Annexure 19 - Guidelines for corridor design

Step 1. Identify priority species requiring protection – Since the design of corridors should be tailored according to the specific needs of focal species, the first step is to identify which species are the priority targets for protection.

Step 2. Understand the biology of the priority species identified - This is an essential first step in the process of evaluating whether or not a corridor will provide connectivity and support to isolated populations of biota. Corridor design is driven by the requirements of the species they are trying to assist (focal species) and a corridor will be ineffective if it does not meet the habitat, cover, food and permeability tolerances of the focal species. For this reason understanding the biology of a species is vital to assess if a corridor could be a useful conservation tool or not and if so, to inform its design. The following factors must be clearly understood:

(i) Level of reliance on corridors – A key consideration is the degree to which a focal species is reliant on terrestrial corridors for movement between sub-populations. In this respect, earth-bound species are clearly far more reliant on terrestrial corridors than species that can travel by air (e.g. birds) or water (e.g. fish). Indeed, some species do not require continuous habitat, but merely stepping stones of suitable habitat. Migratory birds are good examples of species requiring stepping stones rather than contiguous corridors to facilitate movement. For such species, suitable stepping stones available at a regional scale may be sufficient to encourage movement between sub-populations. For ground-based species, corridors may be the only suitable option for movement however, in which case, establishment of suitable corridors is likely to be an important consideration.

(ii) Habitat requirements – Gaining an understanding of the specific habitat requirements of focal species is essential to help design suitable corridors. Here, it is important to understand both what constitutes favourable habitat which would promote use of corridors and unfavourable habitat characteristics that could pose an obstacle to species movement and use of a corridor. Where habitat requirements are very specific, this may substantially limit options for corridor development whereas establishing corridors for species with less specific requirements can be more easily achieved.

(iii) Speed of movement - Understanding the scale and time taken to make movements required for gathering food, seasonal migrations and juvenile dispersal / range expansion is another important consideration. Beier and Loe (1992) distinguish between corridor dwellers (species who may require several days or even generations to pass through the corridor, such as an invertebrate or plant species), and passage species (such as large mammals or birds, who may travel between 2 patches in a single travel event of short duration). The requirements of these two groups are quite different as those species spending generations in the corridor will need all their life requirements to be met by the habitat within the corridor, whilst those simply passing through may only need the corridor to fulfil a subset of requirements such as food and cover.

(iv) Ability to overcome obstacles - The ability of a species to overcome obstacles in its path such as roads, fences, rivers, changes in altitude, breaks in habitat continuity etc. is another important consideration. This requires an understanding of limitations to movement for specific species in order to identify potential obstacles for species

movement. For example, a road may be less of a barrier to an antelope than a chameleon which stands a far higher risk of being run over. A fence however is no barrier to a chameleon but may prohibit movement of small antelope species.

(v) Threats from factors outside of its habitat – Different focal species will be at risk from different threats from outside of their habitat. These threats are greatest at the edges of a habitat, and due to their shape, thin corridors are particularly prone to edge effects (see below – corridor width). If outside threats lead to high mortality in a corridor, the linkage may become a sink habitat where mortality exceeds reproduction. It is important to understand the threats to focal species that may emanate from outside of the corridor. This could include a range of factors from predation to pesticide application in adjoining land uses.

(vi) Sensitivity to human disturbances / influences. Human influences of all kinds may affect species in different ways. Factors such as dust, noise, light, and the presence of people (e.g. walking their dogs) may be important in how and if biota use a corridor. Their sensitivity / reaction to these factors must therefore be understood as this will inform the feasibility and design of a proposed corridor.

Step 3. Assess whether there are other viable patches in the surrounding landscape that support priority species

Once priority species have been identified, core areas identified and their biology understood, it is important to assess whether or not areas of additional habitat that support the species occur within a reasonably close proximity to the population under consideration. This may require additional investigation of adjoining areas to verify occurrence, which could potentially be undertaken in collaboration with provincial conservation bodies.

Step 4: Identify focal species for further consideration – Focal species should be identified as those species for which a corridor may be an effective conservation tool, based on the understanding developed in Step 2 and the availability of other viable patches in the landscape.

