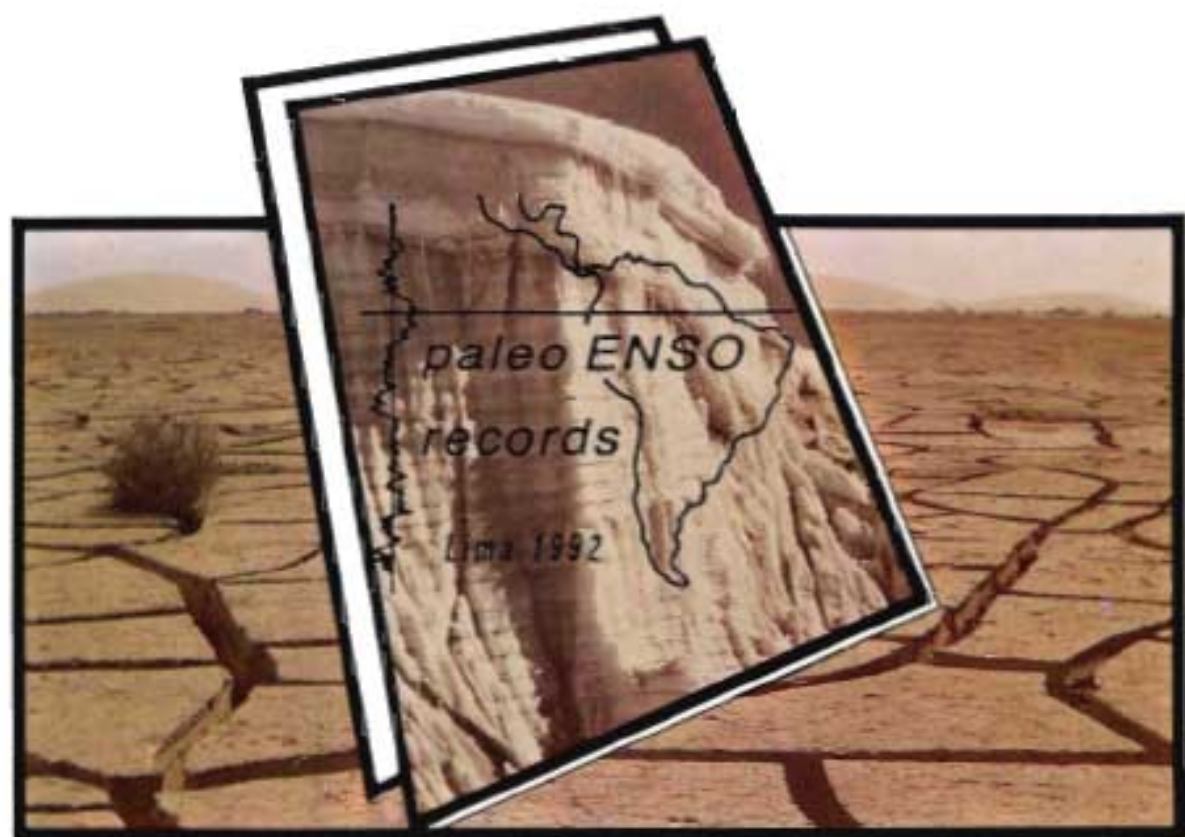


Paleo-ENSO Records international symposium

Extended abstracts

Volume prepared for the International Symposium on
Former ENSO phenomena in western South America: Records of El Niño events
organized by ORSTOM & Instituto Geofísico del Perú
Lima, 4-7 March 1992

L. Ortlieb & J. Macharé
Editors



ORSTOM

L'INSTITUT FRANÇAIS DE RECHERCHE SCIENTIFIQUE
POUR LE DÉVELOPPEMENT EN COOPÉRATION



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**L'Institut Français de Recherche Scientifique
pour le Développement en Coopération**

