

Brief Description of the Simulation Software

'Simulating Competition⁺'

siCo⁺ (α -Version)

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Title: 'Software for Simulation and Visualization of Ecological Competition in its Spatial Context'

Project-term: March to September 2008

a joint project by

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Idea

The simulation software SiCo⁺ gives users the possibility to investigate ecological mechanisms and coherences - especially competition. The dynamic development of populations is simulated and presented graphically, making SiCo⁺ a tool for students to gain access to important topics of ecology easily. Moreover an open framework allows researchers to adapt and amend the software to the needs of particular case studies.

Realization

This software has to fulfill two duties: first to create individual based models and test them in simulations (core functionality) and second to offer a graphical user interface for simple user interaction and visual feedback.

It is written in the platform independent and object oriented computing language Java.

The core implementation strictly follows the ideas of high modularity and abstraction, e.g. by regular use of common design patterns.

For the GUI the usage of the Reflection API allows automated updates of the graphical user interface due to changes in the core. It further uses classes of the SwingX library.

Object serialization in the XML format (annotation-style of the SimpleXML library) enables the user to make the configuration of the software persistent.

User Interface

The user interface has two main components:

The editor [Fig. 1] to create prototypes and scenarios and the simulator [Fig. 2] for the graphical presentation and the

analysis of the simulation runs.

Editor

Prototypes

Prototypes are the original for the generation of individuals. The user creates them by defining their properties and actions [Fig. 3, Fig. 4, Fig. 5]. The parameters of these properties and actions are customized by the user [Fig. 6]. The accomplishment of actions may be connected to different conditions [Fig. 7, Fig. 8].

Scenarios

The software offers a 2d-lattice model of variable size to explicitly include spatial distributions in the simulations. The user may place any number of individuals into the fields of this grid [Fig. 9].

Simulator

The simulator [Fig. 2] consists of three components. The lattice model (map), which visualizes running processes, a log to record simulation runs and a device for the control of the simulation runs.

Map & Map View

The abundances of individuals at each time step are shown in each grid cell as colored bars of different heights. It is possible to show one quantitative property, like e.g. an amount of energy, in the lower third of the fields of the grid. A temperature scale displays the current value relating to the maximum value [Fig. 10]. The User can – also during the runtime of a simulation – choose, which populations and which quantitative property is shown [Fig. 11].

Log

The log counts every execution of all actions for each time

step and these numbers are shown. The whole content of the log or a selection of it may be saved to an external data file. Thus it is accessible to other statistical software [Fig. 12].

Simulation Control & Simulation Info

The user may set the number of time steps per run and the number of runs to execute. The progress of each time step and of the whole run is displayed [Fig. 13].

