

2009

# Project for the Study and Conservation of Sand Dune Lizard



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Museo de La Plata

26/05/2009

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## BACKGROUND INFORMATION

### About the SDL

Five species of lizards occur in the coastal sand dunes in Buenos Aires province and the northern coastal region of Río Negro province, Argentina. These are *Liolaemus multimaculatus*, *L. wiegmanni*, *L. gracilis*, *L. darwini*, and *Stenocercus pectinatus*. All but *L. darwini* are known as sand-dwelling lizards due to their preference for sandy biotopes. In addition, *L. multimaculatus* and *L. wiegmanni* are highly specialized for life in the sand, and are accordingly clustered in a monophyletic assemblage of “sand-dwelling lizards” within the genus *Liolaemus*. However, only the populations of *L. multimaculatus* occur exclusively in these habitats, whereas the other four species have wider geographic distributions.



Historically, this species could be found throughout the marine coast of Buenos Aires; now, however, it has become hard to find in areas where it used to be abundant. Its habitat specializations make this lizard an “indicator species.” Indicator species reflect the “health” of the ecosystems they

inhabit and are the first to disappear when faced with serious alterations of their habitats.



*Liolaemus multimaculatus* is a small saurian, less than 70 mm long from snout to vent, with a flattened body and stout head. Its dorsal coloration shows a somewhat irregular pattern of dark spots in transverse series on a brownish background. The spots are outlined posteriorly by white scales, which give them a sand-like appearance. These lizards show evident sexual dimorphism in size and ventral coloration (males are larger and have scattered ventral spots). They usually are seen on dunes with low or sparse plant cover as they scurry away; when not in motion, the lizards are virtually undetectable; their coloration and texture is a perfect match for the substrate. To sand-bury and sand-swimming, these lizards require loose sandy substrate, which does not occur in areas with abundant vegetation, such as the those planted with exotic species such as pines (*Pinus* sp.) and Acacia (*Acacia* sp.).

### **SDL problematic**

This species is highly adapted to life in the sand. Its sand-bury and sand-swimming abilities and cryptic coloration attest to the close evolutionary ties between this lizard and the coastal dunes.



Its situation is even more critical given the severe alterations experienced by the coastal habitats in Buenos Aires Province, because it cannot colonize and survive in other habitat types. Studies carried out in a dune sector called “Mar del Sur” have shown that this species is highly sensitive to habitat alteration; minor disturbances such as the establishment of a trail for 4 x 4 vehicles can seriously affect its natural populations, causing a critical drop in population density and eventually leading to localized extirpation. This situation is clearly evident in the dune sector situated between the towns of Villa Gesell and Cariló, where this lizard was abundant no more than 10 years ago; today it is practically impossible to find in that area.

Due to their restricted distribution, their apparently low abundance and the man-made disturbance on their habitat,

the SDL has been categorized as vulnerable species (Lavilla et al. 2000). Previous studies demonstrated that anthropogenic factors such as habitat fragmentation and loss of native plant species in coastal dunes could be reducing the natural abundance of this lizard species, promoting local extinctions (Vega 2001). Currently there are only six remnants of natural dune areas in Buenos Aires Province that support populations of Sand dune lizards. Nevertheless, only one of these areas, namely Mar Chiquita Provincial Nature Reserve, efficiently protects one population of this lizard as a result of conservation actions (Kacolis et al. 2006).

Since 2005 a “**Sand Dune Lizard Study and Conservation Project**” is carried out. This project includes several actions like educational campaigns, researches about this species and their habitat and the promotion of management strategies for the coastal dunes habitats.

**Sand dune lizard is an endemic and vulnerable species that inhabits coastal dunes of Buenos Aires and Río Negro Provinces, with a total suitable habitat of approximately 20,000 ha. Their habitats are in critical status due to human impact. Moreover, populations are isolated by natural and human barriers, and some of these could be impede lizards interbreeding.**

There are several reasons that justify the urgent necessity of increase

information about SDL wild population and promote a conservation strategy. Suitable habitats for this lizard are still available. However, there is a lack of coastal Reserves and dunes areas are suffering a higher human impact due to uncontrolled tourism and develop of coastal cities. In this framework, there are some common questions: is the protection of SDL population possible? Which are the risks that need to be reduced? How can we help SDL?



