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Bird Strike Risk Analysis on Aktion Airfield (Greece) and Recommendations for Improvements in Bird Strike Prevention

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Summary

A survey of Aktion airfield in Greece was carried out from 14 to 18 October 1996 initiated by the Flight Safety Division of the NATO E-3A Component Geilenkirchen (Germany) as an reaction to the accident of an AWACS-aircraft on 14. July 1996, initially caused by a bird strike event.

The survey of Aktion airfield led to the conclusion that the bird strike risk is extremely high at this airfield. Reasons are:

- The geographical location of the airfield at the Adriatic coast which is a migratory pathway for many birds.
- The location of the airfield on a narrow peninsula surrounded by water on almost three sides.
- The natural biological richness of the region with a big number of aquatic habitats and agricultural land use etc.
- The natural richness of the airfield itself, being very attractive for many bird species, as there are good resting and feeding conditions.

These facts result in the presence of single birds and flocks of birds throughout the year. During spring and autumn migration the bird strike risk even increases. Against the passage of seasonal migrating birds no actions for altering the pathways are applicable. However, a consequent habitat management will prevent birds resting and/or feeding on the airfield. As a result of the survey of Aktion airfield recommendations were made with the intention changing the bird species composition to smaller, less heavy species, and thus decreasing the risk of bird strikes causing damages.

INTRODUCTION

On September 22, 1995, a bird strike downed an E-3B AWACS aircraft of the US Air Force at Elmendorf Air Force Base in Alaska, killing all of its 24 crew members.

Not just one year later an E-3A aircraft of the NATO Airborne Early Warning Force suffered a bird strike at the Forward Operating Base (FOB) Aktion in Greece.[1] The following short description of this aircraft accident was taken from the HQ NAEW Force investigation report:

1. The planned take-off time was 1515_z (1815_{local}) 14 July 1996.

2. The normal crew of 17 had been reduced to 14 for the mission due to an expected low level of air activity.

3. The take-off brief called for a rolling right seat take-off. At approximately 120 kts a flock of birds was seen rising towards the left side of the aircraft and sounds of impact along the left side of the fuselage were heard. The Aircraft Commander (AC) contemplated aborting the take-off at that moment, but elected to continue. The aircraft continued to accelerate with all engine indications normal. As the aircraft nose started to rise the crew saw a large black bird moving from left to right in close proximity to the aircraft. A noise, interpreted as the bird impact, was then heard on the right-hand side of the aircraft. The AC elected to abort the take-off and initiated the procedure. The remainder of the flight deck crew responded accordingly. However, as the abort procedure was carried out, it became rapidly apparent that the aircraft would not be stopped on the remaining runway. The aircraft departed the runway at approximately 60 kts down a sandy incline onto the landing lights support structure and into the sea. The main landing gear separated from the aircraft after contacting the rocks, while the aircraft continued forward, eventually coming to rest some 500 ft from the end of the runway, rotated approximately 60 degrees to the right, with the aft section on the support structure and the partly separated nose section resting in the metre deep sea.

4. All crew members egressed successfully.

The Board determined that the accident was a direct result of the following cause factors:

a. Environment - Bird strike. Despite the existence of a Bird Control programme at FOB Aktion, the presence of birds and a confirmed bird strike during take-off roll influenced the pilot's decision to discontinue the take-off.

[1] The home base of the NATO E-3A Component is Geilenkirchen in the western parts of Germany. The four FOB´s of this component are in Greece, Italy, Turkey and Norway.

b. Personnel - Pilot - Judgement. The pilot elected to discontinue the take-off at a speed beyond the correctly calculated and briefed Decision Speed and Refusal Speed in the absence of a confirmed serious malfunction.

As an reaction to this accident a bird strike risk analysis on Aktion airfield was initiated by the Flight Safety Division of the NATO E-3A Component Geilenkirchen (Germany). This risk analysis was given by Dr. H. Weitz and W. Ruhe (German Military Geophysical Office, Science Division - Biology Section) following a biological/ecological survey of Aktion airfield and its surrounding from 14 to 18 October 1996.

LOCALISATION OF AKTION AIRFIELD

Greece is a large (c. 132.000 sq. km) maritime state composed of part of south-eastern continental Europe. The continental mainland is bordered to the north by Albania, Yugoslavia and Bulgaria, to the east by Turkey. The southern and western margins are coastal. Aktion airfield is located on the western coast of Greece adjoining to the Ionian Sea, the island of Lefkas is nearby (Fig. 1).
Topographically Greece is characterised by a mountainous interior, in the west the mountains are close to the sea so that any lowland fringe is extremely narrow. Migrating birds avoiding to fly over sea or mountains are forced to use this small lowland fringe.
Greece has some of the largest and most important wetlands in the Mediterranean area. One of them, the Gulf of Amvrakia (c. 52.000 ha), is located in the north and east of Aktion airfield.

