

The Long-legged Buzzard *Buteo rufinus* in Cyprus: three decades of presence and range expansion

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Land-use and climate change result in substantial range shifts of avian species, with dramatic changes to global land cover projected for this century. The Long-legged Buzzard started nesting on Cyprus in the early 1990s. Here, we present data on breeding population size and range expansion from 2005 to 2021. The Long-legged Buzzard population in Cyprus increased from 34 occupied territories (2005) to 63 (2012) and to 115 (2021), representing a threefold increase in the last 17 years. This was accompanied by a breeding range expansion from the western and southwestern parts of the island to the eastern and central mountainous parts. The western and southwestern parts still remain the species' stronghold, with more than 70% of the nesting territories. The broad diet spectrum of the Long-legged Buzzard and its readiness to use easily available food sources seem to have facilitated its establishment on the island. Agricultural abandonment, apparent from a decline in agricultural land cover from 63% (1949) to 48% (2012), combined with depopulation of the countryside and increased woodland, have favored its main prey species and decreased disturbance and persecution of breeding pairs. Nesting on trees, compared to cliffs, increased from 3% of nesting pairs (2005) to 32% (2021). The near extinction of Common Raven and Griffon Vulture increased available nesting sites and vacant territories over the last three decades. Climate change may have contributed to the colonization of higher mountain areas at elevations >800 m a.s.l. and increased availability of reptile prey earlier in the season.

Over the past few decades, land-use and climate change have had important impacts on biodiversity, resulting in substantial range shifts of avian species (Jetz et al. 2007). One such species is the Long-legged Buzzard *Buteo rufinus*, a medium-sized raptor with a wide breeding range, extending from the southern Palearctic eastwards to the Indo-Malayan region. In Europe it breeds in the southeastern dry steppes, representing approximately 17% of its global range (BirdLife International 2015). During the last three decades, the expansion of the Long-legged Buzzard across most of Eastern and Central Europe, colonizing areas of Eastern Romania and Hungary (Danko 2012, Lawicki et al. 2013, Baltag et al. 2014), has been attributed to climate change, to steppe expansion, and to a lesser degree to increased food availability (Mrlik and Landsfeld 2002).

In Cyprus, the Long-legged Buzzard is a new breeding species; it was regarded as a scarce and irregular winter visitor and scarce passage migrant until the early 1990s (Flint and Stewart 1992). The first confirmed nest was found in 1992 (Kourtellarides 1998). Whaley and Dawes (2003) estimated the population at about 20 pairs. In a 2005 population survey, 34 pairs were counted, 80% of which were in the southwestern part of

the island (Kassinis 2009). Since then, the species has shown an increasing population trend, with more than 70 pairs in 2015 (Kassinis and Mammides 2016), expanding eastward and to the central mountainous parts of the island, approximating 80 pairs in 2017 (Flint 2019).

Expansions of Long-legged Buzzard populations can have strong effects on sympatric species. For example, interspecific competition over nesting sites and territories between recently established Long-legged Buzzard territories in Israel and the sympatric Short-toed Snake-eagle *Circaetus gallicus* resulted in a dominance of Long-legged Buzzards, with a negative impact on the spatial and demographic distribution of the eagle (Friedemann et al. 2017). In Cyprus, the Long-legged Buzzard is sympatric to the Bonelli's Eagle *Aquila fasciata*, a flagship species of Mediterranean ecosystems. The Cyprian population of the Bonelli's Eagle is currently estimated at about 40 occupied territories in areas under the effective control of the Cyprian Government (Kassinis et al. 2021), with another 10-plus pairs estimated to have territories in the Turkish-occupied northeastern part of the island (Beton et al. 2013). The two species have a good conservation status in Cyprus

and a wide distribution, living in relative proximity to each other in many areas. Even though the Bonelli's Eagle is mostly a tree-nester in Cyprus (Kassinis 2010), while the Long-legged Buzzard a predominant cliff-nester (Kassinis 2009), they share common areas for nesting and foraging. Similarly, in Israel, the Short-toed Snake-eagle nests mostly in trees and the Long-legged Buzzard mostly on cliffs (Friedemann et al. 2016)

The aim of this study was to evaluate the population trend and range expansion in the Long-legged Buzzard from the early 1990s until 2021. The factors facilitating and determining this expansion are discussed, including possible competition with the Bonelli's Eagle for food resources, and increased availability of nesting sites resulting from the extinction or near extinction of other sympatric raptors.