Figures

Fig. 1: The Editor

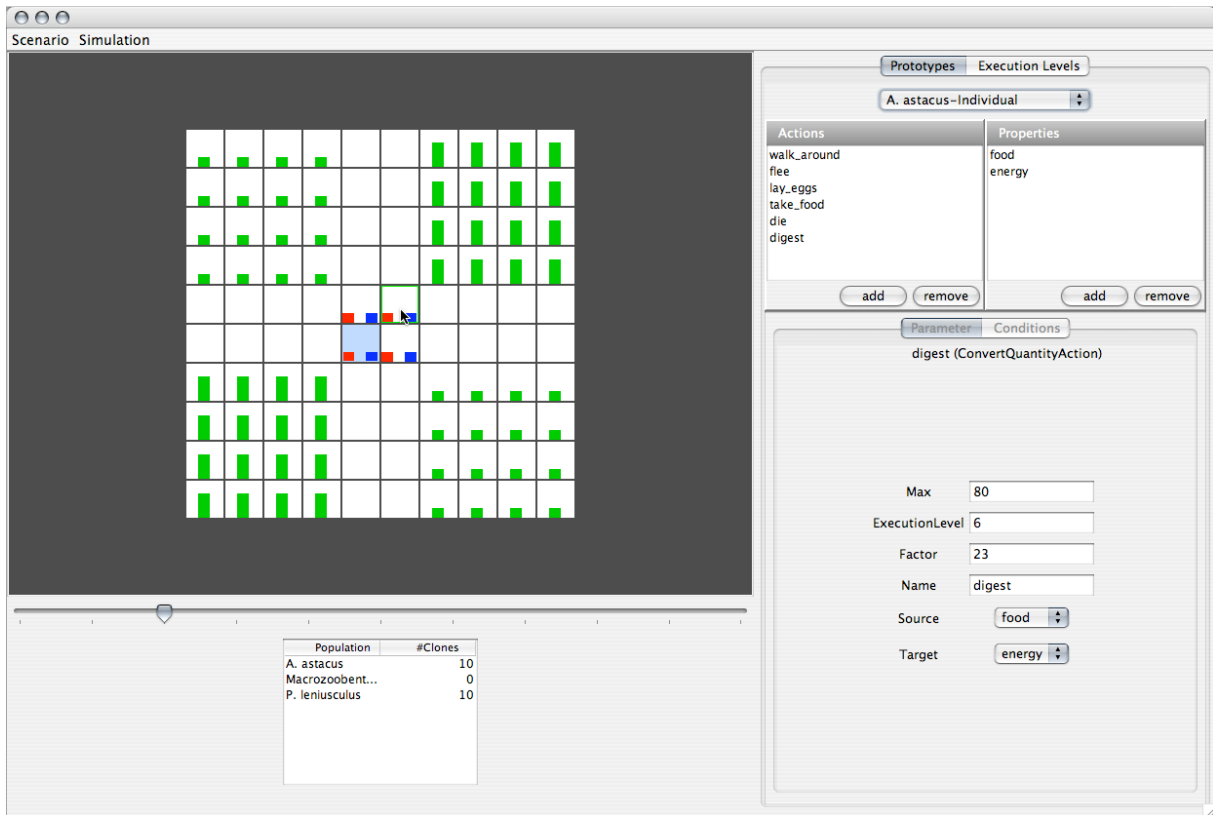


Fig. 2: The Simulator

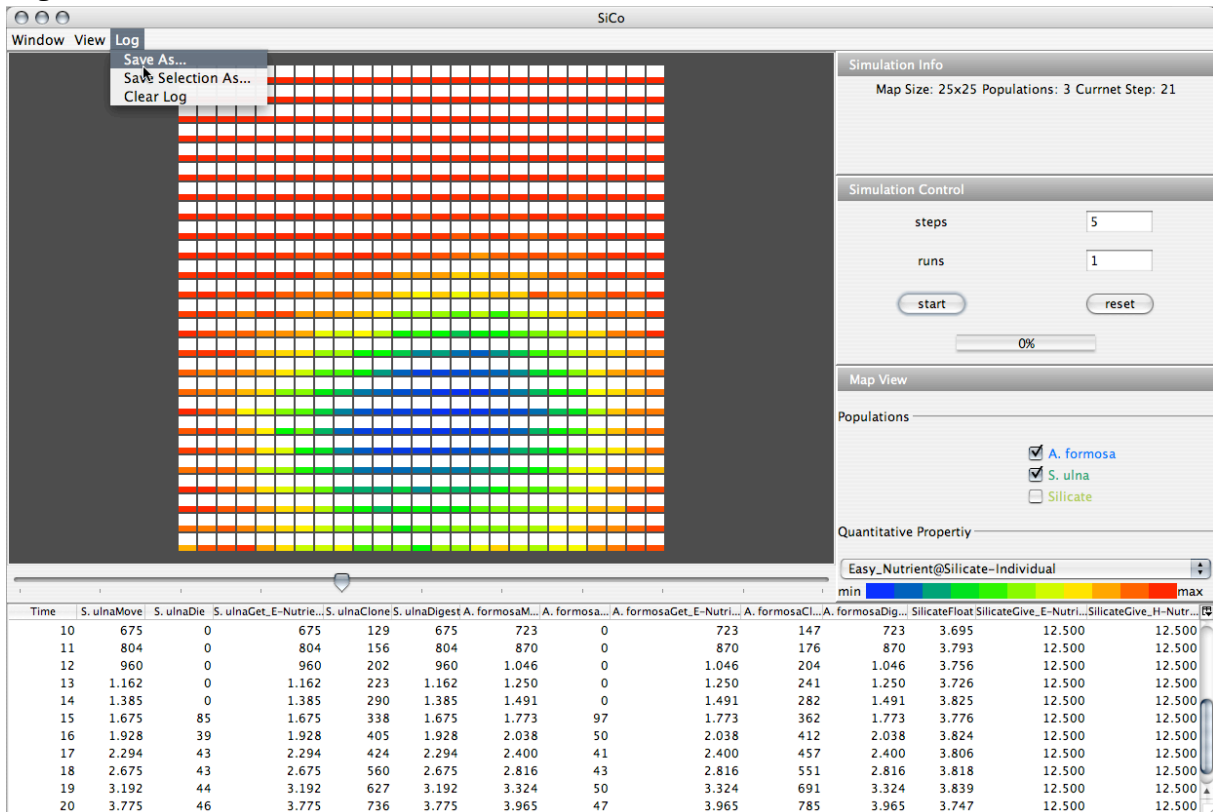


Fig. 3: Editing Prototypes

