

IV SEMESTER MSC BOTANY
ENVIRONMENTAL BIOLOGY
AND
BIODIVERSITY CONSERVATION

TOPIC: ALLEE PRINCIPLE OF
AGGREGATION AND REFUGING

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**ALLEE PRINCIPLE OF
AGGREGATION
AND
REFUGING**

Varying degrees of clumping are characteristics of the internal structure of most populations at one time or another

Such clumping is a result of individual aggregating :

- 1. In response to local habitat or landscape differences**
- 2. In response to daily and seasonal weather changes**
- 3. Because of reproductive process**
- 4. Because of social attractions**

Aggregation may increase competition between individuals for resources such as nutrients, food or space , but this is often counterbalanced by increased survival of the group because of its ability to defend itself , to find resources , or to modify microclimate or microhabitat conditions

THE ALLEE PRINCIPLE OF AGGREGATION AND REFUGING

○ Aggregation

- Local habitat or landscape differences
- Daily and seasonal weather changes
- Reproductive processes
- Social attraction

○ Allee principle of aggregation

- undercrowding or overcrowding may be limiting

Allee principle of aggregation states that either overcrowding or undercrowding are detrimental to the population survival , growth and development

W.C.Allee observed that grouping of individuals are at more advantage than single organisms .

Allee principle states that the density is limiting factor of population growth. Either density is low or high it will resist the population growth

Allee principle of aggregation : organisms aggregate to form clusters in response to social attraction ,daily or seasonal climatic change etc..

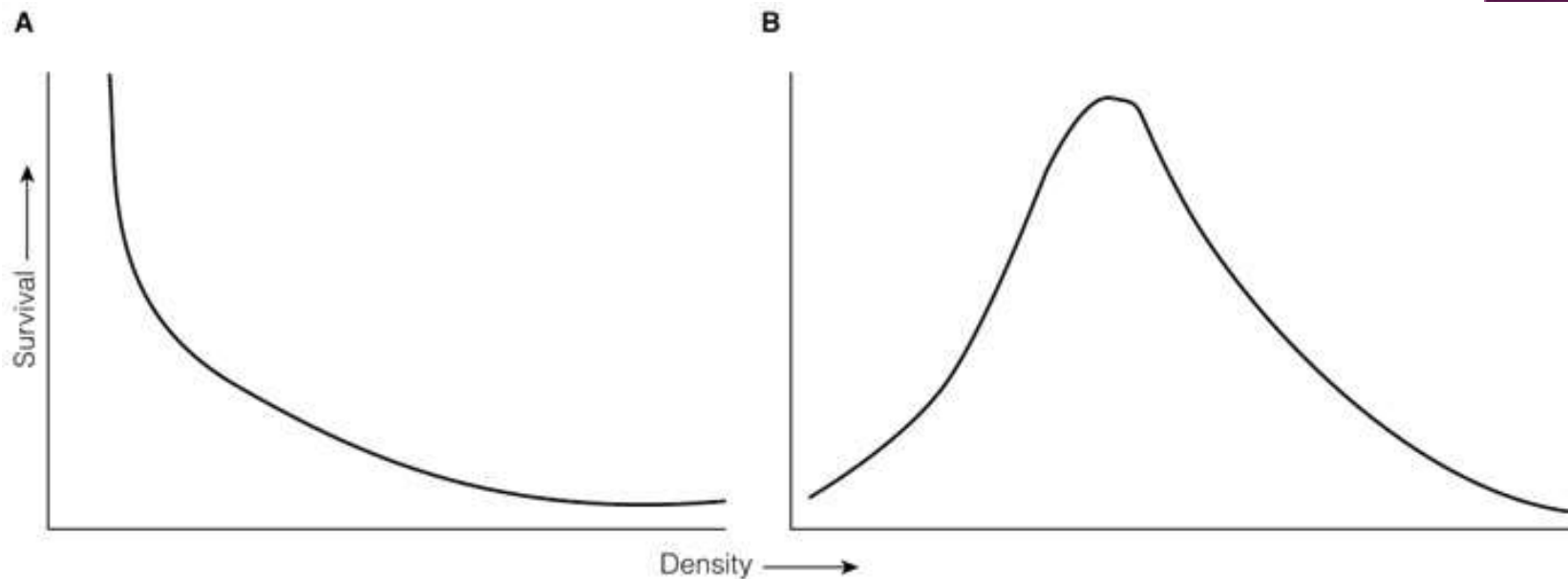


Fig. 6-23. Illustration of the Allee principle.

(A) Growth and survival is greatest when the population size is small.

(B) In an intermediate-sized population being the most favorable.

In the latter instance, undercrowding is as detrimental as overcrowding.

