**Supplementary data**

Assessment of Surrogate of Ecosystem Health Using Indicator Species and Mixed-Species Bird Flock

**Appendix 1.** List of species with each IV values in three different areas at BBSNP and its presences in joining mixed-species flock

| Species                        | IV forest | IV agriculture | IV edge | Mixed flock |
|-------------------------------|-----------|----------------|---------|-------------|
| Aceros undulatus              | 1.39      | 0              | 2.78    | 0           |
| Aegithina viridissima         | 0.44      | 0              | 22.37   | 1           |
| Alcedo atthis                 | 1.39      | 1.39           | 1.39    | 0           |
| Alcedo meninting              | 1.39      | 0              | 5.56    | 0           |
| Amaurornis phoenicurus        | 0         | 4.17           | 0       | 0           |
| Anthreptes malacensis         | 0.39      | 28.97          | 12.21   | 0           |
| Anthreptes singalensis        | 1.67      | 0              | 5       | 1           |
| Aplonis panayensis            | 0         | 24.59          | 0.07    | 1           |
| Arachnotera robusta           | 1.39      | 1.39           | 1.39    | 0           |
| Arachnothera flavigaster      | 0         | 4.17           | 0       | 0           |
| Arachnothera longirostra      | 46.26     | 1.36           | 14.56   | 1           |
| Argusianus argus              | 15.63     | 0              | 2.08    | 0           |
| Aviceda jerdoni               | 0         | 8.33           | 0       | 0           |
| Bubo sumatranus               | 2.08      | 0              | 2.08    | 0           |
| Buceros rhinoceros            | 9.38      | 1.04           | 0       | 0           |
| Cacomantis merulinus          | 1.39      | 36.11          | 11.46   | 1           |
| Cacomantis sepulcralis        | 0         | 2.08           | 2.08    | 0           |
| Calorhamphus fuliginosus      | 0.42      | 0              | 11.25   | 0           |
| Calyptomena viridis           | 4.17      | 0              | 0       | 0           |
| Celeus brachyurus             | 0.46      | 13.89          | 1.85    | 1           |
| Centropus bengalensis         | 0.18      | 0.36           | 21.74   | 0           |
| Centropus sinensis            | 4.17      | 4.17           | 4.17    | 1           |
| Ceyx rufidorsa                | 0         | 0              | 12.5    | 0           |
| Chalcophaps indica            | 0.46      | 5.56           | 1.85    | 0           |
| Chloropsis cochinchinensis    | 8.33      | 0              | 0       | 0           |
| Chloropsis cyanopogon         | 0         | 0              | 8.33    | 0           |
| Collocalia linchi             | 1.01      | 8.11           | 28.15   | 0           |
| Copsychus saularis            | 0         | 12.5           | 0       | 0           |
| Corvus enca                   | 1.79      | 0.6            | 1.79    | 0           |
| Corydon sumatranus            | 19.74     | 0              | 0.88    | 1           |
| Cymbirhynchus macrorhynchos   | 0         | 1.04           | 9.38    | 0           |
| Dicaeum agile                 | 1.39      | 1.39           | 1.39    | 0           |
| Dicaeum cruentatum            | 0.64      | 13.46          | 15.38   | 1           |
| Dicaeum sanguinolentum        | 0         | 4.17           | 0       | 0           |
| Species                        | IV forest | IV agriculture | IV edge | Mixed flock |
|-------------------------------|-----------|----------------|---------|-------------|
| Dicaeum trigonostigma         | 0.42      | 50.72          | 29.62   | 1           |
| Dicaeum trochileum            | 0         | 2.08           | 2.08    | 1           |
| Dicrurus aeneus               | 10        | 0              | 0.83    | 0           |
| Dicrurus paradiseus           | 7.94      | 0              | 20.63   | 1           |
| Dicrurus sumatranus           | 8.33      | 0              | 0       | 0           |
