

**Field Report: Investigation of
September 2, 1992 Nicaragua Tsunami**

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QUICK RESPONSE RESEARCH REPORT #66

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FIELD REPORT: INVESTIGATION OF SEPTEMBER 2, 1992 NICARAGUA TSUNAMI

A RESEARCH FOCUS

On September 2, 1992, A tsunami was generated by a 7.0 magnitude earthquake off the Pacific coast of Nicaragua (see Figure 1). The research focus was on determination of societal impacts with particular interest on relationships between land use and damage patterning as well as integrative and secondary impacts. A related issue to be investigated pertained to the impact of access/transportation configuration on response.

METHODOLOGY

A coastal region of approximately 200 miles along Nicaragua coast suffered damaging effects. During the six day trip, it was possible to visit 15 of the 24 communities in the impact area. At each location damage was surveyed and photographed. Unstructured interviews were conducted with approximately 30 survivors. Information was recorded on a questionnaire prepared with the USGS/National Earthquake Information Center (see Appendix A for English and Spanish translation of questionnaires).

A regional planner from the Instituto Nicaragunse de Estudios Territoriales (INTETER) accompanied us. The multi-disciplinary team was a joint team sponsored by EERI and independent tsunami investigators (see Appendix B for the names of the U.S. team members and a list of local contacts).

FIGURE 1

NICARAGUA TSUNAMI IMPACT AREAS



EARTHQUAKE DATA:

Date of Occurrence: 9/2/92
Magnitude: 7.0 Ms
Location: 11.6 N 87.4 W

FINDINGS

LAND USE IMPACTS

Primary land uses affected were residential and tourism with one port (industrial use).

Tourist communities are of two types planned and unplanned. In the planned communities, structures have been built in accordance with quality based standards. These structures for the most part suffered damage - but were not destroyed. The tourist facilities (restaurants) are being rebuilt rapidly. No reconstruction or repair was observed on second homes.

The most severe residential damage was to unplanned communities where structures were primarily built by the occupants through the informal sector. These structures were for the most part totally destroyed. A related hardship was that many homes were occupied by fishermen who lost their boats i.e. source of livelihood.

The Pacific Coast is a rural area inhabited primarily by fishermen and farmers. Approximately 1,300 primary houses were destroyed. Approximately 14,500 people living in extended multi generational families were displaced.

According to INETAR, almost 100% of the displacees are in temporary refuge. On-site investigations indicate some people are filtering back to their houses *if* the wells have not been contaminated. Because of the warm climate, they can "make do". Refugee resources, therefore, most heavily needed are food and water purification. The hardest impacted communities are those where the wells were contaminated (by latrines and/or salt water). In these communities a cholera outbreak has occurred.

Deaths were overwhelmingly children who had been put to bed and were washed away while sleeping. The other category of fatalities was primarily fishermen who were also asleep (since they put out to sea around 4 AM). No women fatalities were documented.

REBUILDING AND REPAIR

Tourist/Resorts

Many of the restaurants were "open air". By the time of the visit 10 days after the event they had been cleaned up and had replaced tables and chairs. Small beach side hotels which had been fairly well-maintained were being repaired i.e. large doors and windows being replaced. No activity, or site clearance activity was occurring on the

more severely damaged structures. No rebuilding or repair was observed on second/vacation homes.

Residential

Several different techniques were observed. In the most severely impacted (and poorest) communities, the Nicaraguan government was actively involved. The following were noted:

- Salinas Grande a gathering was held on Tuesday September 15, 1992, to distribute lots.
- Transito new home sites were being identified on Saturday, September 19, 1992.
- Families whose homes were destroyed in Papoyo were being relocated to 11 concrete prefabricated homes in El Astillero. Six were under construction on Friday September 18, 1992. In addition, a newly plotted subdivision for 25 homes to be built in Salinas (with lumber donated by Costa Rica) had been laid out.
- In Casares no decisions had been made because the government wanted new houses to be built approximately 1 kilometer inland. The fishermen who wanted to remain on the water in order to be near their boats were very angry. They would also have preferred assistance in replacing their boats - instead of housing.

RESPONSE

There is no continuous access along the coast. Rather there is one major highway with roadways radiating from the capital city in each district. Thus, communities with similar effects and geographic proximity are often several hours separated in terms of travel time.