Step 5: Evaluate feasibility for implementing corridors – The situation on the ground is vital to the feasibility of implementing a corridor and to the design process. If for example, the land use matrix between habitat patches is unsuitable for the movement of the focal species, or if the cost of securing the protection of a corridor is too high, then any effort to establish a corridor may be futile, and the species could be eliminated from the list, or the idea of a corridor abandoned altogether. If this is the case, legitimate reasons for not establishing corridors should be appropriately motivated. Key criteria that should be considered in assessing the feasibility of corridor establishment include:

(i) Barriers / permeability of the matrix – Certain barriers or land uses may preclude the development of a corridor, though these are entirely species specific. For example, a river may prove to be impassable for a terrestrial invertebrate, but will not be an obstacle to a bird. Most obstacles will relate to interruptions in habitat continuity and their potential limitation to movement. Where such limitations re identified, the possibility of addressing these concerns should be investigated.

(ii) Existing land use matrix - This represents the landcover / use that is present between habitat patches through which the corridor will need to pass. In some cases many corridor options will be available due to large areas of existing ideal habitat. In other

cases, due to the paucity of ideal habitat, corridors will need to be carefully worked out based on a route of least resistance (see below under Corridor Design). The extreme case will be areas where very little to no habitat is available. The less habitat that is available for a corridor, the less likely it is that it will be successful.

(iii) Existing land tenure – The ownership or management structure of the land through which the corridor must pass is obviously important. Without the permission and support of the landowner, establishing an effective corridor is unlikely. It may also be that the cost of securing the land in an untransformed state is unreasonably high, and the funds could be better spent on other conservation efforts.

(iv) Existing land management / plans – As somewhat of a combination of the first three factors mentioned above, the management or future planned management of a site will determine if a corridor is worth considering. It will be important to know that an area has been earmarked for development, or that a landowner is planning an expansion of activities which would significantly impact a corridor.

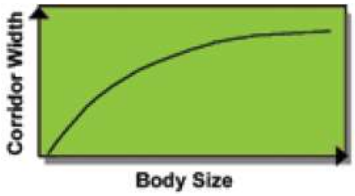
Step 6. Refine the list of focal species based on the availability of suitable corridor options

It is important to continually review the list of focal species for which a corridor is still a viable option.

Step 7. Corridor design – Once a list of focal species has been finalized, and it has been established that the required factors are available, a corridor can be established. The following design criteria should be considered:

(i). Corridor width - There is no 'correct width' for a corridor. The required width is determined by the focal species and their particular requirements. Due to the nature of a corridor as a thin rectilinear shape, its edge to area ratio is high and thus factors outside the habitat strip affect a large portion of the corridor's habitat around the edge (edge effects). In order to ensure that the corridor is effective, the width should ideally be sufficient to *shield the focal species from edge effects* and allow unhindered travel, migration (seasonal or in response to environmental changes), breeding and genetic interchange. This width will be different for each species. Corridor dwellers will require a wider corridor than passage species and will need sufficient habitat contained in the corridor to meet all their living requirements including food, water and opportunities for breeding, whilst passage species will require a width that will merely provide sufficient cover, protection and security. As **a general rule of thumb**, Bentrup (2008) suggests the following:

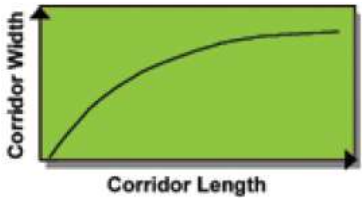
- The larger the species, the wider the corridor should be



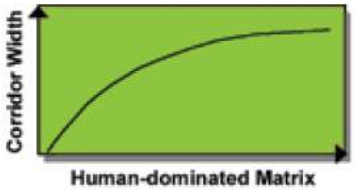
It could be added that the more edge-aversive (sensitive to edge effects or disturbances) species are, the wider the corridor will need to be. This would be important for extremely shy species such as some forest species which are not

necessarily large in body size, but are only found deep within their preferred habitat.