1. Study area and methods

1.1. Study area

Cyprus is the third-largest Mediterranean island (after Sicily and Sardinia), covering an area of 9251 km² (Vogiatzakis et al. 2020). The island is dominated by two mountain ranges, the central Troodos Mountains and the smaller Pentadaktylos Range with the large, flat central plain of Mesaoria in between. Cyprus has a Mediterranean climate with dry, hot summers and rainy, mild winters, and relatively short autumn and spring seasons. High forests, mainly of Calabrian Pine *Pinus brutia*, cover 17% of the surface of the island. The endemic Golden Oak *Quercus alnifolia* exists in either pure stands or under conifers in elevations over 700 m

a.s.l. across the Troodos Range. Dominant shrubs typical of Mediterranean landscapes occur as scrubland (maquis of *Olea*, *Ceratonia*, and *Pistacia* species) with low thorny cover, and a different scrubland (matorral; *Juniperus phoenicea*) characteristic of the coastal areas (Tsintides et al. 2007).

The island's proximity to the Middle East makes it one of the hottest parts of the Mediterranean. The mean annual temperature has increased by >1 °C during the last century, with a more rapid increase of 0.015 °C per annum since the 1970s (Flint 2019). Zachariadis (2016) stated that «this increase exceeds the mean global temperature rise observed for the same period». During the last century, the climate has become increasingly arid, with droughts and water shortages becoming a frequent phenomenon (Tsiourtis 2002). During the 20th century, the average annual precipitation was 559 mm in its first 30 years and 462 mm in its last 30 years, a decrease of 17% (Flint 2019), whereas in the first 19 years of this century (2001–2019), the annual average precipitation was 491 mm (calculated from data provided by the Department of Meteorology 2020), showing no further decrease so far.

1.2. Methods

A standard methodology was used for finding and monitoring large raptor nesting sites (Gilbert et al. 1998) and is described in detail in previous studies (Kassinis 2009). Nesting pairs of the Long-legged Buzzard (Fig. 1) were monitored annually between 2005 and 2021, including a search for new pairs, by locating occupied nesting sites and recording data on breeding performance. Only areas under the effective control of the government of the Republic of Cyprus were surveyed.



Figure 1. Long-legged Buzzard *Buteo rufinus*, Cyprus. Photo Nicolaos Kassinis, Game and Fauna service. Adlerbussard *Buteo rufinus*, Zypern.

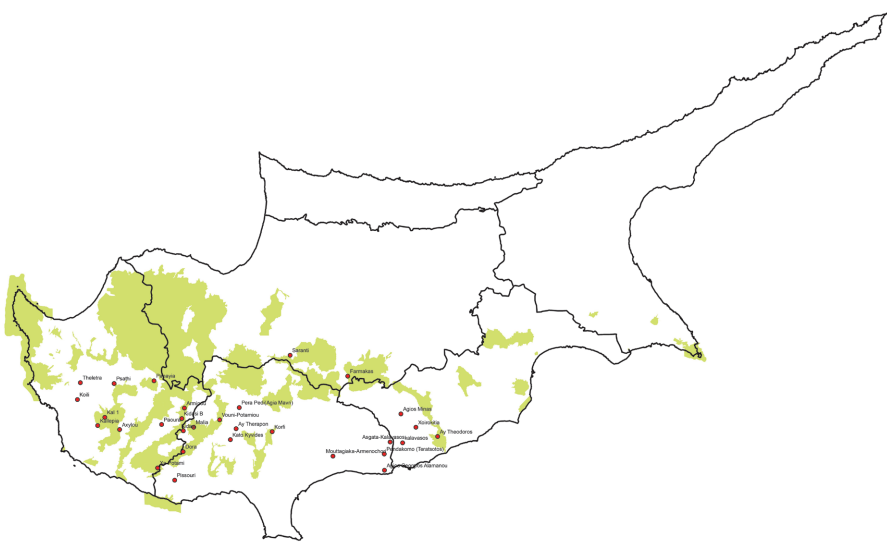


Figure 2. Occupied territories of the Long-legged Buzzard in 2005. Areas in green are Natura 2000 sites.
Besetzte Reviere des Adlerbusards 2005. Die grün markierten Gebiete sind Natura-2000-Gebiete.



