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THESIS

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Title

Contribution to the Study of Wintering and Reproductive Strategies of Common Coots (*Fulica atra*) and Anatidae across the Hauts Plateaux of Northeast Algeria

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INTRODUCTION

The common Coot *Fulica atra* is part sedentary, part migratory water bird (Harrison, 1982). It is pledged to open humid milieu such as lakes, marshes, rivers, ponds, Reservoirs, dams, channels… (Pelsy-Mozimann, 1999). As a herbivorous bird, it feeds mainly diurnally on algae and vegetative parts (stems and leaves) of floating or submerged aquatic plants (Cramp and Simmons, 1980; Tamisier and Dehorter, 1999) and graze in flocks on grassland in winter (Irwin and O'Halloran, 1997). Its ecology, essentially wintering, has been well documented in Europe (Blűms, 1973; Fjeldsa, 1977; Allouche and Tamisier, 1984; Asensio *et al*., 1986; Draulans and Vanherck, 1987; Allouche, 1988; Odin, 1988; Pelsy-Mozimann, 1999). In North Africa, the species was reported to be abundant (Etchecopar and Hüe, 1964) and wintering on permanent waters in both Sahara and the north eastern coast of Algeria (Van Dijk and Ledant, 1983; Dupuy, 1969; Skinner and Smart, 1984). Previous wintering census campaign, on few monitored sites, held between 1984 and 1986 estimated, only partially, Coot population in West North Africa (Monval *et al*., 1987); however, the whole population remains, in Algeria in particular, poorly known.

Time budgets are tools used to provide biological data for the amount of time allocated to various activities by birds and to clarify the habitat selection and feeding activity relationship (Paulus, 1988; Baldassarre *et al*., 1988). Many features of Coot behaviour, including winter behaviour, are poorly understood (Cramp and Simmons, 1980).

The Coot *Fulica atra* was also reported as a breeder on many suiTable water bodies in the North African part of the Mediterranean area and with unexplained marked population.(Etchecopar and Hŭe,1964).Although Common Coot breeding ecology is well studied in Europe(Alley and Boyd, 1947; Sage, 1969 ; Havlin, 1970; Fjeldsa, 1973; Gadsby, 1978 ; Salathé et Boy, 1987; Cavé *et al*., 1989; Jotray, 2002) there are only quite few studies, to our knowledge, carried out in North Africa (Rizi, 1999; Houam *et al.,* 2005; Samraoui et Samraoui, 2007) where data were either limited or collected for only one season.

Since the study of behaviour of Coots is beneficial to understand the geographic variation in the wintering strategies and to identify key ecological requirement of the species for management purposes.

Therefore, the first part of present study aimed to (1) count wintering Coots within the wetland complex of Oum El Bouaghi (O.E.B), Algeria and to (2) describe their behaviour and habitat use.

A prelude study carried out by Samraoui chenafi (2005) showed that proximal factors influence short-term changes in breeding success of Coots and the frequence of alternative reproductive strategies. This induced us to investigate deeply the effect of years and sites on nesting and breeding characteristics of the Common Coot. Thus, the second part of present investigation objectives are to study (1) the evolution of nesting couples at.G.Timerganine and compared it with those of Chott el maleh within two consecutive years 2005 and 2006, (2) the influence of years and sites on Ecologic descriptors of nesting site and on reproduction parameters, and (3) comparison of Hauts Plateaux data with previous Algerian and European ones.

Chapter 1. Description of Study Sites and Climatology

1.1 The Ecologic and socio-economic benefit of wetlands:

One essential feature of wetlands is the availability of water that is controlled by hydraulic cycle. A wetland is a natural depression and water placement, in a wetland, depends on equilibrium between entries (precipitation, undergrounds' water slick) and exits (evaporation) of water. The wetlands play a multidimensional role and it contribute to the maintain and amelioration of water quality by acting as a refining filter, physical filter, because it promote the accumulations of sediments and many species of bacteria that acts as a degrader of elements and toxic substances in aquatic milieu (Ledant *et al*., 1981).

The wetlands, also, constitute a favourable site for biological diversity. The latter depends on hydric conditions' variability of these sites. Many animal and vegetal species (birds, micro-and macro invertebrates…etc) relay on their feeding and reproduction on wetlands. Moreover, it can be considered as a source of water for different uses (drinkable water for humans use, agricultural and industrials activities). It contributes, also, to the creation and regulation of microclimates.

1.2 Description of study sites:

1.2.1 Generalities on the Hauts Plateaux of the Algerian East:

One geomorphologic element characterizing the north east of Algeria is the Hauts Plateaux that dominate the coastal plains of the north. These Hauts Plateaux covering huge surface, mainly from Setif to Oum El- Bouaghi wilaya, undergo a semi arid climate. It is a large region on the south of Constantine containing twenty wetlands of very ecologic and economic importance (Jacobs and Ochando, 1979). Our knowledge on these Hauts Plateaux remains highly insufficient due to the rarity of multi-disciplinal studies (ecology, climatology, Hydrology, geology, sociology, etc). The region constitutes a wide corridor dominated by two mountain chains:

Aures massive to the south and the chains of Constantine Mountains to the north. The main feature of the local pouring basins is the endoreism that results in many Sebkhets (salt lakes) occupying the center of these plains. The majority of these are wide, shallow salt lakes that remain poorly known but that have recently been investigated (Samraoui *et al*., 2006; Boulekhssaim *et al*., 2006; Samraoui and Samraoui, 2008).

The most spacious wetlands are: Garaet Taref, Garaet Guelif, Garaet Ank Djemel and Garaet Zemoul. Most of them remain hard to have access to due to striking lack of road infrastructure (Figure1).The major wetland zones are:

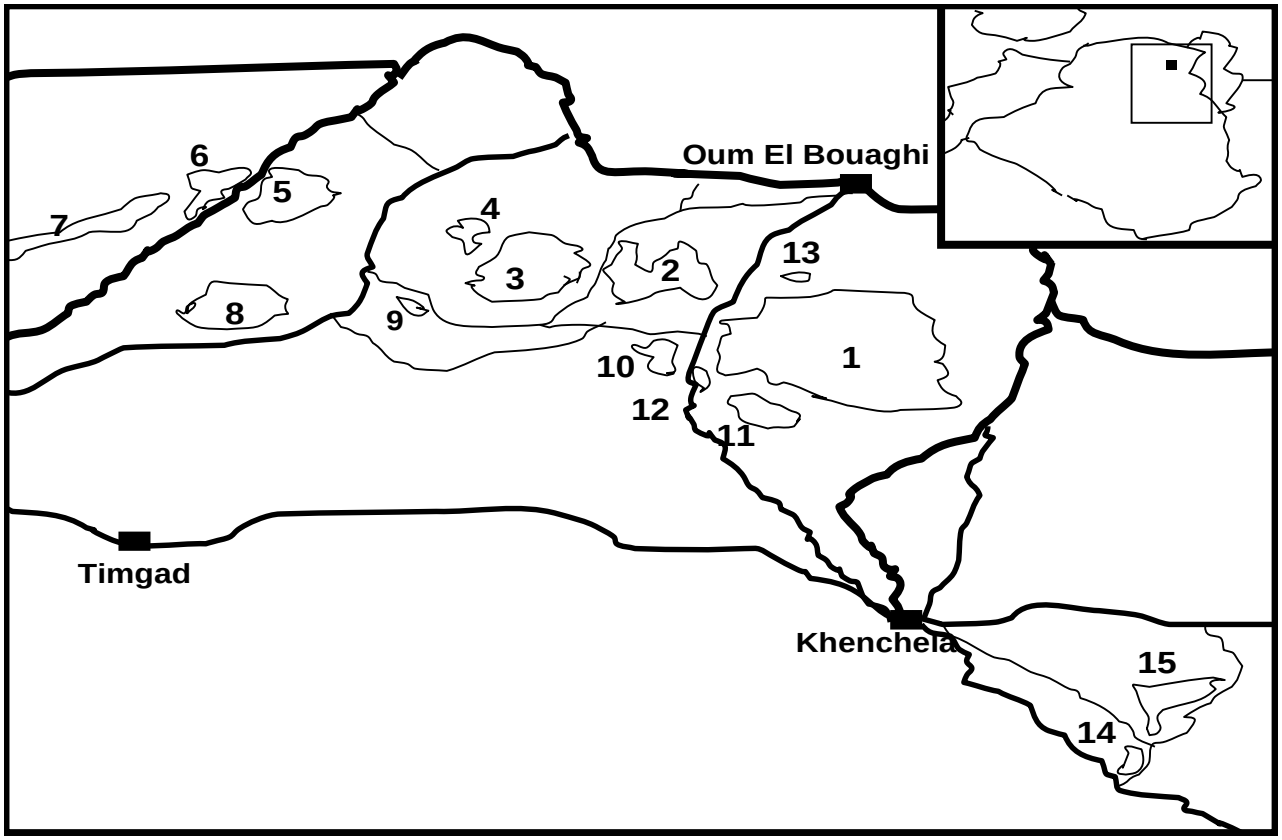


Figure1: Wetland complex of the Hauts Plateaux of East Algeria.

1= G.Et Tarf, 2= G.Guelif, 3=G.Ank Djemel, 4=G.El Maghsel, 5=G.Ezzemoul, 6= Chott Tinsilt, 7= Chott Gadaine, 8=G.Djendli, 9=G.Boulhilat, 10=G.Timerganine, 11=Chott. El Maleh, 12: G. Gémot, 13 =G.Boussif, 14:G.Tazouguarte 1, 15: Tazouguarte 2

1.2.1.1 Garaet Tarf :

Administratively, Garaet Tarf belongs to the wilaya and Daira of Oum El- Bouaghi, municipality of Ain Zitoune. The site is 14 Km far from the wilaya and can be accessed to by the national road linking Oum El- Bouaghi to Khenchela or by the national road linking Ain El Beïda to Khenchela. On the hydrologic level, the site is mainly fed by rain waters forwarded by Oued Boulefreiss, Oued Maarouf, Oued Remila, and Oued Gueiss. The overflowing of these wadis results in big volume of clay and mud, a favourable milieu for plovers. This water stretch is the biggest wetland in the region covering

a surface of 25500ha. Its water is salty, 75.6 ms/cm with a pH 8.2, less deep, and fluctuates depending on precipitations. The water stretch dry up in the summer and is deprived of vegetation all around with the exception of *Salicornia*, *Artemisia* and *Atriplex* that cover the wetland. Garaet Tarf, like all wetlands of the region, shelter each year very diversified aquatic avifauna constituted mainly of Common Shelduck, Greater Flamingo, Common Crane, surface Ducks and Plovers (Metzmatcher, 1976). The site was classified by Ramsar convention as a site of International importance on December 15th 2005.

The south part of Garaet Tarf characterized by many depressions that overflow and appear as water stretches (water stretches satellites).

1.2.1.2 Garaet Guelif:

Garaet Guelif belongs to the Oum El- Bouaghi Wilaya, municipality of Aïn Zitoune. The site is located at 12 Km to south of Oum El- Bouaghi, and it is accessible through the road linking Oum El- Bouaghi and Khenchela or through the road linking Oum El- Bouaghi and Boughrara Saoudi. It is mainly fed by Oued Tallizerdane, Oued Houassi, and Oued Ourleiss. The water level is about 40 to 50 cm during heavily rainy years. Its water is salty 152 ms/cm with a pH 7.86. The site dries up in the summer due to intense evaporation. Garaet Guelif shelters each year many waterbirds where the most common species are the Common Shelduck, Greater Flamingo, surface Ducks and Plovers. Starting from March, we meet a very large number of Avocets, Black Winged Stilts, Slender-billed Gulls, and of Gull-Billed Terns. Cereal culture occupies the largest part surrounding the site, whereas; the left is colonized by *Atriplex halimus* and *Salicornia fructicosa*. The ornithological richness of site notably by the Greater Flamingo, the Common Shelduck, the Eurasian Wigeon, and the Northern Shoveler provide the site the status of International importance since it receives more than 1% of Mediterranean population of these species.

1.2.1.3 Garaet Ank Djmel:

Administratively, the site belongs to Oum El- Bouaghi Wilaya, Daïra of Aïn Fakroun, and municipality of Boughrara Saoudi. The site, to the east, is attached to Garaet Guelif and considered as the second large water stretch of the region in surface. Its water is, also, salty and featured by heavy seasonal

rains. From the Hydrologic point of view, the site is mainly fed by Oued Tallizerdane and Oued Berrou. Very diversified aquatic avifauna frequents the site and the most abundant species are Greater Flamingo *Phoenocopterus roseus*, the Common Shelduck *Tadorna tadorna*, the Common Crane *Grus grus* and other Anatidea species. Garaet Ank Djemel was classified on 2004 as a Wetland of an International importance because it holds more than 1% of Mediterranean population of two species: Greater Flamingo and Common Shelduck.

1.2.1.4 Garaet El Maghsel:

Administratively, the site belongs to Oum El- Bouaghi Wilaya, Daïra of Aïn Fakroun, and minicipality of Boughrara Saoudi. .It is an endoroeic depression of 125 ha with salty water. The site is colonized by a halophile vegetation and enclosed between a sequence of mountain chains composed of El Maghsel to the west, the mountain chain of Oum Kechrid to the north and Ank Djmel Djebel to the east and to the south east.

1.2.1.5 Garaet Boucif (Ogla Touila):

The site has a surface aqual to 170 ha and is located near the national road linking Oum El- Bouaghi to Khenchela. Administratively, it belongs to the Daïra of Oum El- Bouaghi, municipality of Aïn Zitoun. The Sebkhat is located in the plain Medfoun, at the base of Tarf Djebel. The water stretch is surrounded by durum wheat fields and frequented, especially in high raininess years, by a large number of waterbirds such as the common Shelduck, Northern Pintail, and the Plovers.

1.2.1.6 Chott El Maleh:

It is a water stretch satellite of Garaet Tarf with a surface of about 875 ha. Situated at 35° 35. 49.00 'North, 7° 03.49.3'East at 902 m in altitude. Chott El Maleh is composed of four units located to the south of Garaet Tarf. His brakich water lays only within rainy years and it is fed mainly by Oued Maarouf and Oued Remila waters. The site contains two types of Vegetation Sea Club-rush (*Scirpus maritimus*) and Reed (*Phragmites australis*) where the first species is the dominante in the four units. The site is favourable for many species of waterbirds where the Coots, the Northern Shovelers, and the

Eurasian Wigeons are the most abundant. Not only the site is used for wintering but, also, for breeding during rainy seasons (Figure 2).

Figure 2: Chott El Maleh (Mellah)

1.2.1.7 Sebkhat Gemot:

Sebkhat Gemot is only a continuity of Garaet Tarf and it is a small water stretch with a surface of 10 ha providing, with its vegetation composed of Tamarix and its appropriate water depth, an adequate milieu for aquatic avifauna notably the Ardeidea, the Rallidea, The Ducks, and the plovers.

1.2.1.8 Garaet Timerganine:

Situated at 35° 39′ 56 ″ North and 06° 57′ 02″ East at altitude equal to 843 m, this endoreic Garaet is fed mainly by rain fall and by Oued Boulefreiss, originated from the massive of Aures mountains, that overflows the different basins of G.Timerganine. It is characterized with its relatively important water depth in the region and with a surface approximating 700 ha. This is brackish fresh water stretch has a conductivity of 2.01 ms/cm and pH 8.54. The site can be accessible through the national road linking Oum El- Bouaghi to Khenchela.

Timerganine Garaet is located at 25 km to the south of Oum El- Bouaghi and it is bordered at the North by Aïn Zitoun municipality and at the south by Remila plain. Administratively, it belongs to the wilaya of Oum El- Bouaghi, municipality of Aïn Zitoun. The site featured by its dense vegetation, mainly composed of *Eleocharis palustris*, *Scirpus maritimus*, *Scirpus triqueter*, and *Phragmites australis*, and by its water depth serve as an ideal milieu for wintering and breeding of many waterbirds notably the Anatidea and the Rallidea, particularly Coots (Figure 3) (Samraoui and Samraoui, 2007).

Figure 3: Gareat Timerganine

1.2.1.9 Chott Tinsilt:

The site is located on the territory of the Wilaya of Oum El- Bouaghi, Daïra de Souk Naamane, and Minicipality Ouled Zouaï. It is at 17 km to the south of Ain M'lila on the national road N° 3 linking Ain M'lila to Batna. Its flooded surface inondable is 1 000 ha.

The Chott is fed by rain waters coming from Oued Zerhaib; its water is brackish with a mild conductivity, 38ms/cm, an alkaline pH 8.05, and a depth that never exceed 50 cm. The chott is surrounded by une humid meadow covered with herbaceous vegetation represented by two families, the Chenopodiacea and the Aizonacea. Moreover, the site is, also, a wintering milieu for different species notably the Anatidea,

the Greater Flamingo, and the Plovers. It is classified as a wetland of an International importance, RAMSAR site on December 15th 2004.

1.2.1.10 Sebkhet Ezzemoul:

The Sebkhet or Garaet Ezzemoul is located to the East of Chott Tinsilt 35°53′ North and 06°33′ East, it is separated from the latter by the national road N° 3 linking Constantine to Batna. A Part of this Sebkhet is exploited for salt extraction. It only becomes filled with water when the seasons are heavily rainy. Its surface is 4 600 ha, and it is usually dry during summer .This drought may bypass the two month–period. It holds invertebrates such as *Artemia tunisiana* and *Branchinella spinosa* which seem to tolerate the salinity more than 151g/l NaCl (Samraoui *et al.,* 2006b). The site holds, also, an important ornithological richness (Samraoui *et al.*, 2006a) where the most abundant species is the Common Shelduck *Tadorna tadona* (Morgan, 1982; Boulkhssaïm *et al.,* 2006).

1.2.1.11 Sebkhet Djendli:

It is Located at 35° 43′ North and 06° 32′ East, with an altitude of 825m. The surface of it is 200 ha. Its water is salty (29g/l NaCl) and rich with *Branchinectella media* and with Gasteropoda (Samraoui *et al*., 2006). The site dries up in the summer for, at least a short period. More than 8000 Ducks were counted in winter in the site where the most frequent waterbird is the Common Shelduck *Tadorna tadorna* (Morgan, 1982), the Great Flamingo, and, also, Ducks' surface.

Sebkhet Djendli is situated surrounded by three mountain chains: Djebel Bou Arif to the south, Djebel Toumbait and Tafrout to the North and to the west. To the East, the sebkhet Djendli open on the plains of Boulhilet and Chemora. It is a water stretch of a surface 3 700 ha, fed mainly by waters rain (Morgan, 1982).

1. 2.1.12 Sebkhet Tazougart:

Sebkhet Tazougart (35 ° 23.777'N, 7 ° 19.920'E) is a brackish stretched lake, divided into many sequence of units, where two of them, the main ones, are known under the names: Sebkhet Ouled Amara and Sebkhet Ouled M'barek, which are fed by Oued Ounrhal. Many species of waterbirds were counted during winter where those of higher numbers are Anatidae particularly the Eurasian Wigeon, the

Northern Shoveler, the Northern Pintail, Common Pochard, and the Common Shelduck. Rallidea, particularly, Coots, were, also, counted in very high numbers in winters.

1.2.1.13 The plain of Remila:

During High raininess years, , we could observed the formation of a lot of temporal ponds with variable surfaces that are important at least in the whole plain of Remila (wilaya of Khenchela). The plain is usually used for cereal culture. These formed ponds shelter many waterbirds among which surface Ducks and Plovers.

1.2.1.14 Garaet Boulhilate:

G. Boulhilate (35°44.699'N, 6°47.431'E) is a freshwater pond of 290 ha fed mainly by O.boulhilate and rainfall. It is surrounded by a belt of *Tamarix gallica*; and is easily accessed trough WR 26 linking Ain Kercha and Boulhilate (Figure 4).

Figure 4: Gareat Boulhilate

1.2.1.15 Touzeline Reservoir:

Touzeline Reservoir (35°55.37’N, 6°58.27’E) is a fresh water reservoir of 36 ha near the road RN10 joining the village of Ain Fakroun to the town of Oum El Bouaghi and fed mainly by O. Ourkis and rainfall. It has been built for irrigation of cereal crops.

Figure 5: Touzeline Reservoir

1.3 Geography and hydrology:

The wetland complex of the north east Algeria is located on a plain surrounded by hills and by Plateux. To the south these sites are bordered by Aures mountainous chain. The oriental border is formed by F'kirina, village, Boutoukhma (1349 m), Fedjidjet, and Amamet El-Kebir (1337m) moutains. Sidi Rghis (1635m) mountains and a whole sequence of mountains coming through Ain Fakroun till Constantine border them to the north, However, towards the western side, these sites open towards other wetlands that reach Setif i.e; Garaet Beida Bordj, Sebkhet Bazer Sakhra, Chott El-Frain, Sebkhet El-Hammiet, and Chott Gadaine.

The hydrographical system of the region depends heavily on meteorological conditions, the major wadis that feed these wetlands are:

- Oued Boulefreiss and Oued Gueiss that originate from Aures.
- Oued Tallizerdane feeding Sebkhet Guelif originates from the mountainous chain of' Oum Kechrid.
- Oued Chemora feeds Boulhilet (blocked actually by the Timgad dam).
- Oued El Madher originates from Djebel Kasserou.
- Oued Maarouf originates in Remila plain.

1.4 Climatology:

Climate is defined as the whole meteorological characters of a given region within long term (Ramade, 2003).The climate corresponds to statistical distribution of atmospheric conditions in a given region during a given period of time.

The determination of climate is carried out using averages established from statistical, annual, and monthly measures on local atmospheric data: temperature, precipitations, Sunshine period, humidity, wind speed (Wikipedia, 2008).

1.4.1 Geographic location:

The wilaya of Oum El Bouaghi is bordered with the following wilayas: Constantine, Mila, Guelma, Souk Ahras, Batna, Tébessa and Khenchela. It occupies an important geographical position linking the north to the south.

1.4.1.1 Generalities on Algerian climate and on the study zone:

The climate is a Mediterranean type over the entire northern fringe that includes the littoral and the Tellian Atlas (Hot and dry summers, humid and cool winters), a semi-arid climate on the Hauts Plateaux in the country center, and desert climate once the Atlas saharian is crossed.

In Algeria the met climatic regions are those of stages and varieties defined by (Emberger, 1955).

1.4.1.2 Regional climate:

It is defined with the help of data provided from different meteorological stations. The region of Oum El Bouaghi is subjected to the Mediterranean climate influences characterized by irregular precipitations, and a long period of dry summer.

The climate of Oum El Bouaghi is a cool semi-arid type featured by two distinct periods:

- A dry and hot period in summer of 150 days.
- A humid and cold period in winter of 210 days.

This climate is marked by its continental feature since Oum El Bouaghi is located at about 200km from the sea.

1.4.1.3 Local Climate:

The study of local climate requires climatic data of the study zone.

The position of the reference station (Oum El Bouaghi) has a slight different altitude from that of study zone; this led us to do corrections of temperature and of pluviometry in order to come closer to local climate (O.E.B Wetland Complex). The climatic data were collected from the meteorologic services (office national de météorologie, ONM) for a period 1990-2006 that are illustrated Table1.

Table1: climatic data of Oum El Bouaghi for the period (1990-2006), source (ONM).

Parameters / Month	P (mm)	m (^{0}C)	M (^{0}C)	$\frac{M+m}{2}$	Hum%	Snow	Wind m/s	Freeze
January	43.02	1. 37	10.96	6.16	78.52	2.05	1. 58	12.58
February	26.37	1. 55	12.74	7.14	72.64	1.94	1.72	8.23
March	27.16	4.21	16.37	10.29	68.05	0.52	2.33	4.47
April	33.15	6. 34	19.07	12.70	66.52	0.29	2.06	1.00
May	41.42	11.00	25.17	18.08	60.88	0.00	1.81	0.05
June	22.62	15.28	30.71	22.99	52.17	0.00	2.16	0.00
July	10.95	17.54	34.19	25.86	45.82	0.00	2.01	0.00
August	25.61	17.92	33.81	25.86	50.35	0.00	1.79	0.00
September	37.99	14.80	28.47	21.63	60.94	0.00	1.65	0.00
October	23.40	11.07	23.75	17.41	65.70	0.00	1.43	0.00
November	41.20	5.67	16.45	11.06	74.00	0.11	1.57	2.35
December	45.35	2.44	11.95	7.19	78.88	1.41	1.73	8.58
Total	**378.24**	**109.19**	**263.64**	**186.37**	**1174.47**	**6.32**	**21.84**	**37.26**
Average	**22.24**	**9.09**	**21.97**	**15.53**	**97.87**	**0.52**	**1.82**	**3.10**

Note :

- Snow and freeze are expressed in number of days.
- The corrections are carried out on one station :

o The station wetland complex is located at an average of 950 meters.

o The station of reference Oum el-Bouaghi is located at 891 meters.

1.4.2 Precipitations and temperatures corrections:

It is worth noting to recall that theoretically according to SELTZER altitudinal gradient:

For the pluviometry: an augmentation of 40 mm every 100m for the continental (which is our case) and of 80 mm every 100m for the littoral.

For the temperature: a diminution of 0.7°C for (M) for 100m of elevation, and a diminution of 0.4°c for (m) for 100m of elevation.

These will give an increasing altitudinal gradient for the precipitations and a decreasing one for the temperatures (Tirk., 1997 cited by Kherief, 2006).

1.4.3 Determination of bioclimatic stages of study stations:

The climate plays a major role in living organisms' distribution. Thus, it is necessary for ecologist to characterize the different bioclimates. For the Mediterranean region, the Emberger method was very useful for ecologists (Stewart, 1974 cité par Kherief, 2006). The calculation of pluviometric quotient Q_2 of Emberger (1955) is necessary for the determination of bioclimate stage of a station; therefore, the following parameters are taken in consideration:

- P : Annual pluviometry in mm ;
- M : Maximal temperature of the hottest month in kelvin degree ;
- m: Minimal temperature of the coldest month in kelvin degree.

The formulae used for the calculation of Q_2 is as follows:

$$Q2 = \frac{2000xP}{M^2-m^2}.$$

The results are given in Table 2.

Table 2: Results of Q_2 for the study (O.E.B Wetland complex) and Reference station.

Parameters / Stations	Annual pluviometry in (mm)	M (^{0}C)	m (^{0}C)	Q_2
Oum El Bouaghi	378.24	34.19	1.37	39.63
O.E.B Wetland complex	400.87	33.78	1.14	42.28

The highest maximal temperatures for the two stations are marked during the month of July and August. The summer season is represented by relatively high values which gives a dry season.

The lowest minimal temperatures for the stations are marked during the month of January and February. Wintering season is represented by low values which favour freeze risks.

From the obtained results, if the values of Q_2 and m are reported on Emberger climagramme (Figure 2), we can deduct that the two stations (Oum El Bouaghi and wetland complex) are located in the cool semi-arid stage.