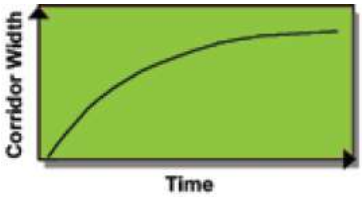
- The longer the corridor, the wider it should be in order to increase the chance of the corridor being effective.



- The more human influence there is in the corridor area, the wider the corridor will need to be. This will limit edge effects which impact on the corridor's efficacy.



- Corridors that are designed to operate over longer time scales, such as those designed to facilitate dispersal of slow moving organisms, should be wider than those operating over shorter periods of time.



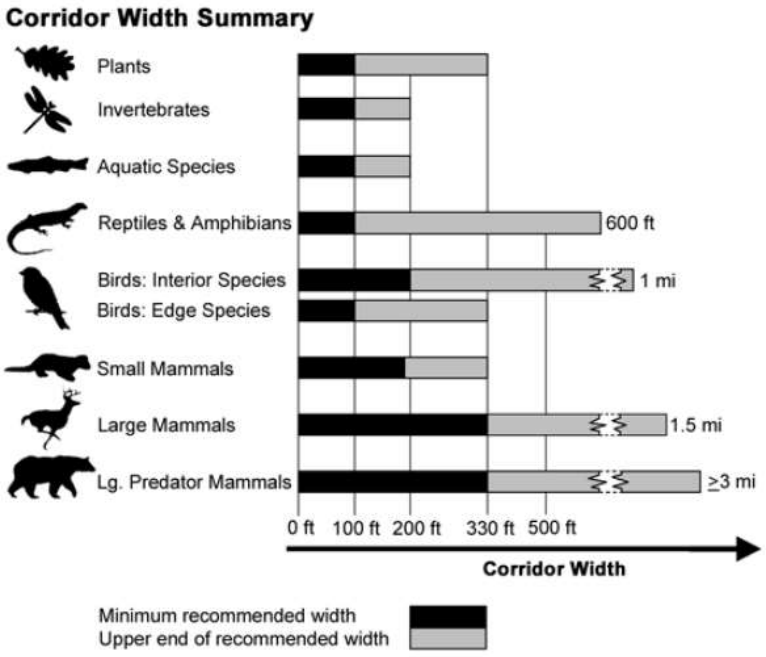


Figure 1. Summary of corridor widths required by different biota (Bentrup2008)

(ii). Path of least resistance - The path of least resistance is the route along which the focal species will encounter the least obstacles and best habitat. This is likely to be the best route along which to place a corridor. On a small scale this can be identified by site visits and by plotting it on a map, whilst on a larger scale, the ideal is to divide the area between patches into cells or grid squares, and assign a resistance or permeability rating to each cell based on quality of habitat and on obstacles encountered. Any one of a number of computer packages can then be used to establish the optimal route. Where a large number of corridor route options are available (e.g. undeveloped landscapes), if possible, design corridors along existing movement routes. Species which exist in the area are likely to be already using routes along which movement is most feasible in terms of their requirements.

(iii). Encouraging use of the corridor – It is important to consider "what will draw the animal into the corridor" since it does not know that it is required to do so for the good of its species. If the species is likely to use the corridor as an extension of its habitat patch, then it is likely to move through it. Ask the questions "based on the topography, vegetation and location, is it likely that individuals will

i. encounter the entrance to the corridor,
ii. enter the corridor,
iii. have sufficient food / cover / water in the corridor (taking into account the length of time the individual will spend in the corridor - passage species vs dweller species)

These considerations should be used to help implement measures to improve the attractiveness and suitability of the corridor for targeted species.

(iv). Overcoming barriers using structures - Some barriers can be overcome using structures such as bridges and underpasses. These have to be carefully assessed and as with the corridor, matched to the species' mobility and sensitivities.

References

Beier, P., Loe, S. (1992). A checklist for evaluating impacts to wildlife movement corridors. Wldlife Society Bulletin 20, 434 – 440.

Bentrup, G. (2008). Conservation buffers: design guidelines for buffers, corridors and greenways. General Technical Report SRS-109. Ashville, NC. Department of Agriculture, Forest Service, Southern Research Station.