and

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CONTENTS

Aceltuno P. Anomalías de precipitación en Chile Central relacionadas con la Oscilación del Sur: Mecanismos asociados	1
Aceltuno P. & A. Montecinos Análisis de la estabilidad de la relación entre la Oscilación del Sur y la precipitación en América del Sur	7
Antunez de Mayolo S. Recurrencia del Fenómeno "El Niño" y el Titicaca	15
Balsley B. Large-scale digital signal processing for dendrochronology	21
Callenes R., E. Cárcamo & G. Florez Variabilidad de las condiciones oceanográficas en la sección de Paita (1965-1991)	25
Castillo F. & Z. Vizcalno Principales organismos fitoplanctónicos como indicadores biológicos del fenómeno El Niño en el Pacífico Colombiano	27
Chavez F. Phytoplankton, El Niño and the sedimentary record	39
Compagnuccl R. Are southern South America winters surface circulation normal during ENSO events?	41
Compagnuccl R. & M.A. Salles Southern South American anomalies in relation to surface circulation patterns during 1976-1977 ENSO event	47
Corte A. Present and past cryogenic conditions in South America	53
Craig A. Peruvian beach ridges: Are they a reliable ENSO indicator?	55
Dabrio C., C. Zazo, J.L. Goy, T. Bardajl, P. Silva & D. Polo Control of small-scale changes of sea level from coastal deposits in SE Spain	57
Del Carmen C. El Niño, lo complejo de su pronóstico y lo sencillo de minimizar daños y optimizar beneficios, un ejemplo milenario	61
Depetris P., W. Mook & S. Kempe The 1982 ENSO impact on the Parana River: evidence from stable isotopes	69

Díaz A. & L. Ortlieb	
El fenómeno El Niño y los moluscos en la costa peruana	73
Dueñas H.	
The Paleo-ENSO Record in the lower Magdalena Basin, Colombia	81
Dumont J.-F., F. García & M. Fournier	
Registros de cambios climáticos por los depósitos y morfologías fluviales en la Amazonía Occidental	87
Elera C., J. Pinilla & V. Vásquez	
Bioindicadores zoológicos de eventos ENSO para el Formativo Medio y Tardío de Puemape - Perú	93
Espino M.	
El Niño y su efecto en la dinámica poblacional de los principales peces demersales del Perú	99
Fairbanks R., J. Cole, M. Moore, L. Wells & G. Shen	
The variance spectra of the Southern Oscillation under different climatological boundary conditions	101
Ferreira R.	
Efectos del fenómeno El Niño en la flora y vegetación de la costa peruana	103
Francou B.	
Medidas de balance efectuadas sobre un glaciar en la Cordillera Central del Perú durante El Niño de 1983	107
Galindo I. & P. Mosiño	
Precipitation patterns in Mexico associated with the El Niño/Southern Oscillation (ENSO)	111
Grados M.C., E. Llata & M. Farfán	
Variaciones estacionales de la temperatura, salinidad y oxígeno disuelto en la superficie del mar frente a las costas del Perú y el fenómeno ENSO 1972-1973, 1982-83 y 1987	117
Grodzicki J.	
Los geoglifos de Nazca según algunos datos geológicos	119
Hisard Ph.	
Centenaire de l'observation du courant côtier El Niño, Carranza, 1892: Contributions de Krusenstern et de Humbolt a l'observation du phénomène "ENSO"	133
Hocquenghem A.M. & L. Ortlieb	
Historical record of El Niño events in Peru (XVI-XVIIIth centuries): The Quinn et al. (1987) chronology revisited	143
Huertas L.	
El fenómeno El Niño como factor desacumulante de la economía	151

Irlondo M.	Dinámica litoral en la costa ecuatorial durante el Holoceno Superior	155
Kaulicke P.	Evidencias paleoclimáticas en el Alto Piura durante el período Intermedio Temprano	159
Lagos P.	ENSO research in the Tropical South America: Future directions	165
Laos G.	Condiciones oceanográficas en la costa del Perú durante el año 1991	167
Laurent I.	El Niño, sequías y estrategias campesinas en el alto valle de Chancay 1940-1973	171
Lines A. & A. Mabres	Repercusiones del fenómeno El Niño en escenarios lejanos	173
Mabres A., R. Woodman & R. Zeta	Algunos apuntes históricos adicionales sobre la cronología de El Niño	175
Macharé J. & L. Ortlieb	Recent research on records of former El Niño events in Peru	177
Markgraf V.	El Niño/Southern Oscillation climate variability in South America paleo-environmental records	185
Martin L., M. Absy, M. Fournier, Ph. Mourglart, A. Sifeddine, B. Turcq & C. Volkmer Ribeiro	Some climatic alterations recorded in South America during the last 7000 years may be expounded by long-term El Niño-like conditions	187
Martínez J.O.	Geomorfología de la costa del Pacífico Colombiano y aspectos relativos a su estabilidad	193
Miguel E.	Variación de la estructura térmica del mar en el área del Callao	197
Mörner N.A.	Present El Niño-ENSO events and past super-ENSO events; effects of changes in the earth's rate of rotation	201
Moseley M., J. Tapia, D. Satterlee & J.B. Richardson III	Flood events, El Niño events, and tectonic events	207
Norte F.	Las nevadas en Mendoza (Argentina) y su teleconexión con el fenómeno El Niño	213

