

# Contents

|          |   |            |
|----------|---|------------|
| <b>1</b> | <b>General Introduction</b> .....   | <b>1</b>   |
|          | Armando Lenz  |            |
| <b>2</b> | <b>European deciduous trees exhibit similar safety margins against damage by spring freeze events along elevational gradients</b> ..... | <b>11</b>  |
|          | Armando Lenz, Günter Hoch, Yann Vitasse and Christian Körner  |            |
| <b>3</b> | <b>Convergence of leaf-out towards minimum risk of freezing damage in temperate trees</b> .....   | <b>41</b>  |
|          | Armando Lenz, Günter Hoch, Christian Körner and Yann Vitasse  |            |
| <b>4</b> | <b>Growth and carbon relations of temperate deciduous tree species at their upper elevation range limit</b> .....                       | <b>73</b>  |
|          | Armando Lenz, Yann Vitasse, Günter Hoch and Christian Körner  |            |
| <b>5</b> | <b>Further publications</b> .....   | <b>103</b> |
| 5.1      | Tree recruitment of European tree species at their current upper elevational limits in the Swiss Alps .....                             | 104        |

|          |  |            |
|----------|--|------------|
| 5.2      | Fast acclimation of freezing resistance suggests no influence of winter minimum temperature on the range limit of European beech . . . . .     | 106        |
| 5.3      | Earlier leaf-out rather than difference in freezing resistance puts juvenile trees at greater risk of freeze damage than adult trees . . . . . | 108        |
| 5.4      | Spring patterns of freezing resistance and photosynthesis of two leaf phenotypes of <i>Hedera helix</i> .                                      | 110        |
| 5.5      | Elevational adaptation and plasticity in seedling phenology of temperate deciduous tree species . . . . .                                      | 112        |
| 5.6      | Genetic vs. non-genetic responses of leaf morphology and growth to elevation in temperate tree species . . . . .                               | 114        |
| 5.7      | Early season temperature controls cambial activity and total tree ring width at the alpine treeline . . . . .                                  | 116        |
| 5.8      | Physiological minimum temperatures for root growth in seven common European broad-leaved tree species . .                                      | 118        |
| <b>6</b> | <b>Summary &amp; Conclusion . . . . .</b><br>Armando Lenz  | <b>121</b> |
| <b>A</b> | <b>Curriculum Vitae . . . . .</b>  | <b>127</b> |