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# Ecology of the Imperial Eagle *Aquila heliaca* in Georgia

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## INTRODUCTION

Until recently, the Imperial Eagle was one of the indeterminate and insufficiently known species of the Georgian and Caucasian avifauna. As a result, information has been scarce and contradictory. Thus, in the Georgian ornithological literature, the Imperial Eagle was classed as a winter visitor or passage migrant (Radde 1884; Satunin 1907; Chkhikvishvili 1949; Kutubidze 1968, 1985). Only a few writers (e.g. Bankovski 1913) regarded it as a resident species. Even to-day (Panchesnikova 1983; Red Data Book of the Georgian SSR 1982, etc.) the past and present status of the species has not been summarized. There is also a complete lack of data regarding its distribution, habitat selection, numbers, breeding biology and feeding habits.

This report gives some results of studies in Georgia and the neighbouring territories - western Azerbaijan and northern Armenia - carried out in the years 1975-1992.

## DISTRIBUTION

The Imperial Eagle to-day occurs practically only in SE Georgia, in the Caspian Sea catchment area (Figure 1). During the breeding season it inhabits the flood-lands of such large rivers as the Kuta, Alazani, Iori and Khrami, the Iori plateau, and the eastern (and probably northern) slopes of the Trialethi Range in Caucasus Minor.

The species' nesting habitat in Georgia comprises about 5,500-6,000 km$^2$, i.e. 8-8.5% of the total area of the country, with a vertical limit of between 250 and 1,100m a.s.l. Single birds have also been recorded up to 3,500m, but these have undoubtedly been non-breeding nomads. Reports of nesting in the subalpine zone of southern Georgia, Dzharakheti uplands near the border with Turkey, must in my opinion be regarded as mistaken (Red Data Book of the Georgian SSR 1982).

Unquestionably, neither in the past nor in the present has the Imperial Eagle ever bred in Western Georgia, i.e. in the Black Sea catchment area.

## HABITAT

The Imperial Eagle in Georgia occurs in four types of biotope (see Fig.2).

1. Large rivers and flood-land forests 250-300m a.s.l., the main areas being the Kura river catchment area and valleys of the rivers Kura, Alazani, Iori and Khrami.

