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CONSOLIDATING PATHWAYS BETWEEN TWO ALIEN SPECIES DATABASES: DAISIE AND GISD

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INTRODUCTION

The Millennium Ecosystem Assessment (2005) designated invasive alien species (IAS), alongside climate change, habitat destruction, pollution and overexploitation, as one of the main causes of global biodiversity loss. Alien (or non-native, non-indigenous, foreign, exotic, introduced) species (AS) are defined by the Convention on Biological Diversity (CBD) as “a species, subspecies or lower taxon (such as a variety, race, provenance or stock), introduced outside its natural past or present distribution, which includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce” where “introduction” refers to the movement by human agency, indirect or direct, of an alien species outside of its natural (past or present) range (COP 6, decision VI/23) and invasive alien species (IAS) as “an alien species whose introduction and/or spread threaten biological diversity” (COP 6, decision VI/23).

Alien species, and particularly the subset that are considered invasive, have received increasing attention in recent years. Alien species (AS) are being introduced into Europe at unprecedented and unpredictable rates and those that become invasive are known to be one of the greatest threats to biodiversity by decreasing the uniqueness of ecosystems at a genetic, functional and taxonomical level. The Guiding Principles of the CBD advocate a three-tiered approach (prevention, eradication and control) which is widely adopted across the globe. It is recognised that an important first step in developing a strategy for addressing the problems posed by IAS is to document the AS already present in regions, as well as those likely to arrive (either because they have been introduced into a adjacent region, or are spread by an existing vector/pathway).

There are a number of international agreements which recognise the negative effects of IAS and reflect the growing concerns of many people. For example, European countries now have obligations in relation to alien species and must: “strictly control the introduction of non-indigenous species” (Bern Convention on the Conservation of European Wildlife & Natural Habitats) and “eradicate those alien species which threaten ecosystems, habitats or species” (UN Convention on Biological Diversity). Many countries across Europe have developed strategies in relation to IAS and there is a move to consider these through a unified European-wide approach. The European Commission has formally recognised the urgent need to tackle invasions ('Towards an EU Strategy on Invasive Species' (COM (2008) 789 final) committing to develop a policy on the issue and establish an early warning system. For example, the European Parliament resolution of 20 April 2012 on our life insurance, our natural capital: an EU biodiversity strategy to 2020 (2011/2307(INI)), explicitly “Urges the Commission to come forward in 2012 with a legislative proposal which takes a holistic approach to the problem of invasive alien plant and animal species in order to establish a common EU policy on the prevention, monitoring, eradication and management of these species and on rapid alert systems in this area”. Indeed the European Commission is developing a comprehensive legal instrument to combat IAS and the problems they cause. It is essential that such a policy instrument is underpinned by easily accessible, high quality, comprehensive information. A comprehensive approach, including all AS, is crucial to ensure predictive elements such as early warning and horizon scanning at the regional scale.

Information on AS is currently scattered across Europe in a multitude of sources, such as regional and national databases, peer-reviewed and grey literature, unpublished research projects or institutional datasets and with taxonomic experts. There have been recent efforts to consolidate information into centralised European (DAISIE) and Global (GISD) databases. However, there are other data sources at regional (e.g. NOBANIS, REABIC, ESENIAS, MAMIAS, the Baltic Sea alien species database) and national (e.g. Britain, Vojvodina) scales. A major challenge is to establish common exchange standards and harmonise terminology and other information in existing AS databases. In addition it is essential to

identify the needs and formats for AS information by different user groups and for the implementation of early warning tools and a rapid response system.

There are key fields within all databases that should be a priority for harmonization. Information on the pathway of arrival of an AS is one such example. The importance of pathways is recognized by Aichi Biodiversity Target 9 (By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment). DAISIE and GISD are recognised as major sources of information on AS and so here we provide a summary of the consolidation of pathway information between these two databases.

In summary it was straightforward to harmonise a large proportion of the pathway information within the two databases - 81% of pathway entries for a species in DAISIE matched with ease to defined GISD pathways (Table 1). However, for the remaining species further work is required to elucidate the appropriate pathway relevant to both databases. Further work is also required to ensure that the definition for each pathway term is explicit and clear. Additional next steps will include undertaking the same process with an additional database such as the CABI Invasive Species Compendium. Following this it will be essential to publish the information with recommendations of appropriate terminology for pathways of arrival.

SUMMARY OF CONSOLIDATING

- 23398 (81%) of the pathway entries in DAISIE can be directly matched to a GISD pathway
- 5525 (19%) of the pathway entries in DAISIE cannot be directly matched to GISD pathways without further investigation

DAISIE pathway categories

Table 1 DAISIE categories, the number of entries in the DAISIE database assigned to that category and the matching GISD pathway where they directly map. Entries in red are DAISIE pathways which cannot be directly mapped to GISD pathways.

