(Published August 1984)

# RESEARCH ON THE MOSQUITOES OF PORTUGAL (*Diptera, Culicidae*)
# VII — TWO NEW ANOPHELINE RECORDS

HELENA DA CUNHA RAMOS *
H. RIBEIRO **
C. ALVES PIRES **
R. ANTUNES CAPELA ***

RESUMO

Neste trabalho, baseado em material colhido no decurso do reconhecimento sistematizado dos culicídeos de Portugal que o nosso grupo tem vindo a levar a cabo desde 1975, acrescentam-se duas espécies de anofelíneos à fauna culicideológica do nosso País: *Anopheles (Anopheles) algeriensis* Theobald, 1903 e *Anopheles (Anopheles) subalpinus* Hackett & Lewis, 1935. Com estas duas novas adições, julga-se que a lista dos mosquitos portugueses passa a incluir 39 taxa distintos. Para cada uma das espécies, indica-se qual o material examinado pelos autores e a distribuição geográfica conhecida, juntando-se ainda algumas notas taxonómicas e bioecológicas. Por fim, a importância médica dos dois anofelíneos é sucintamente considerada.

SUMMARY

In this paper, based on material collected in the course of the general survey of the mosquitoes of Portugal being carried out by our team since 1975, two anopheline species are added to the mosquito fauna of our country: *Anopheles (Anopheles) algeriensis* Theobald, 1903 and *Anopheles (Anopheles) subalpinus* Hackett & Lewis, 1935. With these two new additions, the list of Portuguese mosquitoes is now thought to include 39 distinct taxa. Under each one of the species, the material examined by the writers and the known geographical distribution are given, and some taxonomic and bioecological notes are added. Finally, the medical importance of the two anophelines is briefly considered.

*AKNOWLEDGEMENTS*

*The writers are thankful to Mrs. M. L. Rodrigues for typing the manuscript of this paper.*

* Centro de Zoologia, Laboratório de Investigação Científica Tropical/JICU, 1300 LISBOA (PORTUGAL).

** Centro de Doenças Infecciosas e Parasitárias da Universidade Nova de Lisboa, Disciplina de Entomologia, Instituto de Higiene e Medicina Tropical, 1300 LISBOA (PORTUGAL).

*** Museu e Laboratório Zoológico e Antropológico, Faculdade de Ciências, 1200 LISBOA (PORTUGAL).

(Recebido para publicação em 29/4/82).

## 1. INTRODUCTION

During two brief stays at the Algarve in March and May 1981, the first and second authors could collect a few adults and immatures of an anopheline not yet known in our country, *Anopheles algeriensis* Theo. The same year, during the survey of Portuguese mosquitoes being carried out by our research group, an adult female of the *maculipennis* complex was caught in the province of Beira Baixa, near the Portugal-Spain border, which showed to be *Anopheles subalpinus* H. & L.

With these two new additions, here dealt with, the list of Portuguese mosquitoes is thought to include now 39 names [1, 2, 3, 4].

The terminology here adopted for larval and pupal setae is based on the system developed by Belkin [5].

## 2. THE COLLECTING LOCALITIES

The approximate coordinates and altitudes of the Portuguese collecting localities cited in the text are as given below.

