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Sustainable coexistence of the parent species and hemiclonal interspecific hybrids is provided by the variety of onthogenetic strategies: simulation HPS *Pelophylax esculentus* complex preliminary results

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Water frogs, or *Pelophylax esculentus* complex, consist of two parent species (*Pelophylax lessonae* and *Pelophylax ridibundus*) and their hemiclonal hybrids, named analogous to the species' name, i.e. *Pelophylax esculentus* (Fig. 1). Reproduction of *P. esculentus* occurs in the biological systems which called Hemiclonal Population Systems, HPSs (Шабанов, Литвинчук, 2010). Norh-East Ukraine is a location of so called Siverskyi Donets center of water frog`s diversity, which is characterized by R-E-HPSs, consisting of *P. ridibundus* and *P. esculentus*.

The stability of water frogs' HPS was studied using simulation model, described more closely in another article (Shabanov et al, 2015). It was considered only R-E-HPS, consisting of RRs and diploid hybrids, where ^{X}L-genomes (female genomes of *P. lessonae*) are transmitted in gametes — ♀♀^{X}R(^{X}L) and ♂♂^{Y}R(^{X}L).

In the case of equal viability of RRs and R(L)s, proportion of hybrids in HPS rises continually, as all offsprings from crossings between RRs and R(L)s are hybrids. In this case HPS is dying due to unvilability of offspring from reciprocal crossings between R(L)s. (Fig. 4). Thus, trasnformations of described HPSs can lead to one of the following outcomes: (1) population of *P. ridibundus*, (2) R-E-HPS or (3) death of the HPS (Fig. 5).

It was suggested, that hybrids' advantage in reproduction is offset by their weaker viability, and this is the explanation of distribution of described R-E-HPSs. Initially, we assumed, that RRs and R(L)s have the same age of sexual maturity and fertility and have an equal lifespan. Using this conditions, simulation has showed that coexistence of RRs and R(L)s is not stable. With all correlations between viability of RRs and R(L)s and with all initial compositions of the HPS simulation results in outcome (1) or (3) (Fig. 6).

Different result was observed, when individuals from the modelled HPS shown different onthogenetic strategies. Intrapopulation onthogenetic strategy of precocity is characterized by increasing of growth rate and number of offspring per breeding season, and also by reducing of age of sexual maturity and by probable lifespan decreasing. The stuntedity strategy has the opposite characteristics (Шабанов и др., 2014).

In case individuals RR and R(L) use different ontogenetic strategies, the stable zone of their viability values occurs, where their stable coexistence is possible. At certain ratios of RRs and R(L)s viability, the outcome 2 is more likely to be the result of simulation (Fig. 7).

We assume that registered by us phenomenon is the result of effect of more general mechanism, allowing stable coexistence of competing species.

