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Trends in abundance of migrating raptors at Gibraltar in spring

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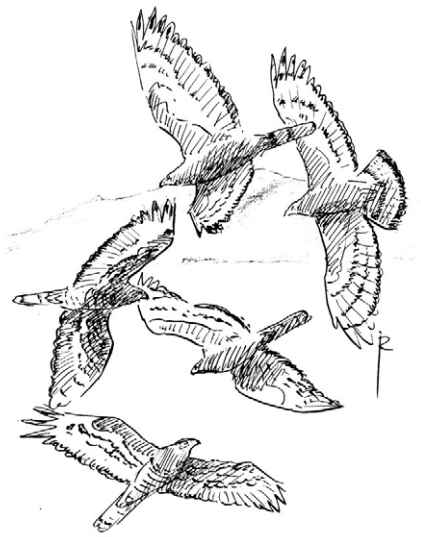

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Raptor migration has been monitored regularly at Gibraltar since the mid-1960s. Long-term trends in abundance of spring migration were investigated for the ten most frequent species, five of which changed significantly in abundance during the study period. Black Kites *Milvus migrans*, Eurasian Sparrowhawks *Accipiter nisus* and Booted Eagles *Hieraaetus pennatus* increased. The trends for these three species correspond with those observed elsewhere in western Europe. European Honey-buzzards *Pernis apivorus* and Common Buzzards *Buteo buteo*, whose western European populations are described as stable, both decreased. For Common Buzzards at least this discrepancy appears to represent a shift in wintering distribution, possibly as a result of climate change, with populations that wintered formerly in North Africa now wintering closer to their breeding grounds.

Key words: Raptors, spring migration, Strait of Gibraltar, climate change

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INTRODUCTION

Movements of migrating raptors across the Strait of Gibraltar are the largest in Western Europe at a single site, in terms of numbers and species. They attracted the attention of early authors such as White (1788), Reid (1871–74), Irby (1875) and Verner (1909) but raptor counts at Gibraltar began no earlier than the mid-1960s.

Organised counts of raptor migration across the entire length of the Strait of Gibraltar were first carried out in the 1970s by the 'Grupo Español de Migración de Rapaces' (GEMRA) (Bernis 1973, 1980a,b). These resumed on an annual basis since 1997 under the auspices of 'Programa Migres', an initiative co-ordinated by SEO/BirdLife, with the cooperation of the Gibraltar Ornithological & Natural History Society (GONHS). Both of these sets of surveys cover the southbound or 'autumn' migration, largely because this occurs on a much narrower front than the 'spring' movements (Bernis 1975).

Counting migrating raptors at bottlenecks offers the possibility of monitoring population sizes of some of the species involved (Bednarz *et al.* 1990, Titus *et al.* 1990, Hoffman & Smith 2003). The usefulness of raptor counting as a population-monitoring tool can be assessed by comparing observed trends at bottlenecks with trends on the breeding grounds (Kjellén 1997), as summarised for European species by Birdlife International (2004).

Achieving 'complete' counts is difficult when monitoring raptors at Gibraltar and elsewhere, as the numbers recorded are influenced by meteorological factors. Nevertheless, even partial counts

Figure 1. View of the study area with Gibraltar to the left, Spain to the right and in the foreground. Beyond the Strait the coast of North Africa is visible (photo Gibraltar Tourist Board).

may provide useful information on population trends, provided that sufficient observations are made over a long-enough period. This paper presents such information based on the data collected at Gibraltar.

METHODS

All the observations were made from the Rock of Gibraltar, at the eastern end of the Strait of Gibraltar (36°08'N, 5°21'W; Fig. 1). Observations by Gibraltar-based observers in spring were not carried out elsewhere along the northern shore of the Strait on a systematic basis, not least because direct access to Spain from Gibraltar was not possible between 1969 and 1982. Hence, records from the rest of the coastline of the Strait are not considered here.

We compared the raptor passage during the period 1967–77 with that of 1990–2004: comprising nine years pre-1980s (1967–72, 1974, 1976–77) and nine years post-1980s (1990–92, 1996, 1999, 2000, 2002–04).

