BP/BirdLife International/Fauna & Flora International
CONSERVATION PROGRAMME

PROJECT TITLE:

Adji lake ecosystem - conservation for the future

Kharkiv state university expedition to Adji lake, Dagestan Republic, Russia, May - November 1998

FINAL REPORT

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SUMMARY

The unique brackish water lake situated at western coast of the Caspian Sea in Dagestan Republic, Russia was in focus of the project "Adji lake ecosystem - conservation for future", a joint expedition of Ukrainian and Dagestanian scientists and students with a view to help to conserve the lake ecosystem and surrounding semi-desert & coastal habitats.

Current status, habitat requirements and numbers of 3 globally threatened species (Pygmy Cormorant, Dalmatian Pelican, Ferruginous Duck) and 2 vulnerable species (Mediterranean Spur-thighed Tortoise, Little Bustard) were investigated. Marbled Duck, the species which probably bred at the lake wasn't found. However, another globally threatened species, White-headed Duck, was registered as probably breeding. Breeding bird species composition and numbers in all main types of habitats (shallows with reed vegetation, canals, semi-desert, sand dune and coastal habitats) were estimated. Assessment of adverse factors impact on the ecosystem state revealed that reduction of water level is the most important factor of threat.

Draft programme of conservation measures for the ecosystem is being developed. Assignment of target means in local budget for lake water level regulation and prohibition of grazing in dune habitats are among prime measures to be taken in the nearest future. Close relations between game management officers, regional environmentalists and local schools established when implementing the project considerably contributed to raising public awareness of the ecosystem state. Project implementation formed viable basis for future investigations and conservation of Adji lake ecosystem.

CONTENTS

INTRODUCTION

Dagestan Republic is one of the most interesting and less studied countries of the Caucasus situated in the north-eastern part of the Caucasus region (see Fig. 1). The total area of the Republic is about 50,000 sq. km, the total population - about 2 mln. people.

The territory of Republic can be divided into 2 main parts: the northern one, with plain relief, and the southern one which is mountainous (Andian, Bogossian and Samurian mountain ranges of the Great Caucasus). The climate is rather dry in plain part of the country and even in mountainous regions. Diverse climate and relief conditions resulted in developing an unique (even for Caucasus region!) variety of landscapes in Dagestan. Dry climate conditions which have existed in the region for a very long period of time promoted forming a rich distinctive flora containing numerous xerophytic plant species. Many of these species are endemic for the region. Dagestan became a centre for dispersion of xerophytic species for the whole Caucasus region.

The northern part of Dagestan and narrow strip between Caspian sea and mountains are occupied by lowlands which originated as a result of sequential transgressions and regressions of the Caspian sea (Vronsky, Amirkhanov, 1990). The main habitats are crops and dry steppe & sand semi-deserts which are degraded due to over-grazing. These steppe and semi-desert habitats are traditionally used as winter pastures. Spreading of pasture stock-breeding resulted in changes of vegetation structure and in development of semi-natural ecosystems.

Among numerous places of interest in Dagestan Republic one of the most attractive for biologists and conservationists is Adji lake situated in southern part of the country on narrow plain between mountains and the Caspian sea (see Fig. 2). It is the only large wetland area along the 500 km stretch of the western coast of the Caspian Sea between Caspiysk, Russia and Apsheron peninsula, Azerbaijan.

The whole territory of the lake and surroundings are below sea level (-20 m, in average). The total territory of lake water surface occupies about 2000 ha. Adji lake is mainly shallow and brackish. The whole territory of the lake and its surroundings are in state property.

In 1970s the system of canals was created around the lake that substantially changed the hydrological regime. In early 1990s the lake was overused for fishery. The water level several times was artificially lowered for this purpose. This factor negatively affected the conditions of breeding of almost all waterfowl species. Since mid 1990s the territory have been under authority of Papas game management office and the threat of artificial water level lowering have been avoided. Nevertheless, exhaustion of fish species populations is still appreciable.

Adji lake is a breeding ground for some endangered and rare steppe bird species and also a staging area and winter quarters of many bird species which migrate along the Western Caspian flyway.

Preliminary studies of bird communities in 1996-1997 under the IBA programme of BirdLife International revealed the unique role of the lake in maintenance of rare species populations (A1 and A4 criteria). These surveys have shown that Adji lake is one of the very few places in Russia where such globally threatened species as Ferruginous Duck (Aythya nyroca) is breeding. Another globally threatened species, Marbled Duck (Marmaronetta angustirostris) was reported by local game office as probably breeding at the lake. Moreover, it was revealed that such globally threatened species as Pygmy Cormorant (Phalacrocorax pygmaeus) and Dalmatian Pelican (Pelecanus crispus) use the lake as stopover site during migration.

Adji lake is a staging area and winter quarter of many bird species which use the Western Caspian flyway to migrate along Dagestan coast of the Caspian Sea towards their wintering grounds in Southern Azerbaijan, Iran and Iraq. In particular, in autumn 1997 preliminary surveys showed that the surroundings of Adji lake is an unique site for Little Bustard (Tetrax tetrax) conservation since the species forms a great accumulation in steppe and semi-desert habitats at the lake on southward passage.

Not only bird but also some interesting and rare reptile species had been recorded during IBA surveys in sand dune and semi-desert habitats at the lake. Among them the most interesting species was Mediterranean Spur-thighed Tortoise (Testudo graeca) considered as vulnerable.

In 1996-1997 preliminary surveys at Adji lake revealed that more accurate and complete data on the status, numbers, and habitat requirements of globally threatened and vulnerable bird & reptile species are required to facilitate planning the conservation actions.

Different habitats of the ecosystem are under threat due to the impact of harmful factors both natural and human such as fluctuations of water level, recreation, hunting and pasture pressure. Despite this the action plan for the ecosystem conservation hadn't been developed by the time of preliminary surveys.

Lately in 1997 the idea of more in-depth study of the lake with drawing into the work Ukrainian and Dagestanian scientists was proposed by Gadjibek Dzhamirsoev. He discussed it with his friends in Kharkiv university, in Ukraine where he graduated and with friends in Dagestan where he was born. As a result the project was developed to address threat to the ecosystem state and to determine conservation priorities for the territory. The fieldwork of the project was allotted between three expeditions in May, June and November. Each expedition pursued an aim to investigate the status and numbers of certain rare species or to assess specific adverse factor impact.

The project received the approval by the Department of Conservation and Sustainable Development of Game Resources, Game Management Board of Dagestan Republic Government. The project started in May, 1998 after receiving the support by BP/BirdLife International/Fauna & Flora International Conservation Programme.

PERSONNEL

1. **Gadjibek S. Dzhamirsoev**, 28 years old, Lezhinian, MSc (Biology), post-graduate, Kharkiv state university, experienced in bird conservation practice, role in project: project leader, co-ordinator of project conservation programme
2. **Andrey A. Atemasov**, 33 years old, Russian, junior research worker, Laboratory of Applied Problems in Animal Ecology, Kharkiv state university, MSc (Biology), has an experience in bird counts using methods of territory mapping and line transects, role in project: co-ordinator of general scientific programme, responsible for training in bird counts
3. **Mikhail V. Banik**, 25 years old, Ukrainian, junior research worker, Laboratory of Forest Monitoring & Radioecology, Ukrainian Forestry Research Institute, Kharkiv, MSc (Biology), has an experience in line transect counts (full distance measuring) of birds in open habitats and duck broods counts, role in project: contact person, co-ordinator of waterfowl counts, responsible for the assessment of different factors' impact on the ecosystem
4. **Yaroslav N. Cherednikov**, 20 years old, Russian, student of Biology department, Kharkiv state university, has an experience in IBA programme implementation in Ukraine (1996), role in project: observer (bird counts)

5. **Eugeny S. Vilkov**, 32 years old, Russian, post-graduate, Dagestan state university, has a high experience in Dagestan avifauna studies and in ecological education organisation, role in project: co-ordinator of education programme
6. **Mamed N. Magomedov**, 19 years old, Rhutulian, student of Biology department, Dagestan state university, has an experience as a bird-watcher, role in project: observer (bird/reptile counts)
7. **Muslim M. Alilov**, 45 years old, Khumikian, gamekeeper, Papas game management office, greatly familiarised with the study area and local bird species, role in project: guide, contacts with local population
8. **Mamed L. Abdhurachmanov**, 17 years old, Avarian, student of Ecological College, Makhachkala, has an experience as a bird-watcher, role in project: observer (bird/reptile counts)

FIELDWORK METHODOLOGY

The following methods were used in project fieldwork:

- Direct counts of key species on the whole territory of the lake and on adjacent territories (Pygmy Cormorant, Dalmatian Pelican, Little Bustard; see Bibby et al., 1992). For Little Bustard numbers' estimation the data of transect counts were used also (see below);
- Brood counts for estimation of breeding population size of duck species (Bibby et al., 1992);

For brood counts we used the following methodology:

On certain site along the shore-line several counts of broods were made by feet and by using telescope. Then the data of several counts made for the same site were analysed to get an estimate of brood numbers. For each brood the number and age of ducklings were recorded. The age of ducklings was estimated with use of a simple scale proposed by American scientists (Gollop, Marshall, 1954). In the scale 3 main age classes and 7 sub-classes are discerned according to visual characters (presence or absence of feathers, colour brightness of ducklings' down, body shape characters, the extent of feather appearance in ducklings' plumage). Age scale for ducklings of Anas and Aythya species is given in Appendix II along with the data on the numbers of ducklings in broods of certain duck species at Adji lake in 1998.

- Transect counts to study bird communities in different types of habitats;

Transect routes of fixed length were established in 6 main types of habitats. On these routes the count method of full-distance measuring was used. The method was originally developed by Hayne (Hayne, 1949) and lately modified by Yu.S. Ravkin (Ravkin, 1967). It is extremely useful for counting birds in open habitats. All birds occurred within selected habitat type are counted regardless of the distance. Flying birds are counted also and then included in calculation using Yapp method (Yapp, 1956). The following assumption was made when calculating population densities: singing males are considered as pairs for those species regarded as probably breeding. Population densities for certain species were calculated using separate recount by the distances of detection. 6 classes of distances of detection were used: 0-25 m, 25-50 m, 50-100 m, 100-250 m, over 250 m. To calculate population density we used the following formula:

$$D_i = \frac{\sum_{j=1}^{m} k_j n_{ij}}{L},$$

where D_i - population density of a certain species i, in ind./sq.km, n_{ij} - the number of individuals of i species counted in a j-class of distances, L - the total length of transect, k_j - constant coefficient depending on the width of a given interval of distances of detection.

When data of several transect counts of uneven length were used, weighting procedure was applied to get final mean density value.

- Transect counts to estimate the abundance and habitat distribution of Mediterranean Spur-thighed Tortoise;

Transect counts of fixed length were used. The method was the same as for birds but two different types of calculation were applied. One calculation type is separate recount by the distances of detection (see above). Another one is simple calculation using fixed width of the transect. For one habitat type (long-fallow lands on sandy soils) absolute count on a fixed area was used.

- Vegetation structure assessment on sample plots for studying habitat requirements of Little Bustard;

The design of sample plots is similar to that one used for U.S. Forest Health Monitoring (Tallent-Halsell, 1994). This flexible design have been developed jointly by the U.S. Forest Service and the EPA based on an optimally cost-effective plot design for Forest Inventory & Analysis measurements (Stolte, 1994).

One sample plot contains four fixed-radius subplots arranged in an equilateral triangle with an additional subplot at the centre of the triangle (Scott, 1991). The centres of the outer subplots are 20 meters from the centre of the central subplot. The radius of each subplot is 5 m.

For the analysis we used the data gathered on 20 plots randomly located over the investigated territory (semi-desert habitats mainly) and the data from 20 plots established in sites where Little Bustard flocks were registered. The rectangular 200 x 200 m grid superimposed on the local map was used to determine where the plots of the first group should be located. All 200 x 200 m squares were numbered and then random number table was used to select the necessary 20 plots.

On each subplot the following indicators were estimated: land use type, terrain position, limit of view, mean cover, mean height of vegetation cover, stratification, maximum height of each stratum for those subplots where the cover was stratified, grass presence, moss/lichens presence, grass to herb ratio, grazing regime (for some of these indicators see Oppermann, 1990; Bibby et al., 1992). Also the number of birds in a flock was recorded for each plot at sites of Little Bustard observations.

