# Supplementary Material 1

**Table A1** List of the 55 questions (Qs) making up the Terrestrial Animal Species Invasiveness Screening Kit (TAS-ISK) v2.3.1. Sector codes (in parentheses): C = Commercial; E = Environmental; S = Species or population nuisance traits. Changes of questions relative to AS-ISK v2.3.1: G = Guidance; Q = Question (text). For each Q, the corresponding Question (text), Guidance and choice of Response (with coding as displayed in report and score) are indicated.

| **Section (Sector code)** | **Q no.** | **Changes** | **Question (text)** | **Guidance** | **Response** |
| --- | --- | --- | --- | --- | --- |
| ***A. Biogeography/Historical*** |  |
| *1. Domestication/Cultivation* |  |
| 1.01 (C) | 1 | G | Has the taxon been the subject of domestication (or cultivation) for at least 20 generations? | The taxon must have been grown deliberately and subjected to substantial human selection for at least 20 generations, or it must be known to be easily reared in captivity (e.g. farms, pets or domesticated animals, hunting enclosures). This may be in the organism's native or introduced ranges. | Yes (Y = 2); No (N = 0); Not applicable (n/a = 0) |
| 1.02 (C) | 2 | G | Is the taxon harvested in the wild and likely to be sold or used in its live form? | Examples of this are: 1) animals to be released into different habitats; 2) mammals, reptiles, insects etc. for use in captivity (e.g. private and public zoos, pet trade, parks, agriculture); 3) animals sold live as bushmeat. | Yes (Y = 1); No (N = −1); Not applicable (n/a = 0) |
| 1.03 (S) | 3 | n.c. | Does the taxon have invasive races, varieties, sub-taxa or congeners? | One or more of the taxon's varieties (races, morphs, etc.), or other species within the same genus, are known to be serious pests. | Yes (Y = 1); No (N = −1); Not applicable (n/a = 0) |
| *2. Climate, distribution and introduction risk* |  |
| 2.01 (E)  | 4 | n.c. | How similar are the climatic conditions of the Risk Assessment (RA) area and the taxon's native range? | The intention of this question is to assess the likelihood of a taxon establishing self-sustaining populations in the Risk Assessment (RA) area. If readily available, then a climate matching approach (e.g. Climex, GARP, Climatch) may be used (see summary in: Venette et al. 2010, BioScience 60: 349-362). If a climate matching model is not available, then make a ‘best estimate’ through consultation of the Köppen-Geiger climate classification system (see: [www.hydrol-earth-syst-sci-discuss.net/4/439/2007/hessd-4-439-2007.pdf](http://www.hydrol-earth-syst-sci-discuss.net/4/439/2007/hessd-4-439-2007.pdf)) and/or local expertise. | Low (1); Medium (2); High (3); n/a (0) |
| 2.02 (E)  | 5 | n.c. | What is the quality of the climate matching data? | The quality is an estimate of how complete are the data used to generate the climate analysis. | Low (1); Medium (2); High (3); n/a (0) |
| 2.03 (CS)  | 6 | n.c. | Is the taxon already present outside of captivity in the RA area? | Where possible, this should be assessed using documented evidence that the taxon has been found outside of captivity in the RA area. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 2.04 (CS)  | 7 | n.c. | How many potential vectors could the taxon use to enter in the RA area? | Consider all likely vectors (i.e. forms of transport) of entry (unintentional and intentional) and categorise the response accordingly. | No vector (Nil = −1); One vector (1 = 0); >1 vector (>1 = 1); Not applicable (n/a = 0) |
| 2.05 (CS)  | 8 | G | Is the taxon currently found in close proximity to, and likely to enter into, the RA area in the near future (e.g. unintentional and intentional introductions)? | There must be documented evidence of the organism being established in an open habitat of a neighbouring country or region. | Yes (Y = 2); No (N = 0); Not applicable (n/a = 0) |
| *3. Invasive elsewhere* |  |
| 3.01 (S)  | 9 | n.c. | Has the taxon become naturalised (established viable populations) outside its native range? | To be classed as naturalised, the taxon must have maintained self-sustaining populations for a minimum of 50 generations (for short generation-time species, i.e. ≤ 1 year) or 20 generations (for longer generation-time species, i.e. ≥ 2 years) in at least one location outside its native range. | Yes (Y = 1); No (N = −1); Not applicable (n/a = 0) |
| 3.02 (C) | 10 | n.c. | In the taxon's introduced range, are there known adverse impacts to wild stocks or commercial taxa? | Where possible, this should be assessed using documented evidence of real impacts (i.e. decline of native species, disease introduction or transmission). In cases where circumstantial or opinion-based judgments are used, then the Confidence level attributed to the response is expected to be ‘Low’ or not higher than ‘Medium’. | Yes (Y = 2); No (N = 0); Not applicable (n/a = 0) |
