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Habitat fragmentation-a menace of biodiversity: A review

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Abstract
Hunting, emergent diseases, habitat conversion and fragmentation are main reasons of global decline of population of organisms. Habitat fragmentation is main problem in conservation biodiversity. It is the division of habitat into smaller spatially isolated patches. It disrupts the physical and biological processes of ecosystems. Habitat fragmentation is caused by fire, flood, highways, railway lines, water channels and windfall; but most important it is caused by increased and extension of human land use. It is a landscape-level process and this landscape differs in size and shape of fragments and in their spatial configuration. It is playing a central role in population decline, biodiversity loss, and alteration of community structure and ecosystem functioning in anthropogenic modified landscapes. It reduces the size and increase the spatial isolation of plant population. There should be conservation efforts to stop habitat restoration. We should set up long term goals to conserve biodiversity in fragment landscape.

Keywords: Habitat loss, habitat fragmentation, conservation, population decline

Introduction
Habitat fragmentation is threat to biodiversity in terrestrial and aquatic ecosystems; it is the division of habitat into smaller spatially isolated patches. It disrupts the physical and biological processes of ecosystems (Young *et al.* 1996; Hargis *et al.* 1998) [48, 23]. Habitat loss and fragmentation do not occur in a single event, but typically extend over many decades (Van Rossum *et al*. 2004) [39]. In a particular habitat, population of organisms is lost due to habitat destruction causing extinction of different species (Fahrig, 2002) [20]. Population changes causes the erosion of genetic variation and increased interpopulation genetics divergence by enlarge random genetic drift, increased interbreeding, reduction of interpopulation gene flow, and elevated local extinction of demes within metapopulation (Skole and Tucker, 1993; Young *et al.* 1996; Cushman, 2006) [38, 48, 12].

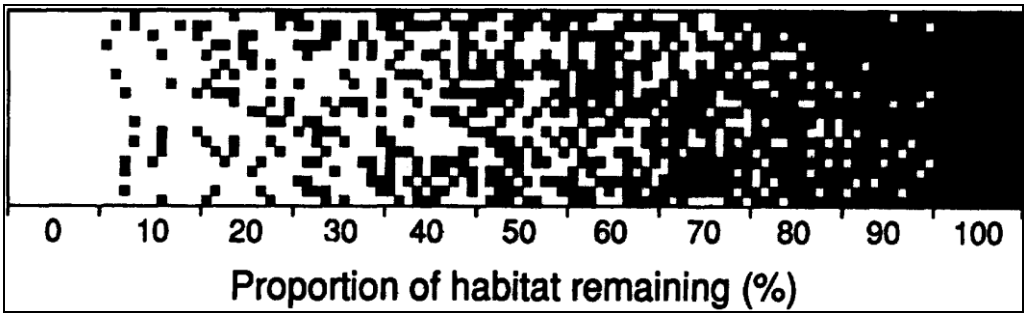

Fig 1: Composite example of artificial maps generated by a random process, showing habitat fragmentation in a landscape of different proportion of two habitats. The shaded area presents the original habitat and the unshaded areas the extent of habitat loss (Andren, 1994) [3].

Species extinction is caused by two main factors i.e. habitat destruction and fragmentation, it directly and indirectly causes the reduction of population sizes which enhancing the probability of extinction (Fahrig, 1997; Opdam and Wascher, 2004; Zaviezo *et al.* 2006) [19, 34, 49]. Habitat fragmentation is caused by fire, flood, highways, railway lines, water channels and windfall; but most important it is caused by increased and extension of human land use

(Arroyo-Rodríguez and Dias, 2010; Zanin *et al.* 2015) [4, 48]. Biological diversity within original habitat is declining due to loss of original habitat, reduced habitat patch size, and increased isolation of habitat patch (Andren, 1994; Wilson *et al.* 2016) [3, 46]. Isolation influences the local population by restricting their emigration and immigration (McGarigal *et al.* 2005) [31].

