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A HUMAN CASE OF OTOACARIASIS INVOLVING A HISTIOSTOMATID MITE (ACARI: HISTIOSTOMATIDAE)

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Abstract. A 31-year-old Saudi man was seen at an ear, nose, and throat clinic at Riyadh, Saudi Arabia, with bilateral itching in the external auditory canal. On otoscopic examination, the skin lining the ear canal was thickened with whitish sheets of sloughed cells and thick discharge. Large numbers of mites of an undescribed species closely related to members of the genus *Loxanoetus* (Histiostomatidae) were present. The patient underwent successive washings of the ear canal with saline and 70% ethanol at intervals of 2–3 months and was treated with antibiotics. Treatment with Eurax® (crotamiton) ear drops for one week cleared the mite infestation. This represents the first reported case of human otoacariasis involving a histiostomatid mite. Based on the known biology of histiostomatid mites and the associated hosts of *Loxanoetus* and related genera, there is reason to speculate that the patient acquired the infestation while swimming in a lake or pond where this mite was present.

INTRODUCTION

Otoacariasis is a common condition in livestock and domestic animals caused by infestation of the ear canal with mites or ticks. Such a condition is rarely seen in humans. Cases of human otoacariases caused by ticks have been reported from South Africa,[1–3] Nepal,[4] Chile,[5] Malaysia,[6,7] Sri Lanka,[8] and the United States.[9] Infestations of the human ear canal by mites other than ticks is less common. A case of ear infestation with *Otodectes cynotis* (*Psoroptidae)* causing otitis externa was reported from Belgium by Van de Heyning and Thienpont.[10] This parasitic mite is a common cause of otoacariasis in dogs and cats. Rossiter described two cases of otitis externa caused by infestation with *Dermanyssus gallinae*, the red poultry mite (Dermanyssidae), occurring as an occupational problem in poultry workers.[11] Paleri and Ruckley reported a case of recurrent infestation of otherwise-healthy mastoid cavities with the storage mite *Sancassania* (*Caloglyphus) berlesei* [Acaridae]);[12] this case occurred secondary to occupational exposure. The same species was reported by Cho and others in the external auditory canal of a 46-year-old man in South Korea.[13] The patient complained of feeling a foreign body and itching in the left external auditory canal for one month, with accompanying otalgia for three days. Based on the duration of the patient's complaint and the 8–9-day life cycle of the mite, the mites were believed to have lived in the patient's ear for more than three generations.

We describe a case of human otoacariasis caused by a histiostomatid mite (Histiostomatidae). To our knowledge, this is the first report of a mite in this family living in the auditory canal of humans.

CASE REPORT

The patient was a 31-year-old Saudi man who was studying chemical engineering in the United States while living in Hackensack, New Jersey from early 2001 to December 2002. The only time he traveled during this period was in the summer of 2001 when he made a vacation trip to Saudi Arabia. About September 2001, three months after his return from Saudi Arabia to Hackensack, he started to develop ear symptoms, primarily itching in the external auditory canal (EAC). Despite persistence of the symptoms, he did not seek medical attention while in the United States. He returned to Saudi Arabia at the end of 2002, where he underwent ear treatment with repeated courses of antibiotics and antifungal drugs at a private hospital beginning in January 2003. Treatment was continued for 12 months without resolving the condition. On February 21, 2004, the patient was seen by one of the authors (A.M.A-A.) at the Ear, Nose, and Throat (ENT) Clinic at King Abdulaziz University Hospital in Riyadh, Saudi Arabia with bilateral itching in the EAC and associated discharge. By this time, it had been 30 months since the onset of symptoms.

On otoscopic examination, the skin lining the ear canal was thickened, with white sheets of sloughed cells and thick discharge. Microscopic examination at higher magnification was then done with a video otoscope. The left EAC showed thickening and scaling of skin with thick sheets of cell debris. There were numerous mites at different stages of development in the osseous canal. Mites were also observed in the right EAC, but with milder, associated pathologic changes.

The patient underwent six sessions of washing the EAC with saline and 70% ethanol at intervals of 2–3 months and was treated with repeated courses of antibiotics (local neomycin and gentamicin otic preparations). One week after the initial washing, the patient's symptoms persisted and mites were still detectable in the EAC. The patient was then treated daily with ear drops of Eurax® (crotamiton) lotion (Novartis, Horsham, United Kindgom) for one week, at the end of which symptoms cleared and an otoscopic examination demonstrated complete clearance of the mites.