| 3.03 (C)  | 11 | Q, G | In the taxon's introduced range, are there known adverse impacts to agriculture and forestry? | Impacts on agriculture and forestry impose a cost to control/manage the organism and/or result in productivity losses. If information is not available on the exact species but is for a closely-related species, then base the response on the known impacts of the related species. | Yes (Y = 2); No (N = 0); Not applicable (n/a = 0) |
| 3.04 (E) | 12 | n.c. | In the taxon's introduced range, are there known adverse impacts to ecosystem services? | Where possible, this should be assessed using documented evidence that the organism has resulted in impacts to ecosystem services outside the RA area. | Yes (Y = 2); No (N = 0); Not applicable (n/a = 0) |
| 3.05 (C)  | 13 | G | In the taxon's introduced range, are there known adverse socio-economic impacts? | Where possible, this should be assessed using documented evidence that the organism's introduction has led to adverse socio-economic impacts (e.g. amenities, livelihoods, cultural value, recreational activities/behaviours, human-wildlife interactions). | Yes (Y = 2); No (N = 0); Not applicable (n/a = 0) |
| ***B. Biology/Ecology*** |  |
| *4. Undesirable (or persistence) traits* |  |
| 4.01 (S)  | 14 | n.c. | Is it likely that the taxon will be poisonous or pose other risks to human health? | Applicable if the organism's presence is known, for any reason, to cause discomfort or pain to humans. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 4.02 (S)  | 15 | Q, G | Is it likely that the taxon will suppress the growth of one or more native taxa (that are not threatened or protected)? | Some non-native species are known to suppress the growth of native species. For example, some non-native insects displace native species. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 4.03 (S)  | 16 | n.c. | Are there any threatened or protected taxa that the non-native taxon would parasitise in the RA area? | This question is specifically aimed at identifying whether or not the introduced organism would become a predator or parasite of threatened or protected native species (e.g. local, regional, national red lists; Habitats & Species Directive Annexes; IUCN Red List, etc.). In the case of an endoparasite, the appropriate response should be ‘Yes’. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 4.04 (S) | 17 | n.c. | Is the taxon adaptable in terms of climatic and other environmental conditions, thus enhancing its potential persistence if it has invaded or could invade the RA area? | ‘Adaptability’ refers to the species' ability to overcome physiological or other barriers in order to establish self-sustaining populations, and thus distinguishes itself from ‘tolerance’ (Section 8: ‘Tolerance attributes’), which refer to the organism's ability to persist in harsh/extreme conditions. Output from climate matching can help answer this question, combined with the known versatility of the organism as regards climate region distribution. | Yes (Y = 1); No (N = −1); Not applicable (n/a = 0) |
| 4.05 (E)  | 18 | Q | Is the taxon likely to disrupt food-web structure/function in terrestrial ecosystems if it has invaded or is likely to invade the RA area? | Where possible, this should be assessed using documented evidence that the introduction of the taxon (whether or not it establishes a self-sustaining population) disrupts food-web structure and/or function. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 4.06 (E)  | 19 | G | Is the taxon likely to exert adverse impacts on ecosystem services in the RA area? | Various amenities (e.g. hunting, hiking and similar outdoor activities) and ecosystem products (e.g. wild edible plants and fungi, beekeeping, free range farming in semi-wild conditions) in the RA area may be likely to be impacted. If information is not available on the exact species but is for a closely-related species, then base the response on the known impacts of the related species and attribute a ‘Low’ or ‘Medium’ Confidence level to the response. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 4.07 (S) | 20 | n.c. | Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are endemic in the RA area? | The main concerns are existing infectious agents, with the host being an additional vector of the infectious agent in the RA area. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 4.08 (S) | 21 | n.c. | Is it likely that the taxon will host, and/or act as a vector for, recognised pests and infectious agents that are absent from (novel to) the RA area? | The main concerns are non-native infectious agents, with the host being the original introduction vector of the disease in the RA area. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 4.09 (S) | 22 | G | Is it likely that the taxon will achieve a body size that will make it more likely to be released from captivity? | For example, large-bodied animals can be of major concern as they can quickly outgrow their holding facilities (e.g. cages, terrariums, pens). | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 4.10 (S) | 23 | Q, G | Is the taxon versatile in habitat use? | Species that are known to be euryobionts should attract a ‘Yes’ response. