

Scientific Contributions of Dr. Niranjan V. Joshi.

Niranjan Joshi's research has spanned the areas of biophysics, social behaviour, ecology and evolutionary biology (it is a measure of his versatility that he has also done highly acclaimed work in modelling rainfall trends). Theories in biology often tend to be either unrealistically simple minded or so complicated and mathematical that no experimentalist looks at them. In contrast, the hallmark of Joshi's approach is his ability to rapidly familiarise himself with an experimental situation, model the situation effectively and then work out the consequences with the help of an array of sophisticated techniques in mathematics and statistics. It is no exaggeration to state that Joshi is among the best and most highly regarded theoretical biologists in the country today.

Starting with the advantage of a firm footing in the physical sciences, he has become enough of a biologist himself to collaborate very effectively with a number of biologist colleagues on a variety of problems. His studies are characterised by a meticulous analysis of data, the setting up of simple models with clearly stated assumptions and a rigorous exploration of the outcomes of the models. As is characteristic of good models, his end up explaining more facts than those used in formulating the models. His papers, divided roughly evenly between things he has carried out entirely on his own and joint publications with others, are noteworthy for their clarity and quality of exposition. A brief summary of his important contributions follows. The list of publications will indicate the names of collaborators wherever relevant.

1. Conformational studies on sugars.

Using classical potential functions Joshi investigated the preferred conformations of hexose and pentose sugar rings. The results showed that the chair configuration was rather flexible and not rigid as previously believed. More recent molecular dynamics calculations have confirmed the extent of variability indicated by these studies carried out in 1978.

2. The evolution of altruism.

Joshi has modelled the evolution of cooperation (altruistic behaviour) as an n-person game and has demonstrated that the smaller the size of a group, the likelier it is that cooperative behaviour will be selected for. A novel feature of his model is that it predicts that a population can be 'taken over' by individuals capable of exhibiting more and more discriminating strategies.

3. The ecology of avian species.

With the help of extensive data on the lists of bird species collected over the last century, a model for estimating the total number of bird species in an area was developed and tested for robustness by using Monte Carlo techniques. The deviations between numbers predicted by the model and those observed have provided useful insights into ecological changes - as reflected by changes in the composition of bird species - in Uttara

Kannada. This study has been extended to develop 'rational and flexible methodologies for conservation.

4. The evolution of social behaviour

Sex ratio theory has provided major insights into the evolution of insect sociality. Joshi has collaborated in developing a general model for the evolution of social behaviour by simultaneously including the effects of local mate competition, polyandry and kin recognition. This was among the earliest formal illustrations of the importance of kin recognition in promoting the evolution of social behaviour.

5. Transposable elements and the evolution of sex

There has been some discussion of the possible role of sexual behaviour in mediating the spread of transposable elements. Joshi has examined whether, within an asexual population, a sexual mutant can spread if its being sexual is contingent on the possession of a transposable element. Such spread is shown to be indeed possible, suggesting that transposable elements could have a role in regulating sexual reproduction.