In spring northbound raptors converge on the Rock only during periods of westerly winds (Finlayson *et al.* 1976, Cortes *et al.* 1980, Finlayson & Cortes 1987, Finlayson 1990, 1992). For this reason, between-year variation in the annual totals of raptors at Gibraltar is of limited biological significance, reflecting in part the relative abundance of wind directions.

Since seasonal totals from Gibraltar cannot be used to assess the abundance of migrating raptors, hourly rates of passage have been used instead for comparisons between periods. We have assumed that significant increases or decreases in rates of passage indicate significant increases or decreases

in the number of birds passing over Gibraltar. Rates for each species are based only on watches subsequent to the appearance of the first individual, i.e. covering species-specific migration periods. Passage rates are presented for each species as the mean number of individuals per hour per year. Watch duration was taken as the interval between the first and last birds recorded during a watch session. Only watches of at least two hours in length have been included, to omit incidental and discontinuous observations.

The ten species considered in this paper are those that are most common on passage across the Strait of Gibraltar (Table 1). A range of other species occur regularly but these are relatively scarce over Gibraltar and are not included here.

Statistical Analysis

As our sample sizes (the number of years per study period) were small and in general distributions did not meet the necessary requirements for parametric analysis, Mann-Whitney *U* tests were used to compare mean passage rates during the two study periods, 1967–77 and 1990–2004.

RESULTS

Temporal trends observed in the abundance of migrating raptors at Gibraltar (Table 1) show significant increases in the abundance of Black Kites *Milvus migrans*, Sparrowhawks *Accipiter nisus* and Booted Eagles *Hieraaetus pennatus*. The mean hourly rate of Black Kites crossing the Strait during the pre-nuptial migration has increased by 54% since the 1970s. Indeed, this species has become the most abundant of migrant raptors in the spring. There has been a sharp increase in the numbers of Sparrowhawks crossing the Strait at Gibraltar in spring. The mean hourly passage rate has increased by 75% since the 1970s. Similarly, the mean hourly rate of Booted Eagle arrivals during the pre-nuptial migration has risen by 65% (Table 1).

In contrast, there have been significant decreases in Honey-buzzards *Pernis apivorus* and Common Buzzards *Buteo buteo*. The Honey-buzzard was formerly the most abundant raptor at Gibraltar (Bernis 1980a, Cortés *et al.* 1980), generally accounting for over 50% of all the raptors

Table 1. Changes in mean annual raptor passage rates between the pre-1980s and post-1980s. *n* = number of years considered within each set of years. Mean estimates and trends for 1990–2000 of the western European populations[a] of the species considered are also given (after BirdLife International 2004).

	Pre-nuptial migration at Gibraltar						Western European breeding populations	
	Mean hourly rate (birds/hr)							
Species	pre-1980s	post-1980s	*n*	*Z*	*P*	Trend	Mean population estimate (pairs)	Trend
Honey-buzzard	120.83	56.15	7	–2.28	0.023	decrease	27909	stable
Black Kite	24.81	54.21	9	2.25	0.024	increase	36665	increase
Egyptian Vulture	0.58	0.54	9	–1.15	NS	none	1566	large decline
Griffon Vulture	2.03	1.27	6	–0.13	NS	none	18584	large increase
Montagu's Harrier	0.87	0.94	8	0.72	NS	none	11866	stable
Marsh Harrier	0.70	1.22	8	1.54	NS	none	13405	increase
Eurasian Sparrowhawk	1.06	4.27	9	2.78	0.005	increase	138868	increase
Common Buzzard	2.50	0.51	8	–2.73	0.006	decrease	364375	stable
Booted Eagle	1.58	4.55	8	2.52	0.012	increase	4166	increase[b]
Short-toed Eagle	2.14	4.08	9	1.72	NS	none	5579	stable

[a]Includes Spain, Portugal, France, Germany, Scandinavia, Benelux and the United Kingdom. [b]Martí & Del Moral 2003.