BIRD STRIKES, AVIFAUNA AND BIRD STRIKE RISK

On Aktion airfield there were no records on bird strike events available. For this reason a comparison with the bird strike rate of other airports of the region is not possible. However, VASSILAKIS (1996) analysed 420 incidents from all airlines between 1980 and 1992 in Greece, reported to the Civil Aviation Authority. This analysis revealed that Aktion has the second highest probability for bird strikes from all airports in Greece.

During the survey between 14 and 18 October 1996, 31 different bird species could be observed on/or over Aktion airfield (Table 1). Due to the short observation period and the time of the year - most of the migrating birds had already left the region - the species list in Tab. 1 does not absolutely represent the avifauna of Aktion airfield throughout the year. In Tab. 1 "+, (+) or - " indicates, which bird species are especially hazardous to aircraft, which are less hazardous and which are not, depending on the flocking behaviour and the body mass of the birds.
Despite the limitations mentioned above pelicans, herons, birds of prey, gulls and starlings are the most dangerous birds to aircraft on Aktion airfield[2].

[2] Unfortunately the feather remains of the bird/birds involved in the accident on 14 July 1996 were not collected, therefore a determination of the bird species was not possible.
Another bird strike in autumn 1996 was caused by a two years old male Peregrine falcon (*Falco peregrinus).*

In the course of the year the bird strike risk increases especially in spring and fall. It is well known that many migratory birds cross Greece. The position of Greece favours the concentration of many migratory birds when travelling over eastern Mediterranean to and from Africa. Ornithologists discovered three main migratory flyways, the western, central and eastern one. As mentioned above on the western flyway there is a concentration of those bird species which avoid to cross water or mountains because the lowland fringe (were Aktion airfield is located) is only very small (Fig. 2). Main migration periods are from February to mid of April and from mid of August to November.

A very critical area for flight safety on Aktion airfield is the Gulf of Amvrakia. This gulf is an extensive complex of brackish lagoons, sandy coastal strips, saltmarsh, reedbeds and mudflats. It is one of the most intact European wetlands.
The site holds the largest concentration of waterfowl in Greece with an average Januar maximum of 145.000 Anatidae and *Fulica atra*. (GRIMMET, R.F.A. & T.A. JONES, 1989).

As a conclusion one can summarise that the bird strike risk is high to extremely high in the area where Aktion airfield is located. Reasons are:

- The geographical location of the airfield at the adriatic coast which is a migratory pathway for many birds. The bird strike risk increases drastically during spring and autumn migration.

- The location of the airfield on a narrow peninsula surrounded by water on almost three sides, the Mediteranean Sea in the west and the Gulf of Amvraki in the north and east with their seabird and waterfowl populations.

- The natural biological richness of the region with a big number of aquatic habitats and agricultural land use etc.

Because of this enormous danger for flight safety all efforts should be done to reduce the risk of bird strikes at Aktion airfield. But the methods of bird strike prevention are only applicable on the airfield itself and possibly in the very close vicinity. Against the passage of seasonal migrating birds no actions for altering the pathways are applicable. However, a consequent habitat management will prevent these birds from resting on the airfield.

Airfields cannot be kept free of birds. Every airfield has a special avifauna with different numbers of bird species and individuals. The range of species and their numbers that occur on airfields is determined, at least partly by the habitat types that are available on the airfield. Waterfowl for example are hardly to be found on airfields when ponds and lakes are missing.
This is the basis for all habitat management techniques. Habitat management means, changing an airfield in such a way that it is less attractive for a category of birds which are a potential risk for flight safety. Birds belonging to this category have a big body mass and/or are highly gregarious, often forming huge flocks. The destiny of habitat management on airfields is to change the species composition to smaller, less heavy species, and thus decreasing the risk of bird strikes causing damages.

SURVEY OF AKTION AIRFIELD

On Aktion airfield there is a broad spectrum of habitat types which in a consequence are attractive for diverse bird species with different ecological demands, clearly indicated by the bird species composition that could be observed on and over Aktion airfield (Tab 1).

- A great part of the area is covered with grass of different density and height. In the shelter area in the south-east corner of the airfield shrubs and bushes dominate.