Endogenous and exogenous processes can lead to the habitat fragmentation (Fischer and Lindenmayer, 2007) [20]. Endogenous processes include species biology typically changes in biology, behavior and interactions within or between species that ultimately lead to the changes in breeding patterns (Brook *et al.* 2008; Rybicki and Hanski, I2013) [6, 35]. While exogenous processes include habitat degradation, habitat subdivision or habitat isolation (Buskirk, 2000) [7]. These changes can lead to decrease in a density of species, increased competition or even increased predation (Cushman, 2006; Arroyo-Rodríguez and Dias, 2010) [12, 4].

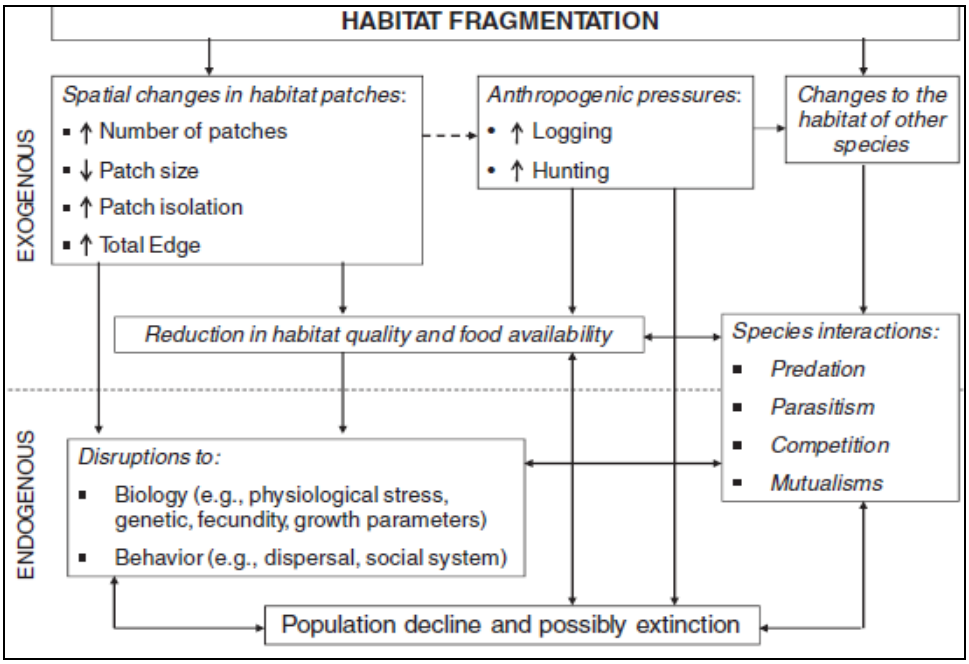

Fig 2: Deterministic threatening processes arising from habitat fragmentation as experienced by a declining animal species (Arroyo-Rodríguez and Dias, 2010) [4]

The Scale of Habitat Fragmentation

Habitat fragmentation is a landscape-level process and this landscape differs in size and shape of fragments and in their spatial configuration (Faaborg *et al.* 1993' Fahrig, 1997) [17, 19]. We compare whole landscapes to study habitat fragmentation. These comparisons are very significant because landscape have different properties than fragments and movement of species between fragments (Bennett and Saunders, 2010; Kacholi, 2013) [5, 27].