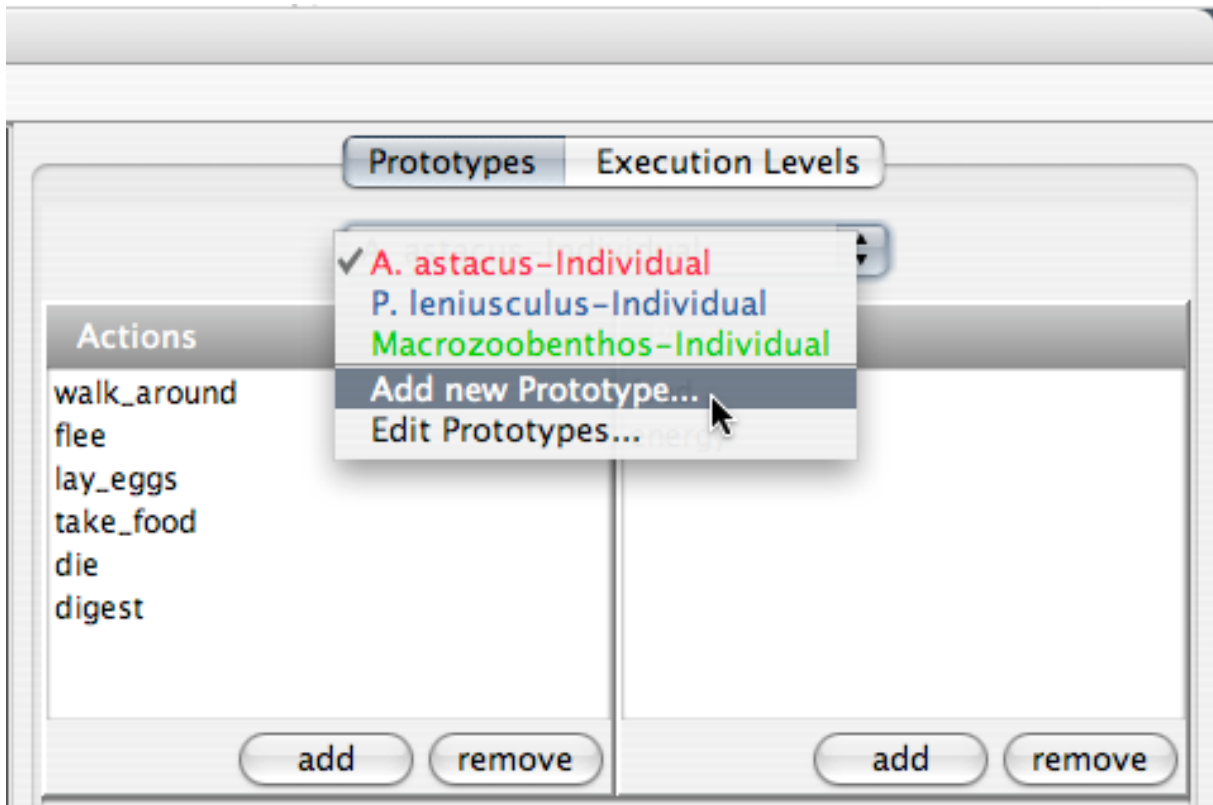


Fig. 4: Properties of a Prototype

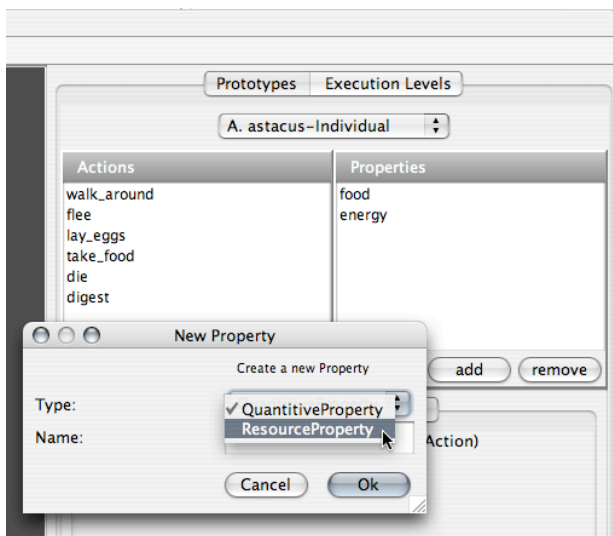


Fig. 5: Actions of a Prototype

