Nice Musical Chairs model

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Documentation

WHAT IS IT?

The Nice Musical Chairs (NMC) model represent the competition for space between groups of stakeholders of farming and herding activities in the arid Afro-Eurasia. This is a follow up of a simpler model, the Musical Chairs model, which depict the same general idea, disregarding any explicit representation of groups and the different rules of behaviour presented here (i.e. scenarios).

HOW IT WORKS

The NMC model relates land use and their stakeholders (patches) and the groups around which they aggregate (agents). It represents a context where farming (sedentary land use) and herding (seasonal mobile) land use compete seasonally for a limited space, but also groups compete for territorial influence. Although patches DO represent spatial units, spatial relationships (neighborhood, distance) are not relevant in this model.

The cycle beggins with the calculation of the demand for land of both farming and herding in each group (`growth` procedure). The demand may be generated by intrinsic (*density dependent*) or extrinsic (*density independent*) factors. If pairing is activated, the overall demand of a group will increase (up to a maximum defined by `optimal_growth_increase`) the closer the internal farming ratio is to the optimum (`optimum_farming_ratio`).

Aiming to satisfy such demand, groups will attempt to expand, first over the land not used, and them over the land used by other groups (`expansion` procedures). Bigger groups will be here penalysed by the lack of oportunities to expand. Whenever a group presses against the land use of another group, the patch at hand will register the former as a "contender" (saved in a list to be filled with other possible contenders). If access to pastures is open, farming stakeholders may settle automatically and change

the land use; if there is a restricted access regime, the group will be registred as a contender.

The procedure `check-competitions` iterate over all four modalities of competitive situations (farming pressing farming, farming pressing herding, herding pressing herding and herding pressing farming; particularly in this order), over all patches, and resolve them (`resolve-competition`). The resolution is a stochastic process comparing the contender and the defender strengths, which here depend on `groupSize` (number of patches belonging to the group) and the `groupEffectiveness` (a function of `effectiveness_gradient` and `groupSize`).

After all competitive situations are resolved, individual stakeholders may have the opportunity to translate themselves and their land to another (stronger) group (`group-change`). The frequency of this opportunity within a group will vary up to `max_group_change_rate`, depending on its `groupEffectiveness`. Among the group options considered by each stakeholder is the possible group that can be formed with all defective members of the same group (i.e. group fission).

Last, whenever `management` is enabled, groups can modify the land use of their members, adjusting their `farmingRatio` to their `targetFarmingRatio` (which is fixed to a random number upon the creation of the group). This process depend also on the `groupEffectiveness`.

HOW TO USE IT

First, you should select the desired type of experiment (`typeOfExperiment`):

- "defined by GUI": all values introduced by the user in sliders, boxes and choosers (except `expNumber`) will be applied.
- "random": randomly selects values for all the parameters (except `expNumber` and `allow_within-class_competition`), choosing also randomly among the eight possible scenarios.
- "defined by expNumber": the setup procedure will call for the `load-experiment` procedure, which set the parameters with values of a "exp_<expNumber>.csv" file, if available. The parameters `allow_within-class_competition` and `scenario` must be manually set by the user.

GUI elements:

- `allow_within-class_competition`: if set to false, farming-farming and herding-herding competitive situations will not be allowed to occur.

- `scenario`: allows to choose among the eight possible scenarios (combinations of open/restricted access to pastures, management and pairing).
- `endSimulation`: the number of cycles to simulate.
- `display_mode`: choose between visualizing (a) the proportion between farming and herding land use (green=farming, yellow=herding), and (b) the distribution of land units (colored by land use) among groups (red circles). Click `refresh` to apply changes when the simulation is paused.
- `display_details`: if enabled, tick number and the two main state variables will be displayed in the view canvas.
- `init_farming`: the initial number of patches used for farming.
- `init_herding`: the initial number of patches used for herding.
- `initial_number_of_groups`: the initial number of groups.
- `base_intrinsic_growth_rate`: the base value of the intrinsic growth for land use per patch, for both land use classes (0.05 = 5%).
- `max_extrinsic_growth_rate`: the maximum value of the extrinsic growth for land use, for both land use classes (0.1 = 10%).
- `effectiveness_gradient`: the number of patches in a group with the maximum competitive strength possible. Greater penalization on group size is denoted by smaller values.
- `max_group_change_rate`: the maximum rate in which patches can change groups.
- `optimum`: the percentage of farming within a group that allows patches to generate the maximum demand for land use.
- `optimal_growth_increase`: the maximum increase of growth for land use per patch, in terms of percentage of the base intrinsic growth due to the benefits of land use pairing.

THINGS TO NOTICE

The NMC model allows exploring how land use competition may be constrained by social structure and dynamics, according to which individual stakeholders compete and cooperate depending on adscription to social groups.

The NMC model also enables to test the effects of two particular modalities of cooperative mechanisms: land use pairing, the awarding, in terms of productivity, of any direct collaboration between farming and herding within a group; and group management, the prerogative of a group leadership to manage individual stakeholders in order to pursue a particular proportion between farming and herding.

Lastly, the model allows assessing the effects of these mechanisms under either open or restricted access to pasture regimes.

THINGS TO TRY

* increase the `max_group_change_rate` and decrease `effectiveness_gradient`: there will be a lot of group diversity and constant change of their influence. However, does the land use patern change significantly?

* try out the scenario "Ar" with several combinations of initial farming and herding (be aware not to sum up more than the number of patches available): Are the end values sensitive to the initial conditions?

* try out several values of `optimal_growth_increase`, fixing the `optimum` at 0.5, throughout all scenarios with pairing: Does this parameter have any effect?

RELATED MODELS

Musical Chairs

Angourakis, Andreas (2016, February 3). "Musical Chairs" (Version 1). CoMSES Computational Model Library. Retrieved from: https://www.openabm.org/model/4880/version/1

Available also in NetLogo Model Library (http://ccl.northwestern.edu/netlogo/models/),

and Netlogo Modeling Commons (http://modelingcommons.org/).