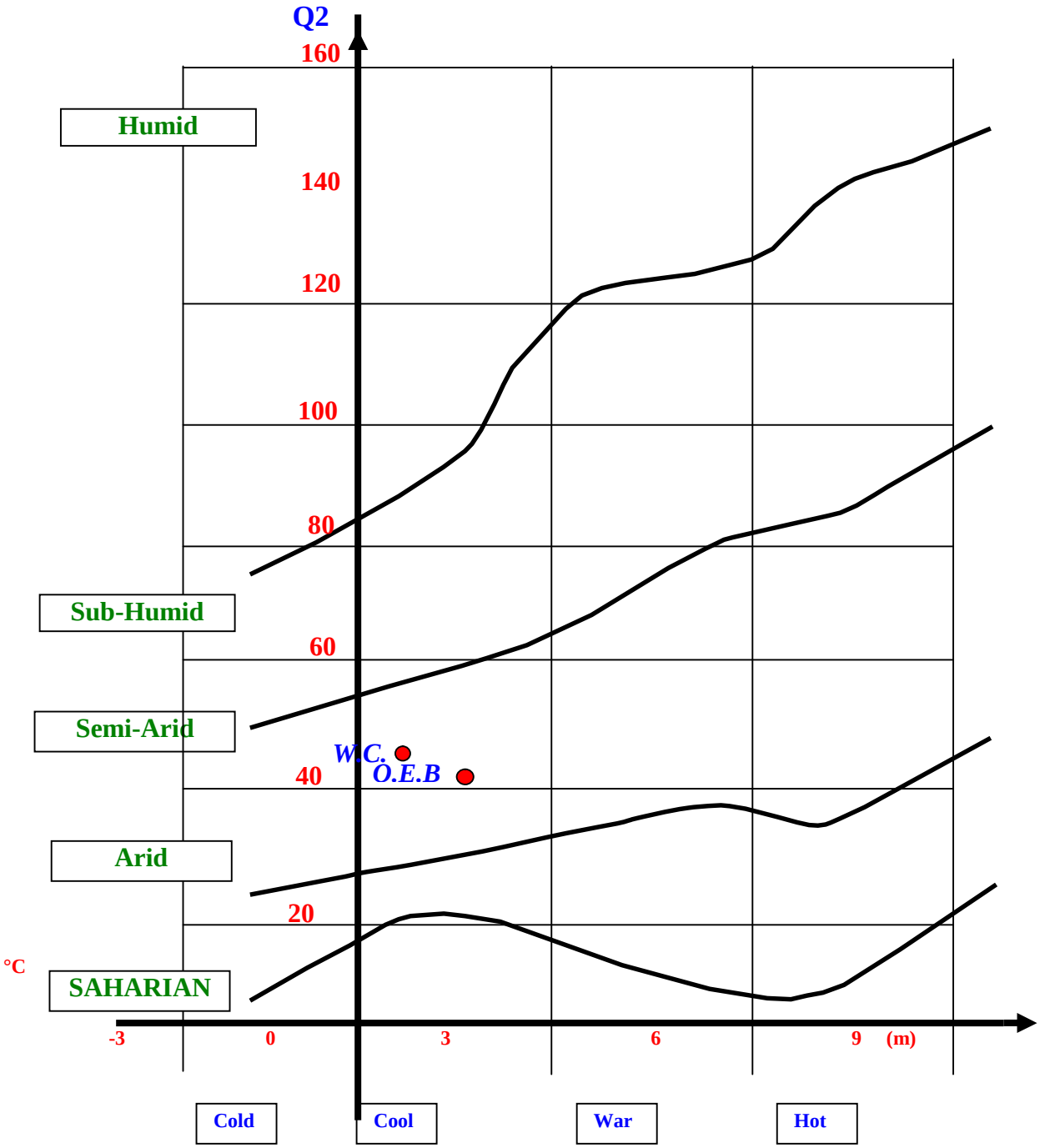


Figure 6: Emberger Climagramme

1.4.4 Climatic synthesis:

The temperatures ant the precipitations constitute the two main parameters of climate since Sun shining is generally well correlated with the temperature. Different types of diagrams are destined to provide a graphic representation of major parameters of climate suiTable for a given region. The main are

the Ombrothermic diagrams of Gaussen (Figure 3) and the climagramme of Emberger (Ramade, 2003) from which the climatic characteristics of a given region are provided.

Ombrothermic diagram:

It constitutes a very useful type of representation to compare the climates (Ramade, 2003). Bagnoul and Gaussen cited by Kadik, 1987, consider a dry month when the total of precipitations expressed in mm is equal or less than a double of the temperature expressed in Celsius degree.

It consists to draw on ordinate to the left the monthly average temperatures in °C with a double scale compared to that of precipitations (P=2T), on abscissa the months of the year and in ordonate to the right the monthly average precipitations in mm and, then, to join the obtained points. In fact, we obtain two superposed diagrams. The aridity periodes are those where the pluviometric curve is under the thermic curve (Ramade, 2003).

According to the scale P=2T, the Ombrothermic curves determine two periods, one humid and the other is dry.

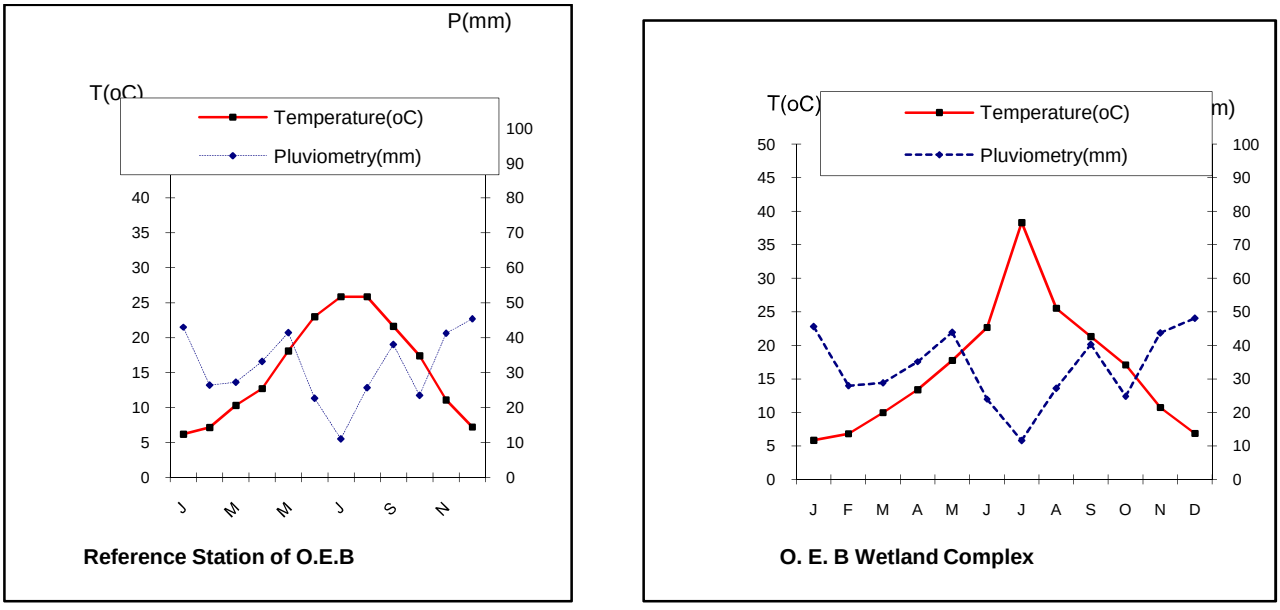


Figure 7: Ombrothermic Diagrams of Gaussen.

Table 3: Duration of humid and dry periods for the Study stations.

Stations	Duration in Days	
	Dry Period	Humid Period
O.E.B reference station	150	210
Wetland complex of O.E.B	150	210

Note:

In order to facilitate the calculation, each month was considered equal to 30 days.

For Oum El-Bouaghi station:

- Dry period: characterized by high temperatures showing two maximums, one in July, and the other in August.
- Humid period: characterized by precipitations showing two maximums, one in December, and the other in January.

For the wetland complex station:

- Dry period: characterized by two maximums temperature, one in July, and the other in August not far from that of Oum El Bouaghi station.
- Humid period: characterized by high precipitations showing two maximums, one in December, and the other in January more intense than that of Oum El Bouaghi station.

In Conclusion, the region belongs to semi-arid bioclimatic stage with a cold winter characterized by a cold continental climate, rainy in winter and hot, dry in summer where the dominating winds are of South-West, West and North-West (Sirocco). The rain is torrential and irregular. The annual pluviometry varies between 185.20 mm and 665 mm. The annual minimal and maximal Temperature varie ,respectively from -1,6 to 2°C and 32.7 to 36,9°C.

Chapter 2. Biology of the Common Coot

2 Biology of the Coot:

Coots are good Bio-indicators: the concept of bio-indication is based on the assumption that an organism can, simply by its presence or absence, provide information about the condition of, and alterations in, the environment.

Birds react to alterations in the environment very sensitively and they are qualified as bio-indicators for the following reasons:

1-Homoiothermy, high metabolic rate and the complexity of their behaviour involve a strong dependence of bird population on certain factors in the environment.

2-The position of most birds in ecosystems is well defined, consequently, changes in bird stocks or in the diversity of species allow conclusions to be drawn about the condition of the environment.

It is relatively easy to find, identify and count birds. Therefore, changes in the size of populations or in the diversity can be used to analyse the condition of the landscape.

3- waterfowl, such as Coots, are particularly useful bio-indicators because of their wide distribution; relative ease of identification and counting in Autumn and in winter, different trophic positions between primary and end consumers; and significance as structural parts of aquatic ecosystems.

Essentially, waterfowl, like Coots, can indicate the trophic, structural and toxic conditions of aquatic ecosystems. Because of their specific adaptations, they react in distribution, frequency, and behaviour very sensitively and in well –defined ways. Therefore, in many cases it is possible to correlate the changes in the environment and the reaction of waterfowl. (Rutschke, 1987).

We use the term" waterbirds"for the regrouping of species of the family Anatidae (Ducks, Geesee, and Swans)and the species *Fulica atra* (The Common Coot) of the family Rallidae. The Anatidae and the Coots are species very far away in the classification since they belong to two different orders (the order Anseriformes for Anatidae, and Gruiformes for Coots. They can be regrouped since they share similar life style where they occupy the same aquatic milieus, and their feeding is similar. In general, they are migratory birds that winter at the same latitudes. Therefore they share the same ecologic niches in the same time within an ecosystem.

2.1 Morphology and Description:

The length of the common Coot (*Fulica atra)* is 36-38cm (Cramp and Simmons, 1980); its weight reaches 600g in males, 800g in females (Samraoui, 2005). It is a slaty duck like bird with blackish head and neck, a short tail, a short bill that extends towards the front by an oval bony plaque called 'frontal shield' about the size and texture of the ball of the human thumb and red eyes in adult and brown in juvenile (Figure 8) (Perrins, 2003). It shows a slender white band, visible on flying decorate the wings (Sterry, 2004; Haouem, 2003).the wing –span is about 70-80 cm (Cramp and Simmons, 1980). The feet are covered with yellowish green scales that support the body in almost horizontal position (Schifferli, 1970).The toes are strong, long, and dark green with sharp nails and large flat lobes enabling the bird to swim quite unlike other Rallidae and resembling those of grebes(Podicipedidae)(Gill ,1995) and /or escape a potential predator(Samraoui, 2005). Sexes are similar with no seasonal variation, yet the juvenile is distinct. (Cramp and Simmons, 1980; Peterson, 1980).

The adult: (1) at rest or feeding, appears wholly slate –black, dark and glossy on head and with grey tone most developed on flanks and under body. In (2) flight at close range, grey webs and white tips of secondaries are obvious, forming pale border along rear edge of wing.

The young: covered in black down and have red and blue markings on the head.

The Juvenile: the back and wings are duller than in adult; the rest of plumage much paler.

The crown, hindneck, chest sides, flanks, and undertail are grey brown; However, the face, throat, foreneck, chest center, and belly are white (Cramp and Simmons, 1980).

Coots swim with head closer to body and nodded much less. It dives well but only for short time (Peterson, 1980). In flight, it appears much bulkier, with long, pattering run across water essential to take off and rate of wing-beats always seeming quick. It lands on water with breast first. The gait is less free with twisting walk and awkward waddling run (assisted by flapping wings) (Cramp and Simmons, 1980).

Figure 8: The Common Coot (*Fulica atra.*)

(www.charliesbirdblog.com/.../coots)

2.2 Systematic of the Common Coot:

The order Gruiformes involves birds that are terrestrial and aquatic at once where this order involves 11 families among whish is Rallidae (Del Hoyo *et al.*, 1996). The latter is the largest family comprising 147species and it is a cosmopolite family of rail, gallinules and Coots (Samraoui, 2005).

Rank	Name
Kingdom	Animalia
Subkingdom	Eumetazoa
Phylum	Chordata
Subphylum	Vertebrata
Infraphylum	Gnathostomata
Class	Aves
Subclass	Passerae
Superorder	Ciconiimorphae
Order	Gruiformes
Suborder	Ralli
Superfamily	Ralloidea
Family	Rallidae
Genus	*Fulica*
Species	***atra***

2.3 Habitat:

The Common Coot frequent large, still waters and slow rivers; reservoirs and even quiet inshore seawaters, dams, lagoons, pools, ponds, canals, drainage channels, flooded lands; now exploits urban park lakes. It shuns small ponds and streams, but less hesitant in grazing away from water also found on reservoirs, usually in sizeable flocks (Cramp and Simmons, 1980; Sterry, 2004). It prefers, also, fresh water with an adequate depth for diving for submerged vegetation, and with thick reeds or waterside vegetation. (Harrison, 1982).

The Coot requires a minimum of open water, and tolerates some exposure and wave action, but during reproduction not normally found far from banks or from emergent or floating vegetation. Coots Avoids dense vegetation.The common Coot lives where quiet shores providing sufficient food and enable the breeding (Schifferli, 1970). It is has been reported that the Common Coot can Live at high altitudes in Europe till 1380m and even breed at 2500 m in Himalaya or at 3700 m in New-Ghinea ((Schifferli, 1970). Coots frequent mainly lowlands, but penetrated to mountains where adequate water occur, for instance, it breed in Switzerland up to 1000-1100 m, in Tadzhikistan and Iran. To 1800 - 2000m (Cramp and Simmons, 1980).

2.4 Distribution:

The most abundant species of Rallidae in the west of Paleartic are the Water Rail *Rallus aquaticus*, the Common Moorhen *Gallinula chloropus*, the Purple Swamp-Hen *Porphyrio porphyrio* and the Common Coot *Fulica atra* (Haouem, 2003).

The Common Coot *F.atra* lives in abroad zone most of Europe, southern Asia, Australia and New Zealand and in North Africa (Harrison, 1982, Sterry, 2004) Figure 9.

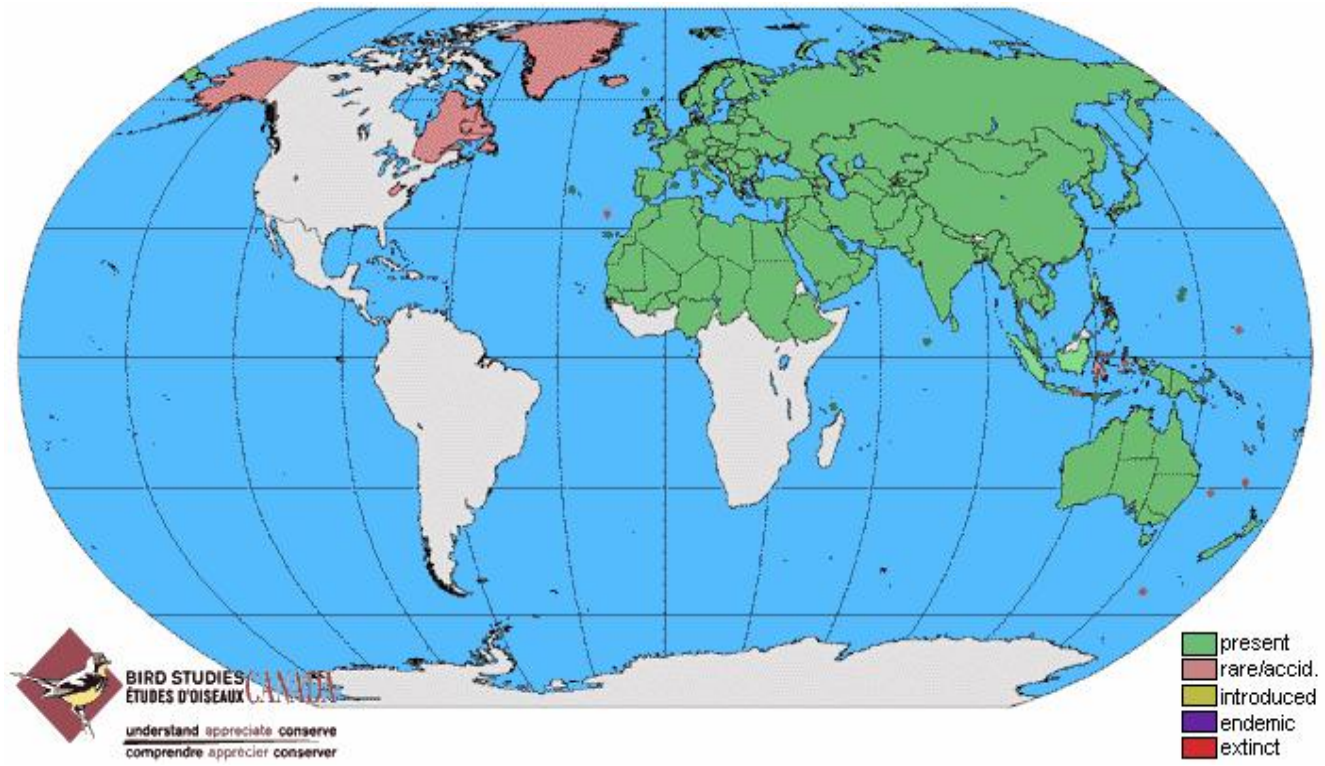


Figure 9: Common Coot distribution throughout the world

(wikimedia.org/wikipedia/commons)

On the contrary of the Common Coot wide spreading throughout the world, the Red knobbed (Crested) Coot *Fulica cristata could* only be observed in southern Spain and north-west (Morocco) and southern Africa (Cramp and Simmons, 1980; Harrison, 1982). This species, may has been a form which failed to decolonize Western Europe after glaciation where the Common Coot replacing it in most areas. In Algeria no previous report, as far as we know, documented the observation of this species.

Other species of Coots exist throughout the world among which are:

The Hawaiian Coot (*Fulica alai* VU); American Coot (*Fulica Americana*); Caribbean Coot (*Fulica carabaea*); White winged Coot (*Fulica leucopetra*); Andean Coot or Slate-coloured Coot (*Fulica ardesiaca*); Reg gatered Coot (*Fulic*a *armillata*); and Red fronted Coot *(Fulica rufifrons*); Giant Coot (*Fulica gigantean*); Horned Coot (*Fulica cornuta* NT); and Mascarene Coot or Newton's Coot (*Fulica newtoni* EX) (Delany andScott, 2006).

In Algeria the ralliadae includes Water Rail (*Rallus aquaticus*), Corn Crake (*Crex crex*).Commmon Moorhen (*Gallinula chloropus*), Purple Swamp-Hen (*Porphyria porohyrio*) (ledant, 1981; Isenmann and Moali, 2000).

2.5 Population:

Neither estimation nor precise data is available so far to North Africa (Morocco, Algeria, Tunisia, Libya, and Egypt) Common Coot population. The total population number may depends on the weather conditions in southern Europe.

The only first books providing the Algerian Avifauna status is those of Heim de Balsac and Mayaut (HB-M) in 1962 and Etchécopar and Hüe in 1964. HB-M reported that the Common Coot *Fulica atra* as a breeding species in Fetzara, Macta and wintering from October to March with penetration far in the Sahara oases : Biskra Tougourt, , Béni Abbès, Ain Salah, Arak (Ledant *et al*., 1981) at Ouargla and El Golea ,a few hundreds of Coots were observed in 1964 and 1965 by Dupy (1969) and Coots reaches even the Hoggar (HB-M, 1962), and it was, also, observed aroud El Kala, in the Oranian east, in Réghaia and in Boughazoul and the Tell since 1973 by many observers (Ledant *et al* .,1981) The species

was reported to be wintering at Lack El Mellah where 35000 individuals were counted by Johson and Hafner (1972).

The total Common Coot *Fulica atra* population in Algeria was never estimated with the exception of individual counts at no regular, different times, and diverse sites where it was reported that several tens of thousands winter visitors distribute between September/October and March /early April on the large northern wetlands (21000 in Juanury 1993, Rose and Tylor 1993 and 45000-46000 in Juanuar, 1994; Rose, 1995).The species was reported to be distributed from the Oran to El Kala region where the maximum number counted in November 29th, 1971 by Johnson and Hafner (1972) varied between 31500 to 35000 individuals at Lack Oubeira and Lack Melah, respectively. In 17 th January 1992 the number recorded was 30000-35000 at Lack Oubeira (Isenmann and Moali, 2000). In Bougzoul reservoir (dam) a number of 6500 Coots were counted by Morgan and Boy in1982. In Tunisia at Lack Ichkeul, an important number (36000 individuals) was reported by Morgan (1982); however, for the same site Bredein and Skinner (1983) reported a high number of 70000 Coots in 1983 that has never been recorded in Algeria.

In Morocco, the Common Coot was reported as winter visitor and its total never exceeded 65000 (average mid winter total for 1983-95 was c 35000) individuals (Thévenot *et al*., 2003).

The latest Coot population estimations (Jortay, 2002; Delany and Scott, 2006) revealed a 1 100 000- 1 750 000 individuals in Europe; and in Black sea, Mediterranean, and West Africa the number revealed was 2500 000 individuals; in South west and Central Asia the estimated population was 2 000 000, and in Australia, the population size probably close to 1 000 000.

In 1977 Ledant and Van Dijk comment on the Constantinois region as chotts poor in vegetation and nesting birds where Coots was not stated at all neither a wintering nor a nesting waterbird . In 1981 Ledant *et al* (1981) reported that the Common Coot *Fulica atra* was rare and only observed at Gareat. Boulhilet by Le Berre and Rostan (1976) and himself, the population size was not given. One possible explanation for lacking information about the Coot population in this huge complex wetlands, containing 20 sites, is the fact that these sites were under estimated, or were ignored due to lack of road leading to

them, like Gareat G.Timerganine, at that time where most interest was given to other Algerian wetland sites.

In a previous study carried out by Chalabi (1990) on the importance of wetlands in protecting the Avifauna , he reported that Common Coots occupy 35 wetland zone over 80 studied, i.e. 43.75% and the high concentration of Coots were in Lak El Mellah, Lak Oubeira, Mekhada water stretches, Lak Tonga, Macta water stretches ; and he concluded that the species has a Geographic distribution of "Mesotope" type and "EURECE" in ecological valence (99% of Average National Count, A.N.C) and according to Total A.N.C , the Coot *Fulica atra* presents the second large group of birds after Anatidae wintering in Algeria. In The "Constantinois" (accordint to ANC) Anatidae (68.90%), Coots (18.21%), Greater Flamingo (9.49%) and Common Crane (3.40). However, this study depended only on occasional (not regular) counts provided by Forest services, without covering the entire twenty wetland sites of the Hauts Plateaux.

2.6 Movements:

It is worth nothing to recall bird migration in the West Palearctic region; in general, the annual biological cycle of birds involves four phases: Autumn migration, Spring migration, the reproduction and the moulting (Filter and Roux, 1982).The wintering occupy an important part of this cycle. Among the biological characters, the most spectacular, is the migration which is a real adaptive strategy that lead birds to look for further receiving zones more favorable either climatically or alimentary. These zones are located far from breeding site, to the South 55^{e} Parallel in the Sahelians sides (Mauritania, Senegal, Mali, and Tchad) and in North Africa.

In migration, Birds exert each year two obligatory movements that are occurred at a Leaving and Return rhythm ("Round- trip") (Jarry, 1988).The prenuptial migration is called "ascending" and occurs, during spring, from South to North. The postnuptial migration is called "descending" and occurs in the end of the summer-Autumn from North to South. Globally, birds breed in North of 55^{e} parallel till 10^{e} and for some species till 10^{e} and for other species till 30^{e} South (Gerard, 1987).The migration flux is guided according North-East/ South-West Axis (Filter and Roux, 1982).

Regarding this migratory flux, Algeria is placed on the two main paths of Flyway of Atlantic east. It is crossed by tens of thousands of birds going till main Sahel wetlands, usually through crossing over the Sahara.

In warm and temperate regions, The Coots are present all year (though individual not necessarily resident), but mainly migratory in north and especially Eastern Europe under influence of continental climate. The Common Coots winter from North Sea, Baltic, east-central Europe, and southern Russia (former USSR), southwards to Senegal delta, Oases of southern Sahara, and river valleys and lakes of Sudan and may be Ethiopia. Though Coots are present in strength throughout Palearctic part of this range, largest winter Coot numbers are found in west and west-central Europe, Mediterranean Basin, and Near East, especially in Denmark, Germany, Netherlands, Morocco, Tunisia, Turkey, Black sea Cost, Caspian sea, and Iraq (Cramp and Simmons ,1980).

From the pervious observations on Coots' distribution in Algeria, it appear that the North east Flyway is the most important for Coots migration into Algeria, but this observation requires a detail and in depth research to estimate the total migratory and the sedentary Common Coot population. The recoveries of the Common Coot are Belgium France, Germany, Spain, Switerzrland, Former Yugoslavia (Isenmann and Moali, 2000).

2.7 Wintering Strategies:

To study the distribution and evolution of different behaviours exhibited by waterbirds species during the winter, observation methods were put in use (Tamisier, 1972; Altmann, 1974; Baldassarre *et al.*, 1988).Continued observation were carried out on groups of birds. The digital data were converted into temporal data, where it was obtained the average allocated time by bird to each of these activities: the so called time budget.

The analysis of these time budgets in Camargue (France) shows the existence of" *species effect*" that characterized each group. The granivorous species feed mainly at night while the herbivorous species feed during whole night and part of the day, probably due to the low energetic value of the ingested food

(Campredon, 1982; Allouche, 1988).The zoophagous species feed on rich protein diet that allow them to reduce feeding duration.

Studies carried out in Camargue on the Common teal (*Anas crecca*) (Tamisier, 1974), Eurasian Wigeon (*Anas Penelope*) (Campredon, 1982), and the Gadwall (*Anas Americana*) (Allouche, 1988) showed the existence of "*Month effect*" within winter. The latter permits, then, the identification three phases of winter in Ducks (Tamisier, 1985):

Growth and recovery phase: the birds arrive from their breeding sites and their body mass is weak (low) the important energetic needs force these birds to long periods of feeding and sleeping (the majority of these birds are juveniles and complete their growth).

Couple formation phase: The climatic conditions are still favorable allowing birds to allocate a part of their time to loafing and couple formation**.**

Energetic reserves' storage phase: The daily cycle is again saturated with feeding and sleeping time that allows storing necessary energetic reserve for return migration and for breeding.