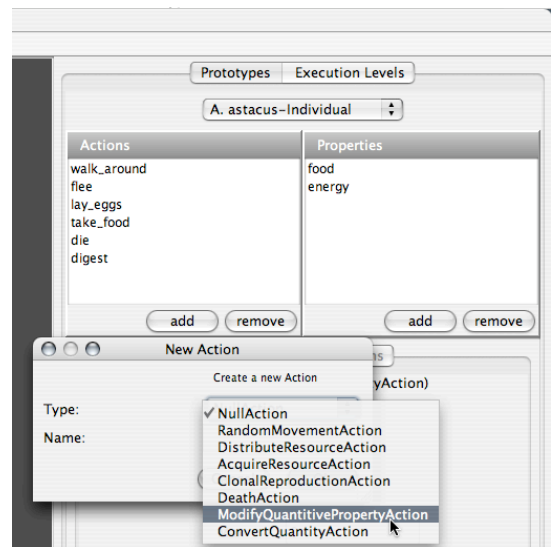


Fig. 6: Parameters of an action

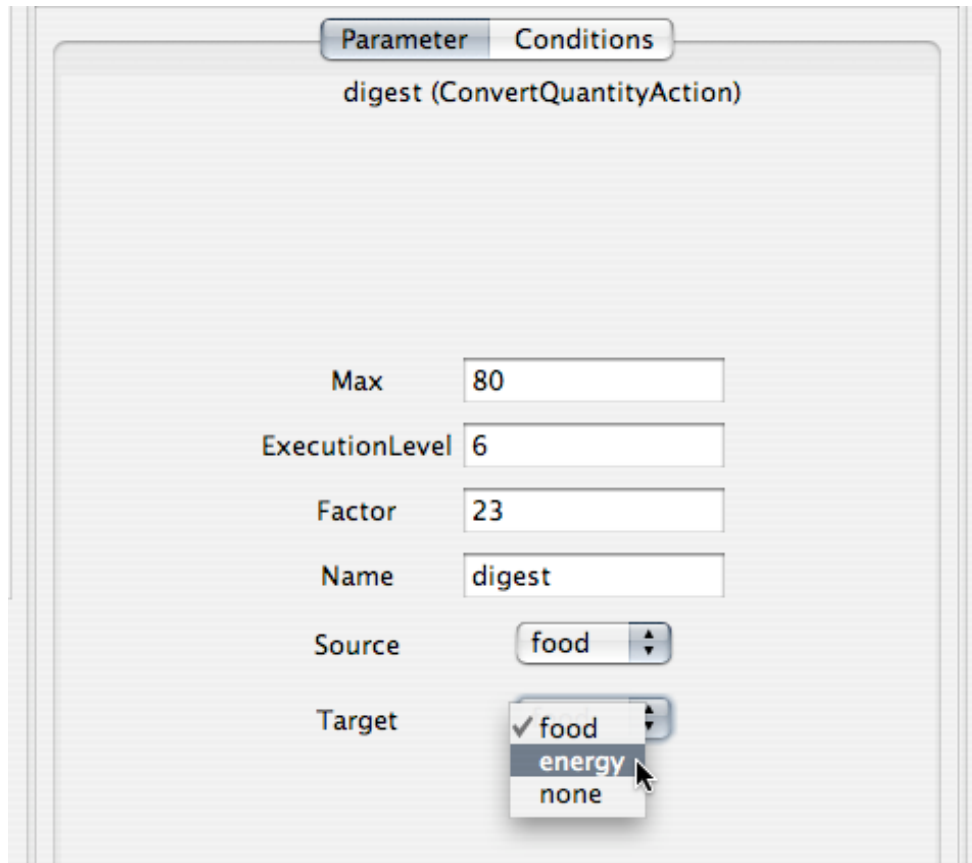


Fig. 7: Conditions of an action I

