Coenopopulations of *Myricaria bracteata* Royal at the territory of the Republic of Kazakhstan and their ontogenetic structure

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Abstract. The article represents the analysis of 4 *Myricaria bracteata* populations in Kazakhstan. It was found that ontogenetic spectrum reflects the development degree of coenopopulations related to succession processes of riparian communities. Depending on the floodplain width, free space and phytocenotic pressure, the ontogenetic spectrum and stability of coenopopulation vary from left-sided incomplete to centered incomplete; from unstable invasive (in a narrow floodplain) through successive transitional and young normal to mature normal stable (in a wide floodplain) ones.

1 Introduction

Woody plants play an important role in forming riparian vegetation of floodplains and valleys of mountain and plain rivers. The population approach to assess individual elements of such vegetation occurred to be a justified one, reflecting on one hand the species behavior at different levels of organization (organism and population), on the other hand – various dynamic phenomena taking place under changing ecological and phytocenotic conditions [1]. Such studies make it possible to estimate the level of population stability and plant adaptation, as well as to characterize the succession series associated with both anthropogenic and natural processes in riverside zones.

Myricaria bracteata Royal (family Tamaricaceae) is a geoxyl shrub widespread in Central Asia; in the mountains of East Kazakhstan the species is common from Jungar Alatau to Gorny Altai. Its typical habitat is rocky-sandy banks of highland rivers, pebbles, stream dry canals [2]. All species of the genus *Myricaria* are evolving in stream and creek floodplains, and belong to the ecological group of fluviaphytes adapted to short rapid floods. They develop a strong root system and orthotropic whip-like flexible shoots contributing alluvium and sand-silt storage [3]. Growing in floodplain plant groups, *M. bracteata* should be considered as a pioneer tree species providing the upper soil horizon accumulation. At the same time, it can be used as a universal model object to construct succession series reflecting the natural overgrowth of riparian zones. Similar researchhasnot been carried outin Kazakhstan. The work objective is to study the

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ontogenetic structure of *M. bracteata* cenopopulations (CP) in communities at the primary succession various stages.

2 Materials and methods

4 cenopopulations of *M. bracteata* have been studies at the territory of the Republic of Kazakhstan, on floodplains differing topographically as parts of diverse plant communities at the primary succession various stages.

The main population-ontogenetic techniques [4, 5] are used. The ontogenetic spectrum is described based on accounting at least 200 sites by 2 m^2 size on transects along and across a riverbed made in a regular way. An individual (genet) and partial formations (ramet) are applied as counting units. The individual ontogenetic states based on qualitative and quantitative morphological features have been described by authors earlier [6]. The population type is determined using classifications by A.A. Uranov and O.V. Smirnova [7] and "delta-omega" by L.A. Zhivotovsky [8]. The following demographic characteristics are used as integral parameters: Δ – age index [9] and ω – efficiency index [8]. The ecological density is determined on the number of individuals per a habitable space unit [10].

3 Results and discussion

On the assumption of main biological features, *M. bracteata* individuals' ontogenesis is simple, complete, less often complex (as a result of a bush injury and some branches rooting). CP self-maintenance is carried out exclusively by seeds. As it has been found by authors earlier, *M. bracteata* seed production and germination are high: seed productivity coefficient is 65-70 laboratory germination rate is 92-96 % [11, 6].

CP1 was studied in riverbed pebble part of the lower Zhuzagash River bank on the Tarbagatai Range northern macroslope (48.754198 N, 82.385573 E). The floodplain was 100 m width covered with loess clay sediments in some sites. The immature plant community with a total projective cover (TPC) of 10% is formed by single samples of the genus *Salix* ssp. of 30-50 cm height and *M. bracteata* species, the species projective cover (SPC) is 5%.

CP was represented by a locus of 100x500 m size. CP density was 2.07 samples/2 m^2 at the study period. The ontogenetic spectrum was left-sided, incomplete (Fig. 1a) with a maximum on virginile individuals (*v*) – 52 % and a large proportion of immature ones (*im*) – 45 %. High values of these plants were related to inspermation, or input by organisms, wind and water of plant seeds or other germs (diaspores) providing infestation [12] and genets transport from the river upper reach. It should be noted that part of virginile individuals were developed due to rooted branches (partial formations of the virginile state), having their own ontogenesis. Low values of young generative groups (g_1) 3 % and absence of other ontogenetic groups characterized this CP as unstable invasive at the initial stage of its development. According to "delta-omega" classification CP is young, $\Delta = 0{,}09$; $\omega = 0{,}33$.

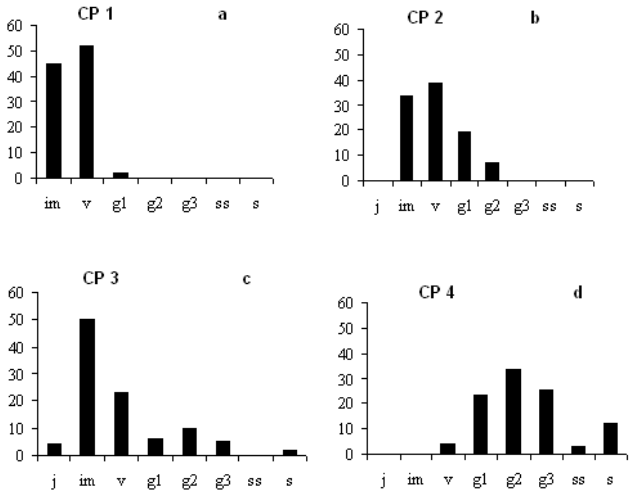

Fig. 1. Ontogenetic spectra of *Myricaria bracteata* cenopopulations. X-axis – ontogenetic states; Y-axis – content of ontogenetic groups, %.