The need to protect SDL population is clear. SDL must confront all risks associated to “small populations”. Small populations increase the likelihood of population extinction by environmental stochasticity (Miller and Lacy 2005). This lizard also must confront risks associated to very specialized species. Analyzing information about SDL habitat use and behavior we detected some causes that could be affecting wild populations. Because of that, we decided to initiate management actions with the aim to protect this lizard and their habitat. Our effort was focused on research activities and educational campaigns. Clearly, summer tourism and coastal cities

development is the most important cause of dunes habitat lost and fragmentation. Our work included population studies and educational actions.

In 2004, as part of a Ph.D. research program, a study of the population dynamics of this lizard was initiated. Due to its restricted distribution in dune islands, as well as its high degree of specialization for this particular type of environment, this species is an excellent model organism for basic ecological studies. Later, after considering the problems that affect this species, the project was expanded to include new aspects related to the protection of its relictual populations. The main goals of this project are: (1) **Locating, assessing, and monitoring the status of wild populations**, and (2) **providing the general public with clear information about its circumstances, and taking action to promote conservation strategies for this species in particular and the sand dunes in general**. This is accomplished by means of two interrelated programs, the research program and the educational program.

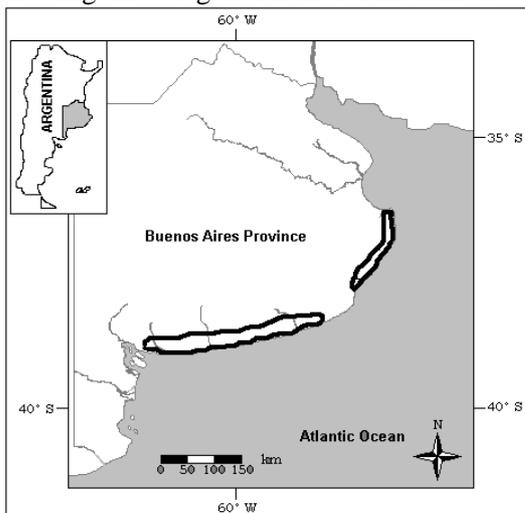
During the 2008-2009 seasons we generated new information about SDL ecology of great importance for the development of management tools. We also develop educational actions oriented to inform a lot of children’s, local people and tourists, about SDL and dunes problematic. **In this report we present work, techniques and results of the SDL Study and Conservation Project**

**between August 2008 and May 2009 in the Coastal Dunes, Buenos Aires Province, Argentina.**

### WORK SITES

The coastal dunes at Buenos Aires province are separated in two large dunes sectors, by a natural barrier (a hill), placed at the Mar del Plata city. These sectors are: (1) the “Barrera medianosa oriental” (located at the north-east of the province) and, (2) the “Barrera medianosa austral” (located at the south-west of the province) (Figure 1).

**Figure 1.** Map of the Buenos Aires province showing the two greats Barreras medianosas.



Both sectors also have other smaller barriers (naturals and humans) like rivers, towns and cities. Several of these sites had categories of Reserve, but only one, the Mar Chiquita Provincial Park, due to management actions, protects efficiently one SDL population. Mar del

Plata hills clearly divide SDL populations in two isolated groups without interbreeding possibilities, and the other smaller barriers could be also impeding the interbreeding between populations.



Monitoring of SDL populations were carried out in three sites placed at three large dunes sectors: Mar Chiquita Provincial Park (located at the Barrera medianosa oriental); Arroyo Zabála Provincial Park (located at the Barrera medianosa austral); and Balneario Marisol (located at the Barrera medianosa austral). The last area is recently considered like a possible place to make a new Reserve. Educational meetings were made in three coastal cities: Mar de Ajó, Villa Gesell and San Bernardo.

### RESEARCH ACTIVITIES

*Attempts to conserve Sand dune lizard populations will be successful only if data on the factors limiting their populations become available. Researches about the lizards' ecology are necessary in order to develop management actions for each dunes sector. We are worked on this aim*

the past 4 years with success. In this section we present results of the studies performed during spring and summer of 2008 and 2009.



