

# **Table of contents**

Preface to the First Edition ix

Preface to the Second Edition xi

Acknowledgments xiii

How to Use the Book xv

## **Part I Methods for Diagnosing Fish Diseases**

### **1. Major Cultured Species 5**

Aquarium (Pet) Fish 5

Bait Fish 7

Food Fish 7

Laboratory Fish 8

### **2. Types of Culture Systems 9**

Closed Culture Systems: Aquaria 9

Closed Culture Systems: Ponds 10

Flow-Through Culture Systems 11

Semi-Open Culture Systems 12

### **3. The Clinical Workup 13**

Equipping a Fish Disease Diagnostic Facility 13

Case Submissions 13

Water-Quality Analysis 16

Taking the History 17

The Physical Exam 17

Clinical Techniques: Routine Methods 20

Clinical Techniques: Specialized Methods 35

#### **4. Postmortem Techniques 49**

Euthanasia 49

Preserving Parasites 49

Culturing for Bacteria 49

Sampling for Water Molds and Fungi 55

Sampling for Viruses 55

Examining Tissues Postmortem 55

Zoonotic Diseases and Other Human Pathogens 63

#### **5. Guidelines for Interpreting Clinical Findings 65**

Environment, Stress, and Fish Disease 65

Acclimation 65

How to Use Part II, the Problem List 65

Sample Problem Data Sheet 66

Clinical Decision Making: Have the Major Problems Been Identified? 67

Prioritizing Problems 68

Treatment Plans 68

When to Refer Cases 68

#### **6. Health Management 69**

Biosecurity 69

Health Promotion and Maintenance 73

Animal Welfare 77

Food Safety 78

Environmental Safety 78

## **Part II Problem List**

**7. Problems 1 through 10: Diagnoses made with commercially available water-quality test kits or equipment that should be present in the clinician's clinic 83**

1. Environmental hypoxia 83
2. Temperature stress 88
3. Temperature stratification 90
4. Ammonia poisoning 91
5. Nitrite poisoning 96
6. Nitrate poisoning 98
7. Too low (too acidic) pH 100
8. Too high (too alkaline) pH 102
9. Improper hardness 103
10. Improper salinity 104

**8. Problems 11 through 43: Diagnoses made by either gross external examination of fish, wet mounts of skin/gills, or histopathology of skin/ gills 107**

11. Gas supersaturation 107
12. Lamprey infestation 109
13. Leech infestation 110
14. Copepod infestation/infection 112
15. Branchiuran infestation 119

16. Isopod infestation 121
17. Monogenean infestation 123
18. Turbellarian infection 129
19. Protozoan ectoparasites: general features 129
20. Ich infection 131
21. Marine white spot disease 135
22. Trichodinosis 137
23. *Chilodonella* infestation 138
24. *Brooklynella* infestation 139
25. Tetrahymenosis 140
26. Scuticociliatosis 141
27. Marine velvet disease 143
28. Freshwater velvet disease 147
29. Ichthyobodosis 148
30. Gill *Cryptobia* infestation 150
31. Gill amoebic infestation 150
32. Sessile, solitary, ectocommensal ciliate infestation 153
33. Sessile, colonial, ectocommensal ciliate infestation 155
34. Typical water mold infection 156
35. Epizootic ulcerative syndrome 162
36. Branchiomycosis 164
37. Columnaris infection 166
38. Bacterial cold water disease 169

- 39. Bacterial gill disease 170
- 40. Lymphocystis 171
- 41. Epitheliocystis 172
- 42. Miscellaneous skin and gill diseases 174
- 43. Incidental findings 176

**9. Problem 44: Diagnoses made by examination of a gill clip or a blood smear 179**

- 44. Primary hemopathies 179

**10. Problems 45 through 57: Diagnoses made by bacterial culture of the kidney or affected organs 183**

- 45. Bacterial dermatopathies/systemic bacterial infections: general features 183
- 46. Motile aeromonad infection 185
- 47. *Aeromonas salmonicida* infection 186
- 48. Enteric septicemia of catfish 190
- 49. *Edwardsiella tarda* infection 192
- 50. Vibriosis 193
- 51. Pasteurellosis 196
- 52. Enteric redmouth disease 197
- 53. Streptococcosis 199
- 54. Bacterial kidney disease 201
- 55. Mycobacteriosis 204
- 56. Piscirickettsiosis 208
- 57. Miscellaneous systemic bacterial infections 210

**11. Problems 58 through 76: Diagnoses made by necropsy of the viscera and examination of wet mounts or histopathology of internal organs 215**

58. Digenean trematode infection: general features 215
59. Digenean gill infection 220
60. Nematode infection 222
61. Cestode infection 226
62. Acanthocephalan infection 229
63. Myxozoan infection: general features 229
64. Proliferative gill disease 236
65. *Ceratomyxa shasta* infection 237
66. *Hoferellus carassii* infection 239
67. Proliferative kidney disease 239
68. Whirling disease 242
69. Miscellaneous important myxozoan infections 243
70. Microsporidian infection 247
71. Ichthyophonosis 253
72. True fungal infections 254
73. Diplomonad flagellate infection 257
74. Tissue coccidiosis 258
75. Miscellaneous endoparasitic infections 264
76. Idiopathic epidermal proliferation/neoplasia 264

**12. Problems 77 through 88: Rule-out diagnoses 1 (viral infections):**  
***Presumptive diagnosis is based on the absence of other etiologies combined with a diagnostically appropriate history, clinical signs, and/or pathology.***  
***Definitive diagnosis is based on presumptive diagnosis combined with confirmation of viral presence (e.g., antibody probe, gene probe), 269***

