

Reintroduction of Raptors to Ramat HaNadiv

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Abstract

Until the 1960s, Mt. Carmel used to be a birdwatcher's paradise. Its habitats vary from Mediterranean grove to dense and open scrubland. The area enjoys a dramatic visual combination of mountain and sea and a variety of soil and rock formation. On the cliffs of Mt. Carmel many raptor species used to nest: griffon vulture - 60 pairs, Egyptian vulture - 20 pairs, lanner falcon, Bonelli's eagle and others. Most of these species have become extinct on Mt. Carmel, as in most other Mediterranean habitats of Israel (and elsewhere in the Middle East), or undergone dramatic decline and their populations are vulnerable and active action is needed to restore them. This dramatic decline of raptors on Mt. Carmel is a result of human interference in the ecosystem, mainly the use of pesticides, particularly rodenticides (this use ended only in the late 1970s). In the late 1980s the Society for the Protection of Nature in Israel (SPNI) established a project to reintroduce the populations of griffon vulture, Egyptian vulture and lanner falcon to Mt. Carmel with the cooperation of the Tel-Aviv University Research Zoo and the Israeli Nature Reserves Authority. The project goals are: to re-establish and restore breeding populations of raptors on the cliffs of Mt. Carmel; to advance knowledge and research of raptor biology, ecology, conservation and management (especially endangered species); and to use the two previous topics as an educational example of successful nature conservation and reintroduction of nearly extinct species, back into their natural habitat. Since the project started 65 griffon vultures were released on Mt. Carmel and 75 lanner falcons and in 2000 and 1999 both species bred there. This was the first breeding of these species in this range for almost 40 years. Released birds also integrated into the vulnerable wild populations of these species and are now breeding in the wild (e.g., griffon vultures in Gamla Nature Reserve since 1998). The project promotes management measures for raptors in particular and wildlife in general, in Israel and other countries in the Mediterranean.

Résumé

Jusque dans les années soixante, le Mt Carmel était un paradis pour les ornithologues. Avec des habitats variés comme le maquis méditerranéen ou la garrigue et des bosquets denses ou ouverts, cette région offre des vues magnifiques sur la mer et les montagnes ainsi qu'une variété de types de sols et de formations rocheuses. Sur les parois du Mt Carmel, il y avait beaucoup de rapaces nicheurs: 60 couples de Vautours fauves *Gyps fulvus*, le Percnoptère d'Égypte *Neophron percnopterus* (20 couples), le Faucon lanier *Falco biarmicus*, l'Aigle de Bonelli *Haliaeetus fasciatus* et d'autres encore.

La plupart de ces espèces sont maintenant disparues du Mt Carmel tout comme de la plupart des habitats méditerranéens en Israël (et ailleurs au Moyen Orient), ou alors elles ont connu un déclin tel que leurs populations sont vulnérables et des mesures actives sont nécessaires pour les rétablir. Ce sévère déclin des rapaces au Mt Carmel est la conséquence d'interférences humaines dans les écosystèmes principalement à cause des pesticides et en particulier ceux visant les rongeurs (leur emploi ayant été arrêté seulement à la fin des années soixante-dix).

À la fin des années quatre-vingt, la Société pour la Protection de la Nature en Israël a lancé un projet visant la réintroduction du Vautour fauve, du Percnoptère d'Égypte et du Faucon lanier au Mt Carmel, avec la coopération du Zoo pour la Recherche de l'Université de Tel-Aviv et des autorités israéliennes en charge des Parcs Nationaux et de la Nature. Les objectifs du projet sont de rétablir les populations nicheuses des rapaces au Mt Carmel, de promouvoir la recherche et d'améliorer les connaissances sur la biologie, l'écologie la conservation et la gestion des rapaces (surtout ceux qui sont menacés), d'utiliser ces dernières activités comme exemple éducatif d'une réussite dans la conservation et la réintroduction dans leurs habitats naturels d'espèces pratiquement disparues. Depuis le début du projet, 65 Vautours fauves et 72 faucons laniers ont été réintroduits au Mt Carmel. En 1999 et 2000, ces deux espèces ont niché au Mt Carmel. Ceci constitue le premier cas de nidification dans cette zone depuis près de 40 ans. Des oiseaux relâchés ont également réintégré des populations vulnérables de ces espèces et nichent à l'état sauvage (comme le Vautour fauve dans la Réserve Naturelle de Gamla). Ce projet encourage des mesures de gestion des rapaces et de la faune en général, en Israël et dans d'autres pays en Méditerranée.