**Figure 1. Area of present distribution of the Imperial Eagle in Caucasia.**

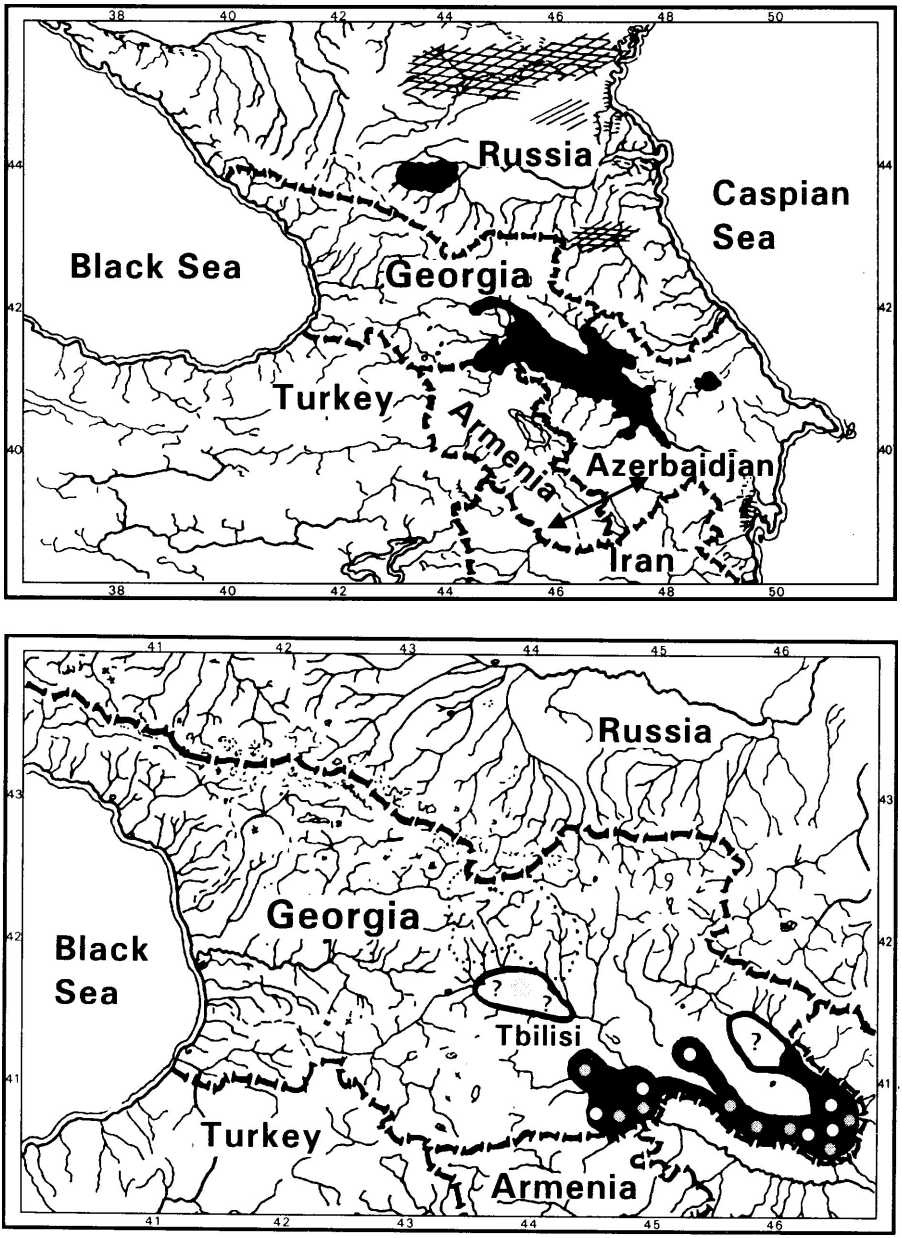
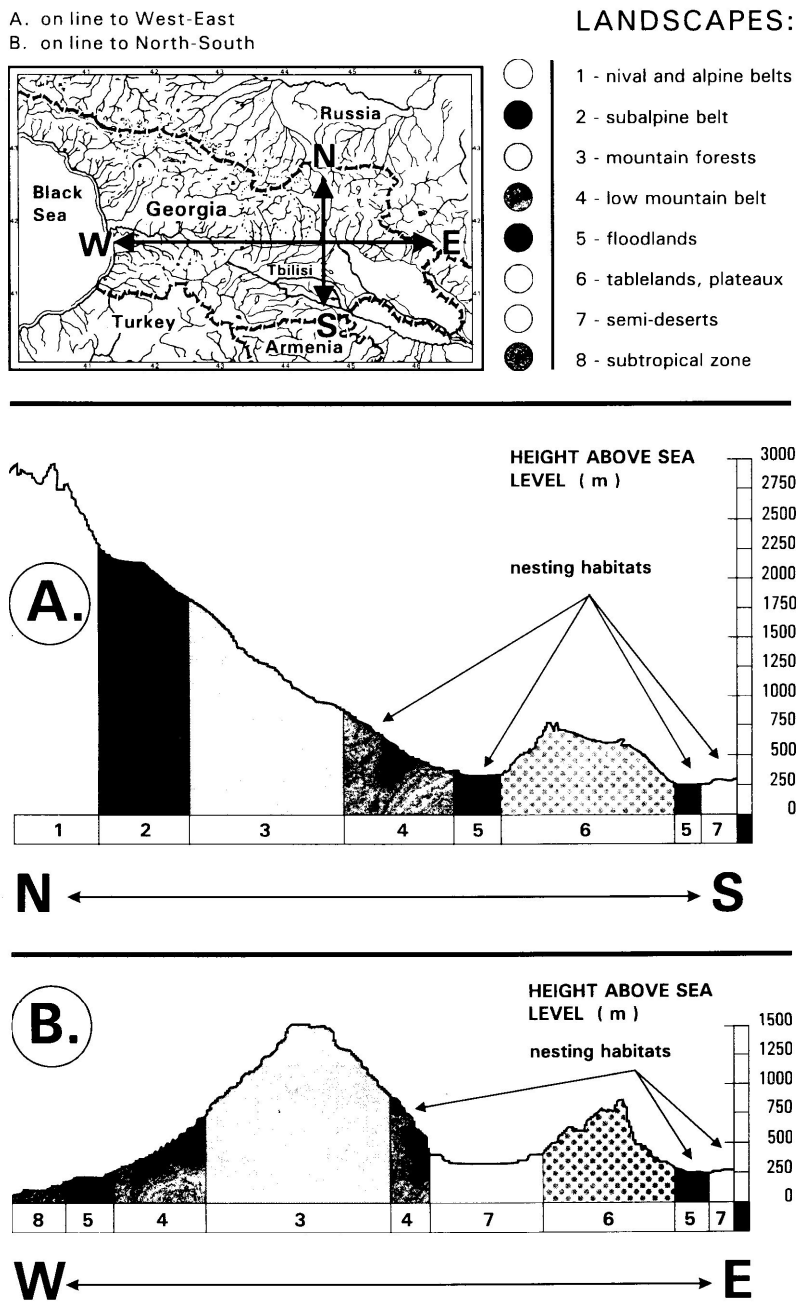