Ortlieb L., M. Fournier & J. Macharé Sequences of Holocene beach ridges in northern Peru: Chronological framework and possible relationships with former El Niño events	215
Paredes P. & J. Ramos Evidencias arqueológicas del "Niño" en las excavaciones de Pachacamac	225
Perota C. Cambios climáticos y la ocupación pre-histórica en la Amazonía	235
Perrier C., L. Ortlieb & C. Hillaire-Marcel Coastal evolution and El Niño impact in Santa area, NW Peru, based on isotopic composition of Holocene mollusk shells	237
Perrier C., C. Hillaire-Marcel & L. Ortlieb Isotopic record of recent and paleo-El Niño events on mollusk shells from NW Peru	245
Pizarro L. Características de la atmósfera frente al Perú durante 1990	251
Pourrut P. ENSO en Equateur: Incidence sur les pluies, les écoulements et le milieu	253
Prieto M.R. & J. Boninsegna Dendrochronological and historical evidences of climatic anomalies related to ENSO in south South America during the XVIII and XIX centuries	263
Quinn W. The large-scale ENSO event, the El Niño and other important regional features	265
Quispe J. La temperatura del mar en Puerto Chicama y el IOS 1925-1991	267
Richardson III, J. & J. Tapia The Holocene beach ridges of the Piura River and El Niño	273
Rodríguez R., A. Mabres, R. Woodman, B. Balsley & R. Phipps Avances sobre estudios dendrocronológicos en la región costera norte del Perú, para obtener un registro pasado del fenómeno El Niño	275
Sánchez A. Evidencia del fenómeno El Niño en los datos arqueológicos: avance de investigación	281
Sandweiss D. An archaeological perspective on the prehistory of "El Niño"	283
Schaedel R. Paleotechnology and flood control on the Peruvian north coast	285

Shen G., L. Linn, M. Price, J. Cole, R. Fairbanks, D. Lea, T. McConnaughey Paleochemistry of reef corals: Historical variability of the Tropical Pacific	287
Steinltz M., M. Nienaber & M. Riedinger The fossil diatoms of lake Yambo, Ecuador; a 2500 year record of intense El Niño events	295
Tarazona J. & C. Paredes Impacto de los eventos El Niño sobre las comunidades bentónicas de playa arenosa durante 1976-1986	299
Teves N. Erosion and accretion processes during El Niño phenomenon of 1982-83 and its relation to previous events	305
Thompson L. Reconstructing the Paleo Enso records from tropical and subtropical ice cores	311
Tomlíc J. Evidencias de eventos "El Niño-Oscilación del Sur" (ENOS) medianos y fuertes: Aparición de moluscos tropicales y subtropicales en bahías del norte de Chile	313
Uceda S. Evidencias de grandes precipitaciones en diversas etapas constructivas de la Huaca de La Luna, costa norte del Perú	315
Valverde M. & I. Trebejo Fenómeno "El Niño" en los últimos setenta años	319
Villagrán C. & R. Villa Historia de la vegetación de Chile Central: su relación con el clima cuaternario de la costa pacífica de Sudamérica	323
Vreeland J., Jr. Indigenous response mechanisms to periodic climatic disasters on the Peruvian north coast: Paleotechnological repertory in 1578	329
Woodman R. & A. Mabres Formación de una nueva línea de costa en Máncora durante El Niño de 1983	331
Late abstract :	
Cornejo M.H. Distribución y abundancia de quetognatos en aguas ecuatorianas durante febrero y diciembre de 1991	333

HISTORICAL RECORD OF EL NIÑO EVENTS IN PERU (XVI-XVIIIth CENTURIES): THE QUINN ET AL. (1987) CHRONOLOGY REVISITED

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El registro histórico de eventos El Niño en Perú: un reexamen de la cronología propuesta por Quinn et al. (1987) para el periodo s.XVI-s.XVIII.

