

Faculty of Veterinary Science
Department of Animal Breeding, Nutrition, and
Laboratory Animal Science

Breeding Chukar Partridges (*Alectoris chukar*) in Cyprus

by Hemonides Efstathios

Tutor:

Dr. Miklos Marosan PhD, Dr.habil.

Department of Animal Breeding

Budapest 2013

Index:	Page
1. Introduction	4
1.1. Aims	6
2. Review of literature	7
2.1. Classification	7
2.3. Adaptation	7
2.4. Nutrition	8
2.5. Reproduction	8
2.6. Description	9
3. Material and methods	9
3.1. Sex determination	10
4. Results and discussion	12
4.1. Characteristics of the chukar eggs	12
4.2. Egg care	12
4.3. Egg storage	13
4.4. Hatching	15
4.5. Incubation	15

4.6. Embryo Mortality	16
4.7. Brooding	17
4.8. Growing Chukars	19
4.9. Lighting for growing Chukars	19
4.10. Nutrition	20
4.11. Management of breeders	22
4.12. Mating ratio	23
4.13. Fertility	23
4.14. Egg production	23
4.15. Sanitation	24
4.16. Diseases	25
5. Conclusions	34
6. Summary	35
7. List of reference	36

1. Introduction

Alectoris chukar Cypriotes (picture 1.) the best known game bird seen throughout the year all over Cyprus.

Is one of the most handsome birds of Cyprus belonging to the Phasianidae family. It is also the best known game bird. It is a common resident bird seen throughout the year all over the island. The Cypriotes race also occurs in Crete and southern Aegean islands. Its habitat extends throughout Cyprus from the dry rocky or arid land to the vine-covered hill-sides and as high on mountains 1900 meters above sea level.

Its striking combination of colours and patterns is quite impressive with prominent colour of the upper parts pale gray the forehead been ash grey and flanks barred black, white and chestnut, the belly is warm buff, white cheeks and throat bordered with black and a characteristic red bill and legs.

Pairing occurs as early as mid January in the lowlands and as late March in the higher mountains. Clutches between 11-15 are the norm and occur from February to May. Young ones appear in late March to August. Chukars are persistent if their first clutch is lost. If conditions are favourable chukars may lay 2 successive clutches even though this is not very common. (Kassinis, 2001)

During the summer and autumn partridges may seen in coveys of up to twelve or more but later in the year they appear in pairs or small parties. They make a nest of dry grass on the ground and in March and April lay from eight to sixteen eggs which are hatched in about twenty-two days. Partridges spend most of their time on the ground and being good runners they often adopt this method of avoiding their enemies rather than taking to flight. Still, they are renowned for their powerful direct flight. (Kassinis, 2001)

Great efforts are made every year to increase the chukar population. From 1990 a new legislation was introduced providing for the allocation of the funds coming from shooting license, to the protection and development of game and wildlife. About 2 million euro is spent annually for the improvement of habitat, rearing of game species, protection and scientific research. (URL₁)

There is a state-operated farm in Stavrovouni that produces 120 thousand chukar partridges a year. Pen-reared chukars are released in the wild twice a year, in January and summer. In January, year-old birds are released after being conditioned in large pens at the release site to reinforce the decrease due to shooting.



Picture 1. *Alectoris chukar* Cypriotes (URL₁)

The breeding program is under the authority of the Cypriot government. A special department that is responsible for the preservation of wild life, controlling illegal hunting and rescue of wild life in danger is operating the program all under the supervision of the ministry of internal affairs. The government is raising the necessary funds for supporting the program from

hunters paying annual hunting permit fees. The program started in 1990 and in only two years time the annual release of birds was 25 thousand. From that time until today with the experience of working staff in the field the annual release of birds has reached 120 thousand. The breeding facilities are situated in the Stavrovouni forest (picture 2.) which is the most natural habitat of the Alectoris Chukar Cypriotes. (URL₁)



Picture 2. Location of the breeding farm (URL₁)

1.1 Aims

The breeding of Alectoris chukar for hunting and wild life preservation. The annual breeding program gives 120 thousand birds that are released out in nature. The farm is under the authority of the game fund that belongs to the Cypriot government.

2. Review of literature

2.1 Classification:

Domain: Eukaria means that the organism has a true nucleus and membrane bound organelles.

Kindom: Animalia means that the organism is a multicellular heterotroph with cell walls.

Phylum: Chordata means the organism possesses notochord, tubular nerve chord, pharyngeal pouches, endostyle and a post anal tail.

Subphylum: Vertebrata means that the organism has a set of vertebrae.

Class: Aves means that the organism has a horny beak, no teeth, feathers, and large yoked hard shelled eggs.

Order: Calliformes means that the organism is fowl-like with a stocky body.

