Crau plain grasshopper

A Strategy for its Conservation 2015-2020

Edited by Axel Hochkirch, Laurent Tatin & Mark Stanley Price

IUCN SSC Species Survival Commission

Conservatoire d'espaces naturels Provence-Alpes-Côte d'Azur

Réserve Naturelle COUSSOULS DE CRAU

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The Strategy for the Conservation of the Crau plain grasshopper is edited in English and French.

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INTRODUCTION

Western Europe, and particularly France, is known for its highly diverse landscapes. From the high mountains (Alps, Pyrennees, Appenines, etc.) to the Mediterranean coast the high biodiversity value has been recognised for long. In southern France, there is a landscape that remains mostly unkown by a large audience but considered as a priority in terms of conservation (Habitat Directive CEE 92/43) and classified as National Nature Reserve in 2001 (decree 8 October 2001 NOR ATEN0190054D): the Crau plain. It is the former delta of the Durance River, located at the east of the Rhône valley and the Camargue delta (Fig. 1). The natural habitat is a mediterranean steppe fragmented in several patches that total 11 000 ha (Fig. 2), the remainder of the 50 000 ha that existed in the XVIth Century. The landscape is a semi-arid pasture similar to dry grasslands of southern Spain and North Africa. The soil surface is covered by stones transported by the Durance River between 650,000 and 35,000 years BP. The climate is Mediterranean with high inter-annual variability, low rainfall (400–500 mm per year) with maxima in spring and autumn, long hot summers and mild winters (mean annual temperature: 14°C). On average, the sun shines 3,000 hours per year and the very strong predominant wind blows from the north–west about 90 days per year (at least 30km/h). Thus, evapotranspiration is high, and June, July and August are considered as arid months (Devaux, 1983). This habitat, composed mainly by *Brachypodium retusum* and *Thymus vulgaris* in association with *Asphodelus fistulosus* and *Stipa capillata,* is named "coussouls" and was formed by climatic conditions, ground structure and sheep grazing which it has supported for 4000 years (for details see Tatin *et al.* 2013).

Figure 1: View of the Crau dry grassland (©J-F. Alignan)

The Crau has been considered for its importance in terms of steppe land birds as it shelters the only French population of Pin-tailed Sandgrouse (*Pterocles alchata*), 95% of the Calandra lark (*Melanochoripha calandra*) population, nearly half the population of Little bustard (*Tetrax tetrax*) and Lesser Kestrel (*Falco naumanni*). Dragonflies are also well known as one canal supports 72% of the species identifiied for France. Sheep grazing and archaeological remains of Roman sheepfarms are two well recognised values. On the other hand, Orthopterans belong to the most important primary consumers of this ecosystem and they represent the main prey for threatened insectivores like Little bustards, Stone curlew, Little owl, Lesser kestrel and Ocellated lizard. Nevertheless they suffer from a gap in knowledge which is especially true for one endemic sub-species: the Crau Plain Grasshopper (*Prionotropis hystrix rhodanica*).

Figure 2: Natural National Reserve of the Crau (green polygons). The white area denotes a huge military zone (natural habitat and buildings).

Invertebrates, unlike mammals and birds, have not benefited from strong consideration since the expansion of nature conservation studies and actions. The European strategy for the conservation of insects (Haslett 2007) mentioned that vertebrates represent only 6% of species richness, but controversially reintroductions concerned only 8% the invertebrates. Strategies planning for their conservation are still scarce (Species Conservation Planning Sub-Committee, Chairman: Mark Stanley Price). The IUCN SSC Specialist Group in charge of Orthoptera was created only in 2010 (Chairman: Axel Hochkirch) and status assessment of the whole species is still under process. Many studies focused on locust control have been conducted but few were oriented towards Orthopteran conservation. Today an increasing interest occurs because some of the species are threatened and on the edge of extinction. The Crau Plain Grasshopper is a flagship of this situation. The species was

discovered in 1923 by Uvarov and the two main studies on its ecology and bionomics[1] were conducted 70 years later, between 1995 and 2001 by Foucart and Streiff. Today, the species is facing a high extinction risk identified thanks to the alert given by Foucart and the study driven by the Crau National Nature Reserve (L. Tatin). A conservation strategy which will be integrated with the Crau plain management plans and fill the identified gaps is now crucial for the species survival.

STATUS REVIEW

Species description

Systematics / Taxonomy

The Crau Plain Grasshopper, *Prionotropis hystrix rhodanica* (Fig. 3), is a large grasshopper, endemic to the Crau (southern France). It belongs to the family Pamphagidae (Stone Grasshoppers) and the subfamily Thrinchinae. The genus *Prionotropis* consists of four known species, *P. appula* from Italy and Greece, *P. flexuosa* from Spain, *P. maculinervis* from Anatolia and *P. hystrix* from southern France and the Dalmatian coast (Eades et al. 2013). The species *Prionotropis hystrix* is subdivided into three subspecies: (1) *P. hystrix hystrix*, the nominate subspecies, which occurs along the Dalmatian coast from NE Italy, via Slovenia, Croatia and Bosnia to Serbia; (2) *P. hystrix azami*, which occurs in southern France (Provence) and (3) *P. hystrix rhodanica*, endemic to the Crau (Eades et al. 2013).

There is genetic evidence (Berthier 2000) that the nominate subspecies *P. h. hystrix* is strongly differentiated from *P. h. azami* and *P. h. rhodanica* (Fig. 4). These may thus be divided in the future into two species: *P. hystrix* from Dalmatia and *P. azami* from France. *P. h. rhodanica* would in this case become a subspecies of *P. azami*; i.e. *P. a. rhodanica*, but it is unlikely that *P. h. rhodanica* is a separate species.

Figure 3: Prionotropis hystrix rhodanica ©A. Hochkirch

[1] Bionimics is defined as the study of an organism and its relation to its environment.

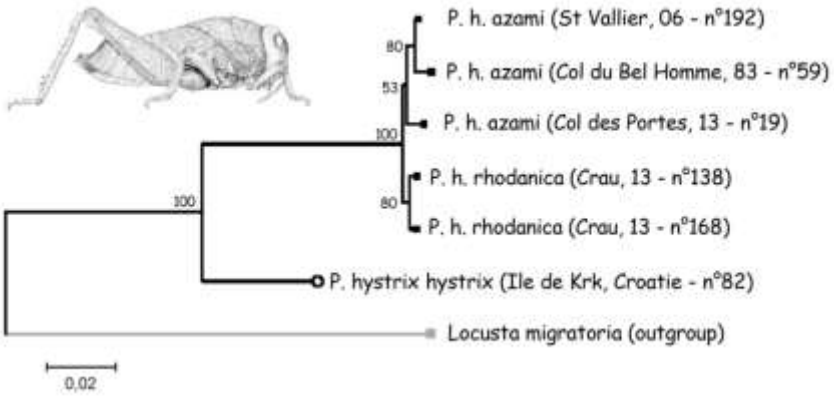

Figure 4: Phylogenetic tree for Prionotropis hystrix based upon 690 bp of cyt B (from Berthier 2000).

Biology & Ecology

P. h. rhodanica has a large body size (males 31 mm, females 45 mm). However, due to its cryptic colouration (stone-like appearance) and its reluctance to jump (they usually do not move when disturbed) the species is very elusive (Fig. 5 & 6). The song is rarely heard and therefore is not useful for bioacoustic monitoring.

Figure 5: P. h. rhodanica is the largest grasshopper species in the Crau ©L.Tatin

Figure 6: Copulation. Male body size is smaller than female's one ©A. Hochkirch.

The species has a univoltine life cycle. Nymphs hatch in April and become adult at the end of May. Adults can be found until July (Fig. 7). The clutch size is small (16 ± 2 eggs, Fig. 8). The development time of the eggs remains unknown, but in most Orthoptera species the eggs hibernate once and nymphs hatch in the following year. After the very cool and rainy spring in 2013 the adult season started approximately two weeks later (Fig. 9, Schuld 2013).

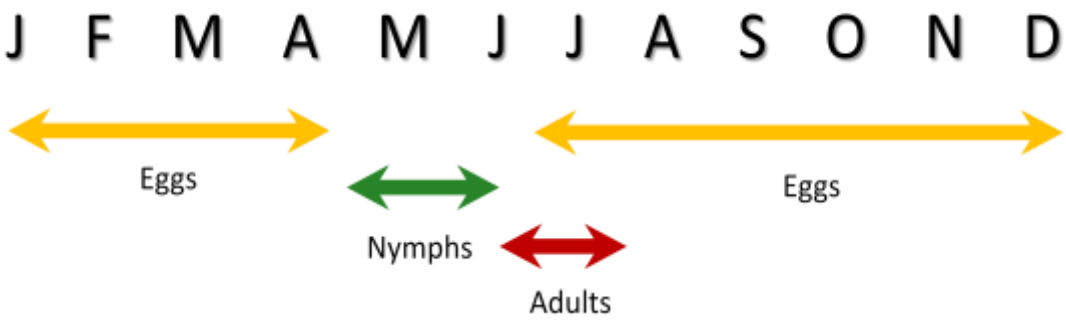

Figure 7: Life cycle of the species.

Figure 8: A female laying eggs, an egg pod (some eggs can be seen) and two pictures of an excavated pod©A. Foucart.

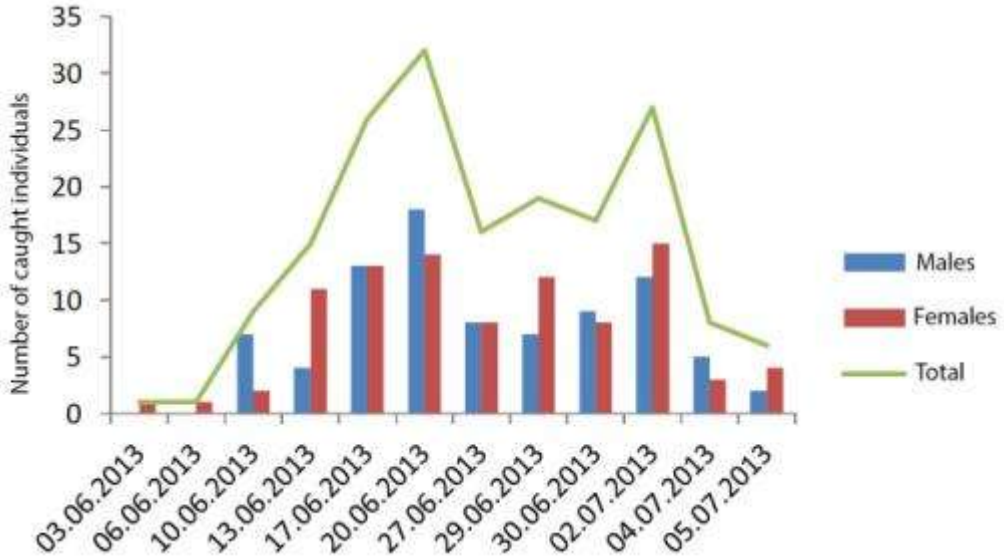

Figure 9: Number of adult specimens (blue: males, red: females, green: total) caught during a mark-recapture study in 2013. Note that the season started ca. two weeks later compared to usual years (from Schuld 2013).