In addition to discontinuous routing, the majority of roads leading to the coastal villages i.e. the non-tourist centers, are unpaved. The six categories of roads in Nicaragua are listed below. See Figure 2 for locations.

FIGURE 2
NICARAGUA ROADWAY NETWORK

— ALL WEATHER HARD SURFACE ROADS
 - - - ALL WEATHER LOSE OR LIGHT SURFACE ROADS
 — FAIR OR DRY WEATHER LOOSE SURFACE ROADS

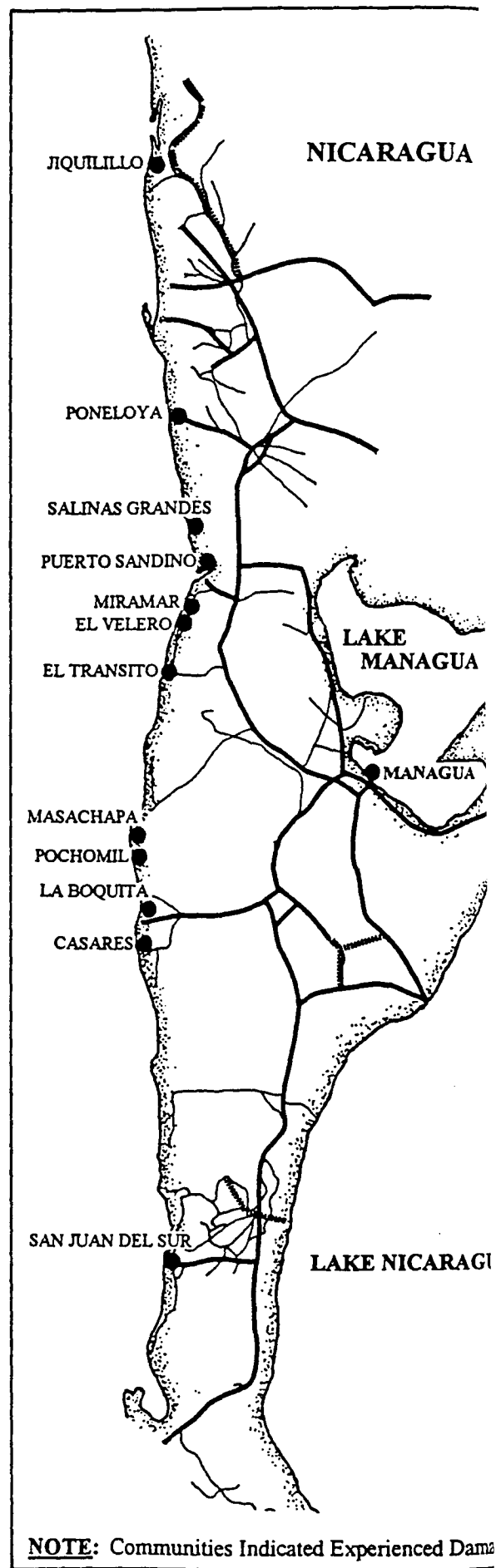


TABLE 1

<u>CLASS. CODE</u>	<u>ROAD TYPE</u>	<u>NUMBER OF LANES</u>
A	All weather hard surface	2 or 3
B	All weather hard surface	1 or 2
C	All weather loose or light surface	1
D	Fair or dry weather loose surface	1
E	Cart track	1
F	Footpath	N/A

TABLE 2

<u>ROAD CLASS. OF ACCESS</u>	<u>COMMUNITY</u>	<u>LEVEL OF DAMAGE</u>
A	Poneloya	Bad
D/E	Las Penitas	Very Bad
E/F	Salinas Grande	Very Bad
A	Puerto Sandino	Light
B	Miramar	Light
B	El Velero	None
E/F	El Transito	Very Bad
A	Montelimar	Very Light
A	Masachapa	Bad
D	Pochomil	Light
E	Pochomil Viejo	Very Bad
	Casera	Very Bad
F	Popayo	Very Bad
B	San Juan del Sur	Bad

The impact of the access route on response was dramatic. The first investigators arrived from Managua in Maschapa (Class A) approximately 12 hours after the event. The first assistance to Transito (Class E) was 36 to 48 hours originating from the Honduran fire department and the Red Cross. The hardest impacted communities were generally located on unpaved roadways only accessible during dry weather. The tsunami occurred during the rainy season, which meant that class D and below roads were impassible.