- Parts of the north-western airfield areas are used by local farmers for hay production. Because farmers are interested to harvest as much biomass as possible, they use to cut the grass very short, right above the soil.

- In the south-west some areas of the airfield are used for agriculture (potatoes, vegetables). Agricultural exploitation generally means an increase in the overall available biomass. But birds will not only be attracted by the farming products but also by the organisms living in the soil, that are easily available during and after agriculture works.

- Many parts of the airfield are under poor drainage conditions. Ponds and shallow lakes are formed after intensive rainfall. Even temporal ponds and shallow lakes attract waterbirds like herons, ducks, lapwings, other waders and gulls. All these bird species are very dangerous to aircraft. If such ponds exist for a longer period, they are also optimal breeding places for insects like mosquitoes. Mosquitoes are a favoured prey of swifts and swallows. Therefore these bird species often gather in big flocks in the air above those ponds and lakes.

- On Aktion airfield there are 3 main ditches for the drainage of the airfield, running mainly parallel to the runway. Along these ditches there are bushes, mainly bramble, which are inhabited only by smaller birds like warblers. These lines of bramble reduce the open space of the airfield preferred by bird species dangerous to aircraft.

- In and around the shelter area parts of the bushes and shrubs had been removed by burning and soil works, leaving places with sparse vegetation and even bare soil. After an intense rainfall on 17 October 1996 a great number of earthworms could be found which were easily to detect and caught by birds.

In the vicinity of Aktion airfield there are bigger areas in agricultural use, especially in the north and south. They are mainly cultivated with vegetable, crop, corn and olive plantations as well as pasture. Because of the available food, these agriculturally used areas are very attractive for birds.
On a harvested field of corn north of the airfield there were lots of starlings, hooded crows and sparrows. Swallows could be observed in great numbers above the lakes close to the northern fence. Additionally there were great numbers of starlings and swallows around the area of cattle breeding south of the airfield. These were attracted by insects, which breed favourably in excrements from cattle.

According to the principles of bird strike prevention it would be big advantage to manage the habitats in the vicinity of the airfield under the same criteria as it has to be done on the airfield itself. The realisation, however, is hardly possible if land is private property.
Scaring of birds in the vicinity of the airfield is not recommended. It would be an additional danger, as it is very probable that birds cross or rest on the airfield, like it happens when there is hunting in the vicinity of the airfield. Therefore all scaring has to be concentrated on the airfield itself to make the habitat unattractive.

RECOMMENDATIONS

Depending on the results of the survey of Aktion airfield the following recommendations were given:

- Application of the so called long grass method on Aktion airfield. This means, that the grass cover will be kept at minimum heights of at least 15-20 cm. The number of cuts should be reduced to a maximum of two cuts a year. In the course of the year, the first mowing should not begin before the end of march. Beginning earlier in the year, the still migrating birds passing over the area could be attracted by the fresh cut areas. For the same reason, if a second mowing should be necessary, it should be done after the beginning of rainfall in autumn/winter. After that date still some regrowth of the grass is possible preventing wintering birds using the airfield. A removal of cuttings is not necessary. The dead organic material accumulates on the ground and mineralisation of it means that the fertility of the soil will improve. This is important to maintain a relatively dense and close vegetation cover, because the soil in most areas of the airfield is less fertile as could be proved by the examination of soil samples of Aktion airfield.

- Agricultural exploitation on any part of the airfield should be forbidden. The agricultural use of the parts in the south-west of the airfield should be shifted to a long grass regime.

- Improvement of the drainage conditions on the airfield. That could be done by cleaning the 3 main ditches for a better and faster water runoff. Besides the already existing ditches some additional ditches of smaller dimensions should be constructed and connected with the three main ditches. They are especially necessary between the taxiway and the shelter area. If it is not possible or too expensive, the digging of holes and refilling with gravel would slightly improve the drainage.

- Earthworms can easily reach the runway and taxiway, because on Aktion Airfield there are no drainage channels besides the runway. Reducing earthworm populations using chemical treatment is one approach for suppressing worm populations. We do not recommend such chemical treatments because the result is not sustained and due to the impact to the environment. With the improvement of the drainage conditions (see above) we expect a reduction of earthworm numbers appearing on the soil surface after intense rain.

- If foxes, martens and weasels appear on the airfield, they should not be hunted. These mammals are the natural enemies of mice, moles and ground nesting birds. They will therefore not only reduce the food for birds of prey and owls but also reduce the bird populations directly.