MATERIALS AND METHODS

Samples of mites recovered from the patient were slide-mounted for microscopic examination, without clearing, using two mounting media: a synthetic medium of distrene, plasticizer and xylene (DPX; British Drug House, Poole, United Kingdom), and Canada balsam, and two sizes of coverglasses

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(23 × 23 mm and 50 × 23 mm). Digital images were taken by light microscopy of representative slide-mounted specimens of various developmental stages recovered from the ear canal.

Four specimens (two males, one female, and one nymph), together with fragments of other individuals, were prepared and mounted for examination by scanning electron microscopy. The mites were pre-fixed in 3% glutaraldehyde in phosphate buffer, pH 7.4, for three hours, washed twice in phosphate buffer, pH 7.4, and post-fixed in 1% osmic acid for one hour. They were again washed in phosphate buffer, dehydrated in an alcohol series (50%, 70%, 80%, 90%, 100%) for 10 minutes each and placed in propylene oxide for 15 minutes. After drying with hexamethyldisilizane, the specimens were mounted on stubs and coated with gold using a coating machine prior to study using a scanning electron microscope (SEM) (JEOL1-5510; Jeol, Tokyo, Japan).

A total of 11 minutes of video recording was made during otoscopic examinations of the patient during pre-treatment, treatment, and post-treatment visits to the ENT clinic.

Twenty images of slide-mounted mites, together with four SEM images and 13 microscope slides with mounted mites, were sent to one of the authors (G.R.M.) at Auburn University for identification. Additional SEM images were taken of the stub-mounted mites at the Auburn University Research Instrumentation Facility using a Zeiss (Thornwood, NY) digital scanning microscope 940.

To facilitate recovery of the mites for subsequent clearing and remounting, individual mites were located on the slides, and the coverglasses were then cut around the mites with a diamond-tip glasscutter to retrieve the specimens under small pieces of the coverglass without losing them when the slides were subsequently transferred to appropriate solvents. The DPX slides were placed in xylene, whereas the Canada balsam slides were placed in xylene:absolute ethanol (1:1) to dissolve the respective mounting medium. The recovered mites were hydrated in a series of 100%, 95%, 80%, and 70% ethanol, then cleared in Nesbitt's fluid (40 g of chloral hydrate dissolved in 2.5 mL of concentrated hydrochloric acid and 25 mL of distilled water) and remounted in Hoyer's medium (200 g of chloral hydrate, 30 g of gum arabic crystals, 20 mL of glycerine, and 50 mL of distilled water). Nesbitt's fluid was the clearing agent of choice because many of the originally slide-mounted mites contained guanine crystals that obscured important morphologic characters that were necessary to see to make a taxonomic determination. A total of 19 mites was remounted (5 males, 5 females, and 9 nymphs). Representative images and slide-mounted specimens were subsequently forwarded to one of the authors (B.O.) at the University of Michigan for his examination and taxonomic assistance.

Voucher specimens were deposited in the University of Michigan Museum of Zoology (Ann Arbor, MI) pending formal taxonomic description.

RESULTS

The video recording documented literally hundreds of mites of all stages, white in appearance, actively crawling on the moist inner surface of the EAC and tympanum (Figure 1).

Examination of the light-microscope images and slide-mounted specimens showed that the mites belonged to a single astigmatid species, representing most developmental stages, i.e., eggs, larvae, homeomorphic nymphs (Figure 2), and adults (Figure 3 and 4). Based on their general morphology (Figures 3–5), structure of the chelicerae and palps or gnathosoma (Figure 6), and the presence of ventral ring structures (Figure 5), these specimens were tentatively identified as members of the family Histiostomatidae (Anoetidae). This determination was subsequently confirmed, along with the conclusion that the mites represent an undescribed species closely related to members of the genus *Loxanoetus*.[14,15] The mite exhibits striking sexual dimorphism, with the male being larger and more robust than the female, with distinctive sculpturing of the dorsal aspect of the gnathosoma (Figure 4) and bearing enlarged legs, particularly legs 1 and 2 (Figures 3 and 4).

