Bulletin de l'Institut Scientifique, Rabat, section Sciences de la Vie, 2012, n° 34 (2), p. 115-120.

On the presence of *Tenodera rungsi* Uvarov, 1935 and *Apteromantis bolivari* (Werner, 1929) in Morocco with considerations on the ecology and conservation of some North African mantids (Insecta: Mantodea)

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Abstract. During an expedition held in 2011 in North Morocco, living populations of very rare mantids like *Tenodera rungsi*, *Apteromantis bolivari* were encountered and recorded, confirming their presence after more than half a century of silence. Collected specimens, compared with other species by their taxonomy and biogeography, confirmed old records and descriptions and gave important information on the ecology of mantids in the Mediterranean area. The rarity, the reduced distribution and the poor knowledge on Moroccan mantids lead to some considerations on the conservation problems and priorities about these insects.

Keywords: Morocco, mantids, ecology, taxonomy, conservation, *Ameles, Apteromantis, Mantis, Rivetina, Sphodromantis, Tenodera.*

Sur la présence de *Tenodera rungsi* Uvarov, 1935 et d'*Apteromantis bolivari* (Werner, 1929) au Maroc avec des données sur l'écologie et la conservation de certains mantides nord-africains (Insecta : Mantodea).

Résumé. Au cours de l'expédition effectuée dans le Nord du Maroc en 2011, des populations vivantes de Mantes, beaucoup rares, comme *Tenodera rungsi, Apteromantis bolivari,* ont été observées et notées en confirmant ainsi leur présence après plus d'un demi-siècle de silence. La comparaison des spécimens collectés, sur le plan taxinomique et biogéographique, avec d'autres espèces déposées dans différentes collections renforce les descriptions et les données anciennes et apporte aussi des informations importantes sur l'écologie des Mantes méditerranéennes. La rareté, la distribution localisée et les connaissances insuffisantes des Mantes marocaines poussent à faire des considérations à propos des problèmes de conservation et des priorités de ces insectes.

Mots clés: Maroc, Mantes, écologie, taxinomie, conservation, *Ameles, Apteromantis, Mantis, Rivetina, Sphodromantis, Tenodera.*

INTRODUCTION

Between May and June 2011, an entomological expedition was held in Morocco as a part of the Apteromantis Project, a scientific research promoted by the Grasshopper Specialist Group, Species Survival Commission of the International Union for Conservation of Nature in cooperation with the University Mohammed V - Agdal of Rabat. The purpose of the expedition was to collect information about some Mediterranean mantids, in particular to confirm the presence in Morocco of *Apteromantis bolivari* Werner, 1929, and to collect some specimens suitable for a molecular comparison with *Apteromantis aptera* (Fuente, 1894) endemic species of the Iberian peninsula. The collecting localities were distributed in different natural environments from Fès (type locality of *A. bolivari*) to Rabat and from Rabat to Casablanca (Had Kourt region, type locality of *T. rungsi*).

Since available collecting records of many species of Moroccan mantids are old or poorly significant, other mantids encountered during the expedition were examined to improve and update the knowledge on their distribution, ecology and taxonomy. *A. bolivari* is a wingless Mediterranean mantid known only for few tens of adult specimens collected by Bolivar, Ebner, Morales Agacino and Werner before 1941, now preserved in Museo Nacional Ciencias Naturales of Madrid, Naturhistorisches Museum of Wien, Natural History Museum of London and Zoologisches Museum Hamburg. The last known confirmed record of *A. bolivari* was a juvenile specimen collected in 1948 in Morocco and preserved in the National Museum of Natural History at the Scientific Institute (University Mohamed V -Agdal, Rabat).