Family: Phasianidae means that the organism is a blunt-winged terrestrial bird commonly known as grouse, turkeys, pheasants and partridges.

Genus: Alectoris means that the organism is a plump bird with a grey or tan back, grey chest, and stocky belly.

Species: Alectoris Chukar means that the organism is a partridge game-bird. The phylogenetic tree shows Alectoris chukar and graeca more closely related than to Alectoris rufa based on mitochondrial DNA sequence variation.

Subspecies: Alectoris Chukar Cypristes means that the organism is a partridge game-bird found in Cyprus also Creta, southern Aegean islands and southern Turkey. (Dudich and Loksa, 1987; Papp, 1996)

2.2. Habitat: Found throughout Cyprus from the dry rocky or arid land to the vine-covered hill-sides and as high mountains one thousand nine hundred meters above sea level. (Kassinis, 2001)

2.3. Adaptation: Chukars do not migrate during the winter months. Instead they do altitudinal migration. This means that they move up and down in elevation based on snow and storms. Chukars are strong flyers but unless they are being attacked from above, their escape mechanism of choice is running. (Kassinis, 2001)

2.4. Nutrition: The source of all tissue proteins, including the major muscle mass of the body, is dietary proteins and amino acids. The closer the supply of dietary amino acids comes to actual levels required for optimum growth, the greater the proportion of lean tissue in the body. The body of the bird, like humans, has remarkable capacity for storing surplus dietary energy in the form of fat. Certain amount of fat on the carcass of the chukar may be desirable for its meat has a tendency to be dry. The suggested protein level of the starter diet is 25%. For most laying flocks of chukars a diet containing 16% protein is adequate. When raised in a farm or by other forms of breeders a chukars diet is somewhat different it mainly consist of yellow corn, soybean meal, wheat bran, limestone, fat and salt. Adequate source of water is very essential. (Woodard, 1982)

2.5. Reproduction: In their natural habitat chukars pairing occur as early as mid January in the lowlands and as late March in the higher mountains. Clutches between 11-15 are the norm and occur from February to May. Young ones appear in late March to August. Chukars are persistent if their first clutch is lost. If conditions are favourable chukars may lay two successive clutches even though this not very common. During summer and autumn chukars may be seen in coveys of up to twelve or more but later in the year they appear in pairs. They

make a nest of dry grass on the ground and in March and April lay from eight to sixteen eggs which are hatched in about twenty-two days. (Woodard, 1982)

2.6. Description

The chukar is a rotund 32-35cm long with a light brown back, grey breast and buff belly. The chukar can best be identified by the black band running across the forehead through the eyes, down the neck, and meeting as a gorget, between the white throat feathers and upper breast. The lower breast and back are generally ash-grey. Feathers on the flanks are gray at the base and have two black bands at the tip, giving the appearance of numerous bands of black bars flanking the side. The bill, legs and feet of both sexes are orange-red. (Peterson at al, 1986; Mullarney at all, 2002)

3. Material and methods

I visited the Stavrovouni farm spending there four weeks going through all breeding procedures of chukars starting from storage of eggs hatching room's incubator machine technological elements of brooding. I collected data and studied the hatchability of chukar eggs and compared with other game bird species. Also studied all aspects of nutrition with analytical tables of the feed stuff from the day old chicks to the ones kept for breeding. I went through all potential disease problems presenting analytical table with all viral, bacterial, and parasitological diseases the usual symptoms and the recommended ways of treatment. The aspect of the difference of the natural behaviour of chukars and the ways are kept in captivity was also studied

3.1. Sex Determination

There is no obvious feather colour dimorphism in chukars. Consequently, sexing adult birds for the untrained eye is most difficult. However, it is possible to distinguish adult males from female by body size, shape of the head (blocky appearance in males) and presence of the metatarsal spur (which can be present on some females). (Picture 3.) A more reliable technique for determining sexes was developed from workers at the farm examining the genital protuberance (pictures 4-5.) for evidence of a rudimentary sex organ is about 95 percent accurate for determining differenced in sex. In adult males the cone-shaped protuberance is usually centrally located on the cloacal fold. In females it is absent or two small nodules appear off-center of the mid-region of the fold. The rudimentary protuberance, averaging about 2.78mm in diameter, is easier to see on older birds.



Picture 3. A female and a male chukar (*Hemonides*)



Picture 4-5. *Genital protuberance (Hemonides)*

4. Result and discussion

Characteristics of the Chukar Egg

Chukar eggs (Picture 6.) are uniformly yellowish-white in color, with numerous speckles of brown, of varying sizes and shapes, appearing over most of the shell. Eggs weight from 16 to 25 g(average about 21 g)are oblong in shape, and are an average 42mm long and 31 mm wide. Egg shell thickness is about 0.228mm and shell membranes about 0.047mm.The wet proportion of shell, yolk and albumen to total egg weight are 15.2 percent, 35.0 percent and 49.8 percent respectively.



