Appendix 3: Explanation of Entities

Input Variables and processes for manipulation their of.

Any model requires data as input variables. This data may be spatial or alphanumeric from many different sources. This data needs to be defined, and in some cases manipulated to conform to the requirements of the ENDeM model. These input variables and some suggested processes for manipulation are defined here.

The Explanation of Entities provides a description of the data required for input into the Ecological Network Design Model.

A3.1. THE ENTITIES

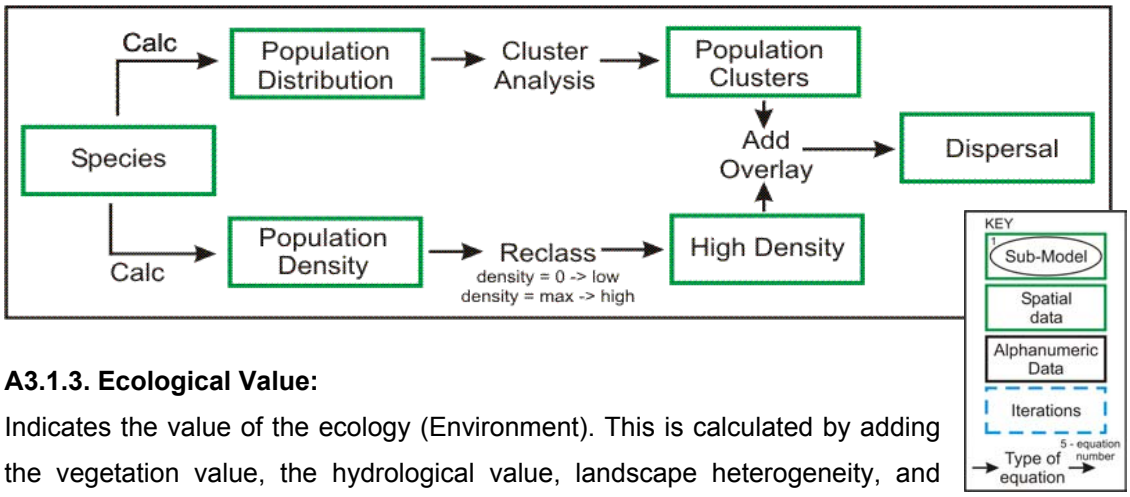
A3.1.1. Dams:

Indicates the presence of large water bodies. May be extracted from hydrology.

A3.1.2. Dispersal:

Indicated the distribution and density of species. In other words where there is a high concentration of a particular species as illustrated in figure A3.1.

Figure A3.1: Defining Dispersal (Hedding, *Per. Com.*, 2003)