77. Systemic viral diseases: general features 269

78. Channel catfish virus disease 270
79. Infectious pancreatic necrosis and other aquatic birnaviruses 271
80. Infectious hematopoietic necrosis 274
81. Viral hemorrhagic septicemia 278
82. Infectious salmon anemia 282
83. Spring viremia of carp 285
84. Iridoviral diseases 287
85. Nodaviral diseases 289
86. Koi herpesvirus disease 292
87. Alphavirus diseases 294
88. Miscellaneous systemic viral diseases and infections 298

**13. Problems 89 through 99: Rule-out diagnoses 2: *Presumptive diagnosis is based on the absence of other etiologies combined with a diagnostically appropriate history, clinical signs, and/or pathology. Definitive diagnosis is based on presumptive evidence combined with further, more extensive workup with a specific identification of the problem 305***

89. Nutritional deficiency 305
90. Hypercarbia 309
91. Hydrogen sulfide poisoning 309
92. Chlorine/chloramine poisoning 310
93. Metal poisoning 311
94. Cyanide poisoning 314
95. Miscellaneous water-borne poisonings 315
96. Harmful algal blooms, 321
97. Acute ulceration response/environmental shock/delayed mortality syndrome 325

98. Traumatic lesions 326

99. Genetic anomalies 330

**14. Problems 100 through 102: Rule-out diagnoses 3: *Presumptive diagnosis is based on the absence of other etiologies combined with a diagnostically appropriate history, clinical signs, and/or pathology. Definitive diagnosis is not possible since the etiology is unknown (idiopathic) 333***

100. Lateral line depigmentation 333

101. Senescence 336

102. Miscellaneous important idiopathic diseases 336

**15. Problem 103: Diagnoses made by examination of eggs 341**

103. Egg diseases 341

## **Part III Methods for Treating Fish Diseases**

**16. General Concepts in Therapy 347**

Treatment Guidelines 347

Routes of Drug Administration 358

Recommended Treatments in Various Culture Systems 371

Which Dosage to Use 373

**17. Pharmacopoeia 375**

Acetic Acid 376

Acriflavin 376

Activated Carbon 376

Agricultural Lime 376

Alum 376

Anesthetics 376

- Antibiotics 377
- Amoxycillin Trihydrate 378
- Ampicillin Sodium 378
- Chloramphenicol 378
- Enrofloxacin 378
- Erythromycin 379
- Florfenicol 379
- Flumequine 380
- Furaltadone 380
- Furazolidone 380
- Kanamycin Sulfate 380
- Nalidixic Acid 380
- Neomycin Sulfate 381
- Nifurpirinol 381
- Nitrofurazone 381
- Oxolinic Acid 381
- Oxytetracycline 382
- Sarafloxacin 383
- Sulfadiazone-Trimethoprim 383
- Sulfadimethoxine-Ormetoprim 384
- Sulfadimidine-Trimethoprim 384
- Sulfamerazine 384
- Sulfamethoxazole-Trimethoprim 384

Antiseptics 384  
Bayluscide® 385  
Benzocaine 385  
Biological Control 385  
Bithionol 385  
Bronopol 385  
Buffers: Freshwater Aquaria 386  
Buffers: Marine Aquaria 386  
Buffers: Ponds 386  
Butorphanol 387  
Calcium 387  
Carbon Dioxide 387  
Chloramine Neutralizer 388  
Chloramine-T 388  
Chlorhexidine 389  
Chloride 389  
Chlorine 389  
Chlorine Neutralizer 390  
Chloroquine Diphosphate 390  
Chorionic Gonadotropin 391  
Clove Oil 391  
Copper 391  
Chelated Copper 391

Copper Sulfate 392  
Deionized Water 393  
Diflubenzuron 393  
Dimetridazole 394  
Diquat 394  
Disinfection 394  
Electroshock 396  
Enamectin Benzoate 396  
Eugenol 397  
Euthanasia 397  
Fenbendazole 398  
Flubendazole 399  
Formalin 399  
Formalin/Malachite Green 400  
Freshwater 400  
Fumagillin 401  
Gonadotropin Releasing Hormone 401  
Hydrogen Peroxide 401  
Hypsosalinity 402  
Hypothermia 403  
Immunostimulants 403  
Ivermectin 404  
Ketamine 404

Ketoprofen 404  
Levamisole Hydrochloride 404  
Lidocaine 404  
Magnesium Sulfate 404  
Malachite Green 405  
Mebendazole 406  
Methylene Blue 406  
Methyltestosterone 406  
Metomidate 407  
Metronidazole 407  
Monensin Sodium 407  
Nitrifying Bacteria 407  
Organophosphate 408  
Ozone 409  
Peat 410  
2-Phenoxyethanol 410  
Piperazine Sulfate 410  
Potassium Permanganate 410  
Povidone Iodine 411  
Praziquantel 412  
Pyrethroid 413  
Quaternary Ammonium Compounds 413  
Quinaldine Sulfate 414

Salt 414  
Secnidazole 415  
Sedatives 415  
Silver Sulfadiazine 415  
Slaked Lime 415  
Sodium Bicarbonate 416  
Sodium Pentobarbital 416  
Sodium Phosphate 417  
Sodium Sulfi te 417  
Teflubenzuron 417  
TFM 417  
Toltrazuril 417  
Tonic Immobility 417  
Tricaine 417  
Triclabendazole 418  
Ultraviolet Light 418  
Unslaked Lime 419  
Vaccines 419  
Virkon® Aquatic 419  
Water Change 419  
Wound Sealant 420  
Zeolite 420  
Literature Cited 421

Appendix I Fish Disease Diagnosis Form 471

Appendix II Suppliers 473

Appendix III Scientific Names of Fish Mentioned in the Text 481

Appendix IV Definitions of Terms 491

Appendix V Example Form for Shipping Fish to a Clinic or Diagnostic Laboratory 495

Index 497