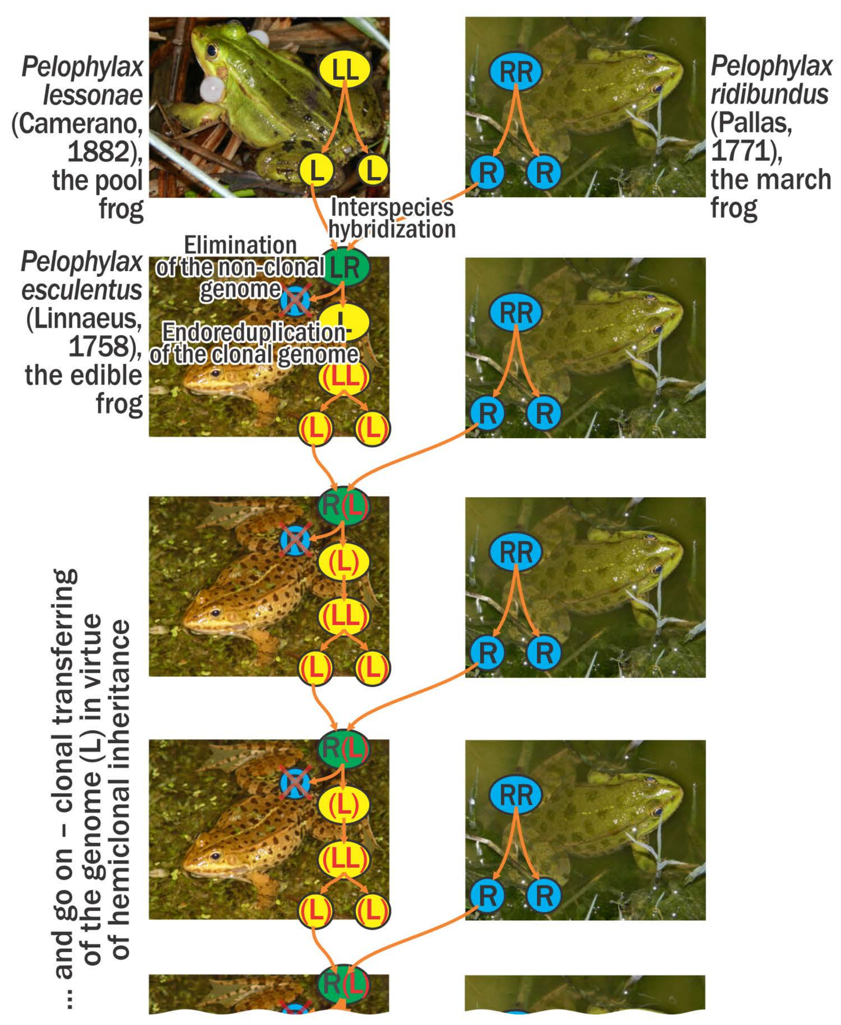

Fig. 1. Composition of *Pelophylax esculentus* complex and their reproduction in RE-HPS consisting of RR individuals and hybrids to which L-genoms were transfered