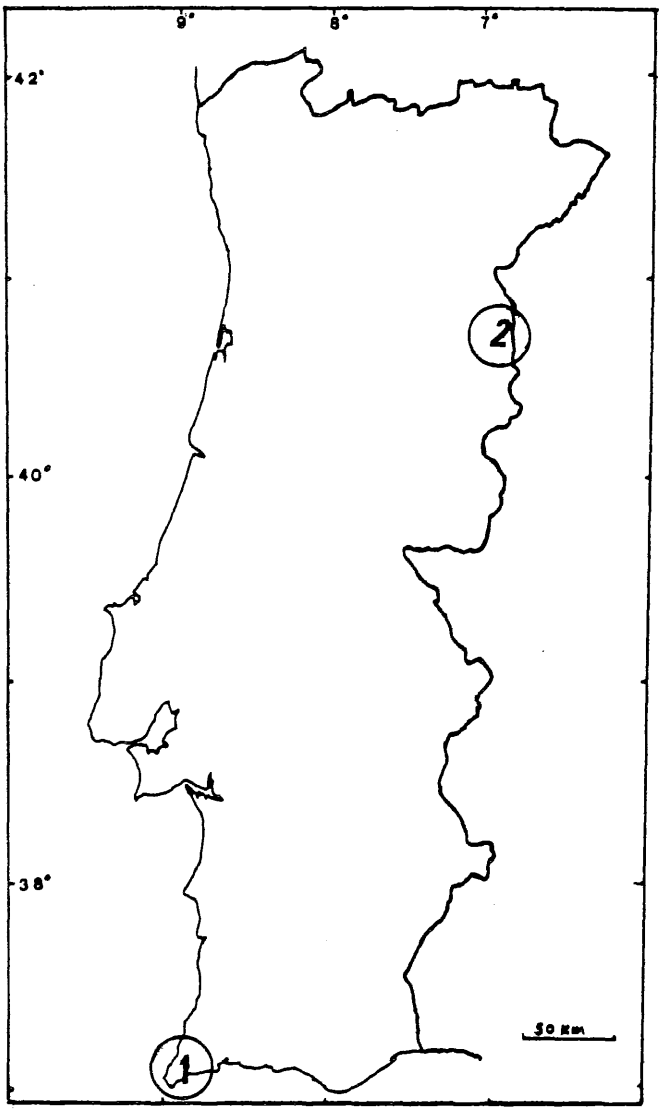
| Localities | Latitude N | Longitude W | Altitude (m) |
|---|---|---|---|
| Boca do Rio (*circa* Budens) | 37° 05′ | 8° 48′ | sea coast |
| Escarigo (*circa* Figueira Castelo Rodrigo) | 40° 50′ | 6° 50′ | 600 |

These two localities are also shown on MAP 1.

## 3. THE NEW ANOPHELINE RECORDS

### 3.1. *Anopheles (Anopheles) algeriensis* Theobald, 1903

*In*: A monograph of the *Culicidae* or mosquitoes. Vol. 3, 359 pp., illust., 17 pls. London, 1903.




MAP 1 — Known Portuguese localities for *Anopheles algeriensis* Theo. ① and *An. subalpinus* H. & L. ②.

*Anopheles lukisii*. Christophers, Indian J. med. Res., 4: 120, 1916.

*Anopheles bifurcatus* var. *algeriensis*. Parrot, Arch. Inst. Pasteur d'Algér., 1: 291-293, 1923.

*Anopheles algeriensis* var. *turkestani*. Schingarew, Russ. J. trop. Med., 2: 42-48, 1926.

Type-locality: Algeria.

MATERIAL EXAMINED. BOCA DO RIO (*circa* Budens, Algarve), 5 ♀ 1 ♂ (3 females and the male, *ex pupa*), 17 larvae, 3 larval pelts and 1 pupa plus 3 pupal pelts, 8.III.1981 and 2.V.1981.

DISTRIBUTION. *An. algeriensis* is typically a species of the Mediterranean Subregion (of the Palaearctic Region), widely distributed from Turkestan and Iran to Morocco and the Iberian Peninsula. In Spain, *algeriensis* is known from a few specimens in only six localities in the provinces of Alicante, Murcia and Granada, in the south [6].

Occasionally, however, *An. algeriensis* has been recorded from Central and Northern Europe, namely from northern Germany [7, 8] and southern England [9].

MAP 2 shows the now known distribution of *algeriensis* in the Iberian Peninsula.

TAXONOMIC NOTE. *An. algeriensis*, one of the four portuguese *Anopheles* species with uniformly dark wings, can be immediately distinguished from the others by the absence of a white frontal tuft of scales projecting between the eyes.

In the female palp of *algeriensis*, seg. III is obviously longer than segs. IV + V, this difference being apparently greater than in *An. claviger* and *An. petragnanii*.

The terminalia of our males are in quite good agreement with known discriptions, namely those by Senevet & Andarelli [10] and Marshall [9]. Coxites have only one parabasal spine, not two, inserted on a large, strongly sclerotized tubercle and with its tip somewhat expanded and bent. Like *An. claviger* and *An. petragnanii*, *An. algeriensis* also has the internal spine inserted near the apex of the coxite. The phallosome bears 2 or 3 pairs of leaflets at its tip. The harpagones are divided into 3 lobes, the outer one with 3 pointed spines, the mid lobe with 2 flattened bristles with curved tips, and the inner lobe with 3 thin, pointed bristles (Fig. 1).

