

Food diversity and niche-overlap of sympatric tits (Great Tit, *Parus major*, Blue Tit, *Cyanistes caeruleus* and Coal Tit *Periparus ater*) in the Hyrcanian Plain forests

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Abstract. This study was carried out between early summer 1998 and late summer 1999 in the Hyrcanian Plain forests, the southern Caspian Sea woodlands. In total, the gizzard contents of 241 specimens of the Great Tit (*Parus major* Linnaeus, 1758), Blue Tit (*Cyanistes caeruleus* Linnaeus, 1758), and Coal Tit (*Periparus ater* (Linnaeus, 1758)) were collected so that the percentages of grit, plants and animal materials could be estimated and the plant and invertebrate species consumed identified. The data were tested by a series of Mann-Whitney *U*, ANOVA and Kruskal-Wallis tests. To survey niche overlap of food materials between species and season, the symmetrical overlap index developed by PIANKA (1973) was used. The most important invertebrates (maximum of percentage per season) in the diet of *P. major* were Coleoptera (36.5%) and Lepidoptera (33.6%), for *C. caeruleus* Coleoptera (34.5%) and Araneae (31.2%), and for *Pe. ater* Coleoptera (38.2%) and Araneae (35.6%). The most important plants consumed by *P. major* were *Sorghum halepense* (68.7%) and *Ficus carica* (65.6%), by *C. caeruleus* were *F. carica* (67.5%) and *Alnus glutinosa* (39.4%), and by *Pe. ater* were *Lonicera* spp. (82.9%). There was a greater degree of overlap and competition for animal food, but plant feeding overlap among the three tit species was low. Two species, *P. major* and *C. caeruleus*, showed high feeding overlap for animal items (0.92), whereas *Pe. ater* and *C. caeruleus* had no significant feeding overlap. The Coal Tit had a greater tendency to forage for vegetable matter and *P. major* had a greater tendency to forage for animal matter. Analysis of gizzard contents of *P. major* and *Pe. ater* showed that, despite the high degree of feeding overlap, the extent of plant materials consumed indicated no significant competition between the two species. Because *Pe. ater* is present mostly in autumn and winter, this study cannot establish any degree of competition and food-niche overlap during the breeding season between this and other tit species.

Key words. Paridae, feeding, niche-overlap, Hyrcanian forest, Iran, Middle East.

Introduction

The search for mechanisms that permit the coexistence of trophically similar species is a central issue of community ecology (BEGON et al. 1990). Gause's principle demonstrated experimentally that two species with identical ecological requirements cannot occupy the same environment. The ornithologist J. GRINNELL wrote in 1904: "Two species of approximately the same food habits are not likely to remain long evenly balanced in numbers in the same region. One will crowd the other out. The one longest exposed to local conditions, and hence best fitted, though ever so slightly, will survive to the exclusion of any less-favored would be invader." (SMITH 1997). Competitive exclusion can influence the range and distribution of species. Competitive exclusion between species from portions of their fundamental