P. h. rhodanica is a specialist of the coussoul habitat of the Crau (Fig. 10). In 2010, a pilot study on habitat preferences was conducted. Vegetation cover, maximum vegetation height and spatial structure were the most important variables explaining *P. h. rhodanica* densities. The maximum vegetation height was negatively correlated to density showing that vegetation is not suitable for the species. High grasshopper densities were present for a vegetation cover > 70%. A recent habitat analysis in 2013 showed that the Calissanne (see below) area provides an overall suitable habitat for the subspecies. However, the microhabitat analysis did not provide any information on the importance of forb cover vs. bare ground cover or anything else (Seibel 2013). The spatial dispersion of grasshoppers in the Calisanne was nearly normally distributed, suggesting that this site provides overall optimal conditions without any spatial variation (Schuld 2013). The species seems to have a high temperature tolerance compared to other grasshopper species and uses active thermoregulation. At substrate temperatures below 35°C, individuals have generally a higher temperature than their substrate, whereas only at temperatures > 50°C, body temperature is lower than that of the substrate (Seibel 2013, Fig. 11, whereas other species usually attain lower body temperatures already at substrate temperatures of 40-45°C. The requirements of the eggs concerning water, temperature, diapause are unknown (see below). It is also unknown whether the nymphs differ in their habitat requirements from adults.

Fig.ure 10: Typical habitat of Prionotropis hystrix rhodanica ©L. Tatin

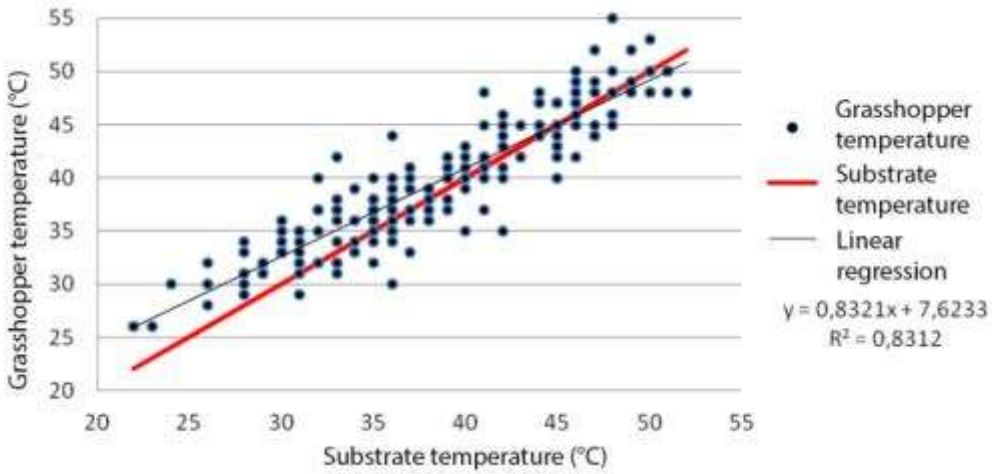

Figure 11: Linear regression between body temperature (ordinate) and substrate temperature (abscissa) of Prionotropis hystrix rhodanica, measured in the Calisanne. The red line shows the line of the substrate temperature. Note that at temperatures < 35°C the body temperature is usually higher than the substrate temperature, while only at the highest temperatures (> 50°C) it becomes lower.

Its large body size makes *P. h. rhodanica* an important prey for birds, such as Magpie, Crows, Stone Curlew, Little Bustard and Little Kestrel. The influence of predation on the population size has not been studied. A recent GIS analysis showed no clear relationship between sightings of magpie and crows and the sites of disappearance of this species from the Central Crau, but there was an indication for a relationship with cattle egret sightings (Schmitt 2014). Its own diet is little studied, but probably consists of different forbs (*Trifolium sp., Euphorbia sp., Plantago sp., Taraxacum sp., Bellis sylvestris,* etc.). It seems that *Brachypodium retusum,* is important as a shelter*,* but not for food. In the laboratory it has been fed successfully with bran and salad (Foucart, pers.. com.).

The species is wingless, moving very little (mean: 20 m; max: 50 m in one season, Streiff et al. 2005). Foucart (1995) reported that a female moved 24 m during 11 days. A recent mark-recapture study (1.5 month during adult stage) in the Calissanne found a mean of 20.7 m ± 6.4 m for males and 26.2 m ± 5.6 m for females with a maximum of 38.5 m for males and 43.0 m for females (Schuld 2013). The average daily distance moved was 5.5 m for males and 6.9 m for females (mean: 6.4 ± 1.7 m; Schuld 2013). Distances are straight lines, they are not figuring all the spatial movements.

Adult population densities are low, but difficult to determine due to the low recapture probabilities (ca. 6%; e.g. Tatin et al 2013, Schuld 2013): A capture-recapture study (Foucart 1995) estimated a density of 40 adults/ha (10 visits), Dutoit (2006) reported densities between 5 and 133 individuals/ha (mean = 14.4 individuals/ha, SE = 26.8). A recent study in the Calisanne estimated 200 adults/ha (12 visits, Schuld 2013). Juvenile densities are generally higher: Berthier (2000) counted 130 juveniles/ha (total census on circles of 100m diameter by 3 observers). Outbreaks of *P. h. rhodanica* have been reported in the past. This seems to be a general phenomenon of the species. The nominate subspecies *P. h. hystrix* has caused some damage on farmland in the past and it has been collected by people (as in Slovenia at the begining of the last century, Gomboc pers. comm.)

The genetic diversity is high and the populations are strongly spatially structured, suggesting little gene flow (Streiff et al. 2005). The high genetic diversity is probably a consequence of the large population sizes in the past. The spatial structure of the population suggests that the very limited dispersal leads to spatial aggregation of highly related individuals (Berthier 2000). It leads also to isolation by geographic distance: distant individuals are less related than individuals found in a close distance (Streiff et al 2005).

The subspecies is listed as Critically Endangered on the IUCN Red List (Hochkirch 2012) as well as on the French national Red List (Sardet & Defaut 2004). It is protected in France (Arrêté du 23 avril 2007, NOR: DEVN0752762A Version consolidée au 06 mai 2007, article 3) so that destruction of any stage of the animal (juvenile or adult individuals and eggs) is strictly forbidden.

Several research gaps are identified:

- Diet (but probably the species is not specialized in diet and so it is unlikely to be a critical factor)
- Microclimatic requirements of the eggs (water & temperature requirements)
- Egg diapause (especially the ability to survive in ground and the factors responsible for the diapause break)
- Ecology of the nymphs
- Reliable population size estimates of all subpopulations
- Spatial extent of the existing populations and their spatiotemporal dynamics
- Population connectivity
- Extinction/colonization processes (metapopulation dynamics)
- Importance of predators and pathogens

Function and values

The species does not have a strong cultural link to people except the one initiated trhough this conservation strategy. It probably also does not provide any measurable ecosystem service to humans. However, due to its large body size it is probably one of the most important primary consumers in the Crau habitat and thus in nutrient cycling. It also may be an important component of the diet of several threatened bird species, particularly Little Bustard, Lesser Kestrel and Stone Curlew.

Historical account

The historic distribution is shown in Figure 12. The species colonized nearly the complete central area of the Crau as well as some marginal parts. No systematic mapping was done prior to 2012. So it remains unclear if the historic distribution map is complete and if (and to what extend) the range size fluctuated. The number of populations has decreased substantially during the past decades. The reasons for this decline are not fully understood. In former times, the species probably lost some populations in areas where the stone steppe habitat had been converted for agricultural land use (e.g. to grassland for hay production) or industrial development (sites of the French Army and the BMW training site; industrial areas of Miramas and Istres). After the First World War it was considered in some years to be a fairly common species in Crau (Vayssière 1921); later, Chopard (1951) mentioned presence of the species and Bigot et al (1983) detected 50 adults in 1981 and considered the species as uncommon but distributed over the whole natural habitat. In 2001 a subpopulation was studied in the central Crau and known as the biggest one (Streiff pers. com., Fig. 13).

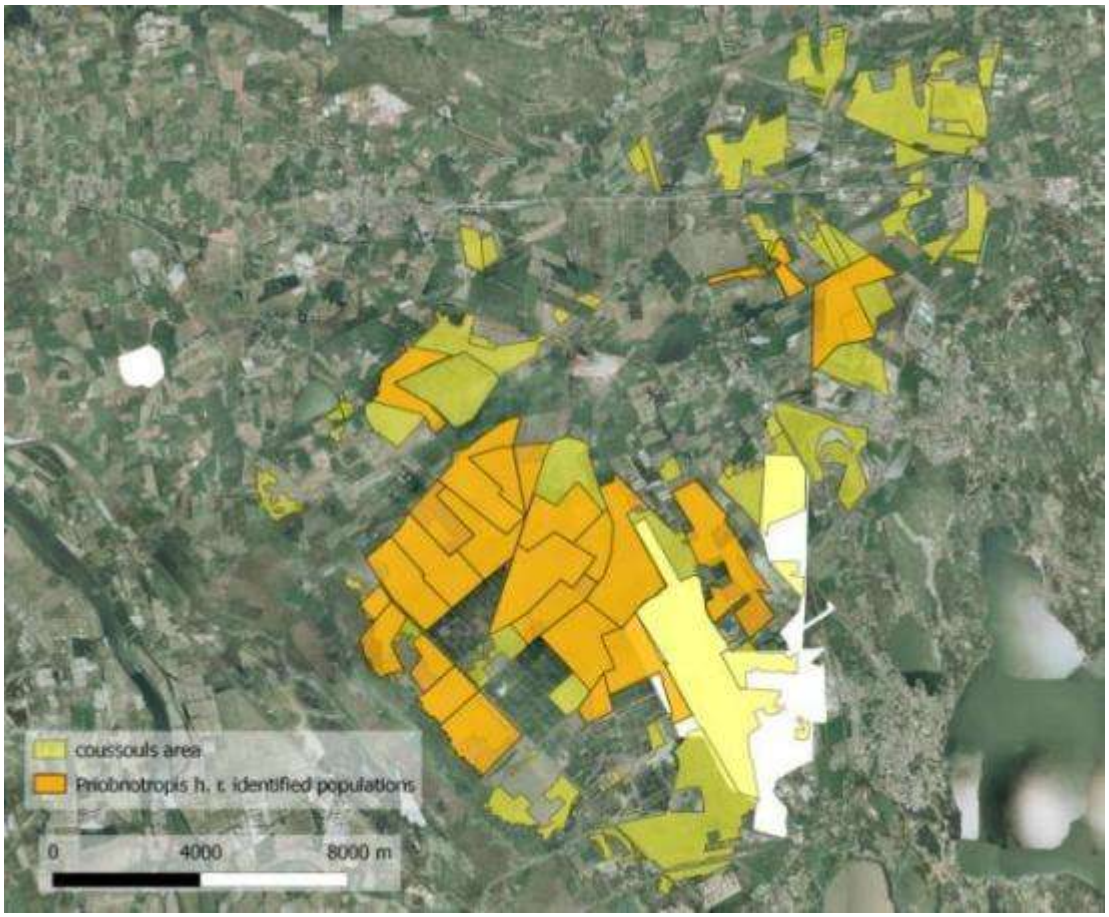

Figure 12: Cumulated observations of P. h.rhodanica before 2009 (from 1979 to 2009).