Background

The land of Israel enjoys an abundance of raptors (more than 40 species) – nesting, wintering, and migrating (Leshem 1987). Since the beginning of the twentieth century however, nine species of raptors have become extinct as nesting species in Israel, including eight species of diurnal raptors: cinereous vulture (*Aegypius monachus*), white-tailed eagle (*Haliaeetus albicilla*), greater spotted eagle (*Aquila clanga*), the marsh harrier (*Circus aeruginosus*), peregrine falcon (*Falco peregrinus brookei*), black kite (*Milvus migrans*), bearded vulture (*Gypaetus barbatus*), and the lappet-faced vulture (*Torgos tracheliotós negevensis*), and one species of nocturnal raptor: the brown fish owl (*Ketupa zeylonensis*) Bahat and Leshem 1991). Other species in Israel have been affected and are endangered or vulnerable (Paz 1986) due to various factors or their combination:

- Uncontrolled use of poisons, pesticides and general environmental pollution
- A steep decline in the availability of food sources since the 1950s
- Habitat destruction or disturbance as a result of human activity
- Electrocution (griffon vultures, specifically)

Reintroduction to the Wild

As part of the SPNI project at Ramat HaNadiv, funded by the Yad HaNadiv Foundation,

two species of diurnal raptors have been selected for reintroduction to the wild in the Carmel, both of which nested in the Mediterranean region in the past and whose population† in Israel has greatly decreased. Criteria for reintroduction to the wild were applied according to the guidelines determined by the International Union for the Conservation of Nature (IUCN) (Petrides 1968):

- The last to become extinct is the first to be reintroduced
- The causes of extinction have been removed without radical changes having occurred to habitat
- The individuals to be reintroduced are of the same sub-species as the population that became extinct
- The origin of the individuals to be reintroduced, if they are not of the same sub-species as the extinct population, must be from an area with ecological characteristics similar to the area of the proposed reintroduction to the wild

Reintroduction to the wild and restocking through release of individuals to the wild are a means of rehabilitation of populations of wild animals, when “conventional” means of nature conservation through protection and enforcement are insufficient (Temple 1978).

For the reintroduction at Ramat HaNadiv, located at the southern end of Mount Carmel, the griffon vulture and the lanner falcon (*Falco biarmicus tanypterus*) were selected. The griffon vulture population in Israel has plummeted from hundreds (and perhaps thousands) of pairs at the beginning of the twentieth century, to about 100 pairs at the end of the 1980s and about 70 pairs at the end of the 1990s. On the Carmel, over 60 pairs nested in the 1940s but in 1952 the last griffon vulture egg was laid there (Bahat 1997). Lanner falcons disappeared completely from the Mediterranean region, where they nested in all the riverbed canyons in the Carmel and Galilee; only about 30 pairs now remain, and in the arid area only (Hatzofe 1990).

