

STELLAGAMA STELLIO DAANI (BEUTLER & FRÖR, 1980)
AS A PREY OF *FALCO TINNUNCULUS* LINNAEUS, 1758 ON
TILOS ISLAND (DODECANESE, AEGEAN SEA)

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Abstract

The aim of this work is to provide some notes on the biology and feeding habits of the common kestrel *Falco tinnunculus* Linnaeus, 1758 on Tilos Island (Dodecanese, Greece). The discovery of many remains of the starred agama *Stellagama stellio daani* (Beutler & Frör, 1980) in several pellets and near a nest-roost of the common kestrel confirms the importance of this lizard in kestrel feeding.

Keywords: Tilos, *Stellagama stellio*, *Falco tinnunculus*, trophic plasticity, Dodecanese.

Introduction

Tilos is a small island of the Dodecanese Archipelago (Greece), covering a surface area of 64.3 km² and a coastline developed for 63 km. It is located between Rhodes (12 nm), Chalki (8 nm) and Nisyros (12 nm) islands, about 20 km from the nearest point of the Turkish mainland (Desio 1923, 1924, 1928). It is surrounded by numerous smaller uninhabited offshore islets the largest of which are Gaidhouronisi (NE) and Antitilos (SE). Tilos is a mountainous and rocky island and its tallest peak is Profitis Ilias (650 m a.s.l.). The most fertile and flat area in the island is located between Aghios Antonios bay (north) and Eristos bay (south). Tilos is also characterized by the presence of deep inlets like Stavros, Tholos and Skaphi. Tilos is mainly dry; there are only few springs (Lethra, Skaphi and Aghios Pandleimon). From a geological point of view, Tilos presents a remarkable uniformity being almost totally composed of limestones. There are some areas with ceroid limestone (east). The plains of the western half of the island are covered with volcanic tuffs from the explosion of the nearby volcanic island of Nisyros (Desio 1924, Broggi 2006, Cattaneo 2009). The entire island is a Special Protected Area (SPA) according to the EU Directive for Birds, since it hosts numerous rare species of birds. It is also included in the Natura 2000 Network (GR4210024), due to the presence of highly representative and exclusive habitats, like the temporary ponds in Livadia village (Code 92/43/EC - 3170* "Mediterranean temporary ponds"). A non-profit association "The Tilos Park Association" was formed in October 2003 for the protection, maintenance and promotion of the natural and cultural environment of the island of Tilos.

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Many of the birds of Tilos are protected by international Conventions (Bern and Bonn) as well as the 2009/147/EC Directive for the protection of wild birds. Because of its geographical position within the boundaries of the migration "flyway" of the eastern Aegean islands and the western coast of Turkey as well as its remote insular character, Tilos is an important stopover for many birds during their migration. One possible migration route that some birds may follow in spring is Crete-Karpathos-Rhodes-Chalki-Tilos-Nisyros-Kos and Turkey (Rigas & Xenoyanni 2007). Twenty-six strictly protected aviary species have been recorded that are included in the annex I of the European Union Community Directive 79/409. In particular, Tilos is very important for raptor species like: *Hieraaetus fasciatus* (Bonelli's eagle), *Falco eleonora* (Eleonora's falcon) and *Buteo rufinus* (Long - legged buzzard). The island is also important for *Phalacrocorax aristotelis desmarestii* (Mediterranean shag). During the last decades Tilos' natural environment has changed due to anthropogenic influences such as tourism development, land-use changes and other small infrastructure development. All these have threatened the island's traditional agricultural landscapes, its biodiversity and consequently its important avifauna.