Ecological mechanisms:

Numerous ecological mechanism for allee effect exist , the most important ones are:

- 1. Mate limitation** : mate limitation refers to the difficulty of finding a compatible and receptive mate for sexual reproduction at lower population size or density
- 2. Cooperative defence**: another possible benefit of aggregation is to protect against predation by group antipredator behaviour. Single individual- high vigilance rates- so less energy for foraging -thus fitness reduced. Group-less energy for vigilance. Many animals travel as groups - to escape from predator

3. Cooperative feeding:

Certain species also require group foraging in order to survive.

Example species that hunts in packs

4. Environment conditioning or habitat alteration:

Environmental conditioning generally refers to the mechanism in which individuals work together in order to improve their immediate or future environment for the benefit of the species.

This alteration could involve changes in both abiotic (temp) or biotic (toxins, hormones) environmental factors

Eg: spawning salmon- marine nutrients from ocean - migrate to fresh water stream for reproduction - fertilise the surrounding fresh water . So young ones hatch and grow for few months

In plants aggregation may occur in response to three factors (habitat, climate or reproduction) .

In higher animals aggregation may be the result of four factors especially social behaviour

GROUP SURVIVAL VALUE

- It is an important characteristics that may result from aggregation .
- A group of plants may be able to withstand the action of wind better than isolated individuals or may be able to reduce the water loss more effectively
- With green plants , however the deleterious effects of competition for light and nutrients generally soon overbalance the advantages of aggregation

- Allee conducted many experiments in this field and summarised the extensive writings on the subject
- He found for example a group of fishes could withstand a given dose of poison introduced into the water better than could isolated individuals
- Isolated individuals were more resistant to poison when placed in water formerly occupied by a group of fish than when placed in water not so “biologically conditioned”
- In previously occupied waters , mucus and other secretions aided in counteracting the poison
- Thus revealing something of mechanism of group action

The Allee principle:

- Aggregation will subsequently increase competition .
- This often is counter-balanced by the increased survival of the group due to its ability to defend itself, or to find resource, or to modify microhabitat conditions.
- Thus, both under-crowding (lack of aggregation) and over-crowding may be limiting. **This view was put forward by W. C. Allee, a Quaker and V. E. Shelford, and was termed as the Allee effect or Allee principle of aggregation.**
- Allee effect stresses that any optimal function (faster body growth, increased reproduction, or longer life) takes place at an intermediate rather than at minimal density.
- For instance, at low density, a drop in reproductive rate takes place as some females may go unmated because they were not found by males or because of an unbalanced sex ratio.

EXAMPLES:

- ⦿ Bees provide another example of group survival value
- ⦿ A hive or a cluster of bees can generate and retain enough heat in the mass for survival of all the individuals at temperatures low enough to kill the bees if each were isolated

EXAMPLES

- ◉ Bob white quail increase their chance of survivorship by forming a group (covey) during winter months in the mid western united states
- ◉ The covey rests in a circle with heads facing outwards , thus being able to flush in several directions if they are approached by a predator such as red fox
- ◉ This social grouping behaviour and response to disturbances such as human hunters results in atleast some of the individuals in the covey escaping harm and consequently able to reproduce in spring



Figure 6-24. A covey of quail (*Colinus virginianus*), illustrating the Allee principle of aggregation as a behavioral strategy.

- Among higher animals , a very successful aggregation strategy has been termed refuging , as described in detail by W.J Hamilton and Watt 1970
- Refuges are sites or situations where number of an exploited population have some protection from predators and parasites
- Large number of individuals resort to a favourable central place or core , for forage and life support

- Aggregation at a central place is advantageous in ensuring a net energy gain by individuals when good central places are scarce
- Disadvantages of refuges are stress such as pollution ,trampling of vegetation etc
- The Allee principle is relevant to the human conditions
- Aggregation into cities and urban districts(refuging strategy) is obviously beneficial , but only upto a point

Refuging:

Refuging describes a special type of aggregation in which large, socially organised groups of animals establish themselves in a favourable, central place (refuge) from this they disperse and to which they return regularly to satisfy their needs for food, or other resources. Some of the most successfully adapted animals on earth, including starlings and human employ this technique

REFUGES

- ⦿ a very successful aggregation strategy has been termed **refuging**.
- ⦿ **Refuges** are site or situations where members of an exploited population have some favorable central place or core - for example, a starling roost or a large breeding colony of sea birds.
- ⦿ **Lek** (mating arena)
- ⦿ A **lek** is a gathering of males, of certain animal species, for the purposes of competitive mating display.



RELEVANT TO HUMAN

- The Allee principle is relevant to the human condition.
- Aggregation into cities and urban districts (a refuging strategy) is obviously beneficial
- But only up to a point, in connection with the law of diminishing returns.

THANK
YOU