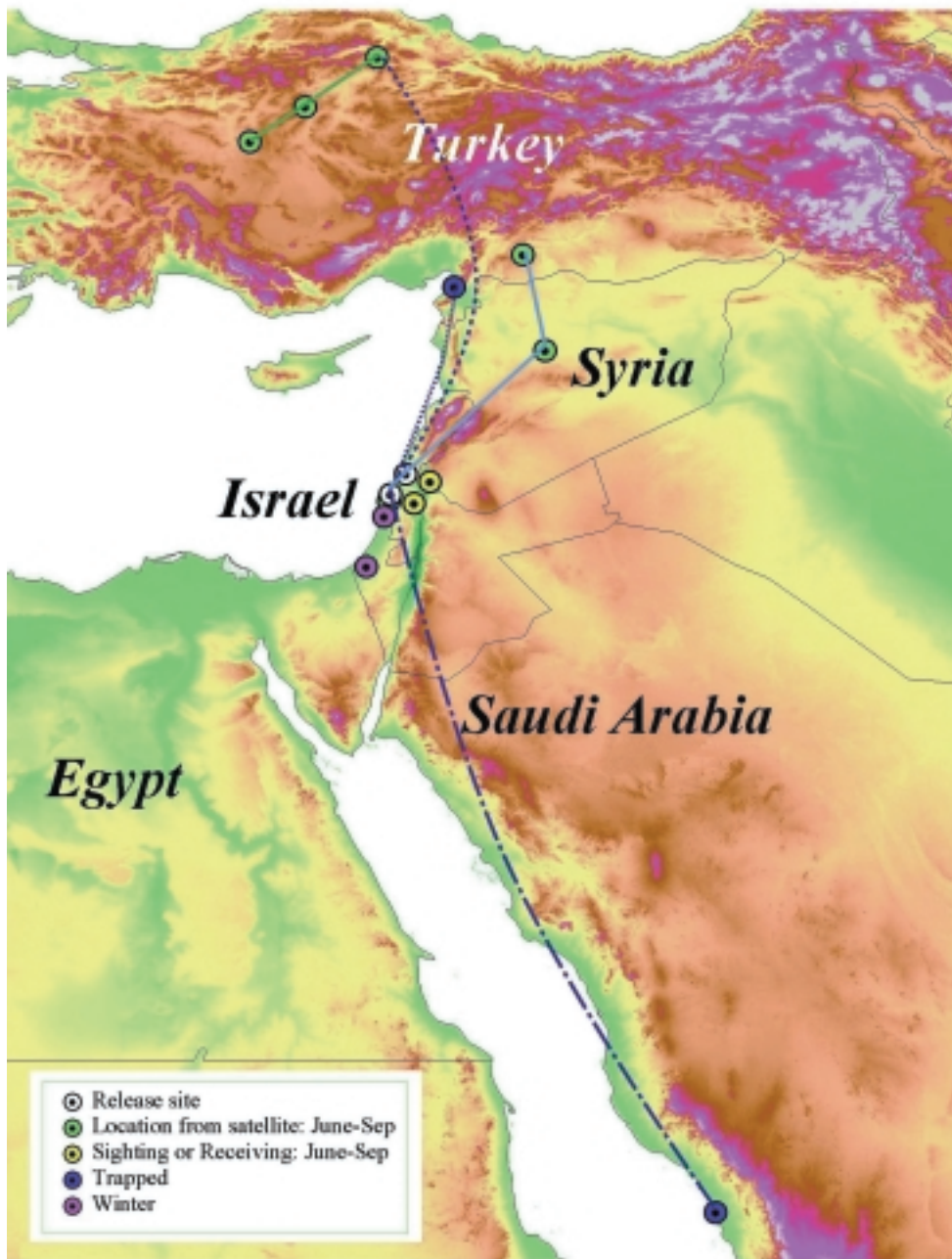
Methods

Reintroduction and restocking are based on acclimatizing and releasing to the wild of suitable individuals. These individuals are obtained through two means:

- Translocation from another wild population (reintroduction of the White-tailed Eagle to the wild in Scotland (Love 1988))
- Breeding in captivity (the Peregrine Falcon in North America (Weaver and Cade 1985))

Breeding in Captivity

Because the two species selected for reintroduction to the wild at Ramat HaNadiv are endangered in Israel and there is no possibility of translocation from another population, their reintroduction was based on breeding in captivity as a source for individuals that would be acclimatized and reintroduced. For purposes of breeding in captivity the following steps were taken:



Released lanner falcons' dispersal in the Middle East (1990-2001)



May 8, 2001 The seminar participants learning about the activity of the author Ohad Hatzofe (Photo: Albert Froneman).

- A breeding nucleus of lanner falcons was established at the Tel Aviv University Research Zoo and in the Nature Gardens of the SPNI in Abu Kabir. The source of these falcons were individuals held in captivity at the zoological garden that had originated in the Judean Desert and eastern Samaria, as well as one-time egg collection from a nest in the wild. (After collection, a replacement clutch was laid in the same nest and five lanner falcons hatched and fledged successfully from this nest.)
- A program was prepared for the breeding of griffon vultures in captivity based on cooperation of zoos maintaining the vultures as part of the reintroduction program: The Zoological Garden at Tel Aviv University research zoo, the Tel Aviv-Ramat Gan Zoological Center (Safari), the nature gardens at Abu Kabir, the Hai Bar Reserve on Mt. Carmel, the Biblical Zoo (Tisch's family zoo) in Jerusalem, and the Biological Center in Haifa. The griffon vultures in the program were all in captivity in Israel when the program started.
- Infrastructure for the incubation and raising of nestlings was established.

