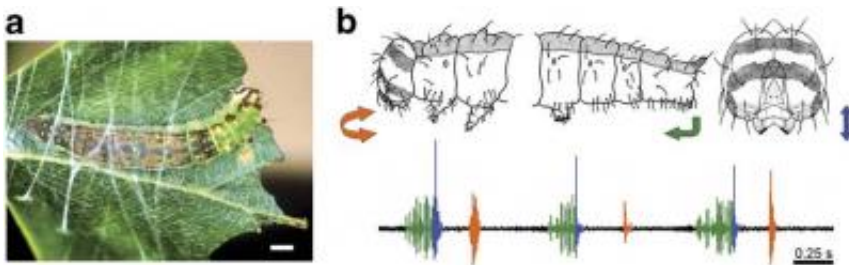


# Ritualized 'talking' in caterpillars evolved from walking (w/ Video)

April 13 2010, by Lin Edwards



(a) Caterpillars build and occupy silken leaf shelters (scale bar, 2.5 mm). (b) When approached by an intruder, the resident produces three types of vibratory signals: anal scraping (green) is performed by pulling the abdominal segment forward while at the same time scratching a sclerotized 'oar' against the leaf surface; mandible drumming (blue) and mandible scraping (orange) are produced by rapidly hitting and laterally scraping opened mandibles against the leaf surface, respectively. Image credit: Nature Communications.

(PhysOrg.com) -- Scientists have long wondered how elaborate animal communication signals evolved, and while animal communication theory holds that many evolved from non-signaling behaviors, there has been little empirical evidence for this. Now scientists in Canada have used comparative and molecular phylogenetic methods to study ritualized territorial signals in caterpillars to show that a communication behavior of some of the caterpillars -- anal scraping to warn off intruders -- evolved from the ritualization of locomotory and fighting behaviors.

The researchers, from Carleton University in Ottawa, Canada analyzed 36 species of caterpillar from two families. In most [caterpillars](#) one of the rearmost segments is a primitive limb called a proleg, and is used for walking. Caterpillars with prolegs tend to physically attack intruders by biting and hitting them to frighten them away. Some caterpillars do not have prolegs, and some of these have specialized anal “oars” in place of the prolegs. The oars resemble the hairs found on the caterpillar’s body, but are thicker and hardened. One example is a caterpillar called *Drepana arcuata*, the masked birch caterpillar, which warns off intruders approaching its silken leaf shelter by drumming and scraping on the leaf with its mandibles and scraping the leaf with its oars. The signaling escalates if the encounter continues until the intruder leaves the territory.

The movements made by the two types of caterpillar are similar, but in the proleg caterpillars the rear end stays put and the front lunges forward, while in the anal oar caterpillars the front end stays put and the rear moves backwards, making a scraping sound.

Researcher Jaclyn Scott and her team sequenced DNA from the caterpillar species and charted their [evolutionary relationships](#). They calculated a 99.9% probability that the [common ancestor](#) of the caterpillar species studied had prolegs. These were lost in the Drepaninae, and replaced in some species by anal oar scrapers, although oars probably disappeared and reappeared several times, and some species did not develop oars at all. The aggressive behavior of the walkers was replaced in the oar caterpillars by ritualized acoustic and vibratory communication signals, which are less likely to result in injury.

The researchers used a laser vibrometer to record vibrations produced during interactions between members of 11 species of caterpillar and compared the vibrations of non-signaling movements (such as crawling or pushing) to the ritualized vibrations. They found that the walker caterpillars do produce vibrations when defending themselves, and

theorized that as these movements evolved into ritualized and repetitive communication signals, they were also amplified. A comparison of body movements used by anal scrapers and walkers showed that scraping uses four body segments while 10 segments are used for crawling, so the anal scrapers produce greater vibrations but with less body movement.

The results of the research, published online in the journal *Nature Communications* on 12 April 2010, provide direct experimental evidence that ritualized territorial signals can evolve from other patterns, in this case walking, and that these can substitute for physical aggression in defending territory. Other animals also use ritualized displays that avoid physical conflict, and it has also been suggested that in humans sports events may represent ritualized fighting displays.

**More information:** *Nature Communications* paper:  
[www.nature.com/ncomms/journal/.../full/ncomms1002.html](http://www.nature.com/ncomms/journal/.../full/ncomms1002.html)

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