| Dinopium javensis             | 0         | 0.83           | 3.33    | 0           |
| Ducula aenea                  | 14.2      | 0.15           | 0.93    | 0           |
| Enicurus leschenaulti         | 2.08      | 0              | 2.08    | 0           |
| Enicurus velatus              | 4.17      | 0              | 0       | 0           |
| Eurylaimus javanicus          | 12.5      | 0              | 0       | 0           |
| Eurylaimus ochromalus         | 41.67     | 0.16           | 4.01    | 0           |
| Gallus gallus                 | 2.78      | 0              | 1.39    | 0           |
| Geopelia striata              | 0         | 28.89          | 17.59   | 0           |
| Gracula religiosa             | 8.58      | 15.32          | 23.1    | 0           |
| Halcyon cyanoventris          | 0         | 0              | 4.17    | 0           |
| Halcyon smyrnensis            | 0         | 18.33          | 11.25   | 0           |
| Harpactes davaucellii         | 4.17      | 0              | 0       | 0           |
| Hemicircus concretus          | 0         | 1.39           | 2.78    | 1           |
| Hemiproene longipennis        | 0         | 11.67          | 5       | 0           |
| Hemipus hirundinaceus         | 0         | 0              | 8.33    | 1           |
| Hirundo tahitica              | 0         | 4.17           | 0       | 0           |
| Hypogramma hypogrammicum      | 4.17      | 0              | 0       | 0           |
| Ictinaetus malayensis         | 4.17      | 0.93           | 3.7     | 0           |
| Iole olivacea                 | 4.17      | 0              | 0       | 0           |
| Lalage nigra                  | 0         | 11.11          | 2.78    | 1           |
| Lanius tigrinus               | 0         | 8.33           | 0       | 1           |
| Lonchura leucogastroides      | 0         | 36.04          | 2.25    | 0           |
| Lonchura maja                 | 0         | 3.79           | 0.38    | 1           |
| Lonchura punctulata           | 0         | 17.31          | 3.85    | 1           |
| Lonchura striata              | 0         | 18.75          | 0.42    | 0           |
| Loriculus galgulus            | 0         | 4.17           | 0       | 0           |
| Macronous gularis             | 8.59      | 15.1           | 26.25   | 1           |
| Macronous ptilosus            | 8.33      | 0              | 0       | 0           |
| Macropygia ruficeps           | 3.33      | 0              | 5       | 0           |
| Macropygia uncal              | 0         | 4.17           | 0       | 0           |
| Megalaima australis           | 6.67      | 1.11           | 11.67   | 0           |
| Megalaima chrysopogon         | 23.08     | 0              | 5.13    | 0           |
| Megalaima haemacephala        | 1.04      | 1.04           | 4.17    | 0           |
| Megalaima mystacophanos       | 30.17     | 6.54           | 15.88   | 1           |
| Meiglyptes tristis            | 1.04      | 0              | 9.38    | 1           |
| Species                        | IV forest | IV agriculture | IV edge | Mixed flock |
|-------------------------------|-----------|----------------|---------|-------------|
| Meiglyptes tukki              | 0.42      | 0.83           | 8.75    | 0           |
| Merops viridis                | 0.17      | 6.94           | 13.02   | 1           |
| Microhierax fringillarius     | 3.75      | 2.5            | 3.33    | 0           |
| Muscicapa daurica             | 0         | 0              | 12.5    | 1           |
| Nectarinia jugularis          | 2.75      | 55.83          | 8.25    | 1           |
| Oriolus xanthonotus           | 22.16     | 0              | 5.11    | 1           |
| Orthotomus ruficeps           | 1.45      | 46.5           | 28.74   | 1           |
| Orthotomus sericeus           | 1.34      | 18.15          | 8.87    | 1           |
| Orthotomus sutorius           | 0         | 2.08           | 2.08    | 1           |