Principles of the griffon vulture breeding program (Hatzofe 1989)

- Identification of griffon vultures held in captivity in Israel (in 1989), banding them with standard metal rings and a colored identification band. A DNA fingerprinting test was conducted in order to determine relationships between individuals and avoid mating of related individuals (inbreeding) (Hanuki and Plotzky 1994).
- Sexing - griffon vultures lack sexual dimorphism, and their sex can only be determined by genetic testing or by invasive methods of gonad identification (endoscopy). From 1989-1993 sex identification was carried out by the Karyotype analysis method (Hatzofe and Getreide 1990). In 1994 sexing was carried out by endoscopy at the Tel Aviv-Ramat Gan Zoological Center (Safari). However this is an invasive procedure and problematic because of technical limitations. Since 1995 sexing was carried out in the genetic laboratory of Heidelberg University (Wink et al. 1998) and in a commercial genetic laboratory in England, using advanced methods.
- Conditions were examined for incubation of griffon vultures in order to ensure the success of artificial incubation (Hatzofe 1996). All griffon vulture eggs laid in captivity are incubated artificially for the following reasons:
 - i. Incubation of eggs under controlled conditions can prevent failure due to parental behavior or conditions of captivity.
 - ii. In nature, griffon vultures lay a single egg per nesting season. By removing the egg from the nest after it is laid (and transferring it to an incubator) the griffon vultures can be "encouraged" to lay a replacement egg and thus double their reproductive capacity.
- Methods of raising nestlings in order to avoid imprinting have been developed, even if eggs were hatched in incubators, as well as methods for transferring nestlings hatched in incubators for adoption by adult griffon vultures.

Acclimatization and Reintroduction to the Wild

Methods of reintroduction to the wild and acclimatization for each species are based on the specific biology and the ecological needs of each species. Their goal is to acclimatize a captive-born individual, or an individual born in a different area, to survive in natural conditions and at the same time to create a philopatry with the release site – the place to which the individual is reintroduced – with the goal of remaining there or returning there in the future to reproduce.

Griffon Vultures

Griffon vultures hatched in captivity are transferred at fledging age (about 140 days after hatching), or when they first leave the nest in which they were grown, to an acclimatization aviary at Ramat HaNadiv. The period of acclimatization is about two years. Before their release, they are banded with an identification bands metal and colored on the legs and with a small backpack radio transmitter (weighing about 70 grams and transmitting for two to three years). After release the birds are tracked daily for two to three weeks in order to confirm their successful acclimatization.

Acclimatization of griffon vultures began at Ramat HaNadiv in an enclosure built on a ridge above the Kabara Cave in January 1991 and release began in late 1993. The method was suited to conditions in Israel based on the model of the reintroduction to the wild project that took place in France, where Spanish birds were translocated, acclimatized and then released (Terrasse et al. 1994). The reintroduction program (Hatzofe 1989) was prepared according to the evaluation that about 50 Griffon Vultures would have to be released before natural breeding in the Carmel could commence.

Lanner Falcons

Lanner falcon nestlings, born from the breeding nucleus, are transferred at the age of 28-30 days to an artificial nest located on the cliff, which resembles a natural nest. The nestlings remain in the nest for about two weeks, until they reach natural fledging age - 44 days after hatching. At that point the protective door of the artificial nest is opened. The entire time they are in the nest and immediately after their release, food is supplied to the nestlings without any direct human contact to avoid imprinting and the formation of a connection between humans and the attainment of food. Before release the nestlings are banded with identification bands (metal and colored) and with small leg mounted or backpack radio transmitters (weighing 15-20 grams and transmitting for up to one year). The first release of lanner falcons was in May 1990. The method was to adapt the system successfully applied in reintroducing peregrine falcons in North America to the wild (Sherrod et al. 1987). In that program (Hatzofe 1990) based on an ecological model, and including survival for the initial period after release and for the entire year following (which was developed for Peregrine Falcons in North America (United States

Fish & Wildlife Service 1979) it was estimated that at least 50 individuals would have to be released in order to achieve a first nesting of lanner falcons in the Carmel.

Results

Griffon Vultures: From the outset of the project, 1989-2000, 70 nestlings were raised successfully in Israel. Fifty-six were released in the Carmel together with nine griffon vultures from the wild: in Ramat HaNadiv (38) and at the Hai-Bar (27) where a similar release system is in operation. Five more griffon vultures were also released after they had spent a short time in rehabilitation, or had been trapped in the area (these do not appear in Table 1). Fourteen individuals from the breeding nucleus are being held in the acclimatization enclosures and will be released in the future. Four additional individuals from the breeding nucleus, two males and two females, were left to reproduce in captivity as part of the breeding nucleus.