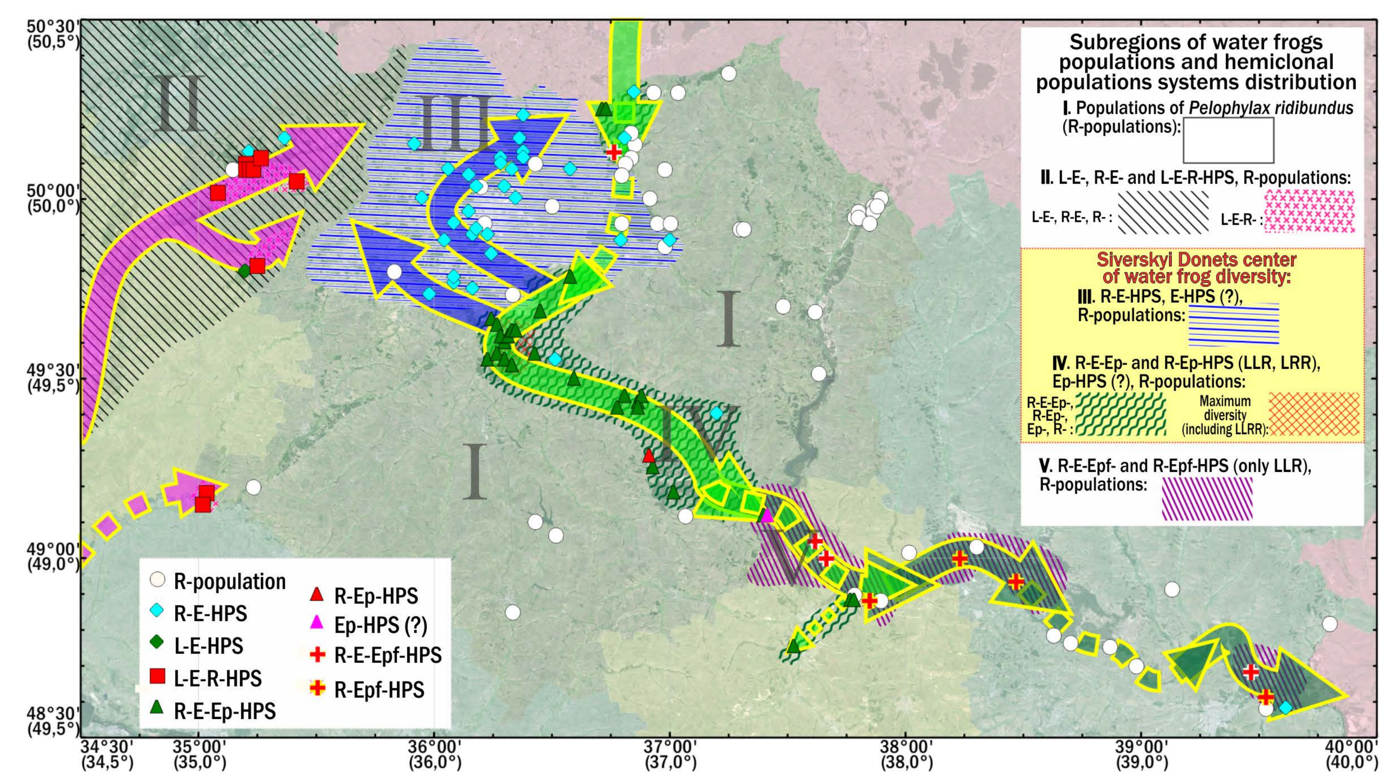

Fig. 2. Distribution of populations and hemiclonal population systems (HPS) of *Pelophylax esculentus* complex in the North-Eastern Ukraine (Шабанов, 2015). Colored arrows show the possible ways of dispersal HPS frogs. Roman numerals indicate the number of subregions allocated to based characteristic on their HPS. R-E-HPS discussed in this article are inherent to the sub-region III.

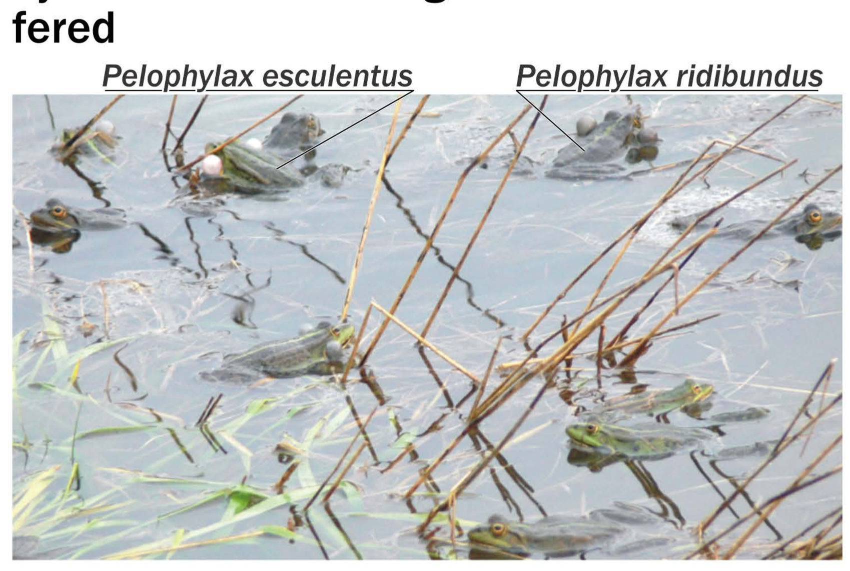

Fig. 3. The spawning in R-E-HPS populations in the city Kharkiv (sub-region III on Fig.2)

$$\text{♀}{}^{X}R^{X}R \times \text{♂}{}^{X}R^{Y}R \rightarrow \text{♀♀}{}^{X}R^{X}R : \text{♂♂}{}^{X}R^{X}R$$

$$\text{♀}{}^{X}R^{X}R \times \text{♂}{}^{Y}R({}^{X}L) \rightarrow \text{♀♀}{}^{X}R({}^{X}L)$$

$$\text{♀}{}^{X}R({}^{X}L) \times \text{♂}{}^{X}R^{Y}R \rightarrow \text{♀♀}{}^{X}R({}^{X}L) : \text{♂♂}{}^{Y}R({}^{X}L)$$

$$\text{♀}{}^{X}R({}^{X}L) \times \text{♂}{}^{Y}R({}^{X}L) \rightarrow \text{♀♀}({}^{X}L)({}^{X}L) \rightarrow \dagger$$

Fig. 4. Types of crossbreedings in RE-HPS systems. The crossbreeding of two hybrids is unviable (Plötner, 2005)