Definitions and reporting units for these indicators are given below:

Land use type: The objective of land use classification is to separate natural habitats from habitats considerably altered by human disturbance. The following classes are recognised: 1 - pastures in semi-deserts, 2 - long-fallow lands, 3 - arable lands, 4 - pasture meadows.

Terrain position: The terrain position was considered as the position of the subplot in relation to the surrounding topography. The following unites were discerned: 1 - flatland (level terrain not related to elevation changes), 2 - elevated flatland (level terrain on the tops of hills with minimal elevation changes), 3 - lowered flatland (mainly the bottoms of dried up semi-desert lakes,

minimal elevation changes), 4 - slightly rolling flatland (elevation changes occurred but they weren't obvious), 5 - slopes.

Limit of view: The objective of this indicator is to assess the subplot surroundings as providing conditions of safe feeding of Little Bustard flocks. We tried to estimate the distance at which Little Bustards can detect predators/intruders by four main directions. In our scheme we took into account the presence of some obstructions for the view at distances lesser than 150 m. This distance was chosen as critical since about 50% of Little Bustard flocks flushed when the observer approached at 150 m. As a result the following scheme of 5 classes was used to assess limit of view: 1 - no obstructions by all directions, 2 - in a sector of 90 degrees obstructions are present at a distance less than 150 m from the subplot centre, 3 - in a sector of 180 degrees obstructions are present at a distance less than 150 m from the subplot centre, 4 - in a sector of 270 degrees obstructions are present at a distance less than 150 m from the subplot centre, 5 - obstructions for the view are present by all directions at a distances less than 150 m.

Mean cover: The indicator represents the estimate of mean vegetation cover on the subplot. It was primarily aimed at assessment of the grazing impact level. The cover was estimated in 5%-classes.

Mean height of vegetation cover: Mean height of vegetation cover was treated as an indicator of facility of intruder detection by feeding Little Bustards. It was estimated in 2.5 cm-classes.

Stratification: On each subplot it was recorded whether the vegetation cover is stratified (usually 2 strata and more rarely 3 strata) or no.

Maximum height of each stratum (if the cover was stratified): For each stratum the maximum height was identified. The indicator was used in addition to the mean height of vegetation cover described above. No special sampling height classes was used for these indicators.

Grass presence: For each subplot it was registered whether grasses of any species are present or no.

Moss/lichens presence: For each subplot it was recorded whether any species of mosses and lichens are present or no.

Grass to herb ratio: The ratio of grass to herb cover was estimated on each subplot. The ratio was treated as a possible indicator of specific Little Bustard food presence.

Grazing regime: The level of grazing impact was visually estimated for each subplot by use of the simple scheme. 5 classes are discerned. 1st class was recorded if no signs of grazing were found while 5th class was assigned if the vegetation cover is almost completely absent due to grazing impact.

- Questioning of local people especially hunters and herdsmen;

FIELDWORK RESULTS

SCIENTIFIC RESULTS

The scientific data gathered during project expeditions have been processed. 178 species of birds had been registered (among them 64 species (35.6%) with unfavourable conservation status, SPEC categories 1-3, see Appendix I) for the whole period of surveys at the lake in 1998.

Particular attention had been paid to the estimation the numbers and habitat requirements of several globally threatened and vulnerable bird species. Main results of these studies as well as general characterisation of breeding bird communities are given below:

Ferruginous Duck

Status and numbers. General information on the status and numbers of Ferruginous Duck at the lake was gathered by transect counts of paired adult birds during May expedition and brood counts during June expedition. In June about 75% of an area with suitable habitats was covered by direct brood counts. The analysis of the data revealed that the status of Ferruginous Duck is quite favourable at Adji lake. The species is among most numerous ducks at the lake (see Appendix I). The total population size is higher only in Red-crested Pochard (Netta rufina) and Common Shelduck (Tadorna tadorna) populations, but breeding population of Common Shelduck is even 1.5 times smaller than Ferruginous Duck one. The total estimated size of breeding Ferruginous Duck population is 35-48 pairs.

Habitat requirements of Ferruginous Duck at the lake can be characterised as follows: shallow sites not far from the shore with heavily patched clumps of reed vegetation and numerous effluents and inner creeks. Nesting and brood guidance occurred in such habitats. It was obvious that Ferruginous Duck was much more numerous in above-mentioned sites comparing to those sites of the lake shore with solid edge of dense reed vegetation and without effluents and numerous inlets and coves. Water depth range is 20 to 60 cm in sites where the majority of Ferruginous Duck broods occurred. Mean depth is 25 cm in these sites.

Breeding. The time for brood counts was selected quite correctly since the majority of birds encountered during the second expedition were in broods. The number of ducklings in a brood ranged from 1 to 17 (see Appendix II). The mean brood size was 5.92 (n=24). The actual mean number probably was even higher (about 6.0-6.3 ducklings) since the size of several "small" broods (1 to 2 ducklings) can be considered as being underestimated. United brood was observed only once with the total number of ducklings amounted to 17 (12.0% of all registered ducklings were in united brood while the corresponding proportion in Red-crested Pochard and Common Shelduck was 11.7% and 63.3%, accordingly). The age of young birds in broods varied greatly from 2-3 days pulli to feathered ducklings of half adult size (see Appendix II). Hatching took place mainly in the end of May (25th May - 5th June) and in June (8th - 20th June) according to the data on the age of ducklings in broods. Nevertheless, sometimes hatching occurred as early as in the mid of May, probably on 15th-16th May. Breeding success seems to be comparatively high and only small part of the population of the species can be considered as over-summering or non-breeding birds (15.0-17.7% of the total population size versus 50.4-52.6% in Red-crested Pochard and 79.2-81.6% in Common Shelduck, Appendix I).

Behaviour. Some results of observations on feeding of Ferruginous Duck broods showed that younger birds (1-2 weeks after hatching) often feed at shallow sites picking food from the water surface while older ducklings (3-4 weeks) feed on deeper sites diving as adult birds. At least 3 times we observed Ferruginous Duck juveniles feeding with ducklings of Red-crested Pochard jointly without aggressive contacts. Any signs of aggressive behaviour weren't found also when adult Ferruginous Ducks were observed feeding in close neighbourhood with feathered ducklings of Red-crested Pochard. No obvious signs of competition between these duck species were found neither for nesting nor for feeding sites.

Ferruginous Duck males which leave their females after ducklings hatched can form constant groups. One of these groups which consists of 10 males was observed permanently on a certain shallow water site of the north-eastern shore of the lake. These males fed at the site along with

over-summering groups of Red-crested Pochards, Black-winged Stilts (Himantopus himantopus), Black-tailed Godwits (Limosa limosa) and Marsh Sandpipers (Tringa stagnatilis). Another Ferruginous Duck male spent his time in solitude on a great shallow water satellite lake north of Adji lake.

In late June some Ferruginous Duck pairs are probably in the stage of incubation at Adji lake. For example, such behaviour pattern as 3-bird flight which is quite characteristic for early stages of mate's breeding cycle (Dwyer, 1974) was observed on 21st June.

Marbled Duck and White-headed Duck

At the planning stage of the project Marbled Duck was considered as probably breeding species based on information provided by Papas (Adji) game management office. The habitats of the lake are suitable for this duck (brackish areas with *Phragmites* vegetation, *Juncus* and *Tamarix* vegetation in semi-desert in strand zone, Green, 1993). Nevertheless, the searches for the species were unsuccessful in 1998 and Marbled Duck wasn't found neither during spring expedition nor during summer one. The results of our surveys showed that Marbled Duck most probably didn't breed at Adji lake in 1998 season. The possible reasons for such absence can be extremely dry climate conditions in Dagestan this spring which caused drying up numerous satellite lakes in neighbourhood of Adji lake.

Despite depressing results of Marbled Duck searches June expedition brought us unlooked-for pleasure. Another globally threatened duck species was found at the lake, namely White-headed Duck. On 24.06.1998 the male of this species was recorded swimming not far from our observation point at the western shore of the lake. On 25.06.1998 the female of the species was registered on one of the numerous inlets of the western shore of the lake at distance of about 500 m from the place of male registration. The inlet was about 100 m length and 30 m width. It was surrounded by 2-2.5 m height reed vegetation. The female was observed when swimming out an effluent to open water. The distance to observer was about 10 m. As soon as the female detected the observer she tried to disappear (the duck began to run on water surface with help of wings producing characteristic slapping sound). Although the nest or the brood wasn't found secretive behaviour of observed bird convinced that breeding of the species is possible. There is a first record of possibly breeding White-headed Ducks for the last 40 years in Dagestan Republic.

Pygmy Cormorant and Dalmatian Pelican

The status and numbers of Pygmy Cormorant at Adji lake were defined as a result of the project expeditions. Pygmy Cormorant is the rare migrant and over-summering species at the lake. In spring and summer small groups of the species (2-10 individuals) were registered during their local feeding movements. The mean density of the species population in shallows with reed vegetation was 1.81 ind./sq.km, while the mean occurrence was 0.81 ind./km. The total number of over-summering Pygmy Cormorants is about 10-14 birds. On southward migration the number of birds can be much more higher. Thus, in November about 200 birds were recorded in comparatively large flocks (three flocks were registered with 87, 106 and 4 individuals) during 3 days period of observations (16-18.11.1998). Nevertheless, these birds didn't stay at the lake probably due to disturbance by hunters.

Dalmatian Pelican was recorded only once during May expedition (one sub-adult individual). We suppose that the status of the species is similar to that of the Pygmy Cormorant but the number is quite small and probably depends on season climatic conditions. Now it's clear that the terms of

the autumn expedition (adjusted for Little Bustard counts mainly) weren't fitting for Pelicans' number estimation since the species probably arrive to the lake in early winter when all resting grounds northerly of the lake became unsuitable for birds.

Little Bustard

Little Bustard is a common species on southward migration in semi-desert habitats in outskirts of the lake. The majority of Little Bustards are in flocks of different size from 2-5 up to 120 individuals. The results of analysis showed that flocks can be obviously separated into three groups by their size. Three size classes were defined using K-means clustering procedure (the total of 47 records was analysed). Small size flocks are most frequently observed (68.1% of all records). In this class also records of single birds are included (19.2% of all observations were records of single birds). But it should be noted that Little Bustards recorded as single birds comprise only 0.8% of all registered birds. The mean flock size in small size class was 5.1 (n=32) with the maximum number of birds in flock amounted to 17. The medium size class comprise flocks of 33 to 56 birds (mean flock size was 42.8, n=9). The large size class was composed of flocks of 83 to 120 birds (mean flock size was 95.2, n=6).

The results of bird counts in semi-desert habitats (the total length of transects was 19.54 km) can be summarised as follows:

The mean weighted density of Little Bustard population in semi-desert habitats (including arable lands) was 11.59 ind./sq.km. The appropriate value for agricultural fields was 0.25 ind./sq.km. The total number of birds was estimated taking into account the size of territories occupied by habitats suitable for Little Bustard in outskirts of the lake. The total number of birds which are staying at the lake in November is 500-650 individuals.

Some data on Little Bustard mortality were gathered also. The mean weighted occurrence of Little Bustard remains was 0.33 ind./km. The total of 8 dead birds was found. Among them the only one dead bird can be considered as being a prey of a big falcon or another unidentified raptor. The rest (87.5%) is most probably a result of Goshawk (Accipiter gentilis) predation as specific characters of the found remains are very similar to those ones characteristic for remains of Goshawk prey (Marz, 1972). It was revealed during our expedition studies that this species is common on southward migration at the lake. In any case, predation of birds of prey is a main cause of Little Bustard mortality during autumn migration at Adji lake.

No cases of Little Bustard shooting were registered during autumn expedition. It should be noted that the main game species at the lake is Coot (Fulica atra) while Little Bustard traditionally wasn't among game species for local population in outskirts of the lake. In addition, Little Bustard's prudence minimises possible negative contacts with men. The birds in flocks allow men to approach at the distance no less than 100-150 m and then flush. Only in evening some small flocks of Little Bustard can flush at lesser distances (about 30-35 m).

During autumn expedition special attention was paid to studying Little Bustard habitat requirements. 20 plots randomly located over the territory and 20 plots on sites used by Little Bustard flocks were sampled to assess vegetation structure indicators (see **Fieldwork Methodology**).

Since each plot comprises a cluster of four subplots, subplot values of each indicator were taken to complete appropriate samples representing randomly selected sites and sites where Little Bustards fed. Comparison of these samples by each variable (habitat indicator) was accomplished with use of non-parametric tests. Non-parametric statistics were chosen since sample size wasn't large, some variables had rank order and in many cases distribution obviously wasn't normal.

