CHAPTER 5

Summary and Conclusions
Chapter 5
SUMMARY AND CONCLUSIONS

River Sharavathi, a major west flowing river of Karnataka state is very rich in diversity of flora and fauna within its basin. Being located in the central region of the Western Ghats, the river basin is rich in endemic flora and is coming under one of the 25 centres of endemism of India (Nayar, 1996). It forms the northernmost limit for many endemic tree species like *Dipterocarpus indicus, Poeciloneuron indicum, Hopea parviflora, Myristica fatua* var. *magnifica*, etc. A new species *Semecarpus kathalekanensis* has been discovered from the *Myristica* swamps of the river basin which is critically endangered with poor regeneration. Like other parts of the tropics, the river basin is also one of the most highly human impacted mountainous tracts of the Western Ghats. Several types of human activities including slash and burn cultivation and selective felling in the past and particularly the establishment of a series of hydroelectric projects in the recent past have resulted in considerable forest losses and fragmentation.

Present study gives the diversity, richness and the regeneration status of endemic trees of Western Ghats in the fragmented forest patches of Sharavathi River Basin which is located in the central region of the Western Ghats of Peninsular India.

A total of 670 tree quadrats of 400 m² each were laid under 130 transects accounting for total sampled area of 26.8 ha. Shrub quadrats of 1340 accounted for sampled area of 3.365 ha and sampled area for herbs
accounted for 0.269 ha. In all 399 species were recorded belonging to 299 genera and 93 families, out of which 203 were tree species under 55 families. Among these tree species, 61 species are endemic to Western Ghats and many of them were restricted to the evergreen forests.

The Hydroelectric projects in the river basin have severely affected the forest. The impact is observed more in the Linganamakki catchment area (catchment area upward to the Linganamakki dam) compared to the area downward to the Linganamakki dam. Except few, most of the high evergreen forest patches are remaining downward to the Linganamakki Dam. When the 130 sampled transects were grouped into five evergreen classes, it is observed that 26 transects coming under first three evergreen classes (0-20 to 41-60%) were distributed in the Sharavathi River Basin upward to the Linganamakki dam whereas others coming under higher evergreen classes (71-80 and 81-100%) were located in the river basin down to the Linganamakki dam.

The Sharavathi River basin is very rich in diversity and comparable to some of the best evergreen forests of the Western Ghats. The percentage of endemic trees and the percentage of trees with fleshy fruits have an increasing trend from lower evergreen class to higher evergreen class. The high and very high evergreen forest patches are richest in Western Ghats endemism and are characterized by high basal area and high percentage of trees with fleshy fruits. The percentage of trees with simple leaves varied from 59% to 78% without showing any clear trend. The number of individuals per quadrats among different evergreen classes varied from 11 to
21 and the estimated individuals per hectare were 287 to 512. The average estimated basal area per hectare varied from 23 m²/ha to 41 m²/ha across the evergreen classes. Among these evergreen classes there is a clear trend of increase in estimated basal area with increase in evergreenness.

The Importance Value Index (IVI) of endemics varied from species to species among different evergreen classes. In case of very low and low evergreen class, the percentage of IVI shared by the endemics was very low and the major share of this was by the deciduous endemic gap species *Tabernaemontana heyneana*. The most dominant species with high IVI were deciduous species *Xylia xylocarpa*, *Terminalia paniculata* and *Terminalia tomentosa*. In the moderate evergreen class, all the endemics together shared the IVI value of 64. The endemic *Holigarna arnottiana* become the fourth dominant endemic sharing IVI of 12.8. Other endemics with major share of IVI were *Ixora brachiata*, *Cinnamomum macrocarpum* and *Symplocos macrocarpa*. For the high and very high evergreen class, the IVI shared by the endemics was quite high. Major endemics contributing to the IVI in the high evergreen class were *Symplocos macrocarpa*, *Ixora brachiata* and *Flacourtia montana* and for very high evergreen class were *Knema attenuata*, *Reinwardtiodendron anamallayanam*, *Hopea ponga*, *Holigarna grahamii*, *Diospyros candolleana* and *Holigarna arnottiana*. The evergreen *Olea dioica* formed the most dominant species and another evergreen, *Dimocarpus longan* was also very dominant.

The study reveals the regeneration status of the endemic tree species recorded in the Sharavathi River Basin. Out of 61 endemics recorded in the
river basin, 57 (90%) species occurred in the very high evergreen class of which 25 (49%) were exclusive to this evergreen class. Many of the endemics have good regeneration in this very high evergreen forests. Several endemics were restricted to very few forest localities and some of them like *Palaquium ellipticum*, *Vateria indica* and *Dysoxylum malabaricum* were suffering from inadequate regeneration. The most dominant endemics in this evergreen class were *Knema attenuata*, *Hopea ponga* and *Reinwardtiodendron anamallayanam* sharing more than 40 percent of total endemics and 24 percent of total composition of all individuals. Moreover all these three species have excellent regeneration. Other dominant endemics found here were *Holigarna grahamii*, *Diospyros candalleana*, *Holigarna arnottiana*, *Symlocos macrocarpa*, *Ixora brachiata* and *Flacourtia montana* also have very good regeneration. The endemics of climax forests like *Dipterocarpus indicus*, *Poeciloneuron indicum*, *Myristica malabarica*, *Palaquium ellipticum*, *Mastixia arborea* and *Vateria indica* were found only in this evergreen class. The deciduous species like *Lagerstroemia microcarpa*, *Terminalia paniculata* and *Terminalia tomentosa* were found only in the higher girth classes and lack of regeneration in high evergreen forests.

