Towards fully automatic call density estimation —— modelling false positives in acoustic spatial capture-recapture

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Some species are visually cryptic and challenging to trap physically but vocally active. Using passive acoustic monitoring (PAM) methods is advancing rapidly and deserves attention. However, with the explosive growth of sound recording data volume, identifying calls manually in the recording becomes gradually intractable. Machine learning (ML) methods provide an alternative to manual work for animal identification, where false positives become the main issue that needs to be addressed. The false positive observation can substantially affect ecological studies such as occupancy estimation, abundance estimation, and specifically, acoustic spatial capture-recapture for animal density estimation. Here we propose three likelihood-based methods to deal with false positives in ASCR density estimation, which leverage both the spatial information and confidence measure acquired from the ML detection model. The proposed methods can mitigate the density estimation bias from 16.8% to a negligible extent (i.e. 2.94%). Our method can also provide decent variance estimation with coverage around 0.95 compared to the nominated coverage rate of 95% with false positives existing.