On the opposite, only four confirmed records are known for *Tenodera rungsi* 1935 Uvarov: the female holotype collected in 1933 near Rabat, a female collected in 1932 in Port-Lyautey (now Kénitra, 30 km NW of Rabat) and three males collected in the valley of Oued Cherrat (30 km SW of Rabat) cited by Rungs (1952). *Tenodera* is probably one of the most widespread and important genus of mantids, distributed from tropical to temperate areas of Asia and Oceania to central Africa and introduced in North America (Battiston *et al.* 2010). In 1935, Uvarov described the species *T. rungsi* from Morocco using the only specimen known at the time, the female holotype and citing another specimen of this species from the Had Kourt region, with the same peculiar morphology, observed but never collected. Except for these few occasional encounters, the presence of this species was never confirmed in a stable population and the hypothesis of a polymorphism of the widespread African species *T. supertitiosa* Fabricius, 1781, was considered. However, Uvarov underlined in his description something more than the validity of some subjective external characters: the remarkable bio-geographic implication on the natural history of this group. This mantis has a generalist morphology well adapted to

live from tropical to temperate grasslands, but it is absolutely not adapted for the Sahara desert; this is well demonstrated by the strict sub-Saharan distribution of the only other African species *T. supertitiosa*. By this point of view, the presence of a *Tenodera* on the northern side of the desert can be a precious source of information on insects' migration routes and the desertification of the Sahara.

MATERIAL AND METHODS

All the localities from Fès to Casablanca were examined under daylight from late morning to sunset. Sunny weather and favourable climate conditions made possible a clear and detailed exam of the low vegetation in the areas examined, chosen by experience and literature (Battiston *et al.* 2010, Battiston & Fontana 2010, Pascual 2005, Peinado & Mateos 1998, Werner 1932) as suitable for mantids and generally orthopteroid insects.

Museum Abbreviations

BMNH: The Natural History Museum, London, United Kingdom.
LSL: Linnean Society, London, United Kingdom.
MNMS: Museo Nacional de Ciencias Naturales, Madrid, Spain.
NHMW: Naturhistorisches Museum Wien, Vienna, Austria.
NMNH IS: National Museum of Natural History, Institut Scientifique (University Mohammed V-Agdal, Rabat, Morocco).
UNICT: Università degli studi di Catania, Catania, Italy
ZMB: Museum für Naturkunde, Humboldt-Universität, Berlin, Germany.

RESULTS

Ameles maroccana Uvarov. 1931[1930]. Bull. Soc. Sci. Nat. Maroc. 10:210
Ameles abjecta maroccana Morales Agacino, 1948. Eos, Madr. 24:358
Ameles maroccana Obertegger U. & Agabiti B. 2012

Typus: Holotypus f#, BMNH; Allotypus *A. a. maroccana* m#, MNMS.
Morocco: Moulay-Yakoub, 30-V-2011, leg. R. Battiston, coll. Battiston, 1 m# juv (4 molts to the adult stage) (Fig.1- c).
Notes: the male collected as juvenile and reared till the adult stage showed the typical characters of the *A. maroccana.* However a comparison with the allotypus described by Morales Agacino as *Ameles abjecta maroccana* and preserved at the MNMN showed the same reduced wings and tegmina that do not reach the end of the abdomen. This character is not cited by Morales Agacino and the length of the flight organs reported in the original description seems to be overestimated. Now *A. abjecta* is considered a synonym of *A. spallanzania* (Battiston *et al.* 2010) but *A. maroccana* is also considered a valid and distinct species even if the flight organs have not been used as a discriminative character (Badih & Ruiz 1999, Obertegger & Agabiti, 2012). Since the length of the wings is a very important diagnostic character in the group of the Amelinae further analyses need to be done to confirm the real separation of these species and their relationship with other close but poorly known species from Morocco like *A. moralesi* Bolivar 1936.

Apteromantis bolivari **(Werner, 1931)**
Pseudoyersinia bolivari Werner, 1929. Sber. Akad. Wiss. Wien 138: 147.
Typus: Typus f# NHMW.
Morocco: Fès Zalagh, 29-V-2011, leg. Battiston, coll. Battiston 3m# 2f#; Fès Zalagh, 29-V-2011, leg. R. Battiston, IREC 1f#, 2 oothecae; Fès Zalagh, 29-V-2011, leg. R. Battiston, coll. NMNH IS 1f#; Sidi Allal El Bahraoui, 31-V-2011, leg. Battiston, coll. Battiston, 1f#. (Fig.1- a)

