CHAPTER 6

6.0 CONCLUSIONS

1. There are morphological differences between rostrally and caudally directed cerebellum. The rostrally directed cerebellum (*keli's* and *baung's*) were prominently larger than caudally directed cerebellum (*jelawat's* and *tilapia's*). The rostrally directed cerebellum was well-developed and overlaid almost half of the forebrain (prosencephalon) for *keli's*, while *baung's* cerebellum overlaid about two-third of the forebrain. The features of the gross morphology of cerebellum within the same orientation, however, exhibited slight differences between each other. The rostrally directed cerebellum displayed medial longitudinal sulcus and gyrus on its surface, while caudally directed cerebellum did not display such features. The eminentia granularis or also known as caudal lobe was prominently observed in rostrally directed cerebellum but comparatively hard to be observed in caudally directed cerebellum.
2. Both *keli* and *baung* that represented fishes with rostrally directed cerebellum possessed the same body form, which was 'torpedo-shaped'. As for *jelawat* and *tilapia* that represented fishes with caudally directed cerebellum, they both had the same body shape, which was compressed body shape. However, the assumption that through body form, gross morphology and/or orientation of cerebellum only that the swimming pattern of these fishes would be reflected could not be corroborated. This is so since all the experimental fishes except *tilapia*, had the same swimming pattern; subcarangiform. In contrast, the swimming pattern of *tilapia* was carangiform. Thus, there might be some other features that determine or control the swimming pattern of fish, e.g. muscle activity and interaction between the body and water.

3. Indisputably, most neurohistological researches to date were largely done on the mammalian neural system. However, non-mammalian vertebrates could be good experimental models for neural focused researches, since all nervous system is made up of neurons (main cells) and neuroglial cells (supporting cells). There are needs to amplify the limited knowledge regarding non-mammalian neural structures in correlation to their behavior. Comparatively, non-mammalian vertebrates are easily available and managed, less costly, and rather resilient as experimental subjects.

4. Most of past studies were focused on the role of the cerebellum in motor learning and less was done on neurohistological characterization of cerebellum, especially on non-mammalian. The difficulty to histologically process non-mammalian neural tissue as compared to processing the mammalian neural tissue is a big factor for this lack of work on the fish. Therefore, the findings of this study contributed to the development of the database of the central nervous system of freshwater fish in this country. Results could be extrapolated and used as a reference for other researchers to undertake further neuroscience studies, e.g. in the field of neurophysiology.

5. Procedure of neurohistological staining of fish neural tissue, a non-mammalian neural tissue, in a local laboratory was successfully done, e.g. Haematoxylin and Eosin (H&E), Nissl and Thionin stainings used in this study. By using Cresyl Violet as dye for Nissl staining, the neurons were easily observed because it stained the cell bodies to the well seen violet color. Thus, Cresyl Violet might be the most suitable kind of staining to study neural tissue of freshwater fish. Thionin staining was used to identify the presence of fibers in cerebellum. This staining was found to be suitable for fiber staining in teleost fish because of the great color contrast.

6. From neurohistological aspect, the pattern of neuronal organization of the teleost fish cerebellum is similar to that of the other classes of vertebrates. However, the morphology of certain neurons, such as Purkinje cells was different, e.g. the branches of dendritic tree. The cerebellar fibers were found to be present in the white matter of cerebellum for all four fishes species studied. It is assumed that the fibers reflected those arising from other parts of the brain and also the efferents fibers going out of the cerebellum. These fibers might be similar with the ones in higher vertebrates as reported before. Most probably, the neurophysiological characteristics of these neural elements are also similar but this matter needs to be confirmed in future studies.

7. Significant neurohistological unique patterns of innermost area of cerebellar tissue were seen. Architectural 3D details of these patterns and possible correlation to physiological cerebellar functions should be further studied.

8. There were comparative differences observed in cerebellar tissue of the fishes studied, even within the same cerebellar orientation. The different 3D pattern of the distribution of granular layer was obviously seen between those fishes. The higher number and wider distributions of Purkinje cell were seen in *baung's* cerebellar tissue. All these differences could be associated to the different behaviors of the fishes, but further study should be done on this matter for confirmation.