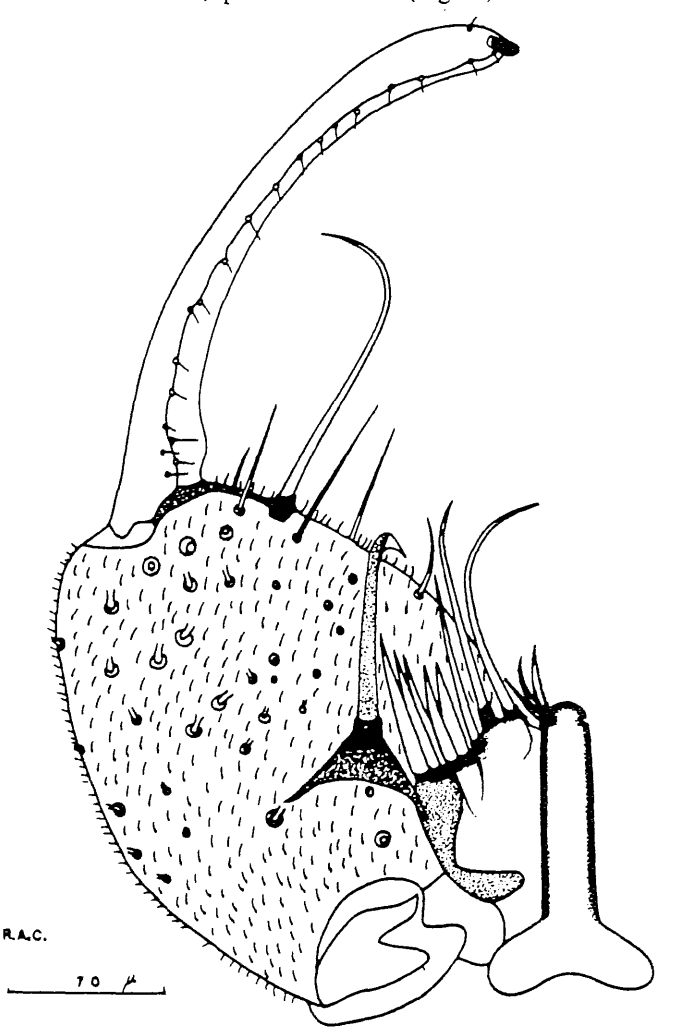
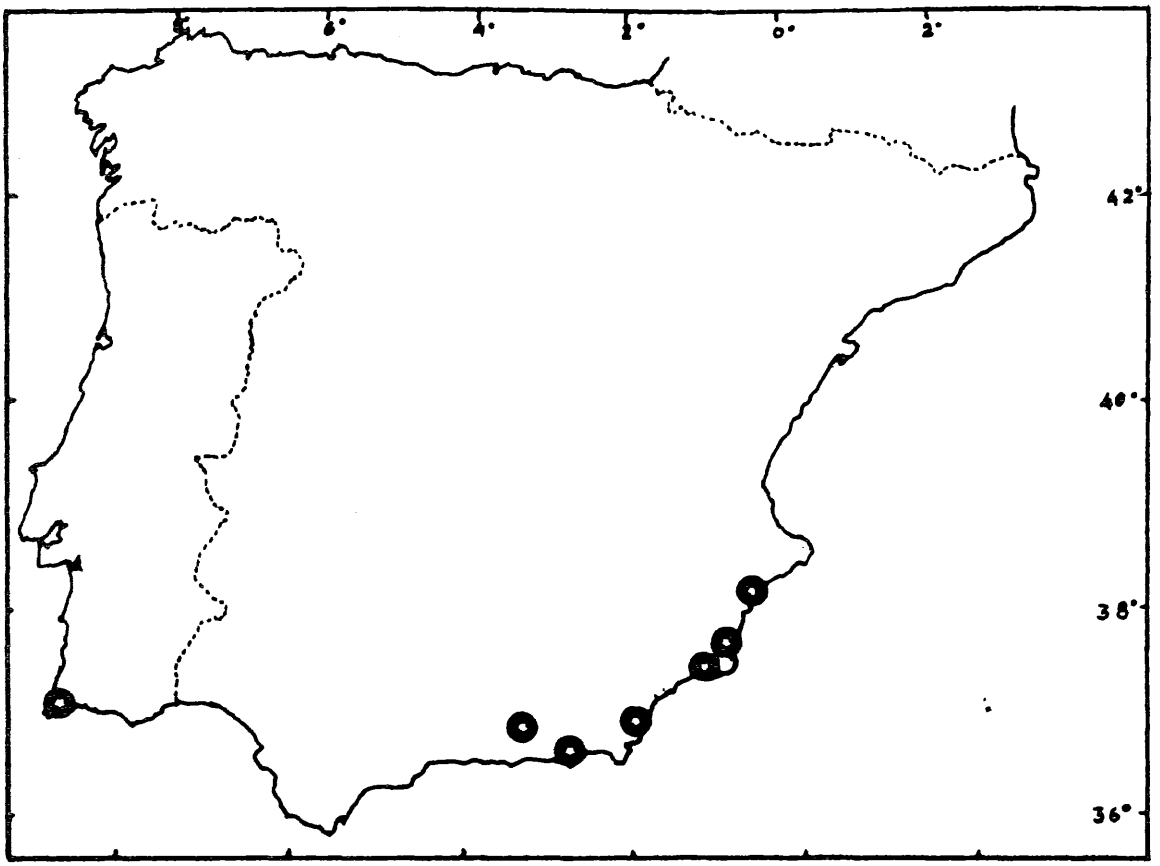