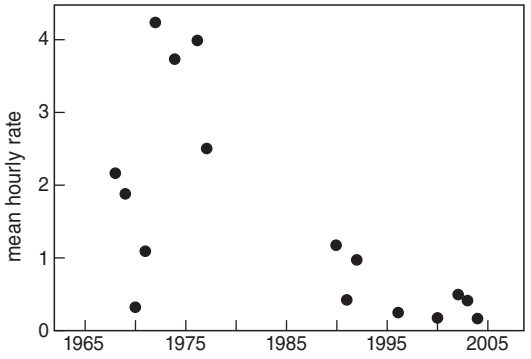

Figure 2. Mean hourly passage rate of migrating Common Buzzards at Gibraltar throughout the period of study ($n = 16$, $r = –0.65$, $P = 0.006$).

using the flyway both in spring and in autumn. In spring however, the species has declined in recent years to the extent that it is no longer the most numerous migrant raptor at Gibraltar. The mean hourly passage rate in spring has decreased by 54% since the 1970s. The decline of the Common Buzzard over Gibraltar is especially striking. Seasonal totals of a few hundred birds were regular in spring before the 1980s. Since the 1990s the species has become scarce and seasonal counts in some recent years have decreased to fewer than ten birds (Fig. 2).

No significant changes were detected in the abundance of Griffon Vultures *Gyps fulvus,* Egyptian Vultures *Neophron percnopterus*, Marsh Harriers *Circus aeruginosus,* Montagu's Harriers *C. pygargus* and Short-toed Eagles *Circaetus gallicus*.

The trends observed at Gibraltar are compared with those given by BirdLife International (2004) for the same species on their breeding grounds (Table 1).

DISCUSSION

The trends revealed by observations at Gibraltar need to be considered in the context of the source populations and migratory behaviour of the species involved.

European Honey-buzzard

Some European source populations, including the important French one, have remained stable since the 1970s (BirdLife International 2004), but those in Germany, The Netherlands, Sweden and Finland are known to have declined (Tjernberg & Ryttman 1994, Bijlsma *et al.* 2001, Honkala & Saurola 2006, Mammen & Stubbe 2006). The observed declines at Gibraltar in spring may reflect such partial decreases in population but perhaps other factors are involved. Large numbers of Honey Buzzards use the central Mediterranean flyway, migrating via Tunisia and Sicily (Corso 2001). It may be that a loop migration, in which increasingly some of the birds which cross south at Gibraltar return north via the Sicilian narrows in spring, occurs in this species and is becoming more marked. Similar loop movements are known to occur in Montagu's Harriers (García & Arroyo 1998).

Black Kite

Almost all European Black Kites winter in sub-Saharan Africa (Cramp & Simmons 1980) and the majority of western European birds use the Gibraltar flyway, since numbers crossing the central Mediterranean are low (up to 1000 individuals at the Strait of Messina in spring, and 3600 over the island of Marettimo in autumn; Agostini *et al.* 2000, Corso 2001, Panuccio *et al.* 2004). Those occurring at Gibraltar are mostly drawn from Spain, France and Germany. Of these by far the biggest population is that of France, with an increasing and expanding population estimated at 19 300 – 24 600 in 2000–02 (Thiollay & Bretagnolle 2004). The German population of 2700–4100 pairs is reported as increasing by 3.2% annually since 1988 (Kostrzewa & Speer 2001, Mammen & Stubbe 2006). The Spanish population, of 2500 – 10 000 pairs, is said to be in decline (BirdLife International 2004), although the exact status of this population is unclear (Martí & Del Moral 2003). For the time being, it must tentatively be concluded that the increases seen at Gibraltar derive principally from those of the French population.

Egyptian Vulture
The vast majority of Egyptian Vultures crossing the Strait are of Iberian origin and the bulk of the population winters in sub-Saharan Africa (Cramp & Simmons 1980). The Spanish population has declined by about 50% during the last 40 years (Del Moral & Martí 2002). Numbers crossing the Strait would be expected to reveal this decline. However, the spring passage over Gibraltar itself, always involving small numbers of birds, does not reveal significant trends.

Griffon Vulture
The great majority of western European Griffon Vultures occur in Iberia. Here the adults are largely resident but an unknown proportion of immature birds migrate to sub-Saharan Africa (SEO/Birdlife 2000). Spanish Griffon Vultures have increased in number considerably, from 3000 pairs in 1979 to 22 000 in 1999 (Del Moral & Martí 2001, Martí & Del Moral 2003). Very large numbers of Griffon Vultures, including flocks of up to 1000 individuals, have been seen flying south at the Strait in October and November in recent years (pers. obs.). However, no significant trends have yet been discerned from spring data at Gibraltar itself. Recently a significant proportion of the spring passage at Gibraltar has been found to occur very late in the season, in June (Garcia & Bensusan 2006), during a period which has traditionally been underwatched. This may partly explain why the population increase has not been detected in the present analysis.