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 4.11 (E) | 24 | G | Is it likely that the taxon's mode of existence (e.g. excretion of by-products) or behaviours (e.g. feeding) will reduce habitat quality for native taxa? | Where possible, this should be assessed using documented evidence that the organism's mode of existence (foraging behaviour) results in an increase in e.g. nitrogen. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 4.12 (S)  | 25 | n.c. | Is the taxon likely to maintain a viable population even when present in low densities (or persisting in adverse conditions by way of a dormant form)? | There should be evidence of established populations of the organism persisting at low density in at least one location of its native and/or introduced range. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| *5. Resource exploitation* |  |
| 5.01 (E) | 26 | G | Is the taxon likely to consume threatened or protected native taxa in the RA area? | This question is specifically aimed at identifying whether or not the introduced organism would exert an additional (non-natural) predation pressure on one or more native species that are threatened or protected (e.g. local, regional, national red lists; Habitats & Species Directive Annexes; IUCN Red List, etc.). This includes organisms that achieve large size quickly, thus allowing them to predate native species. Obligate carnivores are most likely to attract a ‘Yes’ response here, but some facultative species may become voracious predators when introduced to novel environments (e.g.common raccoon Procyon lotor is an opportunistic omnivore but its predation on seabird colonies can be particularly acute on islands where the species has been introduced). For species that ‘consume’ through predation but otherwise do not consume whole their prey, e.g. some mosquito species, the response to Q16 should be ‘Yes’ and the response to this question (Q26) should be ‘No’. | Yes (Y = 5); No (N = 0); Not applicable (n/a = 0) |
| 5.02 (S)  | 27 | n.c. | Is the taxon likely to sequester food resources (including nutrients) to the detriment of native taxa in the RA area? | This question is specifically aimed at identifying whether or not the introduced organism would exploit available resources (including nutrients, minerals, trace elements) at the expense of native species. If the Relative Impact Potential (RIP) value (Dick et al. 2017: J. Appl. Ecol. 54, 1259-1267) for that species has been calculated and was ≥ 1.0, then the appropriate response is ‘Yes’. Whereas, if the RIP value was calculated to be < 1.0, then the appropriate response is ‘No’. | Yes (Y = 2); No (N = 0); Not applicable (n/a = 0) |
| *6. Reproduction* |  |
| 6.01 (S)  | 28 | G | Is the taxon likely to exhibit parental care and/or to reduce age-at-maturity in response to environmental conditions? | Needs at least some documented evidence of the organism exhibiting parental care, or reducing its age at maturity when confronted by different environmental conditions, including population density, precipitation and temperature variation, changes in community composition, etc. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 6.02 (S)  | 29 | n.c. | Is the taxon likely to produce viable gametes or propagules (in the RA area)? | The conditions for maturation and reproduction must be available in the RA area in order to respond ‘Yes’ to this question. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 6.03 (S)  | 30 | n.c. | Is the taxon likely to hybridise naturally with native taxa? | Where possible, this should be assessed using documented evidence of interspecific hybrids occurring, without assistance, under natural conditions. | Yes (Y = 1); No (N = −1); Not applicable (n/a = 0) |
| 6.04 (S)  | 31 | n.c. | Is the taxon likely to be hermaphroditic or to display asexual reproduction? | Needs at least some documented evidence of hermaphroditism/asexual reproduction in that Species, Genus or Family. | Yes (Y = 1); No (N = −1); Not applicable (n/a = 0) |
| 6.05 (S) | 32 | G | Is the taxon dependent on the presence of another taxon (or specific habitat features) to complete its life cycle? | Some species may require specialist incubators (e.g. butterflies lay eggs on species-specific plants for the hatched caterpillars to eat) or specific habitat features (e.g. soil type, vegetation cover) in order to reproduce successfully. | Yes (Y = −1); No (N = 1); Not applicable (n/a = 0) |