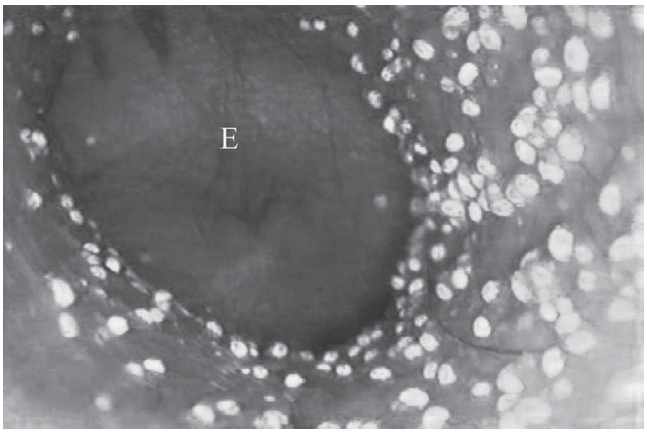

FIGURE 1. Large numbers of histiostomatid mites (white) crawling about on the wall of external auditory canal of right ear of human patient. E = eardrum or tympanum (original magnification × 30).

There was no evidence of hypopodes (non-feeding phoretic morphs of the deutonymph) either in the video clip or among specimens recovered from the ear canal. The fact that the mites were reproducing in the patient's ear was confirmed not only by the high numbers of mites and the presence of all developmental stages, but also by four of the slide-mounted females that had clearly visible eggs. The number of eggs ranged from one to three per female (two females with one egg and two females with two and three eggs, respectively).

Based on measurements of single specimens of the mite during examination with the SEM, the following sizes (length and width) were recorded: adult male = 353, 167 μm; adult female = 275, 118 μm; tritonymph = 110, 87 μm. These mites share certain morphologic features with several possibly different groups of Histiostomatidae. The fixed digit of the chelicera is deep, with very short teeth (Figure 6), a characteristic shared with *Loxanoetus* and *Auricanoetus*. The propodosomal shield has a conspicuous pattern of depressions (Figure 4), similar to those seen in many species of *Histiostoma*, but notably in aquatic species assigned to the subgenus *Ichtanoetus*. Species of the latter group also share the relatively long, thin dorsal body setae. Finally, the enlargement of the ventral spines of the male tarsus II, the relatively small size of the male leg III, and the enlargement of some male dorsal setae into thick spines are shared with *Histiostoma pulchrum* and related species inhabiting phytotelmata (water-holding plant structures). The latter male traits, except the spine-like dorsal setae, are also shared with *Auricanoetus*, which suggests a possible relationship among these taxa.

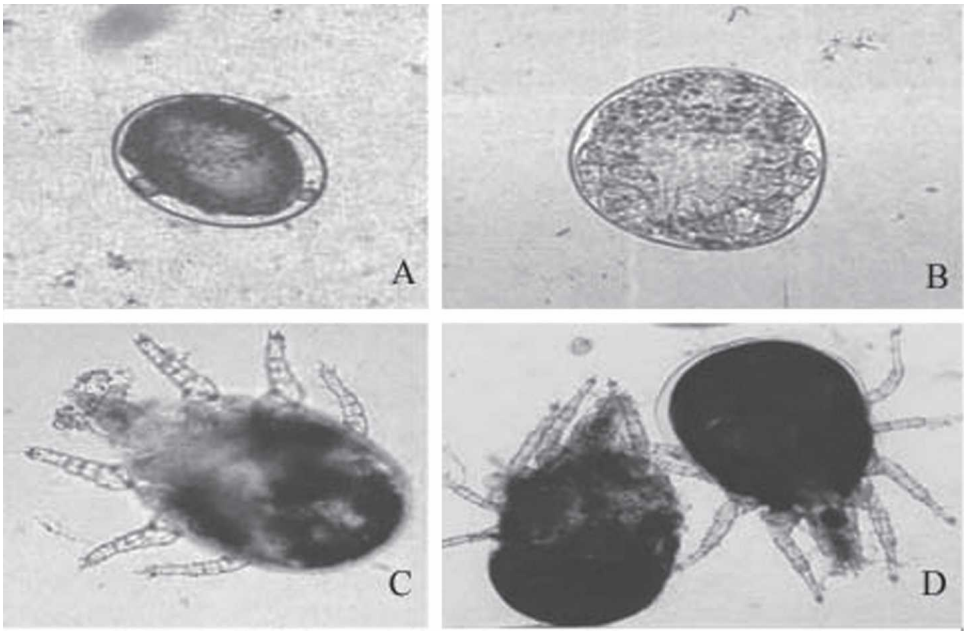

FIGURE 2. Light micrographs of the developmental stages of a histiostomatid mite recovered from the external auditory canal of the patient. **A**, Egg. **B**, Embryonated egg containing developing larva. **C**, Larva with six legs. **D**, Two nymphs with eight legs (original magnification **A**, × 100, **B**, × 130, **C**, × 90, **D**, × 80).

