

Modelling the evolution of sociopolitical complexity

Supervisors

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Hosting Institution: University of Exeter

Project description: For much of our evolutionary history humans lived in small, egalitarian, and undifferentiated groups, yet in some parts of the world large, complex societies arose that have gone on to dominate, and shape the world we live in today. Understanding what drives these evolutionary transitions has received relatively little attention from evolutionary theorists, and the ability of humans to form large, cohesive societies of genetically unrelated individuals presents a puzzle to both evolutionary and social theory. Traditionally such questions have been the province of anthropologists and other social scientists, who proposed theories emphasizing such factors as population growth, warfare, climate change, information management, economic specialization, and long-distance trade. However, these theories have often been formulated as purely verbal hypotheses, and have not been systematically tested with appropriate data. These fundamental questions would benefit from being addressed within the overarching framework of evolutionary theory, and with the more formal approach to the formulation of models and systematic collection of data that characterizes the natural sciences. In previous work, a simple spatially-explicit evolutionary simulation model was developed that focussed on the role of warfare as a selective force favouring the evolution of social norms and institutions that helped solve collective action problems thus enabling increasing social scale and complexity during the period 1500BCE-1500CE. However, other factors have also been implicated in driving the evolution of complex societies such as the importance of trade, variation in the latitudinal extent of different land masses, the antiquity of agriculture, and degree to which land is circumscribed. In this project mathematical models will be developed that assess a range of competing theories about the evolution of sociopolitical complexity. This will involve the explicitly modelling the ecological, demographic, and cultural evolutionary processes assumed by alternative theories. The empirical predictions from these models will be tested against historical data on social complexity. Previous work as has produced a large dataset on the geographical and temporal distribution of complex societies in the Eurasia and Africa. In order to test other hypotheses the student will be able to build on these firm foundations but will need to devote the necessary time and effort to augment these data with other sources of information (e.g. improving the characterization of the resource base used by societies).

Currie, T. E., Greenhill, S. J., Gray, R. D., Hasegawa, T. & Mace, R. 2010 Rise and fall of political complexity in island South-East Asia and the Pacific. *NATURE* 467, 801-804

Turchin, P., Currie, T. E., Turner, E. A. L. & Gavrilets, S. 2013 War, space, and the evolution of Old World complex societies. *PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES* 110, 16384-16389

Training opportunities: This project works at the interface of the biological and social sciences, and the student will have an excellent opportunity to gain training in both these broad areas of research. The successful student will gain training and experience in mathematical modelling, data handling and statistical methods. This will involve developing skills in programming

languages such as Python, R, or Matlab, and in Geographical Information Systems. For the data collection component of the project, due to the nature of historical data sources, the student will receive training in the assessment of these data sources and will be required to spend some time at large libraries (e.g the British Library), or specialized research libraries at other institutions (e.g. University of Oxford, University College London). The student will potentially have the opportunity to gain experience and training by visiting the institutions of the external collaborators (Turchin, Gavrilets).