

Population Prospects of Eleonora's Falcon in relation to Wind Farm Management on Skyros Island.

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1. Introduction

Eleonora's Falcon (*Falco eleonora*) is a bird protected by several national and international laws. Skyros Island has a sizable breeding population of this species. The Greek government announced plans to install a wind farm of 110 turbines on Kochilas Mountain (790 m) on Skyros. As no project of this size has been carried out anywhere so close to the breeding sites of this falcon, this report addresses the expected implications on the Eleonora's Falcon population on Skyros once the wind farm would be erected.

2. Biology of Eleonora's Falcon

More details about the descriptions below can be taken from the general texts by Walter (1979), Ristow (1999), Papaconstantinou (2007) and the special studies by Araujo et al. (1977), Ristow et al. (1983,) and Ristow (2004).

2.1 Yearly rhythm

Eleonora's Falcon is a social raptor of the Mediterranean which breeds colonially along cliff coast lines and on lonesome islands. It weighs 300-430 g and has a wing span of about 1 m. The wintering grounds are in Madagascar and east Africa from where it returns to the Aegean Sea at the end of April. The adult falcons (i.e. 2 years of age or older) may stay at the breeding colonies over night from May onward, but for about two months the numbers present at a breeding site fluctuate until the eggs are laid at the end of July. In the second half of August most of the young hatch, and another month later the first young can fly. During the last two weeks of October the family dissolves, and the individuals depart for Madagascar, so that by early November the last few adult males leave the breeding cliffs.

Eleonora's Falcon pursues its prey in open habitat as all falcon species do. But it is an exclusively aerial predator and as such feeds on winged insects and flying birds caught in midair (rarely on bats, too). In general terms, for 2/3 of the year this falcon depends on insects which it takes over land. Then, as the breeding season is adapted to the autumn migration of passerine birds from Europe to Africa, this falcon shifts to birds as prime prey for supporting the family. The migrants are caught above the sea where they cannot hide.

2.2 Catching insects

Slow flying insects such as beetles and winged ants are approached with gentle wing beats. The insect is simply taken out of the air with a talon and transferred to the beak. Agile insects such as dragonflies may be approached from a shallow angle or horizontal flight accelerated by a few quick wing beats. Also, the falcon often performs a slow straight flight with a few casual wing beats in between across a distance of a hundred metres and about a dozen metres above an olive plantation or vineyard or phrygana on the rocks and turns back to repeat the procedure in the opposite direction but perhaps thirty metres apart. Then, it suddenly interrupts its transect flight by dropping down to take a flying locust or cicada with the talons and immediately afterwards swings up to its former altitude. Here the falcon glides onward, balancing in the air with dangling talons, and the head bows down to take the prey from between the toes. In the open habitat, the characteristic flight movements of capture are noted by other falcons. Upon recognizing the repetition of such flight signals, up to a hundred falcons may join within minutes to exploit a swarm of insects and drift across half a kilometer while soaring together with the rising insects. After perhaps twenty minutes the food source is exhausted, the flock of falcons dissolves, and they continue their transect flights more or less individually. The human observer when equipped with binoculars usually cannot see the flying insect which the falcon takes, but he can see the lowering of talons associated with the characteristic instants of flight maneuvers (and he can analyze the falcon pellets in relation to season).

The strategy of slow flying insects during their short nuptial flight is that they swarm in large numbers, unpredictable in time and space, in order to accomplish that a few individuals evade capture by predators (Ward and Zahavi 1973). To exploit this rich though patchy food source, the falcons' response is to search in a large area by many individuals in loose and distant sight contact. Once a falcon signals success, the other falcons in sight join to exploit this food source which is only briefly available. Therefore, it is characteristic of Eleonora's Falcons that they roost communally and do not have hunting territories like a solitary breeding raptor does (they only have a few metres of nest territory within the breeding colony). From the roost they disperse the next morning. The extension of the insect foraging area of a colony has not been measured yet by telemetry of falcons. So there is only an estimate based on direct observation and a few ring recoveries that the land area for supporting a colony is 1000 km². To reach such areas from a lonesome colony islet, the falcons may travel in transit flight more than 30 km across the sea. As they know from experience that these nuptial flights do not take place early in the morning, the falcons depart from their islet an hour or two after sunrise when the first thermals develop. Typically in doing so, they rise as high as possible by soaring above the colony and then begin the slowly descending glide straight forward to cover long distances. Most of the falcons head in the direction to the nearest peninsula of the main land. But quite a few depart into specific other directions and head for more distant peninsulas. Having lost their initial altitude and having descended to a flight height of about twenty metres above the sea, they continue the travel into head winds with continuous powerful wing beats. When being carried by soft tail winds the falcon does half a dozen wing flappings about every fifty metres, and if there is no wind it simply goes on by continuous wing flapping, until they reach one by one or in small groups the peninsula and go on to areas where they have been successful in search for insects in the past. When a falcon is satisfied with the day's success, it joins a communal roost on the main land or sails back from a peninsula towards the colony cliffs in the afternoon or even after sun set.

