**Annex 3 - Estimated costs of Schemes**

All schemes last for 10 years with 4 replicates (sampling visits) per site expected in each year, based on the need to detect long-term trends and to capture the flight periods of major pollinating insects. Estimated costs are calculated based on the number of sites sampled plus fixed costs. Costs are subdivided as follows:

**Staff costs**

***Surveyor costs*** The estimated costs of collecting the specimens or records. This is 0 where the data collection is undertaken by volunteers.

For professionals (Schemes 1 and 2a/b), we used the average 2019/2020 daily costs (including overheads) of technical staff hired by the Centre for Ecology & Hydrology and the University of Reading, multiplied by 88 (the number of days on a 40% full-time equivalent contract that the staff would be expected to work). These include staff overheads and represent an average of a university and a private/government institution. The number of staff required was based on the assumption that 1 staff member can realistically manage five sites in scheme 1, ten in schemes 2a and eight in scheme 2b. These assumptions are based on practical field experience in relation to the complexity of the methods used.

**Table A3a** – Costs of employing staff across all sites

|  |  |  |
| --- | --- | --- |
|  | Scheme 1 | |
|  | Staff | Costs/year |
| 75 sites | 15 | £351,529 |
| 145 sites | 29 | £679,623 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Scheme 2a | | Scheme 2b | |
|  | Staff | Costs/year | Staff | Costs/year |
| 300 sites | 30 | £703,058 |  |  |
| 800 sites |  |  | 100 | £2,343,528 |

***ID costs*** The estimated costs of the time taken to identify specimens that cannot be identified in the field.

ID costs are estimated as the average time taken by a professional taxonomist to identify a bee or hoverfly specimen to species level (0.09hrs/specimen) when presented individually tubed in ethanol, and enter the data, multiplied by the average number of specimens that require identification collected for each replicate by a given method (see table A3b; from O’connor et al., 2019; Carvell et al., 2018). Prior to reaching taxonomists, pan trap samples are sorted by technical staff to remove, tube and label bees and hoverflies in individual eppendorfs, count other specimens to insect group level and return these to original tubes in ethanol for archiving. This is expected to take 1.5hrs per site survey and is charged at technician time. These estimates are derived from a combination of pilot work in O’Connor et al (2019) and the first two years’ sampling from a network of ca. 70 1km survey squares under the UK Pollinator Monitoring Scheme (Carvell et al., 2018).

Photographic identification to broad taxonomic group level for Scheme 4a is assumed to take 0.008hrs/specimen (30 seconds), based on recorder experience in the Hoverfly Recording Scheme which uses extensive photographic identification (Morris R, Pers Comm). Sample numbers were estimated based on the number of individuals volunteers typically observe and photograph per 10 minute observation.

Identification by DNA barcoding used costs from the development of an individual-based illumina sequencing approach (Creedy et al., 2019). These costs include all consumable materials for the sequencing and barcoding analysis (£1.85 for DNA extraction, £0.26/specimen for PCR Barcoding), £1000 for primers which are assumed to last for a year. Labour costs are based on a postdoctoral researcher at the average rate of the University of Reading and the Centre for Ecology & Hydrology, including overheads. The researcher is assumed to work for approximately 6% of their time per 1000 specimens (£6367.02/1000 specimens), assuming these are already sorted and labelled, as with traditional identification.

**Table A3b** – Consumable costs in DNA barcoding

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Consumable** | **Units/purchase** | **Costs** | **Cost per sample** |
| **DNA extraction** | 0.1-10ul refill tips | 960 | £15 | £0.02 |
|  | 1-200ul refill tips | 960 | £15 | £0.02 |
|  | BioSprint 96 DNA Blood Kit | 384 | £670.00 | £1.74 |
|  | 200ml ATL Buffer | 1000rxns | £52 | £0.05 |
|  | 20ml Proteinase K | 96 rxns | £2 | £0.02 |
| **PCR** | PCR plate | 10 (96 samples per plate) | £20 | £0.02 |
|  | Plate sealer (-80) | 10 (96 samples per plate) | £65 | £0.01 |
|  | 0.1-10ul refill tips | 960 | £15 | £0.02 |
|  | 1-200ul refill tips | 960 | £15 | £0.02 |
|  | 200-1250ul refill tips | 960 | £15 | £0.02 |
|  | Biotaq | 500 | £55.10 | £0.11 |
|  | dNTPs set | 100nM | £74 | £0.07 |

Note that separate uses of some consumables are required at different stages of analysis

In Scheme 2b, crop samples are analysed for yield parameters (weight, shape, size, quality parameter, brix, oil content etc.) by technicians at a cost of ~0.5 days per site (based on Garratt et al., 2016).