Picture 6. *Chukar* eggs. (*Hemonides*)

Egg Care

The critical period for most hatching eggs is the time from lay to actual setting in the incubator. Eggs should be gathered at least four times a day and more frequently during extreme heat or cold. Eggs must not be exposed for long periods of time to ambient temperatures below 5 degrees Celsius and in excess of 26 degrees. Ideally a uniform temperature of 12-15 degrees should be

provided. The nest boxes are wired, eggs will roll out in an area where minimal faecal contamination. Eggs must never be washed in water colder than the temperature of the egg. A wash water temperature of 43-48 degrees is recommended for most eggs and a detergent-sanitizer any chlorine based disinfectant added to reduce egg shell contamination. For 200 eggs no more than 3 liters of water should be used immersion time should not exceed 3 minutes and eggs should be thoroughly dry before being stored. (Picture 7.)



Picture 7. *Egg wash powder (Hemonides)*

Egg Storage

Clean eggs should be stored, large end up, on trays in a cool, well ventilated room kept at about 12.5 degrees and at a relative humidity of 70 percent. A unique feature of chukar eggs is their ability to withstand storage up to 28 days without appreciably affecting hatchability. Eggs that are not stored more than 14 days not need to be turned daily. (Picture 8.)



Picture 8. Egg storage (*Hemonides*)

Table 1. Influence of Length of Storage Time on Hatchability of Game Eggs

<u>Holding period (days)</u>	Hatchability (%)		
	Chukar	Pheasant	Quail
1-7	78.4	58.1	57.4
8-14	77.1	41.7	60.0
15-21	79.4	17.6	25.7
22-28	66.0	7.1	4.2
29-35	37.7	0.0	4.2
36-42	22.3	0.0	0.0

Table 2. Effect of Turning Eggs during Storage on Hatchability in Game Bird Eggs.

Holding period (days)	Hatchability (%)			
	Chukar		Quail	
	Turned	Control	Control	Turned
<u>Control</u>				
1-7	63.0	75.5	61.4	53.4
8-14	60.8	62.0	60.0	60.0
15-21	61.9	48.0	29.2	22.6
22-28	62.2	52.2	11.5	17.2
Average	61.9	59.4	40.5	38.3

Eggs were turned through 90 degrees twice a day during the hold period

Hatching

The hatchery room is a well ventilated and temperature maintained at about 23.5 degrees. For sanitary reasons the hatcher is kept in a separate room from the incubators. Walls are treated with, a water-impervious material. (Picture 9.)



Picture 9. *Hatching machine (Hemonides)*

Incubation

The biggest investment of the farm is the incubators. Large enough to maintain accurate control of temperature (37,7c) and humidity (27, 2%). The farm has four incubators with a capacity of 36000 eggs. Other essential features of the incubators include automatic turning of eggs and forced air movement. Eggs will stay in the incubators for 18-19 days.

Incubation Program

	Temperature	Humidity
1 st day	37, 5	29, 5
2 nd day	37, 5	31
3 rd day	36, 5	32
4 th day	36, 5	33
5 th day	36, 5	34

This temperatures and humidity will be repeated for 19 days.

The increase of the level of humidity is for softening the egg shell.

Embryo Mortality

There are two peaks of embryo mortality for chukar eggs. The first peak occurs between 3 to 5 days of incubation and most mortality is due to a failure to form embryonic structures or to a defect in embryonic and extra embryonic organs and tissues. The second and largest peak in mortality is generally associated with several critical functions occurring from 20th to 24th day. (Picture 10) These functions include: change in the position of the embryo before pipping utilization of the remaining albumen, absorption of the yolk sac, and change from allantoic to pulmonary respiration.



Picture 10. *Embryo mortality – second peak (Hemonides)*

Brooding

The average brooding chukar chick weighs about 13 to 14 grams at hatch. Although amply covered with down feathers at hatch, it is basically an incomplete homoeothermic. It requires supplemental heat for several weeks until its own temperature regulatory mechanism is fully established.

Chicks are brooded successfully on cement room's use of paper litter that absorbs moisture, serves as insulation barrier between bird and floor. (Picture 11) The rooms are highly shield preventing any air drafts entering heating is constantly provided by a gas heater. The average number of chicks in a room is 50 per square meter until second week of life. For a successful brooding the follow should be recommended.