Figure 3. Occupied territories of the Long-legged Buzzard in 2012. Areas in green are Natura 2000 sites.
Besetzte Reviere des Adlerbusards 2012. Die grün markierten Flächen sind Natura-2000-Gebiete.

Past information on breeding sites was used if possible. Field surveys started by mid-January with the aim of visiting all potential nesting habitat with suitable nesting cliffs, including smaller and isolated steep river canyons in semi-arid, pastoral or cultivated land. Woodland areas were also surveyed, but dense, continuous large tracts of forest were excluded from the search because they are known to be avoided by the species. All Long-legged Buzzard observations were mapped, and nests were located by observing nesting pairs. The number of occupied territories and breeding pairs were recorded. Occupancy of a territory was determined based on territorial behaviour (either observing two birds together or witnessing displays or aggression towards other birds) or by observing birds carrying nest

material. The presence of a breeding pair was determined if copulation, courtship behavior and finally incubation were witnessed.

2. Results

The number of nesting territories of the Long-legged Buzzard in Cyprus increased from less than 20 in the late 1990s to 34 in 2005, to 63 in 2012 and to 115 in 2021 (Fig. 2–4). This means a threefold increase over the past 17 years (Fig. 5).

The Long-legged Buzzard population expanded from the western and southwestern part of the island eastwards and to the central mountainous areas, with

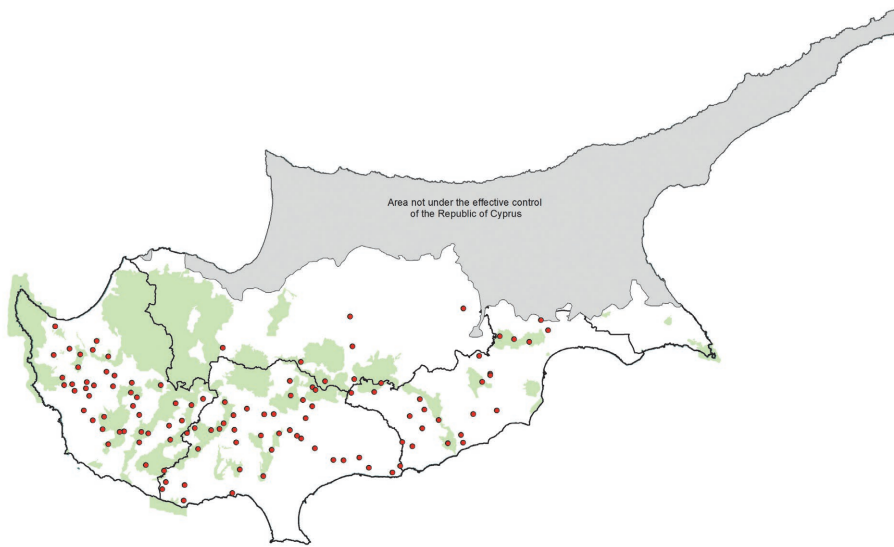


Figure 4. Occupied territories of the Long-legged Buzzard in 2021.
Besetzte Reviere des Adlerbussards 2021.

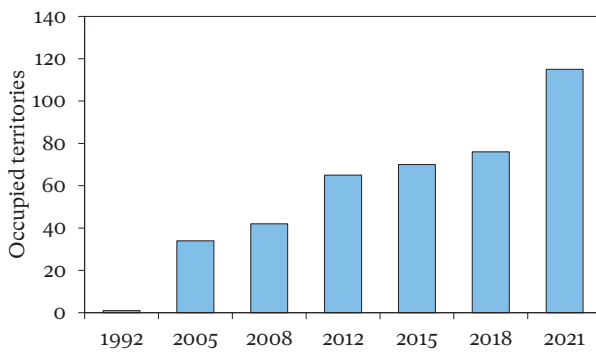


Figure 5. Population increase of the Long-legged Buzzard in Cyprus 1992–2021.
Bestandszunahme (besetzte Reviere) des Adlerbussards in Zypern 1992–2021.