Fig. 1 — *Anopheles algeriensis* Theo. Male terminalia. Boca do Rio, Algarve.




MAP 2 — Known distribution of *Anopheles algeriensis* Theo. in the Iberian Peninsula.

The larva of *An. algeriensis* is very similar to that of *An. claviger* and *An. petragnanii*, though it differs in having the inner clypeal hairs (2-C) frayed with short lateral branches while in *claviger* and *petragnanii* seta 2-C is single or bifurcate distally. Besides, the number of branches of each seta 2-IV and 2-V in *algeriensis* is $1.57 \pm 0.63$, range $1-3$, (28 observations) while in our *claviger* larvae the mean number was 4.10 (range $3-5$) and was 2.50 (range $2-3$) in *petragnanii* larvae.

In *algeriensis* the dorsal plate of abdominal segment VIII is larger than distance between setae 1 (ratio $1.37 \pm 0.15$), while in *claviger* and *petragnanii* distance between palmate hairs is greater than width of dorsal plate. In that concerns the inner clypeal hairs ($2-C$), in *claviger* and *petragnanii* the basal tubercles of insertion are very close, almost touching, while in *algeriensis* they are separated by a distance of about the diameter of one of the basal tubercles.

Posterior clypeals ($4-C$) in our *algeriensis* were single in twelve instances and bifid in one larva, which confirms the observations of Senevet & Andarelli [11] on larvae from Mitidja (Algeria). In this connexion, it is worth to note that in *algeriensis* larvae examined by Buxton [12] in Palestine the posterior clypeals had $4-5$ branches. It is quite possible, if this is confirmed, that the Palestinian material belongs to an eastern *algeriensis* subspecies.

As it was already noted by Marshall [9], the dark markings of the head capsule form transversal bands in *algeriensis* and a dotted pattern in *claviger* and *petragnanii*.

Another interesting characteristic of the fourth instar larva of *An. algeriensis*, which also separates it from *claviger* and *petragnanii*, is the unusual development of the abdominal seta «0», with $5.50 \pm 0.69$ branches (range $4-7$) on segments IV and V ($n=20$).

Lastly, as it was stated by Shagudian [13], seta $1-X$ is inserted well within margin of saddle in *algeriensis* while it arises from a point on or just outside the margin of saddle in *claviger* and, as we could verify, also in *petragnanii*.

In the abdominal segments, the most important characteristics of the Portuguese larvae of *algeriensis* (mean, standard deviation, number of observation in parentheses and observed range, respectively) are as follows: seta 2-I with $6.75 \pm 1.67$ (8) branches, range $5-10$; seta 3-I with $1.13 \pm 0.35$ (8) branches, range $1-2$; seta 4-I with $8.13 \pm 2.48$ (8) branches, range $5-10$; setae 5-I and 6-I and 9-I always single; seta 7-1 with $5.00 \pm 1.29$ (7) branches, range $3-7$; seta 10-I with $1.17 \pm 0.41$ (6) branches, range $1-2$; seta 11-I with $2.50 \pm 0.55$ (6) branches, range $2-3$; seta 12-I with $5.60 \pm 0.34$ (5) branches, range $4-7$. Seta 0-II with $4.33 \pm 1.03$ (6) branches, range $3-6$; seta 1-II with $8 \pm 1.10$ (6) branches, range $6-9$; seta 2-II