- Enforcement of regular bird counts to get a better knowledge about the avifauna of Aktion Airfield. The primary objective of bird monitoring on airfields is to get information of the presence, number and activity of birds. Data on bird distribution will reveal those parts of an airfield which are attractive for birds and where either scaring should be concentrated or where the habitat management should be improved. Data collected for a longer time will also identify those periods of the day or year which are particularly critical for flight safety and when scaring should be intensified.

- Establishment of a Bird Control Unit responsible for bird scaring, control of habitat management, registration of all bird strikes, collection of feather remains after bird strikes, documentation and removal of carcasses of birds and other dead animals, regular education, information and training of all people concerned with the bird strike prevention.

- As mentioned above an effective habitat management is the most successful long-term technique for bird control on airfields. However, one has to be aware, that the methods of habitat management do not affect all bird species in the same way as desired. Those birds are less affected which have a broad habitat adaptability and can therefore exist under different environmental conditions. An additional scaring technique is necessary to control these birds especially at times when habitat management works are done, when there are temporarily attractive areas (e.g. wet spots after heavy rainfall) or when there are significant increases of bird numbers on the airfield due to other impacts (e.g. hunting pressure in the vicinity of the airfield).

- The already existing three gas cannons on the airfield (Manufacturer: Purivox) should be used furtheron for scaring of birds but a modified strategy should be used: Up to now the cannons are prepared for using by the fire brigade on their way to their operating bases. It would be more efficient when they could be triggered selectively from a central point like the tower. The technical feasibility has to be checked with the manufacturer. The operation of the gas cannons (not the operation of shall crackers) should be restricted to main migration periods, times of agricultural activity in the vicinity of the airfield, during winter months when there are wintering birds, and during times of intense hunting pressure. Operating times have to be changed regularly and also the frequency of firing. During an interval of 10 minutes before take off and landing of aircraft the gas cannons must not be operated, otherwise it cannot be excluded, that startled birds cause an additional danger.

- The area of Aktion is crossed by many bird species partly in very high numbers during spring and autumn migration from which some rest in the wetlands declared as nature reserves in the further surroundings of the airfield. Local flights during their resting period cause an additional danger to air traffic besides the birds crossing the area during large scale migration. As there is no continuous and country-wide bird migration observation system in Greece, neither visual nor by radar, we recommend the monitoring of bird flights by radar. This would help to put down the precise routes followed by birds

when flying over the greater Aktion area as well as the range and the frequency of migration in specific time periods. The optimal alternative in the longer run would be to install an Airport Surveillance Radar (ASR) in Aktion. The Radar has to be a new generation radar which will have the option to display also severe weather pattern and bird echoes. The minimum requirement should be the option to provide an interface for extracting data from the primary radar for further analysis of bird echoes as well as for local bird strike warnings.