its stronghold remaining the western and southwestern districts with 70.4% of the total occupied territories. Nesting on trees increased substantially: in 2005, only one pair nested on a tree (on a large Cypress *Cupressus sempervirens*; Kassinis 2009). By 2021, 32% of the nests were built on trees: 60% were on Calabrian Pines, 23% on Cypress, 5.7% on Carobs *Ceratonia siliqua*, 5.7% on Olive trees *Olea europea*, and the rest on the Aleppo Oak *Quercus infectoria* and the Almond *Prunus amygdalus*. A nesting site at an active quarry was discovered in 2021, where a pair successfully fledged three chicks. At this site, there was evidence of nesting activity in 2020 as well.

3. Discussion

The productivity of raptors is affected by different factors such as habitat, food supply, disturbance, weather conditions, and competition (Demerdzhiev 2022). The main drivers of the population growth and expansion of the Long-legged Buzzard in Cyprus are most likely a combination of interrelated factors including its broad dietary and nesting habits, changes in land use, decreasing persecution, extinction or near extinction of sympatric raptor species, and climate change.

The Long-legged Buzzard inhabits arid and semi-arid environments and prefers open habitat types for foraging (Ferguson-Lees and Christie 2001, Friedemann et al. 2011). In Cyprus it can also be found in maquis and woodland areas, avoiding dense, continuous, coniferous forests. Its diet consists mainly of small mammals, reptiles, birds and occasionally insects (Alivizatos and Goutner 1997, Khaleghizadeh et al. 2005, Wu et al. 2008, Kassinis 2009, Milchev 2009, Bakaloudis et al. 2012, Friedemann et al. 2016). In a recent study in Cyprus (Kassinis et al. 2022), the most abundant prey class during the nesting season was small mammals (68.8% frequency, 58.9% biomass), followed by reptiles (16.8% frequency, 36.3% biomass), and birds (4.3% frequency, 4.6% biomass). The most numerous prey species were Black Rats *Rattus rattus*, Starred Agamas *Stellagama stelio*, House Mice *Mus musculus*, and Large Whip Snakes *Dolichophis jugularis*. In terms of biomass, the most important prey items were Black Rats, Large Whip Snakes, Long-eared Hedgehogs *Hemiechinus auritus dorotheae*, and Starred Agamas. The broad diet spectrum of the Long-legged Buzzard and its readiness to use an easily available food source like small mam-

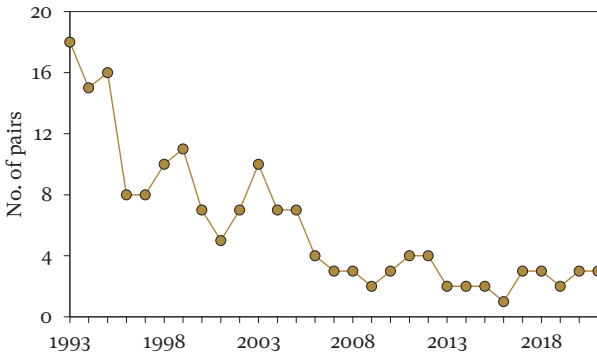


Figure 6. Population decline of the Griffon Vulture in Cyprus 1993–2021. Data until 2011 are from Papadopoulos (2013), and data for subsequent years from the annual Griffon Vulture monitoring program (BirdLife Cyprus and Game and Fauna Service, unpublished).

Bestandsrückgang des Gänsegeiers in Zypern 1993–2021. Die Daten bis 2011 stammen von Papadopoulos (2013), jene für die folgenden Jahre vom jährlichen Gänsegeier-Monitoringprogramm (BirdLife Cyprus und Game and Fauna Service, unveröffentlicht).

mals, in this case rodents and to a lesser degree reptiles, seems to have facilitated its establishment on the island. These prey species are to a lesser extent also used by the Bonelli's Eagle, a species that is mostly an avian predator (Iezekiel et al. 2004, Kassinis 2010, Kassinis et al. 2022). A comparison of diet between the two raptors showed that the Black Rat and reptiles are commonly shared food resources, but that interspecific competition is unlikely (Kassinis et al. 2022).