### SDL population size

Knowing density and their change along time is important to understand population dynamics and viability. We successfully estimate the population size of SDL in three dunes sectors: 1) Mar Chiquita Provincial Park, 2) Arroyo Zabála Provincial Park, and 3) Balneario Marisol. Although the two first sectors are categorized like Natural Reserves, Arroyo Zabála Reserve has human impact due to unregulated transit of vehicles in dunes, whereas in Mar Chiquita, the Park rangers regulate this activity. The Balneario Marisol also has human impact due to vehicles transit. Density was estimated using Distance Sampling techniques. Previous results showed that this method is appropriated for this species in this habitat (allowing all model assumptions). We worked with a systematic line transect design. Transects

were of 1km length and were crossed by three observers until obtain a number of detections of at least 60 lizards (in order to generate robust models). We effectively obtain this number of detections in the three sectors. We work in summer of 2008 and 2009 under similar weather conditions. We prove several models to fit our data and select the better for density estimations (Table 1).

**Table 1.** Density estimations for three SDL populations. D=individuals/ha. LCI=Lower Confidence interval; UCI=Upper Confidence Interval.

	D	LCI	UCI
<b>Mar Chiquita</b>	5,4	3,6	8,1
<b>Arroyo Zabála</b>	5,6	3,8	8,2
<b>Balneario Marisol</b>	5,9	3,2	10,9

Results do not show important differences in lizards' density between sectors. However, in all cases, densities were low (following Zug et al. 2001, which consider low densities those lower than 10 individuals per hectare).

**Table 2.** Population size of each dune sector. Ha= total dunes hectares; LCI= lower Confidence Interval; UCI=Upper confidence interval.

	Ha	LCI	UCI
<b>Mar Chiquita</b>	3050	7625	15555
<b>Arroyo Zabála</b>	800	3040	6560
<b>Balneario Marisol</b>	5200	11440	23400

Although the three sectors have different human impact, we do not find important differences in lizards' density. These results could be indicating that: a) lizards are not highly affected by these disturbs, b) disturbs are not high enough, or c) that the effects are not reflected in lizard's density. More studies in dunes sectors with higher disturbs are necessary to corroborate the possible existence of any effect.

**Our results clearly indicate that densities are sufficiently low to take actions to protect this lizard.**



### **SDL Home Range**

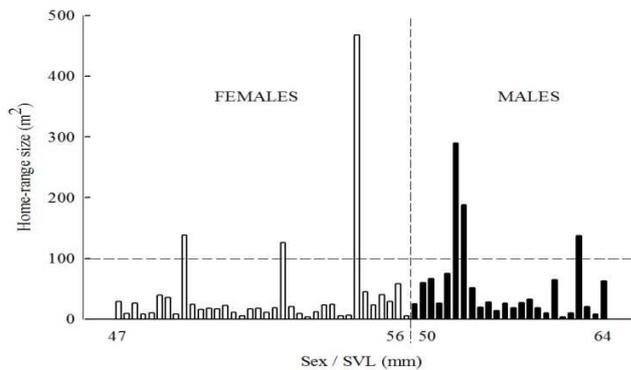
*The home range represents the space that individuals use to carry out their life cycles and is of great importance to understand social systems. With the aim of assess home range size and overlap in Sand dune lizard, we registered location, sex and size of lizards. Home range and overlap was*

calculated using the minimum convex polygon method.



Average home range size was different between sexes. For females the values was of  $21,31 \pm 17,59 \text{ m}^2$ , and for males they was of  $33,52 \pm 24,62 \text{ m}^2$ . Overlaps in lizard home ranges were high in all cases (between 22 to 58 %), and they not showed differences between males and females. As see in other lizard species (Perry and Garland Jr 2002), is probable that dominant males needs enough home range size to cover both: energetic and mate requirements (Figure 3).

A small number of lizards of both sexes showed extremely larger home range than the majority of the individuals, and this could be related with different hierarchies in the social system. Because *L. multimaculatus* is insectivorous and due its sit-and-wait behavior, it does not need to move around over large areas to find food, which in turn reduces the area necessary for it to live.



**Figure 3.** Figure 1. Home range for Sand dune lizard, showing individuals with areas larger than 100 m<sup>2</sup>. Individuals are arranged primarily by sex and secondarily by SVL.

### SDL Escape behavior

*The availability of shelters in a particular microhabitat has profound implications for the survival in small lizards* (Howard *et al.* 2003). With the aim to assess the main patterns of escape behaviour in the Sand dune lizard and their relation with habitat structure, we assessed the main patterns of escape behaviour.



We recorded: a) the distance from lizards to the closest bunch-grass (with a tape measure to the nearest 1 cm); b) the

distance run by lizards, before performing any escape strategy; c) the vegetation cover in the start and the finish points, in a plot of 1m<sup>2</sup>, and; d) the escape strategy used, 1) either to take refuge under a bunch grass, or 2) to bury into the sand. We compare the vegetation cover (VC) at the beginning and end point of one escape event in order to know which preferences had lizards during an escape event.



