COMMUNICATION: The potential use of visual and acoustic sensors for early detection of invasions

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Abstract:

As the threat of global invasions increase it is critically important to develop tools for early detections of invasive species. The earlier such species can be detected the more feasible their control and potential eradication will be. Unfortunately most new invasive species are detected by accident when making general surveys often when it is too late for rapid response or in a location where capacity for response is limited. Early detection as applied to invasive species is a system of active and passive surveillance to find and verify the identity of new invaders as quickly and efficiently as possible. Research is also needed to facilitate the incorporation of technological advances into existing methods such as sensors. A sensor is a device that detects or measures a physical or biological property (here an invasive species), and records, indicates or responds to it. In this talk, I summarize what features of visual and acoustic sensors make effective tools for early detection of invasives but do not include chemical methods such as environmental-DNA which are covered elsewhere. I first define a good sensor as one that is dependable, accurate, flexible, targeted, automated and inexpensive. Clearly all of these traits will not be possible with every sensor, instead their importance will be context-specific. I first start with visual sensors, that include many of the traditional methods of invasive detection, but that have also more recently incorporated technology to automate them. They are also by far the dominant mode of detection, particularly in terrestrial habitats. At small scales, personal mobile phones are now being used to document the presence and location of invasive species. This information is rapidly transmitted and if the web of users is extensive enough such a method can produce accurate and wide-ranging maps. Traps of all sorts are routinely used to detect and count wildlife species, but to date are rarely used for early detection of invasives. However use of traps, for invasive rodents, and camera traps for larger invasive wildlife are now beginning to develop with the advent of remote access to and automated identification of collected images. Similar image acquisition technology is being developed for use of early detection and identification of invasive species from aquatic samples. On a broader geographic scale remote sensing by use of drones, satellites and video technology is being developed to map invasive species habitats in both terrestrial and aquatic environments. There is large potential in the use of acoustic methods for early detection of invasives, but such technology is still in its infancy. Examples of the use acoustics, including automated

identification of the collected sound files to species, exist for invasive cane toads, birds and fishes. I conclude by suggesting that the use of visual and acoustic sensors hold much promise for detecting and monitoring invasive species in both terrestrial and aquatic environments, particularly in remote settings. Their efficiency will increase with the growth of observatories, especially in marine systems. Their use will increase and their cost decrease as technology improves and automation becomes more feasible. In my opinion, growth of the use of sensors for early detection of invasives will be driven primarily by the development of automatic detection and identification procedures, allowing the efficient processing of large amounts of data at time scales where rapid responses are still possible and before such species colonize and naturalize in their new habitats.