Chapter 5
High Pressure Resistance and Adaptation of European Eels

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Abbreviations BL: Body length; COX: Cytochrome c oxidase; d: Density; EC: Energy charge; FPT: Final preferred temperature; HP: Hydrostatic pressure; PRI: Pressure resistance index; Ptr: Pressure threshold; PUFA: Polyunsaturated fatty acids; ROS: Reactive oxygen species; SB: Swim bladder

5.1 Introduction

The fish is often used as a model for experiments under pressure because it has three main advantages (Barthélémy 1985): (a) It is a vertebrate which has an organisation not very different from a mammal; for some authors, due to the high number of species, the fish is even the typical vertebrate (Bone et al. 1995); (b) The ectothermic quality of fish enables study of pressure/temperature interactions; (c) Because they breathe water, fish can be used to study separately the effects of hydrostatic pressure and/or the effects of gas pressure, which is useful in understanding mammalian physiology (see Sébert 1997).

The adverse effects of high pressure on fishes have been known since the 19th century (Bert 1878; Regnard 1885) and are well reviewed in the literature (Gordon 1970; Sébert and Macdonald 1993; Sébert 2003). However, the great majority of these studies are concerned with the biological effects of high hydrostatic pressure (HP) *per se* considered, like temperature, as a thermodynamic factor (see Somero 1991; Sébert 2003). In other words, the effects of pressure on fishes have been studied more from a fundamental than from an ecophysiological point of view. In fact, in regard to pressure, we can consider three types of fishes: those which never encounter variations in pressure, and are unable to adapt to pressure effects (Sébert 2003); those which always live at great depth and have a poor resistance to low (atmospheric) pressure (Siebenaller and Somero 1989; Somero 1991); and finally those which, as the eel, *Anguilla*, live a part of their life under pressure and thus must adapt to its adverse effects. In terms of

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