Tiger conservation areas in Nepal: investigating spatio-temporal patterns in the risk from fire hazard

Background

Fire hazard in Nepal provides significant risk to conservation of threatened species (Barber-Meyer et l. 2010). In 2012, nearly 70% of the Bardiya National Park in Nepal was destroyed from fire; this park provided prime conserved habitat for tiger populations[1]. Fires occur frequently with a large proportion deliberately initiated by grazers, poachers, hunters and non-timber forest product collectors; some as a result of negligence or by accident. Fire provides a valuable method for landscape management to prepare fields for crop cultivation as it is one of the least expensive land clearing methods. However, when such methods are not managed carefully under strict control, fire can spread and becomes a threat to protected areas, habitats and species. The Department of National Parks and Wildlife Conservation (DNPWC) manages protected Areas in Nepal, which in turn is part of the Ministry of Forests and Soil Conservation. These protected areas are home to some of the world's most endangered species. Increasing fire hazard (due to population expansion and a warmer/drier environment) is adding unprecedented pressure on threatened species (Carter et al. 2013), such as *Panthera tigris tigris*, the Bengal tiger which is native to this part of the world. Fire is one of the most prominent causes of forest destruction in Nepal where fire is traditionally linked with the rural livelihoods of communities. Tropical forests of the Terai (Nepali lowlands) consitute prime habitat for the Bengal tiger.

Several environmental factors are thought to influence the occurrence and likely spread of fire. You should read the literature to ascertain which factors (current and future) are important for Nepal, and which you suppose are important for your investigation relative to the datasets which have been provided (e.g. Castro and Chuvieco 1996; Jaiswal et al. 2002; Barbosa et al. 2010).

Scenario

In this assignment, your task is to investigate the historical relationship between fire occurrence and environmental factors likely to influence its occurrence. You should also examine the impact of fire on tiger habitat from 2000-2013. You should use the tools in ArcGIS spatial analyst to aid your analysis. You may find it helpful to divide the fire data set into separate map layers for different sub-periods, and then for each sub-period look at the pattern of fire relative to tiger habitat and landscape characteristics that could influence its occurrence.

You may wish to further your ArcGIS skillset and explore using the spatial statistics tools given that fire time-series data have been provided, e.g. have fire events become more or less clustered over time? Once you have explored the temporal and spatial characteristics of fire occurrence between 2000 and 2013, you should discuss the implications of your findings for management of the tiger population in relation to fire risk.

The Data

Data are provided for Nepal.

[1] http://www.bbc.co.uk/news/science-environment-17937620

- FIRMS MODIS fire/hotspots observations (2000-2013)
  https://earthdata.nasa.gov/data/near-real-time-data/faq/firms#firms20
  (see 'What are the attributes/fields of the active fire data?' in FAQ)
- ICUN threatened species – coverage of known tiger habitat
  http://www.iucnredlist.org/technical-documents/spatial-data
- ASTER GDEM 30m resolution digital elevation model
- FAO land cover
- Existing national park conservation areas
- Major settlement locations

You may download and use additional data if you wish to but it is not a requirement of the assignment.

Assignment Criteria

Your assignment must be no longer than 1800 words (and conform to AU word count policy). Within this you should include the following information:

1. An introduction to factors which are likely to spatially influence fire risk to tiger habitat in Nepal
2. A quantitative assessment as to what environmental factors are linked with fire events in Nepal (processing the data provided) and how these events vary temporally
3. An assessment of how fire has affected tiger habitat between 2000 and 2013
4. Provide a critical appraisal of your analysis highlighting (i) the limitations of analysing the temporal data within GIS (ii) suggestions for how more sophisticated methods could be used to map predicted risk, and (iii) any implications for management of tiger habitat in relation to fire risk

References

This does not form an exhaustive list – there are many more journal articles which will be of relevance to your investigation depending upon how you wish to focus your analysis.

Barber-Meyer SM, Jnawali SR, Karki JB, Khanal P, Lohani S, Long B, MacKenzie DI, Pandav B, Pradhan NMB, Shrestha R, Subedi R, Thapa G, ThapaK,Wikramanayake E, 2012. Influence of prey depletion and human disturbance on tiger occupancy in Nepal. *Journal of Zoology* 289 10-18

Barbosa MR, Seoane JCS, Buratto MG, Dias LS, Raivel JPC, Martins FL, 2010. Forest Fire Alert System: a Geo Web GIS prioritization model considering land susceptibility and hotspots – a case study in the Carajás National Forest, Brazilian Amazon. *International Journal of Geographical Information Science* 24 873-901

Carter NH, Gurung B, Vina AS, Campa H, Karki JB, Liu J, 2013. Assessing spatiotemporal changes in tiger habitat across different land management regimes. *Ecosphere* 4 (Article 124)

Castro R, Chuvieco E, 1998. Modelling forest fire danger from geographic information systems, *Geocarto International* 13 15-23

Jaiswal RK, Mukherjee S, Raju KD, Sazena R, 2002. Forest fire risk zone mapping from satellite imagery and GIS. *International Journal of Applied Earth Observation and Geoinformation* 4 1-10