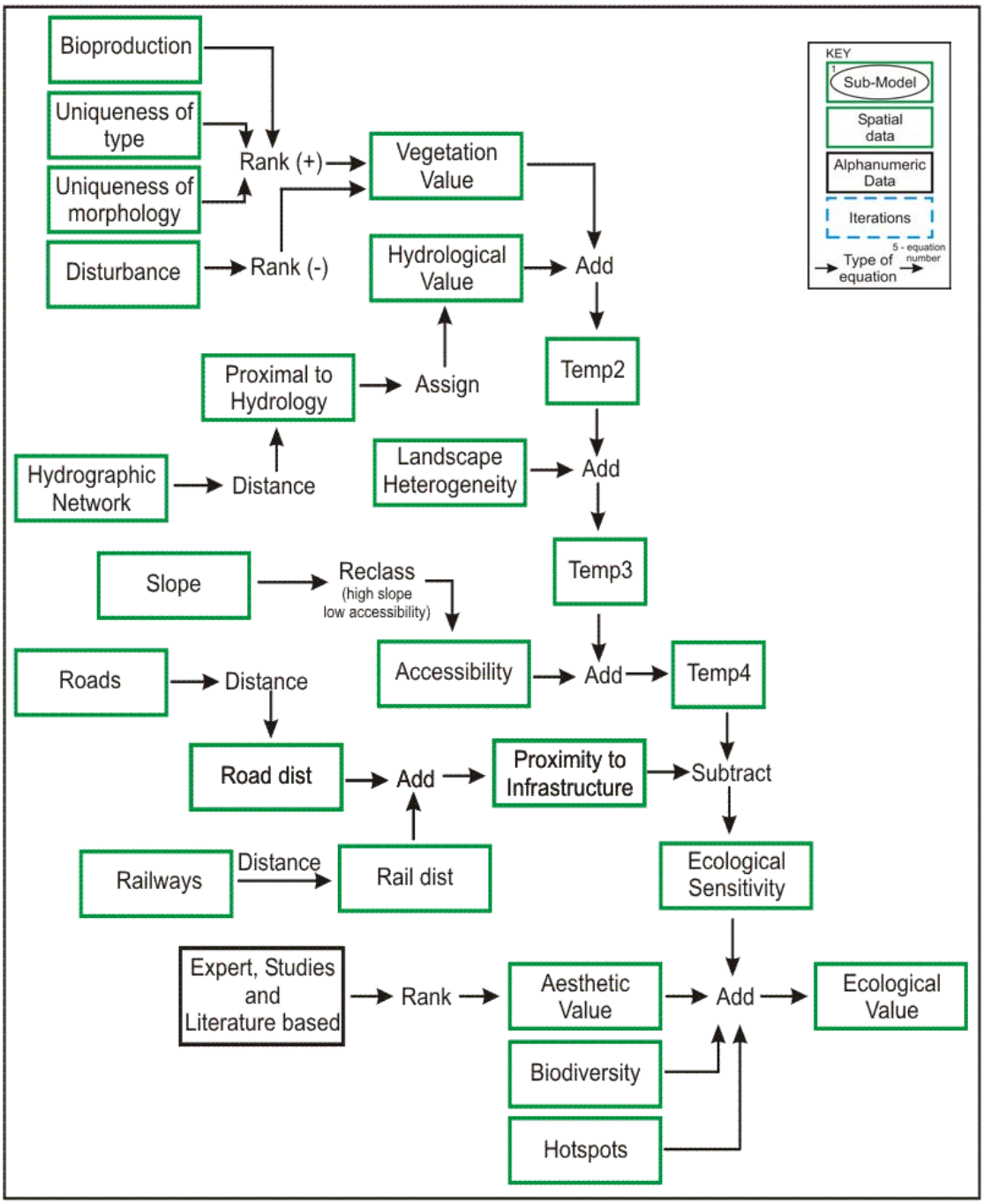
A3.1.3. Ecological Value:

Indicates the value of the ecology (Environment). This is calculated by adding the vegetation value, the hydrological value, landscape heterogeneity, and accessibility together. From this subtract proximity to infrastructure to calculate the ecological sensitivity (Omtzigt, 1996). By adding aesthetic value, biodiversity and hotspots to the ecological sensitivity, the ecological value is calculated (Troumbis, 1995) as illustrated in figure A3.2.

The vegetation value is calculated by combining the positively ranked bioproduction, uniqueness of type, and uniqueness of morphology criteria with the negatively ranked disturbance criterion (Omtzigt, 1996). The hydrological value is calculated by assigning values to the proximity of a cell (or point) to a hydrological feature. The higher the hydrological value

the closer the proximity to water. The calculation of landscape heterogeneity is explained later

Figure A3.2: Defining Ecological Value (adapted from Troumbis 1995 and Omtzigt 1996)