1. Brooder area to be thoroughly cleaned and disinfected before arrival of chicks.
2. Start up heating units at least 4 hours before arrival of chicks. Check heater thermometers for accuracy and use a starting temperature of 35 degrees gradually reducing it until fourth week.
3. Make sure that the brooding area is ventilated enough to avoid ammonia build-up. If odour of ammonia can be detected then additional air movement in the room is needed.
4. Drinking founts should be cleaned and refilled daily until birds are switched to an automatic watering system. Keep litter dry around drinking founts.
5. Start the birds on a chick diet containing about 28 percent protein. Conserve feed by not over- filling feed hoppers.

Check chicks daily for cannibalism or sickness. Remove dead birds immediately and dispose of them in a sanitary manner.



Picture 11. *Concrete floor brooding (Hemonides)*

Growing Chukars

Chukars are very susceptible to blackhead (a condition caused by a protozoan parasite that attacks the liver and ceca) coccidiosis, and worms, including crop, cecal, and intestinal varieties that can cause severe mortality in ground managed birds. The growing pens are separate from brooder house. Houses have a closed pen and open pen the size is usually 5 meters wide and 15 meters long. The average number of birds is in one square meter 30 birds between the ages of 2-8 weeks. From the eight week one square meter is enough for only 5 birds. Overcrowding is one major management problem to avoid. Growth is rapid the first 12 weeks, and then slows during the next 4, and at 16 weeks the bird has attained approximately 92 percent of its adult weight. A male chukar should

reach 500gr weight at about 9 weeks and will consume approximately 1.7 kilograms of feed. The females will attain 500gr weight at 12 weeks consuming 2 kilograms of feed. Chukars raised for shooting activity can be realised at 16-20 weeks. The average flock live weight should be about 600gr a weight reached at about 20 weeks.

Lighting for Growing Chukars

After the first week of brooding, light is used sparingly at low intensities to minimize cannibalism and reduce activity in birds raised for shooting activity. Raised in outside flight pens the birds should receive natural daylight only.

Nutrition

The source of all tissue proteins, including the major muscle mass of the body, is dietary proteins and amino acids. The closer the supply of dietary amino acids comes to actual levels required for optimum growth, the greater the proportion of lean tissue in the body. The body of the bird, like humans, has a remarkable capacity for storing surplus dietary energy in the form of fat. A certain amount of fat on the carcass of the chukar may be desirable for its meat has a tendency to be dry. The protein level of the started diet is 29 percent this level was found to be more than adequate for satisfactory growth in the chukar for the first 2 weeks followed by a 26 percent diet for 4 weeks thereafter switch to a 20 percent diet. A breeder diet containing 16 percent protein is adequate for most laying flocks of chukars.

Analytical table of feed stuff

Starter fine crumb

Analytical constituents: Crude Oils & fats 5.75%, Crude Protein 29.00%, Crude Fibre 4.25%, Crude Ash 6.25%, Calcium 0.9%, Phosphorus 0.74%, Sodium 0.18%, Moisture 13.80%, Lysine 1.69%, Methionine 0.49%

Composition: Wheat, Soya bean meal wheat feed, Fish meal, Distillers (Wheat), Sunflower seed meal, Toasted soya, Vegetable oil & fat, Calcium Phosphate, Sodium Chloride, Yeast Product.

Additives (Per Kg): Vitamins E672 Vitamin A 13500 IU, E671 Vitamin D3 3000 IU

Compounds of trace elements: Calcium iodate anhydrous (E2-Iodine) 4.7mg, Cupric sulphate pentahydrate (E4-Copper) 60mg, Ferrous sulphate monohydrate (E1-Iron) 155mg, Sodium molybdate (E7-Molybdenum) 1.88mg, Selenised yeast inactivated (3b8.110-Selenium) 50.00mg, Manganous oxide (E5-Manganese) 194mg, Sodium selenite (E8-Selenium) 0.44mg, Zinc oxide (E6-Zinc) 83mg

Amino Acids: DL-hydroxy-4-methylmercaptobutyric acid 1300 mg/kg, Monomer acid: min 65%, Total acids: min 85%

Digestibility enhancers: 4a1600 3-phytase (Natuphos) 500.000 FTU

Medication: Avatec 15%CC at a concentration of 120 mg/kg Lasalocid Sodium

Starter mini pellets

Analytical constituents

Crude oils & fats 4.75%, Crude protein 26.00%, Crude fibre 3.50%, Crude ash 5.50%, Calcium 0.9%, Phosphorus 0.62%, Sodium 0.15% Moisture 13.80%, Lysine 1.63%, Methionine 0.43%

Composition: Wheat, Soya bean meal wheat feed, Fish meal, Distillers (Wheat), Sunflower seed meal, Toasted soya, Vegetable oil & fat, Calcium Phosphate, Sodium Chloride, Yeast Product.

