

REVIEW

Candiru—A Little Fish With Bad Habits: Need Travel Health Professionals Worry? A Review

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Background. Over the last 150 years, a little South American fish with alleged unsavory habits has become the stuff legends are made of. With growing visitor numbers to the Amazon basin, the question of whether the animal poses a threat to the many travelers to the region arises.

Methods. Scientific literature was identified by searching MEDLINE, ScienceDirect, ProQuest, and Google Scholar. The reference lists of all obtained sources served to refine the search, including the original historical writings where obtainable. Nonscientific material was discovered through extensive web searches.

Results. First, the current popular understanding of the fish and its interaction with humans are presented followed by an overview of the historical literature on which this understanding is based. Next, the fish and its supposed attraction to humans are introduced. Finally, this review queries the evidence current medical advice utilizes for the prevention of attacks and the treatment of unfortunate hosts.

Conclusions. Until evidence of the fish's threat to humans is forthcoming, there appears to be no need for considering the candiru in health advice for travelers to the Amazon.

International tourist arrivals to South America continue to rise steadily with over 23 million visitors in 2010, an average annual growth of 4.4% over the last 10 years.¹ The increasing interest in nature-based tourism, ecotourism, and adventure tourism reflects in the growing visitor numbers to the Amazon area. Although exact figures from tour operators are difficult to obtain, arrivals to the main countries offering Amazon travel experiences exist: Brazil, 5.2 million; Peru, 2.3 million; Ecuador, 1 million; and Bolivia, estimated 700,000.¹ A portion of those arrivals will have visited the Amazon basin either exclusively or as part of a tour to country- or continent-specific attractions.

Almost 7,000 km long, and with its source determined in 2001 as a spring on Nevado Mismi (altitude 5,597 m) in Peru, the Amazon River represents the largest freshwater system on the planet. Half of the world's remaining rainforests and the habitat of

two thirds of the world's species of animals and plants depend on the enormous network of waterways in the large basin covering an area of over 7 million km². This biodiversity is the main drawcard for tourists interested in spotting key species such as jaguars, giant otters, and many others. A wide variety of touristic options are available for travelers ranging from the budget conscious to those seeking supreme luxury. Day trips and multiday stays in camps, ecolodges, or research facilities provide opportunities to observe flora and fauna. Visits to "untouched" indigenous peoples are often an added item on a tour. Yet others, perhaps in smaller numbers, come for specific drug experiences.² Luxury culinary cruises on the Amazon River are a recent addition to tourist activities.

Many of those travelers will have received the appropriate vaccinations, prophylaxes, and also behavioral advice on food and water, personal protection from insect vectors, and safe sex during the trip. Avoiding animals known to transmit rabies, especially dogs and bats, will have been included in quality health advice. One hopes that travelers, on their own account, refrain from approaching, poking, touching, or feeding

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jaguars, monkeys, snakes, and others. Many will also be aware of the presence of caimans, poisonous frogs, leeches, spiders, electric eels, stingrays, and piranhas, and not feel the need to handle them unwisely. And then, there is one creature that has fueled vivid imaginations and bizarre fantasies—the candiru. Can a tiny fish be of any consequence to modern travel medicine?

The Candiru and Its Popular “Scientification”

The candiru (*carnero* in some Spanish-based accounts) is known as a little fish keen on entering the nether regions of people urinating in the Amazon River. Spikes prevent it from retracting or being removed and so an electrifying buzz is born. Although there are alleged accounts of entries into people’s rectum and some unfortunate women’s vagina,^{3,4} it is the stories of the fish’s focus on the penis and its activities while in there, that create maximum excitement and exquisite anguish.