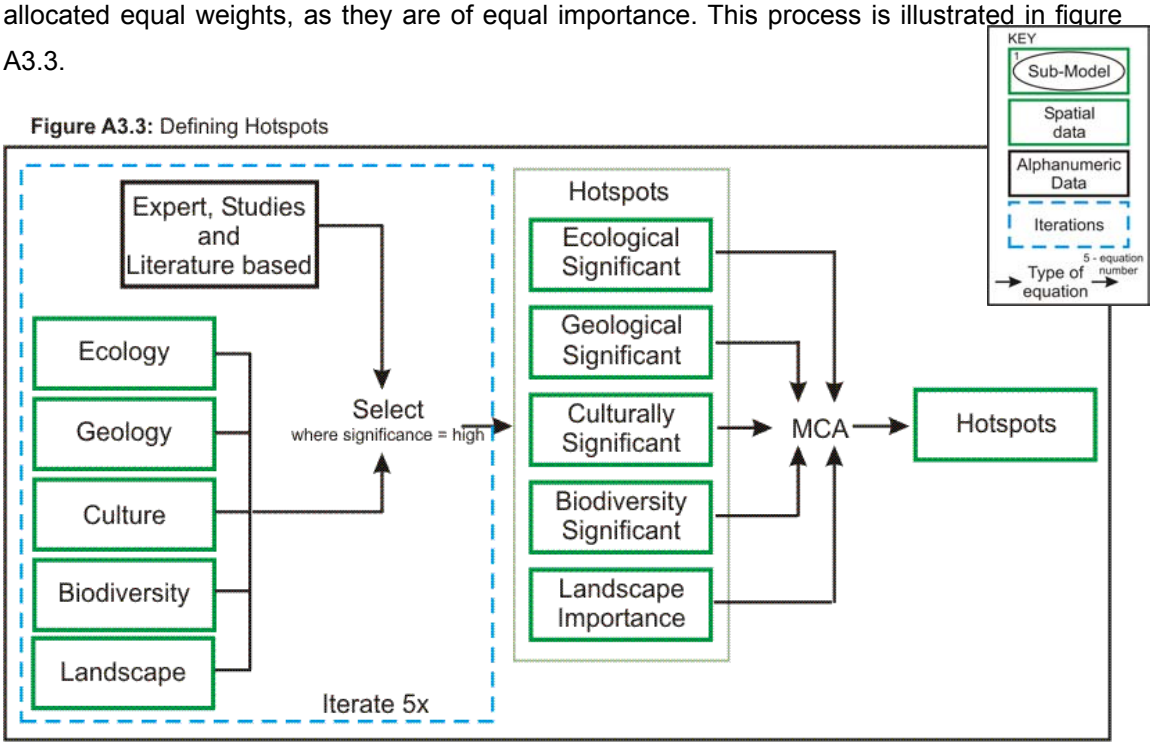
on in the appendix (see figure A3.4). The Accessibility is calculated from a slope surface where the steeper the slope the less accessible the area is. The proximity to infrastructure is calculated by adding the distances from the roads and railways respectively.

A3.1.4. Hotspots:

There are five categories of Hotspots: Ecological, Geological, Cultural, Biodiversity and Landscape. Each of these are selected according to their significance based on expert opinion and with reference to studies and literature. The five categories are then combined through

Multi Criteria Analysis using the Linear Weighted Combination. Each of the five categories, are allocated equal weights, as they are of equal importance. This process is illustrated in figure A3.3.

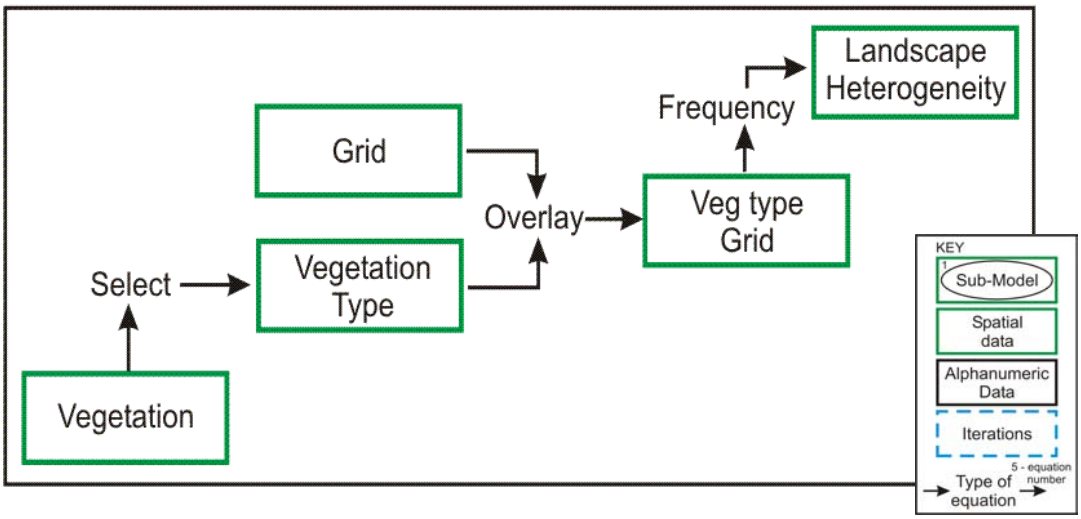
Figure A3.3: Defining Hotspots



A3.1.5. Landscape Heterogeneity:

Landscape Heterogeneity or the diversity of the landscape, is included separately as it forms an input criterion to both the delineation of Corridors and the definition of Ecological Value. Some (Schwirzer, *Pers. Comm.* 2003) argue that the diversity of landscape is based on the geomorphology of the landscape and not only on vegetation as indicated in figure A3.4. For the purposes of this model, it is sufficient to base landscape heterogeneity on the number of different vegetation types within a specified grid size (e.g. 1km x 1km). It is accepted that vegetation type is based on the geomorphology of the area.

