

Life strategies of plants of meander bars

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Abstract. The article generalizes the data on life strategy of plants in meander bars by the example of the species *Limosella aquatica* L., *Silene tatarica* (L.) Pers. and *Petasites spurius* (Retz.) Rchb., taking into account their life span and centres of environmental impact of a specimen, as well as peculiar features of sustaining a coenopopulation. The annual monocarpic *L. aquatica* combines its typical ruderal strategy of leaving numerous posterity with vegetative accrescence and iterative branching. The taproot perennial *S. tatarica* shows a competitor-ruderal strategy: plants entrench themselves and repeatedly territory development the help of root systems, still the coenopopulation (CP) is sustained by means of seed propagation and, possibly, as a kind of support, in a vegetative way, using a bank of dormant buds. Ruderal-competitor strategy of *P. spurius* is supported by vegetative propagation, development, and entrenchment on the territory by means of clones constantly and regularly renewed. So life of plants belonging to different biomorphs in conditions of meander bars is provided by a full or partial shift to ruderal life strategy.

1. Introduction

Meander bars are areas that dry out in the middle in-between the permanent channel and the bottomland situated near a river channel. They are the starting point in forming the bottomland situated near a river channel [1]. During the flood the speed of water flow is the highest, so a considerable amount of sand and sub-sand material gets accumulated here. In a low water season these areas form a part of dry land exposed to wind, high temperature, and rains.

The spectre of life forms in meander bars is scarce. Mostly it is represented by annuals, typical monocarpic therophytes, annuals and short-lived plants of vegetative origin, as well as long rhizome, root sucker, and caudex perennial plants. Closer to water line the share of annuals increases and the share of perennials decreases.

Plants are able to grow in meander bars presumably due to their life strategy, as well as to other biological features. Life strategy is one of the most important features of a species; it is determined by biological features of specimens, including individual development, shoot formation, a life form, and ecological preferences.

Thus the aim of the paper is to estimate life strategies of plants in meander bars by the example of model species with specific biomorphs.

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2. Material and Methods

The objects of research are chosen taking into account the life span and the centres of environmental impact of a specimen, as well as peculiar features of sustaining coenopopulation. They are *Limosella aquatica* L., *Silene tatarica* (L.) Pers., and *Petasites spurius* (Retz.) Rchb.

The research was carried out in 2019–2020 in the communities of sand shores of the right bank of the Vyatka River in the vicinity of Kirov. The research of coenopopulations was carried out on the basis of regulations for this kind of research of vascular plants [2-4]. Shoot systems of the model species were taken away from the substrata, in the laboratory their structure was considered with the help of a stereoscopic microscope MSP-1 variant 22. A life form was described on the basis of the ideas of I. G. Serebryakov [5–7] and C. Raunkiaer [8]. A shoot-forming model was stated according to T. I. Serebryakova [9, 10].

3. Results and Discussion

L. aquatica is a circumboreal, arctic-moderate-tropical [11], pluri-zonal species; a hygrophyte [12]. It mostly grows on limous and sandy shores, shoal heads, in drying bottoms of water bodies, ditches, pools, on flood plains and soddy meadows [13]. It is a monopodially growing rosette polycentric monocarpic with a monopodial rosette model of shoot formation, lateral stolon-upper-rosette shoots, and their systems up to four branching orders [14]. During a vegetation season lateral shoot systems are formed continuously from the buds of the leading and lateral shoots. As a result, in the base of the original rosette shoot they have more branches. Such a kind of shoot formation is analogous to iterate branching (continuous formation of several successive replacement shoots forming the axis of the plant during a vegetation period) typical to grass hygrophytes and hydrophytes. Formation of axillary complexes leads to increasing the assimilating surface, as well as of the energy of seed reproduction of specimens, it contributes to their prolonged in time fruiting and active dispersion [14]. Seed production can reach 1500 seeds per one plant. Ripening fruit crack with a longitudinal slot, they form a bank of seeds which often are washed off and carried away by the stream along the shoal at flood time. So, iterative branching, continuous monopodial axis growing and blooming, as well as formation of axillary complexes help to quickly occupy new territories both in the current year and next year (due to high energy of seed reproduction). It is a typically ruderal life strategy, like that of annual therophytes. Still, unlike them, *L. aquatica* quickly propagates vegetatively and actively spreads (Table).

S. tatarica is a shore-forest border ammophilous mid- and east-European species [11]. Its specimens have a broad range of habitats: sand off-shore bars, old dunes, ridges of fluvial plains, sandy forest meadows, fringes of forests (mostly, pine forest), and road sides. *S. tatarica* is either a grassy polycarpic with a alongrhizomatous-taproot, or a caudexal monocentric basic biomorph with a sympodial long-shoot model of shoot formation, depending on living conditions. A plant keeps the space occupied for long and it can occupy it more than once. It is possible due to the well-developed root system with a deeply seated main root (over 50 sm) and thick horizontally placed branch roots; to a bank of dormant buds on geophilous parts of the plant, the dormant buds have the ability of slowly growing and forming complexes of lateral daughter buds [15]. They (the dormant buds) provide reproduction of the plant, but just in case of some damage or some change in biotope conditions. The above mentioned features characterize *S. tatarica* as a competitor. Still vegetative propagation and expansion do not take place; just seed self-renewal is possible (Table). Ontogenetic specters of the most coenopopulations of the species under

research are left-side ones with the peak on young vegetative specimens (fig. A). Seeds are blown off by the wind with sand particles, they are entrapped and accumulated in low places, and they grow there. Still just a few of them grow to the adult stage; the most are washed away by water or get buried in sand. Due to exponential dynamics of population growth *S. tatarica* is characterized as a ruderal [16], which is typical to many perennial grasses in open free spaces. So, it is possible to define life strategy of *S. tatarica* on the territory of meander bars as a secondary competitor-ruderal one (CR).