Additives (Per Kg): Vitamins E672 Vitamin A 13500 IU, E671 Vitamin D3 3000 IU

Compounds of trace elements: Calcium iodate anhydrous (E2-Iodine) 4.7mg, Cupric sulphate pentahydrate (E4-Copper) 60mg, Ferrous sulphate monohydrate (E1-Iron) 155mg, Sodium molybdate (E7-Molybdenum) 1.88mg, Selenised yeast inactivated (3b8.110-Selenium) 50.00mg, Manganous oxide (E5-Manganese) 194mg, Sodium selenite (E8-Selenium) 0.44mg, Zinc oxide (E6-Zinc) 83mg [http \(marsdensfeeds.co.uk/marsdens-game-feeds\)](http://marsdensfeeds.co.uk/marsdens-game-feeds)

Amino Acids: DL-hydroxy-4-methylmercaptobutyric acid 1300 mg/kg, Monomer acid: min 65%, Total acids: min 85%

Digestibility enhancers: 4a1600 3-phytase (Natuphos) 500.000 FTU

Medication: Avatec 15%CC at a concentration of 120 mg/kg Lasalocid Sodium

Breeder mini pellets:

Analytical constituents: Crude oils & fats 4.25%, Crude protein 20.00%, Crude fibre 3.00%, Crude ash 9.25%, Calcium 2.6%, Phosphorus 0.47%, Sodium 0.14%, Moisture 13.80%, Lysine 1.02%, Methionine 0.31%

Composition: Wheat, Soya bean meal wheat feed, Fish meal, Distillers (Wheat), Sunflower seed meal, Toasted soya, Vegetable oil & fat, Calcium Phosphate, Sodium Chloride, Yeast Product.

Additives (Per Kg): Vitamins E672 Vitamin A 13500 IU, E671 Vitamin D3 3000 IU

Compounds of trace elements: Calcium iodate anhydrous (E2-Iodine) 4.7mg, Cupric sulphate pentahydrate (E4-Copper) 60mg, Ferrous sulphate monohydrate (E1-Iron) 155mg, Sodium molybdate (E7-Molybdenum) 1.88mg, Selenised yeast inactivated (3b8.110-Selenium) 50.00mg, Manganous oxide(E5-Manganese) 194mg, Sodium selenite (E8-Selenium) 0.44mg, Zing oxide (E6-Zinc) 83mg

Amino Acids: DL-hydroxy-4-methylmercaptobutyric acid 1300 mg/kg, Monomer acid: min 65%, Total acids: min 85%

Digestibility enhancers: 4a1600 3-phytase (Natuphos) 500.000 FTU

Management of breeders

For optimum performance partridge breeders should be kept in a laying house in either cage, wire-floor colony pens. When pedigree matings are desired, the individual cage system is used where individual bird performances can easily be

monitored. The ratio for a successful mating is one male to three females. The all wire cages with sloping floors measure 38cm wide x 68cm deep and 40cm high.

Mating ratio

Chukars normally pair-mate in the wild. In captivity, however, 1 male can be mated to 3 females under colony cage or floor managements systems. It is important to candle a sampling of the first setting of eggs to determine level of fertility.

Fertility

Low fertility can result from many management problems:

1. Age of birds when given stimulatory light. It has been demonstrated that breeders should be at least 30 weeks of age before stimulated to lay.
2. Breeder diets low in protein, vitamins or essential amino acids. These can cause fertility problems.
3. Management. Poor or inadequate lighting, overexposure to climatic stress, outbreaks of cannibalism are but a few of the management problems causing a decline in fertility.
4. Disease. Most acute outbreaks of disease will cause a drop in fertility and subsequent termination of lay. A few diseases known to acutely affect fertility are bronchitis, Newcastle and salmonellosis.

Egg production

Reproduction in the chukar is much the same as in other seasonal layers in that eggs are produced in the spring, when favourable light conditions prevail. It is possible, however, to induce lay in chukars at any time of the year with proper preconditioning with light. Experience gained at the farm

has shown that egg production from young chukars (35 to 40 weeks old) for the first lay period is always less than for their second cycle of lay. The use of artificial light to induce lay has one disadvantage in that it takes the males approximately two weeks longer than females to reach sexual maturity. To avoid this problem, males should be separated from the hens and given stimulatory light two weeks in advance of them. For egg production a light intensity of about 50-100 lux is adequate. During the rest period under nonstimulatory light (8L: 16D) the level of intensity should be about 5 lux. For maximum conditioning during the rest period, the long dark period of the day should never be disrupted by light, even for a brief second. It was found that for the birds given light from 4 am to 10 pm the peak of production occurs about 8 hours after the onset of light. Approximately 50 percent of all eggs are laid between the hours of 9 am and noon, the remainder from 1 to 7 pm. A late hour harvest of eggs each day will catch most of the late layers. There is sufficient evidence to indicate that breeders can be held over for a second year of satisfactory egg production even though cycled through 2 previous lay periods. After 2 years of age, however, other reproductive traits show a decline. At the farm they prefer to hold half of the first year males as breeders for the next year.

