# Workshop Session Digest: Earth Observation – Bringing Together Earth Observation Data and Scheme Data

On 4th October 2018, as part of the annual UKTEPoP (UK Terrestrial Evidence Partnership of Partners) meeting, a workshop was held on bringing Earth Observation (EO) and scheme data together. During this workshop session, the potential for earth observation information and scheme volunteers to be of mutual benefit to each other and contribute together to understanding species and the environment was discussed (Figure 1).

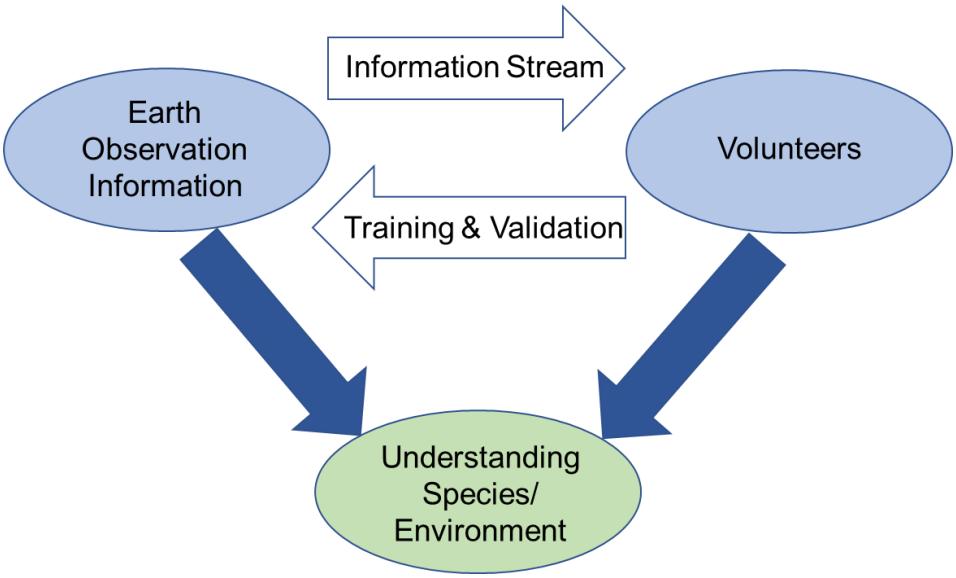


***Figure 1*** *Conceptual model describing the information streams between Earth Observation information, volunteers and our understanding of species and the environment.*

## Section 1 – National and Local Change Detection

The possibilities for information to flow from volunteers to benefit Earth Observation applications are often promoted. To explore which EO products may be of interest to volunteers, examples of EO products (site and national level products) were provided to facilitate discussions.

### 1. Would volunteers find this useful?

The use of EO for navigation, habitat classification and intrinsic interest were discussed.

It was concluded that EO provided little to no benefit in terms of navigation, for example in terms of planning a route or identifying plots (e.g. in upland rovers if previously covered by a different volunteer). The resolution of Sentinel images is courser than Google maps, so although more up-to-date, are unlikely to be any more effective.

On the other hand, provision of local scale habitat classification data derived from EO does have potential to aid volunteers. Many volunteers do not enjoy and are not particularly skilled at collecting habitat data. Giving them an EO derived habitat map of their survey site and simply asking them to confirm whether it was correct could make the process clearer and simpler, allowing them to spend more time focused on the survey's taxa of interest. This would also help to improve the EO data itself, as it would mean more widescale provision of training data for the algorithms. However, this would only be the case if volunteers were accurate in their assessments. Furthermore, this approach risks biasing the volunteer's judgement, overwhelming them with information and reducing their trust in EO where maps are inaccurate. Concerns were also raised about the cost and administrative burden this would place on partner schemes.

The possibility that volunteers would find EO images intrinsically interesting was also discussed. However, several of the schemes already provide an indication of habitat type through, for example land cover maps (NPMS) and OpenStreetMap (BTO) and there has been no demand from

volunteers to have better information on this. It is possible that provision of novel maps, showing something with more information than the maps currently provided (such as productivity maps) could help to engage younger volunteers. The consensus was that this was not a good enough reason alone to explore further, but that if images were being processed for other reasons anyway and were free, readily available and did not place any extra burden on resources, it may be something to consider.

## 2. How would we deliver this?

Habitat maps could be delivered through apps, a web link or a central map repository, with functionality shared across schemes. It could be delivered in offline mode to ensure accessibility in the field. The timescale for circulation could be determined as need arises.

The importance of ensuring a dialogue between EO and volunteers was highlighted. If volunteers understand the mutual benefits and the bigger picture, they are more likely to be supportive than if they consider the benefits to only one party, or think they are just being used for training data without seeing how this benefits their own scheme.

The possibility that the best way forward would not involve delivering EO images to volunteers directly at all, but to only use them behind the scenes at the survey design and analysis stages was also discussed. This would reduce administrative burden and focus resources where it was considered EO could be most useful to the schemes.

## 3. Would it aid survey design?

The possibility of using EO in the design and site selection of both current schemes and potential future surveys was discussed.