Falco tinnunculus

Falco tinnunculus Linnaeus, 1758 is a common diurnal bird of prey. With its long tail and narrow wings, it is easy to distinguish from most other species. The sexes are distinct: in males, the rump and tail are bluish grey and unbarred, whereas in females they are brownish-red with dark barring. Furthermore, the head is grey in males and brown in females. Juveniles are like females, but are usually more yellowish-brown. *Falco tinnunculus* feeds largely on small mammals, snakes, lizards and small birds. Invertebrates are also very important components of the diet (i.e. earthworms taken from cereal fields are particularly important during winter). Lizards represent a substantial part of kestrel's diet (Jesus et al. 2005, Fargallo et al. 2009, Steen et al. 2011, Kaf et al. 2015). *Falco tinnunculus* hunt by sight, and when hovering they can remain still even in strong winds. Upon spotting their quarry, they plunge to the ground, seizing the prey with their talons. If prey is abundant, *F. tinnunculus* will sometimes kill more than they need and cache what they do not eat (Village 1990, Shrubb 1993).

Stellagama stellio

Stellagama stellio (Linnaeus, 1758) (rougntail rock agama or starred agama) is a diurnal lizard that is found in a variety of Mediterranean, arid and semi-arid habitats, always in rocky areas. Populations are often present in rocky mountainous and coastal regions. It can be found on rocks, trees, buildings and other habitats that it can climb on (Amr et al. 2012). This lizard is herbivorous, (Parker 1935), but it also feeds on insects and on large invertebrates such as scolopendres (Lo Cascio et al. 2001, Ibrahim & El Naggar 2013). It may also prey on mice (Baier et al. 2009) and bird hatchlings (Kopan & Yom-Tov 1982). A case of ophiophagy has recently been reported (Karameta et al. 2015). Taxonomically, the history of *Laudakia* dates to 1758 when the first member of this group was described as *Lacerta stellio* by Linnaeus. At that time, the knowledge of systematics was still incomplete and the morphological and behavioral similarities of agamids and iguanids misled many herpetologists to confuse their affiliations (Baig et al. 2012). This species, formerly placed in the paraphyletic genus *Laudakia*, was assigned as the type (and presently sole) species of the new genus *Stellagama* by Baig et al. (2012). This wide-ranging lizard has seven recognized subspecies (although this number varies according to different authors), and it is considered likely to be a species complex. However, "more extensive work is still required before splitting the *S. stellio* complex" (Baig et al. 2012), as most work to date has



Fig. 1. Remains of *Stellagama stellio daani*, Tilos Island.

been conducted on a morphological base and genetics is needed to clarify relationships in this taxon (Baig et al. 2012). In Tilos Island, the subspecies *S. s. daani* is present, previously synonymized with the nominate form, but whose distinctiveness was recognized by Almog et al. (2005), and it is considered a distinct subspecies in the review of *Laudakia* conducted by Baig et al. (2012). The diagnosis of this subspecies is: larger size than other subspecies; head and body moderately depressed; head dorsally colored like back or darker, not distinctly colored from back; back with usually four-five yellowish vertebral blotches on dark grey ground color; belly whitish; throat whitish ground colour, spotted dark usually over half of the

area; vertebral scales heterogeneous, irregular, keeled, larger than other small dorsals, midvertebral moderately large and interrupted at regular intervals by transverse series of highly enlarged mucronate scales; three-five rows precloacal callous glands with more than 30 scales; tail segment of two whorls; tail length about one and half times the distance of snout-vent (Baig et al. 2012).