The irregular and rainy weather in central and northern Europe does not provide the ecological conditions to support raptor colony members with their daily amount of flying insects, but the Mediterranean climate does. In its adaptation of soaring and gliding flights for hawking upon insects, Eleonora's Falcon has a low wing load. When soaring in a thermal updraft together with a Peregrine Falcon which is a specialist hunter for flying birds all year round, the Eleonora's Falcon easily outperforms its relative. On the other hand, Eleonora's Falcon is less adapted to capture birds.

2.3 Capturing birds

In open habitat, a passerine bird responds to an approaching falcon from distances of about a hundred metres. Although a falcon can fly much faster than a small bird, its superb flight maneuverability within short distances gives the passerine a chance to evade several quick capture attempts and to escape down onto the ground and hide. Eleonora's Falcon as an insectivorous specialist has barely a chance to successfully pursue a low flying bird above the land. The situation is different above the sea where the falcons can exhaust the prey by repeated hectic stoops and finally succeed in capture. Most passerine migrants have the strategy to migrate alone (i.e. at distances of several hundred metres) at night and navigate by star orientation to avoid their predators while travelling across unfamiliar terrain. In order to cool themselves during the prolonged flight hours and perhaps to avoid obstacles like mountains on their way, they typically fly at heights of 1 km during nights. They cross the Mediterranean Sea in a broad front and do not depend or use 'bottle-neck-like' landmarks. For navigation they choose nights without cloud cover and start the journey after sunset (all of this confirmed by radar observations). When departing from Bulgaria or northern Greece, at travel speeds of about 40 km/h, they reach the Aegean islands around sun rise and have to continue travelling until they reach some land to go down. They head for any island silhouette that they may note at the horizon. At this time of day, i.e. sun rise and perhaps for two hours onwards, there is a good chance for falcons to intercept migrants. This food source is so rich that on normal days in September the male can carry in a caught passerine every half an hour what amounts to about five birds per day. This is sufficient for the family of this medium sized falcon. It is a predictable food source in time and space. The falcon learns this by experience and by copying the behaviour of conspecifics. The rest of the day it may perch in the shade to guard its nest territory or leave to search for supplemental insects. To reduce energy consumption, the falcons use updrafts wherever available. They fly to locations with the strongest updraft, i.e. especially to mountain ridges, and soar upward without wing beats as high as possible. The rest of the climb they do by wing flapping and heading against the wind so that they more or less keep flying above a given point while ascending. At altitudes of 1 km and more the members of a colony disperse to such an extent that flying neighbours do not interfere directly with each other, that is they fly at separation distances of about a hundred metres at various heights and only do as much wing flapping as is needed to compensate for the head wind. They do not search in a large area; the migrants are approaching the land anyway, so the colony members disperse near the island or the coast line across a kilometer or two to reduce transportation distance to the nest. Upon spotting a migrant, the falcon heads with powerful wing beats towards the prey and begins the chase. If it succeeds to grab the migrant, the falcon hides its prey underneath its tail as much as possible and dives down to land in its nest territory as fast as possible because only here it is safe from competitive neighbours. If the chase up there at the high altitudes is not successful after a few attempts, the flying falcons in the vicinity rush in to join the pursuit. Within half a minute a crowd of twenty falcons or so encircle the passerine by stoops from

different directions so that sooner or later one of the crowd usually succeeds with capture. This one hurries to dive down with its trophy because half a dozen of his competitors have noted which falcon was successful and follow it in hot pursuit with the intention to rob the prey. If one of them gets close enough to attack the successful falcon from above, the latter has to turn round on its back to defend itself with its talons. This instant is the chance for the attacker to grab the prey, too. Both falcons then cling to the prey and simply drop down while wheeling, wrestling, and shrieking until one succeeds to take over and continue the stoop to its nest, still being pursued by the rest of the mob. If a falcon with prey is farer away from its nest, it tries to avoid such food piracy and uses updrafts when available, before heading towards its nest and diving down with closed wings. A low flying falcon when carrying prey towards a colony would be too slow to outmaneuver its competitors. The inexperienced human observer equipped with binoculars usually does not note the hunting maneuvers up at such high altitudes, and if he gets aware of the hectic pursuit of the flock, he only sometimes can see the small passerine evading the stoops.