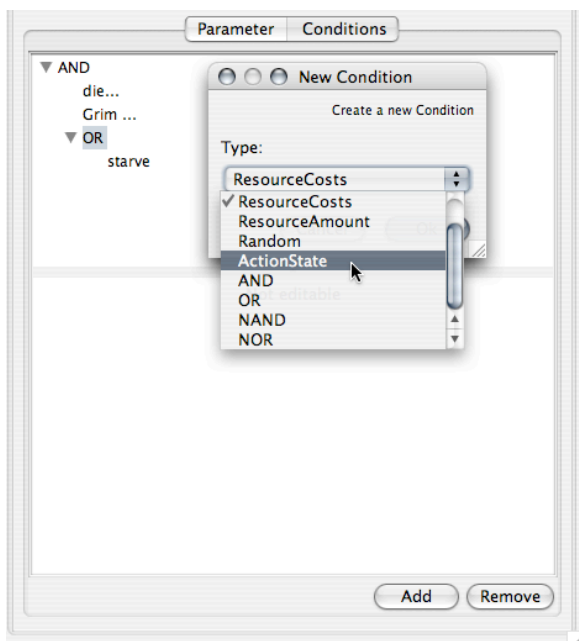


Fig. 8: Conditions of an action II

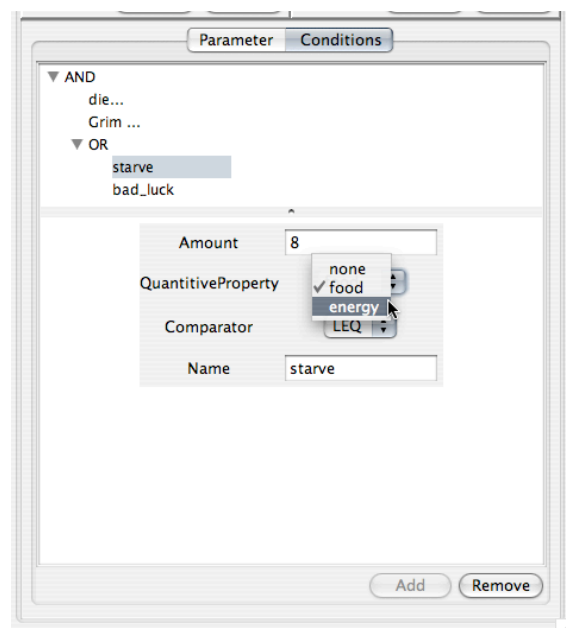


Fig. 9: Spatial distribution of prototypes in the lattice model of the editor