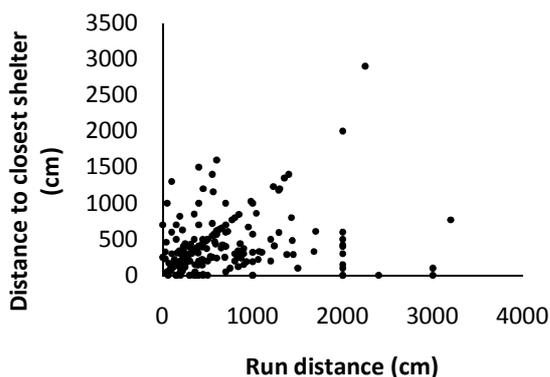
In the majority of the escape events, lizards run from habitats with low VC to habitats with higher VC. These preferences could be related with thermoregulation and the visibility offered by that kind of habitats (Kacoliris, unpub. data). A positive relation between run distance and distance to the closest shelter exists (Figure 4.). This could be indicating that lizards, independently of the escape strategy used, look for shelters at first time, even under a higher energetic cost of escape. In our study, we worked with two groups of lizards: those lizards that run until they took a shelter, and; those lizards that run until they buried under the sand. Results showed that no

differences exist with respect to the distance to the closest bunch-grass, between the two groups of lizards.



Given that avian predators are more abundant in sand dune lizard habitats than terrestrial predators, it is probable that the sand-bury behaviour appears mainly in response to the former kind of predators. Due to the fact that buries are superficial, and lizards use them after a race, individuals remain exposed and defenceless under the attack of terrestrial predators (like foxes or wild cats), which can easily dig up their preys, facilitating the capture. However, for avian predators, digging up lizards is probably more difficult. Further studies must be focused in testing this hypothesis, through experimental designs simulating the attack of both kinds of predators, terrestrial and aerial.

**Figure 4.** Relation between run distance and distance to the closest shelter.



## EDUCATIONAL ACTIVITIES

*The goal of these activities is to provide clear and understandable information about the severe threats affecting the Sand Dune Lizard and the coastal dunes. Results of the research program are conveyed to the local community in an effort to create a greater awareness about these issues. Using a conservationist approach, we emphasize information about the benefits of conserving the coastal natural resources.*



### Education campaigns

We made 3 educational campaigns since July of 2008 and May of 2009.

1. San Bernardo: August of 2008. We made a meeting in a School, about SDL and dunes problematic. Then we go to the field with the children to show some features of the SDL ecology and habitat.
2. Mar del Tuyu: November of 2008. We made a meeting in a School, about SDL and dunes problematic. Then we go to the field with the children to show some features of the SDL ecology and habitat.

- Villa Gesell: March of 2009. We made a meeting with local people about the importance to designate Natural Reserve the area placed near to Arroyo los Gauchos.



### Scientific meetings

We made two presentations that were exposed in the “VIII Congreso Argentino de Herpetología” that was carried out in San Luis Province (Argentina) during November of 2008:

- Molinari, A. E.; **F. P. Kacoliris**; J. D. Williams y A. E. Rafael. Selección de rasgos claves de la vegetación y comportamiento de escape en la lagartija de las dunas (*Liolaemus multimaculatus*). VIII Congreso Argentino de Herpetología. San Luis, Noviembre de 2008.
- Kass, C. A. ; **F. P. Kacoliris** y J. D. Williams. Uso del microhabitat por la lagartija de las dunas (*Liolaemus multimaculatus*) en un sector de la costa pampeana. VIII Congreso Argentino de Herpetología. San Luis, Noviembre de 2008.

### Diffusion material

We edit two kinds of diffusion posters about the problematic of SDL. These posters were distributed in several coastal cities and towns, principally in schools and communal buildings.



### Scientific material

We made 3 scientific articles about SDL ecology, using previous data, and data recorded during the 2008-2009 field season. These articles were sent for publication and yet are in revision.

- Kacoliris, F. P.**; Celsi, C. E.; Molinari, A. And Williams, J. D. How to elude predators? Features of escape behaviour in Sand dune lizard (*Liolaemus multimaculatus*). Sent to Studies on Neotropical Fauna and Environment.
- Kacoliris, F. P.**; Williams, J. D.; Ruíz de Arcaute, C. And Cassino, C.