In Cyprus, the land used for agriculture has decreased from more than 63% in 1949 (Christodoulou 1959) to 48% in 2012 (European Environment Agency 2017). The abandonment of agriculture along with the increased depopulation of the countryside seems to have favored the Black Rat, with large areas of abandoned vineyards, orchards and previously cultivated fields being invaded by scrub and trees and being converted to woodland (Hadjikyriakou 2005, Flint 2019). Moreover, rural depopulation has decreased disturbance and persecution in the countryside and provided opportunities for species such as the Long-legged Buzzard to occupy territories in abandoned agricultural land.

The increase of nesting pairs using trees during the expansion of the species could either suggest a shortage of available cliff nesting sites (Baltag et al. 2014) or an adaptation to habitat change (Friedemann et al. 2011); indeed, woodland areas are increasing due to abandonment of agriculture and due to fire suppression in parts of the mountainous areas. An alternative explanation for the expansion of the ecological niche of a predominantly cliff-nesting species such as the Long-legged Buzzard is the decrease in human perse-

cution, as suggested for other larger raptors in Spain (Martínez-Abraín et al. 2021). Nesting at an active quarry in 2021 was the first such record of the species documented on the island even though nesting in quarries have been documented elsewhere (Djorgova et al. 2021, Demerdzhiev 2022). The Long-legged Buzzard is synanthropic, i.e., it may tolerate human presence (several nesting sites were found near villages or near isolated human settlements) and has been found to tolerate disturbance more than other sympatric raptors (Djorgova et al. 2021), which may also have facilitated its range expansion.

After the extinction of the scarce Eastern Imperial Eagle *Aquila heliaca* in the early 1980s (Kourtellarides 1998), the severe decline of the Griffon Vulture *Gyps fulvus* since the 1990s, and the near extinction of the Common Raven *Corvus corax*, the Long-legged Buzzard and Bonelli's Eagle are potentially the main competitors for nesting territories on the island, along with the forest-dwelling Northern Goshawk *Accipiter gentilis* and the smaller Peregrine Falcon *Falco peregrinus*. The decline of the Common Raven has probably facilitated the expansion of the Long-legged Buzzard, as indicated by 14 historical raven eyries now occupied by Long-legged Buzzards. Demerdzhiev (2022) stated that «ravens appear to be in constant interspecific competition with the Long-legged Buzzards with regard to the breeding sites». Similarly, the decline of the Common Raven in parts of Britain led to increasing populations of Peregrine Falcons (Ratcliffe 1993). The dramatic decline of the Griffon Vulture during the last three decades (Fig. 6) has also led to more available nesting sites, with at least 10 known historic vulture nesting sites now occupied by Long-legged Buzzards.

Globally, climate change is altering biological systems and has already affected the distribution and population dynamics of many species across a broad range of geographical locations and habitats (Walther et al. 2002, Parmesan and Yohe 2003, Root et al. 2003). Evidence emerging from the Iberian Peninsula suggests that the recent colonization by the African subspecies, the Atlas Long-legged Buzzard *B. r. cirtensis*, may be attributed to the northward expansion of Mediterranean biomes as winters become warmer (Chamorro et al. 2017).

According to Flint (2019), a warming climate is a possible reason for the Long-legged Buzzard's northwestern range expansion in Europe, but it is not clear how this would cause it to spread southward into Cyprus. The Long-legged Buzzard population in countries to the north, east and northwest of Cyprus has increased since the 1980s–1990s (Mrlik and Landsfeld 2002, Danko 2012, Stoychev and Demerdzhiev 2020), and the rapid colonization of Cyprus may have been a result of dispersal of these expanding populations.

However, since the end of the 20th century, climate change is affecting Cyprus with decreasing precipitation and annual mean temperature increasing by 0.01 °C per year (Zachariadis 2016). Rainfall decrease has been greatest (15–25%) in the Troodos Mountain range above 500 m a.s.l. (Rossel 2001), with less rainy days and less days with high precipitation (Katsanos et al. 2017). Projections for 2021–2050 are that the average temperature may rise by 1.4 to 1.9 °C, with a decrease in precipitation of 6–18% (Flint 2019). It is possible that climate change may have contributed to the colonization of higher mountain areas at elevations > 800 m a.s.l. by the Long-legged Buzzard and to the use of prey such as reptiles that are now active earlier in spring.