CP2 was studied on a large-pebble, sandy-clay bank washed by a temporary channel of the Aksu River (45.638340 N, 79.454040 E). The area of the washed riverine site was 50x50 m. The sparse shrub vegetation group (TPC 60%) was composed by species of the genus *Salix*, *Caragana frutex* (L.) K. Koch, *Myricaria bracteata* 150-200 cm height, SPC of *M. bracteata* – 15 %; *Poa bulbosa* L. dominated in the grass stand consisted of *Barbarea stricta* Andrz., *Thymus marschallianus* Willd. 10-20 cm high.

CP was represented by a locus of 50x50 m size. The individual density was 32.8 samples/2 m^2. It consisted mainly of juvenile and immature plants, which were concentrated in the center of the riparian site with accumulated alluvial sandy substrate. Adult generative individuals (*g1* and *g2*) grew along the water level due to limited free space and phytocenotic effect of competitive shrubs (Salix, etc.). The ontogenetic spectrum was left-sided, incomplete (Fig. 1b) with a peak at virginile individuals (39 %). Such spectrum type was similar to CP1spectrum formed as a result of the CP development process. However, the spectrum of CP2 compared to CP1 reflects a trend towards greater stability due to the presence in CP2 of young (*g1*) and middle-aged (*g2*) generative individuals (18 % and 7 %, respectively) ensuring the CP renewal. According to "delta-omega" classification CP is young, $\Delta = 0.16$; $\omega = 0.45$. This CP can be considered as successive one, in a state of transition to normal.

CP3 was studied in bushy riparian floodplain of the Kokterek River on the Tarbagatai Range southern macroslope (46.595213 N, 82.168049 E) on gravels of braided riverbeds on the right bank in a grass-shrub community. The floodplain was 50 m width divided by anthropogenic impact into four ridges coming parallel to the main riverbed and sand spit. The studied community (TPC 70%) was dominated by shrubs: *Salix* spp., *Spiraea hiperecifolia* L., *Caragana frutex*, *Myricaria bracteata* 70-90 cm high, *M. bracteata* SPC-30%; herbaceous species –*Bromus tectorum* L., *Poa bulbosa*, *Stipa zalesskii* Wilensky, 25-30 cm height. This CP occupied an area of 50x100 m and represented a set of five loci: four of them were located along the ridges, the fifth one as on a sand spit. The average density of individuals in the CP was 5.7 samples/2 m^2, but it fluctuated sharply at the loci. The CP highest density was at sand spit (74 samples/2 m^2), where grew only immature and virginile individuals. In inter-ridge hollows the density ranged from 1.7 to 8.7 samples/2 m^2, and was represented by g_1, g_2 and g_3. The CP ontogenetic range was left-sided, incomplete (no

specimens of a senile state) (Fig.1 c) with a peak in immature individuals (51 %) reflecting good seed regeneration in previous years and favourable conditions (sand spit) for germination and survival of pregenerative individuals. The gradual decrease in the generative individual portion was associated with phytocenotic pressure by shrubs, which inhibited the development of young plants growing in the inter-ridgehollows. A low portion of post-generative plants was due to the CP development similar to CP2. According to "delta-omega" classification this CP is young, $\Delta = 0.16$; $\omega = 0.38$. It can be characterized as young normal one.

CP4 was studied in the pebble-sandy-clay riverbed part of the Charyn River floodplain, a tributary of the Ili River (43.765111 N, 79.431079 E) in a grass-shrub community. The monodominant shrub community (TPC 45%) is formed by *M. bracteata* of 50–60 cm high. Grasses were represented by *Poa bulbosa*, *Festuca rupicola* Heuff. 20–25 cm high. The floodplain width was 1500 m, the total CP area - 1500x1000 m. CP consisted of 5 loci that remained after automotive vehicles moving along the floodplain. The average density of individuals in the whole CP was 6.3 samples/2 mI. The density ranged from 3.3 to 8.6 samples/2 mI. The ontogenetic spectrum was centered with a peak on middle-aged generative individuals (34%), incomplete (there are no individuals of juvenile and immature states) (Fig. 1d). Pre-generative individuals were confined to sandy loci. But this group was demolished by sand excavation for road construction. The accumulation of mature generative individuals (g3) reflected biological features of the species and was associated with a long generative period, and the floodplain great length (1500 m) effected positively on the population ontogenetic composition and stability. According to “delta-omega” classification this CP is mature, $\Delta = 0.54$; $\omega = 0.78$. The CP can be characterized as stable mature normal one.

4 Conclusions

The population analysis of *M. bracteata* in different ecological and phytocenotic conditions has revealed a unidirectional vector of changes in the CP ontogenetic spectrum, which reflects the processes of its development. The trends of the ontogenetic spectrum changesis directed from the left-sided incomplete (with a small set of ontogenetic groups) through the left-sided incomplete (with a large number of ontogenetic groups) to the centered incomplete. Changes in the spectra reflect the species CP succession series while overgrowing riparian zones: unstable invasive → succesive transitive to normal → young normal → mature normal stable ones. *M. bracteata* CP stability is determined by: 1) floodplain width; 2) free space; 3) absence of phytocenotic pressure.

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