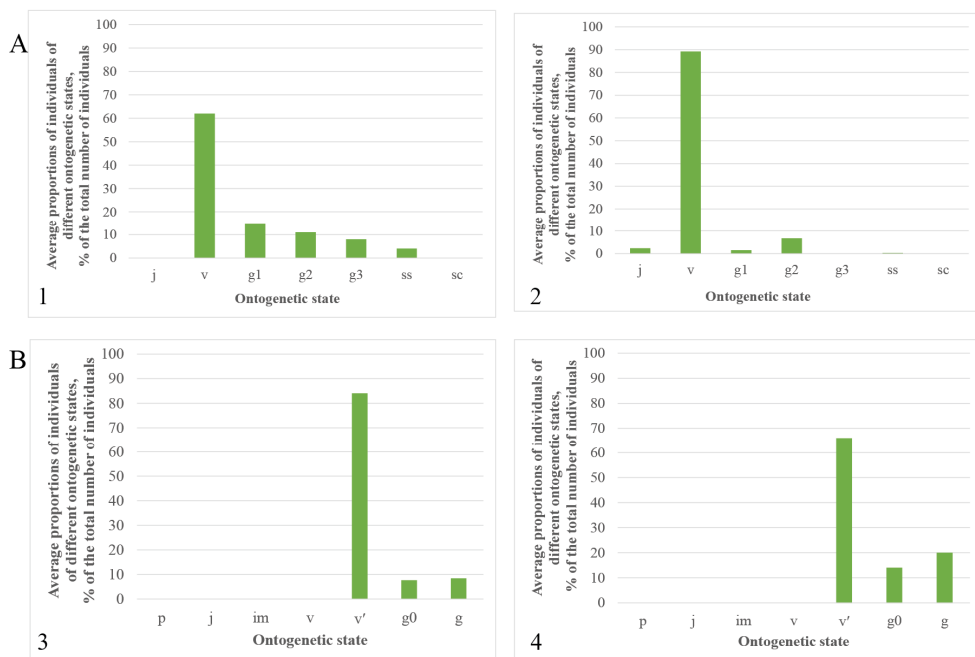


Fig. Ontogenetic spectres of coenopopulations of the model species: A – *Silene tatarica* (1 – coenopopulation 2; 2 – coenopopulation 3); B – *Petasites spurius* (3 – coenopopulation 2; 4 – coenopopulation 3).

Table Comparative characteristic of the model species

№	Feature	Species		
		<i>L. aquatica</i>	<i>P. spurius</i>	<i>S. tatarica</i>
1	Way of fixation	Iterative branching, rooting of lateral shoots in the course of growing	Long rooting geophilous parts	Tap-root system, horizontal lateral shoots
2	Propagation	Seed	Vegetative and seed	Seed
3	Keeping CP	Seed	Mostly vegetative	Mostly seed
4	Life span of a specimen/genets	1 year/1 year	1 year/many years	Many years
5	Keeping the territory	Not long	Long by the species	Long by a specimen
6	Life strategy	R	R–C	C–R

P. spurius is a Euro-West-Siberian moderate [11], boreal-submeridional [12] species. Its main habitats are sandy shores of rivers, lakes, streams; they also live in the vicinity of swamps and wet coombes. It is a summergreen grassy polycarpic with a prolonged geophilous part, a short-lived plants of vegetative origin, a geophyte with a nonsalient-polycentric biomorph and a shoot system of a sympodial semi-rosette model of shoot formation [17].

Owing to formation of a prolonged shoot system (up to 3 m or more per year), *P. spurius* quickly occupies any vacant space in meander bars. Self-maintenance of coenopopulations is both seed and, mostly, vegetative (Table). That is why left-sided specters with peaks on vegetative partial formations prevail in coenopopulations (fig. B), it proves that seed propagation is of less importance. These peculiar features indicate a ruderal strategy of *P. spurius*. Still it is provided in a special way, i. e. by means of vegetative growing and vegetative propagation, not by means of seed propagation typical of ruderal annuals. This species keeps the territory for a long time by the way of successively yearly formed short-lived perennial and annual posterity of vegetative origin as parts of constantly and regularly renewed clones, and not due long life span of plants. Thus life strategy of *P. spurius* has a mixed character and is a secondary ruderal-competitor one (RC).

4. Conclusion

The strategies of species under research are not pure (original). *L. aquatica* has a typical ruderal strategy with a tendency to vegetative accrescence. *S. tatarica* has a competitor-ruderal strategy with a tendency to vegetative accrescence, seed self-maintenance of coenopopulations, and left-sided ontogenetic specters (with peaks on virginal specimens). *P. spurius* has a ruderal-competitor strategy which is supported by vegetative accrescence and propagation.

Thus, all the model species of meander bars have some peculiarities of ruderal life strategy. They are realized in different ways and they show themselves to different degrees. Coenopopulations' self-maintenance of *L. aquatica* is a seed one, coenopopulations' self-maintenance of *S. tatarica* is mostly a seed one, with a vegetative one in support, and coenopopulations' self-maintenance of *P. spurius* is mostly vegetative. The ability of the ruderal *L. aquatica* to keep the territory is rather moderate, while for *S. tatarica* as a competitor it is typical to keep the territory, and *P. spurius* has a special ability to keep the territory due to renewal of clones. Thus plants of different biomorphs grow in conditions of meander bars, which is provided by their full or partial shift to the ruderal life strategy.

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