DISCUSSION

Mites of the family Histiostomatidae (formerly Anoetidae) are known by the name slime mites because of their common occurrence, typically as free-living mites, on the surface of moist, highly organic substrates. They are generally presumed to feed on bacteria and other microorganisms, using their highly modified palps and chelicerae (Figure 6) to filter or strain food material in semi-aquatic and aquatic habitats. The mouthparts are not adapted for piercing tissues or parasitizing other organisms. The deutonymph of many histiostomatid species, however, is typically modified as a non-feeding phoretic stage, called a hypopus, which typically attaches to insects or other arthropods as a means of dispersal. No evidence of this deutonymphal stage was found associated with the human case reported here.

To our knowledge, no previous case of human otoacariasis

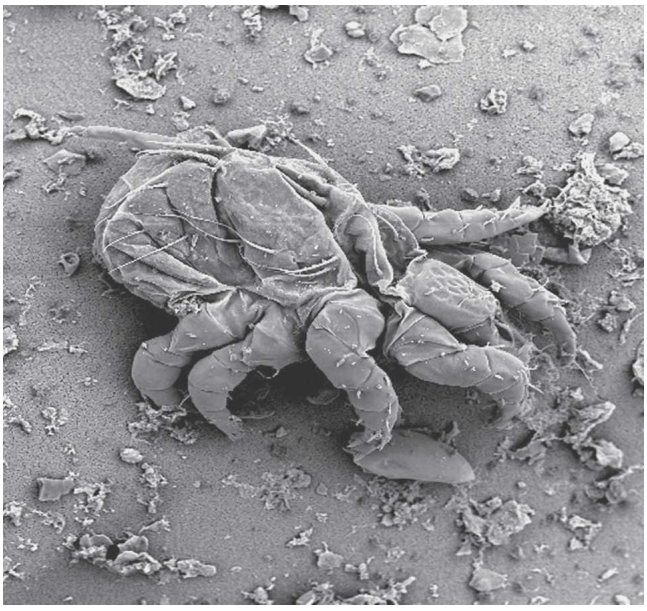

FIGURE 3. Scanning electron micrograph of an adult male histiostomatid mite infesting the external auditory canal of the patient. Note the robust body and enlarged first and second pairs of legs (original magnification × 115).

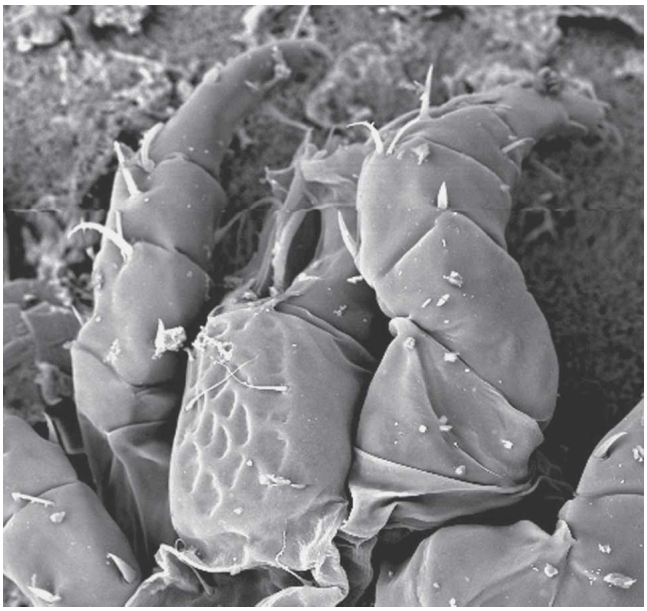

FIGURE 4. Scanning electron micrograph of an adult male histiostomatid mite from external auditory canal of the patient showing gnathosoma and the enlarged first pair of legs. Note the prominent sculpturing on dorsal aspect of gnathosoma of this sexually dimorphic species (original magnification × 310).