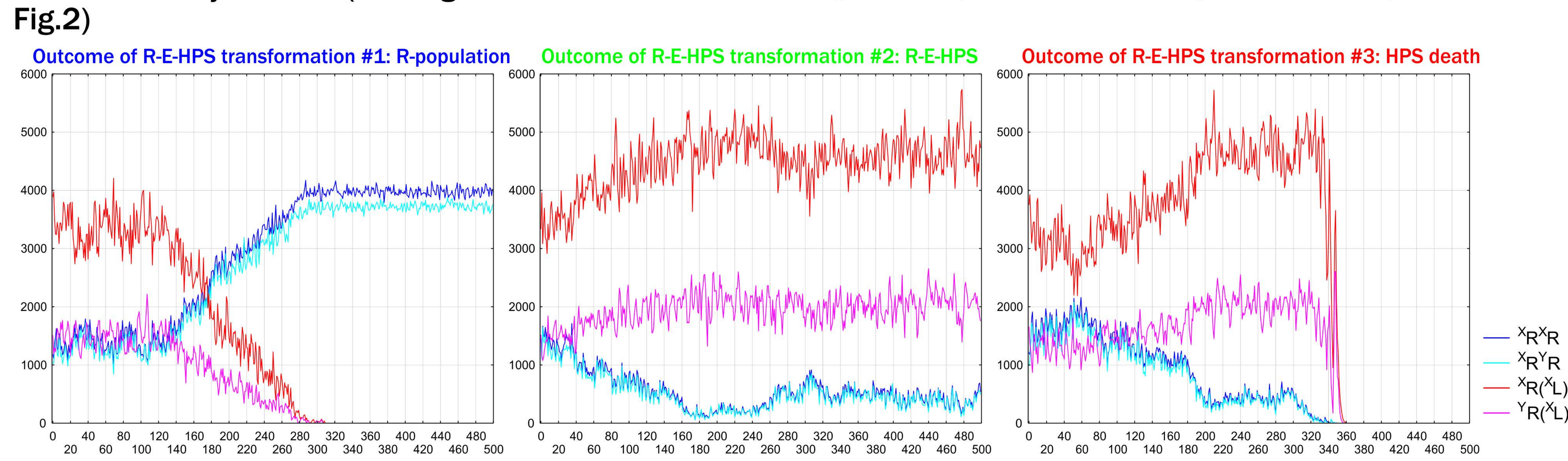

Fig. 5. Examples of the three possible outcomes of R-E-HPS transformation . The x-axis is the conditional years of simulation, the y-axis is the number of different forms of frogs (from fingerlings). Modelling has been conducted for the case whenthere are both precocity individuals and stuntedity ones among RRs as well as among R(L)s