Mantis religiosa religiosa **(Linnaeus, 1758)**
Gryllus (Mantis) religiosus Linnaeus, 1758. Syst. Nat. (ed. 10) 1: 426.
Mantis sancta Fabricius, 1787. Mant. Ins. 1: 228.
Mantis striata Fabricius, 1793 Entomologia Sistematica. Mantodea & Phasmatodea.-Prost, Hafniae, 2: 20, Copenhagen.
Mantis maroccana Thunberg, 1815. Mem. Acad. Sci. St. Petersb. 5: 287-299.
Mantis pia Serville. 1839. Hist. Ins. Orth.: 193.
Mantis radiata Fischer v. Waldheim, 1846. Orth. Ross. 101.
Mantis capensis Saussure, 1872. Miss. Mex., Zool. 6: 46-47.
Mantis griveaudi Paulian, 1959: 33-36.
Mantis religiosa religiosa (Linnaeus, 1758), In: Bazyluk, 1960. Ann. Zool. 18(15): 231-272.

Typus: Holotypus 1 m#, 3 f#s LSL.
Notes: observed but not collected in almost all the localities from Fès to Casablanca from 29-V-2011 to 1-VI-2011, juveniles stage: 2-5 (Fig.1- d).

Rivetina baetica tenuidentata **(La Greca & Lombardo, 1982)**
Mantis baetica Lucas H., 1849, expl. Algérie, Zool., 3:11. Faune ent. Andalous 2:19.
Mantis pallasii Fieber. 1854. Lotos 3:95
Iris (Fischeria) baetica Saussure, 1869. Mitt. schweiz. ent. Ges. 3: 64.
Fischeria baetica Saussure, 1869. In: Stal, 1871. Ofvers. K. VetensAkad. Forh. Stockh. 28(3):398
Rivetina fasciata Thunberg, 1815. In: Chopard, 1943. Faune Emp. fr. 1:81
Rivetina baetica tenuidentata La Greca & Lombardo, 1982. Animalia (Catania) 9(1-3): 353.

Typus: Holotypus m#, Allotypus f#, Paratypi 1 m#, 1 f#, UNICT.
Morocco: Fès Zalagh, 29-V-2011, leg. R. Battiston, coll. Battiston, 1 f# juv (3 molts to the adult stage).
Notes: 4 other juveniles were observed in the locality, but not collected (Fig.1- e).

a

b

c

d

e

f

Fig1 a) *Apteromantis bolivari* (adult); b) *Sphodromantis viridis* (juv.); c) *Ameles maroccana* (juv.); d) *Mantis religiosa* (juv.); e) *Rivetina baetica* (juv.); f) *Tenodera rungsi* (juv.). Photos by R. Battiston.

***Sphodromantis viridis vischeri* (Werner, 1933)**
Gryllus viridis Forskål, 1775. Descr. An. 81.
Mantis guttata Thunberg, 1815. Mem. Acad. Sci. St. Petersb. 5: 290.
Mantis (Stagmatoptera) bimaculata Burmeister, 1838. Handb. Ent., Burm. 2: 537.
Sphodromantis cavibrachia Werner, 1915. Arch. Naturg. 81A(5):82 (*nomen nudum*)
Hierodula bioculata (Burmeister, 1838) In: Saussure, 1869. Mitt. schweiz. ent. Ges. 3: 67.
Sphodromantis guttata (Thunberg, 1815). In: Westwood. 1889. Revis. Mantid. 14.
Stagmatoptera vischeri Werner, 1933. Verh. naturf. Ges. Basel 43: 3.
Sphodromantis viridis vischeri (Werner, 1933) In: Roy, 2010. Bull. Soc. Ent. France, 115 (3): 345-366

Typus: Typus 3 m#, 6 f# ZMB.
Morocco, road from Khémissat to Rabat, 14 km W of Tiflet, 260m, leg. R. Battiston, coll. 1 m# juv (4 molts to the adult stage) (Fig.1- b).
Notes: other juveniles (2-3 stage) of this species were encountered from Fès to Casablanca in different localities, but not collected.