REFERENCES

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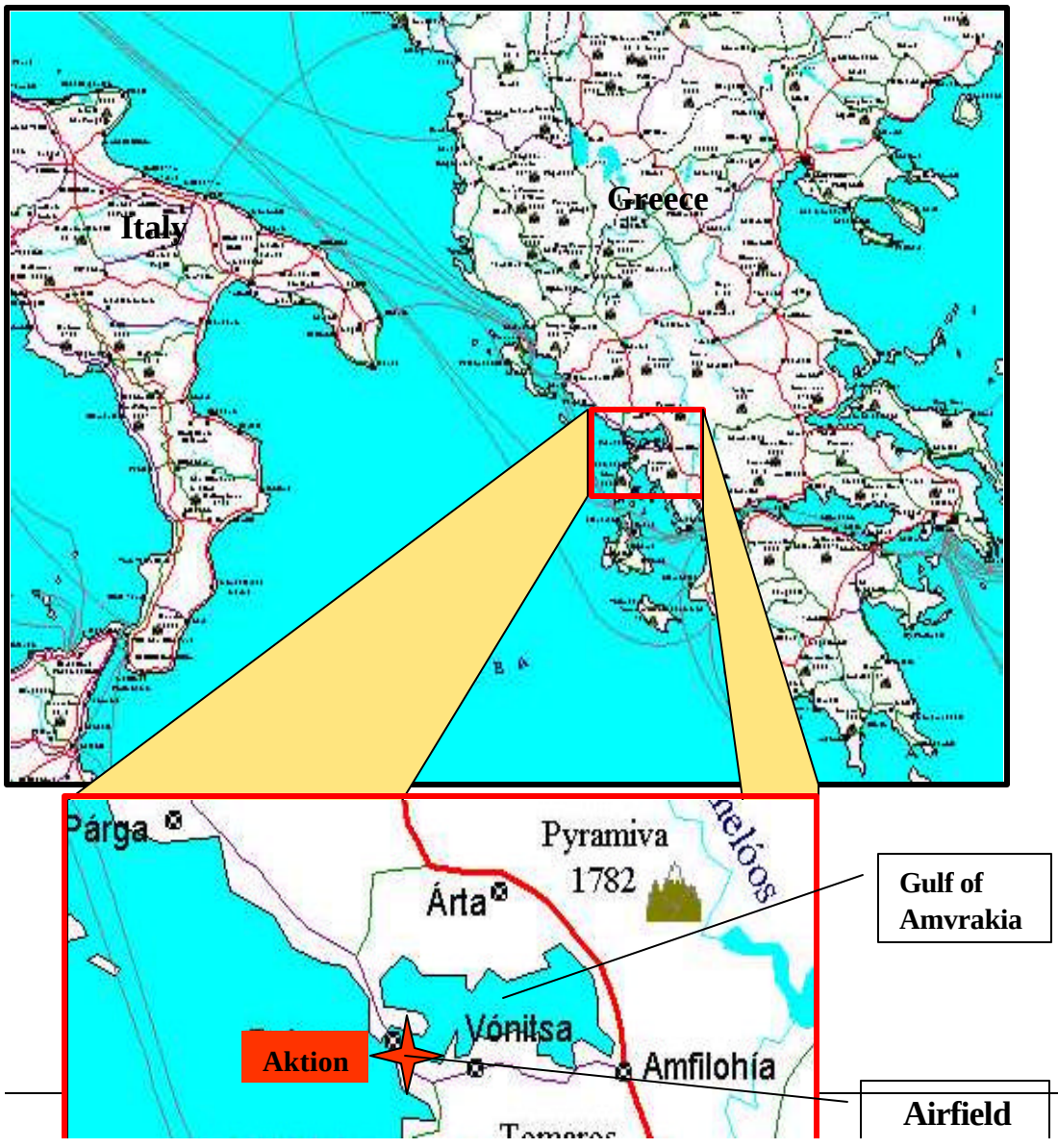
VASSILAKIS, K. (1996): Bird Strikes in Greece. BSCE Meeting 1996, WP 12.



Bird species		Bird strike relevant species	Frequency of observation		Numbers observed		
Latin name	**English name**		**frequently observed**	**less frequently observed**	**single birds**	**small numbers**	**big numbers**
Pelecanus crispus	Dalmatian Pelican	+		+		+	
Ardea cinerea	Grey Heron	+	+			+	
Egretta garzetta	Little Egret	+		+	+		
Hieraaetus fasciatus	Bonelli's Eagle	+		+	+		
Accipiter nisus	Sparrowhawk	(+)		+	+		
Buteo buteo	Buzzard	+	+			+	
Circus aeruginosus	Marsh Harrier	+		+	+		
Falco tinnunculus	Kestrel	+	+			+	
Larus ridibundus	Black-headed Gull	+	+			+	
Larus argentatus	Herring Gull	+		+	+		
Alcedo atthis	Kingfisher	-		+	+		
Galerida cristata	Crested Lark	(+)	+			+	
Hirundo rustica	Swallow	(+)	+				+
Anthus pratensis	Meadow Pipit	-	+			+	
Motacilla alba	White Wagtail	-		+	+		
Motacilla flava	Yellow Wagtail	-		+	+		
Lanius collurio	Red-backed Shrike	-		+	+		
Cisticola juncidis	Fan-tailed Warbler	-		+		+	
Sylvia atricapilla	Blackcap	-		+	+		
Sylvia melanocephala	Sardinian Warbler	-		+	+		
Phylloscopus trochilus	Willow Warbler	-		+	+		

Bird species		Bird strike relevant species	Frequency of observation		Numbers observed		
Latin name	**English name**		**frequently observed**	**less frequently observed**	**single birds**	**small numbers**	**big numbers**
Muscicapa striata	Spotted Flycatcher	-		+	+		
Saxicola torquata	Stonechat	-	+			+	
Phoenicurus ochruros	Black Redstart	-		+	+		
Erithacus rubecula	Robin	-	+			+	
Fringilla coelebs	Chaffinch	-		+		+	
Carduelis carduelis	Goldfinch	-		+		+	
Passer domesticus	House Sparrow	(+)	+				+
Sturnus vugaris	Starling	+	+				+
Pica pica	Magpie	(+)	+			+	
Corvus corone cornix	Hooded Crow	(+)	+			+	

Table 1:
Bird species observed on Aktion airfield between 14. to 18. october 1996.