Many people have a faint recollection of hearing something about such a creature, but it appears that today, and especially in the social media, it is the more juvenile minds that have turned the candiru into a bizarre legend. Innumerable “facts” underline with authority the horrible danger posed by the fish. The Internet provides information limited only by the time one cares to invest in reading such contributions. Randomly selected sites, with names forewarning of the questionable taste to be encountered, offer a wide range of descriptions of this fish’s habit: “it follows the urine stream to its source,” “lodges itself in a person’s bladder,” “lays millions of eggs that hatch and devour the bladder,” “eat away mucous membranes and tissues until haemorrhage kills the host,” “swims into the urethra and there it makes its home,” “the fish kills many many people a year,” “raped by a fish.” Treatment is offered, preferably something as dramatic as pulling the fish out with pliers, promising unimaginable agony for the host, or surgery on the penis or bladder, including penis amputation. Extending the web search to other languages increases the pool of extraordinary rumors tremendously. Brazilian sites, having a home advantage, seem to be particularly prolific with supporting visual evidence of horror stories. “Candiru” is often used as an umbrella term for various catfishes with astonishing behaviors, and so gripping tales abound, eg, a video aptly titled “Candiru devours human.” It displays fish the size of sardines flopping out of a dead body just recovered from a river (possibly *candiru-açu*, a larger catfish feeding on dead mammals).

This thrill is also reflected in the production of cartoons—unburdened by wit or sophistication—and action movies of similar standards. Literature produced by drug-fueled minds (eg, W. Burroughs’ *Naked Lunch* or *The Yage Letters*^{5,6}) adds to the mental mayhem. Travel literature joins in with ease. In preparation for an Amazon trip, O’Hanlon⁷ furnished a cricket box with a tea strainer as a device against candirus.

Otherwise, he advises, “you must ask a surgeon to cut off your penis.” His local inquiries about the fish met with bewilderment though a species feeding on dead bodies was known. Somewhere the lines have been blurred and even reputable news magazines join in with sensationalized stories. The choice of words alone turns rumors into facts, such as descriptions in the online version of a German news magazine⁸ of what the fish “typically” does, implying a regular and documented occurrence. Dr Oz of *The Oprah Show* adds an entirely new dimension explaining that the fish enters as a “baby” and, once inside the urethra, begins to grow. Television series such as “River Monsters,” or the BBC video clip “Horror story: Candiru,” are not much better when a particular choice of words confirms those sensationalized stories and suggests to the viewer that these events are common. Where did this boundless frenzy originate?

Historical Tales of a Peculiar Little Fish

In the 19th and early 20th centuries, European explorers to the Amazon region related exciting accounts of a strange little fish with extraordinarily disturbing habits. This fish, so the native people apparently advised, entered people’s urethras when urinating in the river and did so with terrible consequences. Even though local people were not given much credit, superstitious and “child-like” as they were, the nature of such stories would have lent itself to being repeated again and again and embellished for maximum effect. That white men relayed these accounts only validated them and so confirmed the truth. The earliest mention appears to be by Carl Friedrich Philipp von Martius (1794–1868), followed by similar reports by others, mainly German and French naturalists and explorers. They include Eduard Friedrich Pöppig (1797–1868), Robert Hermann Schomburgk (1804–1865), Comte Francis de Castelnau (1812–1880),⁹ Paul Marcoy, aka Laurent Saint-Cricq (1815–1888), Gustav Wallis (1830–1878),¹⁰ Karl von den Steinen (1855–1929),^{11,12} and Jacques Pellegrin (1873–1944).¹³ In addition, we read of explorers, medical men, and missionaries from Britain, Spain, and Portugal. Diligent literature searches locate historical documents but there are conveniently summarized papers, the first by Carl Eigenmann.¹⁴ Later reviews^{15–18} are based firmly on Eugene Willis Gudger’s two landmark articles in the *American Journal of Surgery* (1930).^{3,4} Never having traveled himself, he wanted “to get to the truth” of the story and reviewed all accounts made available to him at the time.

The following selected excerpts of historical descriptions, taken from Gudger’s review, illustrate the alarm the fish caused during that era: “...with great violence it forces its way in and desiring to eat the flesh...,” “...has the habit of entering with great impetuosity and rapidity into the external openings of the human body...,” “...entered the urethra and