with 3.83±0.75 (6) branches, range 3–5; seta 3-II with 3.40±0.89 (5) branches, range 3–5; seta 4-II with 4.33±0.82 (6) branches, range 3–5; seta 5-II with 4.67±1.16 (3) branches, range 4–6; setae 6-II and 7-II always single; seta 9-II with 4.20±0.45 (5) branches, range 4-5. Seta 0-III with 5.38±0.92 (8) branches, range 4–7; seta 1-III with 6.83±0.98 (6) branches, range 6-8, seta 2-III with 4.33±0.52 (6) branches, range 4–5; seta 3-III with 4.57±0.54 (7), range 4–5; seta 4-III with 4.75±1.28 (8), range 3–7; seta 5-III with 6.13±1.13 (8), range 5–8; seta 6-III with 4.75±0.71 (8), range 4–6; seta 7-III with 5.14±0.69 (7) range 4–6; seta 8-III with 2.14±0.38 (7) range 2–3; setae 9-III and 11-III always single; seta 10-III with 3.00±1.22 (6) branches, range 2–4. Seta 0-IV with 6.50±0.76 (8) branches, range 6–8; seta 1-IV with 6.43±1.40 (7) branches, range 5–8; seta 2-IV with 6.29±0.77 (7), range 5–7; seta 3-IV with 5.50±0.93 (8) branches, range 4–6; seta 4-IV with 2.63±0.52 (8) branches, range 2–3; seta 5-IV with 6.00±1.07 (8) branches, range 4–7; seta 6-IV with 3.50±0.77 (8) branches, range 2–4; seta 7-IV with 3.25±0.27 (8) branches, range 2–5; seta 8-IV with 1.88±0.64 (8) branches, range 1–3; setae 9-IV and 11-IV always single; seta 10-IV with 2.38±0.52 (8) branches, range 2–3. Seta 0-V with 6.29±1.38 (7) branches, range 5–9; seta 1-V with 5.29±0.95 (7) branches, range 4–7; seta 2-V with 5.71±0.49 (7) branches, range 5–6; seta 3-V with 2.57±1.13 (7) branches, range 1–4; seta 4-V with 3.57±0.29 (7) branches, range 3–4; seta 5-V with 5.38±1.60 (8) branches, range 3–7; seta 6-V with 3.33±0.52 (6) branches, range 3–4; seta 7-V with 4.25±0.46 (8) branches, range 4–5; seta 8-V with 1.75±0.71 (8) branches, range 1–3; seta 9-V single; seta 10-V with 1.75±0.71 (8) branches, range 1–3. Seta 0-VI with 4.38±0.52 (8) branches, range 4–5; seta 1-VI with 3.43±0.54 (7) branches, range 3–4; seta 2-VI with 5.17±0.75 (6) branches, range 4–6; seta 3-VI with 1.88±0.84 (8) branches, range 1–3; seta 4-VI with 2.38±0.52 (8) branches, range 2–3; seta 5-VI with 4.75±0.89 (8) branches, range 3–6; seta 6-VI with 1.63±0.52 (8) branches, range 1–2; setae 7-VI, 9-VI and 11-VI always single; seta 8-VI with 1.75±0.46 (8) branches, range 1–2. Seta 0-VII with 3.88±0.84 (8) branches, range 3–5; seta 1-VII with 3.17±0.41 (6) branches, range 3–4; seta 2-VII with 4.14±0.69 (7) branches, range 3–5; seta 3-VII with 2.80±0.84 (5) branches, range 2–4; seta 4-VII with 1.88±0.64 (8) branches, range 1–3; seta 5-VII with 3.75±0.89 (8) branches, range 2–5; setae 6-VII and 11-VII always bifid; setae 7-VII and 9-VII always single; seta 8-VII with 3.13±0.84 (8) branches, range 2–4; seta 10-VII with 2.71±0.49 (7) branches, range 2–3. Seta 0-VIII with 3.14±0.69 (7) branches, range 2–4; seta 1-VIII with 3.00±0.89 (6) branches, range 2–4; seta 4-VIII with 2.88±0.35 (8) branches, range 2–3.

According to that precedes, the unusual development and branching of seta «0» in the abdominal segments of *An. algeriensis* will permit an easy separation of this species either from *An. claviger, An. petragnanii* or *An. plumbeus*. Interestingly enough, a very similar situation arises also with seta 4-VIII which has 2 or 3 well developed branches in *algeriensis* and is minute and single in *claviger, petragnanii* and *plumbeus*.

In the pupa, the following are some of the particulars concerning the chaetotaxy. In the cephalothorax, seta 1-CT with a mean of 3.38±0.52 branches (range 3–4; number of observations = 8); seta 2-CT with 3.24±0.76 branches (range 3–5; n = 7); seta 3-CT with 3.86±0.90 branches (3–5; n = 7); seta 4-CT with 3.0±0.93 branches (2–4; n = 8); seta 5-CT with 7.50±1.23 branches (6–9; n = 6); seta 6-CT with 3.29±0.77 branches (2–4; n = 7); setae 7-CT and 8-CT always single, in 8 observations and seta 9-CT with 5.29±1.11 branches (4–7; n = 7).