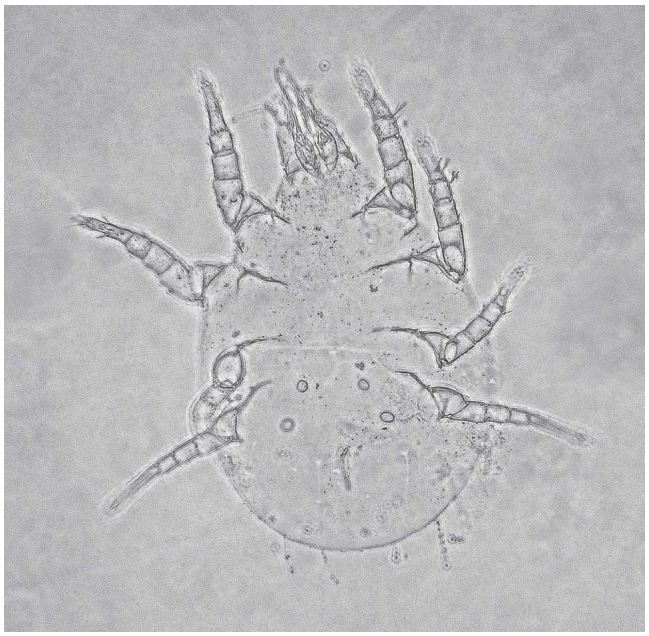

FIGURE 5. Light micrograph of a cleared, slide-mounted nymph of histiostomatid mite (ventral view) recovered from external auditory canal of the patient. Note the two pairs of ring-like structures between bases of the fourth pair of legs, which is characteristic of histiostomatid mites (original magnification × 85).

involving histiostomatid mites has been reported. However, four histiostomatid genera (represented by four described and one undescribed species) have been found infesting the ears of non-human, mammalian hosts: *Auricanoetus*,[15] *Histiostoma* and *Loxanoetus*,[14] and *Otanoetus*.[16]

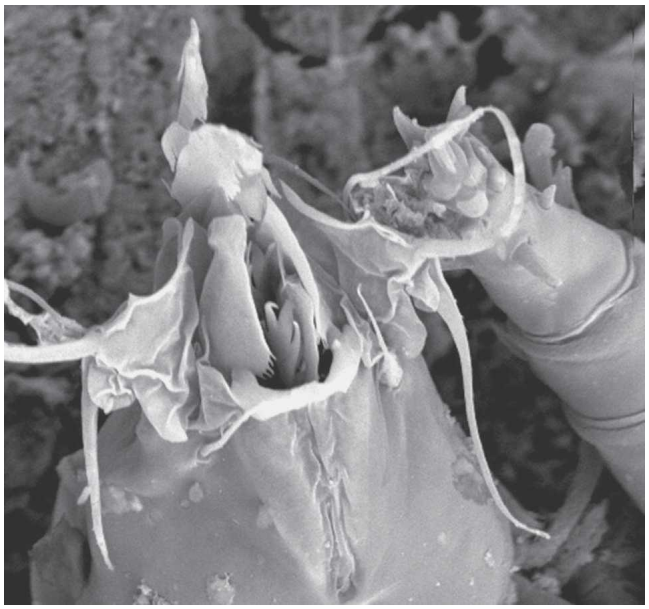

FIGURE 6. Scanning electron micrograph of the gnathosoma of an adult histiostomatid mite recovered from the external auditory canal of the patient showing highly modified chelicerae and associated mouthparts flanked by flap-like palps with two pairs of long, tapered palpal setae adapted for straining microorganisms from wet, organic substrates. The distal end of leg 1 is shown on the right (original magnification × 1,200).

The first discovery was made in 1968 by P. A. Basson who found histiostomatid mites in the external ear canals of the African elephant (*Loxodonta africana*) at Kruger National Park, South Africa, during post-mortem examinations.[17] The mite was subsequently described as *Loxanoetus bassoni*,[14] and later found in ear canals of the African elephant at Karumu Game Reserve in western Uganda[16] and Etosha National Park, Namibia.[15] A second *Loxanoetus* species, *L. lenae*, was described in 1984 from the external ear canal of the Indian elephant (*Elephas maximus* L.) at Townsville, Australia.[18] This species would be assignable to the genus *Auricanoetus* following the concepts of Fain.[15] It was found during post-mortem examination of an 86-year-old circus elephant. A third species found living in the ear canals of the African elephant is *Otanoetus wetzeli*, recovered at Etosha National Park, Namibia.[15]

Three histiostomatid species have been recovered from the outer ear of the African buffalo, *Syncerus caffer* (Matschie) at Karumu Game Reserve, Uganda: *Auricanoetus longitarsus* (originally described as *Loxanoetus* (*A.*) *longitarsus*[15,16]), *Loxanoetus bassoni*, and *Otanoetus wetzeli*.[16] All three species were found infesting the ears of the same buffalo.

