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Author: Luna, Rosa María Licón

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First Report of Myxomatosis in Mexico

Rosa María Licón Luna[1,2] [1] Facultad de Ciencias, Universidad Autónoma de Baja California, Km 108, Carretera Transpeninsular, Ensenada, Baja California, México; [2] Current address: Division of Immunology and Cell Biology, The John Curtin School of Medical Research, The Australian National University, P.O. Box 334, Canberra City ACT 2601, Australia (e-mail: Rosy.Licon@anu.edu.au).

ABSTRACT: An outbreak of myxomatosis occurred between September and October 1993 on a rabbit farm in Punta Colnett (Ensenada, Baja California in northwestern Mexico, Transpeninsular Highway, km 128) and was confirmed by the Mexico-USA Commission for Prevention of Foreign Diseases of Animals (CPA). This represents the first officially confirmed case of the disease in Mexico. Like the cases in California (USA), the brush rabbit (*Sylvilagus bachmani*) seems to be the carrier of the virus, since serum samples from wild rabbits from different areas of the peninsula of Baja California were found to contain antibodies against the myxoma virus.

Key words: Brush rabbits, domestic rabbits, geographical range extension, myxomatosis, *Oryctolagus cuniculus, Sylvilagus bachmani.*

Myxomatosis is a generalized, rapid and lethal virus disease that affects the domestic European rabbit (*Oryctolagus cuniculus*) (Fenner and Ratcliffe, 1965). The epidemiological cycle of myxomatosis arises between the natural enzootic hosts (*Sylvilagus bachmani* in the Californias (USA and Mexico), *Sylvilagus brasiliensis* in Central and South America) and the clinical hosts *O. cuniculus* (Fenner and Ross, 1994), when climatic conditions allow hematophagous insects to mediate transmission between the two hosts. Myxomatosis has become enzootic after deliberate introduction of the virus in the 1950's into free-living populations of *O. cuniculus* in Australia, New Zealand, and Europe.

Infection of the brush rabbits (*Sylvilagus bachmani*) with myxoma virus produces a small fibroma at the site of infection, which regresses within a few weeks. Hematophagus insects can mechanically transmit the virus throughout the duration of lesions (Fenner and Ratcliffe, 1965; Cheeke et al., 1985). Myxoma virus has been isolated from *S. bachmani* and from the vector mosquitoes *Aedes aegypti* and *Anopheles freeborni* in California (Hagen and Gorham, 1976). The geographical distribution of *S. bachmani* ranges from the Columbian River in Oregon (USA) to the North, The Sierra Nevada mountains of California in the East, down to the tip of Baja California (Mexico) peninsula.

Until recently, Mexico was considered free of myxomatosis (Rodriguez, 1977). The official record of the government of Mexico [Diario Oficial de la Federación (México City, México) for the date of September 21, 1993] stated that myxomatosis, tularemia and viral haemorrhagic disease are exotic to all of Mexico. Myxomatosis is also on the B list of the OIE (Office International des Epizooties, 1992) of foreign diseases for Mexico. This B list is defined by the OIE (1992) as "transmissible diseases which are considered to be of socioeconomic and/or public health importance within countries and which are significant in the international trade of animals and animal products."

Domestic rabbits are farmed in several parts of Mexico, including Baja California. When a rabbit farm in Punta Colnett, Baja California, Mexico (31°7′N, 116°12′W) experienced an outbreak of myxomatosis in November 1993, skin and samples of organs from a rabbit that developed the nodular form of the disease were collected by the High Security Laboratory of the Mexico-United States Commission for the Prevention and Eradication of Foot and Mouth Disease and other Foreign Diseases of Animals (Mexico City, Mexico). The disease was confirmed by the complement fixation test (performed as the method described by Chantal et al., 1993), the production of characteristic poxvirus lesions in the chorioallantoic membrane of develop-

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ing chick embryos, the reproduction of typical clinical signs of myxomatosis in adult domestic rabbits using the antigen isolated from the skin samples, and identification of the myxoma virus using electron microscopy. Nine mo after the Punta Colnett outbreak there was another in Ejido Uruapan (31°37′N, 116°28′W), about 90 km away. The observed signs were those of the nodular and respiratory forms of the disease. Once the presumptive diagnosis of myxomatosis was confirmed, the aim of this work was established to determine the origin of the first officially recognized myxomatosis outbreak in Mexico, which occurred in Punta Colnett (Ensenada, Baja California) in November 1993. Two hypothesis were considered: (1) Either the outbreaks in Baja California resulted from transmission via infected *O. cuniculus* imported from California, where the disease is endemic; or (2) natural infection via mosquito vectors and the myxoma virus present in a natural reservoir in *S. bachmani.*

The possibility that the disease originated in California is rejected, because there was no importation of rabbits at least three months prior to the first outbreak and until well after the second outbreak nine months later. The transmission of the virus from one production facility to another could have been possible. However, the distance between the two affected rabbit farms is roughly 90 km. Furthermore, there was a time difference of nine mo between the outbreaks, without exchange of rabbits during that time. The transmission of myxoma virus by insect vector from a local reservoir, was, therefore, a more probable explanation.