**Table A3c** – Number of samples (bee and hoverfly specimens) requiring identification to species level per replicate of each method.

|  |  |  |
| --- | --- | --- |
| Method | Samples requiring identification | |
| Professional | Volunteer |
| Transect walks | 3.44 | NA |
| Pan traps | 19.2 | 19.2 |
| Focal floral observations | NA | 9 |

***Administration costs*** The estimated employment costs of a full or part time administrator. In schemes 1-3, project co-ordinators are assumed to be highly skilled experts, paid at a rate equivalent to a senior scientist (~£106,117 for 220 working days, including organisational overheads, based on the average 2019/2020 salaries for senior researchers at the University of Reading and Centre for Ecology & Hydrology). In scenario 4a, Butterfly Conservation estimates suggest co-ordination would require ~15% of an existing co-ordinators’ time and ~1% of a project managers’ time. This equates to ~£4,400/year (23 days at £160/day, 2 days at £209/day). In Scenario 4b, the project co-ordinator is assumed to be a full time post within an NGO at a salary of ~£33,000, based on existing NGO expenses. Finally, there is assumed to be a general overhead cost of £27,191 per year for facilities and bench fees.

**Material costs**

***Equipment costs*** The estimated costs of material (equipment and consumables) required for each method. These are estimated on a per recorder basis i.e. professional researchers use the material for all their sites in a given year while each volunteer requires their own set of equipment and consumables. The core equipment is assumed to last for 5 years before needing replacement in all scenarios, either due to heavy use in the case of professional based networks (schemes 1 and 2a/b) or through volunteer turnover in Schemes 3a/b. Although transects are walked in Scheme 2, no specimens are caught, eliminating all material costs.

**Table A3c** – Items for use in different survey methods

|  |  |  |
| --- | --- | --- |
| Method | Items | Cost/recorder |
| General kit for professional recorders (pantrap/transect) | Thermos bag, Ice pack, Ice box | £42.70 |
| General kit for all recorders | Postal Boxes for sample tubes (4 per recorder) | £1.49 |
| Pantrap (general) | Trap Station (5 wooden stakes and holders, plus two spares, including labour costs for construction), Plastic Bowls (5 of each colour + 3 spares of each, including the costs of UV spray paint applied to each), Seive, plastic forceps, Washing up liquid x2, mallet, Ethanol container | £82.23 |
| Pantrap (consumables per replicate) | sample tubes, muslin, ethanol (400ml) | £5.16/replicate |
| Transect | Hand net, hand net frame, 50 tubes/site (250 total) | £32.90 |
| Transect (consumables per replicate) | Sample tubes (x2), ethanol (100ml) | £0.93/replicate |
| Hand pollination | Exclusion bag (x3/site), Petri Dish, paint brush, scissors, cable tie, paper bag | £33.50 |

***Storage costs*** The estimated costs of storing specimens in schemes 1 and 3a/b. This is based on the assumption that samples are stored in 99% alcohol in a freezer following identification. The cost of eppendorfs for this purpose is ~£0.012/unit. Longer-term costs for storage, such as freezer facilities, are assumed to be covered as part of the overheads charged when hiring staff.

***Travel costs*** the costs of petrol for professional surveyors to undertake surveys. It was assumed that all data collection would occur at an average of 40 miles round trip from each surveyors base. At a rate of £0.45/mile (university standard rate), this equated to £18 per replicate. These costs are only applied in the professional schemes (1 and 2a/b).

***Postage costs*** The estimated costs of posting specimens and crop samples to be identified. Based on the costs experienced in the PoMS scheme (CEH, 2018) this is £3/replicate, however these costs are doubled to reflect posting to and from identifying experts. There is also an initial postage of materials (assumed to be £10/site) in Scheme 1 that occurs twice to represent turnover in materials. No postage occurs in schemes 2a/b and 4a/b.

**Other costs**

***Training costs*** The estimated costs of running training courses. In schemes 1 and 2a/b this includes the cost of a postdoctoral researcher to give advice on methods and protocols and occurs in years 1, 4, 7 and 10 to account for staff turnover and updated methods. Following Carvell et al., 2018; in Schemes 3a/b, volunteers are trained on a one-to-one basis by scheme staff on an initial site survey, during which they are given all the materials required. In all cases, up to 100 miles fuel expenses are covered for each participant (schemes 1 and 2a/b) or staff member (scheme 3a/b) at £0.45/mile.

***Digital costs*** The estimated costs of maintaining databases and websites. For schemes 1 and 2a/b this is simply £500 to maintain a specific webpage on the project site that can be accessed. £1,000 is estimated for Scheme 3a and 3b as this will require a more volunteer facing site. £10,000 is estimated for Scheme 4b as this requires the establishment of a fully interactive platform for sharing and crowd sourcing specimen identifications.