## Nondimensionalization

The considered model exists in space-time, so we need to specify spatial and temporal units for operating. The set of considered main parameters consists of dispersal and competition radii ( and ), homogenous environment death rate per capita (, and intrinsic birth and death rates ( and ). In sum five parameters matter for our purpose. As far as we use two units, there are only three essential parameters, others can be calculated via these ones. We perform so-called nondimensionalization – the full removal of physical dimensions from an equation by a suitable substitution of parameters.

First of all, we define the well-mixed case or the mean-field case. This term denotes the equilibrium case when the birth and death events are fully random, i.e., exhibit complete spatial randomness and result from homogeneous Poisson point processes. Basically, the well-mixed case demonstrates population equilibrium when no spatial structure in the model is present. Under spatial logistic dynamics the equilibrium mean-field density is defined by the formula

in the space of any dimension.

Using the mean-field equilibrium density as a spatial scale parameter and the inverse birth rate as a temporal one, we extract the following three essential parameters — dispersal and competition standardized radii ( and ) and standardized death rate (). For simplicity in the paper we consider the case when (i.e., per capita death rate is zero). Thus, only essential parameters can be varied.

## The main characteristic of the equilibrium state that is studied in this paper is standardized carrying capacity. This value is defined as the ratio of the equilibrium first moment to the mean-field equilibrium density, i.e., it has the form . We consider standardized carrying capacity in percent. Thus, we present full numerical characterization of the equilibrium densities of spatial logistic dynamics in one-, two-, and three-dimensional habitats because chosen standardized radii fully describe such a characteristic of the community.

## Essential parameters

In the considered cases spatial logistic dynamics in -dimensional space possesses five parameters: the intrinsic per capita birth rate 𝑏, the intrinsic per capita death rate 𝑑, the competition strength 𝑑′, the competition radius (i.e., standard deviation of the competition kernel) , and the dispersal radius (i.e., standard deviation of the dispersal kernel) . The units of these parameters are , , and , where 𝑇 and 𝐿 denote the units of time and length, respectively.

Since these parameters involve two independent units 𝑇 and 𝐿, the number of essential parameters is reduced accordingly relative to the number of all parameters, from 5 down to . Exact dimensionless essential parameters choice depends on which units 𝑇 and 𝐿 are chosen. The most natural choice of the time unit is (the option is less useful as far as the case when is quite interesting for research). The length unit choice is not so obvious, there are a plenty of options. In this paper we use the following approach. We consider the mean-field equilibrium density , that denotes the equilibrium density when no spatial structure is present, and the community is well-mixed. The unit of this value is (so, it is in fact density) and thus why we can use inverse -th root of as the length unit, i.e., . Such a choice allows us to compare general cases with the well-mixed one more precisely.

With the given choice of spatial and time units the described above five model parameters are transformed into the following dimensionless parameters:

As it can be noticed there are only three essential dimensionless parameters: and .

For simplification of the research, we can use , thus only two parameters remain. These parameters are called standardized radii. In the following text we assume that

## Segregation and aggregation effects

Figure 2 shows how standardized carrying capacity changes with the standardized radii.

Изображение выглядит как снимок экрана, диаграмма, Красочность, текст

Автоматически созданное описание

**Figure 2.** Comparative visualization of the standardized carrying capacity dependence on the standardized radii for different number of dimensions. Panels (a) and (d) show the one-dimensional case, panels (b) and (e) stand for the two-dimensional case, and panels (c) and (f) illustrate three-dimensional habitats. Panels (a), (b), and (c) are contour plots for three-dimensional graphics shown in panels (d), (e), and (f), with the same color scheme. The main features that can be seen on this graphics are the values on the diagonal (), the bigger values of   for low values of (which corresponds to the overdispersion effect), and the lower values of for low values of and (which corresponds to the clustering effect).