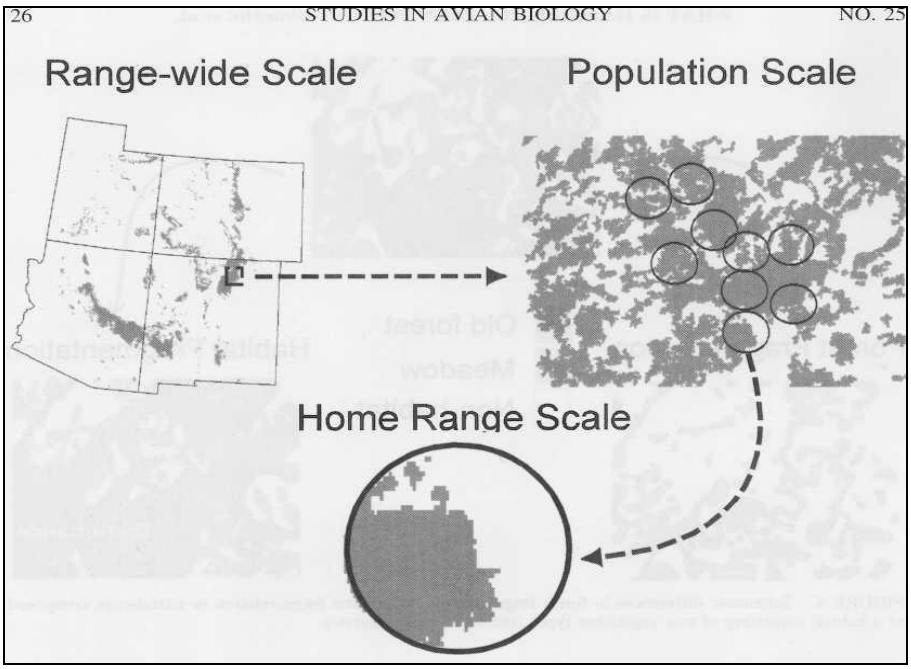

Fig 3: Three different scales of habitat fragmentation (Franklin *et al.* 2002) [21]

Habitat fragmentation can be defined and understand by using hierarchical scale. For example, a range-wide scale of fragmentation that occurs throughout species geographic distribution that alters the distribution between populations, population scale in which fragmentation occurs within a population that effect local population dynamics, and a home-range scale for fragmentation that occurs within home ranges of individuals that alters individual performance such as reproduction and survival (Franklin *et al.* 2002) [21].

Home range scale processes (individual survival and reproduction) do not affect processes at a population or range-wide scale (dispersal between populations of home ranges) (Kruess and Tscharntke, T1994) [29]. For example, fragmentation that affects foraging sites within the home range of an individual can't alter the ability of the offspring of that individual to disperse across a wider area (Franklin *et al.* 2002) [21].

Effect of Habitat Fragmentation on Species Richness

Theory of island biogeography is used to study the effect of habitat fragmentation on species richness (Andren, 1994) [3]. Species show different type of behavior towards habitat fragmentation; some species number becomes increased while other show decline in number (Bennett and Saunders, 2010; Jacquemyn *et al.* 2012) [5, 26]. This type of behavior is necessary in species conservation. Those species that depend on fragment habitat greatly influenced by fragment size and shape (Sawchik *et al.* 2002; Conceição and De Oliveira, 2010) [26, 9]. If the size of fragment decreased then frequency of particular species occurrence decreased due to the smaller area available than acquired for breeding, or for self-sustaining population (Aguilar *et al.* 2006; Aguilar *et al.* 2008; Krauss *et al.* 2010) [1, 2, 28]. Some species persist in fragmented landscapes by incorporating multiple fragments in their territory or daily foraging movements (Cushman *et al.* 2010) [13]. In England, the tawny owl (*Strix aluco*) occupies territories of about 26 ha (hectares) in large deciduous woods, but individuals also persist in highly fragmented areas by including several small woods in their territory. But breeding success decreased when individuals use multiple woods. Species that need different kinds of habitats for breeding and foraging can be disadvantaged due to habitat isolation because they face difficulty between fragment habitats (Debinski and Holt, 2000) [14]. For example movement of amphibians between a breeding pond and overwintering sites in forest. In habitat fragments, species richness for many taxa birds, butterflies, rodents, reptiles, vascular plants, and more, is correlated with fragment size. Species are lost when habitat is fragmented into many small patches (Bennett and Saunders, 2010) [5].