Differences in locations (means) in two samples were tested by Mann-Whitney U test. Differences in general shape of the distributions in these samples were tested by Wald-Wolfowitz runs test and two-sample Kolmogorov-Smirnov test. Also Kruskall-Wallis test was applied to test differences in medians. Additionally, non-parametric correlation coefficients (Spearman R and Kendall tau) are calculated to assess a magnitude of relationship of Little Bustard habitat selection to certain habitat indicators. After the discriminative indicators were identified for analysed samples they were used as variables in discriminant function analysis. The contribution of each variable to discriminatory power of the model was estimated as a result of discriminant function analysis. The results of discriminant analysis were interpreted along with above-mentioned correlation coefficients to ascertain significance of each variable (habitat indicator) in habitat selection by Little Bustard.

The results show that randomly sampled sites and sites used by Little Bustards differ by the following habitat indicators: land use type, terrain position, limit of view, maximum height of the second stratum, maximum height of the third stratum, grass presence, moss/lichen presence, grazing regime (Mann-Whitney U test, $p < 0.05$). Wald-Wolfowitz runs test reveals that differences in distribution shape exist also for such indicators as mean height of vegetation cover and stratification but two-sample Kolmogorov-Smirnov test indicates such differences for only three variables: land use type, terrain position and maximum height of the second stratum ($p < 0.05$). The results of Kruskall-Wallis test are quite similar to those of Mann-Whitney U test.

Statistical tests reveal that some indicators are insignificant to discriminate between analysed samples. These are mean height of vegetation cover, maximum height of the first stratum, grass to herb ratio and mean cover.

The results of discriminant function analysis and correlation coefficients show that above-mentioned habitat indicators can be arranged by their significance for Little Bustard habitat selection in descending order as follows: land use type, maximum height of the second stratum, stratification, grazing regime, limit of view, grass presence, presence of moss/lichens and terrain position.

These indicators can be categorised into two main groups. One group comprises indicators which reflect those habitat features limiting view for feeding Little Bustard flocks (terrain position, maximum height of the second stratum and limit of view). Another group probably consists of the indicators of certain plant species or species groups' presence which are used by Little Bustard as food resource (land use type, stratification, grass presence, presence of moss/lichens and grazing regime).

Mediterranean Spur-thighed Tortoise

The data on number and habitat distribution of the species were obtained during May expedition. Mediterranean Spur-thighed Tortoises are comparatively active in May. Main events of the species life cycle fall on this late spring period. Thus, egg laying and reproductive behaviour (fights between males, copulation) were observed on 14th and 15th May, accordingly. Presumably, the activity of tortoises is greatly influenced by the air temperature. Several times we observed the tortoises burying oneself in sand when the air temperature elevated in midday.

Mediterranean Spur-thighed Tortoises were found in four types of habitats in outskirts of the lake (see section **Breeding bird communities** for concise characterisation of the habitat types). Data on tortoises' numbers were gathered by means of transect counts and absolute count on fixed area (see Table 1). Additionally, some data on numbers of Glass-lizard (Ophisaurus apodus) were collected (see Table 2). The total length of transects in sand dunes, semi-deserts with *Tamarix*

and *Juncus* vegetation and lagoon wetlands with *Juncus* vegetation was 4.72, 6.08 and 1.93 km, accordingly.

Table 1. The habitat distribution and the numbers of Mediterranean Spur-thighed Tortoise at Adji lake, Dagestan in 1998.

Habitat type	Relative abundance		
	Mean density calculated from counts with measuring individual distances, ind./sq.km	Mean density calculated from counts on line transects of fixed width, ind./sq.km	Mean occurence, ind./km
Long-fallow lands at the foots of sand dunes	273.33[1]	-	-
Sand dunes	57.63	48.73	4.87
Semi-desert with *Tamarix* and *Juncus* vegetation	21.39	13.15	1.32
Lagoon wetlands with *Juncus* vegetation at the foots of sand dunes	10.36	5.16	0.52

The highest abundance of Mediterranean Spur-thighed Tortoise was observed on long-fallow lands at the foots of sand dunes. The tortoises are also numerous in sand dunes and in semi-desert habitats with *Tamarix* vegetation. The similar pattern of abundance was observed for Glass-lizard (see Table 2). Almost all habitats where both reptile species were found (excluding semi-desert with scarce vegetation) are related to sand dunes. These habitats can be arranged along the relief profile where sand dunes take central position while semi-desert with *Tamarix* and *Juncus* vegetation and long-fallow lands adjoin sand dunes from the lake side and lagoon wetlands adjoin dunes from Caspian sea side. It should be also taken into account that sand dunes occupy the greatest area in comparison to all above-mentioned habitats. So, just sand dune habitat can be considered as being particularly important for distribution of the investigated species.

Table 2. The habitat distribution and the numbers of Glass-lizard at Adji lake, Dagestan in 1998.

Habitat type	Relative abundance		
	Mean density calculated from counts with measuring individual distances,	Mean density calculated from counts on line transects of fixed width, ind./sq.km	Mean occurence, ind./km

[1] Calculated from data of absolute count on the area of 0.15 sq.km

	ind./sq.km		
Sand dunes	13.10	8.73	0.87
Semi-desert with *Tamarix* and *Juncus* vegetation	6.58	3.29	0.33
Semi-desert with scarce vegetation[2]	4.44	2.22	0.22

Data on the relative abundance of the reptile species in different habitats allow to estimate population numbers of these species in outskirts of Adji lake. The size of Mediterranean Spur-thighed Tortoise population is estimated as 590-710 individuals, while the population size of Glass-lizard is estimated as 210-380 individuals.

The state of Mediterranean Spur-thighed Tortoise population isn't good. For example, visual inspection showed that tortoises are quite commonly infested by parasitic mites.

Field researches convinced also that age ratio in studied tortoise population is shifted towards predominance of older age groups. Thus, the carapace diameter was less than 10 cm only in one (1.05%, !) tortoise among 95 inspected individuals. All other tortoises are bigger in size. Undoubtedly, they are quite old.

We don't know exactly on the reasons for such shifting in age ratio which is undoubtedly unfavourable for population status. 2 factors can effect the state of tortoises population most probably: catching of young individuals and excessive grazing in sand dune habitats. Numerous injuries found on tortoise carapaces are considered as evidences of the second factor effect. About 11% of all inspected tortoises (n=73) had mechanical damages of the carapaces which are most probably related to injuries by hooves of cows and sheep in young age while 1.4% of tortoises had mechanical damages related to senescence (horn plates of the carapace were peeled).

Breeding bird communities

Breeding bird communities were studied by means of transect counts in all main types of habitats during May expedition. The following habitat types were identified: shallows with reed vegetation along the lake shore, irrigation canals, semi-desert with scarce vegetation, semi-desert with *Tamarix* and *Juncus* vegetation, sand dune habitats and coastal habitats of the Caspian sea. Data on bird numbers in all these habitats were gathered. The total length of transects in each type of habitat was as follows: 19.85 km (shallows with reed vegetation), 1.46 km (irrigation canals), 2.47 km (semi-desert with scarce vegetation), 2.22 km (semi-desert with *Tamarix* and *Juncus* vegetation), 4.72 km (sand dune habitats) and 1.93 km (coastal habitats).

The concise characterisation of the discerned types of habitats is given below:

Shallows with reed vegetation along the lake shore. The emergent and submerged vegetation of the lake is represented mainly by reed which forms dense thickets of slight width along southern shores of the lake and more extensive but less dense and highly patched thickets at northern shores. The water depth on shallows ranges from 15 cm to 1 m. The narrow strip of semi-desert habitats, salt marshes and meadows is also included in the type.

Irrigation canals. The lake is surrounded by the system of irrigation canals. The canals are about 5 to 10 m in width. The vegetation cover is formed by reed of about 3-4 m in height.

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[2] Data were gathered by transect counts (total length was 9 km) during June expedition (22-24.06.1998).

Semi-desert with scarce vegetation. This is the most common habitat in surroundings of the lake. The vegetation cover is formed by *Artemisia* species on dry sites and by various halophytic plants such as *Salsola* on more wet sites (salt marshes). The vegetation on salt marshes is suppressed in 1998 due to very dry conditions of the spring season.

Semi-desert with Tamarix and Juncus vegetation. This habitat is characteristic for sites situated between the lake and sand dunes. The soil is more sandy as compared to clay soils of other semi-desert areas. Small hills and depressions shape the relief. In small depressions the vegetation is formed mainly by great tufts of *Juncus* species. Tamarisk is another common species which is entirely absent on other semi-desert sites and is quite common in this type.

Sand dune habitats. Sand dunes separate the lake from the Caspian sea. The mean width of sand dunes is about 0.7 km. The vegetation is highly mosaic and scarce but some species such as *Convolvulus persica* can form comparatively dense cover in suitable sites.

Coastal habitats of the Caspian sea. Coastal habitats themselves are represented by sand beaches with rare big stones. The strip of land between the dunes and the sea is occupied by lagoon wetlands with *Juncus* vegetation.

The total of 100 species of birds were registered in shallows with reed vegetation during May expedition. Among them 45 species can be considered as characteristic for the habitat (see Appendix III). Sedge Warbler (Acrocephalus schoenobaenus), Savi's Warbler (Locustella luscinioides), Paddyfield Warbler (Acrocephalus agricola), Great Reed Warbler (Acrocephalus arundinaceus) and Olivaceous Warbler (Hippolais pallida) are among dominants in passerine bird communities of this habitat. The number of the last species is very high in narrow strip of semi-desert habitats with expensive *Tamarix* vegetation at the edge of reed thickets. Red-crested Pochard, Coot (Fulica atra), Common Cuckoo (Cuculus canorus), Water Rail (Rallus aquaticus) and Common Shelduck are the most numerous non-passerine breeding birds in shallows with reed vegetation. Also such species as Wood Sandpiper (Tringa glareola), Ruff (Philomachus pugnax), Black-winged Stilt, Blue-cheeked Bee-eater (Merops superciliosus) and Yellow-legged Gull (Larus cachinnans) are abundant but they are either only migrating or over-summering. Among them wader species prefer shallow sites in inlets where they usually feed. Blue-cheeked Bee-eater forms large gatherings in reed thickets for roosting along with Barn Swallows (Hirundo rustica) and Sand Martins (Riparia riparia). The total number of swallows and martins in such gatherings at the lake is about 10,000 individuals, while the number of Blue-cheeked Bee-eaters can be estimated as 200 - 300. Over-summering Yellow-legged Gulls are quite common on shallow sites.

13 bird species were registered on irrigation canals. The majority of species are represented by warblers (6 species are characteristic, see Appendix III). Moustached Warbler (Acrocephalus melanopogon), Great Reed Warbler, Paddyfield Warbler, Sedge Warbler and Cetti's Warbler (Cettia cetti) predominated in bird communities in this habitat. The total density is noteworthy. It is very high and exceeds 2,000 individuals per sq. km.

Bird species diversity in semi-desert habitats with scarce vegetation is quite poor. However, the bird community itself seems to be very interesting since 2 species, Isabelline Wheatear (Oenanthe isabellina) and Lesser Short-toed Lark (Calandrella rufescens) are extremely abundant. The population density of these species comprises about 85% of the total density. Also such breeding species as Common Shelduck, Little Owl (Athene noctua), Stone-curlew (Burhinus oedicnemus) and Collared Pratincole (Glareola pratincola) are characteristic for the habitat. The total number of registered species is 17.

In semi-deserts with *Tamarix* and *Juncus* vegetation the number of species is slightly higher comparing to semi-deserts with scarce vegetation mainly due to presence of some passerine

species which depend on shrubby vegetation. The evenness of the distribution by species densities is higher too. The total of 20 species were registered. Olivaceous Warbler (Hippolais pallida) and Menetries's Warbler (Sylvia mystacea) are the most characteristic species of the habitat. Also such species as Skylark (Alauda arvensis), Common Redstart (Phoenicurus phoenicurus), Red-backed Shrike (Lanius collurio) and Isabelline Wheatear are abundant. All these species are breeding except Common Redstart which only stops during migration but is very common.

Dominants of bird population in sand dunes are represented by Sand Martin, Olivaceous Warbler, Red-backed Shrike and Menetries's Warbler. Sand Martin is very common since the majority of birds of the species prefers to feed flying along the dunes above the heated sand surface. The species is non-breeding and uses sand dunes only as habitats for feeding during migration. Another above-mentioned species are breeding birds. The total number of registered species is 32 among which 7 species can be considered as characteristic: Common Whitethroat (Sylvia communis), Magpie (Pica pica) and Stone-curlew in addition to the said species.