**Figure 2. Nesting Habitat Selection of Imperial Eagle in Georgia**



Characteristics of this biotope are the many-tiered forests, so-called "tugai thickets" (poplar, aspen, willow, bramble, sea buckthorn and other typical Central Transcaucasian vegetation). Along the rivers are frequent areas of scrub and reeds, marshes and small freshwater lakes. The rivers often branch out so as to form small islands, and these are the eagle's favourite nest sites.

2. Dry woodlands in a semi-desert landscape zone 300-450m a.s.l. with a vegetation of juniper, pistachio.

3. Plateaux with rocky outcrops, 400-600m a.s.l., with arid vegetation.

4. Old forests in the low and middle mountain belts, 600-1,100m a.s.l., with areas of precipitous cliffs or rocky slopes, together with open meadows and wide glades.

After nesting, the birds spread out into both lower, open landscapes (semi-deserts, steppes and plateaux) and subalpine and alpine meadows up to 3,500m a.s.l.

Seasonal migrations have no correlation with any particular biotope but are quite diffuse. Even so, the birds seem to prefer an open landscape. During the autumn migration the Imperial Eagle can also be met in untypical habitats such as the Kolchida lowlands and the shores of the Black Sea (Abuladze 1984).

The wintering grounds are situated in the semi-desert zone in the extreme south-east of Georgia (Abuladze 1986a).

## NUMBERS

The Georgian population has been estimated following a complete survey of all areas. During the study period, over different years, nine nests were located and six territories recorded. Two nests and two territories were in the low mountain and semi-desert belt; all others were in the flood-lands along large rivers. In my opinion, these figures are virtually definitive, i.e. all nests have been located.

During the years 1985-1991 the total number of breeding pairs ranged between nine and eleven. It is probable that one or two pairs escaped notice in the flood-land area of the Kura river, in the dense forests along the border with Azerbaijan. In addition to these, 10-12 non-breeding birds have occurred in the open landscapes of eastern Georgia during the summer.

In Western Azerbaijan (bordering with SE Georgia), in the Kura river flood-land forests, semi-deserts and low mountains, the Imperial Eagle population has been estimated at about 25 pairs, while two to three breed every year in northern Armenia.

## BREEDING BIOLOGY

Arrival at nesting territories in the study area has been recorded in late March-early April, with extremes of 9th March and 6th April. Soon after arrival the eagles start to repair old nests or build new ones. At the same time copulation takes place (see Table 1).

**Table 1. Phenological data on the Imperial Eagle in Central Transcaucasia (Eastern Georgia, Western Azerbaijan and Northern Armenia), collected in 1975-1992.**

| *Appearance* | *Extreme Dates* | *Average* |
|---|---|---|
| Wintering | 2nd decade of November - 2nd decade of March | December - 1st decade of March |
| Spring migration | February 26 - March 21 | March 7 - 10 |
| Arrival at nesting habitats | March 9 - April 6 | April 1 - 4 |
| Repair and construction of nests | March 22 - April 14 | 1st decade of April |
| Copulation | April 1 - April 9 | 1st decade of April |
| Egg-laying | April 8 - 23 | April 11 - 17 |
| Hatching | May 20 - June 18 | |
| Fledging | July 22 - August 21 | End of July |
| Autumn migration | August 27 - November 2 | 2nd decade of October 2nd decaded of Nov. |