The hypothesis of the existence of real wintering strategy adopted by theses species was put forwards to explain these three wintering phases (Tamisier *et al*., 1995). This strategy of wintering appear as a group of mechanisms allowing birds to adapt to environmental and physiologic conditions that face during winter It permits to understand the three phases of wintering as successive answers to changeable conditions of winter in function of their energetic needs.

Thus, the just arrived birds (First phase) are in need to recover the energy spent before their arrival; then, during the second phase, they dispose of the"free time" for couple formation and bird pairs are hierarchically dominant for the access to alimentary sources. The third phase, finally, they devote entirely their time to storing energy for migration and breeding so that they will be able , at spring, rejoin their nesting quarters as soon as possible. The first arriving birds and in couples, however, are dominant for selecting the best nesting sites and produce to a maximum of chicks.

This strategy makes sense when compared its results with those obtained these late years in North America on the breeding success of waterbirds.

In fact, it exist a strong correlation between the storage obtained on wintering sites and during the migration (Lagrange and Dinsmore, 1988) and the nesting success (Ryder, 1970 in Ankney and Alisauskas, 1991; Krapu, 1981; Ankney *et al.*, 1991). Therefore, once birds arrive at wintering sites, they start a" racing" to be the first in each wintering strategy in order to be able to quit the wintering quarter in the best possible conditions for the reproduction (Tamisier *et al*., 1995).

The three phases described above were described in the Anatidae. The only study of this nature (Allouche, 1988) in Common Coot in Camargue did not show the net cutting up of the three phases (the second phase if wintering does not exist in Coots because couple formation occurs at spring). This work, however, showed the existence of two Coot populations in Camargue, each has a different wintering strategy and exploits distinct habitats. Allouche (1988), put the hypothesis where the migratory and sedentary Coots present in winter do not have a random distribution on the sites of Camargue, but they gather by site following their origin, where some sites are occupied in majority by migratory Coots and others by sedentary Coots.

2.7.1 Feeding:

We can divide waterbirds into three categories (herbivorous, granivorous, and zoophagous).The herbivorous, among which is the Common Coot, feeds mainly on algae and vegetative parts (stems, leaves) of floating or immerged aquatic vegetation. The granivorous feeds on fallen grains in Autumn deep in water bodies, the zoophagous feeds invertebrates and planktons (Tamisier and Dehorter, 1999).

The Coots are diurnal and do not colloquially move over 24 hours. It feeds mainly within the day and sleep at night on the same site (Allouche, 1988; Tamisier and Dehorter, 1999).The Coots are mainly herbivorous and feed on floating vegetation more or less immerged, such as *Potamogeton pectinatus* and *Myriophyllum spicatum* (Allouche, 1988). The diet may include sometimes insects and mollusks Therefore, Coots can be considered omnivorous.

Tamisier and Dehorter (1999) explained why Coots feed all the day and little at night by the requirement related to their alimentary diet. The vegetative parts have low energetic value and are ingested in large quantities, and the digestive process is long and birds must intercalate phases of

digestive resting between alimentary phases. The selection mode of prey appear as determinant of diurnal feeding behaviour of Coots where the preys are mobile and captured by vision (visual selection).This means that Coots select their food precisely by vision where they peck the vegetative parts on the water surface. This explain the lower time devoted by Coots to daily feeding when compared to those of Ducks. Therefore, Tamisier and Dehorter (1999) reported that the only diurnal species is the Coot, and is the only species where the alimentary selection is probably visual.

In contrast, in winter, a duck sleeps within a day and feeds at night. In fact the Anatidae are found during the day on few water stretches called "*remises*" where they gather in high density. The birds, there, are in security (no hunting) and mainly exhibit comfort behaviours (sleep, swimming, preening) and sexual loafing. At night, in contrast, it disperse to numerous places called "gagnages" further by few kilometres from their day places where they feed during the whole night till dusk where they go back to their "*remises*" (Tamisier and Dehorter, 1999).

2.7.1.1 Feeding Strategies of the Coot:

Coots use different strategies in feeding: Surface feeding (Figure 10), head and neck submerged (Figure11), upending, diving, and grazing (Figure 12). Coot feeding behaviour is particularly diversified where the low water level permits the use of head and neck and upending, and when the accessibility of resources is reduced these intermediate behaviours (head and neck and upending) are replaced by diving (Allouche, 1988; Sterry, 2004). In previous study carried out in Irland (Irwin and Ohalloran (1997) reported that the most common feeding strategy for Coot over winter was surface feeding and swimming. In another study, Horsfall (1981) in Great Britain, studied the time budget of the Coot *Fulica atra* and reported that surface feeding is a characteristic strategy used by Coots where they often bring their food to the surface before consumption. Coots largely prefer the less demanding strategy of pecking at the surface as easier foraging technique but food depletion may induce Coots to move to another area or to affect their foraging behaviour that will be altered from surface feeding to diving and searching longer for food. (Draulans and Vanherck, 1987). Fjelsa (1977) considered that Coot is physically non adapted for diving and the energy cost of this behaviour is very high.

Coots use different methods for Feeding that can be summarized in the following: (1) scrapes algae off stems, stones, and tree stumps under water. (2) Picks food of water surface while swimming. (3) Breaks off young emergent plant shoots. (4) Leaps upwards to bring down leaves, seed-heads, and insects. (5) Up-ends in depths up to 40 cm, occasionally immersing whole body. (6) Dives by pressing air out feathers, tilting forwards, and diving almost vertically with neck extended, the food is brought to the surface before eating. The Coot dives normally only to 1-2 m, but up to 6.5 m recorded with a maximum duration beneath water was 20 seconds. (7) Feeds in flocks, on land , normally near water, particularly late Autumn to spring when wing cause high waves.(8) Large food items tossed back and forth by quick shaking of head, that may clean slime off surface, as well as braking them into small pieces. (Cramp and Simmons, 1980).

Figure 10: The Common Coot feeding on the surface of Water

at Touzeline Reservoir.

Figure 11: Head and Neck submerged as a foraging strategy used by Common Coots

Figure 12: Flock of Common Coots Grazing at Touzeline Reservoir on late winter 2006-07.

5.7.1.2 Factors affecting feeding:

Variables such as latitude, habitat, and disturbance may increase or decrease diurnal or nocturnal feeding (Tamisier and Dehorter, 1999). It has long been recognized that the feeding performance of diving birds is influenced by environmental factors such as water depth, food density, and depth of substrate covering the food (Draulans, 1982).

The behaviour of Coots changes during the course of the day and season and between ponds (Draulans and Vanherck, 1987; Irwin and Ohalloran, 1997).

Body condition is an essential determining factor in feeding where for migrant Anatidae wintering in the Camargue, the period following their arrival is marked by an important feeding activity (Tamisier, 1972; Allouche andTamisier, 1988). Asensio *et al*., (1986) suggested that the emphasis on feeding activity during early winter is related to the necessity of constituting an adequate reserve for over wintering. Like other species of waterfowl Coot survival during winter could depend on fat reserve accumulated at the beginning of winter and which can then be considerable (Visser, 1978); However, the decrease in feeding activity for a given period is reflected by the fact that reserve are accumulated during previous months on the same site or on neighbouring site(Allouche, 1988). Other factors, such as predation, hunting Pressure, and physiological characters of the individual, also, influence timing of daily activities. Temperature decline was also reported to lead to an increase in time spent foraging. High wind and rainfall lower feeding activity in non breeding Anatidae (Paulus,1988).

2.8 Social pattern and behaviour:

In Wintering: The Common Coots are the most gregarious of the west Palearctic rails, often in, frequently in flocks outside the breeding season. Winter flocks usually larger and sometimes huge (even many thousands strong. At times associate with aquatic flocking birds, mainly ducks (Anatinae) (Cramp and Simmons, 1980).

In breeding season: the breeders are often gregarious in breeding season (Fjeldsa,1973) where the climate and the food availability allows, a proportion of Coots select territories during December-January and some pairs retain territory throughout the year (al least in north England). If water becomes frozen Coots abandon their territories temporally. Coots are monogamous waterbirds, they form pairs pair-bond) usually during breeding season, or sustained longer when territory are maintained within the year. Timing of pair formation is variable, but often during winter-spring before the acquisition of territory (Horsfall, 1981). Finish birds return from winter quarters already paired and can immediately occupy territories (Cramp and Simmons, 1980). Horsfall (1981) suggested that unpaired male or female are not able to hold breeding territory at the site subjected to pressure from neighbouring pairs; thus birds must often be paired before territory can be gained.

In Brood care: the parent-young bond remain maintained by both sexes until young become independent at 6-8 weeks (Cramp and Simmons, 1980).When hatching occurs asynchronically, the male may lead chicks to water for a short periods while female continues incubating remaining eggs, the last eggs are sometimes abandoned (Alley and Boy 1947).On completion of hatch, brood sometimes divided between parents for short periods where one parent broods and the other forages with the remainder. The young usually remain in parents' territory after acquisition of flight at 8-11 weeks or until migration .On leaving territory, Juveniles form larger units by joining to other juveniles. Coot pairs may have second nesting attempts, usually the male resumes to tend young while female incubates (Cramp and Simmons, 1980).After hatching the second brood, older young are either driven away or remain.

Night Behaviour: The Common Coots, on the contrary of ducks, sleep during night about 8 hours and devote only a few hours for feeding or to swimming (Tamisier and Dehorter, 1999).

2.9 Roosting:

The Common Coot goes to night roost generally at sunset and become active again in very early morning. Sometimes it sleeps for a short period during the day, particularly late morning to early afternoon-usually after a period of preening. Roosting and loafing sites are variable: small islets, mud, or sandbanks, part-submerged rocks, easily accessible branches of trees. Flocks roots mainly on open water

(Figure 13) or in shore vegetation The young roost in nest or specially constructed brood nest, led there by one parent, and at about dusk ,other usually roosting close by (cramps and Simmons ,1980).

Figure 13: Resting behaviour of Common Coot on Water.

2.10 Antagonistic behaviour:

Generally, The Coots reserve their aggressive behaviour for adults (and some times young) of their own, but were from time to time seen attack other species (Cavé *et* al., 1989).

The Common Coot displays an antagonistic behaviour mainly of **courtship**; the displays exhibited by both sexes composed mostly of the following elements. In aggression: Low –posture; Shield showing, Neck-ruff posture , in which neck feathers erected, giving apparent increase(especially in male) Tail – raising and expanding of tail-coverts (Tail-fan), also, occurs. Bowing-posture often adopted, head being lowered with bill pointing towards water of ground or even back towards feet, making shield inconspicuous (Cramps and Simmons, 1980).

Flock behaviour: In favourable feeding places, winter flock is often dense and the activity is synchronized mainly through social facilitation. Intra-specific aggression, within flock, may important as a spacing mechanism but it is generally of lower intensity than among breeders.

Charging- attack also is commonly used by Coots to steal food from subordinate.

Splattering-attack, however, rarely seen outside breeding season (Horsfall, 1981). To maintain individual distance, Coots relay on Shield –showing while head moved rapidly in front of rival; in more intense threat, neck stretched forward, and bird may raise itself on water momentarily by treading movement with feet, and the submitting bird turns away.

Social warning: probably by warning call and a co-operative deference behaviour within flock, exhibited against large flying predators, on open water where a tight pack is formed on sight of the enemy; if thee latter swoops close overhead, Coots splash up water(Cramps and Simmons, 1980).

Aggressive behaviour is well developed among highly territorial breeding pairs where sight of stranger approaching territory limits often induce low intensity threat termed "**Patrolling**": bird makes itself look bigger by slightly raising back feather and adopting Neck ruff-posture and usually silent. If more vigorous response required, often expel intruder by charging attack. The Coot come closer to adversary and speed up into Splattering-attack in which posture of charge retained while bird runs over surface of water aided by flapping wings; the adversary usually flees in similar manner with head erected (Cramps and Simmons, 1980).

Hunched display: occurs in territorial defence where attack often ends on boundaries and sometime well beyond; fleeing birds, then often turns and chases another bird as far as border.

This display involves low – posture, high Wing-Arch, Tail-raising, and Tail –Fan. Once this display is adopted, birds turn and face away from each other. Often up to 4 birds involved in this display. The combats occur mainly during territory establishment or its enlargement into area already occupied by other or during rearing of chicks (Figure 14 a) (Cramps and Simmons, 1980). .

Fights: generally follow Charging-attacks (Figure 14 b, c, d) when neither party gives way. It involves violent, often prolonged, striking with feet, clawing each other's breasts, and stabling with bill; wings are typically spread and held back as each bird tries to unbalance opponents. Thus, the weaker bird often forced on to back or held under water; escape by underwater swim, or by surfacing then turning and fleeing in Splattering –retreat (Cramps and Simmons, 1980).

Most fight occurs after a period of threat between neighbours, but attacks against single birds or pairs attempting to establish themeselves rarely preceded by any threat (Horsfall, 1981).Usually males fight

males, and females fight females. After nearly all contest, participants shake feathers violently, and, also, preen for at least 2 min.

Pairs are also aggressive towards chicks of neighbouring pairs. Will attack them if they trespass, plunging them underwater and shaking them violently by head; chicks attacked play dead, thus usually managing to inhibit attacker, and eventually retreats quietly to home territory. (Horsfall, 1981).

A

B

C

D

Figure 14: Phases of Antagonistic behaviour observed in Coots:

A: Hunched Display, B: Charging Attack

C: Stabling with Bills D: Striking and Clawing

Heterosexual behaviour: Female in early spring, while still swimming, makes continual vocalisations and often carries plant material in bill; the male follows the female continuously. Then after, she swims closer and gives low call, dips bill in water several times, then adopt Bowing-posture (general submissive posture and Preening-invitation display): lower head, so bill under water and Shield well hidden, and rises neck feathers which are allopreened by male. After bond establishment, female generally follows male on excursions in search of territory; when area selected, the male continuously swims round perimeter (Fjeldsa, 1977). At an interval of close to 1.5-2 hours, female approaches male and bowing –and – nibbling ceremony performed repeatedly which may strengthens pair bonds. First copulation occurs soon after occupation of territory; Pairs usually copulate 3-5 times daily where both soliciting and copulation occurs on land or platform, rarely on water Cramps and Simmons, 1980).

Relation within family group: Optimum Coot broodiness depends on visual and tactile stimulus; the parents construct the nest and feed the chicks and assist them in preening during first days. Sage (1969) reported that parents carry young to brood-nest about 1 m above water. Chicks initially depend entirely on adults presenting food. Chicks use Begging-display of hatchling to be fed by parents until 4-5 weeks; then after, they depend on themselves and still beg occasionally from parents (Fjeldsa, 1977).

2.11 Territory defence:

Although Common Coots gather in large flocks during winter, they break up into pairs in spring. Each pair forms a territory which is defended very aggressively, about 40 m out on open water, against intruders (Fjeldsa, 1973). Juveniles are also reported to help parents fight intruders (Cramps and Simmons, 1980).Final limit territory often firmly established by time egg- laying started, but boundaries can be shifted when brood newly hatched, especially if neighboring pairs still incubating (Horsfall, 1981). The territory size can be variable and depends on density and age structure of the population, inexperienced and socially subordinate Coots tend to (1) occupy small marginal areas without any ability to secure them, (2) Habitat factors such as natural barriers, screening vegetation and shoreline amount; (3)

food availability. The typical territories are of 0.1-.05 ha each with approximately 40-50 m of shoreline (Cramps and Simmons, 1980). Marches form variable environments for breeding birds, because the distribution and the availability of resources, such as food or nesting vegetation, may change quickly. Dependence on theses resources is probably greatest during the breeding season, and one strategy to ensure access to them is to defend territory (Salathé and Boy, 1987).

In 1989, Cavé, Visser and Perdeck studied the size and the composition of the breeding territory of the Common Coot *Fulica atra* in relation to age of the breeding birds, the age of their neighbours, and the date of arrival in the territory. Old pairs arrive earlier and have large territories than young pairs. The vegetation elements along the shore are important constituents of the territory and depend on the age of the male and not that of the female. In another study carried out on the Camargue (Southern France) by Salathé and Boy (1987) on the time budget of the breeding Coot *Fulica atra*; it was shown that during pre-laying period, male spent more time in territorial advertisement and territorial defence; and the variability in resources in the March habitat probably forced the Coot to compete for good territories. Thus the territorial behaviour during pre-laying period occupied up to 16% of the time budget.

2.12 Voice:

Rails are compact, rather hen-shaped marsh birds of secretive habits and mysterious voices; more often heard than seen, flight brief and reluctant with legs dangling (Peterson, 1980).

It owes its name to its "Coot" call. Coots' voice consists of different characteristic single or repeated calls, often metallic, resonant, querulous, and explosive sounding; particularly sharp and high when birds are agitated.

Call of adults: are

(1) Combat- call (intimidation call), where the male express a sharp , high pitched , explosive 'pssi' or 'pyee'; and the female call is very short, 'ai' or a soft 'u'. (2)Alarm call, the male express a single, very sharp, metallic variant of combat call ,while the female express a rapid sequence of sounds of varying pitches 'ä-ö- ä- ä- ö'.

(2) Contact call (Enticement call): for female, long sequence of relatively soft ‘p’ or ‘d p’ notes.

(3) Courtship-call (pre-copulatory call in male): a rapid sequence of ‘phsi’ calls

(4) Call for young: (a) contact call is expressed by ‘queer’ or ‘creer’; the begging call (food call) is expressed by ‘bi bi bi’ or kwih (e) kwije (Cramps andSimmons, 1980).

2.13 Breeding:

The Coot Breeding was confirmed for the first time in Europe in 1914 (Schifferli, 1970). In Algeria, its breeding was signalled in 1966 at El Golea (Dupuy, 1966). On the contrary of Anatidae; Coots start their couple formation on breeding sites, in the beginning of spring like in most birds (Del Hoyo *et a*l., 1996).

2.13.1 Season and Laying date:

The starting of the Common Coot breeding season varies from country to another, in central, Europe the first eggs end March but main laying period end April (Havlin, 1970). In Great Britain, Sage (1969) reported that eggs were found 2nd week of March to mid-July. Other researchers (Bezzel, 1970; Havlin, 1970; Blüms, 1973; Gasby, 1978; and Jortay, 2002) reported that Coots start laying in early April in Europe. In Algeria, Etchopar and Hüe 1964 and Rizi *et al*., 1999 reported that the start of laying in late April and May.

Early nesting reported to be advantageous where the best territories become occupied and those Coots which did not acquire a territory may probably gave a poor contribution to the next generation; therefore, territorial behaviour might accentuate individual difference in fitness for breeding; moreover, the rate of laying was found to be correlated with temperatures increase(Fjeldsa, 1973).Factors adversely affecting acquisition of food and subsequent development of nutrient reserve by females will delay time of laying and reduce clutch size (Gary, 1984).

2.13.2 Nest:

Coots nest in ponds, open waters, less profound with a minimum of vegetation on the banks or in water, in reeds particularly in *Phragmites australis* (Figure 15)that provide them food, and necessary material for nest construction. Other materials can be used such as dead and live plants stems and leaves, usually line with slightly finer material. The nest is a platform well stowed, generally, close to shore, composed of braches and other vegetal materials, sometimes is highly visible, sometimes more discretely constructed within vegetation. Coots may also use artificial platforms and rafts (Cramps and Simmons, 1980; Jortay, 2002).

Figure 15: Coot Nest in *Phragmites australis* containing 12 eggs.

Dimensions: nest measurement range from 25-55 cm in external diameter; The internal diameter ranges from 16-30cm;andf nest height ranges from 8-28 m. nest can be build up against rising water level to 35 or even 45 cm (Cramps and Simmons, 1980).

Building: Both sex share in constructing the nest where the male bring most materials and the female incorporate it (cm (Cramps and Simmons, 1980).

Mean distance between nests is variable and range from 45-265m where the minimum usually is 8-22 m, but sometimes as low as 0.75-2.5m (Cramps and Simmons, 1980).

Among factor affecting nest building is Water level and its fluctuation oblige, always Coots to higher their nest level. Total drought, also, around nest causes nest desertion in the long term. Thus, nest dimension may change depending on water level (Rizi *et al*., 1999; Cramps and Simmons, 1980; Jortay, 2002).

The nesting biology of the Common Coot *Fulica atra* was studied in the Camargue, Rhone river delta in southern France by Salathé (1986) where wetlands range from saline and brakish lagoons to fresh water marches. Coots nested only on the latter. The density of nests was lower in marches which dried earlier, and their distribution related to the distribution of emergent vegetation at least 30 cm tall. Nesting started earlier in year with high water level and on marches with large area covered by emergent vegetation. Also, the distributions of nests on marches with mixed vegetation depend on the availability of suiTable vegetation and changed with the growth of new vegetation and the drying of peripheral parts of the Marches. One of nest selection constraints is the vicinity of open water and the opening up of dense vegetation as a consequence of nest building and locomotory behaviour of adults (Gadsby, 1978); therefore, various factors influence on which egg-laying begins and these obviously vary from one locality to another and from year to year among which are the, water, vegetation, presence of high wind and rising of water level which often destroys nest before laying has started (Sage, 1969).

2.13.3 Eggs:

Coot eggs are oval, smooth and slightly glossy, evenly speckled with black and dark brown, measures 53 (in length) x 36(in width) mm in average but may reach 44-61x 33- 40 mm.; the mean weight is 38 g (Cramps and Simmons, 1980).

2.13.4 Clutch size:

The mean clutch size reported by Cramps and Simmons ranges from 6-10 eggs and extends from 1-13 eggs, but over 14 eggs in one nest is probably laid by two females. The clutch size

varies from one country to another where in Czechoslovakia the mean given was 7.9 (Havlin, 1970), in Sweeden, 7.2 and in Great Britain, 5.9 eggs (Sage, 1969).

Clutch size decline during season due to replacement layings, and because older birds lay before younger and lay larger clutches (Havlin, 1970)The earliest clutches reported to be larger , up to 10-12 eggs (Fejldsa, 1973).

In many avian species, female breeding for the first time nest later and have smaller clutches and smaller number of young fledged than older more experienced females(Gary,1984; Cavé *et al.,* 1989).

Cases of second clutches (renesting) are well known among Coots but probably not very frequent (Feljdsa, 1973); and most replacement clutches are smaller than the originals (Sage, 1969). Coots may reach, even, 3 replacements after egg loss with an average time of 7.7 and 5.2 days between loss of the first clutch and re-laying of the second, and the third –re-laying, respectively (Cramps and Simmons, 1980).

2.13.5 Incubation, hatching, and brooding:

Incubation period in Common Coots *Fulica atra* occurs between 21-24 days after the second egg (Cramps and Simmons, 1980; Rizi *et al*., 1999). Gadsby (1978) assumed a 28 day-period between the first egg laid and hatching start (Figure 16 and 17). The process is shared by the two sexes (Salathé, 1986) and starts with the second egg. The hatching is asynchronous. The nestlings are semi precocial so that parental care (feeding and brooding) is necessary for several weeks where female broods for first 3-4 days and the male brings food for the chicks .Later the family may be split between the parents who feed only their young. Just before or at hatching, but sometimes well before, the male builds one or more brood platforms, used for roosting and night –time brooding of young.

After 55-60 days the young are independent and gather in large groups (Salathé, 1986). Common Coots generally raise 1 brood each year, sometimes 2. The age of first breeding 1 or 2 years (Cramps and Simmons, 1980).

Figure 16: Pre-Haching marked eggs in *Scirpus Maritimus*.

Figure17: The first Hatched Egg in a marked Coot Nest.

2.13.6 Breeding success:

Nest success, or hatch rate, is a commonly used measure of breading success, and is defined as the proportion of nests that hatch at least one egg (Kear, 2005).

Previous studies reported different values about the breeding success in Common Coot where in England (Sage, 1969) the hatching was 33.8%, flooding 33%, desertion displacement 17% predation 16%. Another investigator (Alley and Boyd, 1947), in England, reported, 35% for hatching, 23% for displacement or burial, 58% predation. In Sweden, The hatching percentage was 49%. (Cramps and Simmons, 1980) In Czechoslovakia, Havlin (1970) reported that predation was 6.87%, 11.5 % destruction by flooding.

Feeding is an important factor for breeding success in Coots (Brinkhof, 1997; Brinkhof and Cavé, 1997).

2.13.7 Some factors affecting breeding success:

2.13.7.1 Predation:

Predation at the vulnerable egg and pre-fledging stages can be high on some species, and result in clutch reduction, clutch loss or abandonment (Kear, 2005).It is an essential factor affecting both wintering and nest success in Coots. As one of the most factors affecting the survival of birds, during their life span, birds are subject to different kinds of predation and many features of their behaviour (e.g. flocking, and warning behaviour, nest remaining) are adaptation against predation (Veli-Matti Väänänen, 2001). In breeding, the Common Coots select the best territory to build nests such as in dense vegetation like *Phragmites* that has the best cover than in *Scirpus spp* (less covered) and this will diminish the rate of Aerial predation; thus, this camouflage is an effective measure used Coots to prevent or to diminish predation (Salathé,1986).The nest site requirement for the Coot *Fulica atra* was reported to be in a dense stands of emergent vegetation of the last year.((Veli-Matti Väänänen , 2001).

In The Coots, the disturbance is due to Yellow–legged Gull *(Larus cachinnans*) at 55% of cases and Marches Harrier (*Circus aerucinosus*) at Camargue, France (Tamisier and Dehorter, 1999). It causes

a racing more often on water than on flying and this may lasts 1.4 minute per day and per individual (Allouche ,1988).This duration presents, however, just a partial time of disturbance real time. In fact, it appears that after disturbance, the Coots gather densely and take too much time before resuming their initial activities: long preening time, then, long time in swimming that corresponds to group dispersal. At night the predation is very rare, probably the only species susceptible to do so are Wild boar *Sus scrofa* and the fox *Vulpes vulpes.* Coots, like duck are subjected to predation pressure equal if not more than that of ducks because of weak ability for flight. Since Coots feeding is probably a visual selection, they are restrained to be fed within a day light, at least for the essential; thus they have to avoid predation (like ducks) by adopting the gregarism behaviour (Figure 18) *(*Tamisier and Dehorter, 1999).

Figure 18: Aerial Predation on Coots by Slender-Billed Gull at Timgad Dam.

2.13.7.2 Parasitism:

Avian Brood parasitism occurs when a female deliberately lays her eggs in the nest of another individual that subsequently cares for the brood. In wild fowl, con-specific brood parasitism is relatively frequent and inter-specific brood parasitism infrequent, but egg dumping occurs in all groups

and all geographic regions. The extent to which it occurs during normal breeding activities varies considerably (Kear, 2005).

Conspecific brood parasitism was common component of breeding population of American Coots, *Fulica Americana* .In 1993, Bruce Lyon showed that it is a flexible female reproductive tactic .He showed that parasitism occurred in several ecological contexts, each involving different constraints and trade-offs. Parasitism was attributed to floater females without nests or territories of their own; to nesting females who usually laid prior to laying full-sized clutch in their own nests. By laying surplus eggs parasitically females cab bypass the constraints of parental care and increase their total production of offspring.