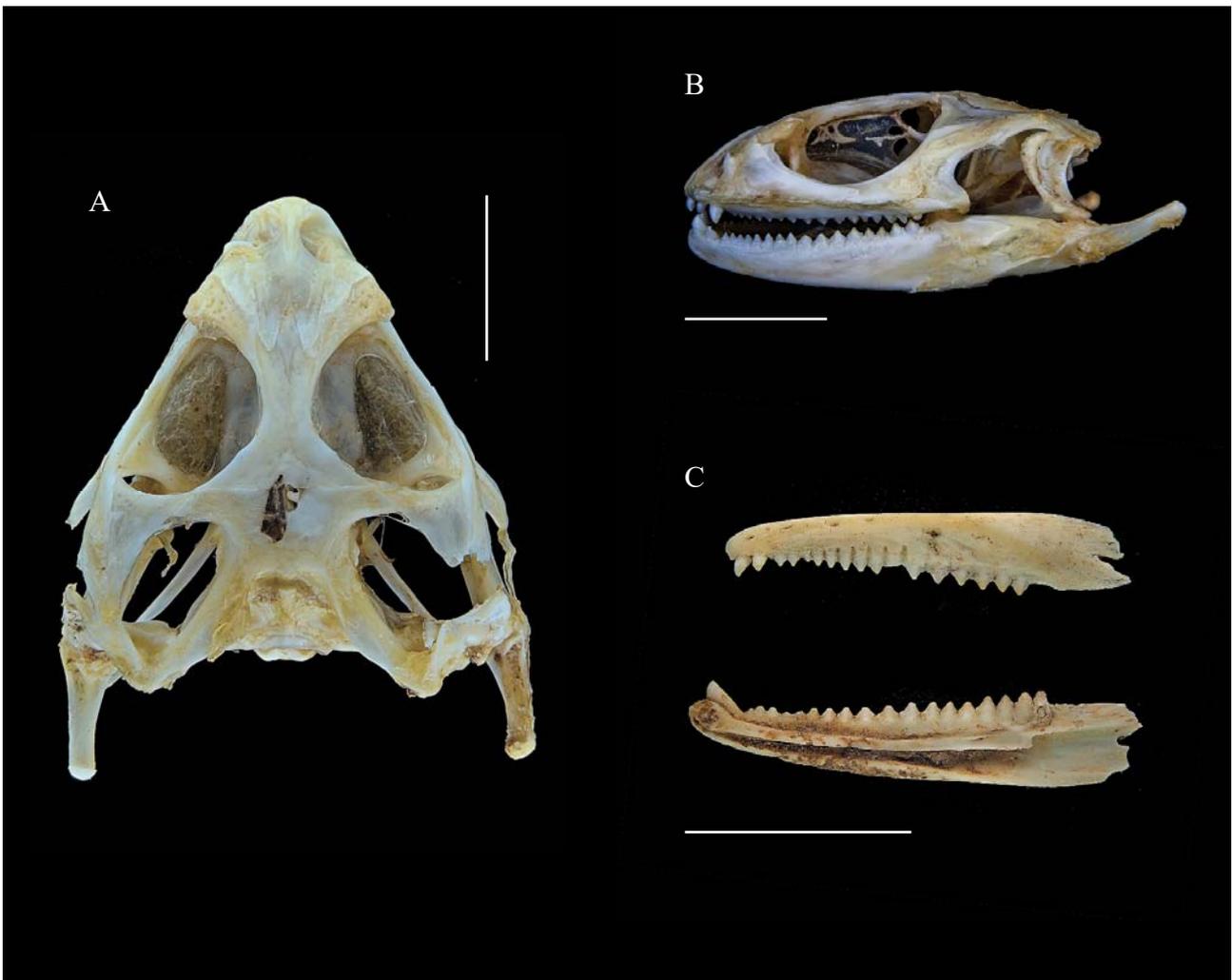


Fig. 2. *Stellagama stellio daani*, Tilos Island. A-B, skull. C, hemimandible. Scale bar: 10mm.

Stellagama stellio as a prey of *Falco tinnunculus* on Tilos Island

Materials and Methods

During naturalistic researches on the Mount Amali, located on the western side of the central part of the island, the authors have found a nest-roost of *F. tinnunculus* (36°24'57.81"N - 27°21'49.68"E, 310 m a.s.l). At the base of the rock where this roost was located, many remains of *S. s. daani* have been found (Fig. 1). These remains consisted in three entire and four partial carcasses and six skulls. About thirty pellets were taken and analyzed. In these pellets, most of the remains belonged to *S. s. daani* (jaws, vertebrae and little bones) whilst a small percentage (15%) consisted of *Rattus rattus* (Linnaeus, 1758) remains. Fieldwork and lab measurements were conducted in accordance with the Greek National Legislation (Presidential Decree 67/81).

