Deceiving through sound: do moths buzz like bees or wasps they morphologically resemble to trick predators?

Insects which are either unpalatable (toxic) or possess defence mechanisms (e.g. are able to sting) often display warning signals "watch out, I'm dangerous!" towards potential predators to avoid attack. Signals can be visual, chemical, or even acoustical. Predators learn to recognize these signals and avoid insects that send them, in fear of being stung, bitten or poisoned. Interestingly, there are a number of species, even entire families, that although harmless, still display warning signals. By pretending that they're vicious, they increase their chance of survival. This imitation is called Batesian mimicry – after the first researcher, who described it. In terms of physical (morphological) resemblances, it has been described in many species across the insect class. Clearwing moths (Sesiidae) are a spectacular example of this type of mimicry – even though they are harmless moths, they have evolved to look like wasps or bees. The imitation is so good that even a biologist has problems in distinguishing a clearwing moth from a bee or wasp in the field, until it unfolds its proboscis – a characteristic butterfly and moth feature, which wasps don't have. It has long been known that clearwing moths look like wasps or bees, all moths in the world belonging to this family do! Only recently, however, has it been proven that they imitate their behaviour as well: bee-like moths fly like bees, whereas wasp-like moths fly like wasps. Nothing, however, is known about the sounds they make. More so, there is no mention in scientific literature that they produce any sounds at all. The concept of this project was developed after I heard a clearwing moth "buzz" in flight, in what seemed to be a similar sound to the buzzing of wasps or bees. Despite mimicry being one of the crucial evolutionary concepts describing remarkable protective adaptations, acoustical predator-prey interactions across the entire animal kingdom are generally poorly studied. Perhaps this is due to difficulties in acoustical cues recording and the fact that some are not detected by the human ear. In this project I propose to record and compare the sounds made in flight by four species of wasp and bee mimics (day-flying clearwing moths and hawkmoths) and eight species of their potential models, i.e. wasps, bees, bumblebees and hornets (insects known to "buzz" in flight). Studies will be performed in their natural habitat, without tethering insects, which is a new methodological approach to acoustical studies of insects in flight. Firstly, to see whether bees and wasps have a distinct mode of "buzzing" I will compare their sounds with those made by a blue bottle fly – a harmless, buzzing fly. Then, I will compare wasp and bee sounds with clearwing moth and hawkmoth sounds to see if they are similar. Finally, by playing the sounds of flies, bees, wasps and mimics (moths) to potential predators (birds – common starlings), I will verify whether they understand audio signals from wasps or bees, whether they are able to distinguish them from other insects, and also whether bluffers, such as clearwing moths or some hawkmoths, can efficiently trick birds with their buzzing. These experiments will include training wild birds and then presenting them models, mimics and control species of insects as food. In a second trail, I will place the insects on miniature speakers playing buzzing sounds, to test whether or not birds also readily eat buzzing insects. If acoustical signalling, or even a basic form of communication, between representatives of different classes of animals (i.e. between insects and birds) exists, it would be a truly novel scientific result.