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*Research article. Annex 3.*

**Reports of abnormal animal behavior in relation to earthquakes in Colombia**

Reportes sobre comportamiento animal anómalo en relación a sismos en Colombia

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**Annex 3. Table S1**

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Supplementary material to the article “*Reports of abnormal animal behavior in relation to earthquakes in Colombia*” by John J. Sánchez.

Table with main aspects of newspapers and magazines reports on AAB in relation to earthquakes, in Colombia and around the world. The “Observations” column contains terms enclosed in square brackets when an alternative term should have been used instead, a writing error was found during translation, or when a clarifying note was included by the author. Superscripts next to name of media: P = newspaper; M = magazine; N = national coverage; L = local coverage. Reports are arranged chronologically.

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| --- | --- | --- | --- | --- | --- |
| Number | Date  (dd-mm-yyy) | Media | Title | Observations | Credits |
| 1 | 26-11-1994 | El TiempoP, N | The wave to resist earthquakes | In the context of earthquake prediction, the article mentions experiments in Japan that show relationships between earthquakes and the behavior of catfish [cod], showing that these fish experience extraordinary activity several days before the occurrence of an earthquake. | L. G. Aycardi, Civil Engineer and University Professor. |
| 2 | 08-02-1995 | El EspectadorP, N | “The terror started in Darien” | The article summarizes the witnesses accounts on the 08-02-1995 earthquake (*MW* 6.4, *IMax* = 8) that shook western Colombia. Darién is a town in the epicentral area. The initial part of the article mentions how the townsfolk conceive the phenomena of earthquakes: they stated that “…it was as if a giant earthworm awoke from within *El Soldado* hill, not far from the town, and displaced itself to a depth of 70 km, shaking and causing devastation”. Also the inhabitants think that the earthquake is a premonition or a sign, and they believed that a time of great disasters was nearing and the earthquake was just the beginning. They also referred to the common effect of earthquake sounds, reported during earthquakes worldwide, saying that “it seemed as if the ground was going to rip itself apart and it bellowed like the raging bulls”. [Although the earthquake referred is listed in the SISHC, no actual reports of AAB were found in the first-stage search, see Appendix 1]. | D. Chonta. El Espectador Special Envoy. |
| 3 | 01-02-1999 | El TiempoP, N | What is going on under our feet? | Explains general aspects of earthquakes. Mentions Colombia and other places around the world. One section includes information on earthquake prediction, with the behavior of animals as a possible hint. | V. Solano, columnist |
| 4 | 01-09-2007 | El TiempoP, N | Natural catastrophes, animals sense them. | The piece was published in response to fake news that circulated days before about an impending earthquake in Colombia. Includes recommendations from Colombian officials and experts. Mentions that nature warns of impending earthquakes, but that only animals and some plants perceive them: According to studies, marine phytoplankton anomalously concentrates along coasts before an earthquake occurs, while wild animals appear to be gifted with a sixth sense that warns them of danger. The latter was proven during the December 26, 2004, earthquake and tsunami that leveled regions of Asia. In Sri Lanka, for example, officials did not find dead animals, in spite of the giant waves that ran up 3 kilometers in Yala National Park, the mayor natural reserve of the country and home to numerous wild elephants, leopards, deer, jackals, and crocodiles. Not a single dead elephant was found, not even a hare or a rabbit. The only explanation: animals can forebode [feel] a disaster. They know [knew] when things are [were] happening and then fled, pointed out H. D. Ratnayake, at Sri Lanka´s National Wildlife Department.  Experts believe that sound waves propagate [propagated] faster in the land than in the water, and that animals would have perceived them many hours before the arrival of the giant tsunami waves. According to M. T. Uribe, Veterinarian, Professor of Ethology and Animal Wellness at Universidad de la Salle (Colombia), among birds, it is clear that geese, and ducks perceive these signals. They sing less, fly away, and if they are confined, they become restless, and want to go out and fly. The report also informs about cases of dogs, for example, start barking and howling minutes before earthquakes happen. Uribe still wonders why seismographs cannot detect these waves that are perceived by animals. There remain professionals and specialist who do not validate what animals are telling us, concludes Uribe. | El Tiempo Editorial Office. |