COMITE NACIONAL DE EMERGENCIA
AFECTACIONES TSUNAMI PACIFICO NICARAGUA 01 SEP 92

09-Sep

NO.	COMUNIDAD	MUER	HERI	DEBA	DAMNIF	VIVI DESTRU	ORG.COOPERAI	
							NOMBRE	No.
I	EL VIEJO	4	20	6	1,804	329		
1	Jiquilillo	2	10	6	1,339	253		
2	Mechapa	1	4		128	33		
3	Paredones-Maderas	1	6		417	43		
II	CORINTO	1	30		329	9		
4	Corinto	1	30		329	9		
III	EL REALEJO		3		627	55		
5	El Realejo		3		627	55		
IV	CHICHIGALPA		1		388	33		
6	Chichigalpa		1		388	33		
V	LEON	16	100	3	1,769	120		
7	Poneloya-Las Peñitas	12	80		790	70		
8	Salinas Grandes	4	20	3	971	50		
VI	NAGAROTE	15	150	10	2,802	295		140
9	El Tránsito	15	150	10	2,493	260	España	120
10	Miramar				550 309	120 25	España	20
VII	VILLA EL CARMEN	5	65		664	12		
11	Salamina-San Diego	5	65		664	12		
VII	SAN RAFA DEL SUR	25	33	11	1,390	100		
12	Masachapa	16	20	11	827	150 60		
13	Pochomil	9	13		563	40		
IX	DIRIAMBA	6	31	11	816	52		
14	Casares	6	31	11	264	52		
15	La Boquita				552			
X	JINOTEPE	2			1,179	32		
16	Huehuate	2			849	30		
17	Tupilapa				330	2		
XI	SANTA TERESA		2		23	1		
18	Veracruz-Escalante-Chacocente		2		23	1		
XII	TOLA	24	12	5	931	44		
19	El Gigante	6	6	2	153	8		
20	Manzanillo	2	1	3	54	3		
21	El Limón				19	15		
22	Playa popoya	15			46	5		
23	El Astillero	1	5		659	13		
XIII	SAN JUAN DEL SUR	7	42	17	785	56	España	60
24	San Juan del Sur	7	42	17	785	56		
	TOTAL	105	489	63	13,387	1,183		200

APPENDIX A



U.S. Geological Survey
National Earthquake Information Center
TSUNAMI QUESTIONNAIRE



- The USGS and NOAA are interested in understanding wave related effects of the recent earthquake; what happened, and where they happen. Please help us by answering a few questions:

1) Did you or someone with whom you spoke notice any unusual wave activity near the date and time of the earthquake?

_____ Yes _____ No

If No go to question 13

If Yes go to question 2

2) If Yes, about when was it noticed?

3) Please tell us where you were when the wave activity was observed?

4) Tell us about what you saw or heard that happened.

5) In what capacity did you observe the wave?

_____ My job _____ Where I live

Activity: surfing, jogging, walking, fishing, other

(Explain)

6) What did you see?

_____ Turbulence

_____ Water went out

_____ All boats went down

_____ Choppy water

_____ Water came far inland

_____ Other (Explain)

7) Was there a direction to the wave/unusual water behavior?

8) Was there any damage? _____ Yes _____ No

9) If Yes, what kind?

10) About how far from the usual high tide were the buildings or structures that were damaged?

_____ At the shoreline
_____ Between 50 and 100 ft
_____ More than 200 ft

_____ Less than 50 ft
_____ Between 100 and 200 ft

11) What else did you notice?

_____ Sand moved around
_____ Effects on marine life
_____ Other (Explain)

12) Do you know of any injuries or fatalities associated with the wave?

_____ Yes _____ No
If yes, how many injuries? _____ Fatalities _____
Circumstances? _____

13) Did you receive a tsunami alert, information bulletin, watch, or warning? _____ Yes _____ No

If yes, indicate type and at what time(s):

_____ Alert
_____ Bulletin
_____ Watch
_____ Warning

If yes, how did you learn of the alert, warning, bulletin, or watch? If more than one, please indicate order:

_____ Siren _____ Radio _____ T.V. _____ Civil Defense
_____ Fire Dept. _____ Police _____ Other (Explain)

What was your response to the alert, warning, bulletin, or watch?