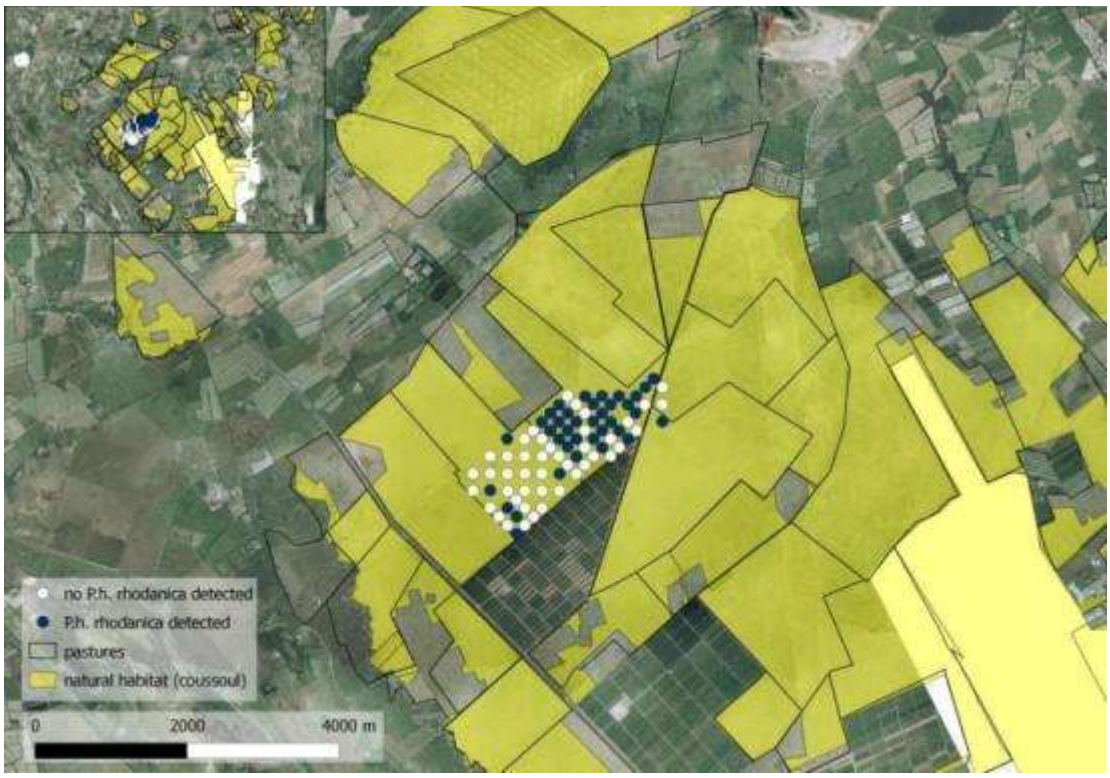

Figure 13: Spatial distribution of the central Crau subpopulation in 2001 (n=79 visited circles, from Streiff pers. com.). White dots = no P.h.rhodanica detected; blue dots = detected P.h.rhodanica.

Current distribution and demography

The mapping method used in 2012/13 is based on a capture-recapture study (Tatin et al. 2013), which has shown that detection probability is 6-7 % (confirmed by Schuld 2013). This means that when prospecting 1 ha for 1 hour by two observers, densities > 12 individuals/ha will be detected (which is very low even for this species). This also means that it is impossible to distinguish low density from absence. Searches are achieved by visiting a circle of 0.8 ha by two observers during one hour (for details see Tatin et al. 2013). This method is used for each searched site. The grid used for mapping is a 400 m x 400 m grid (0.16 km²). A total of 656 cells were chosen for the whole Crau habitat but 406 cells were located in the Crau original stone steppe. To date, 254 cells out of 406 have been visited. About 90 cells are located inside military areas and currently not accessible.

Four populations have been confirmed during the mapping project in 2012/13 (Fig. 14). Two of them have been known for several years (Calissane and Grand carton), and two new ones have been found during the mapping project (Peau de Meau and BMW). One locality (probably the largest population) is situated north of a military site in the Calissanne (Fig. 15). A first capture-recapture (CR) study in this area (2011) revealed that the population size might be ca. 400 individuals on 4 ha (Tatin pers. com.), but due to the low recapture rate the population size estimate has a rather high confidence interval (150-1650 individuals). A second CR study in the Calisanne was performed in 2013 and provided a population estimate of ca. 1910 ± 585 individuals on 9 ha (Schuld 2013). However, there was considerable variation between the models due to the low number of recaptures. In order to obtain more reliable data on population sizes, a much more intensive study with more census days would be needed. This has so far not been done to avoid negative effects of the threatened birds in this area, which are breeding during the same season.

A second population occurs at the BMW training site south of this population. An attempt to run a CR study has been carried out here, but individuals were very difficult to detect because of very high vegetation (probably caused by the rainy spring 2013 and the lack of sheep grazing). Nevertheless the population seems to be substantially smaller than Calissane (the area is also smaller). The other two populations are in the Central Crau. Their sizes remain unknown. But for the Peau de Meau population investigations were more intense in 2013-2014 and revealed that it is very small compared to Calissane and BMW sites (Fig. 16). This population is probably the remnant of a huge population, which has been observed in the past and studied in the surrounding areas from 1995 to 2001 (Fig. 13). However, the remaining population is found in a degraded part of the Crau, which was cultivated from the 1960's to the beginning of the 1980's.

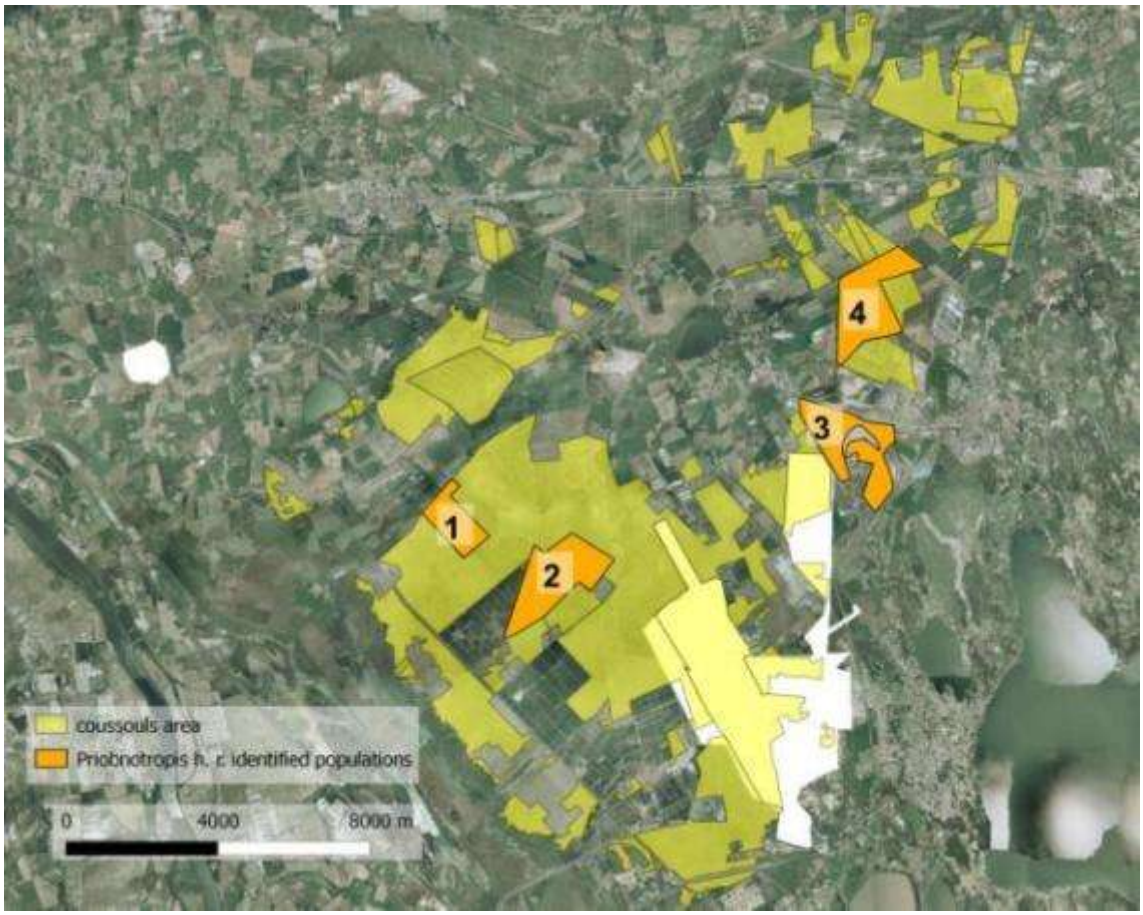

Figure 14: The four identified populations in 2012-2013 (1: Peau de Meau; 2: Grand carton; 3: BMW; 4: Calissane).

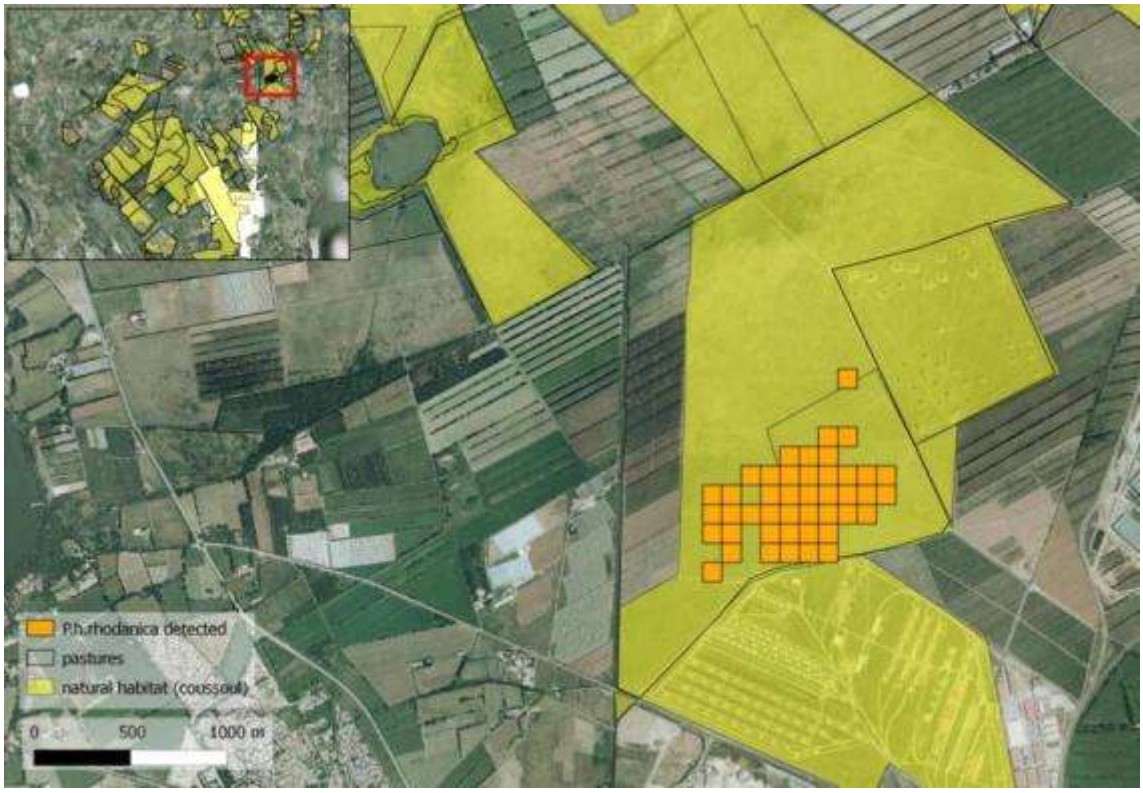

Figure 15: Calissane subpopulation in 2010 (number 4 in Fig. 7). Detection occurred during ten days prospection (70 circles of 1 ha, one hour/circle, 4 observers/circle). 244 individuals detected in 2010. In 2013, this subpopulation is estimated to reach 1960 individuals on 9 ha (Schuld 2013).

Figure 16: Peau de Meau subpopulation (number 1 in Fig. 8). Detection occurred during one day prospection in 2013 (16 circles of 1 ha, one hour/circle, 2 observers/circle). Red dots = sampled circles; blue squares = detected P.h.rhodanica.