Una cronología de eventos El Niño en el transcurso de los últimos 450 años ha sido elaborada por Quinn et al. (1987). Este registro, basado en una amplia compilación de textos históricos referentes a anomalías climáticas en el Perú, es de suma importancia para los estudios de periodicidad y de variaciones de intensidad del fenómeno El Niño, y empieza a ser ampliamente utilizado por numerosos investigadores del sistema ENSO (El Niño-Oscilación Austral). El presente trabajo consiste en revisar la cronología propuesta por Quinn et al., en base a los mismos textos referenciados por los autores (y agregando unos pocos), para el periodo s.XVI-s.XVIII. Este nuevo análisis crítico de textos nos lleva a confirmar la validez de la mayoría de los eventos propuestos en aquella cronología. En algunos casos, sin embargo, consideramos que los elementos disponibles no permiten determinar, con buena probabilidad la ocurrencia de un evento El Niño. En otros casos, por ejemplo cuando sólo se tiene una información aislada sobre una lluvia en Lima, o una crecida del río Rimac, consideramos que se requeriría datos adicionales antes de poder afirmar que estas anomalías corresponden a un evento El Niño. Por otro lado, la determinación de la intensidad de los eventos pasados El Niño sigue siendo un problema difícil de resolver, sobre todo cuando se tiene información parcial y geográficamente limitada.

INTRODUCTION

Quinn et al. (1987) developed a chronological series of the major El Niño events that might have occurred in the last 450 years. This was done through a compilation of historical sources, most of them concerning evidence of meteorological anomalies in Peru. The Quinn et al. (1987) study (further referred to as QNA) included estimates of event intensity, as well as a confidence rating in the evaluation of the event reconstruction. The QNA chronological reconstruction of the main ENSO events in the last few centuries is not the only one (see Hamilton & Garcia, 1986; Huertas, 1987), but it remains the most detailed and the most complete proposed so far. As such, it has been accepted by numerous authors working on paleo-ENSO record. Some researchers even based part of their studies on this chronology (e.g. Enfield, 1988; Enfield & Cid, 1990; Fairbridge, 1990; Nicholls, 1990).

There is a tendency to use the QNA chronology without taking into account some of the uncertainties that Quinn et al. originally expressed (cases with confidence rating of