***Tenodera rungsi* Uvarov, 1935**
Tenodera rungsi Uvarov. 1935. Bull. Soc. Sci. Nat. Maroc. 15: 1.

Typus: Holotypus f#, BMNH.
Morocco: road from Bouznika to Casablanca, 0m, 31,V,2011 leg. R. Battiston, coll. Battiston 1 m#, 5 f# juveniles (1-2 molts to the adult stage) (Fig.1- e).
A total of 10 juveniles were observed in the area, concentrated in a small area of not more than 0.03 km^2. Two opened oothecae of the past generation have been found in the same area.

DISCUSSION AND CONCLUSION

After a very long time of uncertainty, a population of *T. rungsi* has been discovered in a small area on the west coast south of Rabat (Fig. 2). This is a very important finding because it confirms not only the validity of Uvarov's records, but also the presence of the diagnostic characters he described. A preliminary morphological comparison on the specimens we collected in Morocco and three females of *T. supertitiosa* from Central Africa, suggests a remarkable separation between them, especially in the shape of the female pronotum. However, more detailed morphological and molecular analyses and a comparison with a larger series of individuals are needed to confirm the rank of independent species or subspecies.

Finding *A. bolivari* in its type locality (Fig. 2) after 60 years from its last confirmed collecting record is also important to confirm the presence of a stable and sedentary population on the Zalagh Mountain (Fès).

Collecting mantids at the end of the spring gives also an interesting point of view on the life-cycle of these insects in Northern Africa. Encountered species have shown almost the same life-cycle than the Southern Europe ones, even in a region with a considerably warm and dry Mediterranean climate. Most species (*A. maroccana, M. religiosa, R. baetica, S. viridis vischeri, T. rungsi*) seem to maintain an annual life cycle with a growth and development of nymphs during spring and an adult stage reached in summer. *T. rungsi* was found in a very late juvenile stage but in that area also *M. religiosa* was considerably older than the individuals encountered in other places far from the west coast, and the influence of the sea on climate may play a role in it. The only species encountered at the end of its life cycle is *A. bolivari* which shows a similar life cycle of its relative *A. aptera* in Spain (Pascual 2005), where eggs are laid at the beginning of summer, and it overwinters as nymph, even if Torres *et al.* (2011) suggests a more flexible life-cycle.

In Europe, the genus *Empusa* is the only other one with a similar life-cycle but no individuals of this genus were found in our expedition, suggesting that the life cycle of this mantids had just ended (according also to the collecting records of the specimens preserved in the NMNH IS, with Chopard 1943 and Faucheux 2011) or it is simply a very uncommon insect.

The rediscovery of vital populations of so rare and poorly known mantids leads to some considerations on their knowledge and by consequence to their conservation.

A. bolivari seems to be an uncommon insect in Morocco but it seems rather widespread in the whole country, and adaptable to live from high grasses to arid sandy grounds interspaced by bushes. This may have helped this mantis to survive for such a long time to the pasture and agriculture impacts. On the contrary, the only known population of *T. rungsi* seems to be localized in an extremely small area on the west coast. Its presence after 78 years from its first observation seems to indicate that this locality is a very suitable environment for this species, but the extremely reduced distribution makes it vulnerable to environmental changes. This species was observed in a small wild and uncultivated field, surrounded by regimented ones where it was not present. Even if the ecology of this species is completely unknown, mantids of similar groups (i.e., *Mantis religiosa,* present as well in that area) usually can live only in wild and natural habitats, and are absent in cultivated or regimented fields (Battiston & Fontana 2010). The natural habitats are generally still available in Morocco with huge plant biodiversity and even in the cultivated areas where almost no chemicals are used to fight pests or herbs. So those areas are probably still adequate to mantids for foraging. The high density of individuals found in that locality and the total absence in the surroundings lead us to suppose a similar limitation for *T. rungsi*, still preserved thanks to a recent development of the agriculture. Le Coz (1964) reported indeed from the Gharb region (including Had Kourt) that in the beginning of the last century, the occupation of the space was very loose and often sporadic because of the low density of Moroccan population, around 7 millions in 1935 (Escallier, 1984), and the indigence of the used techniques in agriculture. This situation worsened