Habitat and resource assessment

The stone steppe is grazed from February-March to mid-June by about 40 000 sheep distributed on 70 pastures (Fig. 17). The mean herd size is 1600 sheep and the total number of herds on the stone steppe is 33. Grazing is nomadic as the herds move to the Alps from mid-June to mid-October. A few herds return to the stone steppe in autumn (generally for 1-2 months). The effects of grazing on *P. h. rhodanica* (either positive or negative) are little understood. The region has been intensively used for sheep grazing for centuries, but it remains to be analysed whether changes in grazing intensity (e.g. herd sizes, duration, and timing) or spatial distribution have occurred. Positive effects of grazing are generally assumed concerning the effect on vegetation structure, but negative effects of grazing might include resource competition, trampling, or facilitation of predation by birds (e.g. cattle egrets). A recent GIS analysis showed no significant effect of the distance of trees or buildings on the extinction of populations of *P. h. rhodanica* (Schmitt 2014), but cattle egret sightings predominate in areas where populations went extinct. However, it must be taken into consideration that the data on cattle egret sightings have not been recorded systematically.

Figure 17: The Crau steppe is grazed by about 40 000 sheep from February-March to mid-June ©L. Tatin

Threat analysis

The main threat for the species in the past was habitat destruction or degradation (Foucart and Lecoq 1998). Parts of the natural habitat have been transformed to orchards, hay meadows, industrial areas and military sites. From the remaining 11 000 ha habitat, 7 500 are protected. During the last ten years several incidences of habitat destruction have been observed (soil removal, oil spill [Fig. 18], etc.). Recently, 40 to 100 ha were threatened by a project of the French Army to build new weapons warehouses. This project severely threatened the largest subpopulation in the Calisanne (Fig. 15). In 2014, the Army decided to refrain from the project and promote the conservation of the grasshopper.

Figure 18: Eight ha of coussoul have been destroyed by an oil spill in 2009 (left, ©SDIS13); 45 ha have been destroyed in 2014 by a private owner outside the NNR (right, ©CEN PACA).

The reasons for the strong decline of *P. h. rhodanica* in the central part of the Crau remain unknown. The species was common in this area until 2001 (Fig. 13), but dramatically declined within one decade. As no accurate data on the decline is available, the threats leading to it are difficult to analyse. A recent GIS study (Schmitt 2014) analysed spatial correlations between the extinction of

subpopulations and available information on sheep grazing, bird sightings, occurrence of bushes and trees etc. Overall, extinctions occurred at greater distances to trees and buildings compared with extant populations (Figs. 19a & b), suggesting that predation by birds which use or nest in houses and trees (e.g. crows, magpie) does not play a substantial role for the decline (but it needs to be considered that some species, such as jackdaws may cover large distances for foraging). Only cattle egret (*Bubulcus ibis*) sightings correlated significantly with extinctions (Fig. 20), but as mentioned above, these data are rather vague. Nevertheless, it provides some guidance for future studies. Another avian predator is the Lesser Kestrel (*Falco naumanni*), whose population has been managed since 1992 and reached 182 breeding pairs in 2013. The chicks are fed by adults when the Crau plain grasshopper is adult (end-May till end-June). Analyses of the captured prey for chick feeding from 1998 to 2012 show that the grasshopper represents only 0.32% (0-1.21%) of the diet. The data set also shows two periods without any Crau plain grasshoppers in the diet (Tab. 1), probably in line with the normal variation of the generally low numbers of specimens in the diet.

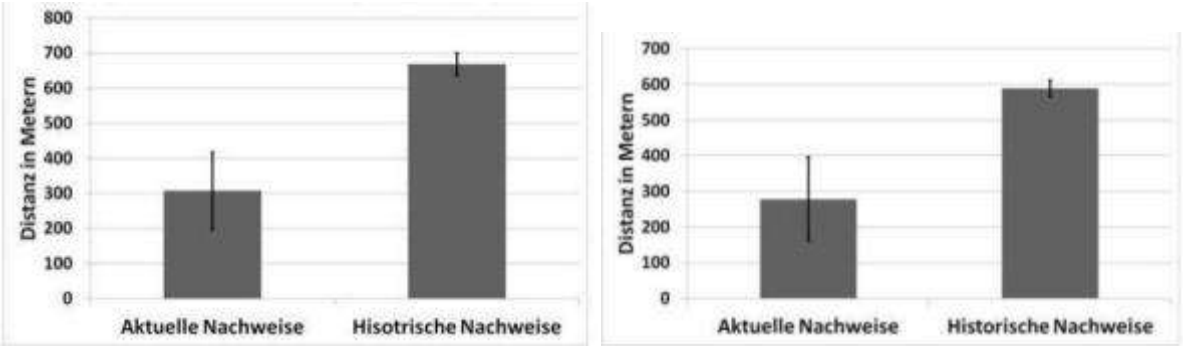

Figure 19: left) Comparison of the distance of extant records of P. h. rhodanica (left column) and historic records (right column) to the next trees, showing that the species generally survived closer to trees; right) Comparison of the distance of extant records of P. h. rhodanica (left column) and historic records (right column) to the next buildings, showing that the species generally survived closer to buildings.

Tab. 1: Abundance and frequency (%) of P.h.rhodanica in the prey of Lesser Kestrel (Falco naumanni) for feeding chicks in spring (data from Pilard and Tatin 2013). [1]: 974 prey items were identified from camera traps at nests of 3 breeding pairs in Peau de Meau (total of 7 breeding pairs). [2] : detected in Peau de Meau

	1998	1999	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013 [1]
N pairs	48	39	63	63	98	129	136	141	125	153	160	208	175	182
N identified preys	2530	342	254	392	596	609	742	775	485	832	1080	1284	1644	2095
N identified *P.h.rhodanica*	29	1	0	0	0	4	9	0	3	2	0	0	0	3[2]
%	1.15	0.29	0	0	0	0.66	1.21	0	0.62	0.24	0	0	0	0.14

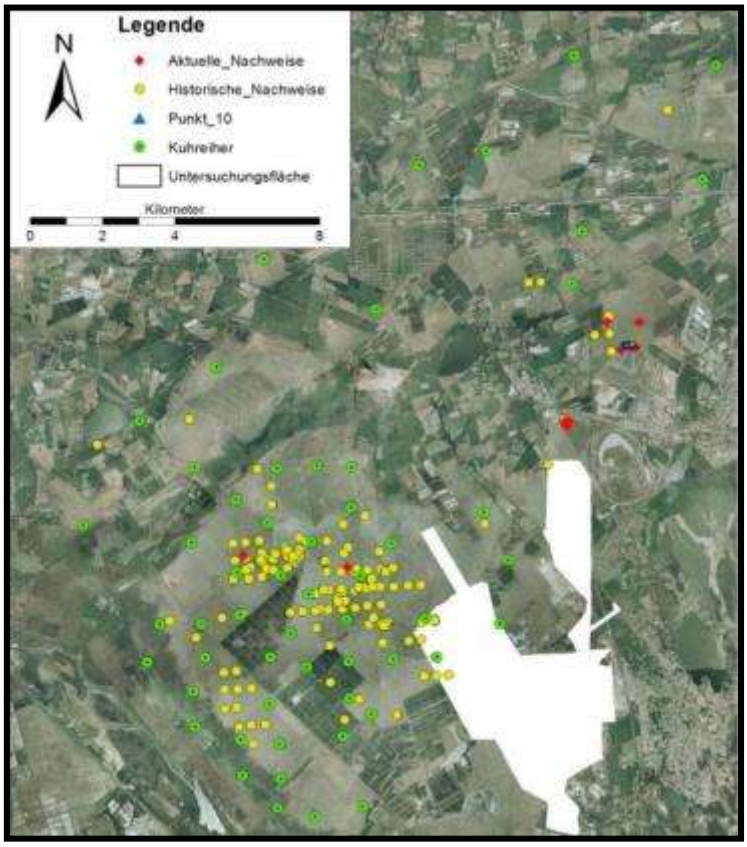

Figure 20: Spatial distribution of historic records (yellow) and existing populations (red) and recent sightings of cattle egret (green).

The climate in the Crau is generally extreme and highly variable. It thus seems unlikely that climatic variables are responsible for the decline of *P. h. rhodanica*. Nevertheless, an analysis of the climatic data of the period 2006-2013 was done and three major climatic extremes were found, which may be candidate factors for the strong decline: the spring of 2006 was very cold (January to May, particularly March to May was 3-5°C colder than on average with frost still occurring in April), which might have been detrimental for nymphal development and reaching adulthood. In 2007, the autumn was very dry (July to December, particularly from September to November nearly no rainfall occurred), which might be detrimental for egg development. By contrast, autumn 2008 was extremely wet (October to December), which might facilitate fungal growth on eggs. However, these are all very vague hypotheses and need to be tested experimentally.

A couple of other potential causes behind the decline still remain to be tested in more detail:

- Pathogens: Little is known about diseases in grasshoppers. Fungal pathogens (e.g. *Entomophaga grylli*) are known to affect some species and are used for locust control in some countries, but it is unlikely that this species will be of importance in a dry steppe area. However, the potential role of other pathogens is unknown. The fact that two of the remaining populations occur in small fragments of the Crau rather than in the large centre, support the hypothesis that pathogens might be an issue.
- Predators: Currently only some very rough analyses are available, which do not provide any clear insight into the role of predation. Based upon the GIS analysis, the cattle egret might be the best candidate for future studies on the role of predation. However, it would be important to study predation from the grasshoppers' perspective rather than simply the amount of grasshoppers in the food of the bird. This can probably only be done experimentally.

- Habitat structure: Currently, it is known that the Calisanne provides an ideal habitat for this species and that too high and dense vegetation might be detrimental. It would be important to study the habitat structure in the areas where the species went extinct, to analyze whether changes in the habitat structure have led to the decline.
- Sheep grazing: Our current knowledge on the effect of sheep grazing is rather limited. It is also poorly documented whether any major changes in sheep grazing management occurred during the last decades at a local scale. More or less all historical and present ranges of *P. h. rhodanica* are grazed by sheep (but note that the BMW site is not grazed; Fig. 21). One old shepherd reported that Crau stone steppe was overgrazed after Second World War, because of arrival of many sheep herds from surrounding areas, but the species has survived.
- Pesticides: Due to the large size of the central Crau it is generally thought to be unlikely that pesticides play any role in the extinction of the populations, particularly as these occurred in the centre of the Crau and not at the edge, which should be more likely to be affected by pesticides.

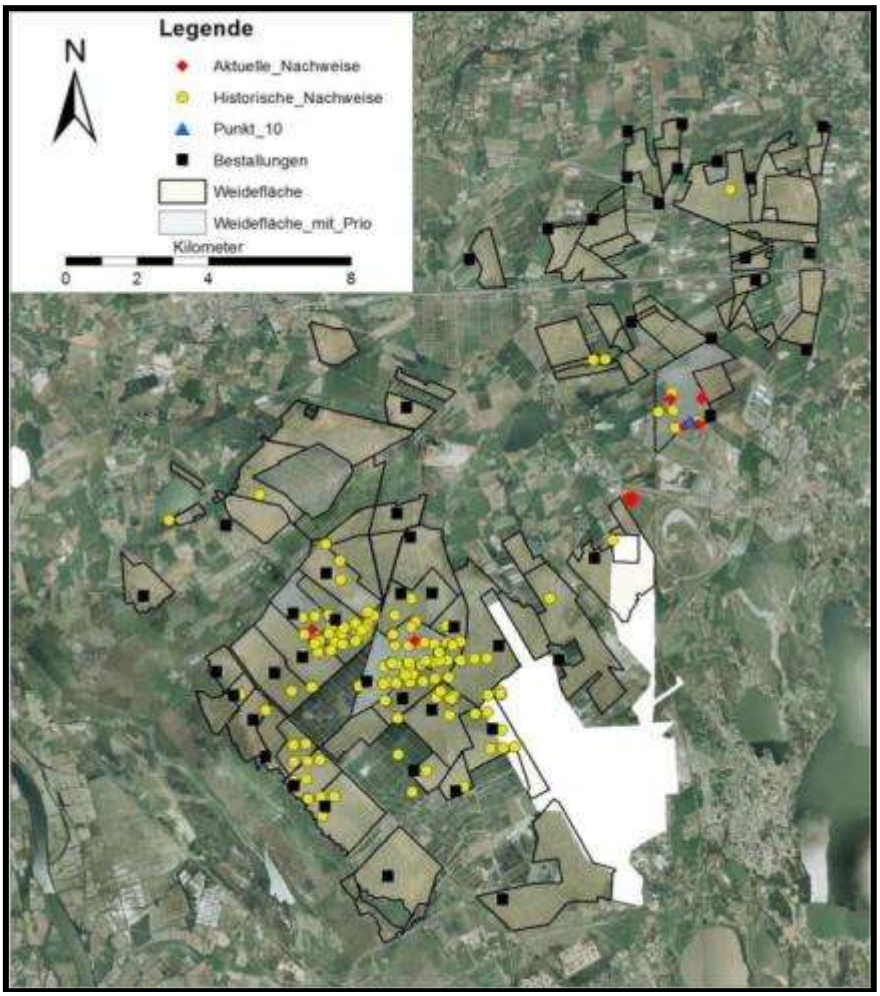

Figure 21: Spatial distribution of historic records (yellow) and existing populations (red) and sheep grazing sites (hatched). Black squares are sheepfolds.