Results and Discussion

The ability of *F. tinnunculus* to feed on different types of prey has always been seen as an opportunistic character that allows common kestrel to take advantage of the abundant food resources within their own hunting grounds (Ferguson-Lees & Christie 2001, Costantini et al. 2005). However, possible changes in population dynamics of their prey, derived from trophic interactions, should also be taken into account (Fargallo et al. 2009). Micromammals constitute the main component in *F. tinnunculus* diet. However, the incidence of reptiles is rather high and is related to climatic-environmental and ecological factors. *Falco tinnunculus* is a generalist predator and has a great capacity to switch to alternative prey when the basic prey becomes scarce (Fargallo et al. 2009). Studies carried out in northern latitudes, revealed that many predators like *F. tinnunculus* specialized on voles. Predator-prey systems are simpler compared to southern ecosystems where predator communities are made up mostly of generalists and predator-prey systems are more complex. The change in the type of predator from more specialized in north Europe to more generalist in south Europe may not be strictly due to a change in the predator community, but also to a change in predator behaviors. For example, *Falco tinnunculus* is considered a nomadic rodent-specialist predator in northern Europe but a nomadic and/or resident generalist predator in the south (Fargallo et al. 2009). This could imply, in the case of kestrels, a possible change in population dynamic of their prey derived from trophic interactions. A study on a population of the *Falco tinnunculus* was conducted over 15 years in a mountainous Mediterranean area (central Spain). The inter-annual variation in the abundance of two main prey species of *F. tinnunculus*, *Microtus arvalis* and *Lacerta lepida* and a third species scarcely represented in kestrel diet, the *Crocidura russula* has been recorded over 11 years (Fargallo et al. 2009). These studies determined that only one prey species (*Microtus arvalis*) has the capacity to modulate population dynamics of generalist predators and reveals the importance of climatic factors in the dynamics of micromammal species and lizards in the Mediterranean region. It was detected that environmental factors like rainfall and temperature have a great effect on the population dynamics of the *Microtus arvalis*. When this primary prey becomes scarce, *F. tinnunculus* may change to other prey shifting its focus on *Lacerta lepida*, particularly during the breeding season. The real role of lizards in kestrel diet is lower as lizards are not predated during autumn, winter and early spring. Lizards are most predated during warm season, when the activity of these reptiles is greater. Other studies conducted on the diet composition of *F. tinnunculus* in the easternmost peninsula of Madeira (Jesus et al. 2005) revealed that *Lacerta dugesii* is a very important component in the diet of kestrel. Food items identified in pellets collected during July and August of 1993 and 1994, revealed a high percentage of mammals 92, 5% and of reptiles (75, 9%). Arthropods (23%) and birds (15%) also occur in a lower percentage (Jesus et al. 2005). Most likely *Falco tinnunculus* may select each prey according to its abundance. The proportion of lizards among vertebrate prey increases further

south in Europe, a correlation due to the great abundance of lizards in warm and dry climates in south Europe (Village 1990). Lizards are an important constituent food items in *F. tinnunculus* diet. Is a prey closely linked to the climate, to the seasons and to the ecological conditions, such as the degree of vegetation density and the effect that this has on the kestrel's hunting ability (Jesus et al. 2005). The same situation most likely occurred on Tilos Island. *Stellagama stellio daani* is the most common lizard in Tilos and of larger size, therefore more visible, and attends numerous environments (Clark 1992, Broggi 2006, Cattaneo 2009). This could reveal and confirm the trophic plasticity of the *F. tinnunculus* that can adapt to a very abundant prey in a given period of the year, switching to alternative prey when probably the basic prey becomes scarce.

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