Home range size and overlap in *Liolaemus multimaculatus* (squamata: liolamidae) in pampean coastal dunes of Argentina. Sent to Journal of South American Herpetology.

3. **Kacoliris, F. P.**; Guerrero E.; Molinari A. and Williams J. To swimming under the sand: observations about one particular behavior in the sand dune lizard (*Liolaemus multimaculatus*). Sent to Cuadernos de Herpetología.

We also made a Book chapter about the SDL conservation status:

- Chevez, J. C., and **F. Kacoliris**. 2008. Lagartija de las Dunas, p. 274-276. In J. C. Chevez [ed.], Los que se van. Fauna argentina amenazada. Tomo 1. Albatros, Buenos Aires, Argentina.

## MANAGEMENT ACTIVITIES

### IUCN Red List

We are working with the IUCN herpetologists group, in order to include the SDL in one of the IUCN Red List categories. We had enough information to support this goal and probably this year SDL will be included in the IUCN Red List in one threat category.

### Provincial monument

Coastal dunes at Buenos Aires province are in risk, and considering that: a) these habitats are categorized as Grassland Valuable Areas for South America (Bilenca and Miñarro 2004),

and; b) SDL is a charismatic species that show the health state of these habitats, because they are a good bioindicator of sand dunes state (Kacoliris 2007, Chevez and Kacoliris 2008), we proposed to pronounce SDL as **natural monument** of the Buenos Aires province. We are working with governments of Buenos Aires province and they are very enthusiastic with this goal. Governments sent this idea as “law project” to the parliament (expedient: E 311 2008 – 2009) and in this moment they are in evaluation by the “Ecology and Environment Commission” of the Senator Chamber of Buenos Aires.

### Arroyo los Gauchos Reserve

Balneario Marisol has been proposed as Natural Reserve in 2007. We are working in this objective with other conservation groups, and authorities are very enthusiastic with our proposal. For this reason we decide to evaluate population status of SDL in this sector. Although those procedures are slow, we think that this goal is possible. Marisol is one of the greater dunes sector that support SDL. Making this area a Natural Reserve, we assure a long-term survival of this species and its habitat.

## PERSPECTIVES

### SDL status

SDL status is critical because lizards densities are low, and they are highly specialized with respect to habitat and

microhabitat use. Small disturbs that affect the dunes in which lizards live, could promote local extinctions of lizards by the lost and fragmentation of suitable habitats. Main cause of habitat lost and fragmentation is the uncontrolled transit of vehicles because this activity destroys the native vegetation that SDL use like refuges and probably like nests.

### Needs in each study area



Mar Chiquita Reserve is the best site in which SDL are protected. Human disturbs are low, because Park Rangers work hard for regulate them. However, a lot of exotic forest exists in this area and they are in expansion. In these exotic forests, the main features of microhabitat that SDL prefer were changed. For this reason, SDL avoid these forests. **In Mar Chiquita, the main needs are to develop control strategies to stop and diminish the expansion of exotic forests.**

Arroyo Zabála is one of the larger areas in coastal dunes in which SDL exist. Although this area was named Reserve, they don't have Park Rangers, management plans and neither

conservation actions were made in this area. Disturbs are increasing year to year. **In Arroyo Zabála is necessary to make a strong educational campaign and to promote local authorities to regulate indiscriminate transit of vehicles in dunes.**

Marisol is a large area in which a large population of SDL can be protected. Although that disturbs exist in this area, they are still low. Authorities and local people are enthusiastic in making a Natural Reserve in this area. **In Marisol, besides regulation of vehicles in dunes, educational activities are needed to show local people the benefits on declaring a Natural Reserve in this dune sector.**

### FUTURE WORK



We need to continue the research, management and the educational activities. Future researches will assess the degree of isolation of each SDL population, effect of disturbs and isolation (fluctuating asymmetry) and evaluate the probability of extinction in