Sanitation

A good disease preventative program is worth the effort to keep equipment and buildings clean and birds isolated from unauthorized traffic. A few sanitation practices to help minimize the occurrence and spread of disease include:

- a. Select healthy vigorous chicks for foundation stock.
- b. Keep young growing chicks separate from adult birds.
- c. Keep the equipment, buildings and pen environment clean.

- d. Place chicks or adult birds from outside sources in quarantine for at least 30 days before combining them with your own birds.
- e. Never crowd growing chicks or breeder stock. Crowding increases cannibalism, egg breakage, vent picking, and other stress related problems.
- f. Dispose of dead birds in an incinerator or deep pit designed for that purpose.
- g. Provide an adequate all purpose diet for all age groups.
- h. When disease occurs, isolate the pen from others by servicing it last, and take a sampling of sick birds to the nearest diagnostic laboratory.

Diseases

Some important disease and pathological agents that have been found in chukars are listed in table below. In event of an outbreak, early diagnosis and quick treatment of the disease will greatly reduce the spread of the agent and subsequent loss due to mortality.

Information that will greatly benefit the veterinarian in making a correct diagnosis include: age of the birds, number of birds seemingly affected in each pen, description of symptoms seen, diet of birds, any change in management, and when the symptoms were first noted.

Treatment used should be determined by antibiotic sensitivity testing in a diagnostic laboratory whenever possible. This information can be most rapidly obtained by submitting several birds characteristic of the problem.

Preventive treatment is always advisable however, unneeded drugs do add substantially to growing expenses and may cause injury problems.

Diseases	Symptoms	Treatment
VIRAL		
Newcastle	Paralysis, tremors, neck contortions, near cessation of lay, profuse diarrhoea.	No effective treatment Vaccines available.
Encephalitis	Nervous disorders, depression, paralysis and abnormal postures.	No treatment. Control vectors. (wild birds)
Mycoplasma sp. (PPLO)	Respiratory disorders, coughing Sinusitis, moderate drop in egg production.	No effective cure. Tylosin sometimes reduces mortality.
BACTERIAL		
Salmonellosis	Acute outbreaks common in young birds. Listlessness, diarrhoea, and high mortality during first week of age are characteristic.	Good sanitation, nitrofurazone, and some antibiotics are helpful.
Ulcerative enteritis	Chronically infected birds are listless, eyes may be partly closed and motionless. Feed consumption is decreased and emaciation rapidly	Some drugs used include Streptomycin, neomycin and bacitracin.

	occurs. Generally high mortality in young birds.	
Chlamydiosis	Acute infections cause inactivity, respiratory distress, and sometimes purulent exudates of eyes or nose. Mortality high in young birds.	Some antibiotics, including chlortetracycline and tetracycline have been used successfully.
Listeriosis	Few visual symptoms, may display torticollis, spasms, and other nervous symptoms. Mortality variable.	Antibiotics
ENDOPARASITES		
Crop worm (Capillaria sp.)	Emaciation, diarrhoea, listlessness, anorexia, reduced water consumption.	5 percent Meldane-2 administered in feed.
Gape worm (Syngamus trachea)	Young birds highly susceptible. Gape worms obstruct the lumen of trachea and cause birds to suffocate.	Barium antimonyl tartrate used as an inhalant. Thiabendazole is effective when administered in feed.
Cecal worm (Heterakis gallinarum)	Gastric disturbances including anorexia, diarrhoea, emaciation.	Phenothiazine given in single or repeated doses.
PROTOZOAN		
Coccidiosis	Acute outbreaks	Many coccidiostats are

Eimeria sp.	normally occur during the second to third week of age and can result in high mortality in young stock. Chicks become droopy, have ruffled feathers. Loss of appetite resulting in slow growth.	Sulfaquinoxaline is the drug most widely used for control, and amprol to a lesser extent.
--------------------	------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------

Genetic consequences of intensive management in game birds

Introduction of wildlife for game restocking is one major pathway of genetic homogenization. The red legged partridge (*Alectoris rufa*, Phasianidae), a small game bird native to south-western Europe, is in high demand by hunters and natural populations are constantly supplemented by commercial stock of captive-bred individuals.