Several factors contribute to the likely establishment of a stable myxoma virus reservoir and vector habitat. Northwestern Baja California has a Mediterranean type climate (humid, cold winters and dry, hot summers) that favors the proliferation of sclerophyll vegetation, mostly Californian (coastal) chaparral. This community covers mountains, hillsides, and foothill landscapes, from below 50 m above sea level (asl) to elevations as high as 2,750 m. The average precipitation is <300 mm annually. Coastal factors such as morning fog, moderate maximum temperatures and other features which reduce evapotranspiration have resulted in coastal vegetation communities dominated by xerophytic scrub. These climatic factors represent an excellent habitat for *S. bachmani* and mosquito vectors. This climatic enclave is boarded by Sonoran Desert to the East and in the extreme south of the peninsula by Sinaloan thorn scrub (Pase and Brown, 1982), but it is contiguous with the California coastal region of the USA.

The five species of wild leporids on the peninsula of Baja California are brush rabbits (*S. bachmani*); desert cottontails (*S. audubonii*); black-tailed jack rabbits (*Lepus californicus*); and two insular forms, San José brush rabbit (*S. mansuetus*) and black jack rabbit (*L. insularis*) on San José and Espiritu Santo Islands, respectively (Hall, 1981).

To determine whether wild leporids were reservoirs for myxoma virus in Baja California, between June and August 1994, I shot 100 *S. bachmani* and six *S. Audubonii* with a .22 cal. center-fire rifle in northwestern Baja California. Three *L. insularis,* one *S. mansuetus,* and three *L. californicus* were collected in the same way by Fernando Cervantes (Universidad Nacional Autónoma de México, Mexico City, Mexico), from the southern part of the Peninsula. Blood was collected in 10 mm blood tubes from the jugular vein or directly from the heart, depending on the place of bullet impact. The blood was centrifuged to separate the serum from the cells and the serum was kept at −70 C for subsequent antibody detection.

For serological analysis, antigen was prepared from myxoma lesions produced in domestic, non-vaccinated rabbits infected by the virus obtained from the sick rabbit collected during the 1993 Punta Colnett outbreak. Myxoma virus suspension was inoculated intradermally into the ven-

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tral surface of the pinna of rabbits. Lesions were observed by the sixth to seventh day post infection. The superficial layer of the dermis was removed, the myxoma lesions were minced in phosphate buffered saline solution, the suspension was filtered and the supernatant was used as antigen.

Flying insects were captured with a fine net in the 1993 outbreak area (Punta Colnett) near a pool of water and sent to the Vector Surveillance and Control Division (San Diego, California, USA) of the Environmental Health Service, where the mosquito families were identified by K. Macbarron.

In the general area of these myxomatosis outbreaks (31°00′ to 31°60′N, 116°00′ to 116°45′W), 16 of 100 *S. bachmani* were seropositive and six of six *S. audubonii* were seronegative. Outside the area of outbreak one of one *S. mansuetus* and two of three *L. insularis* were seropositive; three of three *L. californicus* were seronegative. Therefore, *S. bachmani* appear to be an excellent candidate as the reservoir of the virus responsible for the outbreaks in the two rabbit farms.

Marshall et al. (1963) obtained similar negative results in tests for myxoma antibodies in California in *L. californicus* and *S. audubonii*. Since both studies used only small numbers of individuals, it is not possible to conclude that those two species do not become infected by myxoma virus and/or are not involved in myxomatosis epidemiology. Marshall et al. (1963) also found that antibodies of infected *S. bachmani* and possibly those of other leporids that may have co-evolved with myxoma virus decline rapidly to undetectable levels, which could have been the case for the leporids of the above species.

The positive reaction of sera from San José and Espiritu Santo Islands leporids is interesting, being at five and six km from the coast, respectively, the Islands might be accessible for mosquitoes, suggesting a chance that myxomatosis has occurred there by mechanical transport of the arthropods, or since their colonization by leporids. Further work is required to analyze this problem.

The insects caught in the area of study were members of the families Ceratopogonidae and Anthomyiidae. Fenner and Ratcliffe (1965) mentioned the potential of *Lasiohelia* spp. and *Leptoconops* spp. (Ceratopogonidae) to serve as vectors of myxoma virus on account of the observations of A. L. Dyce that members of these genera feed on rabbits, however, there is no evidence from the laboratory or the wild, that they are vectors. Species from the Ceratopogonidae family are vectors for myxomatosis in France (Joubert et al., 1973). It seems feasible that they serve as vectors in northwestern Baja California as well.

Although this was the first report of a confirmed case of myxomatosis in Mexico, it is very likely that in Baja California, where the natural host of the California strains exist (*S. bachmani*) and in the southeast of Mexico, where the geographical distribution of the natural host of the South American strains (*S. brasiliensis*) starts, there could have been other undetected outbreaks before 1993.

In North America myxomatosis was first described in 1928 from several outbreaks in San Diego (California, USA; Kessel et al. *in* Digiacomo and Maré, 1994). It was speculated that the virus that initiated these outbreaks was introduced to the USA by a shipment of infected rabbits from Baja California (Vail and McKenney, 1943). The first serological evidence that *S. bachmani* is the endemic reservoir of the virus responsible for the myxomatosis outbreaks in California, USA was provided by Regnery and Miller (1972), but no data was given to show whether or not these findings also applies to *S. bachmani* in Baja California.

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ico-USA Commission for the Prevention and Eradication of Foot and Mouth Disease and Other Foreign Diseases of the Animals (CPA). F. Cervantes from the Biology Institute UNAM, kindly provided samples of *S. mansuetus*, *L. insularis*, and *L. californicus* from San José Island and Espiritu Santo Islands, and Baja California Sur, respectively. I thank F. Fenner and E. Mellink for their help and advice in the preparation of the manuscript, and my parents and sister for their support and help.

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