Figure A3.4: Defining Landscape Heterogeneity (After Omtzigt, 1996)



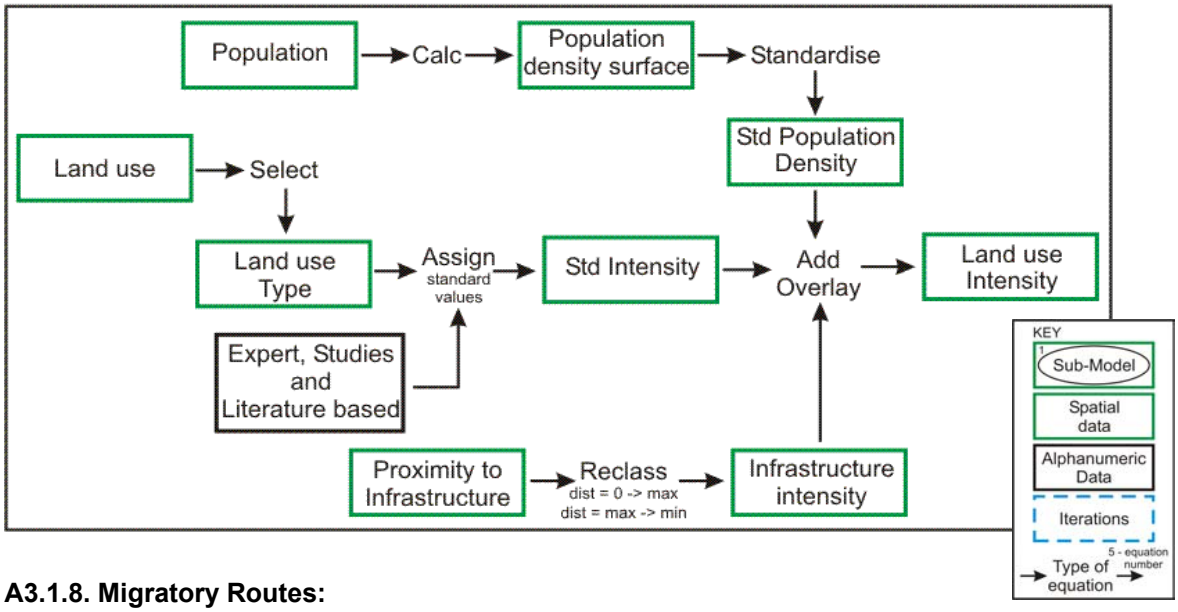
A3.1.6. Land use:

Land use is based on the function (Fairbanks *et. al.*, 2000) of the activities taking place at a specific area. Typically it refers to the human activity associated with an area. The classification required for the model needs to contain an attribute "type" which can be classified as invasive or not. The intensity of the type should either be included or should be able to be assigned to the type. The classification used here is the National Land-Cover (NLC) Database project for South Africa. Land use is very closely related to Land cover, however these are not the same (Fairbanks *et. al.*, 2000). Despite this, these are often used interchangeably. The NLC classification incorporates the land use as a component in the lower hierarchical sub classes. For example "Urban/built-up land (commercial)". This classification may be replaced as soon as the ISO standard for land use types is approved. A comprehensive explanation of each land cover type according to the CSIR - Satellite Application Centre (SAC) guidelines are provided in Appendix 4.

