source of continual disturbances, then the IDT may readily apply. The IDT can be visualized easily in the form of a “hump-backed” curve relating species richness and degree of disturbance, in which intermediate levels of disturbance correspond to the peak species richness value, and the graph trends towards low richness with both increasing and decreasing disturbances.⁷

In order to study the added disturbance of human recreational activity on plant species diversity and richness under the IDT regime, trails of differing condition and use must be examined in order to provide a range of disturbance values. Then, the plots from areas with varying degrees of human disturbance may be surveyed in order to determine the relative number of species and species abundances.

Expected Results and Implications:

I expect human recreational activity to prove to be a source of disturbance that disrupts the equilibrium present in a given community. It is possible that the plots nearest to hiking trails will host higher levels of diversity and richness, however, I would also not be surprised to find that the disturbances from human activities may be too disruptive to the natural processes and may be an example of the extreme end of the “hump-back” curve, where diversity and richness decrease from the peak level caused by intermediate disturbance.

It will be necessary to contrast the human-caused disturbance with other natural sources of disturbance that may contribute more to increased biodiversity, such as wildfires. Perhaps human disturbances cannot be compared easily with non-human disturbances, because of the nature or extent of the disturbances. Care will need to be had in defining various disturbances, especially when considering reproducibility and further applications of the study. The findings of a study such as this one will help park rangers and other interested parties in managing wilderness areas and assessing new trail proposals or existing trail revisions. The findings will also contribute to crucial educational material for wilderness enthusiasts and other stakeholders.

References (GSA citations):

1. Queiroz, R.E., et al., 2014, Plant diversity in hiking trails crossing Natura 2000 areas in the Azores: implications for tourism and nature conservation: *Biodiversity and Conservation*, v. 23, no. 6, p. 1347-1365, doi: 10.1007/s10531-014-0669-7.
2. Tomczyk, A.M., and Ewertowski, M., 2013, Planning of recreational trails in protected areas: Application of regression tree analysis and geographic information systems: *Applied Geography*, v. 40, p. 129-139, doi: 10.1016/j.apgeog.2013.02.004.
3. Englin, J.E., et al., 2004, Valuing ancient forest ecosystems: An analysis of backcountry hiking in Jasper National Park: *Ecological Economics*, v. 57, no. 4, p. 665-678, doi: 10.1016/j.ecolecon.2005.05.022.
4. Tomczyk, A.M., 2011, A GIS assessment and modelling of environmental sensitivity of recreational trails: The case of Gorce National Park, Poland: *Applied Geography*, v. 31, no. 1, p. 339-351, doi: 10.1016/j.apgeog.2010.07.006.
5. Connel, J.H., 1978, Diversity in Tropical Rain Forests and Coral Reefs: *Science*, v. 199, no. 4335, p. 1302-1310, doi: 10.1126/science.199.4335.1302.
6. Krammer, P.M., and Möhl, A., 2002, Factors Controlling Species Richness in Alpine Plant Communities: An Assessment of the Importance of Stress and Disturbance: *Arctic, Antarctic, and Alpine Research*, v. 34, no. 4, p. 398-407.
7. Wilkinson, D.M., 1999, The Disturbing History of Intermediate Disturbance Theory: *Oikos*, v. 84, no. 1, p. 145-147.