Lyon Bruce (2007), also, studied the Mechanism of egg recognition in defences against conspecific brood parasitism in the American Coots (*Fulica americana*). He showed that Hosts of avian brood parasites use a variety of defences based on egg recognition to reduce the costs of parasitism; the most important of which is rejecting the parasitic eggs. Two basic recognition mechanisms are possible: “true recognition”, whereby hosts recognize their own eggs irrespective of their relative frequency in the clutch, and minority recognition (or “recognition by discordancy”), whereby hosts respond to the minority egg type. Since the mechanism used in defences against conspecific brood parasitism is unknown. He experimentally determined the mechanism of egg recognition in American Coots (*Fulica americana*), a species with high levels of conspecific brood parasitism, egg recognition, and rejection. He swapped eggs between pairs of nests to alter frequencies of host and “parasite” eggs and then used two criteria for recognition The non-random incubation positions of parasitic eggs indicates that birds sometimes recognize parasitic eggs without rejecting them and provides a means of assessing recognition on a per nest basis in species with large clutches. Adaptive recognition without rejection may also be an important evolutionary stepping stone to the evolution of egg rejection in some taxa.

2.14 Plumages:

The adult is characterized by a black head and neck, the crown, hind neck, and sides are slightly glossed green .The upper wing-covert, tertials, and tail are dark slate-grey. The tips of longer tertials and

tail are black with slight green gloss.; tips of lower inner scapulars, inner tertials, feathers on lower mantle, back, rump, and upper tail covert are dull olive-brown. The tips of other feathers of upperparts and upper wing covert, also, faintly tipped brown when fresh. Sides of breast and flanks are dark slate grey. Under tail coverts black, remaining under part are dark grey.

Narrow line on leading edge of wing, on outer edge of outer feather of bastard wing, and an outer edge of outer are primary white. Bastard wing, primary coverts, and flight feathers dark brown-grey, inner webs of flight-feathers paler grey, outer webs slightly tinged slate when fresh. Tips of secondaries white with dark horne-brown shafts, under wing –coverts and axillaries grey. The first plumage (acquired from August to November) is darker, but remain duller than adult and (on some) white throat (Cramp and Simmons, 1980).

2.15 Moults:

It is complete in adults post-breeding; flight feathers and all wing coverts simultaneous. It Starts with head, neck, and front of the body from late May, but moult slow during nesting and when caring for the young. Wing –feathers shed in non nesting birds form mid June; later in nesting birds ,but highly variable , late June and early September where the male slightly earlier than female. Loss of tail feathers soon after loss of flight feathers; the whole body in heavy moult in July, mostly finished by late August; head , back, vent, and tail coverts by mid-September .

It is Partial in adult pre-breeding; where head and neck only showing moult in December –May.

It is also partial in post juvenile; head and body, starts before wing full-grown.

It is partial in first pre-breeding, starts from December to May. Like adult, but often greater number of body feather moulted (Cramp and Simmons, 1980).

2.16 Possible factors affecting distribution of wintering waterbirds:

Waterbirds exploitation is a studied issue because of its economic importance. For ornithologist, these birds have a measurable value (Bibby, 2002). The saving of these populations presents major benefits for the national patrimony (Pinet 1993 in Mathetvet and Mesléard, 2002). In order to allow their

durable exploitation, demographic tendencies (count and distribution) of these populations of waterbirds must be preciesely surveyed (Pirot *et al.*, 1989).

The majority of waterbirds are migratory species and have two distribution areas (reproduction and wintering areas) related by migratory phases (Evans *et al*., 1984; Alerstam, 1990).

It is known that before leaving for immigration, birds termed « reproducteur sur capital » such as Geese (Meijer and Drent, 1999), should store energetic reserves that will be used in their flight (Nisbet *et al.*, 1963 in Alerstam, 1990). But it was found that these reserves were, also, essential to start breeding where food resources were not always available at arrival in breeding site (Raveling, 1978, 1979). It was also found that the second type of birds termed « reproducteur sur revenue » such as Ducks (Meijer and Drent, 1999) uses winter to prepare their breeding by pair formation and not to store energy reserves for breeding (Hepp and Hair, 1983). Therefore wintering season considered as a functional link in waterbirds 'breeding (Tamisier, 2001).

In order to exploit these species durably, it is mandatory to understand the group of factors that influence the spatial distribution and the abundance of waterbirds in wintering quarters. Two factors may explain the preceded parameters: global and local factors.

2.16.1 The global factors:

After the end of the breeding period and the post nuptial migration, waterbirds gather in thousands or tens of thousands on a large space of wetlands called wintering quarters that occupy for many months, from August to March (Tamisier, 2001). These sites are subjected to global phenomenon affecting currently our planet such as climatic changes and natural habitat loss, which are susceptible to influence the abundance and distribution of waterbirds.

2.16.1.1 Climatic changes:

Birds' migration can be summarized in being in the right place on the right time« être au bon endroit au bon moment » (Coppack and Both, 2002). Waterbirds are adapted to use in an optimal

manner the available resources on breeding sites and to avoid winter rigors by moving towards more soft regions where resources are available and sufficient (Alerstam, 1990). However, the right place « le bon endroit » is changeable by geologic times' scale. The migratory behaviour of birds should be flexible in order to adapt to global climatic changes (Coppack and Both, 2002). Currently, under climate influence, more and more environmental quick changes are shown, affecting in particular the habitats (Stenseth *et al.*, 2002). For instance, a 3°C variation in average monthly temperature corresponds to isotherms modification clause to 300-400 Km in latitude or 500 m of altitude. With temperature elevation, some habitats are thus modified, leading to a change in species distributions (Hughes, 2000). However, knowing the consequences of these modifications on abundance and distribution of these birds is difficult because within the year they change locations where the climate may develop into different directions which will prohibit adequate adaptation (Coppack and Both, 2002). Long distance migratory birds are affected by climatic changes, some are even facing decline in their populations (Robbins *et al.*, 1989), and since spring migration is triggered by endogenous factors that are not related to breeding sites' climate. These will lead to time difference between arrival date on these sites and abundance surge in food sources linked in turn to temperatures (Both and visser, 2001).

2.16.1.2 Natural habitat loss:

Wetland regression associated with agricultural, industrial, and urban zones is a global phenomenon that causes an important problem for waterbirds frequenting these zones (Sutherland, 1998). Their abundance and distribution depend on the quality, distribution and availability of these habitats (Dehorter and Tamisier, 1996).Three types of habitat losses linked to the use of these sites by birds were defined: wetlands conversion to another use such as agriculture, wetlands degradation by pollution and disturbance by human activity (Van Vessem *et al.*, 1992).

Therefore global factors seem to have an effect on distribution and abundance of waterbirds on wintering quarters.

2.16.2 Local factors:

At the local scale, waterbirds have types of main requirement that determine their choice for a wintering site (Tamisier and Dehorter, 1999). The first is trophic type; the energy acquired within feeding behaviour governs the entire biological cycle of the bird. A part of it fulfils its immediate needs for maintenance and growth, and the other part is stored for future needs such as migration or breeding (Ankey *et al*., 1991).

Second type of requirement is the spatial resources. The waterbirds need during their wintering to have an access to sites where they can carry out their comfort activities (swimming, preening, sleeping) and feeding, in security without being disturbed (Evans and Day, 2001).

2.16.2.1 Local wetlands characteristics:

The factors linked to the physical nature of marshes are susceptible to influence the abundance and the distribution of waterbirds on wintering quarters because they determine the selection of habitat at local level (Allouche *et al.*, 1989; Sanders, 1999).

The surface of marshes is a main factor because waterbirds gather on large water stretches (Tamisier, 1976; Pirot *et al.*, 1984). These gregarism is considered as a response to predation pressure (Tamisier, 1972).

Characteristics linked to water are also very important. Fluctuations of water levels determine the availability and accessibility of food (Clausen, 2000). It also determines the presence of resting sites (Green and Robins, 1993; Guillemain *et al*., 2000). The flooding duration and salinity of marshes are also variable elements that determine the composition of submerged macrophytes communities (Grillas, 1990). These vegetations are the main source of food for numerous waterbirds that feeds on grains, stems, leaves and bulbs (Dervieux and Tamisier, 1987).

Chapter 3. Material and Methods

3.1 Methods: The methods of birds' observation are numerous and dependent on studied species and on study purpose. Two methods are usually used:

The absolute method:

In this case the census is called exhaustive because we consider that the population is estimated directly in its absolute value and all the individuals are counted. It is the kept method when the population is close to observation point and the total number of birds does not exceed 200 individuals.

The relative method:

In this method the population is estimated using sampling that include only a part of the population , we estimate a sample of an average size, then we divide field of vision into several bands and report as many times as number of bands. This method is generally used when individual number exceeds 200 individuals and when the population is far from the observation point (Tamisier and Dehorter, 1999; Altmann, 1974).

We carry out the birds' census for many reasons: to estimate the number of different waterbirds species occupying the site, to know the importance, the role of water stretch, and to obtain indications on the functioning of the site.

The aim of our study is to know the ecology of the Common Coot *Fulica atra* at the Hauts Plateaux northeast Algeria.

We carried out Census of the species; Common Coots and Anatidae within the whole region of Oum el Bouaghi and in Constantine region at a half monthly average where the used technique depends on the population size. During breeding season Counts of adults (mostly birds not maintaining territories) were carried out at weekly basis starting from March.

Time budgets were monitored starting from September to March. All scans lasted 8 h (with scan carried out every half hour between 08:00 AM and 4:00 PM). G. Boulhilate was chosen in the first year for (1) its high water level and (2) the number of Coots wintering in it, (3) ease of access and monitoring. It dried up in the summer 2006 and we switched our study to Touzeline Reservoir, the only remaining body water in the Complex when the sampling of activity budget was resumed. The behavioural study was

based on eight activities: Feeding, Swimming, Preening, Resting (on water or on land), Treading (a bird travelling across the water surface aided by flapping wings), Agonistic behaviour, Sleeping, and Flying. Feeding was, also subdivided into five categories: Surface Feeding, Head andneck submerged, Diving, Upending, and Grazing (feeding on the land).

The maximum water depth never exceeded 70 cm and 93 cm at Touzeline Reservoir and G. Boulhilate, respectively, during the course of the study period.

In addition, The Breeding ecology of the species was studied at two main sites (G.Timerganine and Chott el Maleh) for two years 2005 and 2006.

We followed Samraoui chenafi (2005) by classifying the vegetation of G.Timerganine into four distinguishable strata based on the dominant plant in each formation. These four strata are constituted respectively of Reed (*Phragmites australis*), Sea Club-rush (*Scirpus maritimus*), Triangular Club-rush (*Scirpus triqueter*) and Common Spike-rush (*Eleocharis palustris*). The surface area occupied by each strata was not measured and no trial was made to control for sampling effort. The Reed patch size was evaluated approximately to be the largest and both Sea Club-rush and Common Spike-rush were of similar size, however, Triangular Club-rush was the smallest patch.

The Vegetation of the monitored Chott el Maleh unit one was categorized into two separate strata, Sea Club-rush (*Scirpus maritimus*) and Reed (*Phragmites australis*). The First, it emerged as a belt-like shape and was estimated to be the dominant patch; the second, However, it occupied the inside pond and formed two moderate patches. The other three units contained less vegetations mainly Sea Club-rush. Nests were located in all strata but laying began relatively late among Common Spike-rush. The data were collected when Coots first built their nests in the respective vegetation stand.

Nests contents were inspected at least twice a week during the whole breeding season till hatching and the fate of each nest was recorded.

Data on egg laying was recorded and analyzed based on the date of the first egg (Lack 1950; Havlin1970). First-egg dates (FEDs) were calculated assuming a 28 day interval between FED and

hatching (Gadsby 1978). Each nest and all the eggs were numbered, with a permanent marker. We measured nest site characteristics such as internal, external diameters, nest height, water depth, and vegetation height. Nest vegetation density in $1m^2$ was estimated into four categories as follows:
Minimal (0 – 25%), average (25 -50%), sub-maximal (50 -75%) and maximal (75- 100%). Distance to open Water (DOW) was estimated (m). Eggs were weighed to the nearest 0.1g, using a Pesola spring balance. We also measured lengths (L) and breadths (B) of eggs to the nearest 0.1 mm using vernier callipers. We calculated egg volume (V) using Hoyt's (1979) formula: ($V= 0.000507*L*B^2$) and egg shape index (ES) using the following formula: (ES= B/L*100) (Rizi *et al* 1999).

Complete clutches were defined as such when the number of eggs remained constant between two subsequent visits. A nest was considered predated if one egg or the entire contents of the nest showed signs of predation. A nest was judged vandalized by locals if it was emptied between two consecutive inspections. Signs of Parasitism were recorded using two established criteria (Lyon, 1993; McRae, 1997; Jamieson *et al*., 2000): the one-egg-a-day `rule´ and the presence of newly added eggs after clutch completion.
About 1552 hours were devoted to this study where 576 h for Species Census, 752 h for the breeding, and 224 h for the time budget.

Statistics and Analysis

The hourly data for time budget were analysed in two ways. Firstly, the whole data set was inspected to determine the mean percentage time spent by Coots in each activity for the whole winter season. Secondly, the data were re-analyzed to determine the mean percentage time allocated to different activities during the eight diurnal hours of observation that was divided between 8:00 AM and 4:00 PM. Standard errors are indicated (± SE).

3.2 Used Material:

1 Telescope Optolyth (20×60)(Figure 19 a)

2 Notebook for recording data and observations.

3 Digital Camera Canon A700.

4 Trickle and Formol for taking and conserving trophic resources.

5 A Field guide to the birds.

6 Field Map.

7 Profondimeter.

8 A specialised Costume (Impermeable)

9 GPS.

10 Vernier Callipers (Figure 19 b)

11 A Pesola spring Balance (Figure 19 c)

12 Folding Rule

13 Technical Sheet.

14 Permanent Marker.

15 Tong Depressor (For numbering Nets).

a: A 20x60 Optolyth Telescope used during the study.

b: Vernier Calliper

c: Pesola Spring Balance

Figure 19: Material used for field work

Chapter 4. Results and Discussion

4.1 Results:

4.1.1 Status and Time Budget of the Common Coot:

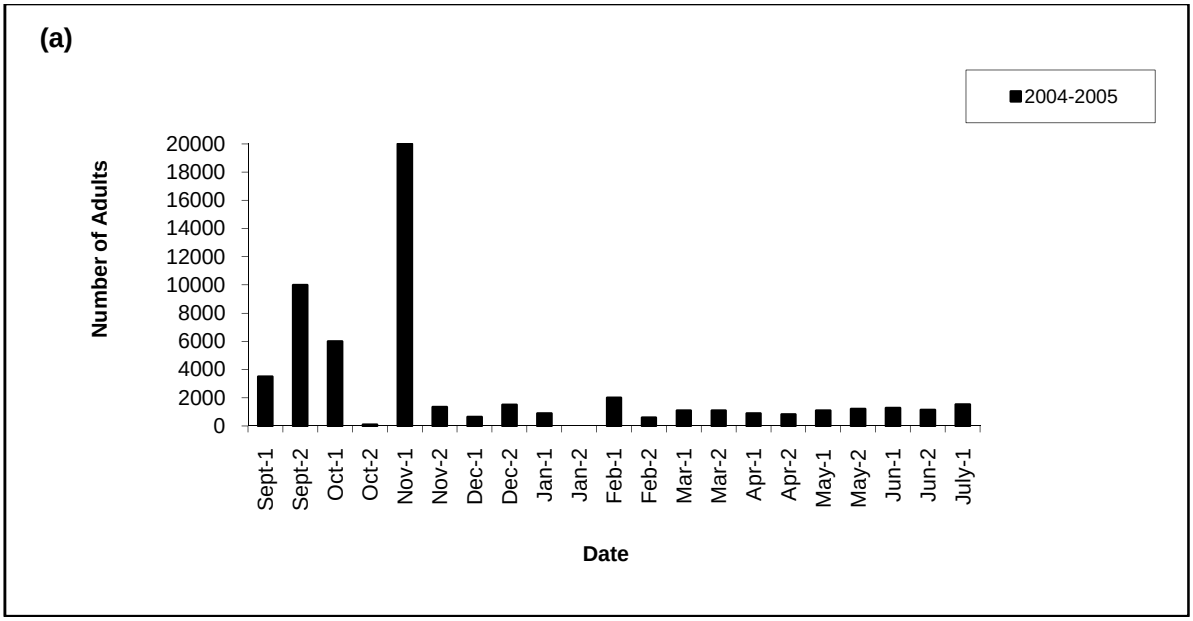
Census of Coots within the wetland complex of Oum El Bouaghi showed a gradual decline in numbers over the three year period with a maximum winter counts recorded in early November 2004 (20000) and in mid September 2005-06 and 2006-07 (4000 and 380, respectively) (Table 4 and Figure 20 a, b, c). Regular observations showed that the species preferred fresh and shallow sites rather than salt sites in the wetland complex of Oum El Bouaghi where it was totally absent. Coots started to occupy G. Boulhilate in early September, with a maximum record in late October (2200) followed by a progressive decline in early March (160). From early March to late April a gradual increase in Coots' number was recorded which then finally abandoned the site altogether (Figure 21a) at the onset of the breeding period.

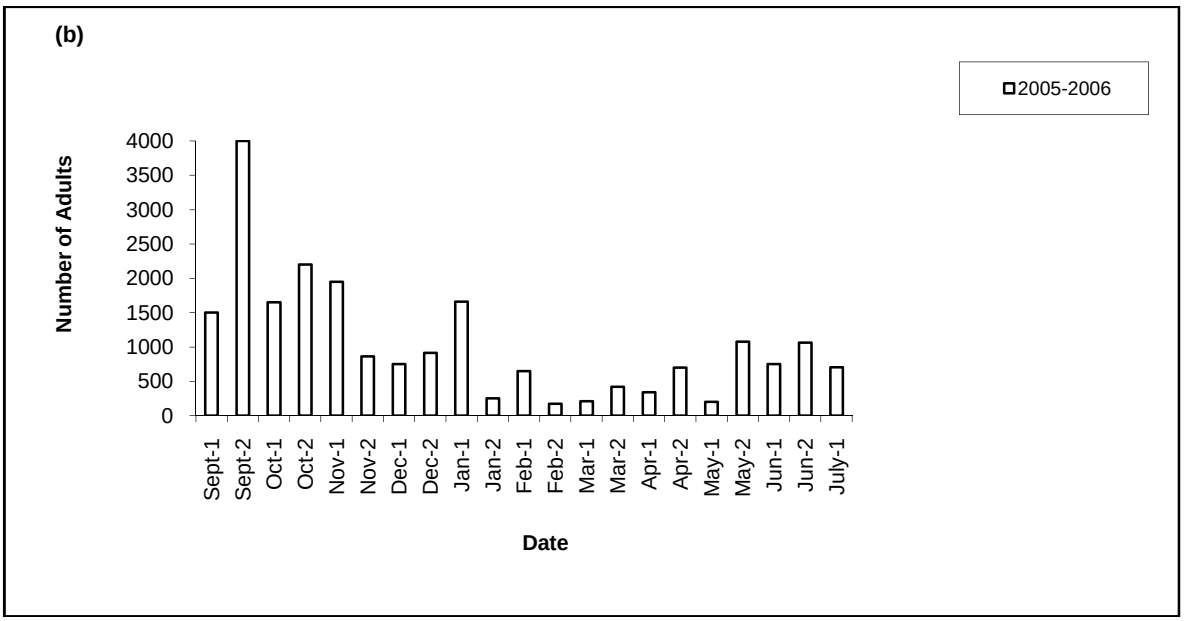
The year 2006-07 was characterized by a drying up of most sites across the wetland complex which resulted in a massive Coot desertion and only a small population of 100 individuals occupied the Touzeline Reservoir in early September, then the number increased gradually to reach a maximum (370) in late January before decreasing progressively (Figure 21b). Only 190 Coots remained at the end of March.

Table 4: Maximum counts of Coots in each main site (M.C.S) with date of sampling at the Oum El Bouaghi wetland complex.

Site	Winter	M.C.S	Date of M.C.S
Timerganine	2004/05	1500	15/12/2004
Chott el Meleh	2004/05	800	26/03/2005
Gimote	2004/05	170	11/03/2005
Touzline reservoir	2004/05	90	01/12/2004
Chott Tinsilt	2004/05	2000	02/02/2005
Tazougert-1	2004/05	20000	05/11/2004
Tazougert-2	2004/05	220	04/02/2005
Salah Derradji*	2004/05	550	22/11/2004
Timerganine	2005/06	1500	06/09/2005
Chott el Meleh	2005/06	dry	
Gimote	2005/06	dry	
Boulhilate	2005/06	3500	30/09/2005
Touzline reservoir	2005/06	650	05/10/2005
Chott Tinsilt	2005/06	dry	
Tazougert-1	2005/06	4000	12/09/2005
Tazougert-2	2005/06	dry	
Salah Derradji*	2005/06	1350	02/01/2006
Ain Semara*	2005/06	78	30/03/2006
Tinhinou*	2005/06	60	29/11/2005
Timerganine	2006/07	380	13/09/2006
Chott el Meleh	2006/07	dry	
Gimote	2006/07	dry	
Boulhilate	2006/07	dry	
Touzline reservoir	2006/07	370	17/01/2007
Chott Tinsilt	2006/07	dry	
Tazougert-1	2006/07	dry	
Tazougert-2	2006/07	dry	
Salah Derradji*	2006/07	269	11/01/2007
Ain Semara*	2006/07	dry	
Tinhinou*	2006/07	dry	
Timgad*	2006/07	2490	11/01/2007

* Other sites in the Hauts Plateaux


(a)
2004-2005
Number of Adults
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Sept-1
Sept-2
Oct-1
Oct-2
Nov-1
Nov-2
Dec-1
Dec-2
Jan-1
Jan-2
Feb-1
Feb-2
Mar-1
Mar-2
Apr-1
Apr-2
May-1
May-2
Jun-1
Jun-2
July-1
Date


(b)
2005-2006
Number of Adults
4000
3500
3000
2500
2000
1500
1000
500
0
Sept-1
Sept-2
Oct-1
Oct-2
Nov-1
Nov-2
Dec-1
Dec-2
Jan-1
Jan-2
Feb-1
Feb-2
Mar-1
Mar-2
Apr-1
Apr-2
May-1
May-2
Jun-1
Jun-2
July-1
Date

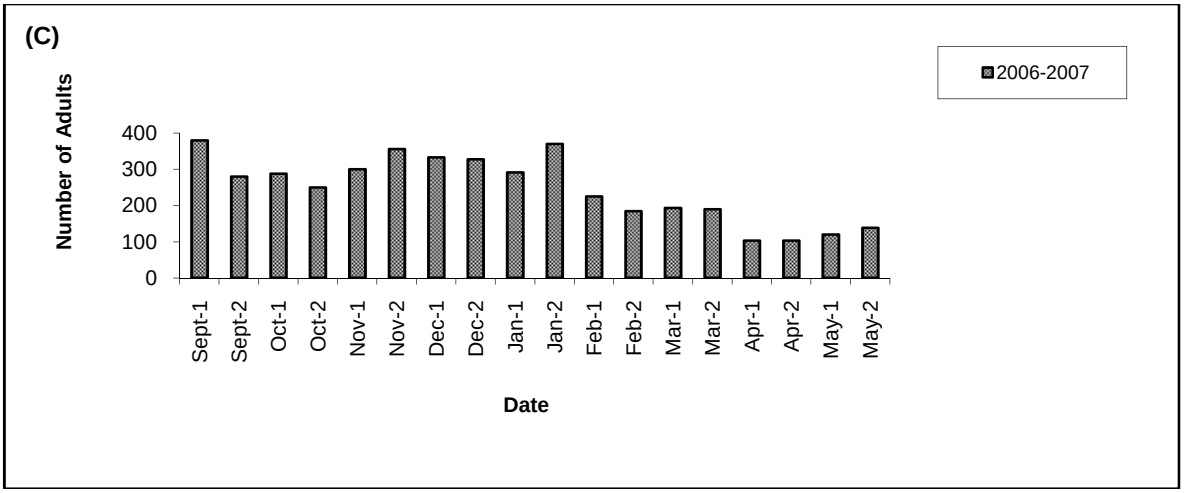
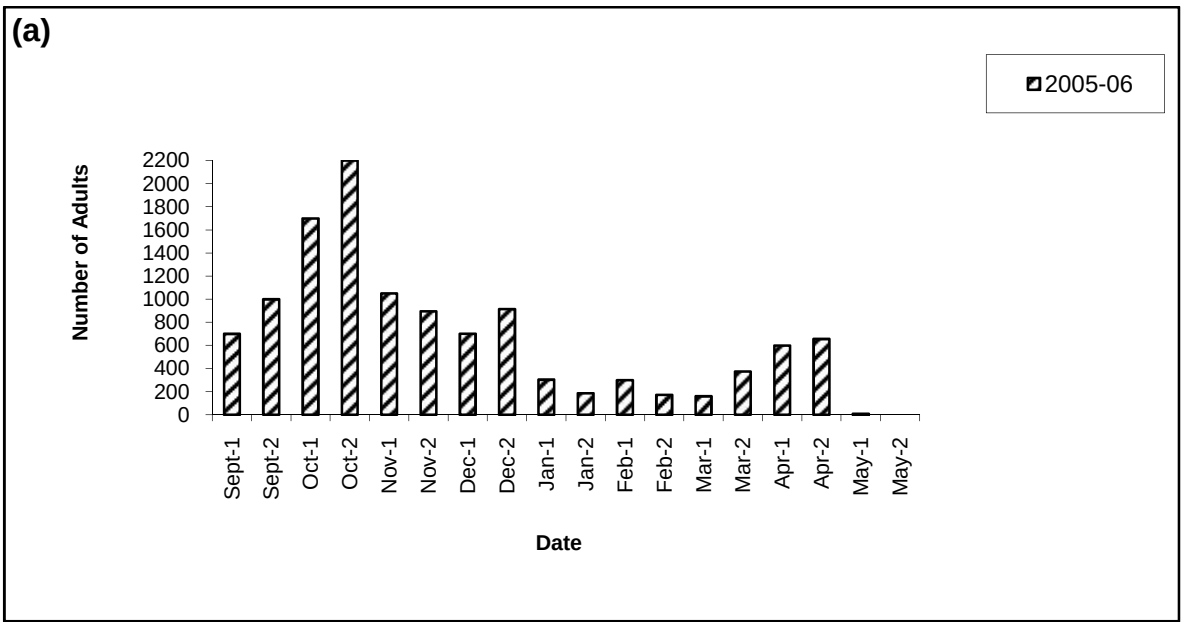


Figure 20: Maximum numbers recorded during twice - monthly counts of Coots across the Oum El Bouaghi wetland complex between (a) 2004-05, (b) 2005-06, and (c) 2006-07.