Many of the current structured schemes are designed to provide an unbiased representation of the countryside, so using EO to assist site selection would not be appropriate. However, there are several examples within the current schemes where this is not the case. Producing the Bird Atlas involves timed visits to 2km tetrads, in which people visit key habitats within the tetrad. Habitat information could improve this targeting. Butterfly Conservation rare species monitoring also involves volunteers estimating the extent of suitable habitat, which is a big source of error. If BC had good habitat maps, they could work out the area of suitable habitat that volunteers are asked to visit, and so minimise this problem. BC also involves asking volunteers to visit a general area and look for specific species, which can be inefficient and frustrating. If volunteers could be more accurately directed to the key habitats and/or to areas that have recently undergone management (e.g. coppicing), they could spend more time in areas where the species are most likely to be.

For unstructured schemes, it could be worth exploring EO as a tool for selecting survey sites. However, there was concern that better knowledge of habitat distribution may bias volunteer behaviour in a way that would complicate analyses. On the other hand, such biases can be accounted for in analyses, as is already the case in structured schemes that have a deliberate selection bias, such as NPMS which preferentially selects squares with semi-natural habitat.

In future surveys, EO could be useful in developing methodology based on stratification by habitat type, or by habitat quality. It could also be used to identify habitat of rare species so we know where to focus sampling. In addition, it would be possible to use EO to target high risk areas (for examples areas that are changing the most quickly) or to flag up local anomalies and ask volunteers to confirm and investigate.

## 4. Would it aid analytics?

The importance of, and potential for EO to assist with, analyses involving habitat data, habitat specific trends and seasonal trends were readily accepted. It could also be useful in making habitat classification more consistent. However, several challenges involving the quality and accuracy of

the data (both in terms of interpretation and resolution) were identified that would need to be addressed before use.

Good training data from ground truthing is needed to create accurate EO maps. As more data is added, accuracy improves. This creates a problem with analyses in terms of whether real change is detected when a map changes, or whether it is due to correction of previously misinterpreted data following the addition of better training data. A system would have to be put in place involving time stamping both outputs from analyses and updates to training data.

Inaccuracies and uncertainty must also be considered in analyses. Whilst true that ground truthing improves the training data, it does not mean that it will be correct everywhere. For example, weather induced changes can create complications, such as temporary surface water following heavy rain looking like open water on an EO image. Similarly, there is no guarantee that volunteers providing the training data are themselves accurate in their habitat corrections.

Map resolution was also discussed as a potential limitation. In a recording context, habitat data need to be at a fine scale, and relevant to the plots and transects surveyed. Sentinel gives 10 $m^2$ resolution, which limits how fine grain habitat divisions can be detected. Higher resolution images do exist, but they must currently be paid for. As technology improves, it is hoped that EO will in the future be able to detect finer habitat differences.

### 5. What other things do we want to detect?

Information about habitat quality was highlighted as potentially even more useful than information about habitat type. It would be of value to schemes if EO could divide habitat categories further (e.g. to identify degraded bog separately from bog). This is possible but would depend on sufficient training data.

Other potential applications include:

- Monitoring of heather burning
- Analysis of agri-environment schemes (their success or compliance)
- Maps showing areas of recent management
- Productivity maps
- Habitat/fertility maps for rare plants
- Improving predictive species modelling (e.g. to predict which moths are flying in an area), so people know what to look out for or to contribute to verification checks

## Section 2 – Adapting Schemes

### 1. How do the schemes differ from ideal EO data collection?

It was recognised that what surveillance schemes need is not necessarily what EO needs. For example, many of the features of biological and ecological significance for birds (dung heaps, standing water, wet flushes, cattle, sheep, etc.) cannot be identified with and are not relevant to EO.

The priority and motivation for volunteers would be carrying out counts for the scheme, rather than collecting habitat data for ground truthing, meaning they are unlikely to put much effort into ensuring the accuracy of the habitat data. Additionally, volunteers are generally not particularly skilled in habitat identification below top level.

EO would need to apply a standardised habitat ID protocol, which would differ from how each scheme currently records such data. Questions were raised over the practicality of standardising habitat data collection across schemes to aid in EO ground truthing and whether the schemes would see enough benefit from it to justify the associated workload.

2. **What are the barriers to volunteers collecting additional information?**
   The main barrier is an expected lack of volunteer motivation, as volunteers are often reluctant to collect habitat data. Concerns were raised that there is likely to be a disconnect between people who need the EO product and the volunteers who would be doing the ground truthing. The burden would be on the volunteer who would see little direct gain from the exercise, although they would gain indirectly from any benefits it brings to the overall scheme.

   The potential to break down this barrier by engaging other groups that have more of an interest in habitat recording was discussed. Suggestions included approaching U3A, ramblers, mountaineers, and creating an online set-up with a competitive element (cf. geo-caching).

## Summary

During these discussions, it was concluded that volunteers would be very useful for providing training data to improve EO habitat classification algorithms, and that volunteers may find correcting habitat maps created using EO technologies easier than classifying habitat from scratch. The incorporation of EO could also be useful to schemes through survey design and data analysis. Whilst there would be many challenges to overcome before EO could be used by partner schemes in such a way, the concept merits further discussion.