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INTERRELATED CHANGES IN GENETIC STRUCTURE AND DYNAMIC MODES OF POPULATION SIZE DUE TO EVOLUTION

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The population number dynamics is complexly connected with change in its genetic structure by cause-effect relations. Quantitative analysis of this interrelation is still an important fundamental problem. To study this problem we have developed a set of mathematical evolutionary models for population dynamics connecting both genetic and ecological approaches.
Analysis of these models shows, the evolutionary change of adaptive allele frequencies accompanied by an increase in the population average fitness can result in appearance of cyclic and chaotic modes of population dynamics. Increasing average fitness of ecologically limited populations proves to be in dissonance with stability of the population size growth. It obviously contradicts the intuitive concepts, the higher average fitness of population the more stability of the population.
Then we consider the more complex nonlinear models of structured population dynamics. The investigation shows, an increase in average individual fitness leads to appearance of chaotic attractors. Their structure and dimension vary with change in model parameter values (figure). In particular, increase in birth and survival rates results in complicating attractor and growth of its fractal dimension.
The study shows, all types of dynamic modes could consequentially occur during evolution of a limited population affected by density-independent natural selection increasing average fitness of populations according to the Fishers fundamental theorem of natural selection. We called the simultaneous action of density-independent selection and density-dependent non-selective ecological limiting factors as F-selection. The paradox of F-selection is that F-selection is density-independent, but leads to cyclic and chaotic modes of population dynamics, which creates conditions for density-dependent selection, like r- and K-selection.
To illustrate our theoretical results we use a specific example of existing genetic diversity by litter size in various (natural and artificial) arctic fox (*Alopex lagopus*) populations.We compared the possibilities of

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maintaining polymorphism in the framework of the classic theory of natural selection by an autosomic gene with the case of selection by a sex-limited gene, that is expressed only in females.

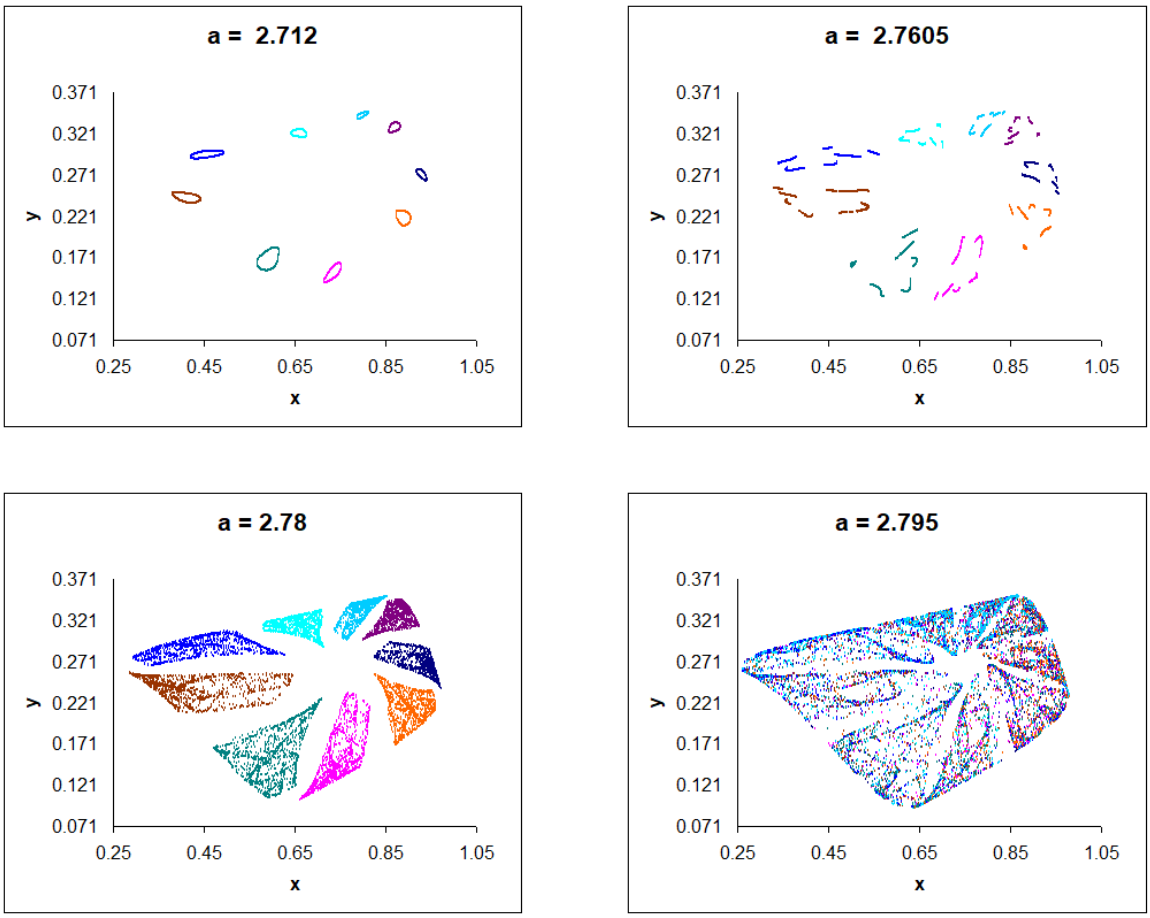

Figure 1: Attractor changes with growing birth rates (a). Here x and y are relative numbers of juvenile and reproductive group of population correspondingly.

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