**Appendix II. Draft Recommendations: DFFU\_IAS**

**30 July 2017**

The list of recommendations below constitute the provisional, unedited suite of draft recommendations identified at the first in-person meeting of the DFFU\_IAS in Leipzig, July 2016. These will be refined and synthesised, as well as edited to include the results of the survey conducted to receive input from the user community, for inclusion in the Final Report. The recommendations are listed by topic, following the four key topics relevant to the task identified during the Leipzig meeting (see Interim Report).

**Data needed for the study, reporting and management of biological invasions**

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|  | **Recommendation** | **Relevance to users, providers, GBIF** |
| 1 | Prioritize and perfect taxonomic information (incl. synonyms and common names), for all species on GRIIS and any other authoritative sources of alien and invasive species information | GBIF |
| 2 | Prioritize gap filling for species on GRIIS, including clarification of native and introduced ranges | GBIF, Providers |
| 3 | Provide appropriate key links from species pages to related/supplementary information sources | GBIF plus... |
| 4 | Data providers to find mechanisms to reduce the time lag between observation and mobilization. | Providers |
| 5 | Checklists are made available for each country and all taxonomic groups with the native or introduced status of that taxa. | Providers, GBIF |
| 6 | All invasive/alien species observations are provided at the highest temporal and spatial resolution possible. | Providers |
| 7 | Habitat data (categorical type) associated with occurrence records. To include “substrate” type --- inanimate or living. To include elevation/depth. | GBIF |
| 8 | Key environmental data associated with specific occurrence records (eg, in marine systems includes salinity and temperature) | Providers |
| 9 | Indication whether occurrence record(s) is on temporary structure (car, plane, ship, train, etc) versus “natural” habitat --- and ultimately whether considered established or “transient” in a region or not --- not just migratory species but also human transported species. The latter is derived by some rule set, but the core data and topic are a “need”. |  |
| 10 | Species traits (eg, life history, trophic mode, growth form, mobility, etc) to evaluate patterns spread and function in space and time. |  |
| 11 | Resource (whether GBIF or outside) for transport mechanism(s) by species. This requires refinement of approach in other standards --- which are conflate various different processes/dynamics. |  |
| 12 | Resource for impact data to evaluate space and time-dependent indicators of invasion effects. |  |
| 13 | Native, non-native, and cryptogenic “range” of each species. Should consider novel genotypes in this as well. Requires regular updates to reflect changes in knowledge. |  |
| 14 | Gaps analysis for key target or indicator taxa --- and possibly used for focused data collection campaigns for species or interest or of high indicator value --- stratified by ecosystem type. |  |
| 15 | Filters (and possible visualization) to flag or rank observations that are unexpected or potential outliers. | GBIF |
| 16 | Possible alert system for particular species of interest to individuals and organizations by region --- as automated system. | GBIF |
|  | Abundance data: Categorical measure of abundance with observation(s) --- 1, multiple, log scale --- as a starting point. Possibly transition to more extensive later or for target species campaigns or demonstration models. |  |
| 17 | Inclusion of key location types and codes that are relevant to the invasive species issue such as islands, protected areas and other recognised areas of high biodiversity value such as Important Plant areas, Important Bird Areas etc. | GBIF |
| 18 | Flagging of provenance of species -inclusion of native range/ alien range | GBIF |
| 19 | Identification of the pathways and Invasiveness of introduced species, | USER |
| 20 | To minimize the introduction of invasive alien species in the future. | USER |
| 21 | Inclusion of annotation of typical use and ‘reason’ for introduction eg -Aquaculture, Mariculture, Forestry, Biofuel production | GBIF |
| 22 | Dynamic updates and prioritization of data for new species added to GRIIS. | GBIF |
| 23 | Determination of the taxonomic groups of introduced species; | USER |
| 24 | Absence data, inferred absence data (confidence of absence) and associated date |  |
| 25 | Links to Risk assessments and key sources of IAS data/ EICAT rank | GBIF |
| 26 | Can any abundance information of available be included from the Verbatim info? | GBIF |
| 27 | Dates of 1st introduction, time series information at and across localities. |  |