2004-05 2005-06 2006-07



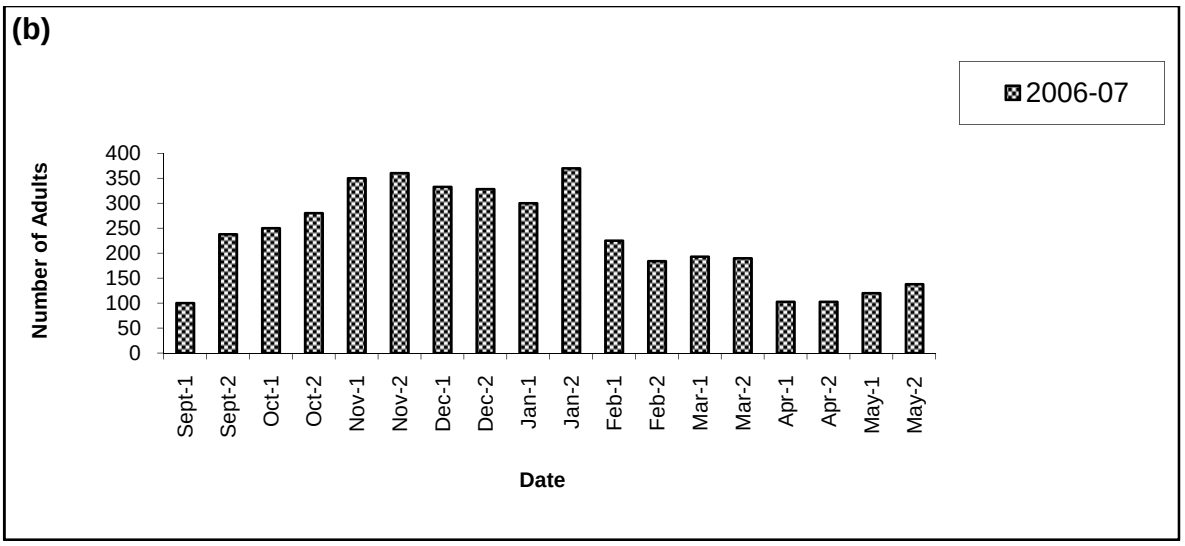
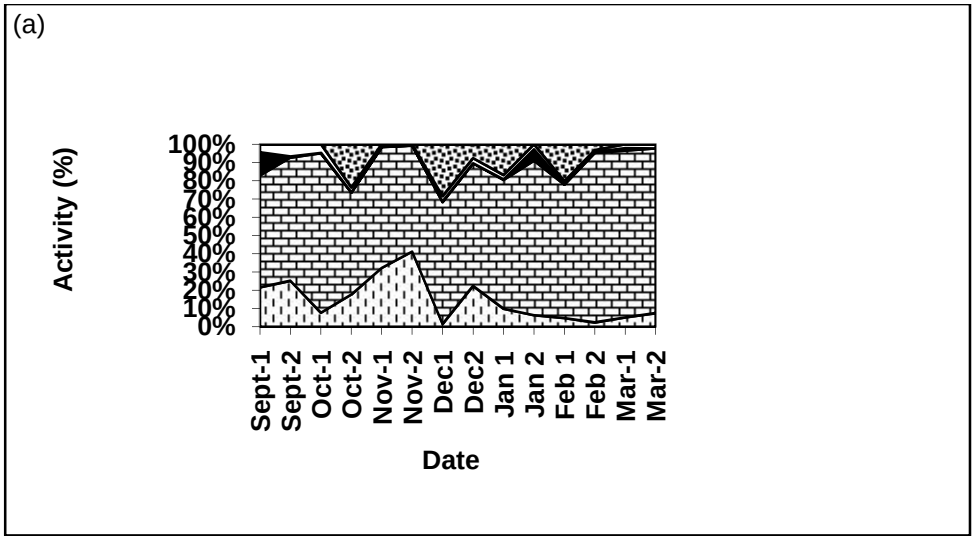


Figure 21: Half monthly count of Coots at (a) G. Boulhilate and (b) Touzeline Reservoir during 2005-06 and 2006-07, respectively.

2005-06 2006-07

The Diurnal activity budgets recorded for Coots throughout the two sites, G. Boulhilate (2005-06) and Touzeline Reservoir (2006-07), indicate that birds devoted almost ¾ their time to feeding [74% and 72% in 2005-06 and 2006-07 respectively; (Table 5, Figure 22)]. At both sites feeding was significantly the major diurnal activity. Marked fluctuations in the time devoted to feeding, in G. Boulhilate were paralleled with treading of Coots. It also coincided with periods of wind and probably cold weather in mid winter (November and December) (Figure 22 a) when birds devoted more time to swimming. At Touzeline Reservoir, however, fewer fluctuations were recorded in early (September-October) and mid winter in time devoted to feeding that remained fairly high, but declined by late winter and early spring (January-March) (Figure 22 b) when Coots devoted more time to swimming.



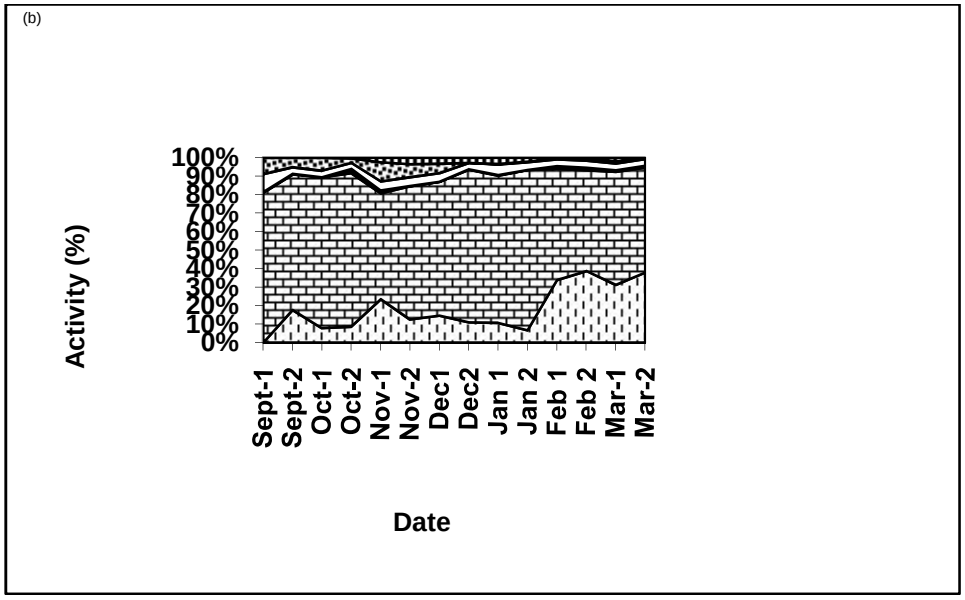
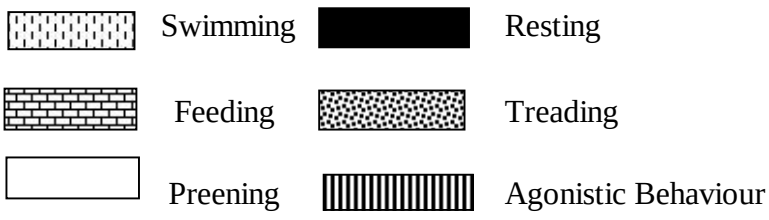


Figure 22: Percentage of time spent by Coots on different activities at (a) G. Boulhilate (2005-06) and (b) Touzeline Reservoir (2006-07).



Mean percentage time allocated to feeding was quite similar between the two sites, but significant differences in the time allocated to other activities were recorded (Table 5) where higher proportion of time spent swimming, preening, and agonistic behaviour and lower proportion of time spent resting and treading at Touzeline Reservoir than their counterparts at G. Boulhilate.

Table 5: Mean time spentby Coots on different activities at G. Boulhilate and Touzeline Reservoir.

Activity (%)	G.Boulhilate (2005-06)		Touzeline Reservoir (2006-07)	
	Mean	± SE	Mean	± SE
Feeding	73,84	(± 12,9)	71,52	(± 11,4)
Swimming	14,63	(± 12,2)	18,19	(± 12,6)
Preening	2,78	(± 1,5)	4,48	(± 1,6)
Resting	1,6	(± 3,4)	0,71	(± 0,7)
Treading	7,13	(± 10,4)	3,57	(± 3,6)
Agonistic behaviour	0,02	(± 0,08)	1,80	(± 1,3)
Sleeping	0		0	
Flying	0		0	

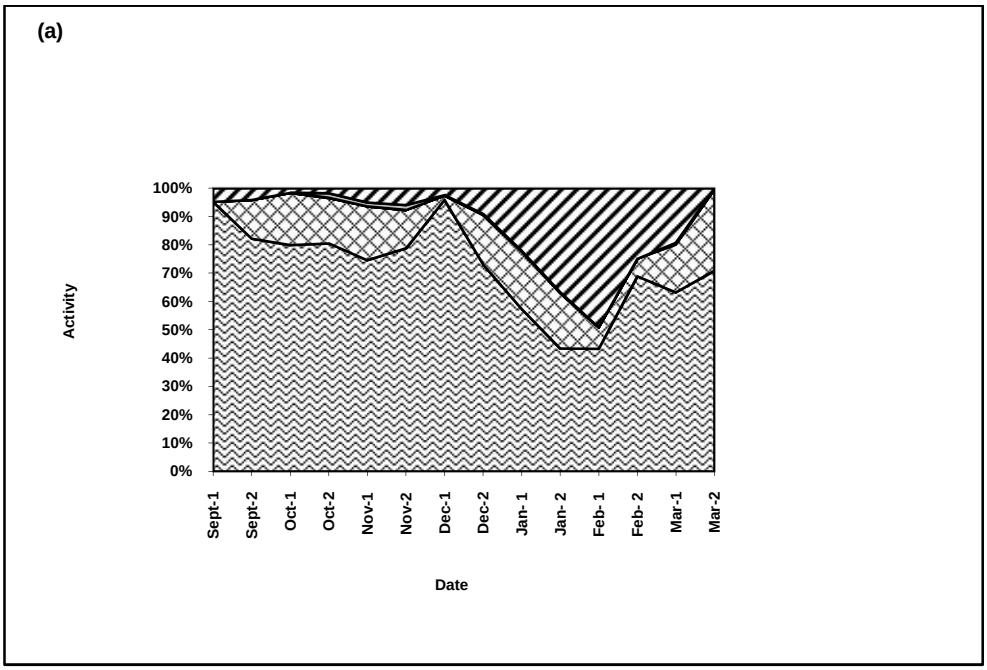
Seasonal changes in diurnal time spent feeding exhibited a similar pattern at the two sites, with a quite different mean value of 68.5% and 79.64% during early and mid winter with 64.57% and 71.01% at both G. Boulhilate and Touzeline Reservoir, respectively. Whereas, a different pattern was shown during late winter and early spring where feeding activity increased to a mean value of 83.86% at G. Boulhilate and declined to 66.43% at Touzeline Reservoir (Figure 22 a, b).

Feeding, as the major activity, was accomplished in three ways: surface feeding, the principal method, diving, and grazing (Figure 23 a, b, c). Surface feeding dominated other feeding

methods at both sites with a similar mean value (~50%). Similarly, time spent diving by Coots was similar in both sites (~ 10%). Mean percentage time spent apportioned to grazing, however, was higher (10.43%) at Boulhilate than at Touzeline (6.42%) (Figure 23 c).

Time spent feeding with head-neck submerged and upending was negligible by Coots as feeding strategies (Figure 23 a, b, c).

Seasonal alterations in foraging strategies used by Coots at both sites showed that surface feeding strategy was used during the course of early and mid winter; then after, its use decreased gradually when grazing , mainly, increased progressively and picked in early February at G. Boulhilate and in early March at Touzeline Reservoir. Meanwhile, the diving strategy was used to lesser extent by Coots all over the winter season at both sites with fewer fluctuations in mid- winter at G. Boulhilate; However, the pattern of this method showed an increase at G.Boulhilate and a decline at Touzeline in late winter early spring.



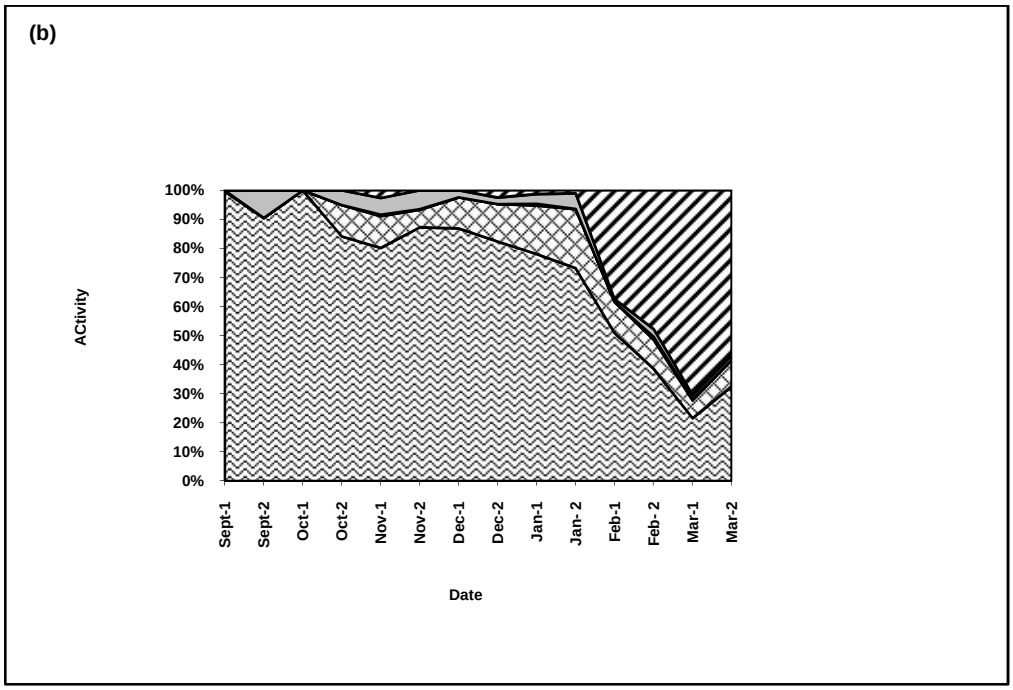
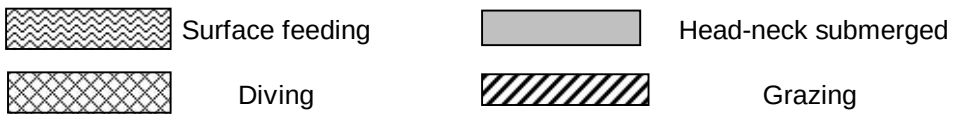


Figure 23: a, **b** Seasonal evolution of different type feeding used by Coots at (a) G. Boulhilate

2005-06 and (b) Touzeline Reservoir 2006-07.



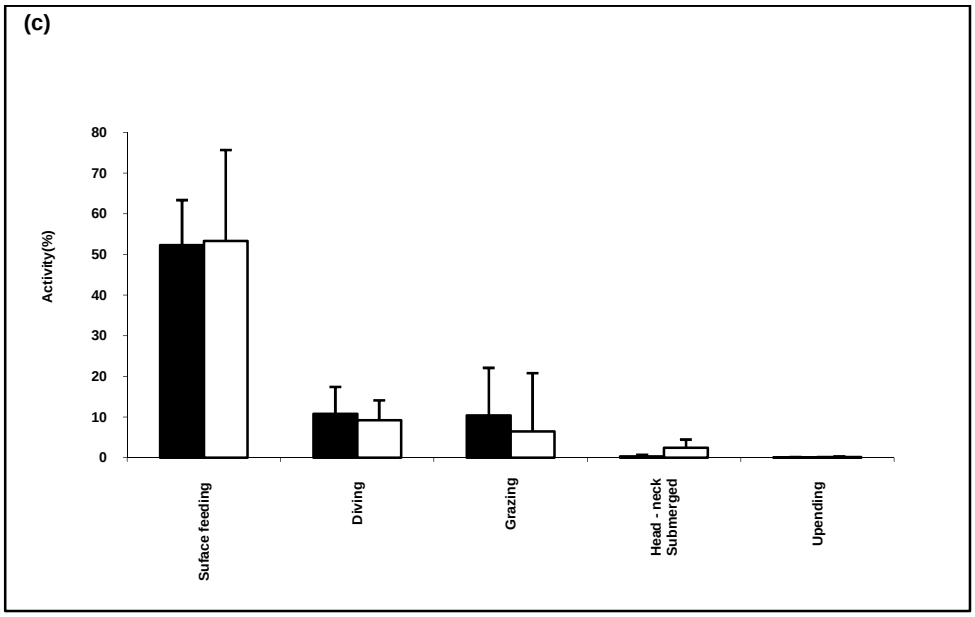


Figure 23: c. Mean percentage of total time spent feeding during diurnal eight hours observation

Using different strategies by Coots at G. Boulhilate and Touzeline Reservoir over

Winter 2005-06 and 2006-07, respectively.

Chott Boulhilate

Touzeline reservoir

Time spent swimming had the second highest mean value (Table 5) and was slightly lower at G. Boulhilate (14.63%) compared to that at Touzeline Reservoir (18.19%). Fluctuations were recorded at both sites all over the wintering seasons with the highest values recorded in October-November and in February-March at G. Boulhilate and Touzeline

Reservoir, respectively. Also, a gradual decline in swimming was recorded at G.Boulhilate starting from early January to late March (Figure 22 a, b)

Mean time devoted to treading was higher at G. Boulhilate (7.13%) by two folds compared to that recorded at Touzeline Reservoir (3.57%). This behaviour was recorded almost within the whole wintering season at G.Boulhilate with a peak of 28.44% of time devoted in early December 2005-06

(Figure 22 a, b). Since this site is located in a herding area and surrounded by riparian vegetation; thus, most of the treading was caused by herders, sheep, dogs or by aerial predators usually Marsh Buzzard (*Circus aeruginosus*) on few occasions. However, presence of the latter was common at Touzeline Reservoir starting from early September to December with a maximum of time devoted to treading (10.31%) recorded in early November 2006-07. Disturbances by humans, at this site, were not as frequent as that at G. Boulhilate.

Preening as a comfort activity had a quite similar mean allocated time (<5%, Table 5) with highest values recorded in early winter at both sites. During mid and late winter early spring the values decreased and remained fairly low (Figure 22 a, b) till the end of the winter season.

Coots appear to devote < 2% (Table 5) of their mean diurnal activity to resting at both sites. Highest values were recorded in early winter and late winter at G. Boulhilate, and in mid and late winter at Touzeline Reservoir (Figure 22 a, b).

Agonistic behaviour was rarely observed at G. Boulhilate. It first appeared in late November, at Touzeline Reservoir, and increased gradually to reach a maximum between early December and late January. Another small increase was recorded in late March which may coincide with the start of the breeding season at the site (Table 5; Figure 22 a, b). In contrast, G. Boulhilate by its total absence of adequate vegetation for breeding might have buried a significant record of this behaviour.

Even though both sites exhibited fluctuations in wintering Coot population and presence of disturbances that led to treading behaviour, Coots were never observed flying during our observation hours at both sites (2005-06 and 2006-07). Similarly, it appears that Coots do not devote their diurnal time to sleeping activity where we could observe only once a swimming and sleeping Coot with a neck slopped on the chest at Touzeline Reservoir.

Diurnal mean percentage within eight hours observation on Coots behaviour showed higher values (83.21 and 80.12%) in mean percentage time devoted to feeding recorded at 8:00 AM at both G. Boulhilate and Touzeline Reservoir, respectively; followed by a slight decline that persisted from 9:00AM to 3:00 PM. Then after; a recovery surge in feeding activity was recorded at both G. Boulhilate (82.93%) and Touzeline Reservoir (72.84%) during the last hour of observation (Figure 24 a, b).

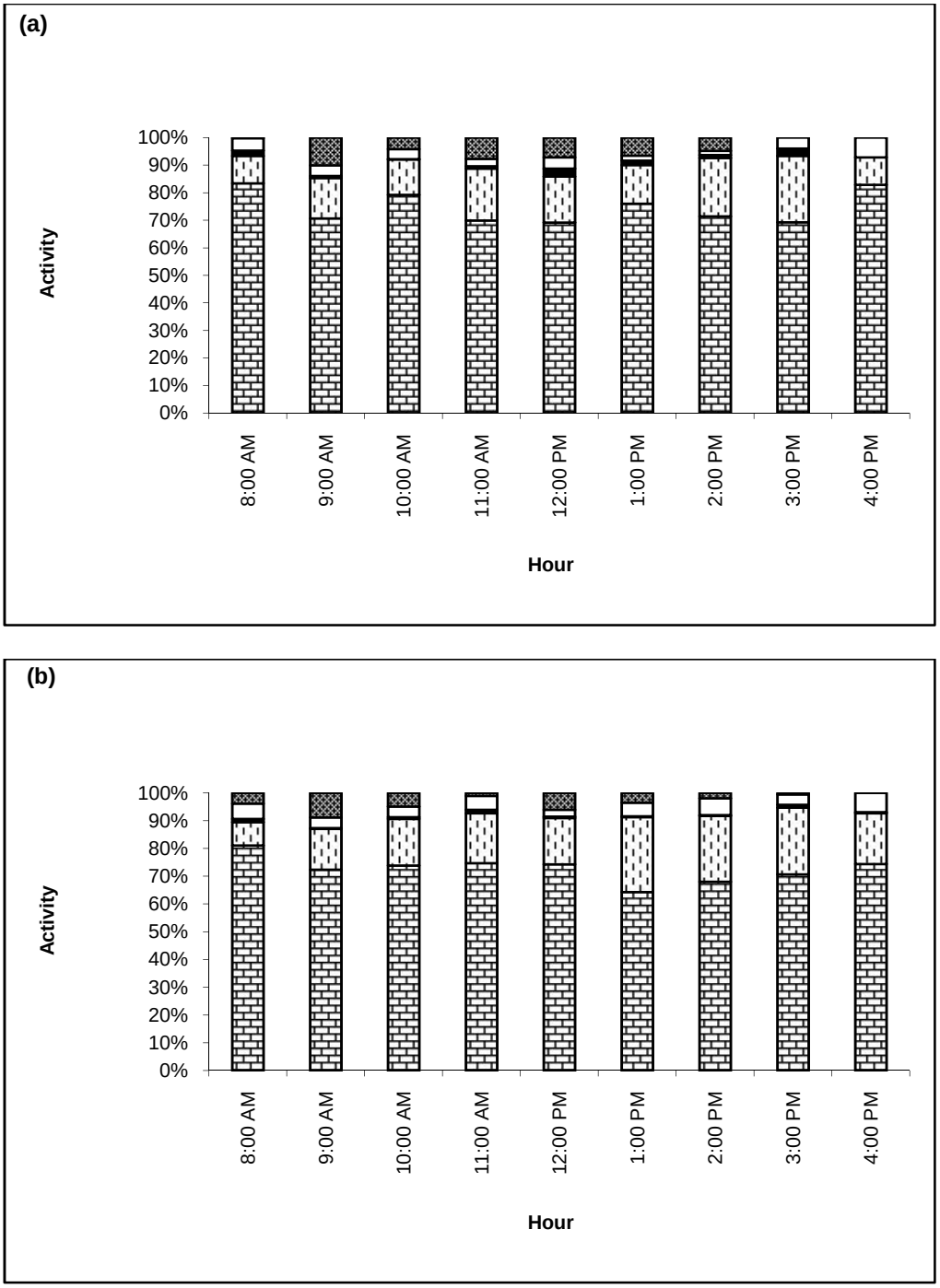


Figure 24: Mean percentage time spent feeding, swimming, Preening and resting expressed

in Hours by Coots at (a) G. Boulhilate during 2005-06 and (b) Touzeline Reservoir 2006-07 over winter season.

In addition, swimming activity displayed gradual increases at both study sites and throughout most observation hours. Maximum increases in values of mean time percentage allocated to swimming were recorded in the afternoon [26.39% at 1:00 PM (three folds) and 24.03% at 3:00 PM (two folds) at Touzeline Reservoir and G.Boulhilate, respectively]. However; during late afternoon (4:00PM) a decrease in mean percentage time allocated to swimming activity (9.92 and 17.93%) was recorded at G. Boulhilate and Touzeline Reservoir, respectively (Figure 24 a, b).These alterations in swimming activity exhibited by Coots at both study site were, however, paralleled by opposite changes in feeding activity of the species.

Moreover, preening activity at both study sites was recorded within the eight hours observation, but with a mean percentage time spent less than 10% and slight fluctuations. The higher values (7.15% and 6.76%) recorded were in late afternoon (4:00PM); whereas, the lower values recorded were in early afternoon (1.49% and 2.35%) at G. Boulhilate and Touzeline Reservoir, respectively (Figure 24 a, b).

The Recorded values of mean percentage time devoted diurnally to resting were lower than 3% at both study sites with surges obtained in late mornings (1.27% and 2.93% at Touzeline Reservoir and G.Boulhilate, respectively) and resting disappearance in very late afternoon (Figure 24 a, b).

Treading behaviour was, also, exhibited at both sites (Figure 24 a, b) where the maximal values of mean time devoted were recorded at 9:00 AM (10.04% and 8.71% at G. Boulhilate and Touzeline Reservoir, respectively). This behaviour was noticed between 9:00 AM and 2:00 PM at both study sites that synchronized with the active time of herders near G. Boulhilate. At Touzeline Reservoir, in contrast, the treading behaviour reflects the usual presence and chasing of dogs and aerial predators, mainly, the Reed Buzzard, at the site (Pers.Observ).

Hourly mean percentage time allocated by Coots to different feeding strategies (Figure 25 a, b) showed that surface feeding was utilized, independently of observation hours, at fairly sTable mean percentage times which were above 50% at both study sites, with only a an increase (21.25%) recorded in late afternoon at G. Boulhilate.

Similarly, Diving as another foraging method was, also, used by Coots with fewer fluctuations, over observation hours, in mean percentage times devoted where it ranged between 10% and 17.5% at Touzeline Reservoir and G.Boulhilate, respectively.

While, grazing as an alternative feeding strategy showed similar pattern between study sites and fluctuations among observation hours (Figure 25 a, b). The higher mean time allocated values were recorded in early mornings (21.23% at G.Boulhilate and 15.63% at Touzeline Reservoir); and the lower mean time devoted values were recorded just before late afternoon (1.85%) at G.Boulhilate and in late morning and mid afternoon (less than 6%) at Touzeline Reservoir bearing in mind that our study sites had different water surface and surrounding vegetations plus the social and economic use of each site.