A3.1.7. Land use intensity:

This is a combination of the population density, the infrastructure intensity and the intensity of the land use type. This could also be considered a measure of the extent or level of disturbance at a particular area. The proposed calculation is outlined below in figure A3.5

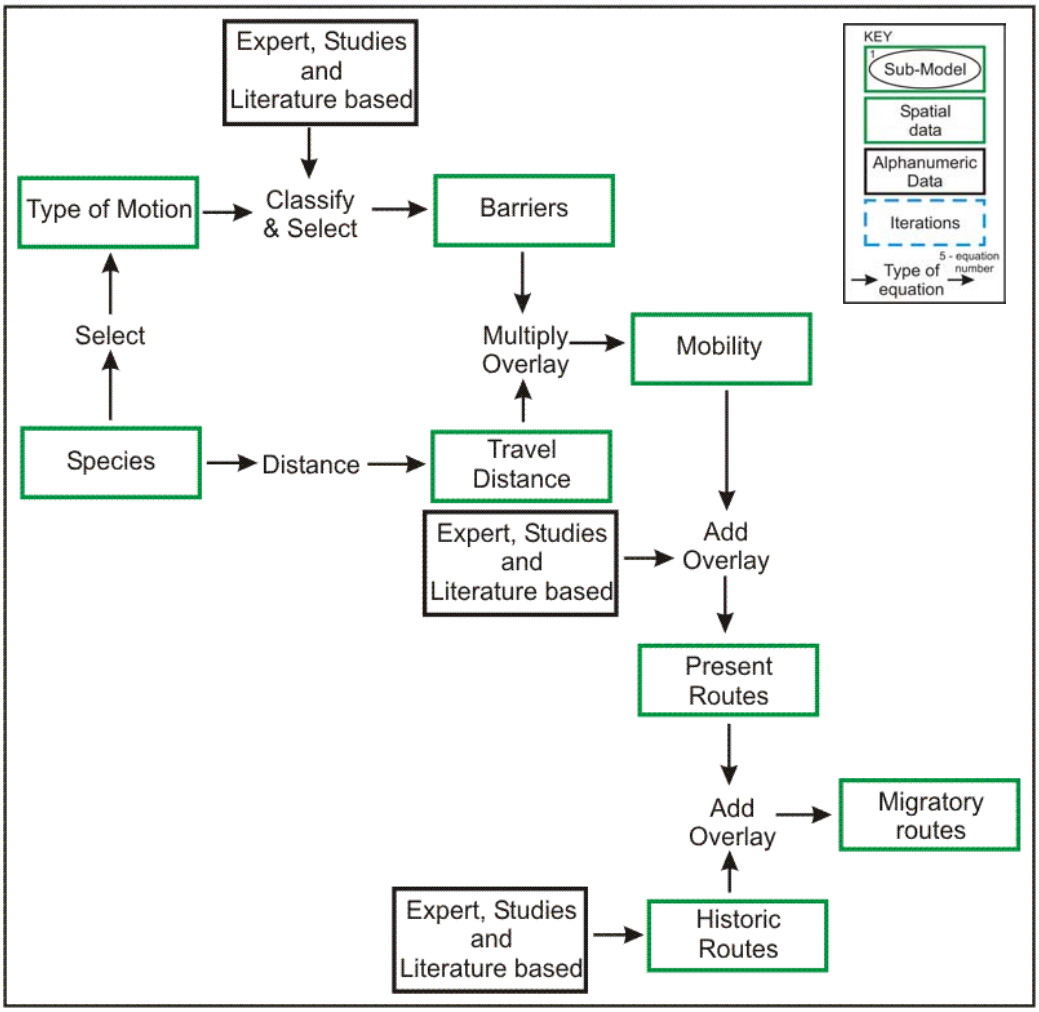
Figure A3.5: Defining Land use intensity



A3.1.8. Migratory Routes:

Migratory routes need to consider those which are currently used and those historic ones which are no longer in use because of human influences. The historic routes are largely determined by expert knowledge, case studies and literature reviews. The present routes are also partly based on the afore mentioned factors but consider mobility as another criterion. Mobility is fundamentally dependent on the species under consideration. In that it is the barriers to mobility, which depend on the type of motion of the species. And the distance a particular individual can travel. How these criteria are combined to determine migratory routes is illustrated in figure A3.6.