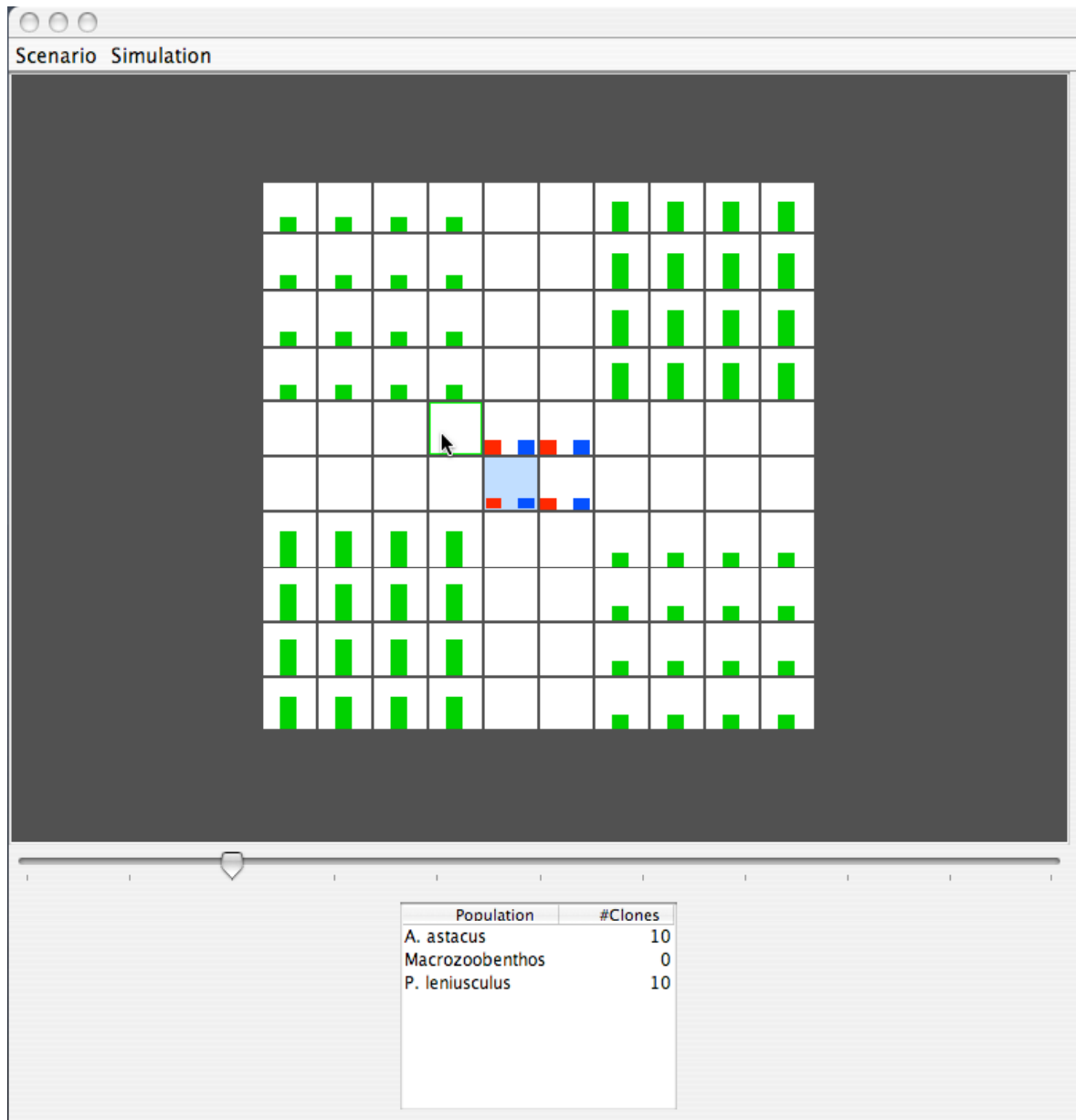


Fig. 10: Display of abundances and of one quantitative propertie in the lattice model of the simulator