Years	QNA, 87 Strength Confid	Major sources	Direct observ- ation	Concerned area of the reported phenomena	Inter- preta- tion	Ref. not seen	Remarks
1525-6	S 3	Jerez, 1534 [1968:197]	+	Colombian coast	*		See H & O., 1990; O. & H., 1991
1531	S 4	Jerez, 1534 [1968:200]	+	Piura	No		See H & O., 1990; O. & H., 1991
1532		Prescott, 1892 [1955:240]	-				
1539		Montesinos, 1642	-	Cuzco	*		dry weather in the Altiplano (Cuzco)
1540	M/S 3	Montesinos, 1642	-	Cuzco - Lima	*		Storm and hail
		Antunez de Mayolo (in QNA)	-	Lima (12.7.1540)	*		"Aguas" and red tide
1541		Cobo, 1653 [1964, t.1:90]	-	Lima	?		Rain, water running in the streets
1552	S 4	Moreno, in: Unanue, 1806 [1815:38]	-	Lima (13.07.1552)	?		1 thunder-clap & 3 lightnings during winter storm
1567		Cobo, 1639	-		*		
1568	S+	Portocarrero, 1926:84-85	-	Coast	*		floods in all the Peruvian rivers [source of original information?]
		Oliva, 1631	-	Equatorial Pacific O.	*		Panama-Lima trip in 26 days (arrival in Lima on 25/3/1568)
		Portocarrero, 1926:84-85	-	Coast	*		floods in all rivers, great damage [from which source?]
1574	S 4	García Rosell, 1903	-	Piura la vieja	M		Rain, [should not be strong because not remembered in 1578]
		Huertas ms, 1987	+	Lambayeque, Trujillo			Rains during two months
1578	V/S 5	Cabello Balboa [1951:222-224]	+	Trujillo	VS		Very strong event, never seen before
		Lizarraga [1986 ch.XVII:14-15]	+	Chicama-Trujillo			
		Acosta, 1590 [1954:82]	+	Trujillo			
		Cobo, 1653 [1964, t.1:90]	-	Trujillo			
		Cobo, 1639 [1964, t.2:311]	-	Lima			Rimac flood
		García Rosell, 1903	-	Alto Piura			
1591-2	S 2	Martínez y Vela, 1702	-	Potosí	*		dry weather in Bolivia
1593		Lizarraga, 1968:14-15	+	Trujillo	S		Storm ("tazac"), not as strong as 1578 event
1594		Lizarraga, 1968:14-15	+	Trujillo	(M)		Storm and lightning, rains
1596		Ocoña & Alvarez, 1969:28	+	Paita	M		Heavy rainfall in Paita area and formation of a pool on the tablarzo
1607	S 5	Cobo, 1639 [1964, t.1:213]	+	Lima (February)	?		Rimac River flood, and destruction of a bridge at Lima
1608		Palma, 1894 [1964:41]	-	Lima	?		Rimac River flood
1614	S 5	Cobo, 1653 [1964, t.1:90]	+	Chancay (Feb./March)	?		Rainstorm, rain from the Sierra according to Cobo
1618	S 4	Vasquez de Espinoza, 1629	+		*		
1619		Cobo, 1653 [1964, t.1:90]	+	Ilo (June)	?		Lightnings and winter storm like in 1552
1624	S+	Cobo, 1653 [1964, t.1:90]	+	Zaña, Trujillo	S		Rain and floodings
1634	S 4	Suardo, 1634 [1936:13-15]	+	Lima (Feb./March)	?		River floods south of Lima, rainstorm in Lima, flood in Arica
1652	S+	Cobo, 1653 [1964, t.1:90]	+	Lima (February)	?		Rainstorm, rain from the Sierra according to Cobo
1660	S 3	Portocarrero, 1926:84-85	-	Supc	?		Supc River flood [original information from which source?]
1671	S 3	Portocarrero, 1926:84-85	-	Supc, Rimac	?		Rimac and Supc river floods [source of original information?]
1681	S 3	Rocha, 1681	+		*		
1686		Schöpsmann ms, 1988	+	Yapatera, Alto Piura	M		Continuous rains that cause destruction
1687	S+	Remy, 1931	-	Lima (2.12.1687)	?		Strong storm that causes destruction
1688		Melo, 1913; Taulis, 1934	-		*		
1696	S 3	Palma, 1894 [1964:42]	-	Lima (11.2.1696)	?		Rimac River flood

1701	S+	4	Feijoo de Sosa, 1763 [1984.1:157] Bueno, 1763-1778 [1951:50] Unanue, 1806 [1815:38-39]	+	Trujillo Trujillo Trujillo	S	Thunderstorm
1707	S	3	Cooke, 1712	+	•	•	
1708			Alcedo y Herrera, 1740	+	•	•	
1714	S	4	Gentil, 1728	+	•	?	Chili: River flood
1715			Portocarrero, 1926:84-85 Labarte, 1914	-	•	•	
1720	S+	4	Rubio y Andrade ms, 1782 Shelvoke, 1726 [1971:103] Feijoo de Sosa, 1763 [1984.1:160-161] Bueno, 1763-1778 [1951:50,53] Palma, 1804 [1964:1151]	+	Zana Paiza (March) Trujillo Zana and valleys Lima	S	Zana River flood, rains during at least two weeks Heavy fog "Not as strong as 1728": important remark "Stronger than 1728": see above Thunderstorm
1728	VS	5	Asson, 1740 [1974:178] Juan & Ulloa, 1748 [1978:22] Feijoo de Sosa, 1763 [1984.1:157-164] Alcedo 1786-89 [1987.t.3:344] Lequanda 1793:168-169	+	Paiza Chochope Trujillo Paiza, Zana Piura	VS	Destruction of the port They made a confusion between 1728 and 1726, 40 days of rain Event stronger than 1720 Zana ruined, damage in Paiza Destruction in the city
1747	S	5	Feijoo de Sosa, 1763 [1984.1:163] Moreno, in: Unanue, 1806 [1815:38] Schlipmann ms, n/d	-	Trujillo Lima Sancor Alto Piura	S	Rains (2 days) in Trujillo and more to the south Thunderstorm Heavy rain
1748			Stevenson, 1825:177-178	-	Chochope		Rain during 11 nights ("and no rain until 1812": not to be trusted!)
1761	S	5	Bueno, 1763-1778 [1951:39]	+	Santa	?	Santa River flood: was it related to EN conditions?
1775	S	4	Puente, 1885	-	•	•	Rimac River flood
1785			Portocarrero, 1926:84-85	-	Lima	?	
1786	S	4	Labarte, 1914 Estrada Icaza, 1977	-	• •	• •	Rimac River flood
1791	VS	5	Mercurio Peruano 7/8/1791 Ruschenberger, 1834 Paz Soldan, 1862 Spruce, 1864:29 Tavara, in: Equiguen 1894:247-248	+	Lima Lambayeque (march) Piura Piura	S	Lambayeque River flood In 1864 the last strong event remembered is the 1791 event