	Born in Nature	Born in Captivity	Total
Released	9	56	65
Dead specimens	4	9	13
Specimens trapped and returned to captivity	2	3	5
Immature (age 1-4 years)	0	55	55
Adults (6 th calendar year and above)	9	1	10
Expected to survive in nature*	3	43	46

Table 1: Release of Griffon Vultures on Mount Carmel

*This number is probably lower; some Griffon Vultures may have died under various circumstances, but have not been located.

Return to captivity: Five individuals that had been released were trapped and returned to the breeding nucleus four (two from the wild and two from captivity) of which were returned after being found unable to adapt to life in the wild. A single individual was returned to captivity as a result of injury (after over three years in the wild).

Mortality: Thirteen individuals released to the wild died in various locations in Israel under the following circumstances:

- Electrocution or collision with high tension wires in the Carmel mountains, the Carmel coast, Ramot Menashe and the lower Galilee: 5
- Collisions with vehicles (cars or train) on the Carmel coast: 3
- Shot in the Sodom region: 1
- Secondary poisoning in the Golan Heights and the Judean Desert: 3
- Unknown circumstances: 1

Observation, receiving, and tracking of released individuals: These activities take place randomly in all the griffon vulture concentrations in the country. The movements of these birds are frequent, particularly among juveniles and immatures; with birds from the wild moving to the Carmel, especially in the autumn. The greatest number of griffon vultures observed in the Carmel at any one time - 36 individuals - was in November 2000. In the year 2000, 28 young birds (hatched during 1999-2000) from the wild were trapped, identified, and released in the Carmel. Two of these were individuals banded in thier nests in Gamla in the summer of 2000. One banded in the Carmel on 9 November 2000 was trapped on 8 December 2000 in the Ramon Crater (250 km south of the Carmel). One release on 26 November 2000 in the Carmel was observed on 4-6 September 2001 in northeastern Greece!

Nesting: The first nesting of griffon vultures released from Ramat HaNadiv was at Gamla Nature Reserve in the Golan Heights in 1997, in two adjacent nests 20 meters apart on the eastern cliff of Nahal Gamla: female hatched in 1990 and released in 1994 mated with a male from the wild, and a male hatched in 1992 and released in 1995 mated with a female from the wild.

In the year 2000 a young pair (a male and female hatched in 1994 and released in 1998) made a first nesting attempt (building the nest; mating) in the Carmel in the Hai Bar Reserve.

Lanner Falcons: Since May 1990 61 lanner falcons have been released on the Carmel. Fourteen more were released in Nahal Kziv in the Galilee. All were from the breeding nucleus.

Year	1990	1991	1992	1993	1994	1995	
Number of Released birds	9	0	5	5	10	9	
Losses (mortality, trapping)	1				3	1	
Year	1996	1997	1998	1999	2000	2001	Total
Number of Released birds	9	0	5	5	10	9	75
Losses (mortality, trapping)	1				3	1	6

Table 2 : Release of Lanner Falcons in Israel

Mortality or Failure Factors:

- Trapping of an individual in Saudi Arabia, about five months from release in Ramat HaNadiv: 1

- Predation by a pair of owls nesting close to Nahal Hame'arot shortly after release: 3
- Found injured (a broken wing) in Nahal Kziv about a month after release: 1
- Trapping of an individual in Turkey, about two months after its release: 1

Observation, receiving, and tracking of released individuals: Northern Turkey: Recording of satellite transmission from Ramat HaNadiv in the year 2000 and another individual in 2001.

Southeast Turkey: return of identification band. Ring/Band recovery

The Golan Heights: telemetry receiving by rangers at the Gamla Nature Reserve

Western Galilee: direct observation

Gilboa: telemetry receiving

Sharon: individual identification

Western Negev: color band identification (Forsman 1999)

Southwestern Saudi Arabia: return of identification band (Hazofe 1993)

Nesting: The first nesting of reintroduced lanner falcons was in 1999 at the Hadera power station by a pair released from Ramat HaNadiv (a male in 1995 and a female in 1997). The pair's apparently single nestling fell out of the nest at the age of 38 days. It was picked up and released together with three nestlings, from the breeding nucleus, in Ramat HaNadiv. The parents "discovered" the nestling and re-adopted it, eight kilometers from the original nest!

Discussion and Conclusions

Griffon Vultures

Griffon vultures released on the Carmel have assimilated into the wild population in Israel, which is estimated at about 350 individuals (Sherrod et al. 1987). They and their offspring comprise about 10-15% of all the griffon vultures in Israel. This survival success of about 80% of all griffon vultures or birds hatched in captivity and released proves the suitability of a long acclimatization period at the reintroduction site for birds born in captivity, the majority of which (85%) were hatched in an incubator and raised in captivity.