| 5 | 12-09-2007 | El TiempoP, N | Is it possible to predict an earthquake? | The article contains an interview with M. M. Arcila, a Geologist with INGEOMINAS (now *Servicio Geológico Colombiano*), again in response to fake news of an impending earthquake in Colombia. The expert explains general and detailed aspects of earthquakes, and in the context of the historical scientific interest in prediction, mentions that British scientist John Milne, described some possible seismic precursors: changes on weather conditions, or in the temperature of thermal springs, changes in animal behavior, appearance of electrical [effects] disturbances in the atmosphere, and recurrence of microearthquakes. | El Tiempo Editorial Office. |
| 6 | 17-08-2008 | El TiempoP, N | Colombian Geologist researches on earthworms´ ability to predict earthquakes. | Report on the work of Geologist J. M. González, who in 2004 started observation of *Amynthas Corticis* earthworms in natural settings within the urban area of Pereira (Risaralda State). González, who worked at the Office for Disaster Prevention and Mitigation in the municipality of Pereira, spearheaded the project “When the rocks sound, the earthworms move”. His theory: some kind of sound or vibration coming from within the Earth, when the tectonic plates are just beginning to rub against each other, this makes the earthworms flee and seek death out in the open. In early July 2005, González witnessed how clews of earthworms desperately crawled on the sidewalks near the housing development where he lived. On the early Sunday morning of July 24th, three ML > 4.0 earthquakes in less than 15 minutes occurred with epicenters in La Virginia (State of Risaralda). According to Gonzalez, the amount of dead earthworms seen is related to the magnitude, epicenter, and depth of the earthquake. The article also mentions cases of AAB around the world. [The only earthquake that is listed in the SGG catalog for the date referred is an *ML* 3.0 near La Virgina] | N. Dávila, Reporter. |
| 7 | 04-04-2009 | El TiempoP, N | Such is the life in the sites of the country where it rains the most; where there is more drought; there are more earthquakes; and there are more lighting strikes. | The piece touches upon the experiences of the inhabitants of La Mesa de Los Santos (Santander State, Colombia), one of the most seismically-active places in the world. Some of the locals affirm that, before an earthquake, tens of cockroaches come out and dogs bark more than normal. | F. L. Quintero, El Tiempo Especial Envoy. |
| 8 | 09-05-2009 | El TiempoP, N | Windows are seismographs for the inhabitants of Mesa de Los Santos, Santander. | A collection of witnesses accounts about earthquakes in LA Mesa de Los Santos, a very seismically-active region in Colombia, which is located above one of the more productive seismic nests in the world (known as the Bucaramanga Nest).The article reasserts the claims of some of the inhabitants of this touristic destination, whom manifest that seconds before an earthquake have seen cockroaches come out of their hiding places in numbers and the dogs bark more than usual. | F. L. Quintero, El Tiempo Correspondent. |
| 9 | 03-11-2009 | El TiempoP, N | Bestiary | A general culture article that mentions the topic of AAB in relation to earthquakes. In the countryside, in many parts around the world, animal sounds and their behavior are key to predict various phenomena, including earthquake. Mentions the following animals: eagles, sheep; donkeys, elephants, swallow, mosquitoes, bees; crocodiles, hyenas; chicks, hens.  The writer affirms that no matter it is myth, legend, or truth, it is not only the sounds of animals in atypical circumstances that are often used to foresee or forecast; but also the behavior; the unusual movements of animals groups are key to know with anticipation that something is about to happen: The in-tandem howling of wolves´ packs; the sudden changes in directions of schools of fish; or the abandoning of hives by bees; not to mention the herds [of pigs], ranches [of cattle], flocks [of sheep], and troops [of horses]. | El Tiempo Editorial Office |
| 10 | 05-12-2011 | SemanaM, N | Is it possible to predict earthquakes? | An article about the difficulties in earthquake prediction, forecasts, and early warnings, based on an interview with B. Baptie (British Geological Survey). Mentions case studies from around the world and among the proposed earthquake precursors, mentions the hypotheses that animals could be capable of sensing imminent earthquakes and the paper by Grant & Halliday (2010) about a toad population that fled its breeding colony three days before a magnitude 6.3 earthquake struck L´Aquila, Italy, in 2009. According to Baptie, it is difficult to objectively and quantifiably study how animals respond to seismic activity, in part because earthquakes are scarce and hit without warning. | Semana Editorial Office. |
| 11 | 25-04-2013 | La PatriaP, L | The inhabitants of El Ruiz are not afraid of the neighbor´s earthquakes | A compilation of accounts and experiences from inhabitants on the rural areas around active Nevado del Ruiz Volcano (Colombia) on felt earthquakes and other signs of activity. Mr. A. Orozco referred to an earthquake felt on the morning of Sunday April 21st, 2013, during which he observed rabbits and dogs that were running aimlessly, very frightened. [The earthquake referred belonged to a swarm of volcano-tectonic earthquakes located near Nevado del Ruiz]. | La Patria Editorial Office. |