If more than one, please indicate order:

_____ Did nothing _____ Evacuated
_____ Waited for further instructions _____ Other (Explain)

If we need to contact you again, please give us your name and telephone number:

Name: _____ Telephone: _____



U.S. Geological Survey
National Earthquake Information Center
TSUNAMI QUESTIONNAIRE



El Servicio Geológico de los Estados Unidos, junto con otros científicos, están interesados en conocer el efecto de ondas del mar, relacionado con el reciente terremoto. Qué pasó, y dónde pasó?. Por favor ayúdenos respondiendo algunas preguntas:

- 1) ¿Notó usted, o alguien con quien usted habló, algo anormal en la marea cerca de la fecha y la hora del terremoto?

_____ Sí _____ No

Si no, pase a la pregunta 13

Si sí, pase a la pregunta 2

- 2) ¿Si su respuesta es sí, aproximadamente cuando lo notó?

- 3) Por favor díganos donde estaba cuando la actividad de la marea fue observada.

- 4) ¿Qué es lo que vio o lo que oyó que pasó?

- 5) ¿En que capacidad observó usted la marea?

_____ Mi trabajo _____ Donde vivo

_____ Actividad: surfing, trotando, caminando, pescando, otra cosa
(Explique) _____

- 6) ¿Que vio?

_____ Turbulencia _____ Agua picada

_____ El agua se salió _____ El agua entró muy tierra adentro

_____ Todas las embarcaciones bajaron

_____ Otra cosa (Explique) _____

- 7) ¿Cuál fué la dirección de la marea/ola inusual en el mar?

- 8) ¿Hubo daños? _____ Sí _____ No

- 9) Si sí, ¿Qué tipo de daño? _____

10) ¿Como a qué distancia sobre el nivel de la marea alta estaban los edificios o estructuras que sufrieron daños?

_____ Al nivel de la costa
_____ Menos de 15 metros
_____ Entre 15 y 30 metros
_____ Entre 30 y 60 metros
_____ Más de 60 metros

11) ¿Que más notó?

_____ Arena removida o depositada
_____ Efectos en la vida marina
_____ Otra cosa (Explique)

12) ¿Supo de heridos, o muertes asociadas con la ola?

_____ Sí _____ No
Si sí, ¿Cuántos heridos? _____ Muertes _____
Circunstancias _____

13) Recibió usted una alerta de Tsunami (ola grande), por algún medio informativo? _____ Sí _____ No

Si sí, indique el tipo y a que hora(s):

_____ Alerta
_____ Boletín
_____ Observación
_____ Advertencia

Si sí, ¿Cómo se enteró de la alerta? Si más de una, por favor indique el orden.

_____ Sirena _____ Radio _____ T.V. _____ Defensa
Civil _____ Bomberos _____ Policía _____ Otro
(Explique) _____

Por favor escriba su nombre y dirección, por si necesitamos contactarnos nuevamente con usted. Muchas gracias.

Nombre: _____ Teléfono: _____
Dirección: _____

APPENDIX B

THE U.S. TEAM MEMBERS

- Mehmet Celebi (USGS)
- David Harlow (USGS)
- Frank Gonzalez (NOAA)
- Arturo Alberto (University of Nevada)
- Jane Preuss (Urban Regional Research)
- Jody Bourgeois (NSF)
- Harry Yeh (University of Washington)
- Kenji Satake (University of Michigan)
- Costas Synolakis (USC)

LOCAL (NICARAGUAN) CONTACTS

Ing. Claudio Gutierrez Huete, Director General
Instituto Nicaraguense de Estudios Territoriales (INETER)-
Ministerio de Construcción y Transporte

Ing. Emilio Soto Coval, Sub-Director General
INETER

Ing. Guillermo Guevara (Capitan) , Presidente Junta
Directiva
Centro de Coordinación para la Prevención de Desastres
Naturales en América Central (CEPRENAC) and Ministry of
Defence
Depart of Civil Defence responsible for preparedness and
response planning for all hazards

Arq. Jorge A. Martinez, Director
Division of Physical Planning, INETER
Responsible for reconstruction

Arq. Ana Isabel Izaguirre
Physical planner working on reconstruction and relocation