rectum, chiefly if one while in the water should satisfy nature . . . ,” “. . . little animal launches itself out of the water and penetrates the urethra by ascending the length of the liquid column . . . ,” “. . . penetrates with eel-like nimbleness into the orifices of bathers and causes many fatal accidents . . . ,” “. . . horrible sufferings which the introduction of this living needle may occasion” To prevent mishap, local people were said to have used tight strings around the penis to avoid entry, or suitably fashioned penis covers (and a contraption for women) to the same effect. Treatment consisted of inserting pieces of the Huito fruit (*Genipa americana*) or drinking hot tea made of it, though many explorers have never heard of the fruit’s use for this purpose. [In 1945, Lins¹⁹ reported on the candiru-dissolving method with the buitach apple (Huito) of “primitive peoples” in the Amazon. Using the principle of the fruit’s acidic property, he developed a synthetic formula to dissolve bladder incrustations via rectal (!) application.] Von den Steinen¹¹ recommended trying a hot bath to expel the troublemaker (*Störenfried*) before more drastic measures were attempted. Operations have reportedly taken place but much is hearsay, repeated over and over again by various authors. Surgical interventions are said to include extractions, suprapubic cystostomies, and penis amputations.^{3,4} Even in modern times, and despite the lack of evidence, the usefulness of “a machete and a strong will to live”²⁰ has been conveyed to university students.

Gudger analyzed these accounts, but he still remained skeptical overall. Yet, he listed the names of eight men whom he could accept as eye witnesses, admitting that just because something seems improbable does not mean it does not exist. Reexamining the material for this paper, the various accounts, especially original documents (de Castelnau,⁹ von den Steinen,^{11,12} Pellegrin,¹³ Jobert,²¹ and Boulenger²²), illustrate that most reports are, in fact, repeated again and again based on the same stories already described elsewhere. Therefore, after careful distillation, very little remains and of that little, even accounts sounding like first-hand descriptions become suspect. H.H. Rusby had claimed that “evidence is abundant and confirmed,” but he failed to provide proof.¹⁶ In retrospect, it is almost impossible to identify genuine eye witnesses of candiru “attacks” and we just have to trust that some reports may, indeed, be true. A number of critical comments shall be made here, not only because it is important to interpret the literature mindfully but because it is the basis of current medical advice. These comments relate to the exoticism of the topic, local language issues, and the translation of original accounts.

Trustworthiness of Historical Accounts

Modern travel, even to the most remote places, has no parallel in early voyages. It is difficult today to appreciate fully the physical and mental challenges these explorers faced. Devoted to their particular field

of interest, they traveled through unknown, often hostile, environments, collecting astonishing objects and information along the way. Something as bizarre as a fish swimming up people’s urethra must have been one of the most exhilarating stories of the time. Of adventurous spirit and in exotic surroundings, it is easy to get carried away. In such circumstances, a first report, relayed with caution, can quickly take on a life of its own and, embellished with more and more gruesome details, eventually becomes a fact. It would have taken little to keep the stories alive. The smallest rumor, added to the “body of knowledge,” simply confirmed now preconceived expectations. On the other hand, despite their captivating accounts, it appears that many explorers’ verdict remains one of skepticism because of the absence of scientific proof.

Another point of caution is the use of local languages in obtaining reports from indigenous tribes. Some explorers studied local languages and would have been able to converse with local informants to some degree. However, others and those who traveled for long periods of time and over considerable distances would not have been in a position to speak all the languages encountered. Despite the use of *língua geral*,²³ a unifying language based on Old Tupi, there is still a great potential for misinterpretation of language, postures, and gestures. For example, locals, making swimming movements with their hand and pulling frightful grimaces, may mean a range of things, such as an attack by a piranha, an electric eel, or a candiru, but perhaps something completely different. The possible help of interpreters may not necessarily make such conversations more valid. An explorer, keen to find evidence of horrible stories heard elsewhere, will be only too quick to confirm the alleged habits of the little fish. In addition, it is very hard to know what fish the “natives” and the white “experts” referred to, given that the culprit is not only a very small and fragile creature but also one of many in this genus.

The validity of translations of original Latin, German, Spanish, Portuguese, and French reports needs to be revisited. Updated cross-translations without a sensationalized agenda could ensure that crucial nuances are interpreted correctly and so the blurred line between embellishment and fact is captured precisely. For example, “I know of three cases” may be understood as “I know three cases,” which some may interpret as knowing three cases personally, ie, having seen them as patients. Suddenly, a story becomes a confirmed report. Also, historical handwritten German accounts will most likely be written in Kurrent script; some of its letters, eg, “g,” “p,” or “q,” can easily confuse a translator. Spotte’s two chapters “Culmination of Evils” and “Urinary Misconduct”¹⁸ are particularly helpful as they also provide some original language excerpts.