| 12 | 01-04-2015 | El TiempoP, N | In Los Santos are not prepared for an earthquake | The article is about earthquake awareness in La Mesa de Los Santos (Santander State, Colombia), deemed as the second most seismically-active nest in the planet. Includes accounts from locals about AAB around the time of earthquakes. Mr. A. Lizarazo recalls his experience during one of the strongest shocks in the area; event that in the interview is dated July 29th, 1969, but most likely correspond to the MW 6.8 on July 29th, 1967, with epicenter near Betulia (Maximum EMS-98 intensity = 8, according to Servicio Geológico Colombiano); mentioning that during the earthquake they [Mr. Lizarazo and companions] were in a farm distant one hour [by car?] from the town, and it shook stronger that during the past March 10th [refers to the MW 6.8 on March 10th, 2015 with epicenter in Los Santos, Maximum EMS-98 intensity = 7, according to Servicio Geológico Colombiano], adding that in that occasion, out of the ground came a strange sound and animals ran terrified. [Although the earthquake referred is listed in the SISHC, no actual reports of AAB were found in the first-stage search, see Appendix 1]. | F. L. Quintero, El Tiempo Especial Envoy. |
| 13 | 20-11-2015 | VanguardiaP, L | In the Eje Cafetero they are detecting earthquakes with earthworms. | The article summarizes the project lead by Systems Engineer C. A. Zapata and Geologist J. M. González, of observing earthworm’s behavior with the purposes of forecasting earthquakes in Colombia. The initiative was motivated by the devastating MW 6.1 earthquake on January 25th, 1999, with epicenter near Armenia. The researchers found evidence of AAB (earthworms) previous to that event. The project includes: (1) Several earthworm farms-laboratories in Manizales, Pereira, and Armenia; (2) regular observations of earthworm’s behavior and measurements of their weights and lengths; (3) Communication with *Servicio Geológico Colombiano-Observatorio Vulcanológico de Manizales* and help from *Centro de Bioinformática y Biología Computacional de Colombia* (BIOS); (4) cooperation with J. D. Hincapié and J. I. Osorio with a device (patent-pending) named “*sismoactuador*” [seismic-actuator] that senses the earthworm’s movements and sends a signal to a cell phone App. The researchers seek help from local and foreign institutions and agencies. [Although the earthquake referred is listed in the SISHC, no actual reports of AAB involving earthworms were found in the first-stage search, see Appendix 1]. | COLPRENSA and Vanguardia.com. |
| 14 | 20-11-2015 | La PatriaP, L | With earthworms, earthquake are being detected. | This is only part of a report, the complete the newspaper article was no longer available online. Appears to be related to another article missing, reported below.  The text that is still available contains information of the efforts of by Engineer C. A. Zapata and Geologist J. M. González to monitor earthworm’s behavior with purposes of earthquake forecasting. See previous entry. | La Patria Editorial Office. |
| 15 | 07-01-2016 | El TiempoP, N | Los Santos, the town that trembles up to 20 times a day. In this town it is animals the ones that warn when the Earth shudders. | A lengthy article on the perceptions of inhabitants of Los Santos (Santander State), a town that sits above the Bucaramanga Seismic Nest. The accounts coincide on the sensitivity of animals to the earthquake phenomena, which they think is superior to that of humans. Observations of cockroaches that come out of their hiding places, dogs barking more than usual, birds tweeting tirelessly, and some cows and horses jumping over their farms’ fences before and earthquake is felt. Mr. A. Lizarazo, the oldest inhabitant of Los Santos, recalls that during the earthquake on July 29th, 1967 [date corrected, see 01-04-2015 entry above], out of the ground came a strange sound and animals ran terrified. [Although the earthquake referred is listed in the SISHC, no actual reports of AAB were found in the first-stage search, see Appendix 1]. | F. L. Quintero, El Tiempo Especial Envoy. |
| 16 | 16-01-2016 | La PatriaP, L | Earthquakes detected with earthworms. | This also is apparently incomplete, the complete the newspaper article was no longer available online.  Relates to entry published on 20-11-2015 (see above), and mentions that several seismic events have already been detected. | La Patria Editorial Office. |
| 17 | 23-04-2019 | La Crónica del Quindío P, L | ¿Can dogs and cats predict an earthquake? | The piece is about the work by scientist from German Research Centre for Geosciences (*GeoForschungsZentrum*-GFZ) to determine the statistical strength of the proposed link between animal behavior and earthquakes. The link is deemed weak because most of the data [the authors analyzed 180 publications with 729 reports of AAB related to 160 earthquakes, spanning from elephants to silkworms] is based on anecdotes, not on experimental studies. Some flaws in the various studies and reports from which the data was collected include the scarcity of record series of animal observations through time; and the fact that most of the reports are unique occurrences. These make it difficult to confirm that the AAB are predictive (I other word, that AAB signals to the event of an earthquake before it begins), the reported AAB could be random occurrences or behaviors linked to the initial stages of an earthquake (for example, foreshocks), that are strongly associated to anomalies in animal behavior in the statistical analysis. The observations of AAB could be related to an earthquake, or to some other type of environmental change, or long-period fluctuation in the health of an animal population or in their predators. [For detailed information on the research, see Woith et al. (2018)]. | Beatriz de Vera, from a note originally published by the Science and Technology Magazine N+1 *Ciencia que suma*, on 19-04-2018, and entitled “Can your dog predict an earthquake?” |