DAISIE Pathway	Description	No. Entries in DAISIE	GISD Pathway
Unknown	<i>Not known</i>	1721	
Aquaculture	<i>Introduced in aquaculture, mariculture, then escaped or causing harm within the culture</i>	736	Aquaculture
Canals	<i>Dispersed through canals or any kind of artificial passage connecting previously separated areas.</i>	941	Interconnected waterways/basins/seas
Fisheries	<i>Fisheries & stock movement as fish food; dispersal via fishing gear</i>	181	Fishery in the wild
Vessels	<i>Floating structures, ballast water and/or sediments in tanks, dispersal via shipping</i>	1209	Transport - Stowaway
Leisure	<i>Leisure and cultural activities</i>	147	

DAISIE Pathway	Description	No. Entries in DAISIE	GISD Pathway
Escapes	<i>Animals, plants and their pests brought intentionally to captivity, farm, field or laboratory then escaped or released unintentionally to the wild</i>	1615	Escape (introduction to confinement)/spread
Ornamental	<i>Live food trade, animals and plants used for ornamental purposes in parks, gardening, bonsai, etc..</i>	6083	Ornamental purpose
Biocontrol	<i>Introduced as biological control agent or pest of another species</i>	779	Biological control
Agriculture	<i>Introduced through agriculture</i>	747	Agriculture
Other	<i>Defined in comments...</i>	434	
Hybrid	<i>Consequence of intentional or unintentional hybridization with other native or non-native species</i>	148	
Stored products	<i>Stored products</i>	2469	Food contaminant
Seed contaminant	<i>Introduced accidentally as a contaminant of crop seed or propagules</i>	1886	Seed contaminant
Mineral contaminant	<i>Introduced accidentally during the deliberate movement of soil or other minerals</i>	113	Transportation of habitat material (soil, vegetation, wood...)
Commodity contaminant	<i>Introduced accidentally as a contaminant of non-crop commodities</i>	476	
Dispersal	<i>Dispersal via natural or artificial connections between regions</i>	1	
Vessel hull fouling	<i>Hull fouling of ships, vessels and barges</i>	3	Ship/boat hull fouling
Vessel ballast	<i>Ballast water and/or sediments in tanks</i>	11	Ship/boat ballast water
Floating structures	<i>Bouys, free floating material, etc...</i>	5	Other means of transport
Escapes from zoos	<i>Escapes from zoos</i>	81	Botanical garden/zoo/aquaria (excluding domestic

DAISIE Pathway	Description	No. Entries in DAISIE	GISD Pathway
			aquaria)
Escapes from farms	<i>Escapes from farms</i>	40	Farmed animals, including animals left under limited control (e.g. free roaming camels)
Escapes from breeding farm	<i>Escapes from breeding farm, animal husbandry</i>	295	Farmed animals, including animals left under limited control (e.g. free roaming camels)
Escaped pets	<i>Escaped pets, incl. escapes from aquariums</i>	80	Pet/aquarium species
Horticulture	<i>Introduced through horticulture</i>	4299	Horticulture
Forestry	<i>Introduced for timber or re-(a)forestation on a forestry scale</i>	762	Forestry
Transport	<i>As contaminant or hitchhiking via transport means, networks of logistics, trade and tourism</i>	751	
Intentional release	<i>Intentional release to the wild. Stocking, fauna improvements, for hunting, pelt gathering, etc...</i>	10	Release in Nature
Natural dispersal	<i>Natural dispersal from neighboring regions through natural</i>	115	
Known	<i>Known</i>		
Unintentional release	<i>Unintentional release to the wild</i>	1732	
Pelt gathering	<i>Released for pelt gathering</i>	3	Release in nature for use (food resources, fur, transport mean, medical use...)
Hunting	<i>Released for hunting</i>	179	Hunting in the wild
Fauna improvement	<i>Released as fauna "improvement"</i>	871	Landscape/flora/fauna "improvement" (in the wild)

Non-matched DAISIE Categories

- Unknown
 - 1721 entries in DAISIE
 - GISD does not have an unknown category, it would be good to include an explicit unknown option as this allows non-completion of required fields for a species to be distinguished from cases where the pathway is genuinely not known
- Leisure (Leisure & Cultural activities)
 - 147 entries in DAISIE
 - Potentially spans several GISD categories (e.g. Ornamental, Pet, fisheries)
 - ✓ For bony fish appears to be mainly Release for fisheries in the wild, however some aquaculture (i.e. escape from confinement)
 - ✓ However in other groups not so clear cut (e.g. sticks insects probably pet trade, crayfish plague disease of imported crayfish or in ballast water) will need proper in depth investigation
- Other
 - 434 entries in DAISIE
 - This is a base level in the DAISIE pathways, GISD has higher level other options but nothing at the base of the hierarchy
 - Can be argued that at the low level this is not helpful perhaps have several other categories for each of the level one GISD categories (i.e. other release, other escape, other contaminant, other stowaway, etc)
 - For mammals, bird and bony fish majority using this category in DAISIE would be best put into “release in nature for use” however there are some others that would map best to escape. Additionally also some species in this category appear to be natural dispersal/spread from surrounding countries/regions and therefore should not map to any GISD category
- Hybrid
 - 148 entries in DAISIE
 - Not quite sure how this is a valid pathway, will need to review these species and consult with plant experts to determine if this is an actual pathway or a result of invasion
- Commodity contaminant
 - 476 entries in DAISIE
 - Need to review the species involved in DAISIE and determine what this category actually means
 - Mainly flowering plants, however also includes 3 other species (i.e. Zebra Mussel, New Zealand Mud Snail and a species of Flatworm which probably should be attributed to timber trade)
- Transport
 - 751 entries in DAISIE
 - Low level DAISIE category which spans 2 level 1 GISD categories (stowaway and contaminant)
- Natural dispersal
 - 115 entries in DAISIE

- Need to review these entries and check the pathways
 - ✓ From a quick investigation seem to be natural dispersal/spread from surrounding regions/countries (where species is non-native but introduced by another pathway)
- Unintentional release
 - 1732 entries in DAISIE
 - Low level DAISIE category with no direct match to GISD (perhaps escape but need to review species and double check)
 - Practically all species are plants (flowering plants mainly) though some ferns, etc will need review as probably span several categories i.e. ornamental, contaminant