In the high evergreen class (61-80%), the most dominant endemics were *Symlocos macrocarpa*, *Holigarna arnottiana*, *Knema attenuata*, *Ixora brachiata* and *Flacourtia Montana* sharing more than 50 percent of total endemics in this class. Other endemics found here are *Reinwardtiodendron anamallayanam*, *Cinnamomum malabathrum*, *Diospyros candalleana*,
Holigarna grahamii, Actinodaphne angustifolia, Hopea ponga and the deciduous endemic Tabernaemontana heyneana. Several endemics in this class have good regeneration. Similarly many of the non endemic evergreens also have good regeneration. The most dominant tree species in this evergreen class was *Olea dioica* a pioneer evergreen tree. The dominant deciduous species were *Lagerstroemia microcarpa*, *Terminalia paniculata* and *Schleichera oleosa*. Among these deciduous trees, *Lagerstroemia microcarpa* and *Terminalia paniculata* have more individuals in the higher girth classes and very less individuals in the younger girth classes. It indicates that there is no further scope for the regeneration of these deciduous tree species in such forests. Even though the endemic *Nothopegia beddomei*, occurred both in very high and high evergreen class, it was maximum in the high evergreen class indicating its habitat preference.

In the moderate evergreen class a gradual decrease in the percent composition of endemics was found compared to the high and very high evergreen classes. The dominant endemic tree species found here are *Holigarna arnottiana*, *Ixora brachiata*, *Symplocos macrocarpa* and *Cinnamomum malabathrum*. The deciduous endemic *Tabernaemontana heyneana* was represented by very few individuals. The dominant deciduous species was *Lagerstroemia microcarpa*. Compared to other evergreen classes, *Holigarna arnottiana* had good regeneration in this evergreen class indicating such forests as its habitat.

The low and very low evergreen class had very few endemic species. Among them the most dominant was *Tabernaemontana heyneana*. The other
endemics with one or two individuals were *Hopea ponga*, *Flacourtia montana* and *Garcinia gummi-gutta*. Except *Tabernaemontana heyneana* no endemics have good regeneration. In both the evergreen class, the most dominant tree species with good regeneration are *Xylica xylocarpa*, *Terminalia paniculata*, *Lagerstroemia microcarpa* and *Terminalia tomentosa*.

**Regeneration of endemic trees in the ground layer:**

Among the endemics, *Knema attenuata* has excellent regeneration in both shrub and herb layer. Some of the other endemics with good regeneration were *Hopea ponga*, *Nothopegia beddomei*, *Ixora brachiata*, *Symplocos macrocarpa*, *Holigarna arnottiana* and *Reinwardtiodendron anamallayanam*. But in case of *Diospyros candolleana*, *Strombusia ceylanica*, *Meiogyne pannosa*, *Polyalthia fragrans*, *Hydnocarpus laurifolia* and *Antidesma menasu*, even though there are some saplings, the seedlings were very poor in number.

Ground layer data shows the endemic tree like *Hydnocarpus laurifolia* and *Meiogyne pannosa* are suffering from lack of seedlings. In case of endemic *Vepris bilocularis*, the seedlings seemed to be unable to survive. The non endemic evergreens like *Antiaris toxicaria* and *Saraca asoca* are also suffering from poor regeneration in the ground layer.

**Conservation of endemics:**

The endemics are most vulnerable to extinction because of their narrow distribution. Hence, priority should be given to their conservation.
Majority of the Western Ghats endemics are confined to some steep valleys, hill tops and ancient *Kumri* (shifting cultivation) land, where people have preserved them due to their sacredness. Because of severe anthropogenic pressure like forest degradation, habitat fragmentation etc., the Western Ghats are on the brink of endemic plant collapse. Many of the endemics have highly fragmented population and at least 50 endemic species could not be relocated.

Some endemics like *Poeciloneuron indicum*, *Myristica fatua* var. *magnifica*, etc. are very ancient in their origin and called Paleoendemics. In Sharavathi River Basin, such relics of primary forests can be seen in Kathalekan, Karikan etc. where *Dipterocarpus indicus* is found. Similarly *Vateria indica* is found in only two primary evergreen forest patches and *Poeciloneuron indicum* is also associated with such forests. Out of 65 endemics recorded in the river basin, 57 (>90%) occurred in the very high evergreen class and 25 of them are exclusive to these high evergreen forests. Therefore conservation priority should be given to the high evergreen forests as they are the home for most of the endemic trees. However, the habitat preferred by the endemics should be considered before any restoration programs.