During 1981-1991, in Georgia and West Azerbaijan, altogether 28 nests were recorded - 27 in trees and 1 on a cliff face. More detailed description of these nests is given in Table 2. As this shows, six tree species are used, preferably 40-70 years old. Most frequently used are poplars (14 nests), more rarely junipers (5) or pines (5). In only three cases were other tree species selected - yew, pistachio-tree and beech. The nests were usually placed in the upper part of the crown, more seldom at the very top (juniper and pine) or on a branch. Their height from the ground varied considerably, depending on the tree species: minimum height 6.6m (juniper); maximum 28.5m (poplar). The cliff nest, situated in a niche, was about 40m above the ground. The same nest can be used for several years running, up to a maximum of five years. Some pairs have a second nest in the same territory, as a rule an old nest occupied in previous years.

The size and structure of the nest are very varied and depend on the age of the nest and the tree species. Extreme sizes (n=28) are: diameter 105-175cm, depth 40-100cm, diameter of cup 45-75cm, depth of cup 5cm. Nests are always adorned with fresh green sprigs of pine or poplar.

Eggs are laid mostly in the first half of April, the extreme dates being 8th-23rd April. Out of 23 known clutches in the Georgia/W & E Azerbaijan area 21 (91.3%) were of two eggs and two (8.7%) were of three, the average clutch size being 2.09. I was able to measure and weigh the eggs from nine clutches (Table 3).

Hatching dates were recorded for only Nests 1 - May 19 and 22; and 2 - May 22, 25 and 27.

**Table 2. Nest-site selection of the Imperial Eagle in central Transcaucasia (Eastern Georgia, Western Azerbaijan)**

| *Tree* | *Position in tree* | | | *Height (m) above ground* | | | | *No of nests* |
|---|---|---|---|---|---|---|---|---|
| | Top | Crown | Branch | <10 | 10-15 | 15-20 | 20> | |
| Poplar | - | 11 | 3 | | 2 | 5 | 7 | 14 |
| Juniper | 5 | - | - | 5 | - | - | - | 5 |
| Pine | 4 | 1 | - | - | 5 | - | - | 5 |
| Pistachio | | 1 | - | 1 | | - | - | 1 |
| Yew-tree | - | 1 | - | - | 1 | - | - | 1 |
| Beech | - | 1 | - | - | - | 1 | - | 1 |
| 6 species | 9 | 15 | 3 | 6 | 8 | 6 | 7 | 27 |

1 nest located on a vertical cliff (SE exposure; height above ground, about 40m.

The young fledge mainly between the last ten days of July and the first half of August and have often been observed in the vicinity of the nest for two to three weeks thereafter, sometimes even returning to the nest itself.

From the end of August adults with young commonly move to the open landscapes, which provide a richer food source, and there they remain for some time, even up to the autumn migration, depending on the climatic conditions.

The breeding success and productivity of the Imperial Eagle in the region have been monitored from 1984 to 1991. The total number of nests controlled each season ranged from four to 11, and occupied territories from four to nine. The main parameters of breeding success are given in Table 4. These figures correspond with those of Caucasian populations (Nikitina 1991).

During my study I made no special investigation into the Imperial Eagle's diet, but some patterns emerged during the period of feeding the nestlings through anlysis of pellets, identification of prey remains and direct observation, both near nests and on the hunting territories. Pellets and prey remains were collected from within and below 11 nests in the Kura and Iora river flood-lands in Eastern Georgia and neighbouring districts of Azerbaijan during 1984-1991 (Table 5). Mammals proved to be the major item in the diet, *ca.* 56% of the total prey. In Central Transcaucasia this raptor also feeds on carrion, basically the carcasses of sheep. Among adult birds, seasonal changes in the diet were noted. During the breeding season and in autumn, carrion is only an occasional food item, but it is regularly consumed by wintering eagles.