Short-toed Eagle
Small numbers of Short-toed Eagles winter in Iberia (pers. obs.) but the majority cross the Strait to sub-Saharan winter quarters (Cramp & Simmons 1980). The bulk of the western European population breeds in Spain, where there have been indications of increases in numbers and range (Martí & del Moral 2003). However, the western European population as a whole is reported as stable (BirdLife International 2004) and this is reflected in the observations at Gibraltar, where no significant changes in abundance have been noted.

Eurasian Marsh Harrier
This species is a partial migrant but significant numbers migrate to North Africa from where most continue south to winter in sub-Saharan Africa (Cramp & Simmons 1980). The Marsh Harrier is not an abundant species at Gibraltar. Harriers generally are reported crossing the Mediterranean on a broad front. The numbers noted in the central Mediterranean recently are substantial both during spring and autumn (Corso 2001, Agostini *et al.* 2003, Panuccio *et al.* 2004, Sammut & Bonavia 2004). European Marsh Harrier populations were suppressed by man for much of the 19th and 20th centuries but have increased considerably recently (BirdLife International 2004). No significant trends in abundance have yet been demonstrated at Gibraltar in spring. In the central Mediterranean, however, recent years have shown a distinct increase in numbers, both in spring and autumn (Beaman & Galea 1974, Agostini *et al.* 2003, Sammut & Bonavia 2004, Agostini 2005).

Montagu's Harrier
The entire European population of this species winters in sub-Saharan Africa (Cramp & Simmons 1980). It has never been abundant at Gibraltar and many cross the central Mediterranean during spring migration (Corso 2001, Panuccio *et al.* 2004). Montagu's Harrier populations in Western Europe have been assessed as stable (BirdLife International 2004). The data from Gibraltar do not reveal any trends.

Eurasian Sparrowhawk
This is a widespread species in Europe, where many populations are resident or dispersive, with a greater migratory tendency in northern populations. However, among 1436 recoveries of Swedish-ringed birds and 375 recoveries of Norwegian-ringed birds, only two Swedish birds have been recovered south of the Pyrenees (Fransson & Pettersson 2001, Bakken *et al.* 2003) The origin of Sparrowhawks wintering in northern Africa is largely unknown but the few recovered in Morocco and Tunisia had been ringed in Germany (3), Switzerland (1) and western Russia (1);

recoveries of European raptors from Algeria are lacking (Isenmann & Moali 2000). Sparrowhawks were among the raptors most affected by the widespread use of persistent organochlorine pesticides from the 1950s to the 1970s and several European populations declined catastrophically at that time. The crash and subsequent recovery, when the pesticides were banned, have been well documented (Newton 1986). A recent assessment shows that the species is increasing or stable in most European countries after a general increase between 1970 and 1990 (BirdLife International 2004). The clear increase in Sparrowhawks at Gibraltar reflects actual increases in the populations involved.

Common Buzzard

The nominate subspecies of the Common Buzzard is largely resident in western and southern Europe, but northern populations are partially migratory, wintering further south in Europe (Cramp & Simmons 1980). A small proportion of these continue south across the Strait to winter in northwest Africa (Thévenot *et al.* 2003). The passage of Common Buzzards across the Strait has never been large but several thousand individuals were certainly involved in the 1960s and 1970s, as suggested by the partial counts from Gibraltar (GONHS records) and by the Strait-wide counts in autumn (Bernis 1980a). However, even this passage involved only a very small fraction of the very large western European population.

The significant decline in Common Buzzards as migrants at Gibraltar contrasts with the marked increase in many European countries in the late 20th century (BirdLife International 2004). The Gibraltar observations indicate that fewer birds now travel as far south as Africa to winter, thus remaining instead further north and within Europe. Whereas changes in migratory behaviour occasioned by climate change have so far been detected in birds mainly in the form of phenological changes (Møller *et al.* 2006), spatial shifts are also possible. The nominate form of the Common Buzzard is an intra-European migrant so our findings are consistent with evidence that responses to climate change are more pronounced in short-distance migrants (Møller *et al.* 2006).