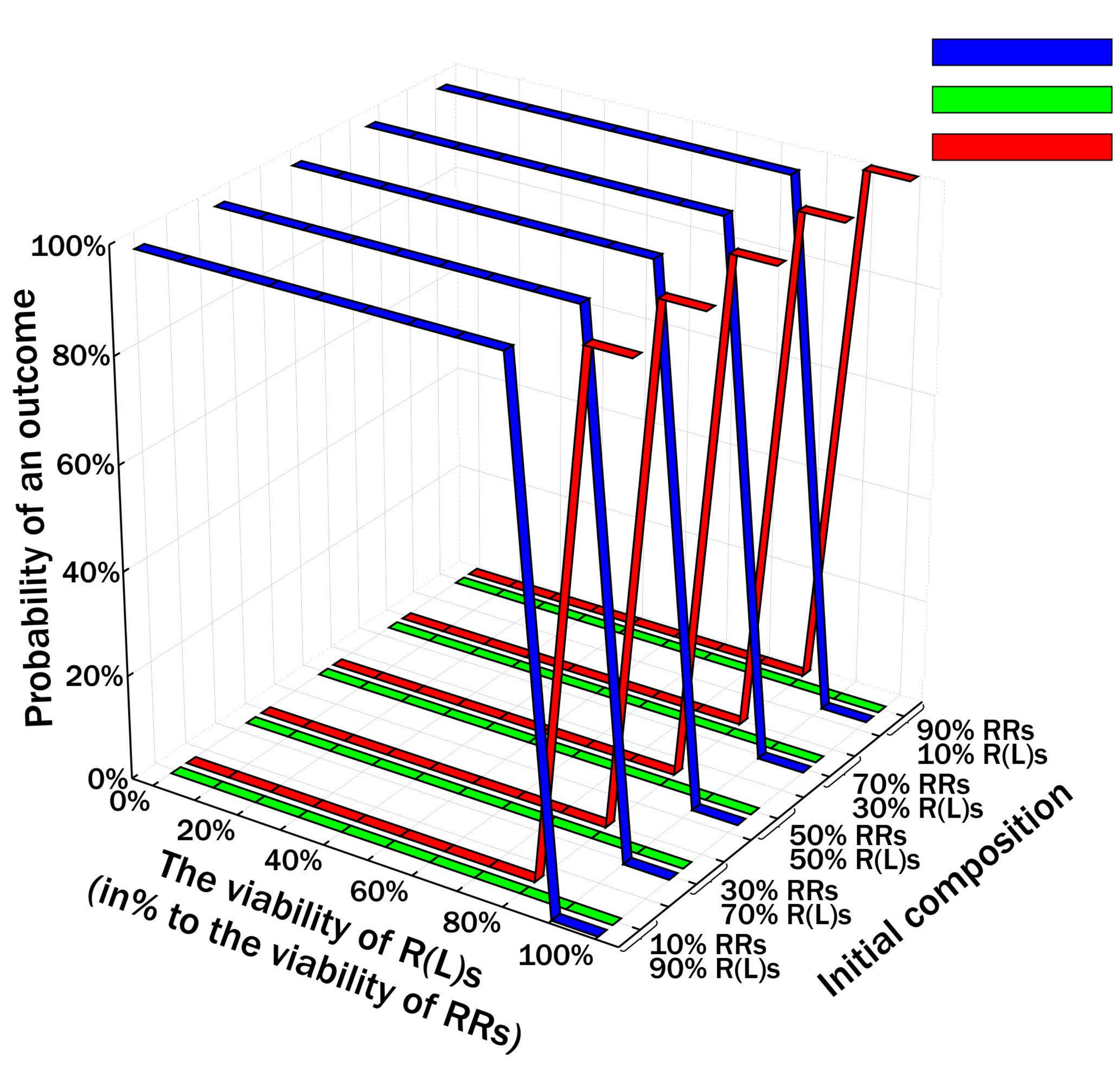

Fig. 6. If RRs and R(L)s ontodenetics strategies are identical, then R-E-HPS is unstable. Color legend for Figs. 6 and 7 is shown on the top