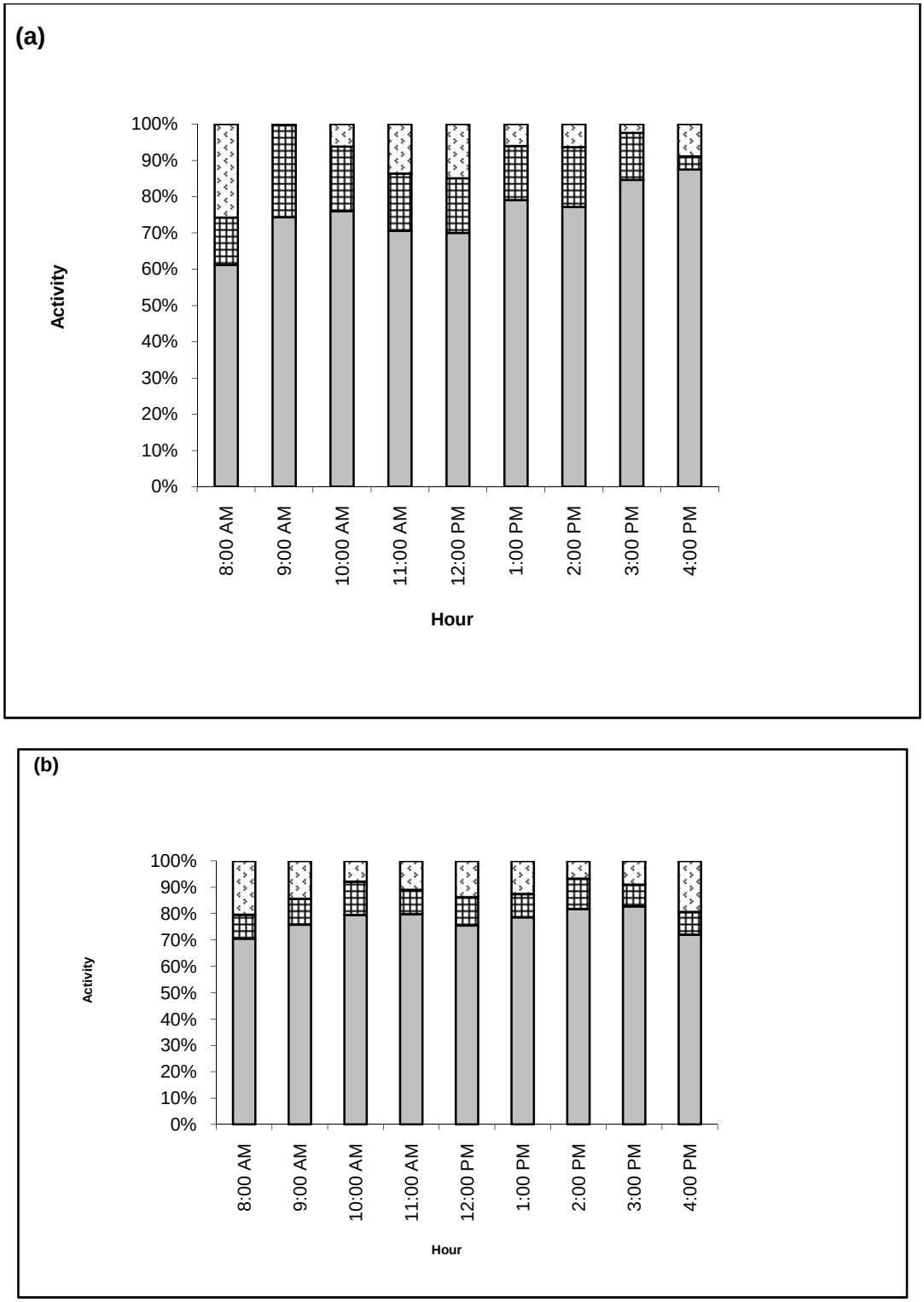


Figure25: Mean time spent Surface feeding, Diving, and Grazing during diurnal eight hours by Coots at (a) G.Boulhilate (2005-06) and (b) Touzeline Reservoir (2006-07) over winter.

Comparison of average time allocated to different activities within 12 hours of the day are shown in Table 6 where it appeared that feeding, resting , and preening were quite alike at both sites; Yet , both swimming and treading altered. Flying and sleeping were not observed and therefore, seemed to be nocturnal behaviours of Coots.

Table 6: Average time in hours allocated to different diurnal (12hours) activities by Coots

Over Winter 2005-06 and 2006-07

Activity (hour)	G.Boulhilate	Touzeline Reservoir
Swimming	1,68	2,18
Feeding	8,93	8,58
Resting	0,19	0,08
Preening	0,34	0,53
Treading	0,86	0,43
Agonistic Behaviour	0,00	0,19
Flying	0,00	0,00
Sleeping	0,00	0,00

4.1.2 The Breeding Ecology:

The Population of Coots

At G. G.Timerganine: The year 2005, fluctuations in the number of visible Coots before ,within and after the breeding season were recorded (Figure 26 a) with a minimal number of 482 in June and a maximal number of 1520 in July. However, during laying period the population remained in the range of 800-900 individuals.

During the year 2006, an increase in number of visible Coots was observed from 90 in first week of May to 1250 individuals in July. During the start of the laying period, the population increased sharply in May from 200 to 1076 individuals. Then after, it remained in the range of 700-900 with a peak of 1062 individuals in June. Therefore, the average size of Coot population during laying period trough 2005-2006 was about 700-900 individuals.

At Chott el Maleh: In the year 2005, fluctuations, also, in the number of visible Coots were recorded before, within and after the laying period (Figure 26.b) with a maximal number of 2000 in March and a minimal of 240 individuals in July. Throughout laying period, the number of visible individuals fluctuated from 565 in early April to 320 in late June, but the population size remained fairly in range of 400 visible individuals. The site was dry over the whole winter 2006, until the heavy rains of early may where we counted the first 46 individuals. The maximal number counted was 83 in late May, then after the number decreased steadily to zero in July. Thus, the size of Coot population in this site was smaller than that of G.Timerganine within the two years-study, variable and year –dependant.

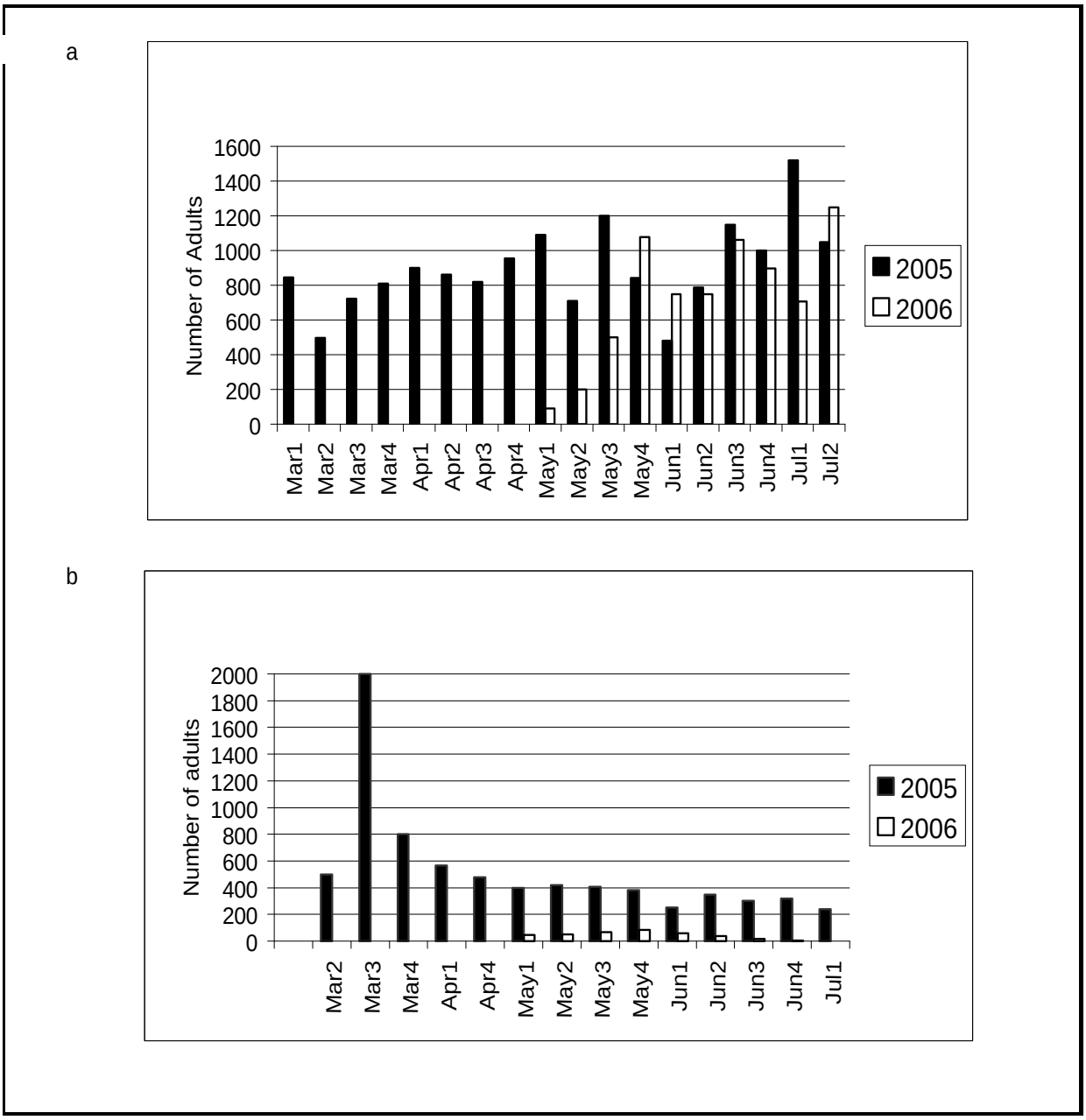


Figure26 a- Counts of visible adult coots at Timerganine during 2005 and 2006 breeding season
b- Counts of visible adult coots at Chott el Mellah during 2005 and 2006 breeding season

Environmental variables

The year 2005 was characterized by considerable precipitation rates in winter and early spring on O.E.B complex. Yet, the year 2006 was almost dry, until one week of heavy rains (early May) that G.Timerganine and not Chott el Maleh recovered its previous water levels.

G.Timerganine: In 2005, water depth in G.Timerganine at reference point (within *Phragmites* stand) decreased steadily from 102 cm (early April) to 52.5cm (early July).While in 2006, water depth decreased , also, gradually from 98 cm (early May) to 71 cm (early July).(Figure 27 a)

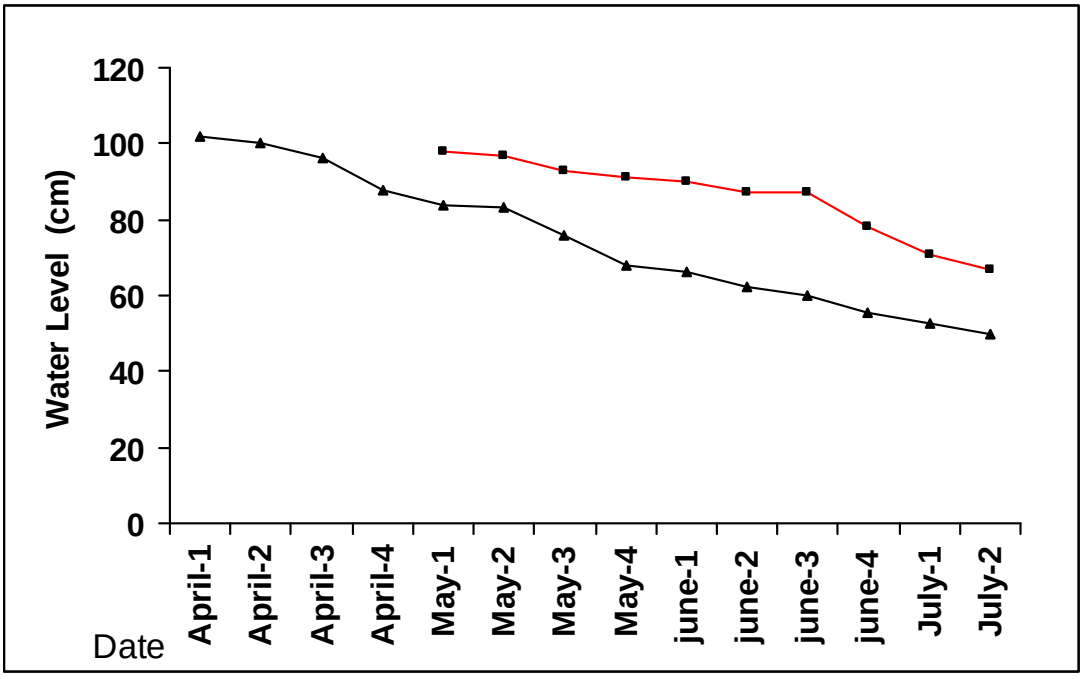


Figure 27: a Seasonal changes in Water level at G.Timerganine
During (▲) 2005 and (■) 2006

Chott el Maleh: Water depth at Chott el Maleh, in 2005, at reference point (within *Phragmites* stand) diminished continuously from 85 cm (early April) to 37 cm (early July). However; in 2006, the quantities of rainfalls was not sufficient that the water depth at reference point (within *Phragmites* stand) decreased acutely from 41cm (early May) to 5 cm (early July). Therefore;

water availability was one of the determinant factors of laying occurrence in the two sites (Figure27 b)

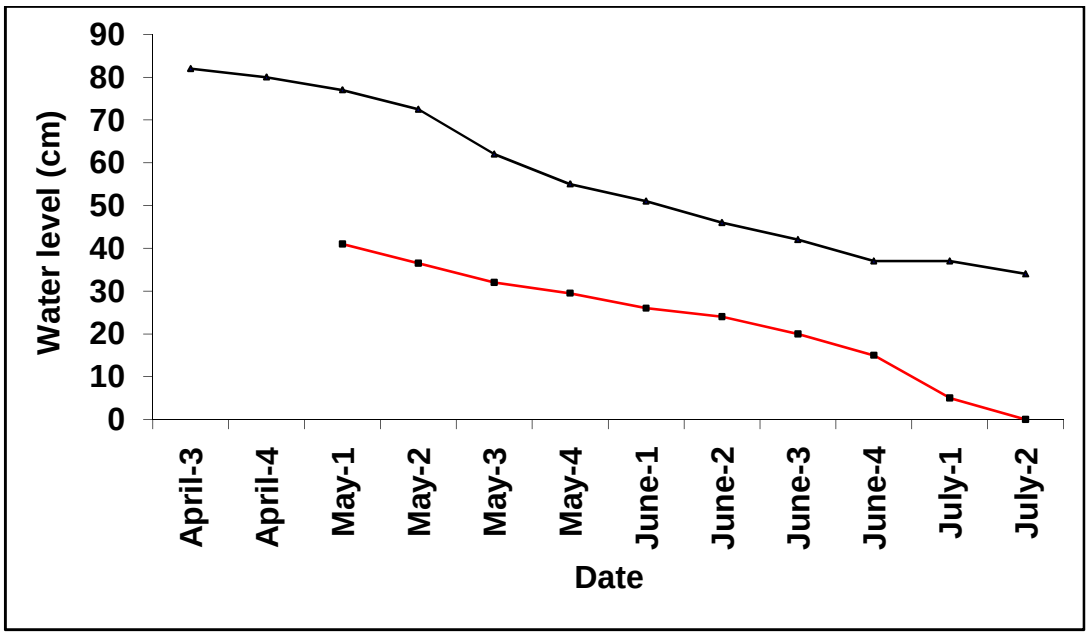


Figure 27:b Seasonal change in Water Level at Chott El Maleh during the year 2005 (▲) and 2006 (■),

Moreover; in G.Timerganine (2005) the *Phragmites* was the early emergent vegetation, both *scirpus maritimus* and *Scirpus triqueter* immerged later in similar rates, and the *Eleocharis palustris* was the last emergent vegetation. Similar sequencing was observed during 2006 but with a delay in timing of emergence. In Chott el Maleh (2005), the *Phragmites* was the early emergent vegetation and the *scirpus maritimus* was the last emergent vegetation. But, in 2006, the sequencing of vegetation outgrowth was reversed due to the delay in water availability in the site.

The exact data on the surface of different vegetation patches is not available; but the mean heights of the vegetations were measured (Table 7) and the results show that Coots had a high plasticity range in selecting their building nest sites at G.Timerganine, the average of the year and emergent vegetation ranged between 100-200 cm; and in Chott el Maleh it ranged between 110 -

135 cm. The minimal and the maximal vegetation height in the two sites, required for building Coot nest, was 10cm (in *Scirpus maritumus* and 480 cm (in *Phragmites australis*) respectively.

Nest Site Utilization

During the breeding season, we searched for active nests (containing at least one egg) among vegetation. In G.Timerganine, 390 (in 2005) and 296 (in 2006) active nests were located. But we estimated that the total nests may be greater in both years by about 20-30 nests. The distribution of nest sites among the vegetation strata (Figure 28 a) showed that most of the Coot nests (38.72% in 2005 and 45.27% in 2006) were located in *Phragmites australis*, while 31.28% and 33.78% (in 2005 and 2006 respectively) were associated with *Scirpus maritimus*, and 21.03 % and 15.54% (in 2005 and 2006 respectively) were situated in *Eleocharis palustris*. Only 8.97% (in2005) and 5.41 % (in2006) were settled in *Scirpus triqueter*. In Chott el Maleh, 245 (in 2005) and 70 (in 2006) active nests were located. The distribution of nest sites among the vegetation(Figure 28 b) showed to be reversed between the two years, where most of Coot nests in 2005 (61.63%) were positioned in *Scirpus maritimus* and the left 38.37% in *Phragmites australis* .Reversely, in 2006 the majority of nests (60%) were placed in *Phragmites australis* and the remaining (40%) in *Scirpus maritimus*. Therefore, the results showed that Coots preferred started laying, when hydroperiod is appropriate, in *Phragmites* where emerging vegetation was growing quickest, and then after used *Scirpus maritimus*, *Scirpus triqueter* and *Eleocharis palustris* in late breeding season, respectively

Moreover, in G.Timerganine, the vegetation density and nest frequency distribution was variable and year dependant where Coots showed (Figure 29 a) to prefer breeding in maximal density in both *Phragmites* and *Scirpus triqueter* and in sub-maximal in both *S.maritimus* and *Eleocharis* (in 2005); while, in 2006 the order of preferred vegetation density was maximal in

Phragmites, S.maritimus and *Eleocharis* and sub- maximal in *S.triqueter*. In Chott el Maleh, the results of two years (Figure 29 b) showed that Coots preferred nesting in maximal vegetation density in both *Phragmites,* and *S.maritimus.*

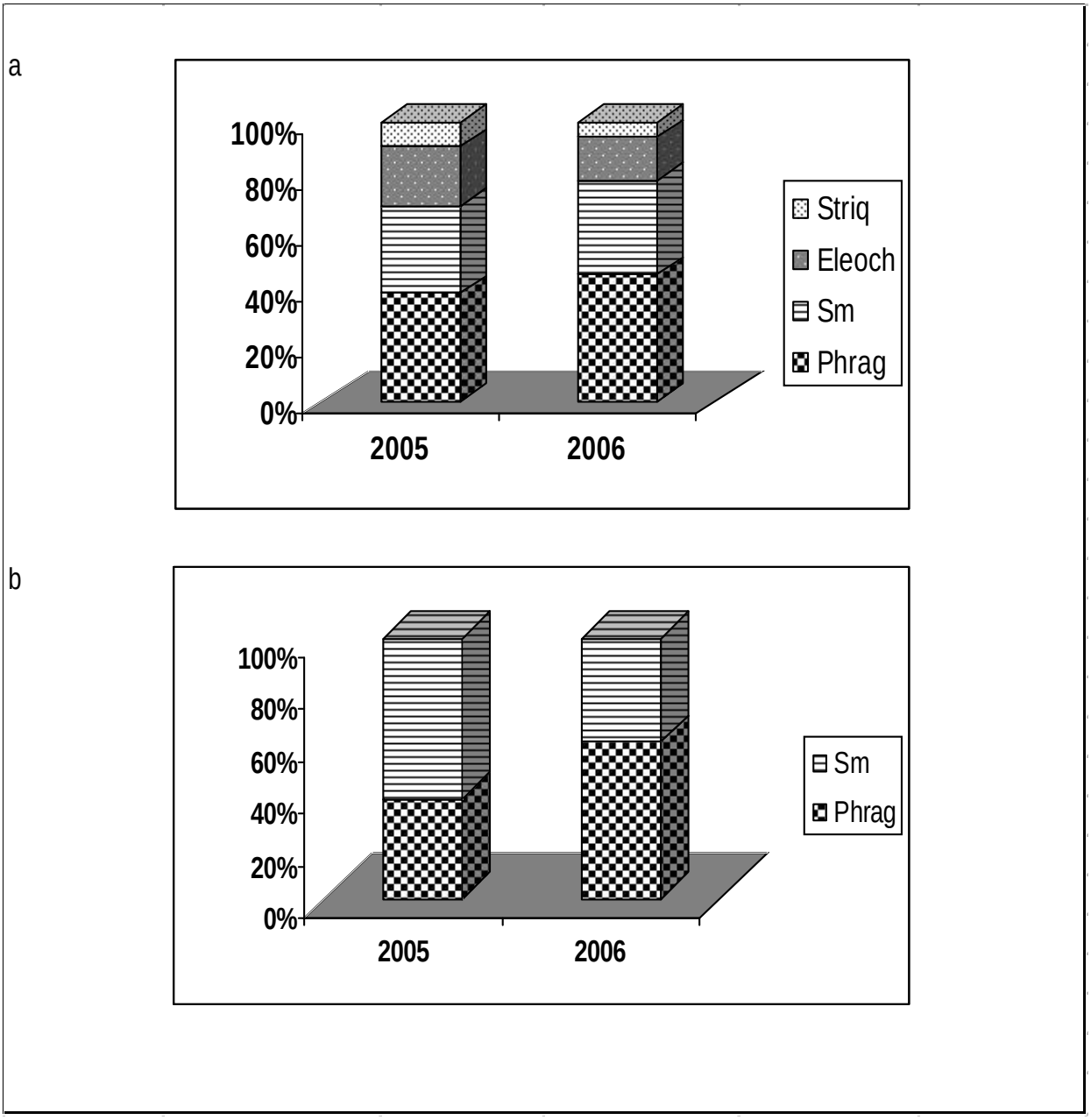
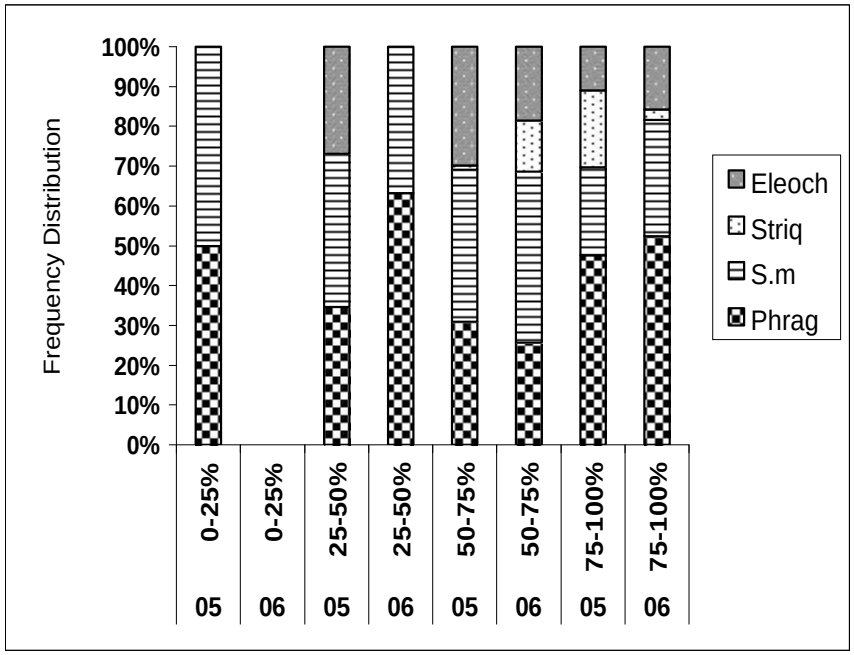


Figure 28: a. Nest site utilisation % at G.Timerganine during Coot breeding season 2005 & 2006
b: Nest site utilisation% at Chott el Maleh during coot breeding season 2005 & 2006

Phragmites australis *Eleocharis palustris*
Scirpus maritimus *Scirpus triqueter*

a



b

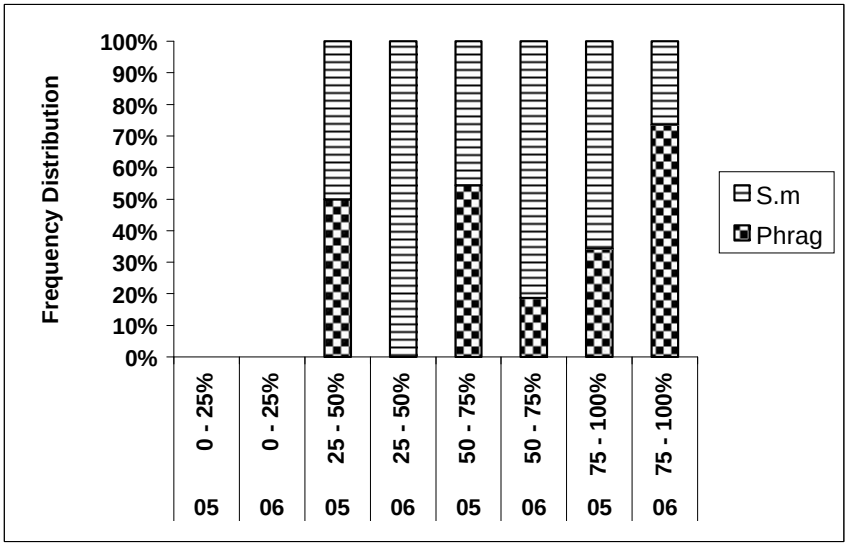
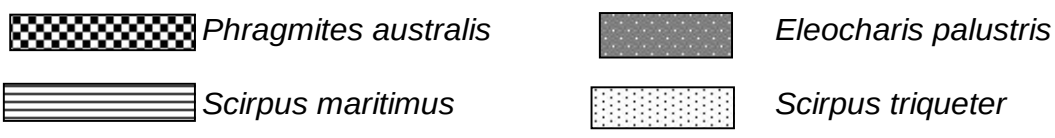


Figure 29: a. Frequency distribution of Coot nests in different vegetation strata densities at G .G.Timerganine during breeding season 2005 and 2006

b. Frequency distribution of Coot nests in different vegetation strata densities at Chott El Maleh during breeding season 2005 and 2006



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Distance to open water (DOW)

The distribution and the density of the vegetation stands differed between the two sites where we observed that G.Timerganine had larger and denser patches than those of Chott el Maleh. This induced us to estimate and compare the Distance to open water between the two sites. The results (Fig 30 a, b, c) showed that Most of the nests located in *Phragmites*, at G.Timerganine, had a lower DOW range (1-2 m) than that of Chott el Maleh (3-4 m). Moreover, In *Scirpus maritimus* the most DOW range, at G.Timerganine, was larger (1-4 m) than that of Chott el Maleh (3-4m).

