Team

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Kelp Ecosystem Ecology Network (http://kelpecosystems.org)
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Background information

Project title 200
Kelp Hunters
Abstract 250
Giant kelp is a critically important species. Forests of giant kelp form the foundation of many temperate and boreal coastal ecosystems, providing food and habitat to a variety of commercially and economically important species of fish, invertebrates, birds, and marine mammals. Individual impacts of extreme climate events on kelp forests have been documented at local scales, however we currently do not have a good understanding of how kelp forests have responded to climate change on global scales. Long-term data on changes in giant kelp ecosystems is limited because of the extremely time- and work-intensive nature of underwater field sampling. Remote sensing tools give us an opportunity to dramatically increase the scales of our observations. Satellite imagery has been used to map giant kelp populations (Cavanaugh et al. 2011), and recently there has been a large increase in the availability of free, long-term historical satellite imagery. This project will utilize a 30 year time series of global Landsat satellite imagery to track long-term changes in giant kelp abundance along coastlines all across the world.
Subject
Biology
Associated website(s)
http://www.icess.ucsb.edu/~kyle/Site/Landsat.html
http://kelpecosystems.org
Current similar Zooniverse projects
Seafloor Explorer
Storm Hunters
Committed resources
This proposal is part of a funded working group of kelp forest scientists who are investigating climate-related changes to kelp forest ecosystems over the past 4 decades. Researchers from this working group will analyze the data provided by the project and conduct educational outreach activities.
Suggestions for referees

1. Please provide a brief description of the science to be addressed by the project. 1,000

Giant kelp forests produce a dense floating canopy that is clearly visible on Landsat satellite imagery. Landsat Thematic Mapper (TM) imagery is freely available to the public and provides global coverage every ~16 days from 1984-present. By providing classifications of changes in kelp canopy cover over the past 30 years on global scales, this project will identify regions where kelp forests have experience significant long-term changes. We will then identify the likely environmental and anthropogenic drivers of these observed changes.

2. Describe the tasks you envisage citizen science participants carrying out - including (a) any required specialist knowledge, (b) minimum requirements for success, (c) desired outcomes. 150

Volunteers will be asked to trace the outline of giant kelp forests on Landsat satellite imagery. Kelp forests are highly distinctive on these images and we believe that by showing a few images of example forests, volunteers would be able to identify forests without any specialist knowledge. There is currently no long-term data on kelp canopy changes for most of the globe, so obtaining reliable classifications for any region (South Africa, Tasmania, New Zealand), would be a substantial improvement over our current data. Our ultimate goal would be to obtain global coverage over the entire Landsat TM time series (1984-present).

3. Describe the nature of the data that would be used in the proposed project - include (a) its format (filetype, size, number of files) (b) any restrictions (including copyright) on its use (c) its availability (is it archive data or still being collected). 150

We can produce jpeg color images using existing public data from the NASA/USGS Landsat archive. We estimate there will be ~400,000-800,000 images. The images will be produced for the project, but there is no problem with releasing them. A typical jpeg would be ~500 kB.

4. What automatic processing routines exist which attempt to solve the problem being addressed? Why can't they be used instead of humans? 150

There are currently many automated processing routines available for classifying satellite imagery. We have experimented with many of these, however they are not well suited for the nearshore coastal environment. Landsat was developed for terrestrial vegetation. The signal from floating aquatic vegetation is much weaker than that of terrestrial vegetation, and so we are working on the edge of Landsat's signal to noise capabilities. High variability in nearshore conditions (e.g. clouds, sunglint, turbidity) complicates the situation. All of the automated processing routines we have used require extensive manual editing to produce an acceptable product.

5. If possible, estimate the minimum number of times a task must be performed on a given element of data to be useful for science (assuming all tasks are performed by competent citizen scientists; once might be enough for exceptionally clear tasks, more times could be required for fuzzier tasks or lots may be necessary if accurate

estimates of uncertainties are needed). How many total tasks must be completed before your research goals are achievable? 150
We expect that at least 10 independent classifications would give us accurate estimates of uncertainty in kelp canopy area. Therefore, we would require a minimum of ~200,000 individual classifications and 4-8 million to achieve our ideal goals.

6. Who will carry out the analysis of the data collected by the project, particularly during any proprietary period (Zooniverse projects usually have a science team who share this responsibility)? Is the necessary funding for this stage of research in place? 150
The existing Kelp Ecosystem Ecology Network working group would analyze the data collected by the project. This group currently has a postdoc and grad student working on similar data and is working towards obtaining additional funding.

7. All data from Zooniverse projects must be eventually made public. What final format (catalogue, annotated image, query tool) would be needed? What are the anticipated final outcomes (e.g., papers, catalogues)? Are the results likely to be of interest to researchers beyond your own field? 150
We expect to publish the final catalog in a remote sensing or ecology journal. We will also make the data available to the public in csv, shapefile, and kml format. High profile papers investigating the climate and anthropogenic drivers of changes in kelp forests will also be published in leading journals.

8. Are there potential extensions to the project that you have in mind? 150
Recently there has been a dramatic increase in the availability of free or low-cost satellite imagery. In addition, the public is being increasingly exposed to satellite imagery through sources such as Google Earth. This project could pave the way for other crowd sourcing of satellite imagery for a huge variety of uses.

9. The primary goal of each of our projects is to produce science, but they have significant educational impact as well. Engaging the community is an excellent way of ensuring they remain committed to producing results for you. Are there members of your team willing to write blog posts, join forum discussions on scientific topics or otherwise take part in outreach? Does the project tie in with any public engagement or education activities you are already involved with? 150
Jarrett Byrnes (University of Massachusetts Boston) has extensive experience blogging to enhance communication between scientists and the public. He runs the blog http://imachordata.com and has connections to http://deepseanews.com and http://theseamonster.com. All three of these blogs are well respected in the marine science community and would provide excellent ways to engage the community. Other members of the Kelp Ecosystem Ecology Network (http://kelpecosystems.org) are also willing to write blog posts about the project. We also have run satellite imagery classification workshops for undergraduate students and could expand this effort in conjunction with the Zooniverse project.

10. Are there any easy targets that would help with marketing your project and recruiting volunteers, such as existing interest groups, local contacts, or media links? 150

The three blogs mentioned above would be valuable tools for marketing our project and recruiting volunteers. Jarrett Byrnes has also managed a #SciFund (http://scifundchallenge.org/) that has raised $250,000 for science via crowdsourcing in 1.5 years. #SciFund would be another important tool for marketing, fund-raising, and recruiting volunteers. In addition, the Monterey Bay Aquarium (http://www.montereybayaquarium.org) has an extensive kelp forest ecosystem exhibit (it is one of the tallest aquarium exhibits in the world). We will establish partnerships with the Aquarium to communicate the value of kelp forest ecosystems and the importance of better understanding how these systems are responding to climate change. Kyle Cavanaugh has recently started a postdoc with the Smithsonian Institute and there may be additional partnership opportunities with the Smithsonian Natural History Museum.

11. If you or your colleagues have carried out the proposed task yourself, how much time do you estimate each individual task will take? 150

Each individual task takes about 1 minute. Therefore, obtaining 10 independent classifications for the entire dataset would take ~70,000-140,000 person hours.