| 6.06 (S)  | 33 | n.c. | Is the taxon known (or likely) to produce a large number of propagules or offspring within a short time span (e.g. < 1 year)? | High fecundity and/or propagule/spore production is normally observed in medium-to-longer lived species. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 6.07 (S)  | 34 | G | How many time units (days, months, years) does the taxon require to reach the age-at-first-reproduction? | Time from hatching/parturition to full maturity (i.e. active reproduction, not just presence of sexual organs). Please specify the number of time units by category relative to the taxonomic group being assessed. [In the Justification field, indicate the relevant time unit being used.] | 1 (1); 2–3 (0); 4–10 (−1); >10 (−1); Not applicable (n/a = 0) |
| *7. Dispersal mechanisms* |  |
| 7.01 (CS) | 35 | n.c. | How many potential internal vectors/pathways could the taxon use to disperse within the RA area (with suitable habitats nearby)? | Consider all likely dispersal pathways/vectors (unintentional and intentional) and provide a justification or comments for each pathway/vector in the response. | No pathway (Nil = −1); One pathway (1 = 0); >1 pathway (>1 = 1); Not applicable (n/a = 0) |
| 7.02 (ES)  | 36 | Q, G | Will any of these vectors/pathways bring the taxon in close proximity to one or more protected areas (e.g. SSSI)? National parks, Nature parks, Special reserve? | Following escape or release from captivity in the RA area. ‘Close proximity’ refers to whether or not the organism can conceivably reach the protected area or nature reserves (SSSI = Site of Special Scientific Interest). E.g. for organisms that disperse passively, there would normally be a natural corridor between the organism's location and the protected area, thus facilitating invasion. For organisms with a short-to-moderate mobility capacity, determine whether there are stepping-stone habitats between the organism's location and the protected area. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 7.03 (S) | 37 | Q, G | Does the taxon have a means of hiding itself (in e.g. shipping parcels) such that it enhances the likelihood of dispersal? | Consider all possible means of hiding, e.g. does the organism have a specialised behaviour that facilitates its permanent or temporary hiding. | Yes (Y = 1); No (N = −1); Not applicable (n/a = 0) |
| 7.04 (S)  | 38 | Q, G | Is natural dispersal of the taxon likely to occur as eggs in the RA area? | There should be at least some documented evidence that eggs are displaced by e.g. other organisms either intentionally or not. | Yes (Y = 1); No (N = −1); Not applicable (n/a = 0) |
| 7.05 (S) | 39 | Q, G | Is natural dispersal of the taxon likely to occur as larvae/juveniles in the RA area? | There should be at least some documented evidence that larvae/juveniles can move independently across considerable distances. | Yes (Y = 1); No (N = −1); Not applicable (n/a = 0) |
| 7.06 (S) | 40 | n.c. | Are older life stages of the taxon likely to migrate in the RA area for reproduction? | There should be at least some documented evidence of migratory behaviour or active dispersal mechanisms, even at a small scale (tens or hundreds of metres). | Yes (Y = 1); No (N = −1); Not applicable (n/a = 0) |
| 7.07 (S) | 41 | G | Are propagules or eggs of the taxon likely to be dispersed in the RA area by other animals? | For example, propagules or eggs that are dispersed by host species moving between regions. | Yes (Y = 1); No (N = −1); Not applicable (n/a = 0) |
| 7.08 (CS) | 42 | n.c. | Is dispersal of the taxon along any of the vectors/pathways mentioned in the previous seven questions (35–41; i.e. both unintentional or intentional) likely to be rapid? | ‘Rapid’ refers to any dispersal between the organism's starting point and the recipient location within the RA area that takes place in less than a calendar year for mobile organisms and less than five years for passive dispersing organisms. | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| 7.09 (S)  | 43 | n.c. | Is dispersal of the taxon density dependent? | Where possible, this should be assessed using documented evidence of the organism spreading out or dispersing when its population density increases. The information may derive from either the organism's native or introduced range (or both). | Yes (Y = 1); No (N = 0); Not applicable (n/a = 0) |
| *8. Tolerance attributes* |   |  |  |
| 8.01 (S)  | 44 | Q, G | Is the taxon able to withstand being in water for extended periods (e.g. minimum of one or more hours) at some stage of its life cycle? | This includes organisms that produce or are some type of dormant form (e.g. nymphs, cocoons) that is revitalised when it again enters an appropriate environment. | Yes (Y = 1); No (N = −1); Not applicable (n/a = 0) |
| 8.02 (S)  | 45 | Q, G | I Is the taxon tolerant of a wide range of soil/air quality conditions relevant to that taxon? [In the Justification field, indicate the relevant quality variable(s) being considered.] | This is to identify taxa that can persist in cases of elevated levels of naturally-occurring or human-produced chemicals (e.g. pesticides, radioactive compounds). | Yes (Y = 1); No (N = −1); Not applicable (n/a = 0) |