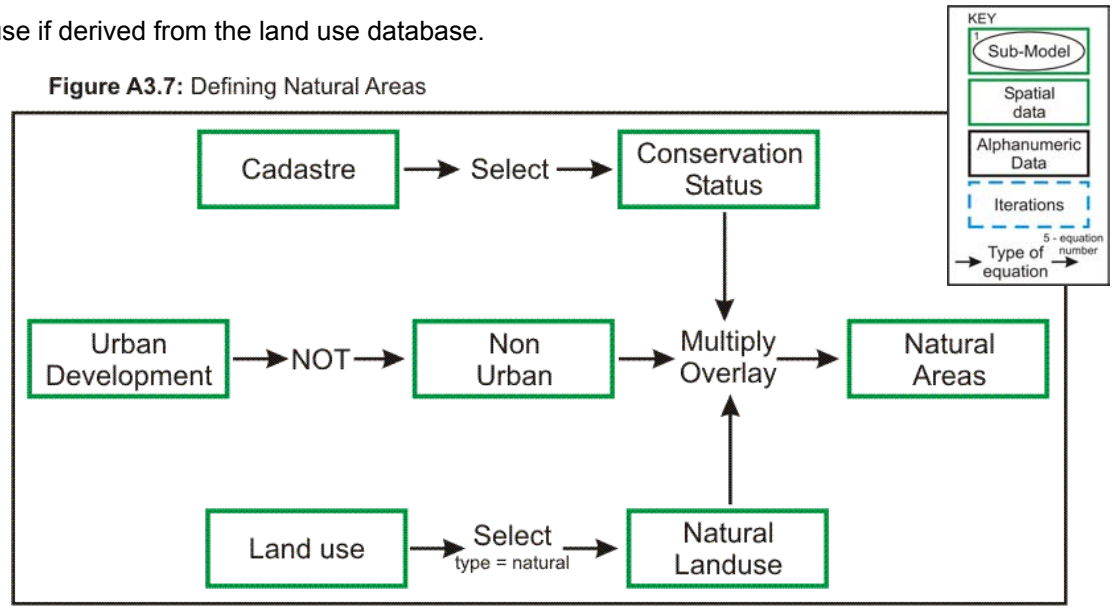
Figure A3.6: Defining migratory routes



A3.1.9. Natural Areas:

The Natural Areas criterion is created in such a way to ensure that more weight is given to areas with already existing conservation status and areas of natural land use, but that urban areas are not included (figure A3.7). The conservation status is derived from the Cadastre data, unless another form is available. The Non Urban areas are derived from the criterion Urban Development which is explained later in this appendix (see figure A3.10). Natural land use if derived from the land use database.

Figure A3.7: Defining Natural Areas



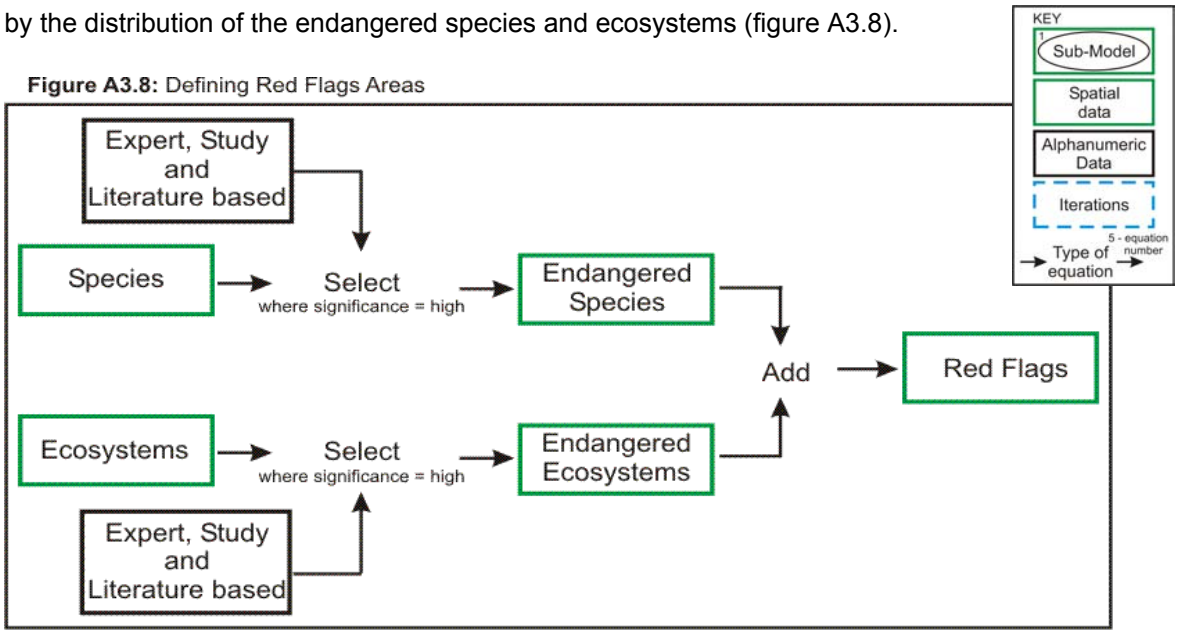
A3.1.10. Railways:

Railways are defined as any fixed track utilised by a motorised vehicle, which can only travel along the fixed track. This includes steam engines, trams, trains, high speed trains and monorails. At this stage there is no provision for ranking the railways types. Further research is necessary for an effective ranking procedure. But more specifically the barrier effects different types of railways present.