In comparison to the frequency of passerines, waders are uncommon in the Aegean, and Eleonora's Falcon has no special foraging strategy for this type of low flying food class. Should a falcon encounter such a migrant above the water, the falcon closes in and stoops down from an altitude of about ten metres. The wader evades the attack by a single quick and short maneuver at the very last moment and hurries on in continuing its former straight flight direction just a metre above the water while the falcon swings up to its former altitude of ten metres and loses speed. The falcon must be careful with its stoop, it must not hit the water. It needs some time then to catch up with the speedy moving wader and gets its next chance after about a hundred metres. Usually such a pursuit continues until both birds are beyond the observation distance for binoculars.

The nocturnal foraging activity of Eleonora's Falcon is incompletely known. Single as well as groups of falcons (sometimes vocalizing with a brief call every minute) have been seen flying during moon-lit hours in the night, and a falcon has even been observed catching a bat at midnight. As bats are uncommon prey in relation to their abundance in Greece, it is from analogy assumed that falcons do not take a large proportion of migrating passerines at night. But a study by radar, transponders, or telemetry to address the question as to the extent of nocturnal activities has not been performed yet.

The Mediterranean climate with its regular clear nights in summer and early autumn guarantees a steady flow of passerine migrants so that the male falcon can acquire the daily food for its family. Passerine autumn migrants take advantage of the meltemi winds which blow quite regularly from northerly directions day and night at this time of year. They support the migrants by tail wind. If there happens to be a day without wind, the falcon family has to fast or may be fortunate to get one of the few agile day time migrants such as a swallow (*Hirundinidae*). If there are several windless days, the adult falcons must leave the colony and search for insects as they did in early summer, an insufficient and too distant food source for a raptor pair with young.

The falcon fledglings when they become independent also head for the land near-by in search of insects to develop their hunting skills.

2.4 Optimal foraging in May to October

The small breeding islands do not have enough insects (or native birds) to support a falcon colony. For feeding, the falcons must go to major islands or the main land. Here on the land, a passerine bird can evade an approaching falcon and hide, in fact it is sufficient to keep sitting on the ground and the aerial predating Eleonora's Falcon does not take it. That is why this falcon feeds on flying insects in May to July. Of course, a falcon may follow for example a roaming dog which flushes a lark (*Alaudidae*) or a pipit (*Motacillidae*), so the falcon gets a chance to stoop in. But such fortunate circumstances are exceptions. On the main land there are falcon communal roost sites. Falcons may stay there over night in May to early July and only once and a while show up at their breeding cliffs. From the falcon's point of view, it would rather regularly be at the nest and demonstrate its occupation to congeners, but the unpredictable insect behaviour is the reason why falcon numbers at the breeding cliffs fluctuate in late spring/early summer and why colony members are distributed across such a large area around their colony and may even be noted inland at this time of year. With the onset of passerine migration in mid July, the falcon's foraging behaviour gradually shifts from insect to bird hunting, and the foraging area shrinks accordingly. As Eleonora's Falcon is not a stealth hunter and approaches prey of both food classes in midair or higher, it takes advantage of thermal updrafts plus the wind updraft in front of mountain slopes and ridges, at the breeding islets if available and definitely above the main land, to reach the desired altitude with minimal effort, and then it starts its transect flight and search for food.

3. Implications for Skyros Island

Skyros and its surrounding islands have an area of about 200 km². This means that members of the local Eleonora's Falcon colonies do not only use all of this area for foraging, but also extend their searching flights beyond Skyros. The falcons know from experience how to use local wind conditions. Naturally, they head for Kochilas Mountain for starting their local transect flights or to depart for gliding towards more distant land. When they approach the slopes from the north, the ascending winds carry them up; they may seem to 'play elevator' in strong winds by spreading and closing their wings and thereby glide up and down whilst in reality they look for the flight silhouettes of distant other falcons in the sky to watch and interpret their flight behaviour. When they approach the top of a slope from the southerly lee side, they cross the ridge just 2 or 3 metres above the ground and head into the updraft to effectively use the lift of the meltemi winds blowing from the north. The Eleonora's Falcon habitually selects slopes and ridges with the strongest winds. Wind turbines are to be erected at just these sites.

4. Conclusion

Eleonora's Falcon is the largest, colonially breeding raptor. As an exclusively aerial predator this falcon feeds on flying insects and birds caught above open habitat. Optimal foraging implies for such a social bird that (a) its breeding range is confined to the Mediterranean basin with its characteristic climate, and (b) colony members take advantage of the local wind conditions near the breeding colony and frequent the locations with strong winds. Wind farms within the foraging area of a colony are bound to afflict falcon numbers. A wind farm on Kochilas Mountain of Skyros Island is no exception.

5. References

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