| 18 | 07-05-2018 | El Colombiano P, L | ¿What do animals tell you? | The article highlights the much higher capacity of animals [as compared to humans] to warn about impending natural phenomena such as storms, hurricanes, volcanic eruptions, earthquakes, and tsunamis. The author mentions always observing his neighbor’s cat going outdoors long before an earthquake was felt. According to the note, cats change their behavior because they sense the sounds associated with Earth’s motions, as well as the changes in atmospheric pressure and ground deformations. Other instances of AAB mentioned include: days before an earthquake cows diminish their milk production because of the stress they feel before the disaster; and elephants [in Thailand?] that fled to higher ground an hour before the waves [tsunami] from the December 26th, 2004 earthquake in Indonesia hit the land, because they have sophisticated hearing capable of detecting frequencies that are imperceptible by humans. | R. Lozano, Columnist. |
| 19 | 22-08-2018 | VanguardiaP, L | Don´t be gullible: an earthquake cannot be predicted. | A note to warn against fake news about earthquake prediction. Experts explain that up to date there is not a sure theory for the prediction of earthquakes anywhere in the world. To the question “Can animals predict an impending earthquake?” Dr. M. Calvache (Servicio Geológico Colombiano) recalls that people have observed the reaction of animals when there are earthquakes, for example in China, where it was seen that hibernating animals came out of their dens before an earthquake [probably referring to the MW 7.3, February 4th, 1975 Haicheng earthquake]. They say animals felt something unusual. A short time after, however, there was another earthquake and no animal showed a different behavior [perhaps referring to the MW 7.8, July 28th, 1976 Tangshan earthquake]. Calvache suggests that perhaps animals could quickly feel the earthquake is it was shallow, and if they are near the point of generation; adding that although is true that animals have more acute sensory organs than humans, there are also many coincidences. | M. A. Morales. |
| 20 | 24-12-2019 | El EspectadorP, N | “The aftershocks of the earthquake are still being felt”: Inhabitant of Lejanías, Meta. | An interview with M. Muñoz, an inhabitant of Lejanías (Meta State, Colombia), with her accounts of the effects from the MW 5.9 [magnitude corrected according to the SGG catalog] earthquake on December 24th, 2019, with epicenter in the rural area of Lejanías. At the time of the earthquake she was in his two-stories wooden house; in a farm located 20 minutes by car from the town. The woman claimed that never, in the two decades that she has lived there, she had felt such a strong tremor. In her account of the earthquake she claims to have felt what appeared to be, at the beginning, an intense wind, that became a movement so strong that forced her to interrupt her lunch and go outside to see what was happening. She went outdoors and [interestingly] the animals and the dogs did not get frightened, “they were tranquil with me, then I thought it was odd”, she adds. The only thing I noticed was that the TV that also started moving, but other than that, there was nothing strange outdoors”.  [This article is interesting because, according to the witness, in two decades, she had never felt such a strong shaking, but animals nearby did not react, and she did not observe anything unusual outdoors.] | National Editorial Office |
| 21 | 26-12-2019 | El Colombiano P, L | What should you do when it [the Earth] shakes? Maybe, do not believe in myths. | An interview with Dr. C. García, a member of Sociedad Colombiana de Geología-SCG about the mitigation of earthquake effects and disproving earthquakes myths. Dr. García mentions that some of the [local?] myths surrounding an impending earthquake include: dogs barking at the same time; lizards [geckos] showing up in the house; and birds singing more than normal. She adds that although the reaction of animals has certain relation with tremors, there is no yet any instrument capable of predicting the timing of phenomenon. According to García, animals are more sensible to waves than humans, that is why they react even when the motion is very mild. For this reason, she points out, AAB should not be always associated to some tragic event. | L. Tamayo. |
| 22 | 28-12-2019 | El Colombiano P, L | It shakes, but do not panic. | The article was motivated by the December 24, 2019 earthquake sequence in Lejanías (Meta State, Colombia). Includes general information on earthquakes and earthquake preparedness. In reference to the relation between AAB and earthquakes, the opinion of Colombian Expert C. García is transcribed. See entry for 26-12-2019. | J. M, Gómez and L. Tamayo, Reporters. |