14 bird species were registered in coastal habitats of the Caspian sea. Little Ringed Plover (Charadrius dubius) and Pied Wagtail (Motacilla alba) are the most numerous breeding birds of this habitat. Nevertheless, Great Cormorant (Phalacrocorax carbo) is the most abundant species among 14 registered during May counts although it is only over-summering like gull species.

DISCUSSION

Methods

Some remarks can be done on the used methods. Field work showed the extreme usefulness of the applied methodology of estimation the numbers of waterfowl breeding populations. Combination of several counts made by feet and by using telescope on certain restricted site along the shore-line seems to be very apt. The posterior analysis of the data of several counts made for the same site provides reliable estimate of the numbers of broods, for example. The necessary estimate for the whole territory is obtained with use of the data on known habitat distribution.

During our expedition we realised one important thing which should be always kept in mind when planning the work for bird numbers' estimation. The crucial question for such studies is the question of most appropriate terms of surveys. We associate our failures in estimation the status and numbers of Dalmatian Pelican and Pygmy Cormorant with situation where the terms of survey doesn't fit the terms of obvious migration. At its turn, successful estimation of the numbers of Ferruginous Duck breeding population was largely depended on correctly chosen terms of counts.

As for other applied methods, plot design used for the assessment of Little Bustard habitat requirements proved to be an efficient tool in getting reliable information on habitat conditions in short terms. We can recommend it for using in habitat case studies.

Duck species

Three duck species, Red-crested Pochard, Common Shelduck and Ferruginous Duck comprise a "core" of dominant waterfowl species at Adji lake.

Red-crested Pochard is undoubtedly the most common and numerous duck species of the lake although reported as being decreased the numbers throughout Russia in recent years (Krivenko, 1994). The situation of predominance of Red-crested Pochard in bird communities of the lakes of

Western Caspian region is widespread and well known (unpublished data of our Azerbaijan colleagues, BP 1998 runner-up project "Population of Ferruginous Duck"). At Adji lake considerable part of this species population is represented by non-breeding birds (50.4-52.6% of the total population size) which concentrated in great gatherings of about 50-80 birds at several suitable sites (mainly coves with shallow water closed on three sides by not dense reed thickets).

The findings of our study allow us to consider the numbers of Red-crested Pochard at the lake as being at near maximum level taking into account the area of suitable breeding habitats. Despite the high numbers of Red-crested Pochard, no aggressive contacts with other duck species were seen neither among adult birds nor among ducklings both during May and June expeditions. Moreover, several times we observed joint feeding of ducklings of Red-crested Pochard and Ferruginous Duck. These observations showed that no apparent competition exists among the above-mentioned species for feeding sites. Some competition among these species can be for breeding territories but we have no evidences of such interactions.

Another numerous species, Common Shelduck obviously meets at Adji lake conditions which are favourable for nesting and over-summering but are much less suitable for rearing broods. The numbers of the species is high (245-265 ind.) but the majority of birds is over-summering and non-breeding (79.2-81.6% of the total population size). Surrounding semi-desert habitats with foxes' burrows and satellite dried up lakes meet the requirements of Common Shelduck in breeding and over-summering sites. Nevertheless, Adji lake itself is less suitable for the species during the period of brood guidance since comparatively dense reed thickets occupy considerable areas at the lake while Common Shelduck prefers sites with scarce reed vegetation along the shore during this stage of the reproductive cycle.

Adji lake habitats support viable breeding population of such globally threatened species as Ferruginous Duck. The estimated population size of the species is 85-115 individuals and only 15.0-17.7% of the population can be considered as non-breeding. High breeding density and breeding success of Ferruginous Duck probably is related to high suitability of lake habitats for this species. Dense but heavily patched reed vegetation which form a wide strip between lake shore and open water are the best habitats for Ferruginous Duck breeding. The water depth on these sites usually doesn't exceed 50 cm. The combination of both shallow sites of inner creeks used by younger ducklings (1-2 week age) and deeper sites preferred by older ducklings (3-4 week age) on restricted territory seems to be optimal for brood rearing in Ferruginous Duck.

In 1998 season breeding of Ferruginous Duck at Adji lake can be treated as successful. The mean number of ducklings in a brood is about 6.0 that is in good agreement with literature data (Makatsch, 1974). United brood was observed only once and the percentage of ducklings in united broods (12.0%) is similar to the value observed for Red-crested Pochard but it is much lesser than in Common Shelduck population (63.3%). Obviously, amalgamation the clutches or broods isn't the common strategy of breeding and rearing juveniles in Ferruginous Duck.

Although the time of hatching varies greatly, in late June the majority of Ferruginous Ducks rear broods and only 1 or 2 pairs can be considered as being incubated probably repeated clutches.

Shallow sites like those used by non-breeding Red-crested Pochards play an important role for Ferruginous Duck males which left their females after hatching. Unfortunately, the time period covered by our expeditions didn't allow us to assess the importance of Adji lake habitats for moulting Ferruginous Ducks and for forming post-breeding accumulations. The time of moulting is a crucial period for duck species. Ferruginous Ducks moult comparatively late in summer (Isakov, 1952) when the drought largely destroys suitable habitats. Therefore, the problem of suitability of habitats in late summer is of great importance for Ferruginous Duck conservation. Unfortunately, this matter wasn't covered by our studies. In autumn (November) Adji lake isn't of great importance for Ferruginous Duck mainly due to disturbance of birds by hunters.

Another globally threatened species, Marbled Duck early reported by local game officers as breeding at the lake wasn't found during our expedition time. 1998 spring and summer drought probably is one of the reasons for Marbled Duck absence at Adji lake in this season. Almost all satellite lakes in outskirts of Adji lake dried up in spring. Just these small lakes are those habitats especially suitable for Marbled Duck as it was reported in recent reviews (for example, Green, 1993). At the same time, it should be stressed that even non-breeding individuals of this species weren't found during the period of our surveys.

One of the most interesting records of our expedition is observation of White-headed Ducks at Adji lake. The breeding of these ducks at the lake is possible taking into account secretive behaviour of the observed female. We think that if these birds really bred at the lake they were in incubation stage in the end of June that agreed with available literature data (Makatsch, 1974, Green, Hughes, 1996). White-headed Duck prefers to breed at large lakes (Makatsch, 1974), and Adji lake is quite suitable for this species breeding.

Pygmy Cormorant & Dalmatian Pelican

Only little information on the status and the numbers of Pygmy Cormorant and Dalmatian Pelican were gathered in project expeditions most probably due to discrepancy of the terms of surveys and the time of maximum concentrations of these birds during migration. One possible reason for the fact that Pygmy Cormorant didn't stay at the lake despite the high numbers of migrating birds is that hunting on Coots enhances the level of disturbance in this period.

Little Bustard

Little Bustard forms accumulations in semi-desert habitats at investigated territory during migration. Unfortunately, we don't know exactly whether there are great gatherings of the species in spring. According to communications of local game keepers the species is very numerous in March although realistic data are absent for this time. But we have at our disposal the data on the status and numbers of this species in autumn. It is well known that Little Bustard occurs on autumn passage in comparatively small flocks in contrast to the spring situation when it departs from winter quarters in Azerbaijan in extremely large flocks consisted of thousands of birds (Vorobyeva, 1986). The total estimated number of Little Bustards stopped at Adji lake in November 1998 is 500 to 650 individuals. One should mentioned that we don't know the arrival and departure dates for Little Bustard population at Adji lake and the terms of our last field trip in November are too short. Therefore, it is possible that the numbers of the species can be even higher in terms for which no reliable data exist (late October or late November).

The analysis of Little Bustard flocks' observations showed that small flocks of 5 to 7 individuals were seen most frequently. Clear distinction of Little Bustard flocks by size can be considered as an indication of their structure. We suppose that large sized flocks originate as a result of medium sized flocks' association while the last ones can be formed by more or less constant groups of about 5 birds. Since single birds or pairs most usually are seen in close neighbourhood to feeding large or medium sized flocks it seems that they are related to such flocks but often feed separately.

Findings of Little Bustard remains in outskirts of Adji lake and some data on hunting practice on the investigated territory were used to identify the causes of mortality. Predation of birds of prey should be considered as main mortality factor for Little Bustard population at Adji lake based on gathered data. Some characters of remains give evidences for the conclusion that Goshawk is the most probable predator. No cases of human caused Little Bustard mortality were registered during our surveys. Our data on local hunting traditions allow us to consider the possible human caused mortality as being only accidental.

Some observations on Little Bustard feeding (checking the sites used by feeding flocks, inspection of Little Bustard droppings) convince that green plants comprise the main food resource for the species.

Special attention was paid to studying Little Bustard habitat requirements. Several habitat indicators were chosen to describe Little Bustard habitat selection. Some of them can be considered as indicators of safe conditions of birds' feeding (limit of view, terrain position, mean height of vegetation cover, stratification, maximum heights of second and third vegetation strata) while others can be regarded as indicators of presence of some food resources (land use type, grass presence, grass to herb ratio, moss/lichen presence, mean cover, grazing regime). Certainly, the proposed distinction isn't absolute and some other relationships with Little Bustard habitat requirements can be found (for example, certain indicators may point out the presence of relevant roosting conditions).

It is surprisingly that some habitat indicators chosen for the assessment proved insignificant for Little Bustard habitat selection. This is true even for those indicators which seemed to be especially meaningful (such as grass to herb ratio and mean cover). Nevertheless, the previous analysis showed that food availability or more precisely, availability of certain plant species used by Little Bustard as food plays the primary role in this species habitat selection most probably. Little Bustards show the clear preference of sites on long-fallow lands in comparison with sites with natural habitats such as semi-deserts. Taking into account that terrain position conditions of such sites (and therefore, safety conditions) most often are quite similar we suppose that Little Bustards select long-fallow lands since some plant species used as food resource can occur solely on these lands. Some other indicators give additional evidences for such hypothesis. For example, moss/lichen presence reflects land use conditions. Mosses and lichens occur primarily on undisturbed sites in semi-desert habitats. These plants are almost completely absent on long-fallow lands. Positive relation between Little Bustard choice of sites and grass presence on these sites possibly reflects the fact that some grass species may be used as food resource.

Another important condition for Little Bustard habitat selection is safety of feeding birds. The safety can be expressed in terms of those habitat features which facilitate birds' ability to detect approaching predator or intruder. That is why such indicators as stratification, limit of view and terrain position contribute considerably to the discriminatory power of the model in discriminant function analysis. All these indicators and also the maximum height of the second stratum reflect such habitat characters (height of vegetation cover, billowy or level terrain) which can obstruct the view for feeding flocks of Little Bustards.

Mediterranean Spur-thighed Tortoise

We consider the state of Mediterranean Spur-thighed Tortoise population at Adji lake as unfavourable since transect counts' data revealed the prevalence of older age groups in this population. Nevertheless, one should supposed that such a shift towards the predominance of older groups can be explained, for example, as a result of differences in habitat use by younger and older tortoises or as a consequence of possible differences between these ones in the time of the highest activity. Unfortunately, our field surveys didn't provide us with any arguments for testing the hypothesis of segregation of younger and older tortoises' niches. Scarce available literature data also can't help in resolving this question.

The analysis of the characteristics of habitat distribution of Mediterranean Spur-thighed Tortoise at Adji lake showed that sandy soils are particularly important for the species. Sandy soil is necessary for such key behaviour activities of tortoises as egg incubation and temperature regulation activity. Sand dunes take a central position in a relief profile and occupy the largest area in comparison with other habitats. Thus we consider sand dunes as main habitats of

Mediterranean Spur-thighed Tortoises while all other habitats in which the species was registered can be treated as secondary. We regard extremely high relative abundance of tortoises on long-fallow lands at the foots of sand dunes as only local phenomenon. Tortoises occurred on these lands can come from adjacent territories in sand dunes. They can use long-fallow lands as being more suitable for feeding needs or for movements. It should be noted also that long-fallow lands on sandy soils occupy a very small area. These considerations lead us to the conclusion that just sand dunes conservation aiming at protection of Mediterranean Spur-thighed Tortoise should be among the main topics of the conservation action plan for the ecosystem.