Parts of the Crau Steppe are protected in the "Réserve naturelle nationale des Coussouls de Crau" since 2001, but others are not protected. Outside the nature reserve, habitat is part of Natura 2000 network (“Crau” Special Protected Area n° FR9310064). The network requires an assessment of development proposals which is used as a notice for guiding local institutional decisions (but this confers no effective protection status).

During 1992-1993, Foucart attempted to breed *P. h. rhodanica* in captivity. No problems were identified during growth, adult life and reproduction. Many matings were observed as well as oviposition. However, no eggs hatched in the laboratory. An attempt to rear and breed the species in its natural habitat was implemented in 1999 without success, because the small cage size required considerable time and effortin feeding and caring for individuals which was not possible during the whole rearing season. In 2013, a test for *in situ* rearing was attempted. A total of 24 nymphs was captured and reared in a terrarium in order to protect them from predation and harsh weather conditions. From this sample, all adults were released in two cages located in natural habitat. A second sample of eight nymphs was captured and directly released in one cage, protected from predation, but not from weather conditions. Matings and oviposition were observed in the three cages but the number of observations was higher for the released adults (n=12) compared to nymphs reared *in situ* (n=1). Movements inside the cages were very variable depending on individuals but most of them visited the whole cage area (Fig. 22). The adult lifespan of individuals reared in the terrarium was similar to wild counterparts (40-46 days). Detection of grasshoppers inside the cage was not very high, for some individuals were missed for several days and finding all dead individuals was not achieved. More details are presented in Tatin (2013).

Capture of juveniles

Ex situ rearing

In situ release

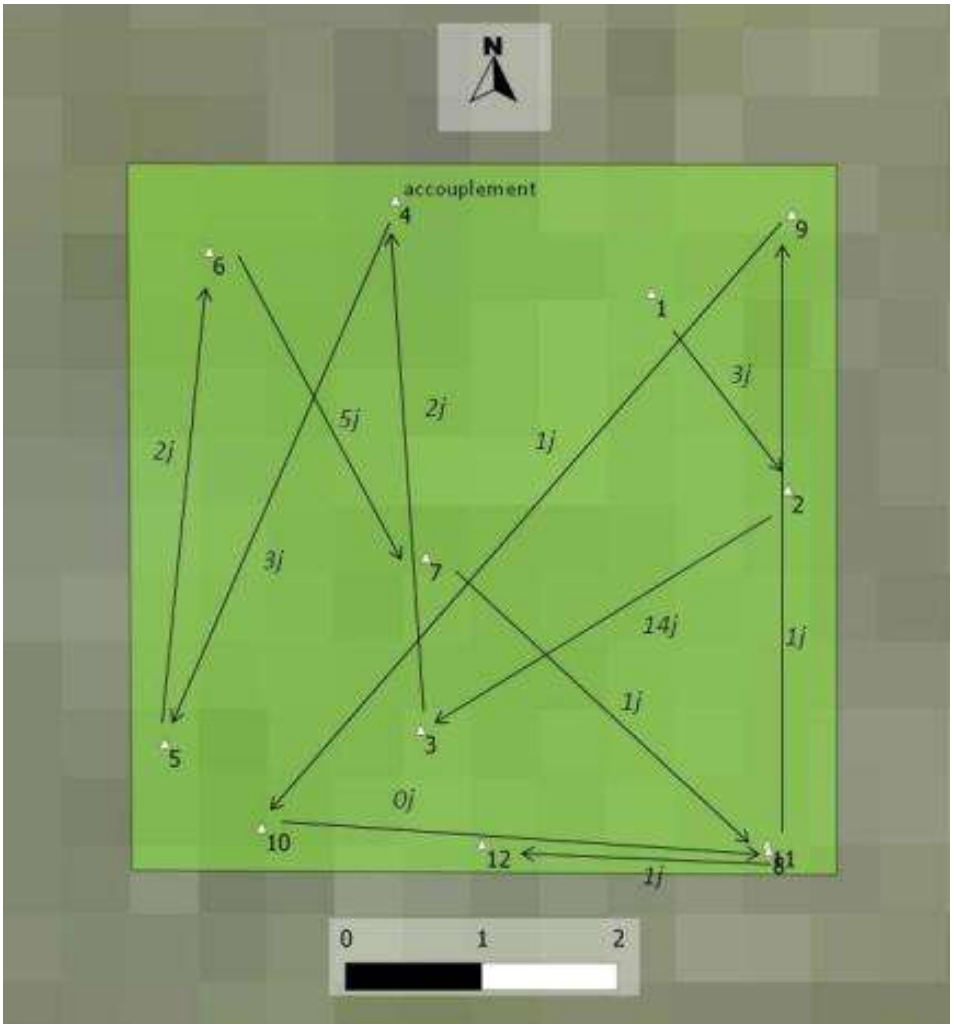

Figure 22: Movements of a male (one point on the left back) inside the cage n°2. Numbers close to triangles show the movements sequence and those along the arrows figure the time between two recorded positions.

CONSERVATION STRATEGY PLANNING

Methodology

Guidelines

To develop the conservation strategy of the Crau plain grasshopper, the handbook of the IUCN Species Survival Commission (IUCN/SSC 2008), strategies from other species and advices from experts were used. Definitions of Vision, Goals, Objectives and Actions were strictly adopted from the IUCN/SSC handbook. The way they interact through the conservation strategy planning is shown in Fig. 23.

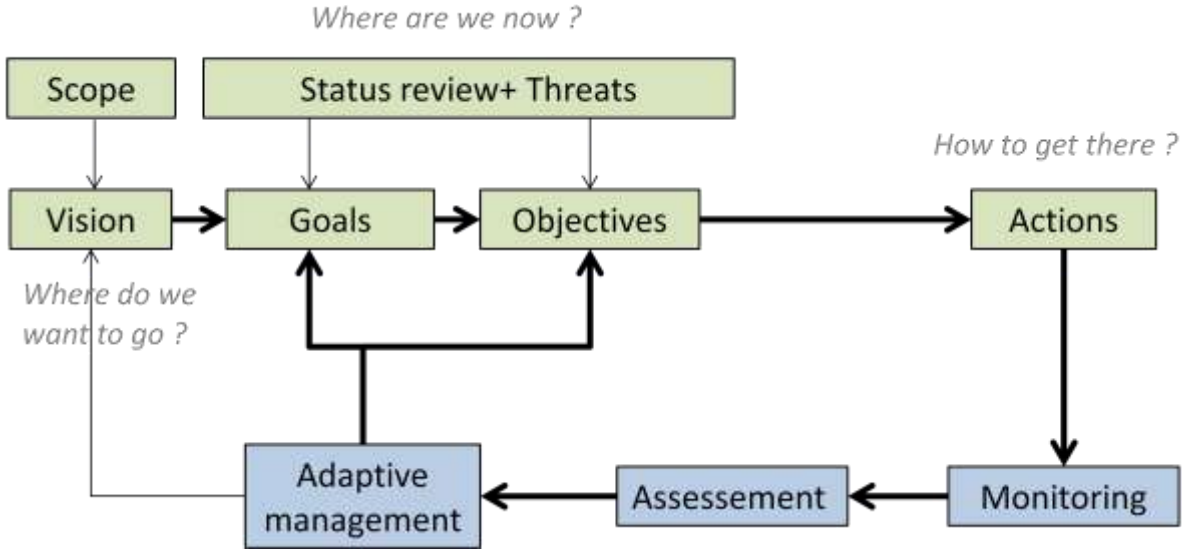

Figure 23: Conservation strategy planning. Adapted from IUCN/SSC (2008).

As defined in the handbook, actions must be SMART: specific, measurable, achievable, realistic and time-bound. Targets were included in actions and goals.

Workshop

To develop a conservation strategy for the Crau grasshopper, the approach of the IUCN Species Survival Commission was used. This requires a review of the species' status and the threats it faces, and development of a Vision for the future, Goals, Objectives and Actions. This was done through a participatory workshop (Fig. 24), involving species specialists and planners, state government agencies, managers, researchers and other stakeholders.

Participants

These included a regional delegation of the Ministry of Ecology (Dreal PACA),the IUCN French Committee, Defense Ministry (EPMu Provence), a sheep owner, land administration (CG13), the

local office for agriculture (CA13), Natura 2000 network, researchers (INRA-CBGP and IMBE), Thoiry and Bristol zoos, one Orthoptera specialist and one student (see Appendix for a detailed list of participants).

Figure24: Conservation Strategy workshop organised on 1-3 June 2014. ©A. Hochkirch and ©G. Dusfour

Programme

The workshop ran from 1st to 4th June and was divided into three main parts: core group discussions (on 1st and 4th June in English), stakeholder discussion and field trip (on 2nd June in French) and development of objectives and actions (on 3rd June in English). The first day was used for developing a draft vision and goals by the core group in order to present them to the stakeholders during the next day. A field trip was also organised for the core group. On 2nd June, information on the species (biology, ecology, threats) and on the strategic planning process was presented. The vision and goals were discussed and modified by stakeholders and a field trip took place. Workshop programme and excecutive summery of the conservation status are given in Appendix II and III.

Vision

The Crau stone steppe ecosystem, a unique habitat whose biodiversity value is maintained by traditional sheep grazing, will support a viable population of the Crau Plain Grasshopper, *Prionotropis hystrix rhodanica*, found only in this ecosystem. There will be larger areas of well-connected steppe under conservation management, for which the species will be a flagship for conservation in the Crau.

The vision was carefully worded to reflect the following points:

(i) "maintained by traditional sheep grazing": the Crau ecosystem, as a rangeland since the Neolithic, is highly dependent on sheep grazing.

(ii) "support a viable population": in addition to the recovery of a relatively large population, it indicates the need for more studies on population dynamics and threats to define a minimum viable population.

(iii) "well-connected steppe": protected natural habitat suffers from fragmentation (7,500 ha in several patches from a total of 11 000 ha); thus protection enhancement and restoration is urgently needed.

(iv) "under conservation management": *ex situ* and *in situ* population management have to be implemented quickly as well as optimal management on sites that shelter subpopulations.

(v) "flagship for conservation": largely unknown to the public, so awareness has to be enhanced.

Once the vision had been defined, the workshop participants identified how to achieve this vision. A chart was used for specify the goals and objectives (Fig. 25).