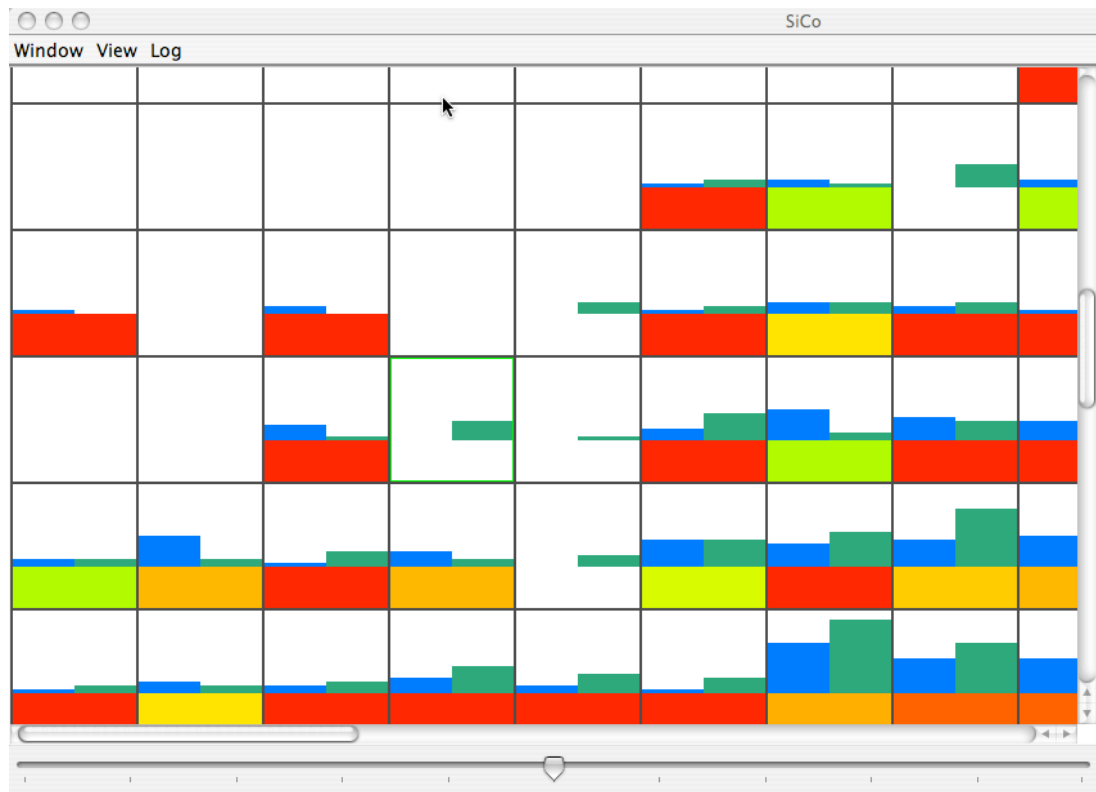


Fig. 11: Control of display options in the simulator

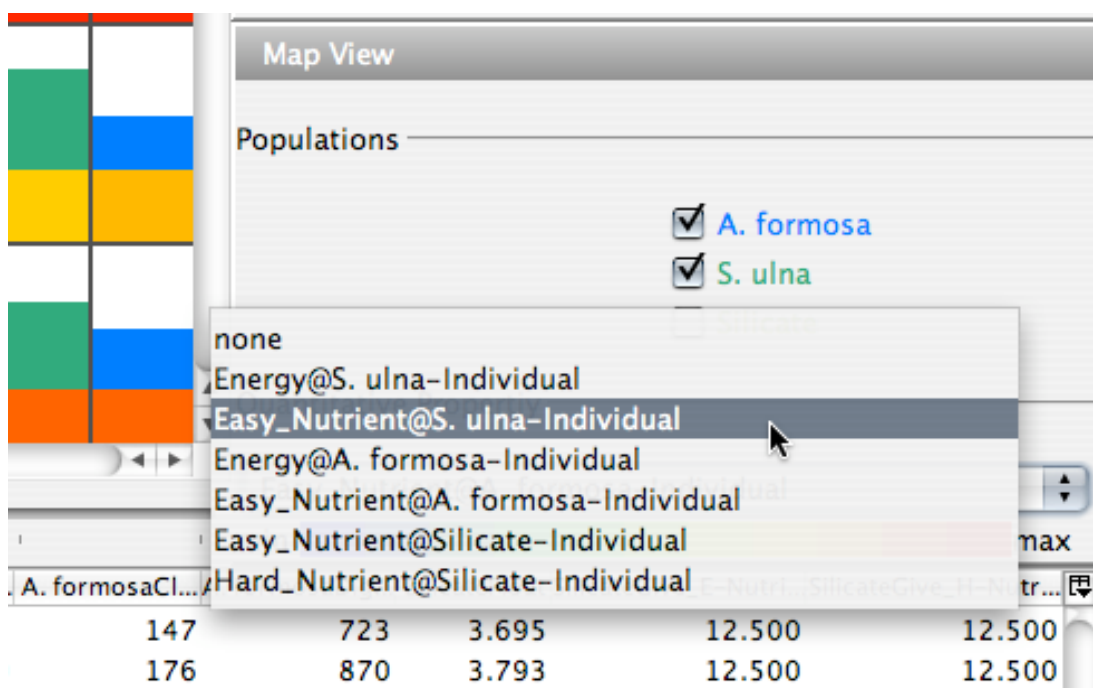


Fig. 12: The Log

Time	S. ulnaMove	S. ulnaDie	S. ulnaGet_E-Nutri...	S. ulnaClone	S. ulnaDigest	A. formosaM...	A. formosa...	A. formosaGet_E-Nutri...	A. formosaCl...	A. formosaDig...	SilicateFloat	SilicateGive_E-Nutri...	SilicateGive_H-Nut...
13	1.162	0	1.162	223	1.162	1.250	0	1.250	241	1.250	3.726	12.500	12.500
14	1.385	0	1.385	290	1.385	1.491	0	1.491	282	1.491	3.825	12.500	12.500
15	1.675	85	1.675	338	1.675	1.773	97	1.773	362	1.773	3.776	12.500	12.500
16	1.928	39	1.928	405	1.928	2.038	50	2.038	412	2.038	3.824	12.500	12.500
17	2.294	43	2.294	424	2.294	2.400	41	2.400	457	2.400	3.806	12.500	12.500
18	2.675	43	2.675	560	2.675	2.816	43	2.816	551	2.816	3.818	12.500	12.500
19	3.192	44	3.192	627	3.192	3.324	50	3.324	691	3.324	3.839	12.500	12.500
20	3.775	46	3.775	736	3.775	3.965	47	3.965	785	3.965	3.747	12.500	12.500
21	4.465	58	4.465	926	4.465	4.703	56	4.703	947	4.703	3.742	12.500	12.500
22	5.333	73	5.333	1.065	5.333	5.594	82	5.594	1.165	5.594	3.767	12.500	12.500
23	6.325	90	6.325	1.291	6.325	6.677	97	6.677	1.366	6.677	3.721	12.500	12.500

Fig. 13: Control of simulation runs

Simulation Info

Map Size: 25x25 Populations: 3 Current Step: 24

Simulation Control

steps

runs

13%