Population Response to Habitat Fragmentation

In The Netherlands, habitat fragmentation had great influence on the red squirrel populations. The probability of red squirrel occurrence significantly increases when a woodlot is situated close to a large, permanently inhabited wood, or when the amount of surrounding woods or the amount of hedgerow increases (Verboom and Apeldoorn, 1990) [39]. Species extinction occurred when population size decreased due to reduced size of habitat fragment (Harrison and Bruna, 1999) [23]. Population lost occurred by both direct and indirect effects of habitat lost (Walkup *et al.* 2017) [40]. In a forest, songbird population is declined due to increased avian nest predation and brood parasitism, and parasitism by arthropod increased threaten the bird population in fragment habitat. In fragment habitat, prey insect outbreaks occurred due to decreased searching efficiency of predator (Murren, 2002) [3]. Similarly, seed production in many plants is reduced in fragment habitat due to decreased visitation of pollinators (Bennett and Saunders, 2010) [5]. A great variety of soil types, greater topographic variation, greater microclimatic variation, and greater number of habitat types are present in large fragments as compared to small fragments (Ewers and Didham, 2006) [16]. Heterogeneous habitat fragments support a large number and variety of species as compared to homogeneous habitat fragments (Wilcove *et al.* 1986; Honnay and Jacquemyn, 2007) [44, 25]. Population in heterogeneous fragment face less extinction as compared to homogeneous fragment (McGarigal and Cushman, 2002; Mona *et al.* 2014) [30, 32]. For example, population of bush crickets in Sweden were remains constant if they remain in an area with various vegetation types as compared to area with small vegetation (Collinge, 1996) [47].

Effect of Habitat Fragmentation on Gene Flow

The geographic scale of habitat fragmentation may affect the extent of gene flow between fragments of population Watanabe *et al.* 2010) [41]. Genetic effects of habitat fragmentation for plants are complex dure to their sessile habit, interspecific differences in longevity, prefragmentation abundance and generation (Watson, 2005) [42]. Habitat fragmentation had great influence on their sexual and asexual reproductive systems, poliination, storage of genetic material as seed, their interactions with pollinators and dispersal vectors (Crooks, 2002; Cooper *et al.* 2012) [11, 10]. It reduce genetic diversity which ultimately effect the species fitness and reduce population viability. Habitat gragmentation is responsibl for genetics variation in wolverines (*Gulo gulo*), lynx (*Lynx lynx*), mountain lions (*Puma concolor*), Ethiopian wolves (*Canis simenesis),* and brown bears (*Ursus arctos)* (Dixon, *et al.* 2007) [15]. Due to habitat fragmentation, large carnivores are more susceptible to losses genetic diversity than other organism because of their large home ranges, low population densities, and long generation times. Species distribution and gene flow is limited by anthropogenic barriers like roads or other human development. Genetic variation in the Florida black bear is lost due to division of habiatat into smaller patches. This loss contributed the population loss that ultimately leads to the species extinction. To restore population number, there is urgent need of gene flow among bear populations (Dixon, *et al.* 2007) [15].

Future Prospectus

Species loss can occur abruptly and directly due to habitat fragmentation and destruction. Critical future success of biodiversity conservation is conservation of biota in fragmented areas. National parks and dedicated conservation reserves are of great importance, but on their own are too few, too small, and not sufficiently representative to conserve all species. The future status of a large portion of Earth's biota depends on presence of plants and animals in fragmented areas covered by agricultural and urban land-uses. Plant and animal species are very important in these fragment areas to sustain food production, clean water and sustainable living environment for humans to maintain ecosystem services.

Conclusion and Recommendations

Major factors in the global decline of species and disruption of ecosystem processes are habitat fragmentation and habitat destruction. Landscape changes include habitat destruction, habitat fragmentation and new forms of land use. Habitat loss has adverse effects on biodiversity. Conservation in fragmented landscapes can be enhanced by: protecting and increasing the amount of habitat, improving habitat quality, increasing connectivity, managing disturbance processes in the wider landscape, planning for the long term, and learning from conservation actions undertaken. Plants and animals assemblages are maintained by healthy activities that protect and expand natural and semi-natural habitats. There should be measures that prevent further destruction and fragmentation of habitats. Size of existing fragments and the total amount of habitat in the landscape should be increased. Conservation area should be increased. Priority should be given to protecting large fragments. Effective conservation planning will be needed to secure landscape from fragmentation. Conservation of fragment habitats ultimately leads to the conservation of biodiversity.

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