**Table 3. Size (mm) and Weight (g) of Imperial Eagles eggs in Georgia**

| Clutch | Size (cms) | | Weight (gr.) | Date |
|---|---|---|---|---|
| | Length | Width | | |
| 1 - 1 | 72.1 | 59.0 | - | April 23, 1984 |
| 1 - 2 | 71.5 | 58.2 | - | April 23, 1984 |
| 2 - 1 | 73.0 | 59.0 | 144.4 | April 19, 1985 |
| 2 - 2 | 71.7 | 58.0 | 132.2 | April 19, 1985 |
| 3 - 1 | 71.9 | 56.8 | - | May 2, 1985 |
| 3 - 2 | 71.5 | 56.5 | - | May 2, 1985 |
| 4 - 1 | 72.8 | 58.0 | - | April 28, 1986 |
| 4 - 2 | 72.0 | 57.8 | - | April 28, 1986 |
| 5 - 1 | 73.1 | 57.9 | 142.0 | April 24, 1987 |
| 5 - 2 | 72.2 | 57.1 | 134.7 | April 24, 1987 |
| 6 - 1 | 73.0 | 57.7 | - | April 29, 1988 |
| 6 - 2 | 72.3 | 57.0 | - | April 29, 1988 |
| 6 - 3 | 72.2 | 56.8 | - | April 29, 1988 |
| 7 - 1 | 73.0 | 56.9 | 136.5 | May 6, 1989 |
| 7 - 2 | 72.5 | 56.9 | 134.0 | May 6, 1989 |
| 7 - 7 | 71.8 | 56.5 | 129.3 | May 6, 1989 |
| 8 - 1 | 73.0 | 58.3 | 141.0 | May 9, 1989 |
| 8 - 2 | 72.3 | 58.0 | 137.5 | May 9, 1989 |
| 9 - 1 | 72.5 | 57.0 | 138.3 | May 1, 1990 |
| 9 - 2 | 72.1 | 57.0 | 135.1 | May 1, 1990 |
| Min. | 71.5 | 56.5 | 129.3 | |
| Max. | 73.0 | 59.0 | 144.4 | |
| Average | (n=20) 72.3 | (n=20) 57.52 | (n=11) 136.82 | |

## LIMITING FACTORS

Without doubt the main limiting factor for the Imperial Eagle, as for all other large raptors, is the destruction of nesting habitats in Transcaucasia, primarily the old flood-land forest, tugai thickets and relict dry woodlands. One of the most destructive

**Table 4. Indices of effectiveness in Imperial Eagle breeding in Central Transcaucasia (Eastern Georgia and Western Azerbaijan) in 1984 - 1991.**

| *Indices* | *Years* | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 |
| Checked territories | 4 | 7 | 6 | 8 | 8 | 11 | 9 | 8 |
| Occupied territories (with pairs) | 4 | 6 | 6 | 7 | 7 | 9 | 7 | 7 |
| Territories with eggs | 3 | 5 | 6 | 7 | 6 | 9 | 7 | 6 |
| No. of successful nestings | 3 | 4 | 4 | 6 | 5 | 7 | 6 | 5 |
| No of unsuccessful nestings | 0 | 1 | 2 | 1 | 1 | 2 | 1 | 1 |
| Percentage of successful nestings | 100.0 | 80.0 | 66.7 | 85.7 | 83.3 | 77.8 | 85.7 | 83.3 |
| No. of young capable of flying | 5 | 6 | 3 | 8 | 6 | 7 | 9 | 5 |
| No. of young capable of flying per successful nesting | 1.67 | 1.5 | 0.75 | 1.33 | 1.2 | 1.0 | 1.5 | 1.0 |
| No of young capable of flying per occupied territory | 1.25 | 1.0 | 0.5 | 1.14 | 0.86 | 0.78 | 1.29 | 0.72 |
| No of young capable of flying per established nesting | 1.67 | 1.2 | 0.5 | 1.14 | 1.0 | 0.78 | 1.29 | 0.83 |
| Territories with no activity | 0 | 1 | 0 | 1 | 1 | 1 | 2 | 1 |
| No data | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