A “+“ in the column “Bird strike relevant species“ indicates bird species that are hazardous to aircraft, a “(+)“ which are less hazardous and a “-“ which are not.

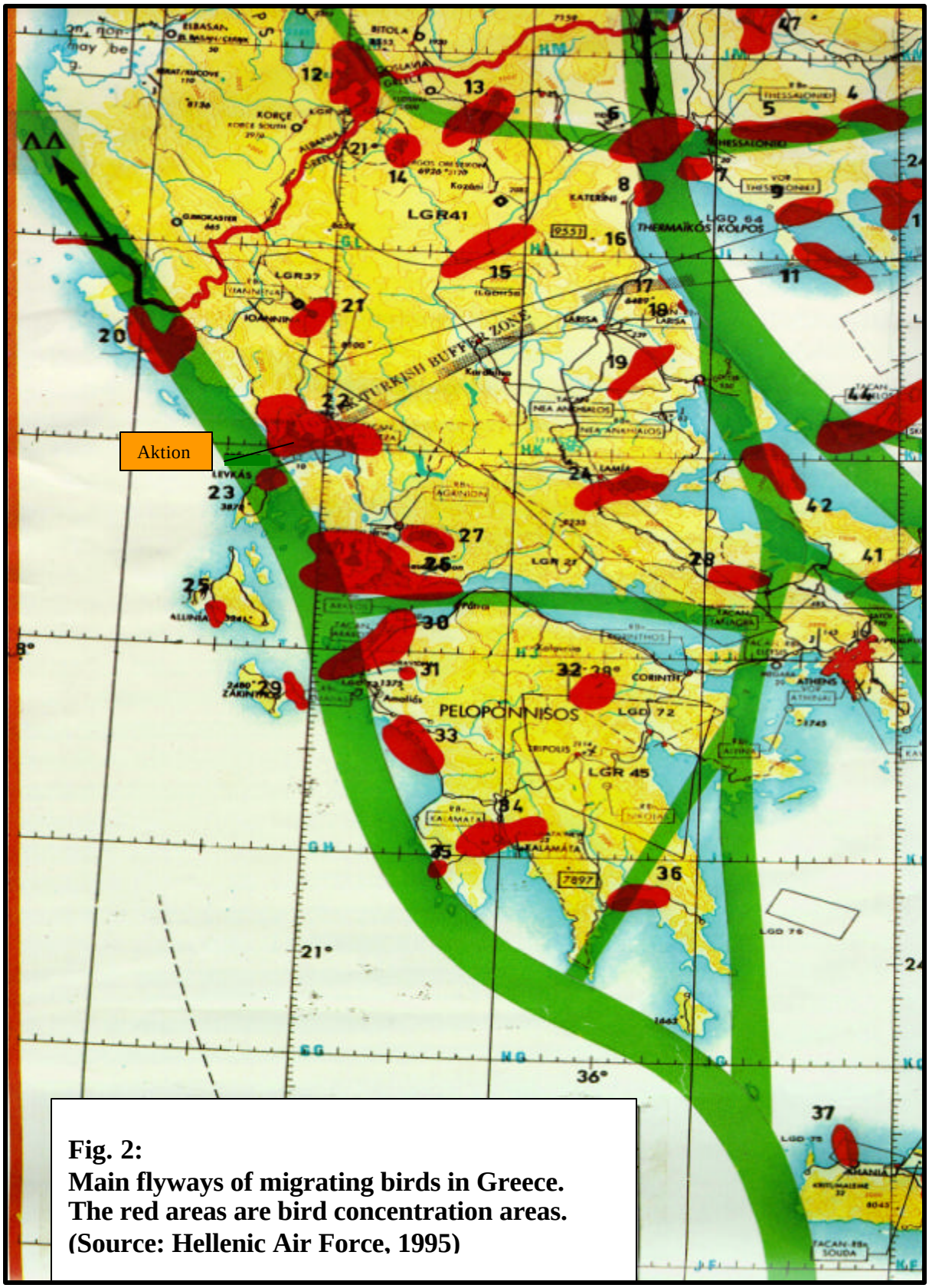


Fig. 2:
Main flyways of migrating birds in Greece.
The red areas are bird concentration areas.
(Source: Hellenic Air Force, 1995)