Also, in recent years human-mediated hybridization with congeneric chukar partridges (*Alectoris chukar*: Greece, Cyprus, from Middle East to East Asia) has been frequently documented in the wild and in captivity. This study attempts to evaluate the genetic consequences of intensive captive breeding and restocking in the *A. rufa* species. We investigated *A. rufa* genetic diversity by making comparisons in both a spatial (across the entire species' range) and a temporal framework. We accomplished this latter by comparing modern vs. ancient partridges resident in museums and collected 1856–1934, well before supplemental stocking became common. Using mtDNA we found significant changes in the haplotype profile of modern vs. ancient *A. rufa*, and widespread introgression with chukar genes across the entire species range only in modern representatives, with the relevant exception of Corsican populations. However,

Random Amplified Polymorphic DNA (RAPD), as opposed to microsatellite DNA markers, showed also modern Corsican populations to harbour many *A. rufa* *A. chukar* hybrids.

We conclude that captive breeding programs should make strict use of time-saving and comparatively low cost DNA barcodes to minimize genetic pollution, such as those provided by diagnostic RAPD markers.

We also recommend that the active ban on import of exotics and/or hybrids be extended to non-local populations. Altogether this would represent a substantial step forward to preserve *A. rufa* as well as other game species subjected to similar intensive management.

Effects of temperature and altitude on ventilation and gas exchange in chukars

The effects of ambient temperature on ventilation and gas temperature on ventilation and gas exchange in chukar partridges were determined after acclimation to low and high altitude. At both LA and HA oxygen consumption increased with decreasing temperature from 20 degrees to -20. At temperatures of 35 to 40 degrees ventilated oxygen increased above thermo neutral values at HA but remained constant and minimal at LA. Water loss rates increased rapidly at temperature above 30 degrees at both altitudes as birds began to pant. Ventilation rates during panting were 5 to 23 fold greater than the minimal at thermo neutral.

Increased ventilated oxygen at temperatures below thermo neutrality was supported by increased minute volume at both altitudes. The change in inspiration volume was primarily a function of changing tidal volume although increased slightly at temperature decline. Oxygen extraction remained fairly constant at temperatures below 20 degrees at both altitudes. Both tidal volume

and oxygen extraction were considerably lower when birds were panting than at lower temperatures.

Chukars showed few obvious ventilator adaptations to HA. The 35% change in oxygen between 340 and 2,500 meters was accommodated by a corresponding change in volume most of which was accomplished by increased respiratory frequency at HA, along with a slight increase in oxygen extraction efficiency.

Chukars adapted well to the experimental apparatus and protocols. They seldom struggled or attempted to escape and were often observed sleeping or standing quietly on the leg. Nevertheless, unusual noises even of the low amplitude, often elicited sudden changes in respiration rate lasting from a few seconds to several minutes.

Habitat requirements of Chukars

Chukars exhibit altitudinal migration, moving from higher elevations to lower terrain during heavy snows. They may also move onto south-facing slopes to escape inclement weather.

Chukars breed monogamously, pairing from February to March or April depending on latitude. Males appear to defend females rather than territory. Clutch eggs are laid at a rate of one per day to one per second day. Clutch size ranges from 10 to 20 eggs with an average of 15. Clutch number is greatly reduced in drought years in extreme drought breeding may not occur at all. Double brooding was reported from captive birds and is suspected to occur in wild birds. Renesting following loss of clutch is normal. Incubation period is typically 24 days. The precocial young leave the nest shortly after hatching.

Individual flight attempts are usually made by two weeks of age and as early as ten days after hatching. Brood flights occur by three weeks of age and by four

weeks of age the chicks have formed flight habits similar to those of adult chukars. The brood and the adult female remain near each other.

The chukar inhabits open, rocky, dry mountain slopes, hillsides. The chukar is also found on open and flat deserts with sparse grass. Nesting habitat is similar to foraging habitat dry rocky slopes with open brushy cover.

Chukars use rocky slopes for shade and escape cover. The hottest part of the day is spent in shady cover. They roost on the ground beneath sagebrush or junipers and in the shelter of rock outcrops. They also roost in open rocky places. Nests are depressions scratched in the ground and lined with leaves and feathers usually well camouflage under shrubs or among rocks. During the breeding season chukars feed in pairs. For the rest of the year feeding occurs in coveys usually en route to watering areas. Coveys are usually about twenty birds infrequently as many as forty or more birds will form a covey. Foraging occurs early morning and late afternoon.

In summer and fall the bulk of chukar diets are composed of cheat grass seeds. Seeds of Russian- thistle, rough fiddle neck, cut leaf filaree, Indian rice grass, and curly dock, wild onion and mustards are also consumed.

How to Hunt Wild Chukar Partridge

So you want to learn how to hunt chukar? I'm not talking about the game farm variety that can't run and can't fly that you'll find stuffed into a bit of cover at a "hunting preserve". Oh no, I'm talking about WILD chukar!

