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千岛湖社鼠种群遗传现状及与生境面积的关系

Population genetics of *Niviventer confucianus* and its relationships with habitat area in Thousand Island Lake region

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中文摘要:

以千岛湖地区13个岛屿上的社鼠(*Niviventer confucianus*)种群为研究对象,利用13个微卫星位点分析了13个社鼠种群的遗传现状,并探讨了种群遗传现状与岛屿面积大小之间的关系。研究结果显示,13个社鼠种群的平均观测等位基因数(N_a)与平均有效等位基因数(N_e)分别为7.385,5.952,平均期望杂合度(H_e)与平均观测杂合度(H_o)分别为0.819,0.930,平均多态信息含量(PIC)为0.760,说明13个社鼠种群均具有较高的遗传多样性。13个种群间的分化系数(F_{st})为0.053,表明种群间的遗传分化较小。3个面积较大且相近岛屿上社鼠种群,即高仙阁种群(Gaoxiange Island,G);乌石T岛种群(Wushi T Island,WT);东门岛种群(Dongmen Island,DM)间的 F_{st} 值均小于0.05,表明种群间无分化,而小岛种群与大岛种群间的分化却比较明显。此外,一元回归结果显示,多态信息含量(PIC)和Shannon多样性指数(I)与岛屿面积大小之间均存在显著地正相关关系。以上结果说明,在社鼠种群进化过程中,生境面积的缩小可能使种群的遗传结构发生改变,并有可能导致种群的快速进化。

English Summary:

Island is a special kind of fence for rodent populations on islands. Island rodents may face increased risk of inbreeding and population decline due to isolation among islands and mainland. We investigated the population genetics of Chinese white-bellied rat (*Niviventer confucianus*) populations on 13 islands in the Thousand Island Lake region in 2008. These islands included 8 small (Chawuling S Island, CS; Zhongdao Island, ZD; Dengta Island, DT; Wushi S Island, WS; Qiaowuping Island, Q; Chawuling F Island, CF; Lanwang Island, LW; Zhusiwu Island, Z) and 5 large islands (Jieshou Island, JS; Dafanlong Island, D; Gaoxiange Island, G; Wushi T Island, WT; Dongmen Island, DM). Of them, JS was the largest one. One hundred ninety two individuals were captured, and the muscle samples were used to extract the genomic DNA. Thirteen microsatellite markers were selected to analyze the population genetics. Five to ten microsatellite loci deviated from Hardy-Weinberg equilibrium (HWE) significantly in the four populations on the small islands (DT, Q, CF, Z), but no significant deviations from HWE were found at any locus on the large islands. Our results showed that the mean numbers of observed alleles (N_a) and effective alleles (N_e) were 7.385 and 5.952, respectively. Mean expected heterozygosity (H_e) and observed heterozygosity (H_o) were 0.819 and 0.930, respectively. Mean polymorphic information content (PIC) was 0.760, and mean Shannon's Information index (I) was 1.780. Based on these results, we concluded that the white-bellied rat populations on 13 islands had a high genetic diversity. The F -statistic (F_{st}) value of the 13 populations was 0.053; thus, mild genetic differentiation was found among these populations. Additionally, the F_{st} values among 3 populations on larger islands (G, WT and DM) were less than 0.05, and we considered that there was little genetic differentiation among the populations on 3 larger islands. However, the genetic differentiation of white-bellied rat populations between smaller and larger islands was conspicuous. We also detected relationships between genetic diversity and island area. Significantly positive correlations were found between PIC and island area ($P = 0.023$), as well as between I and island area ($P = 0.009$). Therefore, rat populations on the larger islands had higher genetic diversity, but relatively lower genetic diversity on the smaller islands. Furthermore, the level of genetic differentiation between populations on the small and large islands presented some difference to some extent. We considered that the reduction of habitat area might result in not only variation in genetic component during the evolutionary process, but also the rapid evolution of animal populations. That is, rodent populations with different habitat areas might face different survival pressures. For instance, populations on small islands might be subjected to increased mortality and high turnover of individuals, and thus experienced more variation in genetics during a short period than those on large islands. Evolution is generally thought to happen in a long-term process. However, this is not always the case, environmental factors, such as extreme temperature, environmental pollution, and so on, might accelerate the evolution of animal populations. On the islands, habitat area is an important factor influencing animal's survival, and rapid evolution might take place in the populations with smaller habitat area.

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