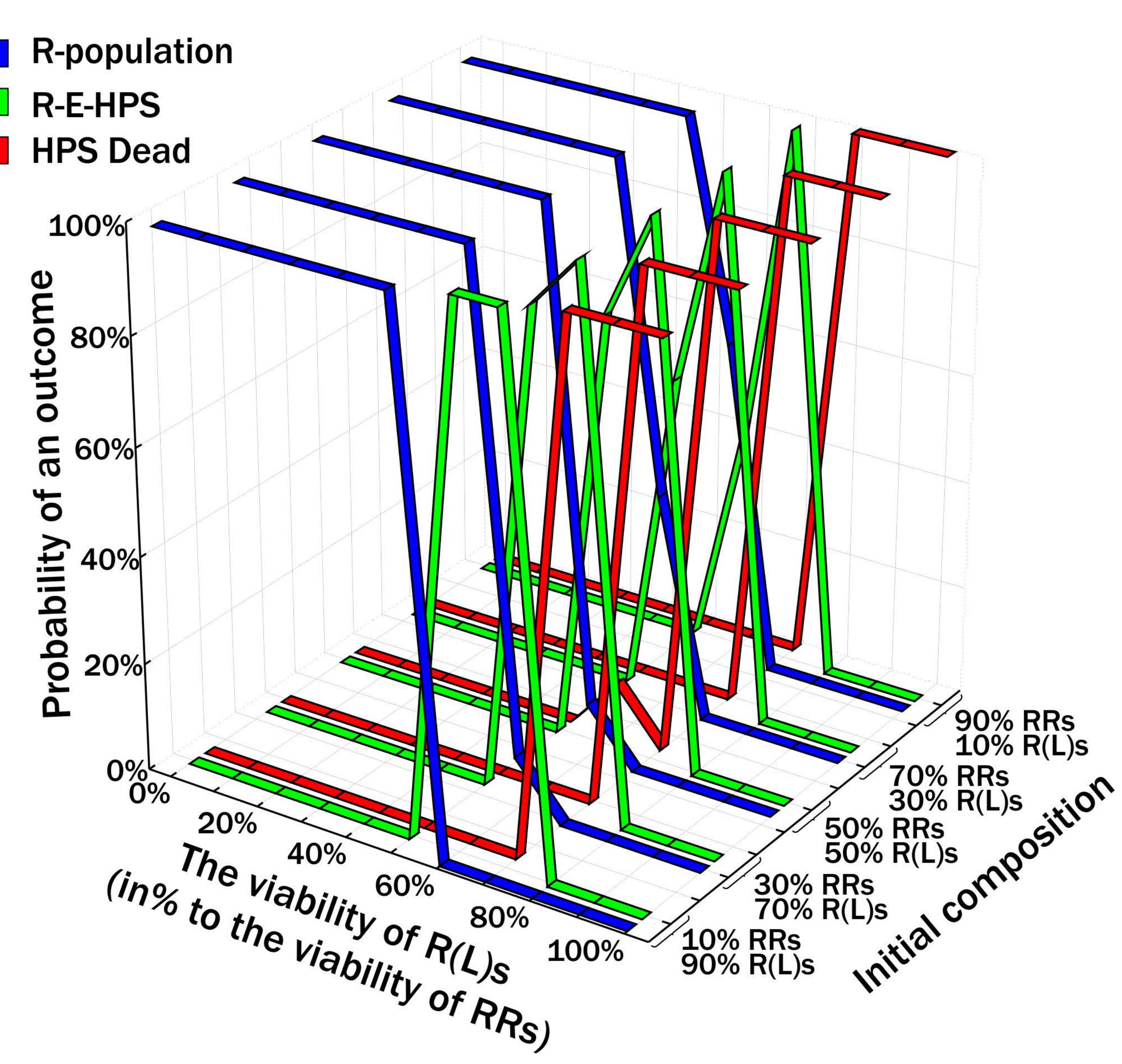

Fig. 7. Scattering similar to Fig. 6 for the case when RRs are characterized by stuntedity, but R(L)s are characterized by precocity. If onthogenetic strategies of RRs and R(L)s are different, then R-E-HPS can be stable

References

Plötner J. Die westpaläarktichen Wasserfrösche. Bielefeld: Laurenti-Verlag, 2005. – 161 S.

Shabanov D., Leonov A., Biruk O., Kravchenko M., Quentin Mair Q., Meleshko O., Newman J., Vladymyrova M., Usova O., Zholtkevych G. Simulation as a Tool to Identify Dynamical Typology of Water Frog Hemiclonal Population Systems. Submitted to Acta Biotheoretica, 2015.

Шабанов Д. А. Еволюційна екологія популяційних систем гібридогенного комплексу зелених жаб (Pelophylax esculentus complex) Лівобережного лісостепу України: автореферат дисертації на здобуття наукового ступеня доктора біологічних наук за спеціальністю 03.00.16 — екологія / Д. А. Шабанов — Дніпропетровськ, 2015. — 36 с. http://batrachos.com/Shabanov_2015_autorapherat

Шабанов Д. А., Литвинчук С. Н. Зеленые лягушки: жизнь без правил или особый способ эволюции? // Природа. – 2010. – № 3 (1135). – С. 29–36. http://batrachos.com/Frogs

Шабанов Д. А., Коршунов А. В., Кравченко М. А., Мелешко Е. В., Шабанова А. В., Усова Е. Е. Внутрипопуляционные онтогенетические стратегии скороспелости и тугорослости: определение на примере бесхвостых амфибий // Вестник Харьковского национального университета имени В.Н.Каразина, серия "Биология". — 2014. — Вып.22, №1126. — с. 115-124. http://batrachos.com/Onthogenetic_strategies