A3.1.11. Red flags:

Red flags are those species or ecosystems, which are regarded as endangered. This selection may be based on the red data book but generally the respondents did not feel that this was adequate especially in local scale networks. The areas selected as red flags are determined by the distribution of the endangered species and ecosystems (figure A3.8).

Figure A3.8: Defining Red Flags Areas



A3.1.12. Rivers:

Rivers are defined as a body of “linear” flowing water irrespective of size. The width of the river is however a necessary attribute for the calculation of its possible barrier effect.

A3.1.13. Roads:

Roads are linear features connecting places. They have an altered surface to that surrounding area (eg no vegetation, gravel, or tar).

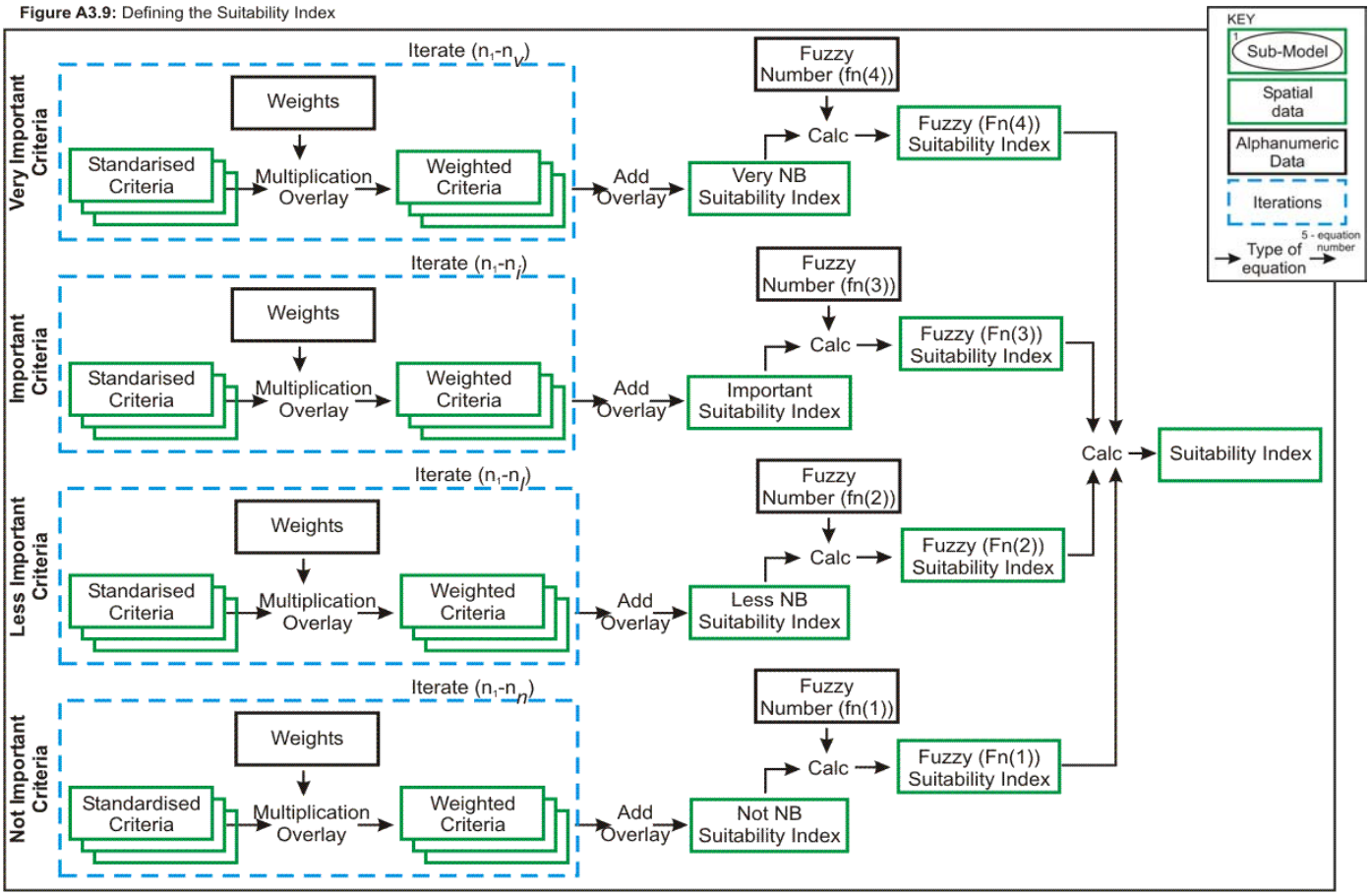
A3.1.14. Species:

