



**AUSTRALIAN AND NEW ZEALAND  
COLLEGE OF VETERINARY SCIENTISTS**

**MEMBERSHIP GUIDELINES**

*Medicine and Management of Aquaculture Species*

**INTRODUCTION**

These Membership Guidelines shall be read in conjunction with the *Membership Candidate Handbook*. It is recommended that candidates have at least two years full-time equivalent experience in this field.

**ELIGIBILITY**

Refer to the *Membership Candidate Handbook*.

**OBJECTIVES**

To demonstrate the candidate has sufficient knowledge of and experience in aquatic animal health to be able to give sound advice in this field to veterinary colleagues.

**Specific Objectives.**

- To advance the science and art of veterinary science as it relates to aquatic animals
- To exchange knowledge and promote excellence in the diagnosis, treatment and prevention of diseases of aquatic animals
- To further the professional education and training of veterinarians with a special interest in aquatic animal health.
- To encourage research in aquatic animal health, and to encourage exchange of knowledge with and collaborative work with other scientists working in the field of aquatic animal health.

## DESCRIPTION OF SUBJECT

Aquatic Animal Health covers all aquatic animals (apart from reptiles, amphibians, birds and mammals), with particular emphasis on those species which are kept for aquaculture or ornamental purposes, including but not limited to teleost fish, molluscs (especially bivalves and abalone), and crustaceans (including marine shrimp / prawns and freshwater crayfish).

Disciplines covered for these species include medicine and management, pathobiology and epidemiology of aquatic animal diseases.

## LEARNING OUTCOMES

1. Candidates will have at least a **basic**<sup>1</sup> knowledge of all disciplines covered by the subject, and a **sound** knowledge of at least one (1) of the subject disciplines, such that they are capable of competently advising veterinary colleagues in this field.
2. The candidate will have a **basic** knowledge of the major types of disease in each of the phylum, and a **sound** knowledge of at least one (1) major phylum.

Relevant phyla of aquatic animals include teleost fish, crustaceans and molluscs (bivalve and univalve), though further specialisation into production and ornamental animals is also acceptable.

Candidates will formally nominate discipline or species groups of special interest prior to examination.

3. The candidate will **be able to:**

- A) **DEMONSTRATE** that they have sufficient experience in, and knowledge of, **MEDICINE AND MANAGEMENT OF AQUATIC ANIMALS** to enable a **competent approach** to the management of aquatic species under varying aquaculture and holding conditions and to the diagnosis, treatment and control of diseases of such species.

The following description of specific learning outcomes relevant to this topic is meant to be a guide only and is neither prescriptive nor restrictive.

### A candidate should study the following:

- a. The biology of the species, including their comparative anatomy and physiology.
- b. The husbandry and management of the species including nutrition, reproductive and genetic management, hygiene, handling, technology of containment facilities, behaviour and record keeping.
- c. The possible deleterious environmental effects of aquaculture and the potential for conflict between aquacultural pursuits and other aquatic activities, especially wild fisheries and recreational activities.

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#### <sup>1</sup>Knowledge levels:

**Sound knowledge** — candidate must know all of the principles of the topic including some of the finer detail, and be able to identify areas where opinions may diverge. A middle level of knowledge.

**Basic knowledge** — candidate must know the main points of the topic and the major literature

Medicine and Management of Aquaculture Species Membership Guidelines 2021

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- B) DEMONSTRATE** that they have sufficient experience in, and knowledge of the **PATHOBIOLOGY OF AQUATIC ANIMALS AND THEIR DISEASES** to interpret aquatic animal disease processes and undertake a logical test program to obtain a specific diagnosis.

Specific learning outcomes to this objective should include:

A **sound** knowledge of the aetiology and pathogenesis of common (*endemic and non-infectious*) and internationally significant diseases.

A **sound** understanding of the immunology and pathophysiology of disease in each class of aquatic animal, and a **basic** understanding of the disciplines of pathology, clinical pathology, parasitology, microbiology (including virology)

**A candidate should study the following:**

- a. Endemic diseases, including aetiology, pathogenesis, epidemiology, diagnosis, treatment and control. This is to include conditions due to microbial and parasitic agents, nutritional deficiencies, toxicants, genetic abnormalities, physical damage and stress.
- b. Major disease exotic to Australasia, especially their potential to affect the aquaculture and wild fisheries industries.

- C) DEMONSTRATE** that they have sufficient experience in, and knowledge of **EPIDEMIOLOGICAL APPROACHES** to **enable a competent approach** to the investigation & control of diseases in aquatic animal populations.

To undertake this, the candidate will **be able to identify criteria for:**

- detecting disease or other production problem
- identifying the causes of disease
- describing the ecology and natural history of a disease
- planning and evaluating disease control strategies
- planning and implementing disease surveillance and monitoring programs
- and assessing the economic effects of disease and of disease control programs

The following description of specific learning outcomes relevant to this topic is meant to be a guide only and is neither prescriptive nor restrictive.