The paddles (Fig. 2) in our 3 pupal pelts and 1 whole pupa, are as follows: (a) outline with the subtriangular shape characteristic of the species; (b) terminal seta single, somewhat curved outwards and about 0.19 (n = 7) length of paddle; (c) accessory hair with 5.63±0.52 short branches (range 5–6); (d) minute spicules present for about the posterior half of internal and external borders; (e) paddle index 1.42 (n = 8), range 1.18–1.58.

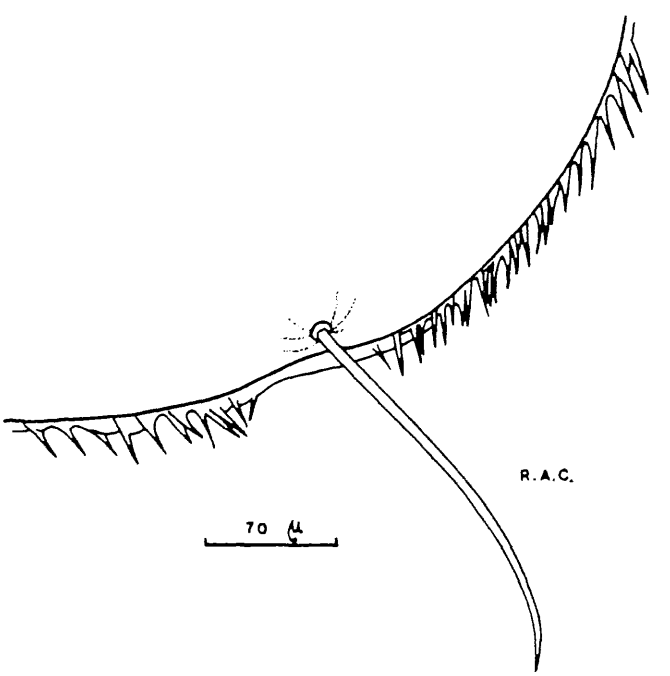



Fig. 2 — *Anopheles algeriensis* Theo. Pupal paddles (detail). Boca do Rio, Algarve.

BIOECOLOGICAL NOTE. Our larvae of *An. algeriensis* were found in May, in a shadded niche in the margins of a large swamp near the sea, with heavy growth of emergent vegetation (*Fragmites* sp., *Juncus* sp. and others), *Lemna* sp. and filamentous green algae (Figs. 3 and 4). The breeding water was relatively cold,

Fig. 3 — Collecting larvae of *Anopheles algeriensis* Theo. from a niche in the grassy margins of the swamp at Boca do Rio, Algarve.

Fig. 4 — General view of the swamp at Boca do Rio, breeding area of *Anopheles algeriensis* Theo.

limpid and clean, with pH = 7.0. Though its salt content was not examined, it was certainly slightly brackish water.

Larval *algeriensis* was found only in this niche, search for larvae being negative in all the other places tried along the swamp margins. No larvae of other mosquito species were also found.

The first *algeriensis* specimens we met, however, were a few hangry females which attacked the writers along the border of this swamp, early in the preceding month of March, at about 6.00 p.m. One of these females could be caught, as well as two other ones resting on the inner walls of a nearby abandoned well (one of these females escaped later). The search for *algeriensis* inside habitations in the area was negative.

No adults of other mosquito species were found along the swamp margins, in March. In May, however, only adults of *Aedes caspius caspius* could be found, either at rest in the same well or landing on man.

Interestingly enough, our present observations on the bioecology of *An. algeriensis* in southern Portugal agree closely with those of other Authors (Marshall [9]; Doby

*et al.* [14]; Rioux *et al.* [15]) in other countries, namely in that concerns the relatively rarity of the species and its scattered distribution, the characteristics of its breeding sites and the ethology of the adult females, including man-biting in the open.

3.2. *Anopheles (Anopheles) subalpinus* Hackett and Lewis, 1935

*In*: A new variety of *Anopheles maculipennis* in southern Europe. Riv. Malariol., **14**: 377-383, 1935 (as *Anopheles maculipennis* var.)

*Anopheles subalpinus*. Canalis *et al.*, Le specie del grupo *maculipennis* identificate col metodo citogenético dal focolai larvali in zona trattata com D. D. T. nelle provincie di Rovigo e Venezia. Venezia, 1954.