Thus, our data showed that the denser the vegetation was the shorter DOW was. And the wider vegetation patch was the lager DOW range was.

a

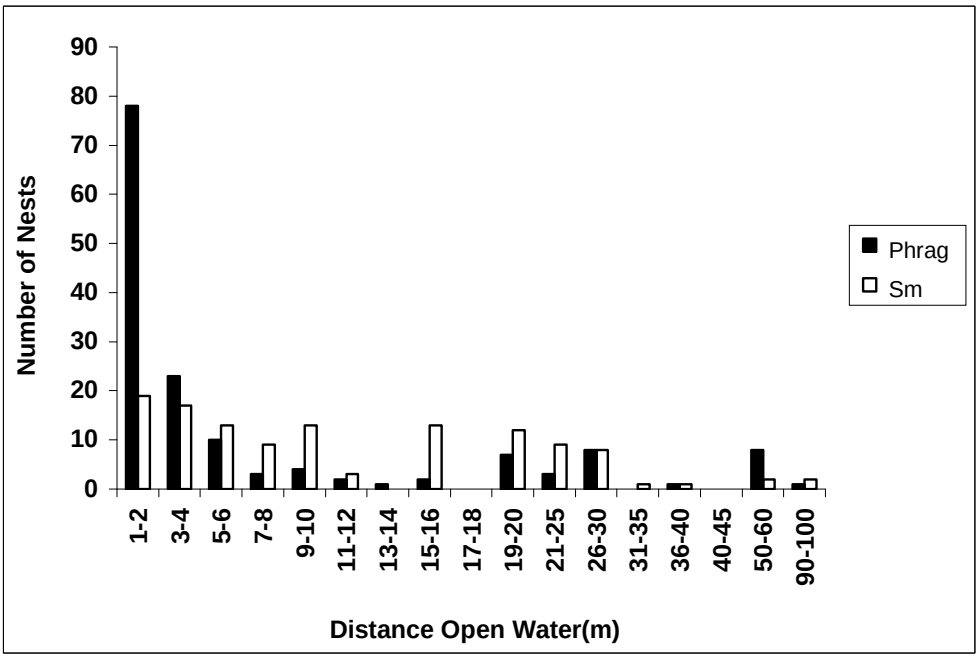


Figure 30 a : Distance Open Water within vegetation Strata atG. Timerganine for the year 2005

b

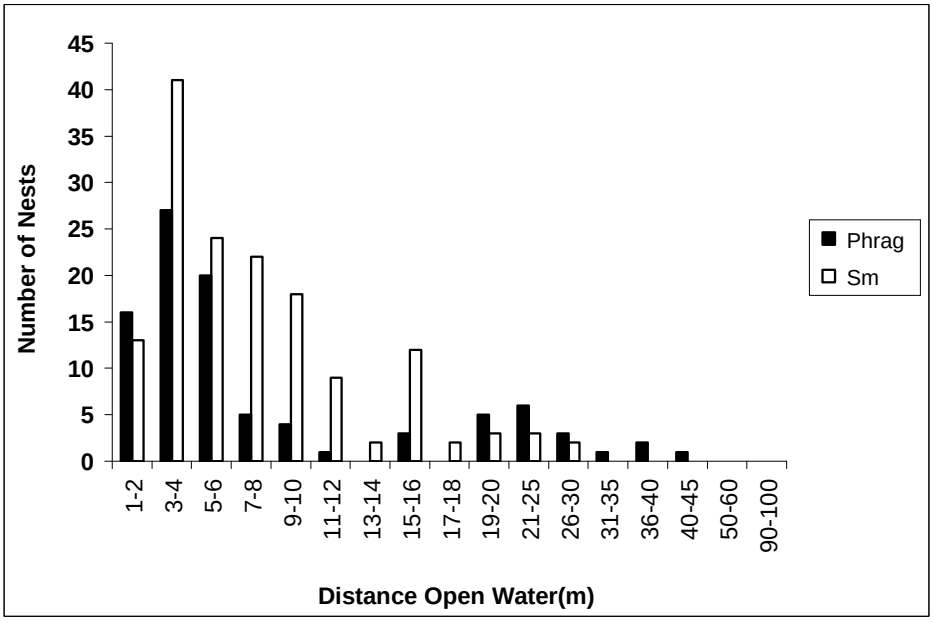


Figure 30 b: Distance Open Water within vegetation Strata at Chott El Maleh for the year 2005

c

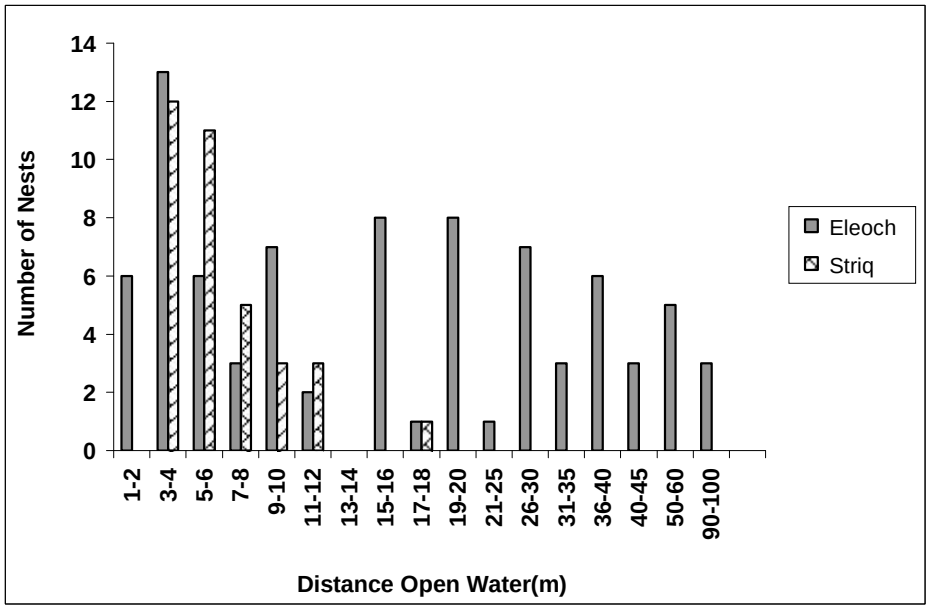
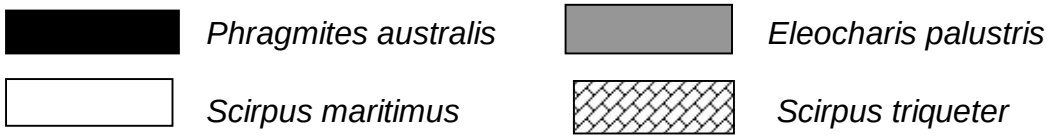


Figure 30 c :Distance Open Water within vegetation Strata at G.Timerganine for the year 2005



Nest characteristics

Table 7 summarizes all the available information on nests characteristics of the two sites and those of Eastern coast of Algeria (Rizi *et al*, 1999 and Houam *et al*, 2005).

Comparison of mean external (MED) and internal diameters (MID) of nests located in G.Timerganine and in Chott el Maleh throughout 2005-2006 showedto be .

Mean Internal diameters means of nests in the study sites ranged between and showed with years and sites.

Means of nest heights (MNH) in the two sites were quite alike.

Water depth (MWD) means at nest site (Figure 31 a, b) at G.Timerganine showed to when water is available. .However, it was in Chott el Maleh which was different between years.

Laying period

Laying period showed to be in sites and years where, in 2005, it lasted days at G.Timerganine and days at Chott el Maleh. Yet, in 2006, as climatically special year on the Hauts Plateaux, the laying period was in both G.Timerganine and Chott el Maleh. In sites, in 2005, the first recorded egg laid on and the last recorded egg laid. Whereas, in 2006, the first recorded egg laid and the last recorded egg laid on , in G.Timerganine, that coincided with the same date as in 2005.While, in Chott el Maleh, the last recorded egg laid .

The mean laying date was, also, in years and sites where in G.Timerganine it was (in 2005) and (in 2006). Similarly, in Chott el Maleh it was (in 2005) and (in 2006). Other east Algerian, north African and European data are provided in Table.

Two nests were reused at G.Timerganine within the two years study, the first contained eggs that hatched successfully later; the second contained eggs that were predated later. In Chott el Maleh (2005), nests were reused and contained between eggs, their fate was that two nests were predated, one hatched, one flooded and one of unknown fate. In 2006 no reused nest was found.

Egg dimensions

Table summarizes data on egg size measured at both G.Timerganine and Chott el Maleh over 2005 and 2006 and comparing it with other local studies. The results shows that means of egg weight, length, breadth, volume and index shape were to those of G.Timerganine 2004 (Samraoui et Samraoui 2007) and of Numidia (Houam *et al* 2005).Whereas, our data were those of Tonga and Oubeira lakes (Rizi *et al* 1999) where it was reported that Coots eggs

.

Clutch Size

Comparison of Coot clutch size in east Algeria is illustrated .The recorded means clutch size showed to be within sites and years ; The mean of clutch size ranged between and the clutches ranged between eggs in both sites within 2005 -2006.When nests known or suspected to have been parasitized were cancelled, mean clutch sizes did not alter significantly neither in G.Timerganine nor in Chott el Maleh in 2005,

Breeding Success

Data on success and failure percentages of Coots breeding at G.Timerganine and Chott el Maleh during two years work field is provided . The sum of percentages of monitored successful and successful and partially predated nests was between sites and years and ranged from . Monitoring clutches that survived till hatching time had a success where we recorded in G.Timerganine on 2005 and 2006, respectively. Similarly in Chott el Maleh, it was in 2005 and in 2006 of total clutches. Thus breeding success was in years and sites but clutch size.

Nest desertion was observed during the field work. Brood survival was efficiently checked, thus, a total of 8 dead chicks were recorded at G.Timerganine (6 in 2005 and 2 in 2006) and only 2 at Chott el Maleh in 2005. Some of them were found floating on water and the others either on nests or in the vicinity.

Predation was an important factor affecting the breeding success (Figure 33). It was sites and years and had total clutches. Its Concentration period between sites and years and ranged from. It occurred in stands and was caused by the viperine Snake *Natrix maura* . Unfortunately, Humans caused considerable losses to the breeding success over the two years study in both sites where it ranged from .Since G.Timerganine is an agricultural and livestock breeding area wherer Cattle intruding and sheepherding (Figure 35 and 36) in the pond treaded over Coot nests located in the vegetation strata stands yearly.

Figure 33: Predated Coot Nest

Figure 35: Intrusion of Cattle at Gareat. G.Timerganine caused nests destruction and promotes Aerial predation.

Figure 36: Sheepherding on *Eleocharis palustris* at G.Timerganine.

Conspecific Brood Parasitism (CBP)

Basing on unusual egg laying rates ≥ one new egg per day; the most indicator of brood parasitism (Lyon.2007), monitored clutches, at G.Timerganine 2005, indicated of them seemed to be parasitized after nest completion. The number of eggs added to these clutches ranged from. As 2006 was a drought year where breeding. This special condition induced us to pay more attention to signs of CBP. 11.82% indicated CBP at G.Timerganine in 2006. The number of added eggs to these nests ranged from. The maximum number of buried eggs down below the cup of parasitized nests was eggs (Figure 37). Moreover, CBP signs were observed reproduction period. seemed, also, to occur where one egg of was added to a monitored Coot nest .In Chott el Maleh 2006, indication of CBP was observed on monitored clutches. The number of added or buried eggs ranged a nest. In addition, many nests showed eggs in water

or were the nest (Figure 38). Differences in back ground color, spot size and color of eggs were, also, observed.

Figure 37: marked Coot eggs

Figure 38: two marked eggs .

Name	Sep.1	Sep.2	Oct.1	Oct.2	Nov.1	Nov.2	Dec.1	Dec.2	Jan.1	Jan.2	Feb.1	Feb.2	Mar.1	Mar.2	Apr.1	Apr.2	May.1	May.2	Jun.1	Jun.2
Gadwall		4	4	30	38	150		6	290	330	212	50	228	21						
Mallard	405	110	300	250	800	1450	370	415	555	856	350	100	252	368	860	174	131	300	1610	600
Northern Pintail	210	93	430	120	463	590	810	710	55	565	885	970	266	130						
Eurasian Wigeon	7		190	300	1135	2070	1200	3150	3835	4500	6800	7990	4135	4280	27	10	7			
Northern Shoveler	1165	3000	520	28	435	4340	2510	10950	1320	2630	1444	2040	637	2430	322		3			
White-Headed Duck			13	10	16			20	17	17	5	12	21	27	12	7	1		3	
Ferruginous Duck	350	50	7	42	5		36				42	19	26	7	10	3	29	5	8	100
Common Pochard	80	50	560	25	275	1400	5800	8700	920	1300	5100	260	3550	242	30	35				4
Tufted Duck	2												3							
Red -Crested Pochard									1											
Garganey														26	14	2	2			
Common Teal			38	100	123	2	90	250	17	130	133	130	150	84	110					
Marbled Duck	953	2950	514	70	92	120	100	150	34	260	238	24	40	56	146	44	8	25	131	2
Ruddy Shelduck	393	248	90	32	35	14	32	7	49	5	75	122	173	189	51	28	34	80	66	8
Common Shelduck	133	93	931	1530	12988	18181	38460	68468	40730	27785	25815	18619	18519	7764	1250	765	176	190	535	142
Greylag Goose												1								

Table12: a. Anatidae Census at the Oum El Bouaghi Wetland Complex during the Year 2004-05

Name	Sep.1	Sep.2	Oct.1	Oct.2	Nov.1	Nov.2	Dec.1	Dec.2	Jan.1	Jan.2	Feb.1	Feb.2	Mar.1	Mar.2	Apr.1	Apr.2	May.1
Gadwall						22	62	350	200	38	4	3			2		
Mallard	1660	811	1960	300	130	104	30	1000	650	805	470	680	1126	182	220	3000	2
Northern Pintail		110	260	200	33	25	122	302	27	652	68	610	1300	200			
Eurasian Wigeon		44	110	1400	430	706	250	5780	120	3554	380	35		365	23		
Northern Shoveler	3050	50	1650	1470	2000	1450	1850	3700	2275	612	783	41	13179	1485	170	10	
White-Headed Duck			1	30	45	5	55	14	19		12			1			
Common Pochard	4		600	270	233		102	50	6	64	300	550		4		3	
Tufted Duck															2		
Ferruginous Duck	55		15	6	20			2		3	6b				9		9
Red -Crested Pochard																	
Greylag Goose																	
Garganey														20			
Common Teal				123	6	330	251	55	240	540	350	8		27			
Marbled Duck	16	13	30	150	1	14	1		53		120	9			2		
Common Shelduck	157	98	73	200	1476	1800	735		1710	1645	5909	701	7808	9672	48	54	4
Ruddy Shelduck	471	28	49	35	35	42	120	202	25	37	10	3	19	13	5	26	

Table 12: b. Anatidae Census at the Oum El Bouaghi Wetland Complex during the Year 2006-07

Name	Sep.2	Oct.1	Oct.2	Nov.1	Nov.2	Dec.1	Dec.2	Jan.1	Jan.2	Feb.1	Feb.2	Mar.1	Mar.2	Apr.1	Apr.2	May.1
Gadwall					Dry	Dry	9	29								
Mallard	3550	150	1400	250	Dry	Dry	447	4800	8	200				30	306	
Northern Pintail	600		53	30	Dry	Dry	137									
Eurasian Wigeon		20	55	305	Dry	Dry	1146	162	4							
Northern Shoveler	950	17	195	350	Dry	Dry	1016	95	14							
White-Headed Duck		25			Dry	Dry										
Common Pochard					Dry	Dry										
Tufted Duck					Dry	Dry										
Ferruginous Duck					Dry	Dry										
Red -Crested Pochard					Dry	Dry										
Garganey					Dry	Dry										
Common Teal				50	Dry	Dry	175	168								
Marbled Duck					Dry	Dry										
Common Shelduck	75	335	135	2153	Dry	Dry	8200	13850	808	930	276	243	728	548	360	53
Ruddy Shelduck	369	23	253	78	Dry	Dry	8	102	12	13				20	17	
Greylag Goose					Dry	Dry										

Table 12:c. Anatidae Census at the Oum El Bouaghi Wetland Complex during the Year 2006-07

4.2 Discussion:

4.2.1 Status and Time budget:

This study indicate the importance of the wetland complex of Oum El Bouaghi, a region known as the 'Constantinois' as a wintering and one of the main breeding areas for the Coot (Samraoui et Samraoui, 2007; Baaziz *et al*., unpubl data) at the Hauts Plateaux in north east Algeria for the Common Coot like many other waterfowl (Saheb *et al*., 2006; Samraoui et *al*., 2006; Boulekhssaïm *et al*., 2006; Samraoui and Samraoui, 2008).

Even though early studies reported the abundance of the common Coot (*Fulica atra*) as a waterbird in North Africa (Etchecopar and Hüe, 1964), no regular census of the species was carried out in Algeria at all sites during winter seasons. A previous study undertaken on only a few regularly monitored sites located in west North Africa reported a total of 131470 Coots in mid January 1986 (Monval *et al*., 1987) where 7000 Coots were counted at the El Kala region (northeast Algeria). Another report (Anonymous, 2002) on the Mekhada marsh in Numidia provided a variable number of Coots counted between 1989 and 1998 where 12300 was the maximum number counted. However, in the period 1971-1979 up to 35000 Coot have been seen at lake Mellah in Numidia (Van Dijk and Ledant, 1983). The species was also reported to winter in the Sahara (Anonymous, 2004; Dupuy, 1969) at Mellah and Goléa Lake, and at Sidi Slimane Chott where the numbers varied between 4 - 2370 individuals. In the west region, the species was reported to be a wintering at Télamine Lake and Dayet El Ferd (7300 Coots counted in 2004).

Therefore, these partial and non regular wintering counts do not allow a fair estimate of the Algerian Coot population size which may require a national campaign to cover all possible Coot wintering areas such as lakes, Garaets, sebkhats, Chotts, wadi, dams, ponds, reservoirs, and channels…etc.

Our systematic survey during a three-year period on the wetland complex of Oum El Bouaghi as part of the huge Hauts Plateaux is a contribution to the evaluation of the Coot population and the identification of the most attractive sites and their carrying capacity. Moreover, it appeared that the gradual decline in Coot population over the three-year study period can be explained non- exclusively by the unfavorable climatic conditions over the last two years that coincided with the study, characterized by a drying up of most wintering sites resulting in mass desertion by Coots. These attractive sites at the Complex probably contain important

food stock (Allouche, 1988). Yet, salt sites were reported to be less rich in submerged vegetation (Dervieux and Tamisier, 1987).

The possible reasons for the differences in selecting habitats within the Complex and rejecting others are (1) adequate water depth and quality (Allouche, 1988), (2) the type of food available that was found to influence the presence, in a given site, of specific species according to their needs (Verhoeven, 1980; Britton and Podlejski, 1981; Del Hoyo *et al*., 1992). In fact, one of the most attractive sites for Coots in the complex was Tazougart Lake that had been used since 2005-06, unfortunately, as a collector for sewage waters and industrial wastes which might lead to some extent to water pollution that might cause the gradual decrease in the number of waterfowl observed at the site (Hafner, 2004); however, this assumption requires further investigation. In the Camargue, Allouche (1988) suggested the existence of two distinct Coot populations, Allochthonous (migratory) and Autochthonous (local nesting). Our results could not be used to clearly separate, if they exist, two distinct Coot populations, but we are confident that G. Boulhilate by its inadequate nesting vegetation is only a wintering site; However, Touzeline Reservoir with its numerous vegetation patches (*Typha angustifolia*) enabled only about 20 pairs to nest (in 2006); another close and major breeding sites at the Oum El Bouaghi wetland Complex is G.Timerganine and Chott el Maleh which did received more than 1000 pairs of Coots during breeding seasons of 2004 and 2005 when Boulhilate was totally deserted (Samraoui and Samraoui, 2007; Baaziz *et al*., unpubl data).Therefore, we believe that the Coot populations studied are a mixture local and migratory populations.

Thus, the results suggest that the Oum El Bouaghi wetland complex is one of the main wintering quarters in Algeria for wintering Coots.

Studies on the time budgets of the common Coot were carried out previously in Europe, but the recorded results on diurnal feeding time were contradictory: in northwest Europe (Irwin and O'Halloran, 1997) the value was 36%, but in the Camargue (France), Allouche (1988) reported a value of 62.8% and 71.6%. Pelsy-Mozimann (1999) noted a range between 15-30% for surface feeding whereas in Belgium, Draulans and Vanherck (1987) reported a mean value of 55%.

The high percentage recorded at both Boulhilate and Touzeline sites (73.84% and 71.26%, respectively) are in accordance with those of Allouche (1988) at the Camargue but higher than the values noted by either Irwin and O'Halloran (1997) in Ireland or Pelsy-Mozimann(1999) at the Camargue. These higher values may indicate lower feeding efficiency, larger energy expenditure, or building important lipid reserves to meet spatial occupation constraint on breeding sites and energy demand for breeding (Allouche, 1988). However, data

should be interpreted with caution as two different habitats are involved because Coot behaviour may vary between ponds (Draulans and Vanherck, 1987). Even more, geographical variation effect on time budgets was observed in wintering Coot population at Ichkeul Lake in Tunisia where the feeding time was found to be elevated till complete depletion of the food sources before the end of winter season (Bredin *et al*., 1986).

Cold, wind, and disturbance seemed to depress feeding activity during the study period. A previous study reported that high wind and rainfall lower the feeding activity in non breeding Anatidae (Paulus, 1988). High waves caused by high wind were observed to induce Coot feeding on water (Odin, 1988) and on land (Irwin and O'Halloran, 1997). The influence of weather was, unfortunately, not investigated in our study, but we did not note any freezing spells during the study period, however, windy days led most of the Coots to increase swimming but had no effect on grazing activity on the banks.

The seasonal pattern of feeding exhibited by Coots did not seem to be consistent with the usual trend exhibited by wintering waterfowl, with a surge in feeding activity in the fall followed by a decrease in winter and an elevation in percentage of time spent feeding in early spring (Paulus, 1988; Tamisier and Dehorter, 1999). Our Data were different from those of Allouche (1988) and partially in agreement with those of Pelsy-Mozimann (1999) at the Camargue where different sites were involved in their studies.

The reasons for such discrepancy are unclear. Nevertheless, one possible reason is that seasonal trends in time budgets of non breeding waterfowl are tightly related to food supply and quality and to energy needs of individuals (Miller, 1985). In addition, for a given species, the feeding behaviour varies on the same site by time due to changes in the available resources according to months or it may, also, alter among sites because the supplied sources do not have the same energetic value (Tamsier and Dehorter, 1999; Draulans and Vanherck, 1987). Species, like Coots, consuming leafy aquatic vegetation that is usually of high water and fiber content with less energetic value spent much of their time feeding (Paulus, 1988; Allouche, 1988; Tamisier and Dehorter, 1999). Therefore, our data may indicate possible differences in the food availability and quality between the two study sites; but further investigation on the quality of food ingested by Coots in each study site is one of the clues for better understanding of Coot time budgets in the Oum El Bouaghi wetland Complex. A second possible explanation is the sharing of the same habitat simultaneously and the consequently possible competition for spatial occupation or for food sources between Coots and other herbivorous waterfowl such the Wigeon (*Anas Penelope*) whose feeding activity was observed to be partly diurnal in Numidia, Algeria (Houhamdi and Samraoui, 2003). This probable reason may induce Coots to spend much of their

time feeding to meet the energy needs by accumulation of reserves that serve as an energy source for over wintering or for preparation for breeding season. This assumption requires further investigations that could highlight the mechanisms responsible for the utilization of space by Coots and other neighboring waterfowl and analysis of the type of food preferred by each species. A third possible explanation is that Coots subjected to repeated disturbance at study sites developed a physiologic adaptive response which led to increased feeding activity (Hafner *et al*., 2004).

The decline in feeding activity observed during late winter-early spring at Touzeline Reservoir can be explained by the fact that reserves were accumulated during previous months on the same site or on neighboring sites (Allouche, 1988; King and Murphy, 1985). Another possible reason is to lower energy expenditure given the approach of the reproductive season that requires more energy to be spent (Irwin and O'Halloran, 1997). However, this decrease was reflected by an increase in swimming, a costly activity that is difficult to explain in this context. Moreover, Touzeline Coot population probably selected this site for its high availability and /or quality of food, security…where it takes profit of a diet less rich in fibers that may promote more protein and less lipid reserves to reach an optimal body mass (Pelsy-Mozimann, 1999).

Thus, the Hauts Plateaux appear to be a wintering quarter distinct from European ones where Coot population developed a particular strategy which is the most adequate for responding efficiently to the specific habitat constraints.

Previous studies documented very well the feeding strategy of Coots in Europe (Horsfall, 1981; Draulans and Vanherck, 1987; Irwin and O'Halloran, 1997; Allouche, 1988; Pelsy-Mozimann, 1999; Tamsier and Dehorter, 1999). At our study sites Coots showed flexibility in their foraging behaviour and used a range of feeding ways: pecking at the water surface, head - neck submerged, diving, and grazing with a prevalence of surface feeding. These results suggest that Coots, as the only diurnal species whose food selection is probably visual (Tamsier and Dehorter, 1999), largely choose the less energy demanding strategy of pecking at the surface (Draulans and Vanherck, 1987; Allouche, 1988). Diving was the second alternative feeding way that was used throughout the whole study period at low percentage because Coots are physically non adapted for submerging and the energy cost for this behaviour is very elevated (Fjeldsa, 1977).

Due to their opportunistic nature of feeding (Cramp and Simmons, 1980), Coots shift their major feeding strategy to grazing once fresh emergent vegetations appear at the banks in late winter early spring. The birds are probably taking advantage of any available less energy costing food. In fact, many factors were reported to influence the foraging and efficiency of waterfowl such as

site, water depth, food density and availability, and the depth of substrate covering the food, predation risk, competition (Draulans, 1982; Draulans and Vanherck, 1987; Tamsier and Dehorter, 1999). Increasing flock size was also reported to be proportional with foraging efficiency in many birds (Krebs, 1974).

The data on hourly percentage time spent feeding over the two study sites remained high within the eight hour observation (Mean = 74.63% and 71.19% at G.Boulhilate and Touzeline Reservoir, respectively) and surged on the first and the last hour of observation. These results are consistent with those of Tamisier and Dehorter (1999) where they reported that diurnal feeding is concentrated on edge hours. Our findings are, also, in agreement with a previous study (Asensio *et al.*, 1986) carried out on Coot time budgets in Spain where the reported percentage time spent feeding during a day was high (81.94%). The slight decrease recorded within the six-day hours (between edge hours) observation may be due to disturbances exerted on the sites or to other unknown factors. Moreover, the nature of habitat and riparian activities such as herding appeared to be factors influencing foraging timing where we recorded the critical time range for herders presence is mainly between 9 AM and 2 PM which may have affected behaviours among which was grazing.

Swimming is likely one of the most costly behaviour for the Coot as for Anatidea (Woolyand Owen, 1978). Coots at both study sites exhibited seasonal differences in pattern and in percentage time devoted to swimming, and diurnal similarities in pattern and in values of mean time spent swimming. The reasons for such alterations are not clear. In fact, our data were lower when compared to those obtained in Europe by Draulans and Vanherck (1987), Irwin and O'Halloran (1997), and Pelsy-Mozimann (1999) where they reported a value of 30%, 38%, and 50-70%, respectively. However, when comparing time devoted to swimming, our results (~ 2hours/ 12hrs) were in the range of that reported by Allouche (1988) where he provided a range of 2-4 hours per day time.

