Update of this page in the near future: improved speciation chapter

For speciation concepts, see for instance:

Groves, C., 2001: Primate Taxonomy (Smithsonian Series in Comparative Evolutionary Biology). Smithsonian Institution Press, Washington, London.   ISBN: 156098872X

Groves, C. P., 2002 in press: Morphology, morphometrics and taxonomy. In: Primate Field Methods, Debbie Curtis, Jo Setchell (eds.).

Practical need for taxonomic research:

"Species" are distinguished because of some crossbreeding limitations or barriers valid in nature. Description of evident phenotypical differences within a taxon may not be sufficient to determine species for conservation. Conservation efforts planned for the average of a metapopulation or based on a distinct subpopulation which happens to have been subject of research may not be sufficient to maintain genetic diversity of the metapopulation. If subpopulations with adaptation to certain environmental conditions exist and survival of other forms in this habitat seems doubtful, conservation and possibly pure captive breeding of specimens of this form (with care adapted to their proper habitat, avoiding wrong selective pressure) or at least storage of frozen sperm and embryos, might be necessary for later reintroduction to the wild, even if there is no other evidence that the form does not crossbreed with others. In addition, genetic or other crossbreeding problems between subpopulations may be present, but not phenotypically evident.

If different types of specimens, phenotypically distinguishable or with a genetic distance indicating longer separation, occur in common or overlapping distribution areas in the wild, some still unrecognized crossbreeding barrier might be present. Certain crossbreeding problems occurring in the wild, for instance as mentioned below under 6, 8 and 10, may not be valid under captive conditions, but their consideration in captive breeding for wild species conservation is necessary.

Cryptic species may exist which are indistinguishable with traditional morphometric methods, but may be identified with molecular methods [87].

Some cross-breeding barriers and possible mechanisms of speciation:

Prezygotic separation: fertilization is impossible:

   1) Species-specific chemical interaction between gametes (for instance differences in gamete recognition proteins, sperm is not attracted by the egg [57, 58]. Rapid evolution by positive selection can lead to high diversity among closely related forms; diversity of presently known proteins mediating fertilization indicates that their rate of evolutionary change may be rapid and that they have evolved independently in different phyla. [57]

   2) Species-specific mechanisms prevent binding of sperm to the egg or penetration of sperm into the egg. [57, 58]

Postzygotic genetic separation:

   3) Hybrid offspring not viable.

   4) Hybrid offspring viable, but sterile.

Spacial separation: mates do not meet because of:

   5) Geographic separation

   6) Different choice of habitat, substrate, altitude in the trees, temperature; animals staying spatially divided in the wild even in cases of more or less sympatric occurrence. Example: The mice *Peromyscus maniculatus bairdi*, with an inherited preference for vertical grass-like structures, and *Peromyscus maniculatus gracilis*, with a preference for areas with trees, interbreed in captivity, but do not interbreed in the wild even in cases of close spatial proximity of their territories [55].

Temporal separation:

   7) Differences in reproductive seasonality, mating of forms occuring at different times of the day or year. [59]

Behavioural or morpological separation which prevents mating:

   8) Different behaviour related to reproduction (example: mate recognition by distinct calls in galagos; maybe olfactory mate recognition in lorises and pottos?). [53, 54] [84].

   9) Differences in morphology, for instance of the genitalia, which make successful copulation unlikely or impossible. [53, 54]

Ecological separation:

   10) Zone of hybridization between different populations; hybrids viable and fertile, but adaptation to their environment diminished, leading to higher mortality or lower reproductive success. Two examples:

     a) The lowland deer *Odocoileus virginianus* and the mountain form *O. hemionus* with a more jumping locomotion: naturally occurring hybrids between both have a locomotor pattern not adapted to either habitat, which makes them susceptible to predation [52]

     b) A population of *Capra ibex ibex* population was successfully introduced within the former distribution area of the species. Later additional introduction of two other subspecies, *Capra ibex aegagrus* and *C. I. nubana*, led to hybridisation; mating of hybrids in autumn instead of winter and birth of their offspring in the coldest time of year then caused the death of otherwise viable and healthy offspring, the population collapsed [60].

Speciation within populations in spite of possible genetic exchange:

11) In certain animal populations, different phenotypes adapted to different parts of the habitat are found. A speciation tendency within such population may occur, particularly if the animals prefer a similarly adapted mate [50, 51].