The only other known report of histiostomatid mites in the ear canals of mammals is an undescribed species referred to the genus *Histiostoma* recovered from horses and donkeys in Mexico.[19] The investigators found large numbers of the mite in more than 50 animals examined at an abbatoir located at Ixtapalapa (Mexico City, Federal District).

Fain and Zumpt pondered the relationship of these mites in the ears of the African buffalo, questioning whether they were commensals or parasites.[16] They speculated that the mites could be feeding on fatty material, dead desquamated cells, and/or superficial epidermal cells lining the ear canal. However, based on the structure of the chelicerae, they also appropriately noted that it did not seem that these mites were capable of piercing the skin to feed on dermal or subdermal tissues such as blood or lymph. In the case of *L. bassoni* and *L. lenae* infesting the African and Indian elephant, respectively, both were associated with waxy exudates, and in the case of *L. lenae* with much debris in the ear canal.[14,18]

On the basis of reports in the literature and what is known about the feeding behavior of histiostomatid mites in general, there is every reason to conclude that these mites are not parasitic and that at best they are facultative commensals, surviving on secretions, exudates, and microflora in the ears of certain mammals. It is also reasonable to surmise that their numbers can increase significantly in animals with ear infections or other otic disorders that promote production of exudates, cerumen, and microbial growth in the warm, moist, protected environment of the external ear canal. It is more plausible to believe that the mites are able to gain a foothold and reproduce in ears that are already irritated or infected, rather than that the mites invade healthy ears and cause a resultant problem by their presence. A similar situation exists for species of *Histiostoma* (*Ichtanoetus*). Some species are described from phytotelmata but most have been described from fish aquaria, either living on non-living aquatic substrates or found on or in the bodies of healthy or diseased fish.[20] Although considered parasites, it also seems likely that mites in such situations may be merely exploiting a rich source of microbial growth.[20,21]

The human case reported here only reinforces this conclu-

sion. The patient experienced a persistent ear problem with dermal irritation, white discharge, and accumulation of cell debris, that was neglected for more than a year before he sought medical attention. Furthermore, much larger numbers of mites were found in the more severely affected right ear, with significantly fewer mites in the left ear characterized by milder pathologic changes.

The fact that all feeding stages of the mite were found, including adult females with large developing eggs and deposited eggs recovered in washings from the ear canal, clearly indicates that the mites were not only able to survive but to actively reproduce in the patient's ears. This conclusion is consistent with similar observations reported in the cases of histiostomatid mites in elephants, African buffalo, horses, and donkeys.

Regarding the source of these mite infestations and how commonly they may occur, one can make certain inferences. The first is that they are acquired by submersion of the animal in water where these particular species of histiostomid mites presumably occur. In the case of elephants and the African buffalo, this is likely to be water holes, ponds, and shallow lakes where the animals go to cool off or cleanse themselves. Similarly in the case of horses and donkeys, the source is likely to be farm ponds or other bodies of standing water with abundant organic material serving as natural habitats for these particular mites.

Fain and Zumpt were inclined to believe that the presence of these mites in the ears of the African buffalo was not simply the result of accidental contamination.[16] They based this conclusion on the large numbers of mites and the fact that they were obviously thriving and actively reproducing. We proffer the opposite view, i.e., that such occurrences are both accidental and incidental. Infestations probably occur only by chance encounters of animals submerging themselves sufficiently enough in aquatic habitats where this particular group of histiostomatid mites occurs to contaminate the ear with mite-infested water. It may be that only a few mites are required to initiate an infestation, whether by contamination of the pinna and mites subsequently entering the ear canal, or by mites being carried by water directly into the ear canal.

It is interesting to speculate that the otoacariasis patient may have acquired the infestation at a lake approximately 24 miles northwest of his former home in Hackensack, New Jersey. As noted in his medical history, he frequently visited Shepherd Lake, a popular recreational area in Ringwood State Park, located in the Ramapo Mountains of Passaic County in northern New Jersey, bordering New York State. The 74-acre, spring-fed mountain lake is known for its invigoratingly cool water that attracts visitors, particularly during the summer months. Its attractions include boating, canoeing, fishing (rainbow and brown trout), and a shoreline beach. The patient often went swimming there.

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