| 8.03 (S) | 46 | n.c. | Can the taxon be controlled or eradicated in the wild with chemical, biological, or other agents/means? | Where possible, this should be assessed using documented evidence of susceptibility of the organism (or taxonomically-related organisms, e.g. congeners, sub-species, varieties, or taxonomic Family members) to chemical or other control agents/means. | Yes (Y = −1); No (N = 1); Not applicable (n/a = 0) |
| 8.04 (S) | 47 | G | Is the taxon likely to tolerate or benefit from environmental/human disturbance? | The growth and spread of some taxa may be enhanced by disruptions or unusual events (e.g. droughts, wildfires, floods, high snow cover), especially human-generated impacts (deforestation, agricultural drainage, intensive farming). | Yes (Y = 3); No (N = −1); Not applicable (n/a = 0) |
| 8.05 (S) | 48 | Q, G | Is the taxon able to tolerate soil acidity or other parameter levels that are higher or lower than those found in its usual environment? | For example, grape *phylloxera Daktulosphaira vitifoliae* has a complex life-cycle consisting of up to 18 stages and is responsible for the destruction of European vineyards, with only a few areas mainly consisting of sand or schist being spared. | Yes (Y = 2); No (N = −1); Not applicable (n/a = 0) |
| 8.06 (S)  | 49 | n.c. | Are there effective natural enemies (predators) of the taxon present in the RA area? | Potentially effective predators or control agents (e.g. infectious agents) of the organism (or related taxa) may be present in the RA area. Base response on the available knowledge (preferably peer-reviewed documents) of food webs (community composition) in the RA area. | Yes (Y = −1); No (N = 1); Not applicable (n/a = 0) |
| ***C. Climate change*** |   |  |  |
| *9. Climate change* |   |  |  |
| 9.01 (S)  | 50 | n.c. | Under the predicted future climatic conditions, are the risks of entry into the RA area posed by the taxon likely to increase, decrease or not change? | Where possible, use existing climate-change research outputs (otherwise use ‘professional judgement’, i.e. best guess) to indicate how future climatic conditions are likely to modify the risks of entry by the organism into the RA area. | Decrease (− = −2); No change (Nil = 0); Increase (+ = 2); Not applicable (n/a = 0) |
| 9.02 (S) | 51 | n.c. | Under the predicted future climatic conditions, are the risks of establishment posed by the taxon likely to increase, decrease or not change? | Where possible, use existing climate-change research outputs (otherwise use ‘professional judgement’, i.e. best guess) to indicate how future climatic conditions are likely to modify the risks of establishment (including the range of habitat types where the organism would be able to establish self-sustaining populations) within the RA area. | Decrease (− = −2); No change (Nil = 0); Increase (+ = 2); Not applicable (n/a = 0) |
| 9.03 (S) | 52 | n.c. | Under the predicted future climatic conditions, are the risks of dispersal within the RA area posed by the taxon likely to increase, decrease or not change? | Where possible, use existing climate-change research outputs (otherwise use ‘professional judgement’, i.e. best guess) to indicate how future climatic conditions are likely to modify the risks of the organism's dispersal within the RA area. | Decrease (− = −2); No change (Nil = 0); Increase (+ = 2); Not applicable (n/a = 0) |
| 9.04 (E) | 53 | G | Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on biodiversity and/or ecological integrity/status? | Where possible, use existing climate-change research outputs (otherwise use ‘professional judgement’, i.e. best guess) to indicate how future climatic conditions are likely to modify the risks of potential adverse impacts by the organism within the RA area on biodiversity and/or ecological integrity. | Lower (− = −2); No change (Nil = 0); Higher (+ = 2); Not applicable (n/a = 0) |
| 9.05 (E)  | 54 | n.c. | Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem structure and/or function? | Where possible, use existing climate-change research outputs (otherwise use ‘professional judgement’, i.e. best guess) to indicate how future climatic conditions are likely to modify the risks of potential adverse impacts by the organism within the RA area on ecosystem structure and function. | Lower (− = −2); No change (Nil = 0); Higher (+ = 2); Not applicable (n/a = 0) |
| 9.06 (C)  | 55 | n.c | Under the predicted future climatic conditions, what is the likely magnitude of future potential impacts on ecosystem services/socio-economic factors? | Where possible, use existing climate-change research outputs (otherwise use ‘professional judgement’, i.e. best guess) to indicate how future climatic conditions are likely to modify the risks of potential adverse impacts by the organism within the RA area on ecosystem services and related socio-economic factors. | Lower (− = −2); No change (Nil = 0); Higher (+ = 2); Not applicable (n/a = 0) |