Finally, there may be particular reasons why locals told white visitors about the candiru. Were they kind and concerned about the explorers’ well-being? Were

they exaggerating a very rare occurrence to keep intruders out?

To conclude this section, it should be fascinating to see what the great explorers of the time wrote about the fish. It has been said that Alexander von Humboldt, Henry Walter Bates, and Alfred Russel Wallace, despite their long years in the area, did not mention the candiru at all.¹⁸ Bates' classic work²⁴ reports on the locals' frequent bathing, fishing, hunting, and cooling down in the river (he calls them "almost amphibious people"), suggesting an absence of the dreaded fish. His book is devoid of any reference to genitals; this may have influenced his selection of reported information. Von den Steinen, on the other hand, switched for such passages to Latin,¹¹ presumably to avoid leading young readers' minds astray. However, Regan²⁵ mentions Wallace's loss of about 200 preserved fish on his journey home and cites a short unreferenced note by the explorer about the peculiar habits of the candiru, a note confirmed by sighting the original document²⁶ and a modern reproduction.²⁷ Therefore, until further confirmation, it may be premature to suggest that neither von Humboldt nor Bates ever mentioned the candiru. Admittedly, many native people have not been aware of the fish either. The assistant of the ill-fated Harvard expedition of 1923 consisting of six scientists, eminent in their respective fields yet supremely inept in anything else, relayed the various mishaps and hardships the group encountered during their attempt to travel in the Amazon basin.²⁸ The candiru fails to make an appearance, perhaps an indication that the fish may only be endemic in certain parts of the Amazon.

What Is a Candiru?

The taxonomy of South American catfishes is complex, much revised,^{18,29} and appears, at times, controversial. Adding to the problem, explorers individually named the specimen they came across for lack of reference works. It is often not even clear if they talk about the same fish, especially when descriptions and sizes of the fish vary tremendously. Given the similarity of many species, and the early explorers' lack of suitable instrumentation to distinguish between them, the lack of agreement is not surprising. When Gustav Wallis discussed the fish in 1864 (his notes were published by Müller in 1870 as a series of journal articles¹⁰), he planned to ensure that his one specimen, kept in spiritus, would reach the appropriate "scientific hands" to get a scientific name which it not yet had. Usually, fish were kept in any grog at hand and deteriorated to the point where they could not be typified at all. As Eigenmann wrote: "with fishes as rare as these and as small... the question arises whether the differences are due to the fact that one worker uses a hand lens and the other a binocular microscope with an arc spotlight..."¹⁴ He emphasized the authority of his statements because of his technical advantage,

whereas his "distinguished predecessors" Pellegrin, de Castelnau, Valenciennes, and Cuvier had only hand lenses.

The candiru is a catfish of the genus *Vandellia*, order Siluriformes; the species *Vandellia cirrhosa* represents the "typical" candiru discussed here. It is a small, slender transparent fish about 3–5 cm long. It feeds on blood from gills of larger fish and has, for this purpose, opercular spines that are used to hold on and provide sufficient space for feeding. These are the very same spines that create so much excitement in the general public. Although candirus are said to be attracted to urine, their predilection for urine, or any substance for that matter, has never been demonstrated. Literature in fish biology, studying the candiru's feeding habits, is inconclusive^{18,30,31} and does not indicate any evidence of attacks on humans. Perhaps, it is a case of "entry by mistake"? The size of the fish certainly allows its accommodation in a urethra. However, with no oxygen available and no room to "swim" up the urethra it is unlikely that the fish survives even minutes. It definitely cannot "make its home" in there. Never mind the physical impossibility of swimming up a liquid column, should the "urinator" be standing above the water level—an event dismissed by von den Steinen¹² as "humbug" (*Münchhausen*). The critical questions posed by Vinton and Stickler in 1941¹⁵ still remain unanswered today.

Current Lack of Evidence

In stark contrast to the numerous historical accounts, and the Internet pieces of wisdom, is the limited coverage of the candiru and its interaction with humans in the more recent academic literature. The scarcity of evidence in historical records has already been pointed out. Are modern publications based on stronger substantiation?