| Passer montanus               | 0         | 4.17           | 0       | 0           |
| Pellorneum capistratum        | 2.08      | 0              | 2.08    | 0           |
| Pericrocotus cinnamomeus      | 1.04      | 0              | 3.13    | 1           |
| Pericrocotus flammeus         | 3.33      | 0              | 2.5     | 1           |
| Phaenicophaeus chlorophaeus   | 43.33     | 0              | 3.33    | 1           |
| Phaenicophaeus curvirostris   | 0.46      | 0              | 14.81   | 1           |
| Phaenicophaeus diardi         | 0         | 0              | 8.33    | 0           |
| Phaenicophaeus javanicus      | 2.08      | 0              | 2.08    | 0           |
| Phaenicophaeus tristis        | 2.08      | 0              | 2.08    | 0           |
| Philentoma pyrhopterum        | 4.17      | 0              | 0       | 1           |
| Picoides moluccensis          | 0         | 55.74          | 1.35    | 1           |
| Picus miniaceus               | 0.52      | 0.52           | 15.63   | 0           |
| Picus puniceus                | 17.31     | 0.64           | 15.38   | 1           |
| Pitta guajana                 | 20        | 0.28           | 6.67    | 1           |
| Pitta sordida                 | 2.08      | 0              | 2.08    | 0           |
| Platysmurus leucopterus       | 12.21     | 0.19           | 39.24   | 1           |
| Ploceus philipinus            | 0         | 4.17           | 0       | 0           |
| Prinia familiaris             | 0.1       | 30.56          | 7.74    | 1           |
| Prinia flaviventris           | 1.04      | 0              | 3.13    | 0           |
| Prionochilus percussus        | 0         | 0              | 4.17    | 0           |
| Prionochilus maculatus        | 5.56      | 0              | 1.39    | 1           |
| Psitinus cyamurus             | 0         | 13.64          | 0.76    | 0           |
| Ptilinopus melanospila        | 0         | 0              | 4.17    | 0           |
| Pycnonotus atriceps           | 1.63      | 1.09           | 15.4    | 1           |
| Pycnonotus aurigaster         | 0.13      | 65.92          | 17.28   | 1           |
| Pycnonotus brunneus           | 4.97      | 3.08           | 38.35   | 1           |
| Pycnonotus erythropthalmos    | 1.79      | 0              | 7.14    | 0           |
| Pycnonotus goiazier           | 0.6       | 40.86          | 36.7    | 1           |
| Pycnonotus melanicterus       | 18.25     | 16.58          | 43.06   | 1           |
| Pycnonotus simplex            | 0.79      | 4.17           | 14.29   | 1           |
| Reinwardtipicus validus       | 0         | 0              | 8.33    | 0           |
| Species                        | IV forest | IV agriculture | IV edge | Mixed flock |
|-------------------------------|-----------|----------------|---------|-------------|
| *Rhinoplax vigil*             | 10.42     | 0              | 0.69    | 0           |
| *Spilornis cheela*            | 0         | 5.95           | 2.38    | 0           |
| *Spizaetus alboniger*         | 0         | 4.17           | 0       | 0           |
| *Stachyris erythroptera*      | 4.17      | 0              | 0       | 0           |
| *Streptopelia bitorquata*     | 0         | 8.93           | 2.38    | 0           |
| *Streptopelia chinensis*      | 0         | 28.26          | 21.92   | 1           |
| *Sturniculus lugubris*        | 0.6       | 13.1           | 20.09   | 1           |
| *Thepodomis gularis*          | 4.17      | 0              | 0       | 0           |
| *Todirhamphus chloris*        | 0.96      | 25.96          | 3.21    | 0           |
| *Treron capellei*             | 5.54      | 0              | 4.64    | 0           |
| *Treron vernans*              | 1.88      | 0              | 28.33   | 1           |
| *Tricholestes criniger*       | 13.89     | 0              | 0.69    | 0           |
| *Turnix suscitator*           | 0         | 4.17           | 0       | 0           |