**Table 5. Identified Prey of Imperial Eagle in Central Trancaucasia. Material collected from 11 nests in the period of feeding of young, 1984-1991.**

| *Species* | *No* | *%* |
|---|---|---|
| House Mouse *Mus musculus* | 20 | 5.86 |
| Wood Mouse *Apodemus sylvaticus* | 11 | 3.23 |
| Mouse spp. | 34 | 9.97 |
| Common Vole *Microtus arvalis* | 2 | 0.59 |
| Social Vole *M. socialis* | 51 | 14.96 |
| Voles (*Microtus*) spp. | 7 | 2.05 |
| Brandt's Hamster *Mesocricetus brandti* | 4 | 1.17 |
| Grey Hamster *Cricetulus migratorius* | 1 | 0.29 |
| Libyan Jird *Meriones libycus* | 29 | 8.50 |
| European Hare *Lepus europeus* | 9 | 2.64 |
| Rodent spp. | 24 | 7.04 |
| Total mammals | 192 | 56.30 |
| Pheasant *Phasianus colchicus* juv | 3 | 0.88 |
| Chukar *Alectoris chukar* juv. | 9 | 2.64 |
| Quail *Coturnix coturnix* | 1 | 0.29 |
| Domestic Hen *Gallus domesticus* | 1 | 0.29 |
| Hooded Crow *Corvus cornix* juv. | 14 | 4.11 |
| Magpie *Pica pica* juv. | 6 | 1.76 |
| Lark spp. | 3 | 0.88 |
| Passeriformes spp. | 11 | 3.23 |
| Total birds | 48 | 14.18 |
| Caucasian Agama *Agama caucasica* | 32 | 9.38 |
| Five-streaked Lizard *Lacerta strigata* | 3 | 0.88 |
| Rock Lizard *Lacerta saxicola* | 8 | 2.35 |
| Three-lined Lizard *Lacerta trilineata* | 9 | 2.64 |
| Lizard spp. | 38 | 11.14 |
| *Ophisaurus apodus* | 3 | 0.88 |
| Mediterranean Turtle *Testudo graeca* | 6 | 1.76 |
| Snake spp. | 2 | 0.59 |
| Total reptiles | 101 | 29.62 |
| Total: | 341 | 100.00 |

impacts is the creation of reservoirs; thus, in the Iori river valley, on the territory of the Chechuna Game Reserve, two pairs of Imperial Eagle regularly bred in 1985-1988. In 1988 a reservoir was created, as a result of which no birds could subsequently breed there. In this case the eagles could find nest trees on the neighbouring slopes, but elsewhere that may not be possible. Apart from this, human disturbance plays a major role. Also in both Georgia and Azerbaijan there have been instances of illegal shooting. One young eagle was electrocuted by a high-tension electricity cable, and one wintering adult died from eating poisoned bait.

## CONSERVATION

Since the 1970s the Imperial Eagle has been a protected species in Georgia and, since 1982, included in the Red Data Book of Georgia as endangered. In Azerbaijan it is included in the list of endangered species. The birds are protected in the Gardabani and Chechuna Game Reserves. Some eagles also winter annually in Vashlovani Reserve (Abuladze 1986b).

Beginning in 1981, the Zoology Institute of Georgia initiated a programme of monitoring all species, including the Imperial Eagle, but unfortunately this work was stopped in 1991.

In my opinion, the main measures for protection of the Imperial Eagle population in Central Transcaucasia are the following:-

- protection of all known nest sites
- a total ban on exploitation or development of old flood-land forest, dry woodlands and low mountains
- recording of all known nests and granting them special protection
- restriction of all human activities during the breeding season
- strict control of illegal shooting and a ban on the use of pesticides throughout the Caucasus
- intensive use of the mass media to enlist public interest and support
- strict control of the use of traps for mammals and a ban on poisoned baits
- consolidation and co-operation between all Caucasian ornithologists in order to co-ordinate both the study and conservation of the species in Central Transcaucasia.

In 1990 I elaborated and submitted to the authorities a long-term programme of measures for raptor conservation. Unfortunately the present political and economic situation prevents this from being implemented. In such conditions, problems concerning wildlife are of little concern. Due to the most recent political circumstances, the research group of professional ornithologists has broken up. One can only hope that the present crisis will not last for ever, so that one day the work begun can be continued with greater efficiency.

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