Supplementary Material – S4

Box 2. Guiding principles for the development of a robust surveillance monitoring methodology.

1. Widespread consultation is essential.

Developing a surveillance monitoring framework for a diverse set of habitats builds upon previous learnings and review of methods already employed in individual regions. A model we found successful was to seek input from experts and follow with widespread consultation across the ecosystem science community. Workshops can then be held to refine particular components and reference groups convened to provide peer-review and guidance during development. Stakeholder groups should be regularly updated, engaged to review and refine proposed methods and provide comment on the pragmatic deployment of methods.

2. Providing a robust baseline from which to detect subsequent change.

A fundamental imperative for creating a monitoring method is the generation of a robust baseline against which ecosystem change can be measured and be sensitive enough to detect relatively small changes. Describing methods in detail ensures they can be accurately reproduced by ecologists with access to a manual and field equipment (White *et al.* 2012a). A long-term surveillance monitoring framework needs to be robust to taxonomic change, thus vouchering and long-term archiving of specimens is critical. It is not always possible to anticipate how practitioners will use data (Burton *et al.* 2014; Bayne *et al.* 2015), therefore subjective data should be minimised hence our framework focuses on high quality, objective data supported by physical samples. This approach allows data to be summarised according to users' analytical needs, whilst maintaining underlying raw data for other end-uses. Quantitative data increase temporal and spatial robustness and enhance change detection.

3. Modular design provides flexibility.

Modular sampling allows components to be implemented separately or in concert. Modularity enables different tasks to be assigned to individuals within a field team and flexibility enables greater uptake of data collection by third parties. The only mandatory module is site establishment. A practitioner implementing part of the method can collect data for those modules they require, and exclude others. Selectively collected modular data are published and analysed alongside data of the same type. Some modules have dependencies, such as the point-intercept module relying on completion of vouchering. Modularity permits a wider group of practitioners to implement the method and benefit from data management pathways.

4. Training and coordination are needed for implementation.

Each field team should comprise, as a minimum, a proficient field botanist capable of discriminating between different plant species and a competent soil scientist and a field technician. With more members, field teams are more efficient with teams of six working well. Field training enhances the pool of expertise.

5. Data and sample management protocols are essential.

To ensure efficient workflow from field to database, all samples such as plant vouchers and tissues are assigned a unique barcode label (pre-prepared on archival quality stickers) for subsequent tracking. Barcodes can then be scanned along with field identifications on a field tablet. Barcodes allow a staging data server to perform three key functions; 1) connect samples with plots and visits; 2) track loaned samples; 3) record references to analysis undertaken by users. Barcodes provide a long-term link between a physical sample and data collected at a plot, making the data system resilient to nomenclatural updates.

6. Open data access is a prerequisite for widespread use.

The impact of collected data is maximised if they are made freely and easily available. Ecosystem science has moved rapidly, and data integration from different disciplines, modelling and re-use are as important as new data collection. These applications benefit from well-described, discoverable and downloadable datasets.