PROGRAMME OF CONSERVATION MEASURES

The programme of conservation measures was developed as a part of regional action plan for the ecosystem conservation. The action plan was designed as a tool for resolving those conservation problems highlighted by our scientific results. The following problems are considered in the plan:

1. **Water level lowering due to drought and over-extraction of water for irrigation purposes.**

This negative factor should be considered as main destructive factor for the ecosystem. The water level in Adji lake is partly maintained and regulated by the supply of water from the system of irrigation canals. This system is based on several small rivers. The sources of the rivers are in proximate mountains. The beds of these rivers were reconstructed and additional canals were built. Irrigation is of great importance for local people since water supply is a main limiting factor for agricultural practice in plain regions of Dagestan and in particular at Adji lake.

Concise characterisation of threat to the ecosystem state:

Numerous satellite semi-desert lakes in vicinity of Adji lake dried up in drought periods. These lakes usually provide many waterfowl species with excellent conditions for feeding and even for breeding. Over-summering populations of bird species depend on the area and the state of shallows where the majority of birds spends the time.

Decrease of water level in Adji lake is also unfavourable both for breeding and over-summering bird species. Conditions of feeding of diving ducks considerably deteriorated due to water level lowering. Probably, the formation of accumulations of Pygmy Cormorants and Dalmatian Pelicans partly depended on the water depth.

For the period of several years consistent droughts can considerably alter the structure of emergent and submerged vegetation that can negatively influence the conditions of breeding of rare duck species.

Over-extraction is especially apparent in drought periods. Therefore, drought reinforces the negative effects of human activities in outskirts of the lake.

The measures proposed for resolving the problem in conservation action plan (to be implemented by local game management officers mainly):

- putting together aware local people and staff of game management offices for combined efforts to water level regulation
- attracting the attention of local authoritative persons to this matter for getting necessary support of water level regulation actions
- consulting with local authorities to find the best solutions in conflict situations with local farmers

- involving the staff of game management office and district nature protection office in awareness raising work with local farmers to explain the significance of water level regulation in Adji lake
- assigning of target means in local budget for lake water level regulation

2. Negative impact of grazing on sand dune habitats and on emergent vegetation of the lake.

Concise characterisation of threat to the ecosystem state:

Grazing is one of the most constant impacting factors for Adji lake ecosystem. The habitats in surroundings of the lake (mainly, semi-deserts) have been under the impact of grazing for a long period of time in autumn, winter and spring. Semi-deserts are used as winter pastures for live-stock from adjacent mountainous regions. It should be noted that the impact of grazing have been decreased in recent years due to decreasing the numbers of live-stock in collective farms. As it was showed by our researches the impact of grazing on semi-desert habitats and, therefore on the state of migrating population of such vulnerable species as Little Bustard isn't very high.

Nevertheless, obvious evidences of negative effects of grazing on sand dune habitats and locally on emergent vegetation at Adji lake were found. In particular, grazing was considered as factor negatively effecting the state of Mediterranean Spur-thighed Tortoise population. Carapaces of younger tortoises are particularly sensitive to possible injuries by cow and sheep hoofs.

In drought periods in spring cows are often grazed on sites with emergent vegetation at Adji lake. Vegetation became seriously damaged due to grazing on some sites which are suitable for waterfowl breeding. Restructuring emergent vegetation led to losses of feeding, roosting and nesting opportunities for waterfowl birds.

The measures proposed for resolving the problem in conservation action plan (to be implemented with help of local game management personal):

- prohibition of grazing in dune habitats
- restriction or even prohibition of grazing at Adji lake shore-line
- awareness raising work with local herdsmen to explain negative effects of grazing in sand dune habitats

3. The problem of hunting and disturbance of birds.

Concise characterisation of threat to the ecosystem state:

The whole territory of Adji lake and some adjacent territories are under the jurisdiction of Papas (Adji) game management office. Consequently, hunting is a steady factor of disturbance for the ecosystem.

Unfortunately, very little is known on the impact of hunting on stability of bird accumulations in post-breeding and early migration periods. Special studies are needed for assessment of the situation in this time. Probably, some rare species bred at the lake can be impacted in this late summer period, for example the population of Ferruginous Duck.

The data provided by Papas game management office showed that hunting mostly impacted bird populations in late autumn and early winter periods when the numbers of Coot, traditionally main game species is at highest point. Shooting of rare species, probably, is a problem but no clear evidences exist on this matter. It seems that the main negative effect of hunting lie in disturbance of birds. It's is especially true taking into account the fact that the lake is comparatively shallow (usually no deeper than 1 m) and special type of hunting on Coots by bringing birds to bay is widely used.

The measures proposed for resolving the problem in conservation action plan:

- organising of annual training of gamekeepers of Papas game management office in rare bird species identification and in bird conservation and attraction methods
- preparing special programme of training for members of local hunting society
- shifting of terms of hunting at the lake

Some additional **scientific investigations and monitoring activities** are included in conservation action plan for Adji lake ecosystem. Among them are:

- clarification a question on whether the requirements of some waterfowl (in particular, Ferruginous Duck) in moulting and post-breeding sites are answered by the state of Adji lake habitats in late summer period
- assessment of the impact of early terms of hunting on post-breeding accumulations of birds
- monitoring activities during migration to determine the sources of threat to birds and to search most sensitive species
- additional searches for breeding Marbled Duck and White-headed Duck
- clarification a question on whether catching young Mediterranean Spur-thighed Tortoises is a real source of threat for this species population

Some positive experience was gained in our project expeditions that can be considered as a model for future conservation action implementation. Thus, in early June our project leader, Gadjibek Dzhamirsoev put together aware local people (mainly herdsmen), local game keepers and representatives of Kayakent district nature protection office to help to flood one large satellite lake north to Adji lake. The satellite lake dried up in spring due to severe drought. In recent years this lake have provided numerous birds by sites especially suitable for feeding over breeding period. The necessity for flooding the lake was clearly understood by all people involved. Leading by Magomed-Tagir Papalashev, Head of Papas (Adji) game management office the people used one of the canals near Adji lake to draw off the water and to flood the lake. This task was pulled off successfully. As a result, the numbers of over-summering birds increased substantially in June as compared to May as evidenced by the data of May and June project expeditions. Common Shelducks, Black-tailed Godwits, Common Redshanks, Marsh Sandpipers were provided by excellent sites for feeding for the whole early summer period.

One important thing we understood as a result of our project implementation is that our efforts can promote and strengthen interactions between local authorities (including local district administration, district nature protection offices and game management offices) and local people in resolving urgent questions of ecosystem conservation and management. The likelihood of conservation actions' success obviously enhances when putting together local people interested in nature conservation and representatives of local authorities for efforts to implement the actions.

Possibilities to implement the action plan for the ecosystem conservation were discussed in details with representatives of local and regional authorities. We consider good relations established with local authorities' representatives as a necessary basis for successful continuation of conservation work started since our project expedition.

Preliminary understanding was achieved on conditions of the conservation action plan implementation with officers of the Ministry of Environmental Protection of Dagestan Republic and scientists from the Institute for Applied Ecology, Makhachkala. The plan was presented to the Ministry of Environmental Protection and to Department of Conservation and Sustainable Development of Game Resources, Game Management Board of Dagestan Republic Government for reviewing and approving. As a result of consultations with officers of the Department we

agreed that some measures of our conservation action plan will be accepted as proper regulations to be implemented since 1999.

RAISING OF PUBLIC AWARENESS

Raising of public awareness of the ecosystem state was considered as an activity of high priority in enhancing the ecosystem conservation status. Several main fields of awareness raising activity were identified and the following actions were implemented within these fields:

CONSERVATION EDUCATION:

1. Excursion for local schoolboys at Adji lake.

During May expedition an excursion for schoolboys from local schools was organised. One surprising thing was that many schoolboys even little knew that so interesting lake is situated within 10 km distance of their native village. Schoolboys were familiarised with some most common and interesting bird and reptile species of the ecosystem. We tried to explain and show the uniqueness of Adji lake and the necessity for conservation measures to be implemented. At the same time, we saw a real interest of children in nature and respect for scientists and scientific activity unexpected for all of us. These feelings encouraged us greatly and we conclude that constant awareness work with both schoolboys and teachers in local schools is obviously needed.

The interest of schoolboys and teachers arose from the excursion resulted in intention to prepare an exhibition in the school hall with illustrated information on Adji lake. The exhibition was prepared during summer vacations with use of some photos taken during our expeditions.

Adults were also the target group for our project activity not only children. Thus, the following actions were done:

2. Meetings with local people.

Meetings with local authoritative persons which were held during June and November expeditions seemed to be very effective and important for guaranteeing successful implementation of any conservation actions on the investigated territory in future. Older people realised the importance of the lake without doubt and their opinions are decisive for other members of local communities in most cases.

During June and November expeditions meetings on problems of the rare bird species conservation with participation of members of local hunting society were organised. The problems of identification of rare bird species are carefully discussed on these meetings. Local game keepers were provided by short training in identification of rare waterfowl. Also possible problems of water level regulation activities were discussed with game keepers.

Additionally, meetings with local herdsmen were organised during all expeditions of the project. Our project team took an opportunity to live together with local herdsmen for some time. We became aware of herdsmen problems aroused from harsh economic situation while they became familiarised with unique role of their native places. We consider good relations established with herdsmen during our project implementation as an important step towards enhancing the level of conservation of the ecosystem.

3. Meetings with local authorities.

Special meeting was organised in June with participation of local authorities' representatives. The representatives of executive authorities, district land management office, collective farms, district game management office and district nature protection office were present at the meeting. The questions of assistance and help which are necessary for local game management office activity in resolving Adji lake conservation problems were discussed. The problem of water level regulation as a possible source of conflict situations was in the focus of the meeting. All authorities' representatives agreed to act in close co-ordination with each other to avoid conflicts and to achieve effective equilibrium between meeting the needs of collective farmers in water supply and necessity to maintain normal water level in Adji lake.

SPREADING HIGH-QUALITY INFORMATION ON ADJI LAKE ECOSYSTEM STATE AND ON MAIN FINDINGS OF THE PROJECT:

1. Meeting with officers of Department of Conservation and Sustainable Development of Game Resources, Game Management Board of Dagestan Republic Government

During June expedition a meeting with officers of Department of Conservation and Sustainable Development of Game Resources, Game Management Board of Dagestan Republic Government was organised. The officers were familiarised with problems of Adji lake conservation. Preliminary agreement was achieved on the question of consideration and possible acceptance of conservation action plan for the ecosystem. The necessity of renovation of the management plan for Papas (Adji) game management office was stressed in discussion. Problems of organising the monitoring of rare waterfowl populations' state were considered and the role of local game management office in such activities was highlighted. The ways for future co-operation of game managers and scientists were outlined during this meeting.

2. Presentations of main project findings on sessions of Kharkiv branch of Ukrainian Union for Bird Conservation

The main project activities and findings were presented on three regular sessions of Kharkiv branch of Ukrainian Union for Bird Conservation (UUBC) in September, October and December, 1998. In this presentations short history of BP Conservation Programme, its objectives and achievements were described. Members of Kharkiv branch of UUBC were familiarised with results of attending a week of field-work technique workshops in London, Great Britain in April, 1998 by one of project team members. In first presentation we also tried to explain carefully the aim and objectives of our project as well as to make clear all used methods and techniques. In second presentation the description of the investigated territory was given along with some information on bird fauna. The results of summer counts of waterfowl were discussed. The preliminary results of the project were highlighted in our second presentation. In third presentation we stressed the importance of Adji lake as a stopover site for migrating birds. The final results and main findings of the project were presented as well. The perspectives for implementation the conservation action plan for the ecosystem and future scientific studies at the lake were discussed with members of Kharkiv branch of UUBC.

3. Spreading information via Internet

Now a web site of Kharkiv branch of UUBC with links to the site with information on results of the project activity is being developed on Internet server of Kharkiv state university.

4. Spreading information in regional and international periodic press

Some information on the project was popularised in form of articles and papers in regional and international periodic press. Some articles on the project objectives and activities were published in Ukrainian national and regional newspapers. Articles are being prepared for Dagestan periodic press also.