Booted Eagle

Most of the Booted Eagles in western Europe inhabit Iberia (BirdLife International 2004) and the great majority of them winter in sub-Saharan Africa. There are clear indications of population increases in Spain (Martí & del Moral 2003) and these are presumably responsible for the large and significant increase noted at Gibraltar.

In summary, the spring observations at Gibraltar corroborate censuses of breeding populations, which revealed increases in western European Black Kites, Sparrowhawks and Booted Eagles, and an overall stability of Short-toed Eagles. They are inconclusive in respect of any population trends in Honey-buzzards, Egyptian and Griffon Vultures and Montagu's and Marsh Harriers, and provide no information on Common Buzzard populations. The monitoring of raptor population sizes is clearly most reliably achieved by counts of breeding birds. However, large-scale breeding censuses are difficult and costly so we suggest that counts of migrants are still useful in providing an early warning of large-scale changes. Migration studies are also an excellent way to monitor changes in the timing of the movements and may become increasingly important for this purpose if changes in phenology occur as a result of climate change.

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SAMENVATTING

Rond de Middellandse Zee liggen verscheidene punten waar roofvogels zich door de lokale topografie laten stuwen om de kortst mogelijke oversteek tussen Europa en Afrika te kunnen maken. Gibraltar is zo'n punt. Benoorden de Middellandse Zee is het de belangrijkste oversteekplaats van roofvogels die van thermiek gebruikmaken. Eerdere analyses van roofvogeltrek over Gibraltar behandelden de najaarstrek, vooral omdat deze zich over een smaller front afspeelt dan de voorjaarstrek. In het voorjaar is de spreiding groter, maar tijdens westenwinden concentreert de trek zich op de rots van Gibraltar. In de loop van de afgelopen decennia zijn hier systematische tellingen van roofvogeltrek gehouden, echter met hiaten die het niet toestaan een complete tijdreeks te presenteren. Om niettemin een indruk te krijgen van eventuele veranderingen in doortrek in de tijd, worden hier twee redelijk goed gedekte tijdvakken met elkaar vergeleken: 1967–77 en 1999–2004.Van de tien talrijkste passanten vertoonden Zwarte Wouw *Milvus migrans*, Sperwer *Accipiter nisus* en Dwergarend *Hieraaetus pennatus* een significante toename van respectievelijk 54%, 75% en 65%. Deze constatering komt overeen met bevindingen in de broedgebieden, waar eveneens forse toenames zijn geconstateerd. Twee soorten waren duidelijk in aantal afgenomen, namelijk Wespendief *Pernis apivorus* en Buizerd *Buteo buteo*. Van Wespendieven is bekend dat ze in grote delen van West- en Noord-Europa in aantal afnemen. De afname van Buizerds klopt niet met de enorme toename in de Europese broedgebieden. De toch al geringe stroom richting Afrika is nagenoeg opgedroogd, vermoedelijk omdat Buizerds dichter in de buurt van hun broedgebied zijn gaan overwinteren. Misschien dat hier klimaatsverandering mede een rol speelt.

De overige soorten lieten geen duidelijke aantalsverandering zien, namelijk Aasgier *Neophron percnopterus* (ondanks afname in broedgebied), Vale Gier *Gyps fulvus* (ondanks zeer sterke toename in Spanje), Slangenarend *Circaetus gallicus* (lichte toename in Spanje), Bruine Kiekendief *Circus aeruginosus* (sterke toename, maar breedfronttrekker die in het voorjaar wel in de Centraal-Mediterrane regio is toegenomen als passant) en Grauwe Kiekendief *Circus pygargus* (breedfronttrekker).

Systematische tellingen van roofvogeltrek op stuwpunten kunnen, in samenhang met onderzoek in de broedgebieden, nuttig zijn om grootschalige veranderingen te detecteren. Daarnaast kunnen fenologische veranderingen worden bijgehouden in de timing van de doortrek, die mogelijk onder invloed van klimaatsveranderingen plaatsvinden. (RGB)

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