On the other hand, the likelihood of reintroducing adult griffon vultures after they have been picked up injured in the wild and rehabilitated is very small (less than 33%). It may be that certain characteristics and/or low fitness of some of these individuals led to their injury. It is important to note that the release began with the reintroduction of adults so that they would be mentors to young birds without any life experience in the wild. This has proven itself as efficient in building up a group of griffon vultures in the Carmel after an absence of about 50 years.

At present the trend in rehabilitation of griffon vultures specifically and injured animals in general is to release the rehabilitated individual as soon as possible and in close proximity to the place where it was found.

There are currently about 20 released individuals on the Carmel at any one time. Individuals originating in the wild join them. The rest of the released individuals are in the Golan Heights and the eastern Galilee, the Negev and the Judean Desert, and (according to data recorded by satellite transmitters attached to two Griffon Vultures in the Carmel) possibly also beyond the borders of Israel.

It is clear to us today that as a result of rapid development and human population growth that began in the 1990s, and a concomitant increase in the utilization of open landscapes and increased numbers of visitors to Ramat HaNadiv, the likelihood successfully reintroducing griffon vultures to nest in the cliffs of the southern Carmel is not great. However, knowledge of their flight range and use of the habitat for foraging indicates that nesting within a range of 22 kilometers “as the crow flies” from Ramat HaNadiv is considered a success. The fact is that these birds, as well as reintroduced griffon vultures nesting in the Golan, return to feed and stay at the release site in Ramat HaNadiv.

Reintroduction in the Carmel, beyond its original goal, is important to strengthen the wild population of these birds in Israel, which is endangered. Perhaps this reintroduction, together with a variety of conservation and management measures, and educational activities, has a large part to play in the fact that in the year 2000, for the first time in very many years, an upward trend in the griffon vulture population has been noted: 101 nesting pairs as opposed to 75 in 1999.

Lanner Falcons

As with griffon vultures, the success of the reintroduction method and program may be measured by the fact that individuals born in captivity have been acclimatized to the wild; they accomplish their migration as expected, return to the release site, and lay claim to territory. However, also as with Griffon Vultures, the project is only in its first stages, because a large enough population to be self-sustaining has not yet been established. It is abundantly clear that the release of additional individuals to the wild in Ramat HaNadiv and in other places in the Carmel and in the western Galilee must continue in order to reestablish a sustainable population. It is difficult to estimate numerically the optimal size for such a population, because we do not have data enabling us to estimate losses in the wild, natural and anthropogenic, of individuals of this species and of the released birds.

The high survival rate of released individuals in the critical period after their release (up to three weeks after release) as opposed to the reintroduction project of the Peregrine Falcons in North America, suggests that it is possible to re-establish a stable population in the Mediterranean region with the release of only another 100 individuals over five to seven years.

The release of raptors of both species meets the expectations of the reintroduction program from the point of view of the projected numbers of reintroduced individuals needed

for the purpose of achieving a first nesting after years of absence from the Carmel area. However, the time needed to attain this stage continues to be longer than expected because of breeding difficulties (mainly health problems such as bacterial contamination of the eggs) among lanner falcons, and mortality among released griffon vultures (as a result of anthropogenic factors, not necessarily at the release site).

It appears that the day is not far off when these raptors and others, among them Bonelli's eagles (*Haliaeetus fasciatus*), Egyptian vultures, (*Neophron percnopterus*), and lesser kestrels, (*Falco naumanni*), will once again nest in the cliffs of the Carmel. Hikers and residents of the area will once again be able to enjoy the landscape as well as the world of fauna that existed here in the past.

The knowledge gained, the success achieved, and the methods developed for reintroducing raptors in Ramat HaNadiv have contributed to practical research and advance in the extensive conservation work with raptors in general and griffon vultures in Israel specifically. The knowledge and the methods are being used at present as a model for conservation and reintroduction programs of these and other species in various places in the world, such as Cyprus and Bulgaria (griffon vultures) and the European Union (lanner falcons). The raptor reintroduction project in Ramat HaNadiv is the first project of its kind in Israel: reintroduction of a number of raptor species that had become extinct in the Carmel and are endangered in Israel. A unique aspect of the project is the fact that it is the rehabilitation of a habitat – the reintroduction of a number of species and not just one single species.

Acknowledgments

This project could only be materialised with the financial support of the Yad HaNadiv, the assistance of many people, volunteers and conservationists.

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