The following scientific papers based on data gathered under the project are being prepared or are in press:

1). Communities of breeding birds of Adji lake, Dagestan Republic, Russia (Caucasian Ornithological Journal, in press);

2). Adji lake as IBA territory (IBA territories in Russia, Russian Bird Conservation Union, in preparation);

3). The state of Ferruginous Duck population at Adji lake, Dagestan Republic, Russia (Casarca bulletin, in preparation);

4). Record of White-headed Duck in Dagestan (Caucasian Ornithological Journal, in press);

5). 1998 Adji lake conservation project: main results (for one of international conservation journals, in preparation);

6). 1998 Adji lake conservation project: main results (for bulletins of Ukrainian Union for Bird Conservation and Russian Bird Conservation Union, in preparation);

7). Interesting records of birds at Adji lake, Dagestan Republic, Russia (Caucasian Ornithological Journal, in preparation);

8). Conservation priorities for Mediterranean Spur-thighed Tortoise population in Dagestan (for one of international conservation journals, in preparation);

9). Little Bustard habitat requirements: the results of case study (for one of international ornithological journals, in preparation);

10). Autumn migration of birds at Adji lake, Dagestan Republic, Russia (Caucasian Ornithological Journal, in preparation);

5. Other ways of spreading the project related information

Two broadcasts on results of project expeditions were prepared and translated by project team participants on Kharkiv regional broadcasting studio.

LOGISTICS AND ADMINISTRATION NOTES

For future work in the region can be helpful keeping in mind the following remarks on our project logistics and administration:

- it was quite reasonable for proper project work that project leader established good relations with local administration during his preliminary journey before main expedition trips

- availability of maps for the studied area was too low due to some restrictions
- permissions were not as so important for successful travelling in Dagestan Republic and other Caucasian regions as adequate behaviour, appearance & clothes and possibility to refer on familiarising with regional or local authoritative persons
- carefully developed routes and guidance by local people are necessary for travelling in Caucasus region
- greatly experienced and familiarised with road police local driver rendered invaluable service for success of our expedition
- good relations with local people (herdsmen) were crucial for appropriate camp organisation and food & water supply of expedition
- consideration of regional traditions was necessary without doubt for dealings with local people while our project work wouldn't be possible in absence of such contacts

Photography

Konica and Kodak films were used for field photographing.

Special attention was given to photographing of Ferruginous Ducks, typical habitats and landscapes at the lake and local people. Unfortunately, much more time was allotted to scientific activity comparatively to that one for photography.

CONCLUSIONS

1998 season field surveys under the project 'Adji lake ecosystem - conservation for the future' confirmed the unique role the lake ecosystem played in maintaining both breeding and migrating along the Western Caspian flyway populations of rare and vulnerable bird species. Among 178 bird species registered during expeditions' time 64 species or 35.6% were those with unfavourable conservation status (SPEC categories 1-3). At first time reliable data on the status, numbers and habitat requirements of these species were gathered that provides necessary background for developing conservation action plan for the ecosystem.

Adji lake maintains viable population of Ferruginous Duck, the species which is declining world-wide. Ferruginous Duck is among dominant duck species at the lake. The total size of the species breeding population was estimated as 35-48 pairs. Breeding success of Ferruginous Duck was high in 1998 as Adji lake habitats obviously meet the ducks' requirements in conditions which can guarantee safety and sufficient food resources during the period of brood rearing. Possible negative factors influencing Ferruginous Duck population are spring and especially summer droughts and disturbance during hunting season. Both factors seem to be most influential in post-breeding period. Unfortunately, due to special time lay-out of the project expeditions only little information was gathered on these factors' impact on Ferruginous Duck population.

The 1998 spring drought is a possible reason for failure in searches of Marbled Duck early reported by local game-keepers as breeding at the lake. Most suitable for this species habitats were in great extent suffered from this drought. The necessity of continuation the searches in next season became evident.

Unexpected record of another globally threatened species, White-headed Duck contrasted to depressing results of Marbled Duck searches. Male and female of the species were registered in habitats which are entirely suitable for breeding. Secretive behaviour of the observed female gave evidences for considering the breeding of the species as possible.

Two globally threatened bird species, Pygmy Cormorant and Dalmatian Pelican were recorded as well but the time of surveys didn't fit to the terms of obvious migration of these species. Pygmy Cormorants and Dalmatian Pelicans mainly use the lake as stopover sites on passage. Small groups of Pygmy Cormorants over-summer at the lake. The autumn migration of the species is well apparent but the disturbance by hunters can prevent long stopping of the birds at Adji lake.

Autumn project expedition was aimed primarily at assessment the numbers and habitat requirements of Little Bustard. The flocks of the species occurred in semi-desert habitats in the lake surroundings. The total numbers of birds at the lake in November 1998 was estimated as 500-650 individuals. The results of preliminary studies of Little Bustard habitat requirements showed that two main factors contribute to this species habitat selection: the availability of food resources and safety conditions of the habitat. Little Bustard prefers to feed on long-fallow lands rather than in comparatively undisturbed semi-desert habitats. The analysis of gathered data revealed that the reason for such choice can be presence of certain plant species used by Little Bustards as food. Those habitat features contributing to the enhancement of safety conditions (height of vegetation or limit of view) also play an important role in Little Bustard habitat choice. On the contrary, level of grazing impact and disturbance by hunters (the species isn't among traditional game species of the region) are of much lesser importance. Undoubtedly, special vegetation studies are necessary to understand clearly Little Bustard habitat requirements.

Among other rare bird species registered on the investigated territory in 1998 Lesser Kestrel (Falco naumanni) records should be noted. The species probably bred on herdsmen buildings in semi-desert habitats in outskirts of the lake.

Project surveys provided the information on the composition and structure of bird communities in main habitat types on the investigated territory. The highest species diversity was recorded for shallows with reed vegetation at Adji lake. The most widespread habitat type in outskirts of the lake is semi-desert with scarce vegetation. Bird communities of this habitat are characterised by clear unevenness of species abundance distribution. Two species, Isabelline Wheatear and Lesser Short-toed Lark comprises about 85% of the total population density.

Not only bird species, but also such reptile species as Mediterranean Spur-thighed Tortoise was in the focus of project studies. Sand dune habitats maintain the population of this species since sand soils are necessary for egg incubation and temperature regulation activities of tortoises. The state of Mediterranean Spur-thighed Tortoise population was considered as unfavourable at Adji lake because the age ratio is shifted towards predominance of older age groups. Grazing in sand dunes evidently resulted in injuring younger tortoises. Another probable negative factor can be catching of young individuals. Nevertheless, no clear evidences of this second factor reality were gathered in our expeditions.

Species and habitat case studies under the project showed that among negative factors influencing the ecosystem state one of the most important is water level lowering and drying up lesser lakes in close vicinity to Adji lake. This factor considerably impacted the conditions of nesting and rearing broods in breeding ducks and the conditions of feeding for numerous over-summering birds. Another adverse factor is over-grazing but it constitute a considerable threat mainly for sand dune habitats and declining Mediterranean Spur-thighed Tortoise population.

The impact of grazing on semi-desert habitats in recent times have been reduced along with decreasing the numbers of livestock. Hunting should be considered as main factor of disturbance for migrating birds which gather at the lake in autumn. Losses from shooting are of lesser concern since the main game species is quite numerous Coot.

The programme of conservation measures oriented towards mitigating the effects of negative factors was developed. Water level regulation activities are among main proposed measures.

Actions on water level regulation ranged from assigning target means in local budget to putting together aware local people and staff of game management offices for combined efforts to water level regulation. The necessity of prohibition of grazing in sand dunes was realised during project implementation. Thus, the prohibition was proposed in our programme. Special measures for hunting regulation are planned also. Shift of terms of hunting is proposed as a measure which is necessary to avoid disturbance of birds in post-breeding accumulations at the lake. We consider also enhancing the skills of local game keepers in bird identification and conservation methods as a proper way of involvement of local game management staff in conservation activities. Continuation of scientific studies or even monitoring activities are needed to create a background for purposeful conservation actions.

One of the important findings of our project is understanding the importance of promotion of interactions between local authorities (including local district administration, district nature protection offices and game management offices) and local people in resolving urgent questions of ecosystem conservation and management.

Implementation of the special programme for raising public awareness of Adji lake ecosystem state showed that local schoolboys knew too little about the lake and the birds. At the same time, children revealed an interest in nature and unexpected respect for scientists and scientific activity during excursion at the lake that encouraged us greatly. Thus we conclude that constant awareness work with both schoolboys and teachers in local schools is obviously needed.

Spread the information on Adji lake importance in regional and state periodic press and other mass media is being continued. For these purposes we try to combine aptly the most vivid scientific results with our insight into conservation problems emphasised by these results.

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Appendix I. Species of European Conservation Concern recorded at Adji lake in 1998 during field expeditions under the project "Adji lake ecosystem - conservation for the future".

	Species	Conservation status		Status on the investigated territory				Estimated numbers on the investigated territory				
		SPEC category	European Threat Status	Breeding	Over-summering or summer visitor	Migrating		Breeding population, in pairs	Over-summering birds, in ind.	Overall population size, in ind.		
						spring	autumn			spring	summer	autumn
1	2	3	4	5	6	7	8	9	10	11	12	13
1	Pygmy Cormorant (Phalacrocorax pygmaeus)	2	V	-	+	?	+	-	10-14	10-14	1-3	150-200
2	Dalmatian Pelican (Pelecanus crispus)	1	V	-	-	+	?	-	-	1	-	-
3	Great Bittern (Botaurus stellaris)	3	(V)	-	-	?	+	-	-	-	-	?[1]
4	Little Bittern (Ixobrychus minutus)	3	(V)	B	-	+	?	60	-	150-170	120	-
5	Night Heron (Nycticorax nycticorax)	3	D	-	-	+	?	-	-	2	-	-
6	Squacco Heron (Ardeola ralloides)	3	V	-	-	+	+	-	-	3-9	-	1
7	Purple Heron (Ardea purpurea)	3	V	B	-	?	+	3-4	-	10	6-8	1-2
8	Glossy Ibis (Plegadis falcinellus)	3	D	-	+	?	?	-	5-10	5-10	10-11	-
9	Eurasian Spoonbill (Platalea leucordia)	2	E	-	+	+	?	-	5	47-50	5	-

[1] Remains of one individual of Great Bittern were found at the lake on 14.11.1998.

1	2	3	4	5	6	7	8	9	10	11	12	13
10	Tundra Swan (Cygnus columbianus)	3	L^w	-	-	?	+	-	-	-	-	10-25
11	Whooper Swan (Cygnus cygnus)	4	S	-	-	+	+	-	-	2	-	1-2
12	Ruddy Shelduck (Tadorna ferruginea)	3	V	C	+	+	+	5-12	5-10	35-40	15-30	50-75
13	Gadwall (Anas strepera)	3	V	C	-	?	?	7-11	-	10-12	14-22	-
14	Pintail (Anas acuta)	3	V	-	+	+	+	-	2-3	2-3	3	1-10
15	Garganey (Anas querquedula)	3	V	C	+	?	+	12-15	14-15	30-40	40-45	10-20
16	Red-crested Pochard (Netta rufina)	3	D	C	+	+	?	60-72	120-160	185-190	240-305	-
17	Common Pochard (Aythya ferina)	4	S	C	+	?	+	3-5	5-6	-	12-16	20-50
18	Ferruginous Duck (Aythya nyroca)	1	V	C	+	?	+	35-48	15-17	60-70	85-113	25-30
19	Greater Scaup (Aythya marila)	3	L^w	-	-	?	+	-	-	-	-	25-50
20	Smew (Mergellus albellus)	3	V	-	-	?	+	-	-	-	-	15-30
21	White-headed Duck (Oxyura leucocephala)	1	E	B	-	?	?	1	-	-	2	-
22	European Honey-buzzard (Pernis apivorus)	4	S	-	-	+	?	-	-	1-2	-	-
23	Black Kite (Milvus migrans)	3	V	-	+	?	?	-	1-2	1-2	-	-
24	Hen Harrier (Circus	3	V	-	-	?	+	-	-	-	-	10-25

	cyaneus)											
1	2	3	4	5	6	7	8	9	10	11	12	13
25	Montagu's Harrier (Circus pygargus)	4	S	B	-	?	?	1	-	2	2	-
26	Long-legged Buzzard (Buteo rufinus)	3	(E)	-	+	?	+	-	1-2	1-2	-	10-25
27	Steppe Eagle (Aquila nipalensis)	3	V	-	-	?	+	-	-	-	-	2-5
28	Golden Eagle (Aquila chrysaetos)	3	R	-	-	?	+	-	-	-	-	1-2
29	Lesser Kestrel (Falco naumanni)	1	(V)	A	-	?	?	2-3	-	4-6	4-6	-
30	Common Kestrel (Falco tinnunculus)	3	D	A	-	?	?	2-3	-	4-6	4-6	-
31	Peregrine Falcon (Falco peregrinus)	3	R	-	-	+	?	-	-	1	-	-
32	Common Quail (Coturnix coturnix)	3	V	-	-	?	+	-	-	-	-	50-100
33	Spotted Crake (Porzana porzana)	4	S	A	-	?	?	5-10	-	10-20	-	-
34	Little Crake (Porzana parva)	4	(S)	A	-	?	?	5-10	-	10-20	-	-
35	Purple Swamp-hen (Porphyrio porphyio)	3	R	B	-	?	?	6	-	2-4	12	-
36	Little Bustard (Tetrax tetrax)	2	V	-	-	?	+	-	-	-	-	500-650
37	Avocet (Recurvirostra avosetta)	4/3	L^w	-	+	+	+	-	7-8	1	7-8	1-2
38	Stone-curlew (Burhinus oedicnemus)	3	V	C	-	?	?	20-22	-	40-45	40-45	-
39	Collared Pratincole	3	E	B	+	?	?	12-15	10-20	30-40	35-50	-