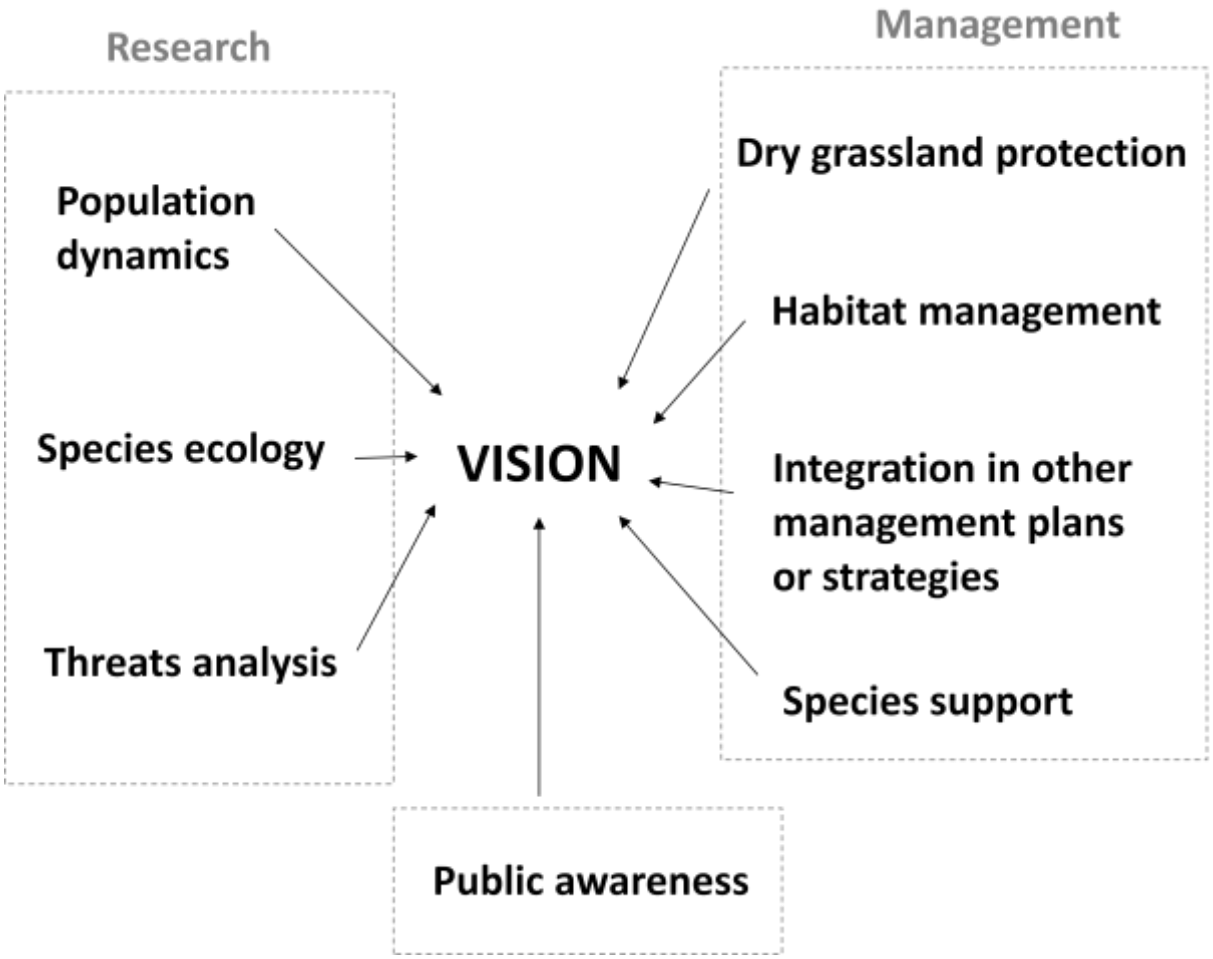

Figure 25: Chart built by the workshop participants of major topics in order to achieve the vision.

Goals, objectives and actions

Goal 1: Research

To obtain the information necessary to describe and monitor population status, dynamics and associated drivers, to identify the present and likely future threats to its persistence, to determine the characteristics of a viable population.

OBJECTIVE 1.1 POPULATION DYNAMICS

To clarify the number of existing populations, their spatial extent and set up a monitoring programme to estimate their sizes, trends and other relevant factors. To use this information to identify criteria for a "viable population" (including the necessary spatial requirements). Currently, based on comparatives, the preliminary target is 10 populations, each with a minimum size of 500 individuals on a minimum of ca. 10 ha of optimal habitat.

Actions

1.1.1 Survey all potentially suitable areas for presence/absence at the appropriate spatial scale

Finalize survey of high quality coussouls[2] by end of 2016
Finalize survey of the degraded coussouls by end of 2017

1.1.2 Explore the current status of the existing populations
Explore spatial extent of the existing populations by end of 2015
Estimate sizes of existing populations using Mark-Recapture by end of 2017

1.1.3 Establish an annual monitoring program
Define the key variables to be monitored
Explore the most efficient sampling strategy (line transects?) by end of 2017
Explore alternative technologies (bioacoustics, reflecting foil, mini GPS, dogs)

1.1.4 Take steps to define 'viable population' and 'optimal habitat'
Obtain information from the literature on comparable species or subspecies by end of 2014
Obtain data on hatching rate and mortality rate (small cage experiment) by end of 2016
Develop method to understand nymphal mortality rates by end of 2016

OBJECTIVE 1.2 THREAT ANALYSIS

To clarify the major threats (including lessons from the past, current observations of species and habitats, and potential future threats).

Priority	No.	Threat	Currrent knowledge	Presumed impact
1	1	Habitat modification • still habitat for *Prionotropis* • may benefit other species	Medium	Medium
	2	Predation (cattle egret, lesser kestrel, other species: crows, magpie)	Low	Medium
	3	Adverse changes in grazing regimes	Low	High
2	4	Habitat fragmentation	Medium	Medium
	5	Parasitism, disease	None	Medium
	6	Climate change (extremes, annual rainfall distribution, 1°C increase since 1980)	Low	Medium
	7	Pesticides (increasing use since 1990s due to orchard increase, sheep)	None	Low
3	8	Habitat destruction	High	High
	9	Human disturbance	Low	Low

Actions

[2] From latin *corsurium* : a xeric rangeland/steppe. This local name represents the Crau steppe natural habitat, a species-rich plant community structured by *Brachypodium retusum* and *Thymus vulgaris*, accompanied by species like *Asphodela fistulosus, Stipa pennata, etc.*.

1.2.1 Habitat modification / grazing

Compare vegetation structure, dominant species, forbs/grass ratio at occupied sites and formerly occupied sites (4 existing, 4 historic, 4 potential reintroduction sites) either using drone technology or field study by 2016

Establish fixed monitoring sites for vegetation structure (plots), grazing pressure (use GPS units on sheep), rainfall (existing station) (4 existing, 4 historic, 4 potential reintroduction sites) by 2016

1.2.2 Predation

Explore methods to track individual prey with

(1) reflective foil
(2) GPS trackers on insects

Develop camera traps for studying individual predation risk and major predators

Study distribution of Cattle Egret colonies

GPS tracking on egrets

Study grasshopper egg mortality (predation, parasitism, fungi)

Analyze Lesser Kestrel data in detail

Study the local impact of kestrel predation around Brunes d'Arles and Neigréron colonies (GPS)

1.2.3 Parasitism, disease

Review the literature on parasites and diseases, particularly flies (*Blaesoxipha*) by end 2014

(1) Take nymphs and adults into captivity and monitor for parasites by 2015
(2) Develop autopsy protocols in captivity by 2015

1.2.4 Climate change

Research impacts of climate (rainfall) changes on life cycle in laboratory by 2017

Use data logger to measure microclimate at oviposition sites in the wild by 2015

1.2.5 Pesticides

Study on use and distribution of sheep medications by end of 2014

Conduct sheep dung eating trials with nymphs and adults by end of 2015

Investigate pollutant effect from the surrounding industrial complex of Fos-sur-Mer.

Goal 2: Management

To increase the area under enhanced conservation management compatible with other relevant plans and strategies, enabling the management of existing and new subpopulations, backed up by an *ex situ* population.

OBJECTIVE 2.1 PROTECTION OF THE CRAU DRY GRASSLANDS

Protect 100% of the remaining high quality coussouls and a maximum of degraded coussouls.

Actions

2.1.1 Explore inclusion of the remaining 30% high quality coussouls outside National Nature Reserve (NNR) into NNR
2.1.2 Explore inclusion of <1500 ha degraded coussouls into NNR
2.1.3 Assess scope for conservation gain for coussouls through mitigation or offsets
2.3.3 Include the Army's 40 ha coussouls outside the NNR into the NNR in Calissane by end 2014

OBJECTIVE 2.2 INTEGRATION INTO PUBLIC POLICY

To integrate Crau plain grasshopper conservation strategy into other management plans and policies.

Actions

2.2.1 Collect relevant existing plans by end of 2014
2.2.2 Ensure Prionotropis conservation is considered in all relevant plans in development or revision
(1) Review other action plans for potential conflict with *Prionotropis* conservation
(2) Engage with planners for any future local plans for species
(3) *Prionotropis* Conservation Strategy to be incorporated into 2015-2019 Management Plan for NRR
(4) Include *Prionotropis* conservation strategy into Natura 2000 Review and coming 2015 Plan
(5) Incorporate *Prionotropis* Conservation Strategy into local land-use planning (urban and rural) and regional (corridors)
(6) Check National Biodiversity Strategy and Action Plan (NBSAP) for reference to Crau
(7) Provide input to next NBSAP

OBJECTIVE 2.3 HABITAT MANAGEMENT

To increase the area under the optimum (adaptative) management (grazing regime, predator management) for grasshopper population performance, compatible with other conservation objectives.

(1) Assumption: the situation in Calissane is the current optimum for *Prionotropis*
(2) Objective: Examine relationship between sheep grazing – vegetation structure – *Prionotropis*
(3) Management will be assessed and adapted to the results obtained from research studies.

Actions

2.3.1 Peau de Meau site management
Determine extent of occurrence in Peau de Meau by mid 2014
Exclude grazing from 10 ha (in the centre of the *Prionotropis* population) from April to end of May in 2015 and 2016
Census *Prionotropis* and monitor vegetation
Relocate or close lesser Kestrel nest boxes by 2015

2.3.2 BMW site management
Implement sheep grazing from March to mid-April by 2015

OBJECTIVE 2.4 SPECIES SUPPORT

To develop a holistic population management plan (in-situ support, translocation, ex-situ conservation, reintroduction).

***Ex-situ* Actions**
Purposes:

- Self-sustaining viable ex-situ population (demographically and genetically): 200 adults individuals per institution and 3 institutions within 3 years
- Potential for return to wild

2.4.1 Risk analysis regarding the establishment of captive population (health)
2.4.2 Removal from the wild: April 2015; 50 nymphs 1st and 2nd instars, and in 2016 if necessary
2.4.3 Complete life cycle in captivity
2.4.4 Develop pathology and post mortem protocols
2.4.5 Develop husbandry guidelines
2.4.6 Develop criteria for splitting first captive population and/or further collection from the wild

Where:

(i) Priority: Thoiry zoo
(ii) Second priority: Bristol Zoological Gardens
(iii) Later: Others (CIRAD, Besançon, Montpellier)

***In situ* Actions**
Purpose: Reaching 10 subpopulations in the wild within 15 to 20 years

2.4.6 Plan for experimental wild-to-wild translocation programme starting 2017
2.4.7 Identify priority sites for reintroduction and design protocols, to start 2019
2.4.8 Assess management needs at priority reintroduction and translocation sites

Goal 3: Public awareness

To build public awareness of and support for the conservation of this unique species and the Crau ecosystem.

