

Three years of zoological records at a Fog-site at Alto Patache, south of Iquique (Chile), during “El Niño” and “La Niña”(1997-2001)

Dr. Horacio Larrain, Universidad Arturo Prat and IECTA, Iquique; A. Ugarte, Instituto de Estudios y Publicaciones J. Ignacio Molina, Santiago; R. Pinto, Equipo de Estudios de Ecosistemas de Niebla, Iquique; P. Cereceda, Pontificia Universidad Católica de Chile; P. Lázaro, Gobierno Regional, Iquique; P. Osses, Pontificia Universidad Católica de Chile; R. S. Schemenauer, Atmospheric Environmental Service, Canada.

Abstract: The results of 3 1/2 years of studies at the Fog site of Alto Patache, in terms of zoological records and in situ observations, are analysed. The whole animal chain from big Mammals to minute Insects and Arachnoidea (Acarina), has been found present. Two main climatic periods are presented as showing different zoological response: a) the period of “El Niño” 1997-1998, under the influence of local rain, which produced a huge growth of many hectares of Plant cover, and b) the following dry period of “La Niña” 1998-2001, with no rain and lower temperatures. Along them, significant differences in number of Genera and Species were recorded. These zoological field observations are based on extensive entomological collections made in the field.

1. INTRODUCTION

Taking profit of weekly measuring visits of a Standard Fog Collector installed at the coastal hills of North Chilean Coast at Iquique, the authors describe the zoological records (particularly entomological) obtained at Alto Patache, 65 km south of Iquique (20°49'S; 70°09'W), at 800-860 m altitude, in a Fog site facing the sea and predominant S and SW Trade winds. The study began in July 1997, at the beginning of a strong ENSO event, and has been continued through February 2001, when “La Niña” coastal meteorological effects were still to be felt (Fuenzalida, 1985, 1992). The complete geographic isolation of the site at the time, and the extremely rare precipitation in the area (in the last twenty years, rains in the area have been only detected during 1983, 1984, 1987, 1992 and 1997), have permitted development in situ of very specialized groups of animals, according to the locally predominant weather conditions. In this article, these conditions and their results in terms of insect presence or predominance, will be explained in detail.

Climatic periods detected through Fog measuring

During more than three years of observations (July 1997- February 2001) and based on our weekly measurements of Fog catching in our SFC at the Fog site of Alto Patache, we were able to verify the presence of at least two major climatic variations along the main two atmospheric phenomena of “El Niño” and “La Niña”. First, “**El Niño” climatic effects**, were detected from July 1997 to March 1998, mainly characterized by high temperatures and a

short but significant period of heavy rains, fallen end of August 1997, in a small coastal segment, between Alto Patache and the fishing village of San Marcos (between 20°49'S and 21°10'S, South of Iquique). Second, “**La Niña” climatic effects**, were felt from April 1998 to February 2001, characterized by descent of temperatures, total absence of local rains, and increasing vegetal desiccation of the Fog area under study. Our weekly observations, were also able to detect some interesting differences between those years normally comprehended under the label of “La Niña” (April 1998 and February 2001), and those adscribed to “El Niño”. In some of “La Niña” years, we have recorded short periods of spring “**garúas**”, local name for heavy Fog precipitation at coastal places, able enough to moisten the rocky soils at the S and SW exposed faces of coastal slopes, producing Plant growth and development. These small differences, which may be of great importance for future studies in our area, are important in terms of local Plant growth and their concomitant Insect population.

2. METHODS

We have installed since 1997 and weekly controlled, during more than three years, three collecting systems: a) simple traps for Insect collecting (glass bottles with broad mouth, buried until the cap and provided with a special bait for attracting beetles), and, b) manual capturing through nets or searching under small rocks and plants, and c), occasional searching with night lamps. We have mainly concentrated on the first two capturing techniques.

The few identifications obtained from specialists, mainly refer to Coleoptera and Lepidoptera Genera and Species. Many other groups are still in process of identification.

The geographical area

The area is subjected to BWN type of climate. Among the 5 or 6 known Fog Oasis, lying between Pisagua and Loa River, we have selected this one for study, due to the presence of an abrupt road opened end 1995. Before that date, the site was completely unknown, and consequently, unvisited.