Species is defined as a type of individual or taxonomic group whose members can interbreed (Wordnet). The attributes required for the model are: minimum viable population; type of motion and size.

A3.1.15. Suitability index:

The calculation of the suitability is the most complicated of all the necessary criteria (figure A3.9). It considers the relative importance of the 30 criteria listed in table 5.1. Firstly the criteria are standardised and then multiplied by their relative weight (as defined in chapter 5) to obtain the weighted criteria. This is repeated for each criterion. For each of the broad categories (Very Important, Important, Less Important and Not Important) the relevant criteria are added together, resulting in four suitability sub-indices. Each of these entities are then converted into part of a fuzzy membership function, according to the conversion of linguistic terms to fuzzy numbers (figure 5.3) as described in chapter 5. The four parts of the fuzzy membership function are then combined to create the suitability index. Some of the input criteria have fuzzy boundaries. Others are finite features. These may be entered into the calculation of the suitability index as long as they are standardised (have values between 0 and 1) to enable a logical result to the suitability index.

Figure A3.9: Defining the Suitability Index



A3.1.16. Urban Development:

Urban development is determined from a combination of the cadastre and a classified (recent) satellite image (figure A3.10). Urban areas are selected from the cadastre. This is correlated and updated by a supervised classification of either satellite imagery or aerial photography. This combination results in areas, which are classified as urban development.

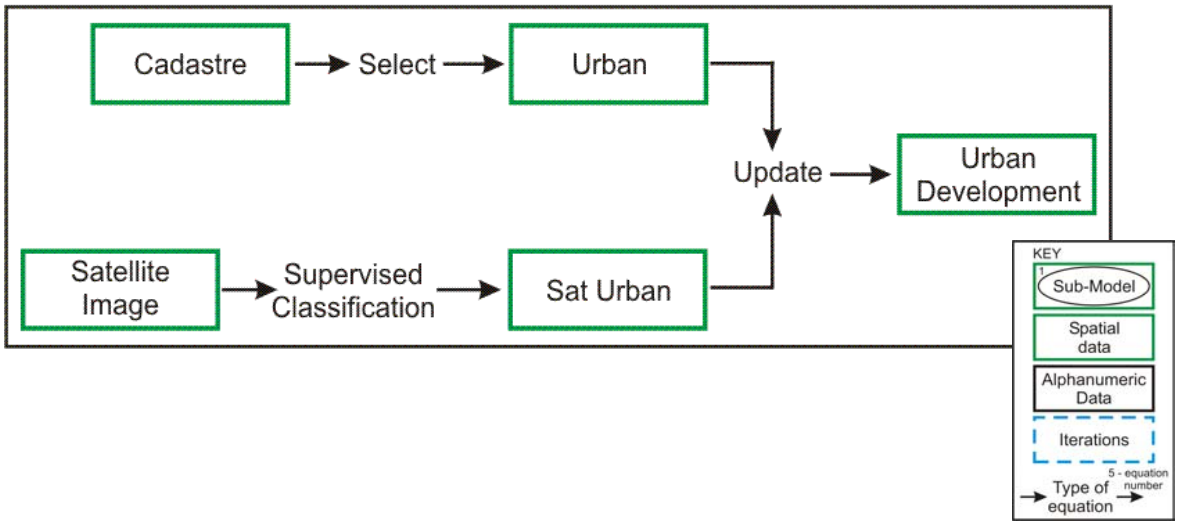



Figure A3.10: Defining Urban Development