*Anopheles (Anopheles) melanoon subalpinus*. Knight & Stone, A Catalog of the Mosquitoes of the World, The Thomas Say Foundation, vol. 6, 611 pp., Baltimore, 1977.

*Anopheles melanoon*. White, Mosq. Syst., **10** (1): 13-44, 1978.

Type-locality: Albania

MATERIAL EXAMINED. ESCARIGO (in Serra da Marofa, *circa* Figueira de Castelo Rodrigo), 1 ♀ plus many eggs, 15.VIII.1981.

DISTRIBUTION. *An. subalpinus* occurs along the southern half of the Mediterranean Subregion (of the Palaearctic Region), from the Caspian Sea to the Iberian Peninsula, where it was known only from near Valencia, in southeastern Spain [16].

The present Portuguese record establishes the westernmost locality for this species, extending its distribution to the area of the Alto Douro basin, well known for its Mediterranean bioclimatic affinities.

TAXONOMIC NOTE. A detailed taxonomic analysis of forms *melanoon s. str.* and *subalpinus s. str.* within the *maculipennis* complex was already carried out by the present writers in a previous paper [3]. Summarizing, we may say that we treat both forms as full species on account of: (a) the distincteness of their eggs; (b) the apparent area of sympatry of both forms in southwestern Europe.

Our female could be identified with *An. subalpinus* H. & L., 1935 owing to a quite characteristic oviposition of 131 eggs, all of them with dark decks showing a pattern of darker areas (mainly two bars at about the extremes of the floats, and at poles), coupled with smooth floats and a «float index» (ratio of length of floats to egg's length) about 0.40 or over.

BIOECOLOGICAL NOTE. Our sole *subalpinus* female was caught along with many other adults of the *maculipennis* complex resting inside a stable with donkeys in the village of Escarigo, near de Portugal-Spain eastern border, at about 10.00 a.m. Ten gravid or half-gravid females of these *An. maculipennis sensu lato* adults were isolated for ovipositions. Unfortunately, however, all of them but three died before laying eggs. Upon the examination of these three ovipositions, it was concluded that one of the females was clearly *An. subalpinus* while the other two were characteristic *An. atroparvus*.

No other mosquito species was found inside the stable, in association with these two members of the *maculipennis* complex.

## 4. RELATION TO DISEASE

According to Horsfall [17], oocists of malaria parasites were found in wild *An. algeriensis* while a malaria epidemic in Algeria was reported by Sergent & Sergent (*fide* Horsfall, *op. cit.*) where *algeriensis* was the only anopheline present.

Neverthless, there seems to be a general agreement as to the usually negligible role of *An. algeriensis* in malaria epidemiology. In favour of this view, are cited several observations on the bioecological characteristics of the species. One of these is the apparently marked zoophily of *algeriensis* with an anthropophilic index, according to Barber & Rice [18], of only about 0.04 (as against 0.39 for *An. sacharovi*). Besides, *An. algeriensis* is also thought to have a low longevity (Horsfall, *op. cit.*), to be highly exophagic and to occur usually at low densities.

In any case, while the vectorial capacity of *An. algeriensis* is not examined in more detail, it must be considered as potencially dangerous whenever it occurs with a minimum of density. In such places, given the easy with which *algeriensis* bites man in the open, it is possible that, as stated by Hedeen [19], it «be of more importance than was formerly believed».

In that concerns *An. subalpinus*, it is thought to be a strictly zoophilic mosquito [20, 21], without any importance as a potencial carrier of human disease. This means that in those areas, if there is any, in which the *maculipennis* complex is represented by only this member there is no danger of malaria reintroduction.

## REFERENCES


1 — RIBEIRO, H.; RAMOS, Helena C.; PIRES, C. A. & CAPELA, R. A. — «Research on the mosquitoes of Portugal (*Diptera, Culicidae*). I — Four new culicine records». *An. Inst. Hig. Med. Trop.*, **5** (1/4): 203-214, 1977-1978.

2 — RIBEIRO, H.; RAMOS, Helena C.; CAPELA, R. A. & PIRES, C. A. — «Research on the mosquitoes of Portugal (*Diptera, Culicidae*). III — Further five new mosquito records». *Garcia de Orta*, Sér. Zool., **6** (1-2), 51-60, 1977.

