



Spatio-temporal distribution of *Artemia* spp. in Salinas in the Camargue

Projet de thèse à la Tour du Valat, Centre de recherche pour les zones humides méditerranéennes

La Tour du Valat est un centre de recherche pour la conservation des zones humides méditerranéennes, basé en Camargue. Elle développe depuis de nombreuses années des programmes de recherche sur ces écosystèmes, propose des méthodes innovantes de gestion et sensibilise les décideurs. Fondation privée reconnue d'utilité publique, elle oeuvre dans tout le bassin méditerranéen.

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- UMR CNRS 5561 Biogéosciences
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Titre de la thèse : Spatio-temporal distribution of *Artemia* spp. in Salinas in the Camargue Salinalgue

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Montant : 2000 euros brut

Description du projet : voir Annexe

-Connaissances et compétences requises

Le candidat devra être titulaire d'un Master2 ou équivalent, avoir des compétences en écologie aquatique, en modélisation spatiale et en statistiques, une forte capacité à travailler sur le terrain et en équipe.

Une bonne maîtrise de l'anglais à l'oral et à l'écrit est indispensable.

Centre de recherche pour la conservation des zones humides méditerranéennes

Fondation reconnue d'utilité publique

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Un permis de conduire valide est indispensable.

Dossier de candidature:

- un CV détaillé (avec vos coordonnées complètes : adresse postale, électronique, téléphone)
- une lettre de motivation (où figure l'intitulé du sujet et le nom du directeur de thèse)
- un projet professionnel (de 1 à 2 pages)
- les relevés de notes et résultats en Licence, M1, M2, ou équivalent (veuillez indiquer votre classement et le nombre d'étudiants de la formation)
- lettre(s) de recommandation

Date limite de dépôt des candidatures: 10 août 2010

Description du projet :
Spatio-temporal distribution of *Artemia* spp. in Salinas in the
Camargue - Salinalgue

Objective

To model spatio-temporal patterns in species composition, production and distribution of brine shrimp in Camargue Salinas, as a basis for assessing the environmental hazards of planned algae culture in abandoned Salinas.

Context

Salinas are important habitats for the wildlife, especially through their secondary production function which support water bird populations, some of them with high conservation value. A large range of aquatic invertebrates develop in Salinas, among which the brine shrimp *Artemia* spp. During summer, populations of *Artemia* spp. (including one exotic species, *A. franciscana*) can reach high densities, up to 16 000 ind/m², in basins with salinity ranging between 70-210 g/l⁻¹ (Britton *et al.* 1986, Britton & Johnson 1987). These lipid and protein rich crustaceans are key food resources for breeding populations of Flamingo (*Phoenicopterus roseus*) and of the Slender-Bill Gull (*Larus genei*). To date, little is known concerning the environmental factors controlling the development and distribution of *Artemia* spp. and the relationships between the temporal and spatial distribution of *Artemia* prey and waterbirds.

Due to their large surface area and volume, Salinas are characterised by fairly predictable environmental conditions (water regime and salinity), in contrast to the hydrological fluctuations experienced by natural marshes (Masero *et al.* 2003). During dry years the relative proportion of the breeding population of Flamingo which is feeding in the Salinas instead of in other feeding sites can double as compared with normal years (26 => 53%; Béchet *et al.* 2009).

Many salt pans are currently being abandoned or transformed into intensive aquaculture projects due to decreased economic returns of salt production (Kurlansky 2003; Amat *et al.* 2005). After salt production is discontinued, salt pans usually become unsuitable for *Artemia* eventually, owing to conversion for aquaculture facilities or tourist development (Alonso-Villalobos *et al.* 2001), siltation (Aguilera & Gracia 2004) or due to a reduction in salinity resulting from the lost of marine water influx or from the impact of irrigation in surrounding areas. In the Camargue, there are plans to exploit abandoned Salinas for the mass culture of micro-algae that can then be used for biofuel, as a carbon sink, etc. In addition, due to its value as fish food, the North American species *A. franciscana* has been introduced to different areas of the Mediterranean and has already colonized salt pans from Portugal, Spain, France, Italy and Morocco, causing the local extinction of native *Artemia* species (Amat *et al.* 2005, 2007).

The development of the culture of micro-algae in abandoned Salinas will be first tested at a small scale. If successful the culture could be developed at large scale over surface areas of several thousand hectares. Although the range of salinity required for *Artemia* and the targeted micro-algae (*Dunaliella salina*) are similar, the culture of the algae will most likely require the reduction or destruction of populations of *Artemia* spp. as the dominant herbivore. The allocation of thousands of ha to the culture of microalgae would thus represent a significant loss of feeding habitat for birds species feeding on *Artemia* and could potentially harm their reproduction and ultimately the persistence of their populations.

The assessment of the impact of the surface reduction of Salinas due to the culture of micro-algae cannot be done directly as the number of birds affected is not necessarily linearly

correlated with the surface area of habitat or with the amount of resources available. Intra-specific competition can lead to a despotic distribution of few birds on the most productive areas (Gill *et al.* 2001). Therefore, a decrease in surface of the best feeding habitat can have a disproportionate impact on the population.

To predict the impact of the decrease in the surface area of Salinas available to Flamingo it is thus necessary to combine energetic models for birds (e.g. McCulloch 2003) with a behavioural approach aiming at identifying how birds are distributed according to resources and which birds (age, dominance, ...) will be the most affected.



Slender-Bill Gull



Breeding colony of Flamingo
in the salinas 10 000 pairs)

Expected research activities

- The accepted candidate first has to write out a detailed research proposal with time table indicating major milestones
- Salinas will be sampled frequently to follow the life cycle of inhabiting brine shrimp and accompanying fauna and for the assessment of environmental drivers (especially primary production).
- Frequent samples will also be used to determine spatial and temporal patterns in hatching, cyst production, standing stock of *Artemia* adults and cysts.
- Spatial and temporal patterns of energetic content and nutritional value of *Artemia* populations will be determined.
- Spatial and temporal patterns will be analysed with the appropriate statistical models and it will be attempted to build a model to predict impact of expected changes due to altered management schemes.

PhD project on *Artemia*

This PhD project will be run in close cooperation with another PhD student working on the bird (mainly Flamingo) populations. The aim of the *Artemia* project is to develop a temporal and spatial model of the density and biomass of *Artemia* spp. in the different active and abandoned Salina basins in relationship with management, salinity and hydrological conditions.

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