**Data structure (structures required to support IAS data)**

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|  | **Recommendation** | **Relevance to users, providers, GBIF** |
| 1 | To allow the recommendation of particular controlled vocabularies for Darwin Core fields establishmentMeans and occuranceStatus | GBIF providers |
| 2 | To add a new field to Darwin Core to express the nativeness of a taxa in checklists (i.e. origin). | GBIF providers |
| 3 | Recommended database structure consist of 4 blocks (georeference, taxonomy,alien, references )  GEOREFERENCE BLOCK  occurenceID – numerical field (Long integer);  Continent – text field (String 40);  Country - text field (String 40);  countryCode - text field (short String 10);  stateProvince – text field (String 40);  county - text field (String 40);  municipality - text field (String 50);  locality - text field (String 100);  TAXONOMY BLOCK  Kingdom -– text field (String 40);  Phylum - text field (String 40);  Class- text field (String 40);  Order- text field (String 40);  Family- text field (String 40);  Species - text field (String 40);  scientificName - text field (String 100);  Common name (vernacularName) - text field (String 50);  ALIEN BLOCK Year of introduction – Dat; Natural distribution area (Origin) - text field (String 250); Type\_of\_introduction- text field (String 250)  Pathway\_of\_introduction - text field (String 50) Donor area - text field (String 250) Habitat- text field (String 250) Status - text field (String 25) Frequency - text field (String 25) Invasiveness - text field (String 25) Impact - text field (String 25) References – BLOB (string) | GBIF |
| 4 | Revise standard vocubularies/fields for vector (pathways) to make this more useful. |  |
| 5 | Review and establish standard vocabularies/fields for traits. |  |

**What GBIF could / should to do with the data**

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|  | **Recommendation** | **Relevance to users, providers, GBIF** |
| 1 | Express accumulation of records for species in GRIIS\*, e.g. temporal trends in records accumulated per species and per country, trends in number of species and number of ‘invasive’ species listed on GRIIS  \*Wherever GRIIS is mentioned other key sources of known alien and invasive species could be added, but GRIIS should be the priority | GBIF |
| 2 | Summary statistics (and maps where relevant) for GRIIS species, e.g. number of species, number per taxon, geographic region, country | GBIF |
| 3 | Global and country reports for alien and invasive species | GBIF |
| 4 | Query functionality to identify species present in trading partners of country A that are not present in it | GBIF |
| 5 | Functionality to receive and export alien and invasive species data with relevant databases such as World Database of Protected areas, World Register of Introduced Marine Species | GBIF |
| 6 | Enable generation of alien and invasive species checklists for various governance scales (e.g. countries, states, protected areas) | GBIF |
| 7 | User friendly and simple access that does not require IT experts | GBIF |
| 8 | Enable visualisation of dynamic range (record) expansion maps | GBIF |
| 9 | Review data resources available for key information types identified above (#1 and 2) to either export or development analytical tools to combine data for analyses and visualization. |  |
| 10 | Use GBIF records to provide automated alerts to other groups and also tools to compare (project) new records against known ranges (and regional checklists) to identify new “outbreaks” for validation. This is one type of “filter” that could be used to detect outliers. This can include citizen science groups, resource managers, etc. Could also facilitate targetted “detection campaigns”. |  |
| 11 | Dynamic visualization and update of non-native species trends and “gaps”, by region, taxa, and groups. Would be interesting to do this by comparison with “native” species. |  |

**GBIF and the IAS community (data providers, users and other infrastructure)**

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|  | **Recommendation** | **Relevance to users, providers, GBIF** |
| 1 | Profile some (which?) priority species and ask data provider community to prioritize (speed up) delivery of data on these species | GBIF plus? |
| 2 | GBIF to provide usage statistics at a data provider level. This will encourage data providers to monitor their data usage. | GBIF |
| 3 | Data users to respect persistent identifiers on data and wherever possible cite the sources of the data they use | Users |
| 4 | Identify “indicator” species for data collection campaigns with providers (eg, citizen science, resource managers, scientists, etc). Establish repeated campaigns perhaps over time, with pulsed frequencies. | Providers |
| 5 | Consider publishers who require archives as source of occurrence records --- as possible service to authors and increase data on AIS. |  |
| 6 | Outline ideal framework for partnerships and data exchanges--- > with an aim to creating functional tools and products, to avoid redundancy in increase utility. Show the functional interactions and ‘unique’ space vs overlap in roles. |  |
| 7 | Implement Outreach / socialization plan to approach these respective partners and build a functional system. |  |
| 8 | Even though DwC is an established standard, there is still widespread ignorance of it outside the field of Biodiversity Informatics. GBIF and other key partners could take a more proactive role in promoting, training and facilitating the use of DwC, particularly among ecologists. | GBIF |