1	2	3	4	5	6	7	8	9	10	11	12	13
40	Kentish Plover (Charadrius alexandrinus)	3	D	B	-	?	?	2-4	-	4-6	4-8	-
41	Ruff (Philomachus pugnax)	4	(S)	-	+	+	+	-	40	40-50	40	5-10
42	Black-tailed Godwit (Limosa limosa)	2	V	-	+	?	+	-	60-120	-	60-120	1-2
43	Eurasian Curlew (Numenius arquata)	3	D^w	-	+	?	+	-	6	-	6	1
44	Common Redshank (Tringa totanus)	2	D	-	+	?	+	-	20-50	-	20-50	2-5
45	Wood Sandpiper (Tringa glareola)	3	D	-	+	+	+	-	5-6	40-55	5-6	1-2
46	Little Gull (Larus minutus)	3	D	-	-	?	+	-	-	-	-	10-25
47	Common Gull (Larus canus)	2	D	-	-	?	+	-	-	-	-	10-15
48	Gull-billed Tern (Sterna nilotica)	3	(E)	-	+	+	?	-	30-35	1-2	30-35	-
49	Caspian Tern (Sterna caspia)	3	(E)	-	+	?	?	-	1-2	-	1-2	-
50	Sandwich Tern (Sterna sandvicensis)	2	D	-	+	?	?	-	7	-	7	-
51	Whiskered Tern (Chlidonias hybridus)	3	D	-	+	+	?	-	65	46-58	65	-
52	Black Tern (Chlidonias niger)	3	D	-	+	-	?	-	-	25-30	-	-
53	Stock Dove (Columba oenas)	4	S	-	-	+	?	-	-	5	-	-

1	2	3	4	5	6	7	8	9	10	11	12	13
54	Wood Pigeon (Columbus palumbus)	4	S	-	-	+	?	-	-	8-10	-	-
55	Turtle Dove (Streptopelia turtur)	3	D	-	+	?	?	-	10-15	-	10-15	-
56	Little Owl (Athene noctua)	3	D	C	-	-	-	12-14	-	24-28	24-28	24-28
57	Common Kingfisher (Alcedo atthis)	3	D	B	-	?	+	5-7	-	10-15	10-15	1-5
58	European Bee-eater (Merops apiaster)	3	D	-	-	+	?	-	-	150-155	-	-
59	European Roller (Coracias garrulus)	2	(D)	-	+	+	?	-	6-10	6-10	6-10	-
60	Calandra Lark (Melanocorypha calandra)	3	(D)	-	-	?	+	-	-	-	-	1000-1250
61	Short-toed Lark (Calandrella brachydactyla)	3	V	B	-	?	+	2-5	-	?	4-10	50-80
62	Lesser Short-toed Lark (Calandrella rufescens)	3	V	C	-	+	+	900-1000	-	1800-2000	1800-2000	200-500
63	Crested Lark (Galerida cristata)	3	(D)	C	-	?	+	42-45	-	85-90	85-90	50-100
64	Skylark (Alauda arvensis)	3	V	C	-	?	+	180-200	-	360-400	360-400	15000-20000
65	Sand Martin (Riparia riparia)	3	D	-	-	+	?	-	-	9000-10000	-	-
66	Barn Swallow (Hirundo rustica)	3	D	C	-	+	?	50-55	-	2500-3000	100-110	-
67	Tawny Pipit (Anthus	3	V	B	-	?	?	3-5	-	6-10	6-10	-

	campestris)											
1	2	3	4	5	6	7	8	9	10	11	12	13
68	Meadow Pipit (Anthus pratensis)	4	S	-	-	+	+	-	-	5-10	-	800-1000
69	Robin (Erithacus rubecula)	4	S	-	-	?	+	-	-	-	-	15-30
70	Common Redstart (Phoenicurus phoenicurus)	2	V	-	-	+	?	-	-	100-135	-	-
71	Whinchat (Saxicola rubetra)	4	S	B	-	?	?	2-5	-	4-10	4-10	-
72	Common Stonechat (Saxicola torquata)	3	(D)	C	-	?	?	10-15	-	20-30	20-30	-
73	Blackbird (Turdus merula)	4	S	-	+	?	?	-	?[2]	-	1	-
74	Savi's Warbler (Locustella luscinioides)	4	(S)	C	-	?	?	200-225	-	400-450	400-450	-
75	Sedge Warbler (Acrocephalus schoenobaenus)	4	(S)	B	-	?	?	300-330	-	600-660	600-660	-
76	Reed Warbler (Acrocephalus scirpaceus)	4	S	C	-	?	?	40	-	80	80	-
77	Olivaceous Warbler (Hippolais pallida)	3	(V)	C	-	?	?	300-350	-	600-700	600-700	-
78	Common Whitethroat (Sylvia communis)	4	S	C	-	?	?	65-70	-	130-140	130-140	-
79	Red-backed Shrike (Lanius collurio)	3	(D)	C	-	?	?	100-125	-	200-250	200-250	-

[2] Remains of one individual of Blackbird were found at the lake on 22.06.1998

1	2	3	4	5	6	7	8	9	10	11	12	13
80	Lesser Grey Shrike (Lanius minor)	2	(D)	C	-	?	?	15-20	-	30-40	30-40	-
81	Great Grey Shrike (Lanius excubitor)	3	D	-	-	?	+	-	-	-	-	2-5
82	Common Chaffinch (Fringilla coelebs)	4	S	-	-	?	+	-	-	-	-	100-250
83	Siskin (Carduelis spinus)	4	S	-	-	-	+	-	-	-	-	50-100
84	Linnet (Carduelis cannabina)	4	S	-	-	?	+	-	-	-	-	30-50
85	Yellowhammer (Emberiza citrinella)	4	(S)	-	-	?	+	-	-	-	-	50-100
86	Ortolan Bunting (Emberiza hortulana)	2	(V)	-	-	+	?	-	-	1-5	-	-
87	Corn Bunting (Miliaria calandra)	4	(S)	C	-	?	+	20-25	-	40-50	40-50	500-700

Table key

Categories of European Conservation Concern according to species global and European status (SPEC categories; Tucker, Heath, 1994):
1 - Species of global conservation concern, i.e. classified as Globally Threatened, Conservation Dependent or Data Deficient
2 - Concentrated in Europe and with an Unfavourable Conservation Status
3 - Not concentrated in Europe but with an Unfavourable Conservation Status
4 - Concentrated in Europe and with a Favourable Conservation Status
- for SPEC categories given as 4/2, the first number is the SPEC category relating to the breeding population, while the second number relates to the winter population

European Threat Status (Tucker, Heath, 1994):
E - Endangered
V - Vulnerable
R - Rare
D - Declining
L - Localised
S - Secure
^{w} - Category relates to winter population
( ) - Status provisional

Status on the investigated territory:
Breeding:
A - Possible breeding
B - Probable breeding
C - Confirmed breeding

Over-summering/migrating:
+ - Species was recorded during project expeditions as over-summering/migrating
? - Species is probably over-summering/migrating but it wasn't recorded during project expeditions

References

1. Tucker, G.M., Heath, M.F. (1994). Birds in Europe: their conservation status. Cambridge, U.K.: BirdLife International (BirdLife Conservation Series no. 3).

Appendix II. Distribution of duck broods by age stages[1] in late June 1998, Adji lake.

[1]	Age class	Age stage	Age of Anas spp. ducklings, in days	Age of Aythya spp. ducklings, in days	Number of recorded broods of Red-crested Pochard	Number of recorded broods of Ferruginous Duck	Number of recorded broods of Common Shelduck	Number of recorded broods of Garganey	Number of recorded broods of Common Pochard	Number of recorded broods of Ruddy Shelduck	Number of recorded broods of Gadwall
1	I	1	1-6	1-6	1	4	1	-	-	-	-
2	I	2	7-13	7-13	9	5	2	-	2	1	1
3	I	3	14-18	14-20	9	1	3	-	-	-	-
4	II	4	19-25	21-28	2	6	7	-	-	-	-
5	II	5	26-35	29-33	8	3	3	1	1	-	-
6	II	6	36-44	34-40	2	2	-	-	-	1	-
7	III	7	45-53	41-50	1	1	-	5	-	-	-
Broods of undetermined age					12	4	1	-	-	1	2
Total					44	26	17	6	3	3	3

[1] Age stages are discerned according to J. Gollop and W. Marshall (Gollop, Marshall, 1954; see **Fieldwork Methodology**)

Appendix III. Breeding bird communities in main habitats of Adji lake and surrounding territories.

1. Bird communities of shallows with reed vegetation along the lake shore including narrow strip of semi-desert habitats, salt marshes and meadows (Adji lake, data of transect counts in May).

1	Species	Mean density calculated from counts with measuring individual distances, ind./sq.km	Mean occurrence, ind./km
1	2	3	4
1	*Sedge Warbler (Acrocephalus schoenobaenus)*	350.17	21.15
2	*Savi's Warbler (Locustella luscinioides)*	234.09	21.31
3	*Paddyfield Warbler (Acrocephalus agricola)*	190.05	23.26
4	*Great Reed Warbler (Acrocephalus arundinaceus)*	179.64	21.36
5	Olivaceous Warbler (Hippolais pallida)	163.86	8.92
6	*Bearded Tit (Panurus biarmicus)*	82.83	8.38
7	*Moustached Warbler (Acrocephalus melanopogon)*	54.04	3.98
8*	Common Redstart (Phoenicurus phoenicurus)	40.97	2.41
9	Common Whitethroat (Sylvia communis)	40.70	2.34
10	*Red-crested Pochard (Netta rufina)*	38.99	16.78
11	*Reed Warbler (Acrocephalus scirpaceus)*	36.49	4.23
12*	Wood Sandpiper (Tringa glareola)	29.95	4.47
13	Red-backed Shrike (Lanius collurio)	28.92	2.41
14*	Ruff (Philomachus pugnax)	26.77	4.16
15**	*Black-winged Stilt (Himantopus himantopus)*	26.17	5.90
16	*Coot (Fulica atra)*	19.20	3.37
17	*Common Cuckoo (Cuculus canorus)*	19.16	3.39
18*	Blue-cheeked Bee-eater (Merops superciliosus)	16.22	3.88
19***	Common Starling (Sturnus vulgaris)	16.10	8.35
20**	Yellow-legged Gull (Larus cachinnans)	14.85	4.90
21	*Water Rail (Rallus aquaticus)*	14.40	1.23
22*	Common Sandpiper (Actitis hypoleucos)	14.40	1.65