3. RESULTS AND DISCUSSION

Except for an occasional collection (Sielfeld et al, 1995), no one has studied the area from a zoological point of view before us. Peña's excellent taxonomic studies on Chilean Tenebrionidae (1971, 1973, 1995) were not yet familiar with these Fog areas. We presented our preliminary results in 1998. After three and a half years of field work, we have come to distinguish two quite different situations: a) those groups who appear under the direct influence of precipitation due to rain, and b) those groups not depending on occasional rain, but only on the deposition of Fog. Within this second group, we detected a substantial diminution of Genera and Species, particularly in the number of individuals

present. Heavy rains fallen in August 1997 caused in Alto Patache an enormous development of the herbaceous cover forming extensive prairies on rocky or sandy soils, and covering hundreds of hectares from 300 m up to 850-900 m high (Pinto, 1999). No less than 45 species of Plants have been here recently recorded by Muñoz and Pinto (Muñoz y Pinto, in press). In rainy years, the Insects contribute with several Coleoptera groups, distributed in 5 families: Tenebrionidae, Carabidae, Curculionidae, Melloideae, and Ptinidae (Table 1), being the family Tenebrionidae by far the richest in Genera, Species and individuals. There were also other groups, typical Plant visitors, present during "El Niño", like Hymenoptera, Hemiptera, Diptera, Lepidoptera (Table 2). Figures show the relative abundance of orders, genera and species in both periods: "El Niño" (1997-April 98) and "La Niña" (May 1998-2000). Many Coleoptera genera and species manage to survive during the driest periods of "La Niña", by drastically reducing their populations, or burying themselves in caves and subterranean galleries as adult forms (imagos), or depending on living lichens, the only vegetal edible species which remain alive and even vigorous any time, or, finally, nourishing on dry organic material left on soil surface, as Tenebrionidae and other Groups (like Tysanura), usually do. Finally, observations have been made concerning other different resident species of mammals, reptiles, birds, and terrestrial Gastropoda (Table 3).

Table 1 Coleoptera Genera and Species present during "El Niño" and "La Niña" at Alto Patache Fog Oasis

Family	Genus	Species	"El Niño"	"La Niña"
Tenebrionidae (10 species at least)	Psammotichus	loensis	++++	++
	Scotobius	planicosta	+++	+
	Nycterinus	borealis	+++	++
	Physogaster	globulus	++	+
	Phylorea	sp	++	+
	Phylorea	sp	++	(-)
	Phylorea	sp	+	(-)
	Thinobatis	sp	+	(-)
	Entomochilus	sp	+	(-)
	Entomochilus	sp	++	(-)
Carabidae (three species)	Calosoma	rufipennis	++++	+
	indet. 1	indet. 1	++	+
	indet. 2	indet. 2	++	+
	Indet. 3	Indet. 3		
Melloideae (two species)	Meloe	sanguinolentum	+	--
	Meloe	indet.	+	--
Curculionidae	indet. 1	indet. 1	+	+
Ptinidae	indet. 1	indet. 1	+	(-)
5	?	16	16	14

++++ extremely abundant ++ regular presence -- absent
 +++ abundant + scarce (-) very scarce

Table 2

Other Insect Groups present during “El Niño” and “La Niña” at Alto Patache Fog Oasis

Order	Family	Genus	Species	“El Niño”	“La Niña”
Hymenoptera (*)	Apidae	Indet.	Indet.	+	--
	“	Indet.	Indet.	+	--
	“	Indet.	Indet.	+	--
	“	Indet.	Indet.	+	--
Hemiptera (**)	Indet.	Several	5-6 spp.	++++	+
	Formicidae	Indet.	Indet.	+	(-)
	Sphecidae	Indet.	Indet.	++	--
	Scoloideae	Indet.	Indet.	+	+
Diptera (**)	Syrphidae	Indet.	Indet.	++	--
	Tabanidae	Indet.	Indet.	+	--
	Muscidae	Indet.	Indet.	++	(-)
	Tachinidae	Indet.	Indet.	++	--
Orthoptera	Acrididae	Indet.	Indet.	+++	--
	Gryllidae	Indet.	Indet.	++	+
Homoptera	Aphididae	Indet.	Indet.	+	--
Thysanura	Indet.	Indet.	Indet.	+	(-)
Lepidoptera	Nymphalidae	Vanessa	Carye	++++	(-)
	Noctuidae	Heliotis	Atacamae	Insuf. obs.	+
	“	Scania	Sp	Insuf. obs.	(-)
	Hesperiidae	Pyrgus	Bocchoris	++	(-)
	Sphingidae	Hyles	Annei	+	(-)
	17	No inform.	more than 30	more than 30	13-15

(*)not included microhymenoptera species. (**) not included several species present

Table 3

Other Zoological Groups present at Alto Patache Fog Oasis

Order	Family	Genus	Species	“El Niño”	“La Niña”
Mamifera	Camelidae	Lama	guanicoe	tracks	--
	Canidae	Pseudalopex	griseus	+	+
			domeykoanus		
Reptilia	Iguanidae	Microlophus	tarapacensis	+++	++
	“	Phrynosaura	reichei	(-)	(-)
	Gekkonidae	Homonota	sp	++	+
Aves	Accipitridae	Buteo	polyosoma	occasional	occasional
	Cathartidae	Cathartes	aura	++	++
	Falconidae	Polyborus	plancus	occasional	--
	Emberizidae	Sicalis	luteiventris	++	++
	Tyrannidae	Muscisaxicola	sp	+	(-)
	Furnariidae	Geositta	maritima	+	(-)
	Thinocoridae	Thinocorus	rumicivorus	occasional	(-)
Mollusca	Gastropodae	2 Genera	3 Species	+	--
	12	14	15	15	10

3. CONCLUSIONS

1. After three and a half years of field observations, we have controlled at Alto Patache the presence of several species of mammals, reptiles, birds, and snails. Among Insects, several species of Coleoptera, Lepidoptera, Hemiptera, and many other minor groups, including Diptera, Thysanura, Aphididae as

also species of Scorpionidae, Pseudoscorpionidae and Arachneae. The richest group, in number of species, is by far the family Tenebrionidae. Most of their representatives are endemic to the area as a result of severe geographical isolation.