3 — RIBEIRO, H.; RAMOS, Helena C.; PIRES, C. A. & CAPELA, R. A. — «Research on the mosquitoes of Portugal (*Diptera, Culicidae*). IV — Two new anopheline records». *Garcia de Orta*, Sér. Zool, **9** (1-2): 129-138, 1980.

4 — CAPELA, R. A.; RIBEIRO, H.; PIRES, C. A.; RAMOS, Helena C. & RIBEIRO, MARIA, E. B. — «Research on the mosquitoes of Portugal (*Diptera, Culicidae*). V — Two new culicine records». *Arq. Mus. Boc. (Série A)*, **2** (2): 13-27, 1983.

5 — BELKIN, J. N. — «The mosquitoes of South Pacific (*Diptera, Culicidae*)». University of California Press, Berkeley. 2 vol, 608 pp. and 412 ph., 1962.

6 — CLAVERO, G. & VIAMONTE, R. — «Nota sobre la distributión del *Anopheles algeriensis* en España». *Rev. San, Hig. Públ.*, **22**: 101-104, 1948.

7 — MARTINI, E. — *In:* Lindner, E., «*Die Fliegen der Palaearktischen Region*», 33 (11, 12), «*Culicidae*». E. S. Verlag., Stuttgart, 1929-1931.

8 — PEUS, F. — *In*: RIOUX, J. A.; SINEGRE, G.; GROSET, H. & GABINEAU, A. — «*Anopheles (A.) algeriensis* Theobald, 1903 en Languedoc méditerranéen». *Ann, Parasit. hum. et comp.* (Paris), **41** (1): 91-100, 1966.

9 — MARSHALL, J. F. — «The British Mosquitoes». The Trustees of the British Museum, London, 1938.

10 — SENEVET, G. & PRUNNELLE, M. — «Les Anophèles d'Algérie. Leur diagnose d'après l'armure génitale des mâles». Arch. Inst. Pasteur d'Algérie, **6**: 468-485, 1928.

11 — SENEVET, G. & ANDARELLI, L. — «Les *Anophèles* de l'Afrique du Nord et du Bassin Méditerranéen». *Encyclopédie Entomologique*, Sér. A., **33**, Paris, 1956.

12 — BUXTON, P. A. — «*Anopheles* larvae from Palestine and elsewhere.» *Bull. ent. Res.*, **14**: 75-82, 1924.

13 — SHAHGUDIAN, E. R. *In*: RUSSEL, P. F.; WEST, L. S.; MANWELL, R. D. & MACDONALD, G. — «Practical Malariology», 2nd E., XV + 750 pp., illus. London, 1963.

14 — DOBY, J.-M.; RAULT, B. & DAVID, F. — «*Theobaldia (Culicella) litorea* (Shute 1928) et *Anopheles (Anopheles) algeriensis* Theobald 1903, dans l'ouest de la France, contribution à l'étude écologique de ces deux espèces». *Ann. Parasit. hum. comp.*, **35** (1-2): 174-189, 1960.

15 — RIOUX, J.-A.; SINEGRE, G.; CROSET, H. & GABINEAU, A. — «*Anopheles* (A.) *algeriensis* Theobald, 1903 en Languedoc méditerranéen». *Ann. Parasit. hum. et comp.*, **41** (1): 91-100, 1966.

16 — FRIZZI, G. — «Studio della fauna anofelica nella piana di Valencia (Spagna)». *Bolletino di Zoologia*, **23** (2): 405-411, 1956.

17 — HORSFALL, W. R. — «Mosquitoes — their bionomics and relation to disease». The Ronald Press Company, New York, 1955.

18 — BARBER, M. A. & RICE, J. B. — «Malaria studies in Greece. The Malaria infection rate in nature and in the laboratory of certain species of *Anopheles* of east Macedonia». *Ann. Trop. Med.* **29**: 329-348, 1935.

19 — HEDEEN, R. A. — «A note on the occurrence of *Anopheles algeriensis* Theobald in western France». *Mosquito News* **17** (2): 97-98, 1957.

20 — BATES, M.; BEKLEMISHEV, W. N. & LA FACE, L. — «Anophelines of the Palaearctic Region» *in* Boyd, M. F., «Malariology», W. H. Saunders Company Philadelphia and London, 1949.

21 — POSTIGLIONE, M.; SMIRAGLIA, C. B.; LAVAGNINO, A.; GÖKBERK, C. & RAMSDALE, C. — «A preliminary note on the occurrence in Turkey of the *subalpinus* form of the *A. maculipennis* complex». *Riv. Parassit.* **31** (2): 155-158, 1970.