Hunting the wily and elusive red-legged partridge is my passion. I've never met anyone better at finding wild chukar than I am. That's not brag. There are four generations of chukar hunters in my family tree and I've earned the knowledge for myself logging thousands of footsore miles in pursuit from the mountains of southern California's Mojave Desert to the rimrock in Montana and every state

in between. I can park my truck where the road ends and the mountain begins, looks up and tells you where we'll find 'em and I've taught others to do the same. I've even done it looking at topographical maps, although not as reliably.

After I was introduced to the obsession, I read and devoured every article, every snippet, and every reference on chukars that I could find. At the time, there were a few academic articles, but nothing substantial regarding the art of hunting chukars. Most provide pretty pictures, give you a few hints, point you in the general direction and send you on your way. I wanted some meat but eventually despaired of finding any.

In the ensuing years, the chukars, the terrain they inhabit, and fellow chukar hunters were my guides. This work has become an evolving piece in which I document, to the best of my ability, everything I've learned hunting chukars over the past 20 years and what I may learn in the years to come. Hopefully, every chukar hunter, whether a complete novice or the most rock hardened veteran, will find something useful within.

If you are or become an experienced chukar hunter, I hope you will take a few minutes to write me and show me where I've erred, provide me some insight I've missed or regale me with a tale or two. If I include your wisdom in future evolutions of this paper, I will assuredly provide you the credit — or the blame!

4. Conclusions

Alectoris chukar is a species that can be easily bred in captivity, comparing the results with pheasant and quail breeding the storage time, number of eggs, hatchability is a lot higher in chukar which makes it a lot easier to have high numbers of birds in shorter time and with also lower costs.



Picture 12. *The chukar farm in Stavrovouni Area, Cyprus (Hemonides)*

A very well manage breeding program with highly experienced staff. The target of the farm today is the annual release for hunting purposes and the same time preservation of the species in the wild 120 thousand birds. From my personal experience at the farm and also discussing all the aspects of breeding *Alectoris chukar* with the general manager they have the experience for a lot higher number of annual release of birds. If the government will have the sources for building some extra buildings then easily the annual release of birds can be around 200 thousand. What was my personal conclusion is that except from the experienced staff, the other important aspect is the nutrition of the birds. Throughout the years they operated some experiments comparing the feed stuff produced in Cyprus and the feed stuff produced in England. The conclusion was that with the feed stuff imported from England gave higher development of the birds, losses were a lot less and the breeding performance were a lot higher. Today all birds for all stages of life receive only those imported feed stuff. That was for the farm a very big achievement that they could prove to the government authorities that it is necessary to import feed stuff for a lot higher cost from the ones produces there. Conclusion is that how important is what quality of feed stuff birds receive. The company that provides the feed stuff is manufacturing feed stuff for game birds for more than half a century.

6. Summary

After spending four weeks at the farm going through all every day procedures I came to the conclusion that breeding chukars is not that difficult and of course this has to do also with the perfect weather conditions in Cyprus and that the farm is really inside the natural habitat of the bird. All procedures are done in a very professional way and one of the most interesting aspects is that the feed stuff provided for the nutrition of the birds are imported from England.

7. List of references

Articles:

1. Kassinis, N, 2001 Chukar partridge status and conservation in Cyprus
2. Papaevangelou, E., 2005, Thomiades, C., Handrinos, G & Haralambides, A. Status of partridge's game and wildlife science.
3. The Cypriot game fund service, Ministry of Interior, Nicosia Cyprus
4. Journal of comparative physiology B (1987) Mark A. Chapel and Theresa L. Bucher
5. The University of California Cooperative Extension. 1982. Allen E. Woodard. Raising Chukar Partridges
6. Barbanera, F, Negro, J. Di Giuseppe, G, Bertoncini, F, Cappelli, F, & Dini, F, 2005 Analysis of genetic structure of red-legged partridge.
7. M. Hadgigerou, P, Panayides P, Sokos, P, Wilkison, Genetic insight into Mediterranean chukar populations.
8. Peterson, R.T.; Mountfort, G. and Hollom P.A.D. (1974): A Field Guide To the Birds of Britain and Europe. Published by Houghton Mifflin
9. Mullarney, K.; Svensson, L.; Zetterström, D. and Grant, P.J. (1999): Collins Birds Guide. Collins. [ISBN 0-00-219728-6](https://www.collins.com/9780002197286).
10. Taxonomy: Dudich E. and Loksa I. (1987): Állatrendszertan. Tankönyvkiadó. Budapest.
11. Papp L. (1996): Zoozaxonómia. Dabas-Jegyzet Kft. Dabas.

Websites:

1. Cyprus government web portal <http://www.cyprus.gov.cy/portal>
2. Marsden's Game Feeds <http://www.marsdensfeeds.co.uk/marsdens-game-feed>
3. Kypros- Net <http://www.kypros.org/>