The found similarity in the low recorded values of Coot behaviour such as preening and resting at both study sites are in agreement with those of Asensio *et al.*, (1986) who reported 4.85% for preening and 0% for resting. These low obtained values are probably due to human disturbance, physiological characters, and predation or to other unknown factors (Tamisier and Dehorter, 1999; Jorde and Owen, 1988; Paulus, 1988).Whereas, the slight difference in seasonal pattern of resting recorded at both sites could be non -exclusively, explained by the fact that G.Boulhilate, by its large surface and adequate water depth, may function as adequate receiving site for autumn migratory Coots in early winter.

It appeared that treading influenced to certain extent all diurnal behaviours observed in Coots. In fact, it was reported previously that disturbance cause behaviour change either by

favouring high costing activities (such treading or swimming) or by decreasing the time spent for activities that allows birds to acquire energy (Hafner *et al*., 2004). In addition the negative effect of hunting on waterfowl behaviour was documented previously (Tamisier and Dehorter, 1999). However, fortunately, it was rarely observed during our study period. Thus, it appeared that human activities had a greater effect on Coot time budgets at G.Boulhilate than at Touzeline Reservoir.

Inasmuch as the present study is limited by the lack of data on food resources and weather effect, and physiologic parameters; further studies are needed, first to highlight the relationship between habitat, trophic resources, weather, and behaviour, and second, to determine the origin of Coots wintering in Algerian wetlands.

4.2.2 Breeding Ecology:

The present study confirmed that the wetland Complex of Oum El Bouaghi, as a part of the Hauts Plateaux North east Algeria, is one of the main sheltering and nesting sites of the Coot *Fulica atra*. G.Timerganine, with its variable and randomly dispersed vegetations, was the most important site in number of adult Coots and nests during the two season study (Samraoui et Smraoui, 2007).Chott el Maleh, distant from G.Timerganine by about 20Km, investigated for the first time and ,was also marked by a considerable Coot population and Clutches number.

The observed in Coot number at G.Timerganine and Chott el Maleh during the two year study before, within and after breeding period indicated the Coots in the Complex. The main recorded numbers, at G.Timerganine, can be explained by three possible reasons :(1) The almost daily human presence, especially, sheepherders, that caused Coots to disperse and hide in the vegetations. (2) The coincidence with vegetation growth which diminish the total vision of the field or (3) with the peak of the laying and the onset of incubation period (Fjeldsa, 1973). The recorded numbers might be due to arrival of non nesting visitor Coots from other sites; whereas, the in Coot number in can be attributed to failed breeders from elsewhere(Sage, 1969; Gadsby,1978 ; Samraoui et Samraoui, 2007). The sharp in Coot number in 2006, at G.Timerganine, is attributed to the climatic conditions of the complex. Just after one week of heavy rains in the presence of last year vegetation mainly *phragmites* that Coots start to occupy the available territories in the site in order to recover. The number recorded in first and second week coincided with the laying rate that lasted for first decade where the Coots were invisible on the water (Fjeldsa, 1973). The in Coot number is likely due to adults having achieved or failed breeding (Gadsby, 1978; Samaraoui et Samraoui, 2007).

Chott el Maleh a four unit complex, with a difficult access during winter, was only known to us in late, the sharp ecorded in Coots number could be due, al least in part, to the full occupation of best available territories (Fjeldsa, 1973) by only nesting Coots in unit one, because the number of Coots the end of the breeding season, or to flying to elsewhere. Furthermore, the number of Coots during 2006 was due to climatic condition mentioned above. Based on nest location, the number of nesting pairs could never been observed. This might be due, at least in part, to invisibility of Coots in the emerging vegetations (Fjeldsa, 1973).

Nest Site Selection

The nests found in G.Timerganine compared to Chott el Maleh can be due to a combination of three main factors: (1) the presence of an adequate water depth until the young reach certain age (Salathé, 1986), (2) the large distribution and diversity of vegetation that provides nesting Coots with nest materials (Jortay, 2002; Samaraoui et Samraoui, 2007) and territories(Perdeck and Cavé, 1989), and (3) nutrient factors as an important factor for successful breeding (Brinkhoff, 1997 ; Brinkhoff and Cavé, 1997). However, the latter assumption could not be assessed in our study.

The nests found in *phragmites* during the two seasons at G.Timerganine can be explained by either (1) the last year and emerging vegetation suitable for nesting materials and appropriate cover to decrease aerial predation probability (Sage, 1969; Salathé 1986) or (2) easily located by Coots as large strata containing wide trophic resources and adequate nest site (Samraoui et Samraoui, 2007). However, the possible reason for alternative over two seasons at Chott el Maleh was likely related to the outgrowth of first emergent vegetation (Sage, 1969; Samraoui et Samraoui, 2007). Adult Coots occupy and defend the best territories-rich in food resources and nesting vegetation- earlier than young ones that results in onset of laying (Fjeldsa, 1973; Cavé *et al*., 1989). Moreover, we noted nest site at both study sites that resulted in nest distribution .

Nest Characteristics

Mean Coot nest dimensions the investigated sites or years. Two possible non- exclusive explanations for this fact are: the first, dimensions of Coot nest were reported on water and on changes in during constructing and incubating nests (Cramp et Simmons, 1980; Jortay, 2002), this, in part, with our finding in G.Timerganine where the water depth within years, however, in Chott el Maleh the water levels were in G.Timerganine; the second, the of the nest depends on the plant species utilized for constructing it (Rizi *et al*., 1999) and Since the nests located in *phragmites* , the dominant vegetations, thus MID.

These finding a previous study carried out (Samraoui et Samraoui, 2007). Comparison of the Hauts Plateaux with those of Algerian eastern Coast (Rizi *et al*., 1999 ; Houam *et al*., 2005) with those of Tonga lake (1997) and of Oubeira lake (1996 and 1997) and Numidia.

Significant were found when compared the to those of previous studies (Samraoui et Samraoui, 2007; Rizi *et al*., 1999; and Houam *et al*., 2005).

The closer range of found in both sites was mostly linked (Cramp et Simmons 1980; Jortay 2002) that did throughout the breeding seasons. This finding a previous study at G.Timerganine .However, mean nest height, when compared to that obtained in Tonga and Oubeira lakes (Rizi *et al*., 1999), of Numidia (Houam *et al*., 2005). This could be probably due to nests in their studies or to a selective study area. In general, the nests observed in the Hauts Plateaux of Algeria were the literature. Cramp et Simmons (1980) reported the following ranges of nest sizes for Coots in Western Palearctic: external diameter; internal diameter cm and nest height cm. In West Siberia, Koshelev (1984) reported alike dimensions where cm and cm for external and internal diameters, respectively. The MWD at nest site appeared on water level. These results confirm G.Timerganine. Means in the Hauts Plateaux Compared to those of Algerian Eastern coast (Rizi *et al*., 1999; Houam *et al*., 2005).

Mean Laying Date and Laying Period

The laying date, laying period and mean laying date influencing factors : first, nesting Coots Arrival, pair age (Perdeck et Cavé, 1989, 1992); second, Weather condition, individuals ponds (Havlin 1970); third, highly changeable rainfall (Rizi *et al* 1999); fourth, outgrowth of aquatic vegetation adequate for nesting materials (Sage,1969; Horsfall, 1981; Salathé 1986); fifth, gradual increase in temperature (Fjeldsa, 1973; Lack, 1950); sixth, Temperature prior to egg laying (Perdeck et Cavé, 1989); seventh, acquisition of nutrient reserve necessary for optimal breeding (Lack, 1950; Havlin, 1970; Hepp, 1984). Moreover, did not affect the end of laying season (Perdeck et Cavé, 1989) with the exception ascribed to a sharp drop of water level. The registered of complete clutch with findings (Samraoui et Samraoui, 2007; Rizi *et al*., 1999) that Coots in Algeria may lay and incubate eggs.

Our chronological data of the Hauts Plateaux G.Timerganine (Samraoui et Samraoui, 2007) and in Numidia (Houam *et al.*, 2005) about where they showed that Coots . The of laying in 2005 (characterized by high precipitation rates) compared to 2006 was in with those of Europe (Gadsby, 1978; blüm, 1973). Etchecopar and Hŭe (1964) and Rizi *et al.*, (1999) reported that North African Coots start laying and Western Palearctic counterparts. Our findings their data. Moreover, the mean laying dates obtained, so far, either in studied sites in Algeria or in Europe. These could be the above mentioned possible factors or by the data sets.

The possible causes of few cases found can be due to (1) Coots that breed than older ones (Havlin, 1970 ; Perdeck et Cavé, 1989) , to (2) a brood (Cramp et Simmons,1980) ,or to (3) a clutch (Samraoui et Samraoui, 2007).

Egg Size Variation

Egg size was found when comparing our data with those of Cramp et Simmons (1980). Thus, The Hauts Plateaux reconfirm previous findings (Samraoui et Samraoui, 2007; Houam *et al*., 2005) reporting that Algerian Coots eggs were than those of Europe as it was reported by Rizi *et al*.,(1999) in Tonga and Oubeira Lakes.

Clutch size

Mean clutch size in the Hauts Plateaux showed to be than that of Numidia (Houam *et al.*, 2005), Tonga and Oubeira lakes (Rizi *et al.*, 1999) but European range data (Sage, 1969; Cramp et Simmons, 1980; Gadsby, 1978; Koshelev, 1984). The Annual and regional variation in clutch size is well documented and the possible many proximate, ultimate and (Lack, 1947; Klomp, 1970). Therefore, the Mean clutch size obtained could be related to many factors. Moreover, Samraoui et Samraoui (2007) indicated correlation between clutch size, environmental variables, and trophic resources (Perrins, 1970) of Coots. Another possible determining factor is the data induce the requirement for further investigation before drawing any conclusions about these Clutch size .

Breeding Success

Breeding success in the Hauts Plateaux turned, however, from clutch size. result was reported in 2004 at G.Timerganine (Samraoui et Samraoui, 2007). Several factors showed to determine the breeding success : (1) Nutrient reserve in the body (Hepp, 1984), (2)Age structure of breeding population (Forslund et Part, 1995) (3) Food supply and timing of breeding (Horsfall, 1981; Perdeck and Cavé, 1992; Brinkhoff *et al.*, 1993; Brinkhoff, 1997; Brinkhoff and Cavé, 1997), (4) water depth and Predation (Salathé, 1986; Salathé,1987), (5) Humans (Salathé,

1987),(6) weather and Habitat heterogeneity (Samraoui et Samraoui, 2007) or a combination of all the above. The finding of complete clutches, was to those of previous researchers in Algeria where both Samraoui et Samraoui (2007) and Rizi *et al*.,(1999) described a hatching success, respectively. Hence, Coots in Algeria proved to have a Western palearctic reported by Cramp et Simmons (1980) that were and ranged between .Our Study suggests that, disturbance by cattle intrusion, and annual weather variability might have resulted in ocal Coots populations.

The chicks mortality rate could not be assessed exactly in our study, but it is expected to be greater and more important (Havlin, 1970); the possible causes of few observed cases are likely due to wandering, attacks by adult territory holding Coots or sickly young (Alley et Boyd, 1947) or to starvation (Lyon, 1993).

Conspecific brood Parasitism

Conspecific brood parasitism (CBP) as a common constituent of breeding was reported to occur in waterfowl and considerable studies were carried out on the American Coot *Fulica Americana* and in the red knobbed Coot *Fulica Cristata* . investigation, for our knowledge, was done on CBP on *Fulica atra*, but many authors indicated its presence within this species in western Palearctic (Gadsby, 1978). The prsence of Conspecific Brood Parasitism in *Fulica atra* was previously anecdotal (Gadsby, 1978).The first qulitative assessment of this phenmonon in the Common Coot was that of Samraoui Chenafi (2005). CBP was found to be common at G.Timerganine and was also reported for Numedia (Samraoui Chenafi, 2005; Samraoui et Samraoui, 2007). CBP, as a subjective survey, in the Hauts Plateaux due to many factors among which are in checking nests on a regular basis, large study sites recorded of CBP signs

Moreover, our finding Coots and mostly parasitic eggs as a common host defense by the nest material (Lyon, 1993, 2007). Our preliminary results suggest that further investigation should be carried out to highlight more on the CBP after protection measures are taken for these Habitats.

Our results on Coot Breeding ecology highlight the need for further investigations on other possible factors determining this process such as the trophic resources, climatologic, predation, and Parasitism effect, body conditions prior and during breeding period, Thus for an

in-depth understanding of the interrelationships among these factors , conservation and protection of Coot breeding sites is compulsory in Algeria.

Conclusion

This work is a systematic study during three year-period on the Common Coot (*Fulica atra)* in the Oum El Bouaghi wetland Complex. It illustrates a new data regarding the ecology of the species at different years and spaces.

Our study shows that wetland Complex of Oum El Bouaghi plays a crucial role in both wintering and breeding of the Common Coot.

The population of Common Coot is very important in many wetland sites of the Complex such as Boulhilate, G.Timerganine, Tazougert-1, Chott el Maleh, and in Touzeline Reservoir. The highest counts were recorded during birds' arrival on September and in wintering season, November/December.

Even though Common Coot was reported previously to be abundant in North Africa (Etchécopar and Hüe in 1964), the total Common Coot *Fulica atra* population in Algeria was never estimated with the exception of individual counts at no regular, different times, and diverse sites where it was reported that several tens of thousands winter visitors distribute between September/October and March /early April on the large northern wetlands. Only one report, on the Constantinois, (Ledant *et al.*, 1981) stated that Common Coot was rare and only observed at Gareat. Boulhilet without providing the population size. Not only a non regular survey was carried out in Algeria, but also, the Oum El Bouaghi wetland Complex role as a wintering and breeding quarter for many waterbirds species was underestimated (Samraoui et Samraoui, 2008). Thus, our systematic survey during a three-year period on the wetland complex of Oum El Bouaghi as part of the huge Hauts Plateaux is a contribution to the evaluation of the Coot population and the identification of the most attractive sites and their carrying capacity either for wintering or for breeding. Moreover, it appeared that the gradual decline in Coot population over the three-year study period can be explained non-exclusively by the unfavorable climatic conditions over the last two years that coincided with the study, characterized by a drying up of most wintering sites resulting in mass desertion by Coots. These attractive sites at the Complex probably contain important food stock (Allouche, 1988). Yet, salt sites were reported to be less rich in submerged vegetation (Dervieux and Tamisier, 1987). This hypothesis requires further investigation on trophic sources which may explain, at least in part, the differences in attraction to the species.

Our results could not be used to clearly separate, if they exist, two distinct Coot populations, but, Wetland sites such Boulhilate, Tazougert-1, Chott Tinsilt, Timgad Dam by their unsuitable habitats for reproduction show to be only wintering sites for Coots; however, G.Timerganine, Chott el Maleh, and Touzeline Reservoir by their adequate habitats are used for both wintering and breeding; therefore, we believe that the Coot populations studied are a mixture local and migratory populations.

Thus, the results suggest that the Oum El Bouaghi wetland complex is one of the essential wintering quarters in Algeria for wintering Coots.

The present study on time budget, for the first time at Oum el Bouaghi wetland complex, at two different sites shows that Common Coots are diurnal waterbirds that devote ¾ of their time to feeding. Our results were in agreement with those of Europe (Allouche, 1988) in the Camargue, France; and, Draulans and Vanherck in Belgium (1987); and different from those of both Irwin and O'Halloran (1997) in Ireland or Pelsy-Mozimann (1999) at the Camargue. Bearing in mind that two different habitats are involved in our study, these higher values recorded can be attributed to many possible factors: dimunition in feeding efficiency, high energy expenditure or to building protein and fat depot for facing the incoming breeding season request.

Marked fluctuations in time devoted to feeding were recorded at both study sites at different times of the wintering season. Possible reasons for these alterations are Cold, wind, and disturbance. Even though the influence of weather was, unfortunately, not investigated in our study, we did not note any freezing spells during the study period; however, windy days led most of the Coots to increase swimming but had no effect on grazing activity on the banks.

The seasonal pattern of feeding exhibited by Coots did not seem to be consistent with the usual trend exhibited by wintering waterfowl. The reasons for such discrepancy are unclear, but nevertheless, our data may indicate (1) possible differences in the food availability and quality between the two study sites; but further investigation on the quality of food ingested by Coots in each study site is one of the clues for better understanding of Coot time budgets in the Oum El Bouaghi wetland Complex; or (2) Competition for the utilization of space by Coots and other neighboring waterfowl, or to (3) disturbance exerted.

Thus, the Hauts Plateaux appear to be a wintering quarter distinct from European ones where Coot population developed a particular strategy which is the most adequate for responding efficiently to the specific habitat constraints.

Regarding feeding strategies used by Common Coots, the study showed that Coots showed flexibility in their foraging behaviour and used a range of feeding ways: pecking at the water surface, head - neck submerged, diving, and grazing with a prevalence of surface feeding. Due to their opportunistic nature of feeding (Cramp and Simmons, 1980), Coots shift their major feeding strategy to grazing once fresh emergent vegetations appear at the banks in late winter early spring.

The data on hourly percentage time spent feeding over the two study sites are consistent with those of Tamisier and Dehorter (1999) where they reported that diurnal feeding is concentrated on edge hours.

Coots at both study sites exhibited seasonal differences in pattern and in percentage time devoted to swimming, and diurnal similarities in pattern and in values of mean time spent swimming. Low values were recorded of preening and resting behaviour at both study sites.

Our study on Coot Breeding ecology on two different wetland zones during two consecutive years (2004-05 and 2005-06) showed the high importance of the Hauts Plateaux as breeding area for Coots where Coot nests was located and studied for the first time. Chott el Maleh was investigated for the first time and showed a marked Coot population.

Common Coots bred at G. G.Timerganine and in Chott el Melah where it appears that habitat quality play a main role in nesting start.

Coots showed a sequenced preference for nest building, the was the first emergent vegetation used by Coots; then after,. The last used vegetation for nesting was the. Thus, sequencing for nest site utilization at both study sites resulted inthe growth of emergent vegetation (Salathé, 1986).

The present data, also, showed that Coot selected vegetation for building their nests. In fact, one of the main criteria used by Coots prior nesting is the milieu where vicinity to open water appeared to be important elements in study.

Our data revealed that nest observed in the Hauts Plateaux of Algeria were the reported in the literature (Cramp and Simmons, 1980) in Europe and was, but changes in water levels.

Water depth at nest site was shown to on water level, but when compared to those of previous studies (Rizi *et al*., 1999, Houam *et al*., 2005) in Coastal region; thus differences may occur.

The current study also shows the one-egg complete clutch like previous findings (Samraoui et Samraoui, 2007; Rizi *et al*., 1999) Coots in Algeria may lay and incubate egg.

Our chronological data of the Hauts Plateaux during two consecutive years at two different sites demonstrate that North African Coots laying onset, laying period, and mean laying date thus, our results were in accordance with those of Europe (Gadsby, 1978; blüm, 1973).

The Egg dimensions measurement taken on laid by Coots in the Hauts Plateaux is number in Algeria and and showed when compared with those of Europe (Cramp et Simmons, 1980) and demonstrate that North African Coots do lay narrower eggs as it was reported by Rizi *et al*., (1999) in Eastern coastal region of Algeria.

Our results showed Hauts Plateaux. It was also Numidia (Houam *et al*., 2005), Tonga and Oubeira lakes (Rizi *et al.*, 1999) but it is the European data (Sage, 1969; Cramp and Simmons, 1980; Gadsby, 1978; Koshelev, 1984). This many factors such as a possible correlation between clutch size, environmental variables, and trophic resources (Perrins, 1970; Samraoui and Samraoui, 2007).

Breeding success in the Hauts Plateaux turned out to Several factors showed, in previous studies (Hepp, 1984; Forslund and Part, 1995; Horsfall, 1981; Perdeck and Cavé, 1992; Brinkhoff *et al*., 1993; Brinkhoff 1997; Brinkhoff and Cavé, 1997; Salathé, 1986) to determine the breeding success. Hatching success, however, for all complete clutches .Therefore, our results were in Algeria (Samraoui Chenafi, 2005 and Rizi *et al.*, 1999). Hence,Coots in Algeria proved to be Western palearctic reported by Cramp et Simmons (1980) .

Our Study suggests that, non disturbance and variability might have resulted on local Coots populations.

previous deep investigation, for knowledge, was done on Conspecific brood parasitism (CBP) on *Fulica atra*, but many authors indicated its presence within this species in western Palearctic (Gadsby, 1978). Our preliminary results recognize eggs as a common host defense by CBP occurred at study sites.

At last, our study on strategies of wintering and breeding of Common Coots *Fulica atra* at the Hauts Plateaux, northeast Algeria highlight the need for further investigations on other possible factors determining this processes such as the trophic resources, climatologic, predation, and Parasitism effect, body conditions prior and during breeding period, Thus for an in-depth understanding of the interrelationships among these factors , conservation and protection of Coot breeding sites is compulsory in Algeria.

Summary

The status, strategies of wintering and breeding of the Common Coot *Fulica atra* was studied at the Hauts Plateaux, northeast Algeria over three year-period (2004-2007).

The results of the study showed the importance of the Oum el Bouaghi wetland complex in both wintering and breeding of Common Coot *Fulica atra*. The population declined sharply in numbers over the study period where the maximum number recorded in November 2004 was 20000 individuals whereas in September 2006 this number fell to only 380. Different wetland sites showed different carrying capacity. Moreover, the behaviour of Coots was investigated by diurnal time budget analysis and was shown to be different between sites (similarity in feeding and differences in other activities) throughout the wintering season. Coots devoted almost 75% of their time feeding followed by swimming (15-18%), whereas resting and preening activities accounted for less than 5%. Treading accounted for 4%-7% of the time allocated. Agonistic behaviour was only observed at one study site. Surface feeding was the major foraging behaviour, accounting for about 50% of feeding time during eight hours observation followed by diving, and grazing which started in late winter and early spring (less than 11%). Hourly data analysis showed that time spent on feeding was high (>80%) and concentrated on edge hours. Swimming activity exhibited, also, a gradual increase by two –three folds during the study period at both sampled sites.

Résumé :

Le statut, les stratégies d'hivernage et de reproduction de la foulque macroule *Fulica atra* a été étudié dans les Hauts Plateaux Nord Est de L'Algérie durant trois années (2004-2007).

Les résultats montrent l'importance du complex des zones humides d'Oum el Bouaghi dans l'hivernage et la reproduction de la foulque macroule *Fulica atra.* La population a décliné d'une manière marquée durant la période d'étude où le nombre maximal enregistré au mois de Novembre était 20000 individus, alors qu'il a diminué jusqu'à seulement 380 en septembre 2006. Des zones humides différentes ont montré une capacité de réception différente. En plus, le comportement de la Foulque macroule été étudié par l'analyse du budget de temps diurne qui parait différent entre les sites (ressemblance dans l'alimentation et différence dans d'autre activités) durant la saison d'hivernage. Les Foulques ont cosacré presque 75% de leur temps en alimentation et nage (15-18%) tandis que le comportement du repos et de toilette est inférieur à 5%. Le temps alloué au dérangement était de 4-7%.Le comportement agonistique n'a été observé que dans un seul site. L'alimentation à la surface (picorage) était l'essentiel du comportement du alimentation avec presque 50% du temps alloué a l'alimentation durant les huit heures d'observation suivi par la plongée, l'alimentation au bord qui commence à la fin de l'hiver et au début du printemps (moins de 11%). L'analyse des données a l'heure a montré que le temps dévoué à l'alimentation était très élevé (>80%) et plus concentré dans les heures extrêmes (début et fin de journée). Le comportement de la nage, aussi, a augmenté graduellment et multiplié par deux à trois fois durant la période d'étude dans les sites échantillonnés.

الملخـــص

تم دراسة مكانة وإستراتيجيات التشتية و التكاثر لطائر الغر الأوراسي في الهضاب العليا للشرق الجزائري خلال فترة 3سنوات(2004-2007).تظهر النتائج أهمية مركب المناطق الرطبة لأم البواقي لكل من التشتية و التكاثر للطائر الغر الأورلسي *Fulica atra* .

. أظهرت النتائج أن جماعة الغر الأورلسي إنخفضت بصورة حادة في العدد خلال فترة الدراسة،حيث كان الرقم الأقصى المسجل في شهر نوفمبر2004 هو20000 فرد بينما إنخفض هذا الرقم إلى380 فرد فقط في شهر سبتمبر2006.

أظهرت مواقع عديدة من مركب المناطق الرطبة لأم البواقي قابلية إستقبال مختلفة للطيور، بالإضافة تم التحقيق في سلوك الطائر الغر الأوراسي من خلال تحليل ميزانية النشاط النهاري التي أظهرت إختلاف ما بين مواقع الدراسة (تشابه في التغذية واختلافات في نشاطات أخرى) خلال فصل التشتية.

كرست طيور الغر الأورلسي مايقارب75 % من وقتها في التغذية و حوالي15-18% في السباحة ، بينما كان الوقت المخصص الراحة والتشور لم يتجاوز5% و كان الوقت المكرس للوطأ4 الى7 % ، و لم يشاهد السلوك العدائي الافي أحد مواقع الدراسة.

كانت التغذية على السطح أهم سلوك البحث عن الغذاء وقدرت بحوالي50 % من وقت التغذية خلال 8ساعات الملاحظة متبوعة بالغطس،ثم بالرعي الذي يبدأ في أواخر فصل الشتاء إلى بداية الربيع (أقل من11%) كما أظهر تحليل النتائج الساعية أن الوقت المستهلك في التغذية كان أكثر من80 % و مركزا خلال الساعات الطرفية ، أظهر أيضا النشاط السباحي زيادة تدريجية بمرتين إلى ثلاث مرات خلال فترة الدراسة عند الموقعين المدروسين.

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Annex: English, French, Latin name of Waterbirds (Isenmann and Moali, 2000)

English name	French name	Latin name
▪ Gadwall	C.Chipeau	*Anas strepera*
▪ Mallard	C.Colvert	*Anas platyrhynchos*
▪ Northern Pintail	C.Pilet	*Anas acuta*
▪ Eurasian Wigeon	C.Sifleur	*Anas penelope*
▪ Northern Shoveler	C.Souchet	*Anas clypeata*
▪ White-Headed Duck	Erismature a T.B	*Oxyura leucocephala*
▪ Common Pochard	Fuligule milouin	*Aythya ferina*
▪ Tufted Duck	Fuligule morillon	*Aythya fuligula*
▪ Ferruginous Duck	Fuligule nyroca	*Aythya nyroca*
▪ Red -Crested Pochard	Nette rousse	*Netta ruffina*
▪ Garganey	Sarcelle d'été	*Anas querquedula*
▪ Common Teal	Sarcelle d'hiver	*Anas crecca*
▪ Marbled Duck	Sarcelle marbrée	*Marmaronetta angustirostris*
▪ Greylag Goose	Oie cendré	*Anser anser*
▪ Common Shelduck	Tadorne de Belon	*Tadorna tadorna*
▪ Ruddy Shelduck	Tadorne casarca	*Tadorna Ferruginea*