OBJECTIVE 3.1 PUBLIC AWARENESS

To maximize the audience which is aware of the Crau ecosystem and its unique grasshopper as a part of the national cultural heritage whose protection and management are of "global interest".

Audiences to influence in support of Crau grasshopper conservation		
	Audience	**Method of influencing**
Directly affected		
1	Politicians: local -> regional -> national	Short reports
2	Sheep breeders and shepherds	Field trips, agricultural Newsletter, local Newspaper, lectures in Shepherd Schools
3	Hunters	Hunters' magazines
4	Amateur naturalists	Field trips, TV, journals, field signage, social media
5	Land-owners, including Army, BMW	Meetings
6	Protected area staff	National journals, Facebook
Indirectly affected / interested		
7	Children	Social media, field visits
8	Students	Social media, field visits
9	Local inhabitants	Local newspapers, social media, TV

Actions

3.1.1 Obtain resources
3.1.2 Develop communications strategy
3.1.3 Start Crau NNR Facebook page and website blog
3.1.4 Short film for TV etc.

Actions' detail sheets

Actions	Who	When	How	Budget (€)	Indicator of success
Goal 1: Research					
OBJECTIVE 1.1 POPULATION DYNAMICS					
1.1.1 Survey all areas for presence/absence at the appropriate spatial scale					
Finalize survey of high quality coussouls	CEN PACA	End 2016	Ongoing protocol[1]	31 500[5]	Maps produced
Finalize survey of the degraded coussouls		End 2017			
1.1.2 Explore the current status of the existing populations					
Explore spatial extent of the existing populations	3 students	End 2015	Special protocol[2]	7 920[3]	Shape of sub-populations
Estimate sizes of existing populations	3 students	End 2017	Mark-Recapture	7 920[3]	Population size even if imprecise
1.1.3 Establish an annual monitoring program					
Define the key variables to be monitored	Trier + CEN PACA + scientific partners	2015-2016	Brain storming	Negligible	Variables included in the reserve management plan
Explore the most efficient sampling strategy (line transects?)		End 2017	To be developed	To be determined	
Explore alternative technologies (bioacoustics, reflecting foil, mini GPS, dogs)			To be developed	To be determined	
1.1.4 Take steps to define 'viable population' and 'optimal habitat'					
Obtain information from comparable species or subspecies	Trier	End 2014	Bibliography	Within existing budget	Review table produced
Obtain data on hatching rate and mortality rate	CEN PACA	End 2016	Small cage experiment	<2 000	
Develop method to understand nymphal mortality rates	Trier + CEN PACA			To be determined	Best estimator identified
OBJECTIVE 1.2 THREATS ANALYSIS					
1.2.1 Habitat modification / grazing					

Actions	Who	When	How	Budget (€)	Indicator of success
Compare vegetation structure, dominant species, forbs/grass, at occupied sites and formerly occupied sites using drone technology (4 existing, 4 historic, 4 potential reintroduction sites)	IMBE	2016	Drone pictures analyses	<8000	Data abalysis produced
Establish fixed monitoring sites for vegetation structure, grazing pressure, rainfall (4 existing, 4 historic, 4 potential reintroduction sites)		2016	Plots, GPS units on sheep, existing meteo station	To be determined	Exclosures implemented
1.2.2 Predation					
Explore methods to track individual prey with	Trier + CEN PACA	Start 2015	To be developed		
(1) reflective foil				Within existing budget	
(2) GPS trackers on insects				To be determined	
Camera traps for studying individual predation risk and major predators	Trier + CEN PACA	Start 2015	To be developed	<4 000	
Study distribution of egret colonies	CEN PACA	Start 2015	Field + interviews	<2 000	
GPS tracking on egrets	Students	Start 2015	To be developed	2 640[3]	
Grasshopper egg mortality (predation, parasitism, fungi)		Start 2015		2 640[3]	
Analyze lesser kestrel data in detail		Start 2015		2 640[3]	
1.2.3 Parasitism, disease					
Review literature on parasites and diseases, particularly flies (*Blaesoxipha*)	Bristol + Thoiry zoos	End 2014	Bibliography	Within existing budget	
(1) Take nymphs and adults into captivity and monitor for parasites	Thoiry zoo + CEN PACA	2015		Within existing budget	
(2) Develop autopsy protocols in captivity	Bristol + Thoiry zoos	2015			
1.2.4 Climate change					

Actions	Who	When	How	Budget (€)	Indicator of success
Research impacts of climate (rainfall) changes on life cycle in laboratory	Trier + Bristol/Thoiry zoos	2017	To be developed by zoos	Within existing budget	
Use data logger to measure microclimate at oviposition sites in the wild	Trier + CEN PACA	2014	ibuttons under ground surface	250-410[4]	
1.2.5 Pesticides					
Study on use and distribution of sheep medications	CA13	End 2014	Interviews	<2 000	Typology over the last 10 years
Conduct sheep dung eating trials with nymphs and adults	Bristol + Thoiry zoos	End 2015	Experiment in terrarium	Within existing budget	
Goal 2: Management					
OBJECTIVE 2.1 PROTECTION OF THE CRAU DRY GRASSLANDS					
2.1.1 Explore inclusion of 30% high quality coussouls outside National Nature Reserve (NNR) into NNR	CEN PACA	2020	Influence on politics	Within existing budget	Creation of a NNR buffer zone
2.1.2 Explore inclusion of <1500 ha degraded coussouls into NNR		2020	Influence on politics		
2.1.3 Assess scope for conservation gain for coussouls through mitigation or offsets		2020	Dialogues with authorities	Negligible	Land purchase
2.3.3 Include the Army's 40 ha coussouls outside the NNR into the NNR in Calissane	CEN PACA + Army	End 2014	Establish management contract	Within existing budget	Management contract signed
OBJECTIVE 2.2 INTEGRATION INTO PUBLIC POLICY					
2.2.1 Collect relevant existing plans	CEN PACA	End 2014		Negligible	
2.2.2 Ensure Prionotropis conservation is considered in all relevant plans in development or revision					
(1) Review other action plans for where conflict with *Prionotropis* conservation		2015	Bibliography	Negligible	

Actions	Who	When	How	Budget (€)	Indicator of success
(2) Engage with planners for any future local plans for species	CEN PACA	2014	Dialogues with authorities	Within existing budget	
(3) *Prionotropis* Conservation Strategy to be incorporated into 2015-2019 Management Plan for NRR		2015		Within existing budget	Developed actions into the NNR management plan
(4) Include *Prionotropis* conservation strategy into Natura 2000 Review and coming 2015 Plan		2015			
(5) Incorporate *Prionotropis* Conservation Strategy into local land-use planning (urban and rural) and regional (corridors)	CEN PACA	2015-2020	Meetings with urban and rural authorities		
(6) Check National Biodiversity Strategy and Action Plan (NBSAP) for reference to Crau		2015	Dialogues with authorities		
(7) Provide input to next NBSAP			Dialogues with authorities		
OBJECTIVE 2.3 HABITAT MANAGEMENT					
2.3.1 Peau de Meau site management					
Determine extent of occurrence in Peau de Meau	CEN PACA	Mid 2014	Ongoing protocol[1]	Within existing budget	Sub-population shaped
Exclude grazing from 10 ha (in the centre of the *Prionotropis* population) from April to end of May		2015	Meeting and contract with header	<4 000	Fence implemented
Census *Prionotropis* and monitor vegetation	CEN PACA + students	2015	Special protocol[2]	2 640	Abundance and spatial size estimators
Close lesser kestrel nest boxes	LPO	Early 2015	Block cavities	Negligible	No breeding pairs in Peau de Meau
2.3.2 BMW site management					

Actions	Who	When	How	Budget (€)	Indicator of success
Implement sheep grazing from March to mid-April	CEN PACA + CA13	2015	Meetings	Negligible	No litter accumulation
OBJECTIVE 2.4 SPECIES SUPPORT					
Ex-situ Actions					
2.4.1 Removal from wild: April 2015; 50 nymphs 1st and 2nd instars, and in 2016 if necessary		2015-2016	Captures		
2.4.2 Complete life cycle in zoo	Bristol + Thoiry zoos	2015-2016	To be developed	Negligible	
2.4.3 Develop pathology and post mortem protocols					
2.4.4 Develop husbandry guidelines					
2.4.5 Develop criteria for splitting first captive population and/or further collection from the wild	Bristol + Thoiry zoos	Start 2015			
In situ Actions					
2.4.6 Plan for experimental wild-to-wild translocation program	CEN PACA	Start 2017	To be developed	To be determined	
2.4.7 Identify priority sites for reintroduction and design protocols,		Start 2019			
2.4.8 Assess management needs at priority reintroduction and translocation sites		2020			
Goal 3: Public awareness					
OBJECTIVE 3.1 PUBLIC AWARENESS					
3.1.1 Obtain resources	CEN PACA	Start 2015	To be developed	To be determined	
3.1.2 Develop communications strategy	IUCN/SSC	Start 2015			
3.1.3 Start Crau NNR Facebook page and website blog	CEN PACA	2015-2016			
3.1.4 Short film for TV etc.		2016			

[1] two observers visiting a 50m diameter circle for 1 hour, each circle are distributed systematically over the study area every 400m.

[2] two to four observers visiting a 50m diameter circle for 1 hour, each circle are distributed systematically over the study area every 100m.

[3] based on French student allocation: 440 € per month, i.e. 2640€ over 6 months

[4] packaging + replacement of 3-6 lost ibuttons (collecting temperatures in the field)

[5] based on 420€/day/person for CEN PACA people

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APPENDIX I

List of participants invited to the workshop and their presence (1-4 June 2014, Saint-Martin-de-Crau, France)

Stakeholders	Stakeholders info	presence	Monday	Tuesday
4RMAT (Colonel Cuvelier)	Landowner, subpopulation presence	yes	1	0
Defense ministery (Paillant)	In charge of partnership beteween Army and NGOs	no	0	0
Dreal (R. Rolland)	Ministry of ecology and funds	yes	1	0
IUCN France (Jean Boutin)	Vice-president of the French committee	yes	1	0
BMW (J. Dulong or supplier and M. Haller-Probst)	Landowner, subpopulation presence	no	0	0
CEN PACA (M. Maury, Ghislaine Dusfour)	In charge of species and habitat conservation	yes	2	1
CG13 (P. Susini)	Landowner and funds	yes	1	0
CDL (C. Guintini)	Landowner	no	0	0
M. Disdier (calissane herder)	Subpopulation presence	yes	1	0
C. Groulet (Peau de meau herder)	Subpopulation presence	no	0	0
Montpellier Zoo (D. Gomis)	Potential partner for *ex situ* rearing	no	0	0
Thoiry zoo (C. Gibault)	Potential partner for *ex situ* rearing	yes	1	1
CBGP (R. Streiff)	Genetic of the species	no	0	0
CBGP (A. Foucart, H. Jourdan)	Species specialist	yes	1	2
CEFE-CNRS (A. Besnard)	CR studies on the species and scientific partner	no	0	1
CA13 (F. Sauguet)	Grazing management	yes	1	0
LPO (P. Pilard)	Predation on the species by Lesser kestrel	no	0	0
Scientific committee RN Crau (T. Dutoit)	Restoration ecology in Crau since 15 years	yes	0	1
Natura 2000 (C. Rugari's student)	In charge of Natura 2000	yes	1	0
Ecole du Merle	Shepherds' school	yes	1	0
Alain Schall	Species observer since 1979	no	0	0
R. Minard	Old shepherd and teacher in the shepherds' school	no	0	0

