Developing Political-Ecological Theory: The Need for Many-Task Computing

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Model of a political-ecological system

Agents make decisions about actions that affect an at-risk species.

An individual-based submodel of this species' abundance affects and is affected by agent decisions.

Need for massive computing

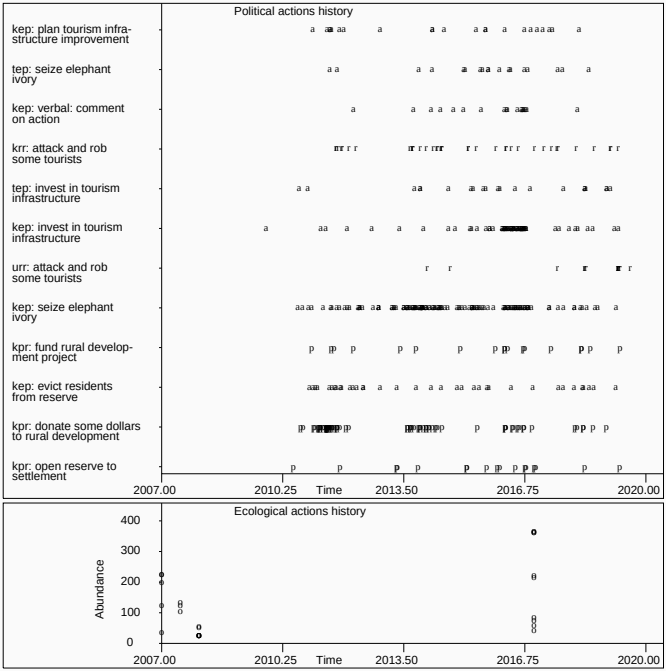
Model runs are expensive. This means that massive computing resources are needed to compute

- parameter estimates
- prediction error rates
- parameter sensitivities
- politically-feasible ecosystem management policies

Cluster computing

A scalable way to perform these computations is with a program running on a *cluster computer*.

Such a program can be written in a platform-independent language called JavaSpaces™.

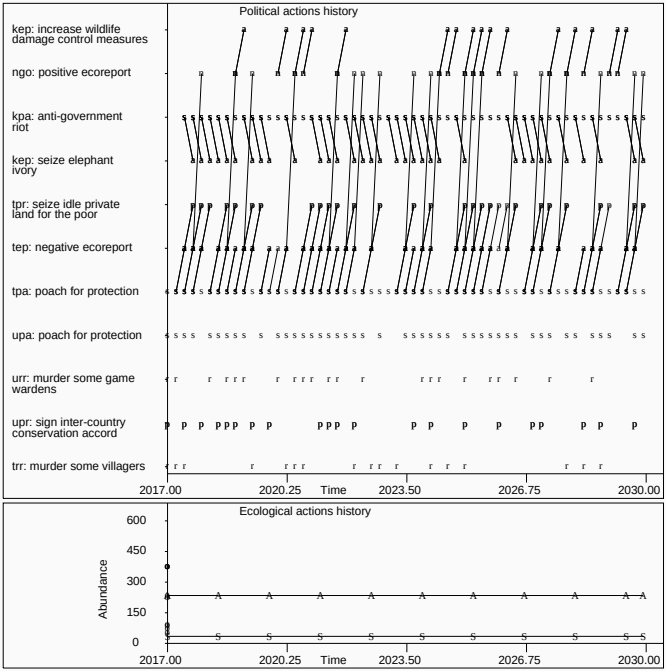

Political actions history
kep: plan tourism infra-structure improvement
tep: seize elephant ivory
kep: verbal: comment on action
krr: attack and rob some tourists
tep: invest in tourism infrastructure
kep: invest in tourism infrastructure
urr: attack and rob some tourists
kep: seize elephant ivory
kpr: fund rural develop-ment project
kep: evict residents from reserve
kpr: donate some dollars to rural development
kpr: open reserve to settlement
2007.00
2010.25
Time
2013.50
2016.75
2020.00
Ecological actions history
Abundance
400
300
200
100
0
2007.00
2010.25
Time
2013.50
2016.75
2020.00

Parameter estimation: agent submodels

Find agent submodel parameter values that maximize the agreement between agent-generated actions and observed actions while simultaneously minimizing the Hellinger distance to a hypothesized set of values.

Parameter estimation: species abundance

Find values of the species abundance submodel's parameters that maximize the agreement between submodel-generated abundance and observed abundance while simultaneously minimizing the Hellinger distance to a hypothesized set of values.


Political actions history
kep: increase wildlife damage control measures
ngo: positive ecoreport
kpa: anti-government riot
kep: seize elephant ivory
tpr: seize idle private land for the poor
tep: negative ecoreport
tpa: poach for protection
upa: poach for protection
urr: murder some game wardens
upr: sign inter-country conservation accord
trr: murder some villagers
2017.00
2020.25
Time
2023.50
2026.75
2030.00
Ecological actions history
Abundance
600
450
300
150
0
2017.00
2020.25
Time
2023.50
2026.75
2030.00

Manuscript under review

https://www.biorxiv.org/content/10.1101/871434v1.full

Thank you.