4. Conclusions

It seems that the broad diet spectrum of the Long-legged Buzzard and its readiness to use easily available food sources has facilitated its establishment on the island. Gradual habitat change since the 1950s, due to agricultural abandonment, has resulted in an increase in woodland areas that favor its main prey, the Black Rat. Moreover, climate change may have contributed to the colonization of higher mountain areas and increased availability of reptile prey earlier in the season. In addition, depopulation of the countryside has led to a decrease of disturbance and persecution. Furthermore, the extinction and near extinction of sympatric raptors over three decades has increased the availability of nesting sites. Not all nesting sites historically used

by Common Ravens and Griffon Vultures are now occupied by Long-legged Buzzards; we therefore expect a further expansion of this species on the island.

The effects of the range expansion on existing populations of sympatric raptors is not known. So far it seems that competition between the Long-legged Buzzard and Bonelli's Eagle for food resources is unlikely; however, further studies on intra- and/or interspecific competition for nesting sites are necessary, especially in view of the high conservation priority of the Bonelli's Eagle. Such studies will shed light on conservation priorities for these two species. Another concern is the extent of secondary poisoning of the Long-legged Buzzard due to Second Generation Anticoagulant Rodenticide (SGAR) application to control rodent pests. Some preliminary laboratory findings on other rodent-eating raptors such as Barn Owls *Tyto alba*, Long-eared Owls *Asio otus*, and Bonelli's Eagles are worrying. It should also be investigated whether surplus individuals produced each year may leave the island, although extensive studies with Bonelli's Eagles have not shown any migration of juveniles from the island.



Figure 7. Nest of Long-legged Buzzard *Buteo rufinus*, Cyprus. Photo Nicolaos Kassinis, Game and Fauna service.
Nest des Adlerbussards Buteo rufinus, Zypern.

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Zusammenfassung

Kassinis NI, Iris Charalambidou I (2022) Der Adlerbussard *Buteo rufinus* in Zypern: drei Jahrzehnte Präsenz und Arealausbreitung. Ornithologischer Beobachter 119: 382–389.

Landnutzung und Klimawandel führen zu erheblichen Verlagerungen des Verbreitungsgebiets von Vogelarten, wobei für dieses Jahrhundert dramatische Veränderungen der globalen Bodenbedeckung prognostiziert werden. Der Adlerbussard brütet seit 1992 in Zypern. Hier werden Daten über den Brutbestand und die Arealausdehnung von 2005 bis 2021 vorgestellt. Der Bestand stieg von 34 (2005) auf 63 (2012) und 115 Reviere (2021), was einer Verdreifachung in 17 Jahren entspricht. Dies ging einher mit einer Ausweitung des Brutgebiets von den westlichen und südwestlichen Teilen der Insel auf die östlichen und zentralen Bergregionen. Der westliche und südwestliche Teil ist nach wie vor die Hochburg der Art, in der über 70 % der Reviere liegen. Das breite Nahrungsspektrum des Adlerbussards und seine Bereitschaft, leicht verfügbare Nahrungsquellen zu nutzen, scheinen die Ansiedlung auf der Insel erleichtert zu haben. Die Aufgabe der Landwirtschaft, die sich in einer Abnahme der landwirtschaftlich genutzten Flächen von 63 (1949) auf 48 % (2012) zeigt, hat in Verbindung mit der Entvölkerung der Landschaft und der Waldzunahme die Bestandsentwicklung seiner Hauptbeutetiere begünstigt und die Störung und Verfolgung der Brutpaare verringert. Der Anteil der auf Bäumen nistenden Paare hat sich – anders als Felsbruten – von 3 (2005) auf 32 % (2021) erhöht. Das fast vollständige Verschwinden von Kolkrabe und Gänsegeier führte in den letzten drei Jahrzehnten zu einem Anstieg der verfügbaren Nistplätze und der freien Reviere. Der Klimawandel könnte zur Besiedlung höher gelegener Berggebiete in Lagen über 800 m ü.M. und zu einer grösseren und früheren Verfügbarkeit von Reptilien während der Brutzeit beitragen haben.

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