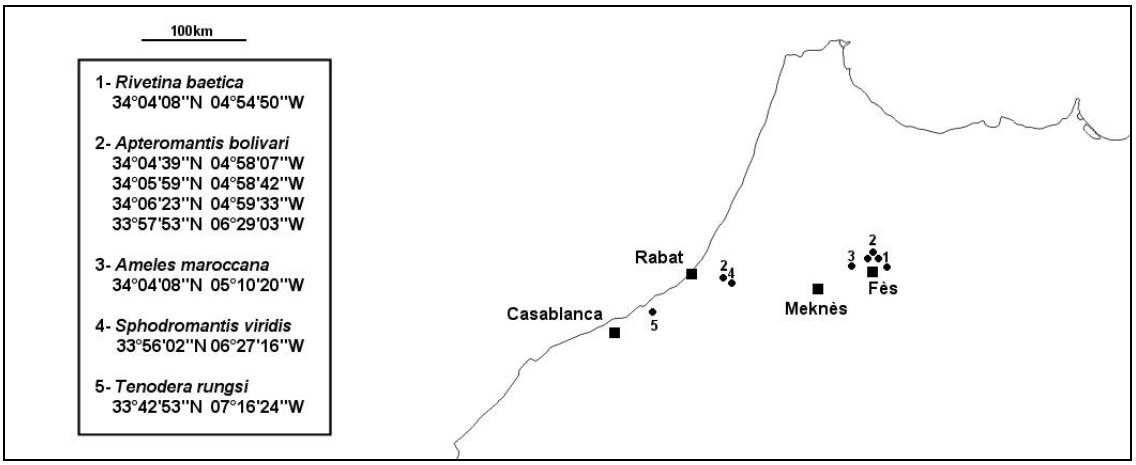

Figure 2. Map of northern Morocco with the collecting localities, species collected and nearest cities.

in the region by the world crisis of the thirties and in spite of the colonization period the agriculture knew little investments, so pristine areas were readily available. The agriculture started to be developed at large scale in the Gharb region after the second war and especially in mid-fifties (Le Coz 1964). Nowadays, the Moroccan agriculture has become intensive and uses modern techniques to satisfy the needs of more than 30 millions of the local population (Haut Commissariat au Plan, 2005). Hence, only some patches around the cultivated areas contain some plant biodiversity and are then still adequate to mantids for food and shelter which explains the fragmentation of the population of these insects. The high density of individuals found in that locality and the total absence in the surroundings lead us to suppose a similar limitation for *T. rungsi*, still preserved in spite of a recent development of the agriculture.

At present, except for local initiatives, only one species of mantis (*Apteromantis aptera*) is protected by international laws, considered as a Lower Risk/Near Threatened species in the International Union for Conservation of Nature (IUCN) red-list and inserted by the European Community in the annex II of directive 92/43/CEE. However, *A. aptera* is a rather well studied insect and other less known mantids seem to be much more close to extinction (Battiston *et. al.* 2010). *Tenodera rungsi* and probably other mantids of Morocco should be in great priority of conservation under legal initiatives. Few days of collecting in the northern part of Morocco showed that there is a great need of further studies, to complete the poor knowledge on the ecology and taxonomy about the mantids of this country, to achieve fast and effective conservation measures. We recommend at first to preserve the area where *T. rungsi* still exists from degradation at least by fencing some square metres of its habitat.

Acknowledgments

This manuscript is the result of an international project promoted during 2011 by the IUCN/SSC Grasshopper Specialist Group and financed by the Mohamed bin Zayed Species Conservation Fund. We would like to thank the Scientific Institute (University Mohammed V-Agdal) in the persons of Pr. Ahmed El Hassani (the director) and Pr. Mohamed Fekhaoui (the chairman of zoology and animal ecology department) for support and hospitality in consulting mantids collections, José Ramon Correas for his help in consulting and verifying the type material preserved at the Museo Nacional de Ciencias Naturales in Madrid, Raffaele Negrin for his supporting in the field work, Andra Meneganzin for her translations from the original manuscripts and Roger Roy from the Muséum National d'Histoire Naturelle of Paris for his valuable comments and suggestions on the manuscript.

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Manuscript received 1st October 2012
Accepted 12 December 2012