Stakeholders	Stakeholders info	presence	Monday	Tuesday
Crau reserve (student and Etienne Becker)	In charge of species and habitat conservation, and sheep grazing	yes	2	0
CSRPN (S. Bence)	Invertebrates specialist in french mediteranean	no	0	0
N total stakeholders			14	6
Groupe criquet			5	5
PNR Alpilles			1	1
Total			20	12

APPENDIX II

Excecutive summery of P.h. rhodanica conservation status for workshop participants

Criquet de Crau (*Prionotropis hystrix rhodanica*)

– Statut de conservation –

Document à l'attention des participants à l'atelier de travail

du 2 et 3 juin 2014 à St Martin de Crau

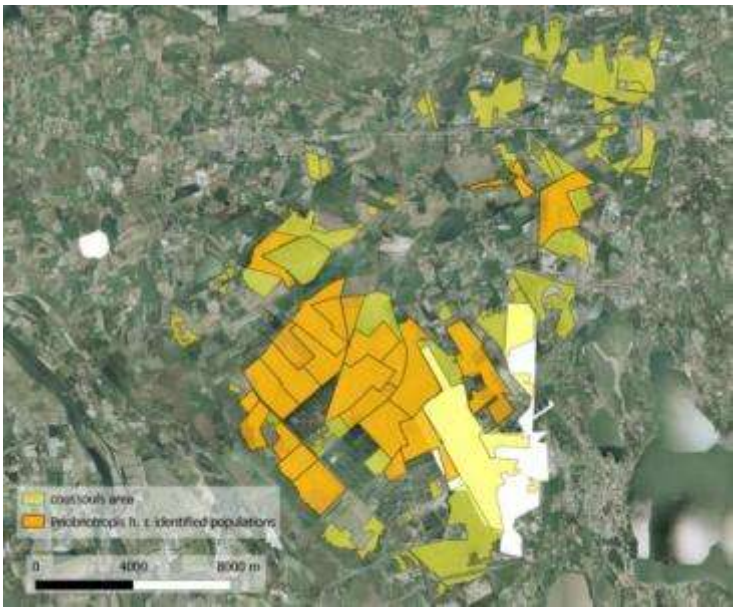
L'espèce

Le Criquet de Crau est un orthoptère présent d'avril à juin dont les ailes sont réduites, dont les capacités saltatoires sont restreintes et qui ne stridule que rarement. Malgré ses caractéristiques différentes des autres criquets, il est bien adapté à son habitat naturel, le coussoul. Capable de supporter de forte chaleur et de s'immobiliser à l'approche du danger, **il passe très souvent inaperçu**… C'est un criquet endémique de la Crau : il n'existe nulle par ailleurs au monde. A. Foucart et R. Streiff ont étudié sa biologie et sa génétique.

Son habitat

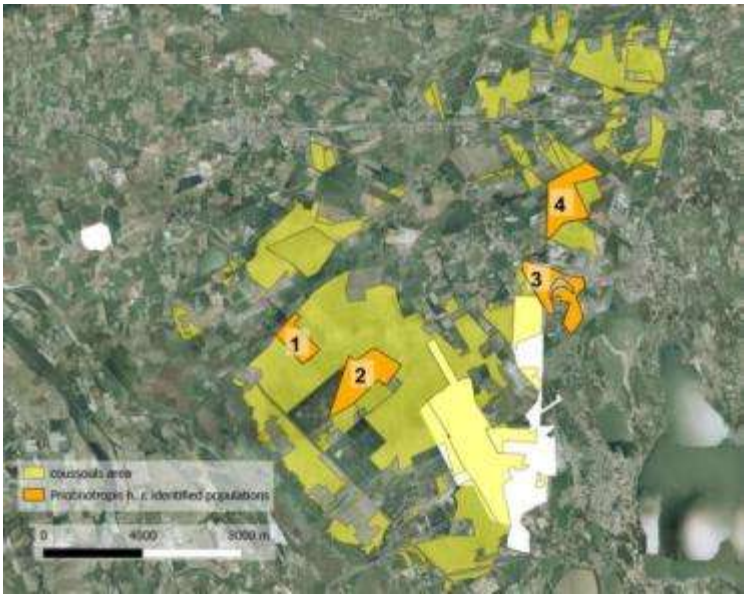
Le Criquet de Crau vit dans le coussoul : pelouse méditerranéenne de la Crau, unique par sa composition végétale. Cet habitat est un avant poste des steppes arides et semi-arides de l'Afrique du Nord et **unique en France**. La steppe de Crau est pâturée au printemps par 40 000 brebis réparties sur 46 places de pâturage dans la réserve naturelle des coussouls de Crau.

Sa distribution passée



Les observations des naturalistes et le patrimoine génétique du Criquet de Crau attestent de sa présence sur toute la steppe de Crau. Une diminution de sa distribution semble s'être engagée depuis les années 90 et accentuée dans les années 2000. Sa présence historique en Crau est en orange sur la carte ci-contre.

Sa distribution actuelle



Une étude de la présence du Criquet de Crau est menée depuis 2011 et atteste aujourd'hui d'une chute drastique de sa population. La carte ci-contre montre les 4 sites ou l'espèce est encore présente : Peau de Meau et Calissane (1 et 4, CEN PACA), Grand Carton (2, CG13) et BMW (3).

L'espèce est considérée comme « **en danger critique** » d'extinction.

Les menaces qui pèsent sur cette espèce

Aucune menace n'est clairement identifiée cependant, plusieurs hypothèses peuvent être dégagées :

- Disparition du coussoul (rupture pipeline, carrières, etc.)
- Maladies
- Changements climatique
- Prédation par le héron garde-bœuf
- Pression de pâturage / structure végétation
- Pesticides
- Autres…

Les actions entreprises

En 2013, un élevage *in situ* a été testé afin de connaître nos capacités à élever l'espèce en conditions contrôlées. Trois cages ont accueilli 24 criquets dont certains se sont reproduits. En avril 2014, il faudra contrôler la présence de descendants et estimer leur abondance pour pouvoir mesurer l'efficacité d'une telle action. Des études sont menées depuis 2011 par la réserve naturelle, en collaboration avec l'université de Trêves (Allemagne) depuis 2013.

Les lacunes…

Elles sont encore nombreuses sur cette espèce méconnue de la Crau. Par exemple, nous ne connaissons pas les capacités des œufs à rester en diapause dans le sol. La taille de population n'est pas connue avec précision. Les processus de dynamique spatiale de l'espèce sont inconnus ainsi que le processus de colonisation/extinction. Le régime alimentaire pourrait aussi être étudié.

La réserve naturelle

Elle existe depuis 2001 et est co-gérée depuis 2004 par le Conservatoire d'espaces naturels de PACA et la Chambre d'Agriculture 13. Elle a pour mission d'étudier, de protéger et de conserver à la fois le coussoul et les espèces qui y vivent, ainsi que de promouvoir le pâturage transhumant traditionnel. La préservation du patrimoine archéologique est aussi un enjeu.

APPENDIX III

Workshop programme

STRATEGIE DE CONSERVATION DU CRIQUET DE CRAU

Atelier de travail, 1-3 juin 2014, St Martin de Crau

Contexte

Evaluer comme « en danger critique » d'extinction par l'Alliance Mondiale de la Nature et de ses Ressources (IUCN), le Criquet de Crau ou Criquet rhodanien (*Prionotropis hystrix rhodanica*) est une sous-espèce endémique des coussouls de Crau. La diminution drastique de la population ces dernières années impose à la fois de réfléchir à des solutions pour lutter contre sa disparition et de rechercher les facteurs à l'origine de cette chute. Pour cela nous avons décidé avec le soutien et l'aide de l'IUCN de vous réunir afin de présenter cette espèce méconnue des acteurs du territoire et de réfléchir ensemble à une stratégie visant à éviter son extinction totale.

Programme

En gris clair = deux journées consacrées au groupe de spécialistes de l'UICN (Core Group) afin qu'ils s'imprègnent du site et de l'espèce. En gris foncée = journées ouvertes à tous dont la première est en partie consacré à l'observation du criquet.

Saturday 31 May – Arrival / Core Group Meeting (english language) ***Journée du groupe spécialiste UICN (en anglais)***	
12:00-16:00	Arrival & Accommodation arrangements
16:30	Field trip to Crau
20:00	Dinner

Sunday 1 June – Core Group Meeting (english language)	
09:00	Welcome and Introduction
09:30	Outlining the worskhop
10:00	Discussing Draft Vision for the Workshop
11:00	*Coffee Break*
11:30	Discussing Draft Goals
12:30	*Lunch*
14:00	Discussing Draft Objectives
15:30	*Coffee Break*
16:00	Discussing Draft Objectives
17:00	Field trip to the Crau
20:00	*Dinner*
Monday 2 June – Stakeholders' day (french language + english slides) ***Journée des acteurs du territoire (en français avec diapos en anglais)***	
9:00	Official welcome and opening remarks / *Messaged e bienvenue* *Jean Boutin and/or Marc Maury*
9:10	Introduction of all participants
9:20	What is the IUCN, the SCP-SC and the GSG? / *Présentation de l'UICN, SSC et GSG* *IUCN French Committee*
9:30	Biology and conservation of the Crau Plain Grasshopper / *Biologie et conservation du Criquet de Crau* *Antoine Foucart*
9:45	Strategic planning for conservation and objectives of the workshop / *Stratégie de conservation et objectifs de l'atelier* *Laurent Tatin*
10:00	*Coffee break / Pause café*
10:20	Historic and Current species distribution / *Distribution passée et actuelle de l'espèce* *Antoine Foucart*
10:30	Status assessment / *Evaluation du statut de conservation* *Laurent Tatin*
10:45	What are the threats on the species? / *Quelles sont les menaces qui pèsent sur l'espèce ?* *Laurent Tatin*
11:00	Discussion / questions
11:15	Discussing a Vision for the Strategic Conservation Plan / *Quelle vision à long terme définir ?*
11:30	Discussing Goals and Goal Targets for the Strategic Conservation Plan / *Quels objectifs à long termes pour la stratégie de conservation ?*
12:30	*Lunch / Déjeuner*
13:30	Field trip – observation of the species in Calissane experiment cages + species prospection /*Sortie sur le terrain avec observation du criquet*

16:00	Discussing Objectives of the Strategic Conservation Plan / *Quels sont les objectifs à court termes ?*
17:00	*Coffee break – Pause café*
17:20	Discussing Objectives of the Strategic Conservation Plan / *Quels sont les objectifs à court termes ? suite...*
18:45	Wrap-up / *Conclusion*
19:00	End of the day / *Fin de la journée*
20:00	*Dinner / Dîner*
	Tuesday 3 June – Scientifics and managers' day (english language) ***Journée science et gestion (en anglais)***
9:00	Introduction of all participants
9:10	Discussion on major objectives: I Conservation management *in situ*
10:30	*Coffee break*
10:50	Discussion on major objectives: II Conservation management *ex situ*
12:00	*Lunch*
13:30	Discussion on major objectives: III Monitoring
14:30	Discussion on major objectives: IV Research
15:30	*Coffee break*
15:50	Discussion on major objectives: V Outreach
16:30	Discussion on implementation: Funding
18:00	End of the workshop

Pour toutes questions relatives à cet atelier de travail, n'hésitez pas à contacter :

Laurent Tatin (chargé de mission scientifique à la RNN des coussouls de Crau)

laurent.tatin@cen-paca.org

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Agreement

The vision, goals and objectives of the Crau plain grasshopper's conservation strategy is shared by :

Scientific committee of the National Nature Reserve of the Crau
Date : October 22th
Signature :

Pr. Dr. Thierry Dutoit
President of the scientific committee

Region scientific committee of nature protection (CSRPN)
Date :
Signature :

Date : 24/03/2015
Signature :

Marcel BARBERO
Président du CSRPN PACA