23*	Sand Martin (Riparia riparia)	14.17	397.29
24	*Common Shelduck (Tadorna tadorna)*	12.23	5.79
1	2	3	4
25	Northern Lapwing (Vanellus vanellus)	12.11	3.42
26	Pied Wagtail (Motacilla alba)	11.63	0.58
27	*Cetti's Warbler (Cettia cetti)*	11.52	1.41
28	*Ferruginous Duck (Aythya nyroca)*	10.75	2.78
29*	Common Snipe (Gallinago gallinago)	10.11	1.18
30*	Barn Swallow (Hirundo rustica)	9.18	303.99
31	Moorhen (Gallinula chloropus)	8.23	0.82
32*	Rosy Starling (Sturnus roseus)	8.03	32.17
33	*Ruddy Shelduck (Tadorna ferruginea)*	7.75	2.78
34*	Yellow Wagtail (Motacilla flava flava)	6.99	1.00
35	*Little Bittern (Ixobrychus minutus)*	6.76	0.59
36	Isabelline Wheater (Oenanthe isabellina)	6.67	0.67
37	Northern Wheater (Oenanthe oenanthe)	6.67	0.67
38	Menetries's Warbler (Sylvia mystacea)	6.67	0.67
39	*Gadwall (Anas strepera)*	5.91	0.81
40**	Great Cormorant (Phalacrocorax carbo)	5.30	4.90
41**	*Glossy Ibis (Plegadis falcinellus)*	5.30	0.42
42	Magpie (Pica pica)	5.30	0.96
43**	*Spoonbill (Platalea leucordia)*	5.09	4.19
44**	Black-headed Gull (Larus ridibundus)	4.83	3.54
45	*Garganey (Anas querquedula)*	4.75	3.10
46	Collared Pratincole (Glareola pratincola)	4.36	3.36
47	*Carrion Crow (Corvus corone cornix)*	4.26	1.80
48	*Little Grebe (Tachybaptus ruficollis)*	3.51	0.28
49	Hoopoe (Upupa epops)	3.33	0.33
50	Lesser Grey Shrike (Lanius minor)	3.33	0.67
51	Crested Lark (Galerida cristata)	2.91	0.58
52	Skylark (Alauda arvensis)	2.91	0.58
53*	Red-throated Pipit (Anthus cervinus)	2.77	1.68
54**	*Great White Egret (Egretta alba)*	2.71	1.15
55	*Little Crake (Porzana parva)*	2.45	0.21

56	*Great Crested Grebe (Podiceps cristatus)*	2.13	0.79
57**	*Mute Swan (Cygnus olor)*	2.06	4.06
58	*Purple Heron (Ardea purpurea)*	1.92	0.42
59**	*Little Egret (Egretta garzetta)*	1.89	1.33
60**	*Pygmy Cormorant (Phalacrocorax pygmaeus)*	1.81	0.81
1	2	3	4
61**	Grey Heron (Ardea cinerea)	1.69	0.66
62	*Kentish Plover (Charadrius alexandrinus)*	1.69	0.34
63	Yellow Wagtail (Motacilla flava feldegg)	1.69	0.17
64	Corn Bunting (Emberiza calandra)	1.68	0.42
65	Tawny Pipit (Anthus campestris)	1.67	0.33
66**	*Whiskered Tern (Chlidonias hybridus)*	1.49	4.94
67**	*Marsh Sandpiper (Tringa stagnatilis)*	1.47	0.18
68	*Northern Shoveler (Anas clypeata)*	1.03	0.60
69**	*Squacco Heron (Ardeola ralloides)*	0.97	0.79
70**	*White-winged Black Tern (Chlidonias leucopterus)*	0.91	1.26
71	*Spotted Crake (Porzana porzana)*	0.85	0.09
72	*Purple Swamp-hen (Porphyrio porphyrio)*	0.85	0.09
73	Little Ringed Plover (Charadrius dubius)	0.85	0.17
74*	Grey Plover (Pluvialis squatarola)	0.85	0.59
75***	European Bee-eater (Merops apiaster)	0.85	6.99
76*	Meadow Pipit (Anthus pratensis)	0.84	0.08
77	*Marsh Harrier (Circus aeruginosus)*	0.78	0.50
78	*Pintail (Anas acuta)*	0.76	0.27
79*	Spotted Redshank (Tringa erythropus)	0.74	0.15
80***	European Roller (Coracias garrulus)	0.60	0.22
81*	Red-necked Phalarope (Phalaropus lobatus)	0.59	0.30
82***	Hobby (Falco subbuteo)	0.53	1.16
83*	Common Teal (Anas crecca)	0.42	0.09
84	Mallard (Anas platyrhynchos)	0.42	0.08
85***	Black Kite (Milvus migrans)	0.42	0.14
86***	Common Kestrel (Falco tinnunculus)	0.42	0.08
87***	Rook (Corvus frugilegus)	0.42	1.16
88**	*Black Tern (Chlidonias niger)*	0.40	2.59

89*	Little Stint (Calidris minuta)	0.37	2.88
90**	Greylag Goose (Anser anser)	0.17	0.09
91**	*Avocet (Recurvirostra avosetta)*	0.17	0.09
92***	Common Swift (Apus apus)	0.15	3.37
93*	Night Heron (Nycticorax nycticorax)	0.09	0.17
94*	*Whooper Swan (Cygnus cygnus)*	0.09	0.17
95**	*Dalmatian Pelican (Pelecanus crispus)*	0.08	0.15
96	*Montagu's Harrier (Circus pygargus)*	0.04	0.13
1	2	3	4
97*	European Honey-buzzard (Pernis apivorus)	0.03	0.08
98**	Great Black-headed Gull (Larus ichthyaetus)	0.03	0.33
99**	Gull-billed Tern (Sterna nilotica)	0.03	0.19
100**	Common Tern (Sterna hirundo)	0.03	0.15
	Total	**1893.43**	**1001.85**

2. Bird communities of irrigation canals (Adji lake surroundings, data of transect counts in May).

1	Species	Mean density calculated from counts with measuring individual distances, ind./sq.km	Mean occurrence, ind./km
1	2	3	4
1	*Moustached Warbler (Acrocephalus melanopogon)*	636.80	31.36
2	*Great Reed Warbler (Acrocephalus arundinaceus)*	541.10	28.77
3	*Paddyfield Warbler (Acrocephalus agricola)*	375.05	20.13
4	*Sedge Warbler (Acrocephalus schoenobaenus)*	218.28	10.76
5	*Cetti's Warbler (Cettia cetti)*	114.45	6.04
6	*Bearded Tit (Panurus biarmicus)*	95.89	5.48
7	Marsh Warbler (Acrocephalus palustris)	62.49	4.03
8	Spotted Crake (Porzana porzana)	27.40	1.37
9	Reed Warbler (Acrocephalus scirpaceus)	20.76	1.02
10	Savi's Warbler (Locustella luscinioides)	10.54	2.01
11	Common Cuckoo (Cuculus canorus)	10.27	1.37
12	Magpie (Pica pica)	10.27	1.37
13*	Grey Plover (Pluvialis squatarola)	0.12	-
	Total	**2123.42**	**113.71**

3. Bird communities of semi-deserts with scarce vegetation (Adji lake surroundings, data of transect counts in May-June).

[1]	Species	Mean density calculated from counts with measuring individual distances, ind./sq.km
1	*Isabelline Wheatear (Oenanthe isabellina)*	261.95
2	*Lesser Short-toed Lark (Calandrella rufescens)*	45.35
3*	Red-throated Pipit (Anthus cervinus)	17.48
4	Red-backed Shrike (Lanius collurio)	9.62
5	*Skylark (Alauda arvensis)*	8.91
6*	Yellow Wagtail (Motacilla flava flava)	6.99
7***	Carrion Crow (Corvus corone cornix)	3.12
8***	European Bee-eater (Merops apiaster)	2.98
9***	Common Cuckoo (Cuculus canorus)	2.80
10	*Common Shelduck (Tadorna tadorna)*	0.97
11	*Little Owl (Athene noctua)*	0.56
12	*Stone-curlew (Burhinus oedicnemus*	0.44
13***	Lesser Kestrel (Falco naumanni)	0.38
14*	Wood Sandpiper (Tringa glareola)	0.28
15***	Purple Heron (Ardea purpurea)	0.27
16***	Barn Swallow (Hirundo rustica)	0.18
17	*Collared Pratincole (Glareola pratincola)*	0.17
	Total	**362.45**

4. Bird communities of semi-deserts with *Tamarix* and *Juncus* vegetation (Adji lake surroundings, data of transect counts in May).

[1]	Species	Mean density calculated from counts with measuring individual distances, ind./sq.km
1	*Olivaceous Warbler (Hippolais pallida)*	47.30
2	Skylark (Alauda arvensis)	27.03
3*	*Common Redstart (Phoenicurus phoenicurus)*	24.78
4	*Red-backed Shrike (Lanius collurio)*	18.92
5	Isabelline Wheatear (Oenanthe isabellina)	18.47
6	*Menetries's Warbler (Sylvia mystacea)*	15.77
7	Crested Lark (Galerida cristata)	13.96
8***	Sand Martin (Riparia riparia)	13.13
9	Common Shelduck (Tadorna tadorna)	7.21
10	Magpie (Pica pica)	6.31
11***	European Bee-eater (Merops apiaster)	3.21
12***	Carrion Crow (Corvus corone cornix)	2.38
13***	Purple Heron (Ardea purpurea)	2.25
14	Northern Lapwing (Vanellus vanellus)	2.25
15***	Barn Swallow (Hirundo rustica)	0.84
16***	Whiskered Tern (Chlidonias hybridus)	0.25
17***	Blue-cheeked Bee-eater (Merops superciliosus)	0.25
18***	Rook (Corvus frugilegus)	0.23

19*	Wood Sandpiper (Tringa glareola)	0.14
20***	Great Cormorant (Phalacrocorax carbo)	0.07
	Total	**204.75**

5. Bird communities of sand dune habitats (Adji lake surroundings, data of transect counts in May).

[1]	Species	Mean density calculated from counts with measuring individual distances, ind./sq.km
1***	*Sand Martin (Riparia riparia)*	105.94
2	*Olivaceous Warbler (Hippolais pallida)*	34.96
3	*Red-backed Shrike (Lanius collurio)*	24.36
4	*Menetries's Warbler (Sylvia mystacea)*	14.83
5	Lesser Grey Shrike (Lanius minor)	11.79
6	Common Cuckoo (Cuculus canorus)	10.48
7*	Common Redstart (Phoenicurus phoenicurus)	8.73
8	*Common Whitethroat (Sylvia communis)*	8.23
9	Isabelline Wheater (Oenanthe isabellina)	7.00
10	*Magpie (Pica pica)*	6.36
11***	Lesser Kestrel (Falco naumanni)	6.17
12*	Yellow Wagtail (Motacilla flava flava)	6.17
13	Carrion Crow (Corvus corone cornix)	6.04
14***	Barn Swallow (Hirundo rustica)	5.65
15	Whinchat (Saxicola rubetra)	4.37
16	Great Reed Warbler (Acrocephalus arundinaceus)	4.37
17	Hoopoe (Upupa epops)	4.12
18	House Sparrow (Passer domesticus)	4.12
19***	Common Swift (Apus apus)	3.10
20	*Stone-curlew (Burhinus oedicnemus)*	2.88
21	Crested Lark (Galerida cristata)	2.88
22***	European Bee-eater (Merops apiaster)	2.02
23***	Blue-cheeked Bee-eater (Merops superciliosus)	0.82
24*	Stock Dove (Columba oenas)	0.20
25*	Wood Pigeon (Columba palumbus)	0.20
26*	Grey Plover (Pluvialis squatarola)	0.18
27***	Yellow-legged Gull (Larus cachinnans)	0.15
28	Pied Wagtail (Motacilla alba)	0.15
29***	Great Cormorant (Phalacrocorax carbo)	0.10
30	Common Shelduck (Tadorna tadorna)	0.09
31***	Common Kestrel (Falco tinnunculus)	0.06
32*	Wood Sandpiper (Tringa glareola)	0.05
	Total	**286.57**

6. Bird communities of coastal habitats of the Caspian sea (Adji lake surroundings, data of transect counts in May).

[1]	Species	Mean density calculated from counts with measuring individual distances, ind./sq.km	Mean occurence, ind./km
1**	*Great Cormorant (Phalacrocorax carbo)*	42.12	37.31
2	*Little Ringed Plover (Charadrius dubius)*	12.95	2.07
3	*Pied Wagtail (Motacilla alba)*	12.95	1.04
4	Coot (Fulica atra)	10.36	0.52
5***	*Common Shelduck (Tadorna tadorna)*	5.18	1.04
6***	*Great Crested Grebe (Podiceps cristatus)*	3.63	2.59
7***	*Carrion Crow (Corvus corone cornix)*	3.63	1.04
8	*Common Sandpiper (Actitis hypoleucos)*	2.59	0.52
9	Hoopoe (Upupa epops)	2.59	0.52
10	Red-backed Shrike (Lanius collurio)	2.59	0.52
11***	Barn Swallow (Hirundo rustica)	1.55	3.11
12***	Sand Martin (Riparia riparia)	0.80	3.11
13**	*Yellow-legged Gull (Larus cachinnans)*	0.18	2.07
14**	*Great Black-headed Gull (Larus ichthyaetus)*	0.10	0.52
	Total -	**101.22**	**55.98**

Table key

* - migrant species which use the habitat for resting and feeding
** - over-summering species
*** - species which regularly visit the habitat to feed (or transit species)
The names of the species which are characteristic for certain habitat are shown in italics.