Table 1. Revised Quinn et al. (1987) chronology of El Niño events (XVI-XVIIIth centuries): see text for explanation. For bibliographical references see Quinn et al. (1987) and this abstract (shaded references).

2 and 3). Because of the importance of such a chronology, especially for studies on the recurrence of the phenomenon in a recent past, it is surprising that the QNA study did not foster more contradictory works. Actually we do not know of studies that pointed to adjustments of the QNA chronology, aside from the two short notes that we previously published (Hocquenghem & Ortlieb, 1990; Ortlieb & Hocquenghem, 1991). In these short papers, we first focused on the evidence concerning the years 1525-26 and 1531-32 and suggested to eliminate the first two events of the sequence of historical El Niños, and in the second one we expressed some doubts about the intensity determined by Quinn et al. for some events of the XVI-XVIIth centuries and about some criteria used in the determination of former occurrences of El Niño events in Peru. Here, we proceed with our critical re-examination of the sources mentioned by Quinn et al. for the period extending to the early XIXth century. Our analysis is presented in the form of a table where we discuss the validity of the sources, the localities where facts were reported, the possible occurrence of El Niño events and their potential intensity.

METHODOLOGICAL APPROACH

Our study aims to reinforce the QNA chronology through a new and independent evaluation of the main published historical sources. The emphasis is put on a critical reading of the texts that mention meteorological (or more exceptionally: oceanographical) anomalies possibly related to El Niño occurrences. For each El Niño event mentioned in the QNA chronology, we first intended to reconfirm the occurrence of the phenomenon, and also tried to evaluate the relative strength of the events. In a few instances, we appended new relevant data.

We basically used the sources cited by Quinn et al. (or took the original version in Spanish). In a few cases, we did not find the texts referred to by these authors (see asterisks in but last column, Table 1). Quinn et al. did not provide the precise location of the relevant information in the texts, but we considered useful to include in Table 1 the number of the pages (and year of edition) of most of the published sources. New references on evidence of events and new descriptions of impacts of former El Niño events include those of Suardo (1936), Lequanda (1793), Lizárraga (1968), Ocoña y Alvarez (1969), Huertas (1987), Schlüpmann (1988), and Stevenson (1825). For the issue concerning the 1525-26 and 1531-32 "events", we had previously referred to a series of texts, not mentioned by Quinn et al., that contradict their interpretation of former occurrence of the phenomenon; we shall not repeat here this discussion and the references herein (see: Hocquenghem & Ortlieb, 1990).

For the reconstruction of a paleo-ENSO chronology, we considered that direct eyewitnesses, or at least authors who wrote shortly after the occurrence of the concerned events, were necessarily more reliable than writers that lived one, two, or three, centuries later. Thus, we distinguished firsthand, from indirect, historical sources (respectively, "+" and "-" in Table 1). We considered as indirect sources those that repeated previous information, even if they did not acknowledge their own sources (in some cases these can be determined unambiguously, notably when the same words were used). We surmise that the mention of such secondhand references is of little help, if not misleading, and should be avoided for clarity-sake. As an example of multiple citations, we can cite the case of the 1720 event, for which it is clear that Petersen (1935) took his information from Remy (1931), who himself cited Unanue (1806), who himself referred to Feijoo de Sosa (1763). In such

cases, we decided to eliminate all the secondhand informants, and keep only those who provided truly original information (Table 1). The indirect writers that were retained in Table 1 are those who provide otherwise unreported data which we did not want to discard totally (until contradictory information is acquired). An asterisk, in the same column ("Direct observation"), simply means that we did not get access to the source referenced by Quinn et al.