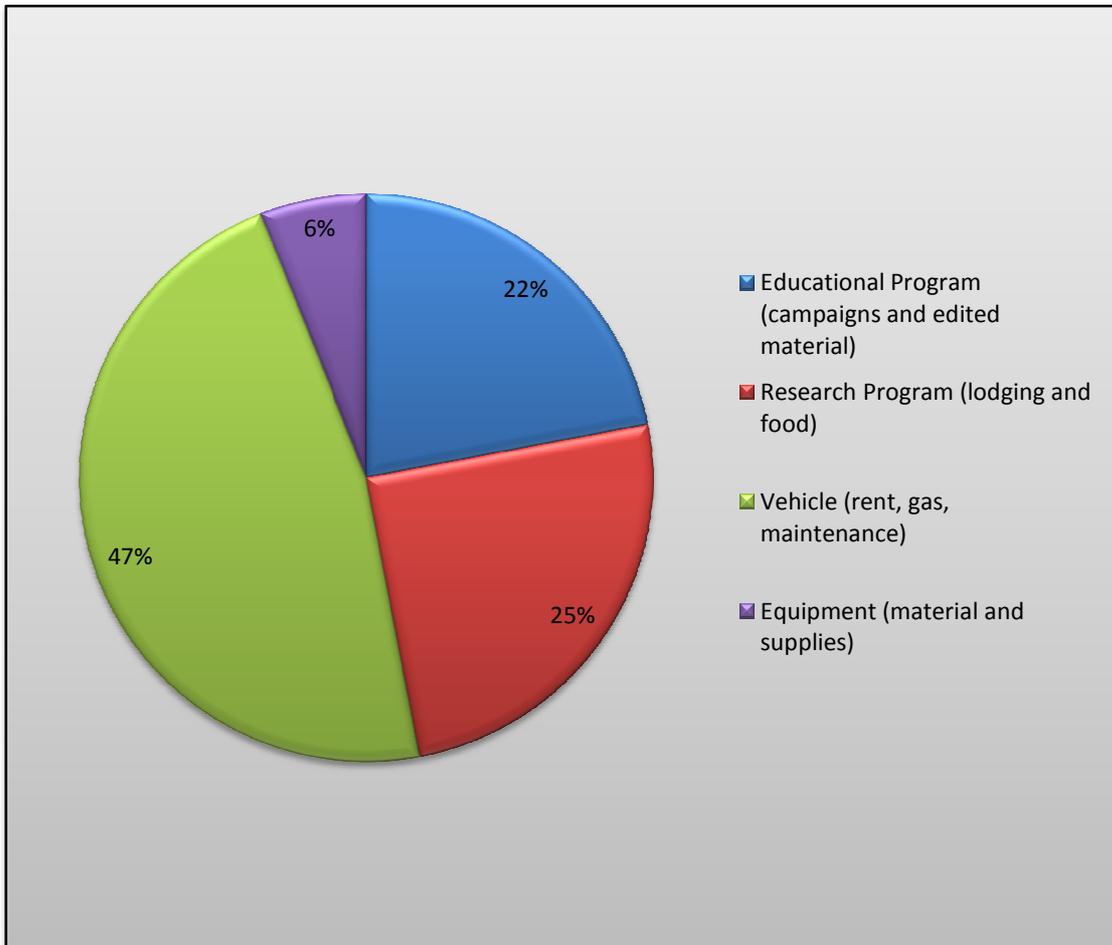
several scenarios through a population viability analysis). Educational activities will continue with the development of diffusion material, scientific material and meetings oriented to schools and local people. We need to work hardly with governments in order to promote actions oriented to the regulation of some disturb activities like the transit of vehicles. We also need to evaluate the possibility of carry out a plan of reduction of exotic forests and restoration of native grasslands in some dunes sectors like the Mar Chiquita Natural Reserve. We need to explore other dunes areas in order to evaluate, in a similar way, the SDL status and the main needs to promote their protection. This information is critical to generate an integral management plain that considers the needs in each sector.



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## Appendix 1 - Budget (£ 3,100)



## Appendix 2 – Field Crew

### Responsible

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Lic. Federico P. Kacolaris (MLP)

### Professional advisors

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Prof. Jorge D. Williams (MLP)

Dr. Arturo Kehr (CECOAL)



### Coordinators of field activities

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Alejandro Molinari (FCNyM)

Alberto Rafael (FCNyM)

Emiliano Guerrero (FCNyM)

### Field assistants

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Ana Laura Monserrat (UBA)

Celeste Ruiz De Arcaute (FCNyM)

Carla Cassino (FCNyM)

Belén Cabrera (UM)



MLP= Museo de La Plata

FCNyM=Facultad de Ciencias naturales y Museo

CECOAL=Centro de Ecología Acuática del Litoral

UBA=Universidad de Buenos Aires

UM=Universidad Maimónides