Lack of solid proof did not stop an eminent German zoologist, the late Bernhard Grzimek, former director of the Frankfurt Zoo and prolific author/filmmaker, to include a paragraph about the candiru and its habits in *Grzimek's Animal Life Encyclopaedia*,³² possibly the most authoritative reference work in zoology. The current edition³³ expands on this topic including an artist's impression of a cross-sectioned invaded penis. Evidence originates from rigorous research. However, experiments have so far been unsatisfactory,¹⁸ not least because of the difficulty in reproducing the natural setting and perhaps a lack of willing volunteers. Also, the fragile fish do not tolerate well being handled. For this reason, there is a tendency to cling to the one much publicized case from Brazil,^{34,35} where in 1997 an extraction of a candiru is said to have been performed. Unfortunately, there are too many inconsistencies and irregularities attached to this case¹⁸ to rely on it with confidence, such as the victim's insistence that the fish jumped out of the water and ascended the urine column. Very few images are

publicly available of *V. cirrhosa*, the same drawings and photos being used over and over again, from crude web sites to academic papers. With so little to show for, how does the candiru fare in the medical literature?

Medical Literature and Travel Health Advice

Despite the lack of evidence, background literature of articles in various disciplines include the candiru's alleged habits uncritically, eg, papers in medical psychology³⁶ or sex research³⁷ on the ritual subincision of the urethra. Urological papers^{38,39} also rely on unverified reports. No further current medical reference could be located through scientific databases. The Centers for Disease Control lists "candiru infection or infestation" in its "Alphabetical Index to Diseases and Nature of Injury"⁴⁰ as B88.8, but no cases have been reported (personal communication, June 2012).

A random selection of travel medicine-related books and specific textbooks revealed no sign of the fish, its behavior, or corresponding advice on preventative behavior or treatment options. Elsewhere, despite lacking evidence, unsubstantiated "facts" are repeated as well as uncritical advice dispensed with authority. An earlier paper is reasonably critical of the historical literature but proceeds to give firm advice on prevention and treatment to travelers.¹⁷ Entries in a wilderness medicine textbook repeat those suggestions.^{41,42} The general advice is to wear tight-fitting bathing suits, while the proposed treatment consists of *G. americana* preparations (as per historical accounts), disregarding the practical aspect of obtaining the fruit when needed urgently. Although published nutritional analyses of the fruit vary greatly, it appears to contain a considerable amount of calcium and also ascorbic acid. Consequently, extreme doses (2–5 g) of vitamin C are recommended as an alternative to acidify the urine and so soften the fish's spines. A reasonable physiological explanation for this treatment is absent, including how long it might take to achieve a successful outcome, a question of particular interest to a victim. The latest Lonely Planet's "Healthy Travel" series only suggests to "cover genitalia"⁴³ in a paragraph that reads as if stating a regular occurrence.

To give such advice, we would need, first, evidence of the fish's alleged interaction and, only then, research into prevention and treatment options. Travelers to the Amazon who are precious about their urethras can be told that there is no evidence of candirus waiting in the rivers ready to attack humans, though tight-fitting bathing suits will alleviate any anxiety and do no harm. This verdict may disappoint a great many people but until very welcome confirmed evidence exists of this fish's interaction with humans, travelers to the Amazon who feel tempted to urinate in the river, perhaps with spine-tingling trepidation, will most likely not return home with heroic survival stories to tell.

Conclusion

Considering the alleged voracious habit of the little fish, the geographical size of its habitat,³³ and the considerable number of people living along the river system, should one not expect by now a few confirmed cases in the medical literature? Has perhaps the adoption of underpants or bathers over the last 150 years prevented new cases? But then, children still swim and urinate in the river. Does the lack of interest in definite experimental research simply reflect the fish's negligible threat to people, even if the odd individual misfortune may occur? If evidence was "abundant and confirmed"¹⁶ in the 19th century, it certainly is not now. The little fish for which once the name *Urinophilus diabolicus* (the devilish urine-lover) was proposed may, at this point in time, not be of importance to the practice of travel medicine.

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Declaration of Interests

The author states that she has no conflicts of interest.

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