2. During “El Niño” event, the number of animal species and individuals by square meter increases considerably when rains become present.

Lepidoptera and certain species of Coleoptera (**Calosoma**, **Psammetichus**, **Nycterinus**) practically invade the area, at the time when most Plants are in flower (October-November).

3. There is a strong relationship between rain, vigorous growth of Vegetation and Insect life, as it was expected. But even in years with no rain (during "La Niña" Period), many species manage to survive in the area, permitting their ecological study.

4. Insect life connect Alto Patache with south Peruvian ecological coastal zones, particularly in the Tenebrionidae and Carabidae Groups. Other Groups like Hemiptera, Hymenoptera, Lepidoptera, Diptera, seem to be related to or identical with those inhabitant the III Region (area Chañaral-Copiapó-Paposo).

5. Only with daily Fog, many Insect species (specially Coleoptera) manage to survive, probably feeding on lichens present at the top of the cliff exposed to the S.W. Winds.

6. Many dark clouds, however, still cover our knowledge on the way how Insects, specially Hymenoptera, and certain Coleoptera, manage to cross over the dry period of La Niña until the arrival of a new "El Niño", when wetter conditions and higher temperatures appear again. In the meantime, 4 to 7 years may well elapse.

Acknowledgements

Special thanks are due to Cia. Minera Punta de Lobos (Patillos, Iquique) for their continuous support in fieldwork activities. Also to our specialists, Dr. Julio Ferrer, entomologist, expert in Tenebrionidae (Stockholm), and Prof. Jürgen Rottmann, ornithologist, (Santiago), for his observations on the behaviour of coastal birds. To Prof. Mario Elgueta (Museo de Historia Natural), for his excellent disposition to identify specimens of Orthoptera and Curculionidae. We would be interested in getting in touch with specialists who may be able to fill the gaps still visible in our Tables. Finally, to Marta Peña, and our students who helped us in many ways in field work and collecting.

5. REFERENCES

- Fuenzalida, R., 1985: Aspectos oceanográficos y meteorológicos de El Niño 1982-83 en la zona costera de Iquique. *Investigaciones Pesqueras* (Chile), 32:47-52.
- Fuenzalida, R., 1992: Anomalías oceanográficas y meteorológicas durante el desarrollo de El Niño 1991-92 en la zona de Iquique (20°18'S). *Investigaciones Pesqueras* (Chile), 37:67-72.
- Fuenzalida, R. et al., (in press). Efectos oceanográficos y meteorológicos durante el evento El Niño 1997-98 en la zona de Iquique (20°S).
- Larrain, H. et al., 1998: Human Occupation and Resources at Alto Patache, South of Iquique. *First Congress on Fog Catching and Coastal Fog Research*, Vancouver, Canada.
- Larrain, H., 1999: Evolución anual de la entomofauna de coleópteros (Fam. Tenebrionidae y Carabidae) en el sitio Alto Patache, sur de Iquique (Chile). *XXI Congreso Nacional de Entomología*, Arica, Chile.
- Muñoz, M., R. Pinto et al.: "Oasis de niebla" en los cerros costeros del sur de Iquique (norte de Chile) durante el evento El Niño 1997-98: diversidad y relaciones florísticas. *Revista Chilena Historia Natural* (en prensa).
- Peña, L.E., 1971: Revisión del Género *Nycterinus* Eschscholtz, 1829. Coleoptera-Tenebrionidae. *Bol. Mus. Nac. Nat.* Chile, 32:129-158
- Peña, L.E., 1973: Nuevas especies del Género *Psammetichus* Latr, (Coleoptera-Tenebrionidae) para Chile y Peru. *Revista Chilena* 7: 137-144
- Peña, L.E., 1995: Revisión del Género *Physogaster* Guérin, 1834 (Coleoptera: Tenebrionidae: Physogasterini). *Gayana Zoológica*, 59(2):119-130
- Pinto, R., 1999: "Oasis de niebla" El Niño 1997. Una expedición botánica a los cerros costeros de Iquique. Imprenta Ograma, Santiago, Chile, 100 pp
- Sielfeld, W. et al., 1995: Información Preliminar sobre los Oasis de Niebla de la Costa de la Primera Región de Tarapacá. Universidad Arturo Prat, *Programa de Recursos Hídricos Naturales Renovables*, Iquique 56 pp