FISHES AND FORESTRY

Worldwide Watershed Interactions and Management

EDITED BY

T.G. NORTHCOTE

and

G.F. HARTMAN

Blackwell Science
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preface</td>
<td>ix</td>
</tr>
<tr>
<td>Acknowledgements</td>
<td>xi</td>
</tr>
<tr>
<td>List of contributors</td>
<td>xiii</td>
</tr>
<tr>
<td><strong>PART I: INTRODUCTION</strong></td>
<td>1</td>
</tr>
<tr>
<td>1 An introductory overview of fish–forestry interactions</td>
<td>3</td>
</tr>
<tr>
<td>T.G. NORTHCOTE AND G.F. HARTMAN</td>
<td></td>
</tr>
<tr>
<td><strong>PART II: ECOLOGY OF THE SYSTEMS</strong></td>
<td>17</td>
</tr>
<tr>
<td>2 Forest ecology</td>
<td>19</td>
</tr>
<tr>
<td>J.P. KIMMINS</td>
<td></td>
</tr>
<tr>
<td>3 Elements of stream ecosystem process</td>
<td>44</td>
</tr>
<tr>
<td>G.F. HARTMAN AND R.E. BILBY</td>
<td></td>
</tr>
<tr>
<td>4 Fundamentals of lake ecology relevant to fish–forestry interactions</td>
<td>67</td>
</tr>
<tr>
<td>T.G. NORTHCOTE</td>
<td></td>
</tr>
<tr>
<td>5 Fundamental aspects of estuarine ecology relevant to fish–forestry</td>
<td>92</td>
</tr>
<tr>
<td>interactions</td>
<td></td>
</tr>
<tr>
<td>T.G. NORTHCOTE AND M.C. HEALEY</td>
<td></td>
</tr>
<tr>
<td><strong>PART III: FISH BIOLOGY AND ECOLOGY</strong></td>
<td>107</td>
</tr>
<tr>
<td>6 Fish life history variation and stock diversity in forested watersheds</td>
<td>109</td>
</tr>
<tr>
<td>T.G. NORTHCOTE</td>
<td></td>
</tr>
<tr>
<td>7 Fish migration and passage in forested watersheds</td>
<td>123</td>
</tr>
<tr>
<td>T.G. NORTHCOTE AND S.G. HINCH</td>
<td></td>
</tr>
</tbody>
</table>
Contents

8 Aspects of fish reproduction and some implications of forestry activities 143
G.F. HARTMAN AND T.E. McMAHON

9 Foraging ecology: from the fish to the forest 169
M. KARAGOSIAN AND N.H. RINGLER

PART IV: FORESTRY ACTIVITIES 193

10 Forest harvest and transportation 195
P. SCHIESS AND F. KROGSTAD

11 Silviculture 216
J.E. BARKER

12 Manufacturing processes and their impact on effluent discharges 241
N. McCUBBIN, E.R. HALL AND K.J. HALL

PART V: FORESTRY EFFECTS ON AQUATIC SYSTEMS AND FISHES 269

13 Effects of forest management activities on watershed processes 271
G.F. HARTMAN

14 Effects of forestry on the limnology and fishes of lakes 303
T.G. NORTHCOTE, M. RASK AND J. LEGGETT

15 Effects of forestry on estuarine ecosystems supporting fishes 320
C.D. LEVINGS AND T.G. NORTHCOTE

16 Environmental effects of effluents from pulp and paper mills 336
K.R. MUNKITTRICK

PART VI: NORTH AMERICAN FISH–FORESTRY INTERACTIONS 363

17 Fish–forestry interactions in Oregon, Washington and Alaska, USA 365
J.D. HALL, C.J. CEDERHOLM, M.L. MURPHY AND KV. KOSKI

18 Fish–forestry interaction research in coastal British Columbia – the Carnation Creek and Queen Charlotte Islands studies 389
P.J. TSCHAPLINSKI, D.L. HOGAN AND G.F. HARTMAN
19 Forestry and fish in the boreal region of Canada  
R.J. STEEDMAN, W.M. TONN, C.A. PASZKOWSKI AND G.J. SCRIMGEOUR  

20 Fish–forestry interactions in freshwaters of Atlantic Canada  
R.A. CUNJAK, R.A. CURRY, D.A. SCRUTON AND K.D. CLARKE  

21 Interactions between forests and fish in the Rocky Mountains of the USA  
K.D. FAUSCH AND M.K. YOUNG  

22 Fish–forestry interface: an overview of Mexico  
A. SÁNCHÉZ-VÉLEZ AND R.M. GARCÍA-NÚÑEZ  

PART VII: NON-NORTH AMERICAN FISH–FORESTRY INTERACTIONS  

23 Fishes–forestry interactions in tropical South America  
C.A.R.M. ARAUJO-LIMA, N. HIGUCHI AND W. BARRELLA  

24 Europe – with special reference to Scandinavia and the British Isles  
D.T. CRISP, T. ERIKSSON AND A. PETER  

25 Freshwater fishes and forests in Japan  
M. INOUE AND F. NAKAMURA  

26 Fish–forest harvesting interactions in perhumid and monsoonal southeast Asia (Sundaland)  
J.H. DICK AND K. MARTIN-SMITH  

27 Regional case studies in fish–forest harvesting interactions: Malaysian and Indonesian Borneo and Cambodia  
J.H. DICK AND K. MARTIN-SMITH  

28 Interactions: mangroves, fisheries and forestry management in Indonesia  
D.G. BENGEN AND I.M. DUTTON  

29 Forestry interactions – New Zealand  
B.J. HICKS, G.J. GLOVA AND M.J. DUNCAN  

30 Australia  
W.D. ERSKINE AND J.H. HARRIS  

Contents
PART VIII: EFFECTING BETTER FISH–FORESTRY INTERACTIONS

31 Guidelines, codes and legislation
K. MOORE AND G. BULL

32 Forest management and watershed restoration:
repairing past damage is part of the future
G.F. HARTMAN

33 Better and broader professional, worker and public education in
fish–forestry interaction
T.G. NORTHCOTE AND J.D. HALL

34 Towards a new fish–forestry interaction in the world's watersheds
T.G. NORTHCOTE AND G.F. HARTMAN

Index

The colour plate section follows page 362.