We observe that many QNA El Niño events have not been documented by evidence from the northern Peruvian coast, and we are particularly concerned by the possibility that some stronger than usual "garua" rains falling on Lima may not indicate any El Niño event. When the reported rains or lightnings, occurred in winter (July), we wonder whether this information does not rather point to strengthened "anti-El Niño" (inappropriately called by some authors "La Niña") conditions. Furthermore, we hesitate to give much credit to the indication of any isolated rainstorm in Lima or in central Peru, as evidence of strong El Niño events.

Another commonly called for argument used by Quinn et al. is the mention of Rimac River floods. But the recent history of exceptional floods ("huaycos") of the Rimac River seems to exclude a direct correlation with El Niño conditions (Hamilton & Garcia, 1986; Ibañez & Gomez, 1990). These floods, which may be catastrophic are related to storms that anomalously cross the high Andes east of Lima, and not to rainfalls linked to Pacific Ocean atmospheric circulation.

Thus, we scrutinized the cases for which available data concern exclusively the central coast of Peru (mainly Lima) from those which referred to the northern coast (Piura, Lambayeque, Trujillo), and also specified the date of the reported phenomena (Table 1).

The determination of former El Niño strengths, on the basis of historical sources, remains a major problem. Quinn et al. considered four categories of events: VS (very strong), S (strong), M (moderate), and W (weak), but recognized almost exclusively VS and S events for the period anterior to 1800 AD. In a few instances, they were able to distinguish S from S+ (slightly more than strong) events, and moderate events. By using essentially the same sources referred to by QNA, we have been more circumspect. Recent studies (Huertas, 1987) have shown that the intensity of the El Niño phenomenon varies geographically within the northern coast of Peru, in such a way that one event may be viewed as strong in Piura and weak in Trujillo, or vice-versa. Consequently, in the (most common) cases where the information is geographically limited, it is particularly uneasy to appraise the strength of former events.

We tend to infer that the moderate events only affected the northern coast of Peru, namely the Piura area, and that the strong and very strong events had noteworthy impacts in a wider geographical area, that encompasses the Lambayeque-Zaña and Trujillo areas. For obvious reasons, the strongest events are the best documented, and therefore are easier to characterize in terms of intensity. Actually, we tend to confirm the intensity evaluation for almost all the VS events defined in the QNA chronology, but are more reticent regarding the S events.

CONCLUSIONS

Two major problems arose from our critical analysis. One deals with the identification of former El Niño events on the basis of data concerning exclusively the central and southern coast of Peru, and the other one is the appraisal of the strength of former events. We expect that discussions in the Paleo-ENSO Records symposium will help to resolve, or at least bring new elements to solve, these two questions.

Practically, this re-examination of the QNA chronology tends to indicate that it is probably still untimely to use the sequence of paleo-El Niño events as a solid basis for recurrence studies of the phenomenon. We interpret that some of the El Niño events included in the QNA chronology probably did not occur, and that some others were possibly less strong than as determined by Quinn et al..

From our analysis (including our previous studies), it seems well established that no major rainfalls occurred between 1531 (inclusively) and 1574-78 in the Piura region (we reassess here that no El Niño event occurred in 1531-32). Therefore, we interpret that the first well-identified, strong or very strong, El Niño event is the one of 1578. At the end of the XVIth century, there are several indications of rains and storms in northern Peru, but it would be unrealistic to consider that several successive (1591-1596) years could be El Niño years (Table 1).

For the XVIIth century, we did not find unambiguous indication of strong or very strong El Niño event (while the QNA chronology includes 11 S or S+ events !). Only two El Niño events appear well documented: one (possibly strong) in 1624, and another one, previously unrecognized, in 1686 (which may have been only moderate ?).

In the XVIIIth century, a very strong event occurred in 1728, and four strong events were registered in 1701, 1720, 1747-48 and 1791. The 1747 event recognized by QNA probably encompassed 1748, according to new data. For the XVIIIth century, Quinn et al. had considered two VS events and 8 S or S+ events.

For future research, we strongly suggest to focus on unpublished manuscripts that concern Piura and Trujillo, like those transcribed by Huertas (1988) and Schlüpman (1988). This type of previously unreleased information presents the highest potential for a better estimation of the strength of former El Niño events.

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Contribution to IGCP Projects 281 and 252.

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**FORMER ENSO PHENOMENA IN WESTERN
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This is to certify that **Anne-Marie Hocquenghem** attended the International Symposium on "Former ENSO Phenomena in Western South America: Records of El Niño events", held in Lima, 4 – 7 March 1992.

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