Chorus Cicada, *Amphipsalta zelandica* (Boisduval), males calling with only wing-clicks

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Over the past decade researchers from Professor Chris Simon’s lab (University of Connecticut, USA) have conducted field work during the summers to study and collect New Zealand cicadas. On three occasions, at three different locations, a single male *Amphipsalta zelandica* (Boisduval) was noted making wing-clicks (sometimes called wing-claps or wing-bangs) without accompanying timbal noise.

Anecdotes from the public occasionally state that sometimes all one can hear is a loud hiss of wing-clicks from these noisy cicadas, however we have assumed that in such cases the observers are only paying attention to the loud, clicky part of the sound. At all times when we have heard choruses of *A. zelandica*, both timbal noise and wing-click sounds have been present, and our total observations include more than 350 individually noted locations throughout New Zealand. On three occasions during our field work, however, the author heard a single male *A. zelandica* making wing-clicks but no timbal noise, for approximately one minute or longer [Wellington: Day’s Bay walking track to Wainuiomata, 02 Mar 2002; Westland: Lake Mahinapua recreation area, S of Hokitika, 16 Feb 2011; Westland: Gillespies Beach, W of Fox Glacier, 06 Feb 2012]. These observations were at approximate distances of ~10m, 3m and <1m respectively. Unfortunately none of these individuals was collected, but the one at Gillespies Beach was sighted and noted to be definitely a male. Each time, the wing-click pattern was in the typical male *A. zelandica* song pattern and with a similar timing to nearby males that were calling with both timbals and wing-clicks. Unfortunately, since we could not collect any of these specimens it is not known whether the timbals were non-
functional or if the cicadas were simply not using the timbals when observed.

The three *Amphipsalta* Fleming species have a duetting mode of pair-formation like most species in their tribe (Cicadettini), where males produce cues to which the females wing-flick in order to attract the male for mating (Gwynne, 1987; Lane, 1995; Cooley and Marshall, 2001; Sueur and Aubin, 2004; Marshall and Hill, 2009; unpublished data). *Amphipsalta* have quite complicated songs, including “warm-up” sections that include no cues followed by sections of complete song phrases (see also Dugdale and Fleming, 1969; Lane, 1995). The song of *A. zelandica* generally begins with repeated echemes “dididuuureeeeee” (without wing-clicks) transitioning to “diclickdiclickdididuuureeeeee” etc, then eventually giving cue notes “diclickdiclickdididuuureeeeee-dit” (where “dit” is the note that cues the female to wingflick, see Fig. 1). A male can be attracted by clicks of the fingers or tongue if they are made within approximately 50-100 milliseconds of the end of the cueing note. One to five wing-clicks can be made in one echeme (Fig 1, Dugdale and Fleming, 1969). The precise mechanism of wing-click sound production in *Amphipsalta* is still not known. *Amphipsalta zelandica* are loud for their size (pers. obs.), and (unlike many other New Zealand cicadas) they are easily audible even to most older people as their timbal song is broad-spectrum with a relatively low peak frequency ranging from ~4-12kHz, and because the wing-clicks add sound frequencies down to ~1 kHz (Fig. 1).

In many cicada species, some males sit quietly while others sing (pers. obs.). When collecting species that use duetting pair-formation we often simulate female wing-flicks in order to attract males to us (Cooley and Marshall, 2001; Hill and Marshall, 2008; Marshall and Hill, 2009), and this commonly elicits singing behavior from previously silent males – who apparently seek to compete with the original male for the “female’s” attention (we call these “cheater males”). Sometimes, these males search for the “female” (i.e., the person making the clicks) without making any sound (“silent cheaters”) (pers. obs.). In *A. zelandica*, however, what could be the point of a singing male using only wing clicks?
We have often wondered about the use of the female cue (produced with timbal sound) in the dense, unsynchronised choruses of *A. zelandica*. The constant din of sound in such aggregations, including continual male wing-clicks, must make it difficult both for females to hear the male cue notes, and for males to determine that wing-clicks are actually replies from females rather than just part of the song of a nearby male. Perhaps *Amphipsalta* males can omit cues when singing in dense choruses, and females simply approach nearby males and initiate mating – in a manner more like that observed in some cicadas that lack duetting pair-formation (pers. obs.). In this situation the male wing-clicks could be mostly visual signals (e.g., Sueur and Aubin, 2004). If female *A. zelandica* are attracted to an area by the general noise of the chorus, but then initiate specific matings simply by walking up to a male, then they may do so principally based on seeing the male by the movement of his wings. If this is the case, any males that “sing” by only producing wing-clicks may be able to attract females for mating, although we assume that they would be less attractive outside of a chorus. Eventually this could lead to *A. zelandica* males evolving not only “cheater” males but alternative singing strategies, where some males only wing-click, perhaps to conserve energy, or possibly to better hear what is going on around them. One problem with this idea is understanding why most of the chorusing males would keep timbalising, unless the chance of getting a mating was higher. Intriguingly, however, there are at least three independent origins of complete timbal-loss within Cicadidae, all involving cicadas that have switched to only wing-clicking. Could *A. zelandica* be headed this way?

The three males reported here to be only wing-clicking were not “singing” within loud choruses, although other “normal” males were singing nearby. If male *A. zelandica* occasionally lose the function of their timbals through damage, we should hear some males at the periphery of choruses making only wing-clicks, as reported here. Alternatively, if some males in a chorus choose not to timbalise but still wing-click to visually signal to females, we should presumably not hear these males making wing-clicking-only songs outside of loud choruses. Lastly, some males within a chorus may be teneral, and able to wing-click but unable to timbalise.
Newly eclosed males we have kept caged could produce only barely audible protest sounds even at three days, when they were hard and could fly and almost certainly could have wing-clicked (pers. obs. – unfortunately we have not been able to rear such males to full maturity). We have observed teneral males of other cicada species that could barely make any noise from their timbals acting as “cheater” males, and maybe the stimulation of chorusing males nearby could induce teneral A. zelandica males to “sing” even when they could only produce the wing-click part of the song. Could a species that could wing-click before it could timbalise drive the evolution of wing-clicking-only cicadas? Further studies will have to be done in order to determine the method of pair-formation in dense choruses of A. zelandica, and the author would welcome any other observations – especially accompanied by sound recordings or video – reporting A. zelandica males “singing” only with wing-clicks.

Acknowledgements
I thank David Marshall for critiquing the paper and helping with field work, and Chris Simon for obtaining funding and helping with field work. Funding for field work was supplied by NSF grants DEB 00-89946, DEB 04-22386 and DEB 09-55849 to Chris Simon.

References


Fig. 1. Sonogram showing partial calling song of a “normal” male *Amphipsalta zelandica* from Lake Mahinapua recreation area, Westland (created using Raven Pro v1.4). Most of the song is made using the timbals. Triangles at base = male wing-clicks; “c” = cues (see text); “r” = response to cue, in this case David Marshall is snapping his fingers.