**A candidate should study the following:**

- a. Diseases exotic to Australia, **especially those of international concern**, and appropriate methods to prevent their introduction.
- b. Administration of aquaculture activities especially disease control aspects, including organizational structures and aims, legislation, staff training and continuing education

## EXAMINATIONS

For information on the standard and format of both the Written and Oral examinations, candidates are referred to the Membership Candidate Handbook. The Membership examination has **two separate, components:**

1. Written Examination (Component 1)
  - Written Paper 1** (two hours): Principles of the Subject
  - Written Paper 2** (two hours): Applied Aspects of the Subject
2. Oral Examination (Component 2)
  - Oral** (one hour)

The written examination will comprise of two separate two-hour written papers taken on the same day. There will be an additional 15 minutes perusal time for each paper, during which no writing in an answer booklet is permitted. In each paper you are provided with four (4) questions to answer, worth 30 marks each, giving a total of 120 marks per paper. There may be limited choice within some questions to allow candidates to demonstrate a thorough knowledge in their nominated discipline or species area. Questions may be long essay type, a series of shorter answer sub-questions, or multiple-choice questions. Marks allocated to each question and to each subsection of questions will be clearly indicated on the written paper.

### **Written Paper 1:**

This paper is designed to test the candidate's knowledge of the principles of Medicine and Management of Aquaculture Species as described in the Learning Outcomes. Where questions relate to general principles, answers may cite specific examples, but should primarily demonstrate an understanding of the underlying theoretical basis.

### **Written Paper 2:**

This paper is designed to (a) test the candidate's ability to apply the principles of Medicine and Management of Aquaculture Species to particular cases/problems or tasks and (b) test the candidate's familiarity with the current practices and issues within the discipline of Medicine and Management of Aquaculture Species.

### **Oral Examination:**

This examination requires the candidate to demonstrate achievement of the above-mentioned Learning Outcomes, through the discussion of case material. Five (5) principal questions are presented with additional supporting questions asked verbally in a face-to-face setting. The oral examination has a total of 100 marks with each case allocated 20 marks. It will include questions on each candidate's nominated area of special interest (discipline and species range). The duration of this examination is approximately one (1) hour. Questions will be in the form of both short answers and more extended discussions that may include, but are not limited to case management, techniques and procedures, interpretation of diagnostic findings and species identification. Questions may have supporting images or information that the candidate will be required to interpret.

## RECOMMENDED READING MATERIAL

The candidate is expected to read widely within the discipline, paying particular attention to areas not part of their normal work experiences. This list of books and journals is intended to guide the candidate to some major references and other source material. Candidates also should be guided by their mentors. *The list is not comprehensive and is not intended as an indicator of the content of the examination.*

### Essential Reading:

OIE 2013. . International Aquatic Animal Health Code- 16<sup>th</sup> edition. OIE  
<http://www.oie.int/international-standard-setting/aquatic-code/> .

OIE 2009. *Manual of Diagnostic Tests for Aquatic Animals*. 6<sup>th</sup> edition, World Organisation for Animal Health (OIE), 2009.  
<http://www.oie.int/international-standard-setting/aquatic-manual/>

Bondad-Reantaso, MG. McGladdery, SE. East, I & Subasinghe, RP. (eds.), Asia Diagnostic Guide to Aquatic Animal Diseases. *FAO Fisheries Technical Paper No. 402, Supplement 2*. Rome, FAO. 2001. 240 p. <http://library.enaca.org/NACA-Publications/ADG-complete.pdf>

Bower, SM & McGladdery, SE. 1997. Synopsis of Infectious Diseases and Parasites of Commercially Exploited Shellfish:  
URL: <http://www-sci.pac.dfo-mpo.gc.ca/sealane/aquac/pages/intro.htm>

Ferguson, HW. (Ed) 2006. Systemic Pathology of Fish (2<sup>nd</sup> Ed). Scotian Press, London.

### Standard Reference Texts:

#### Fish diseases:

Roberts RJ. 2012 Fish Pathology 4<sup>th</sup> Ed. WB Saunders London

Austin, B & Austin, DA. Bacterial Fish Pathogens: Disease of Farmed and Wild Fish. (3<sup>rd</sup> Ed 1999 or 4<sup>th</sup> Ed, 2007). Springer-Praxis Series in Aquaculture and Fisheries. Praxis Publishing, Chicester.

Treves-Brown, KM. 2000. Applied Fish Pharmacology (Aquaculture Series) Springer.

Lom J & Dykova I. 1992. Protozoan parasites of fishes. Elsevier, Amsterdam London New York & Tokyo.

Noga EJ.(ed.) 2010. Fish Disease. Diagnosis and Treatment 2<sup>nd</sup> edition. Mosby-Year Book Inc, Missouri

Stoskopf, MK. 1993. Fish Medicine. W.B. Saunders Co. Philadelphia

Woo, PTK. & Bruno, DW. Fish Diseases and Disorders.  
Vol 1. 1995. Protozoan and Metazoan Infections. CABI Publishing.  
Vol 2. 1998. Non-infectious Diseases. CABI Publishing.

Vol 3. 1999. Viral, Bacterial and Fungal Infections. CABI Publishing.

### **Fish histology**

Amin, AB., Mortensen, L. & Poppe TT. 1992. Histology Atlas, normal structure of salmonids. APL, Bodo, Norway

Takashima, F & Hibiya, T. 1982. An Atlas of Fish Histology. Normal and Pathological Features. Kodansha, Tokyo.

Yasutake, WT & Wales, JH. 1983. Microscopic Anatomy of Salmonids: An Atlas. U.S. Department of the Interior, Washington D.C.

### **Fish clinical medicine:**

Lewbart, G. 1991. Self-Assessment Color Review of Ornamental Fish Wiley-Blackwell.

Loh, R & Landos M. 2011. Fish Vetting Essentials. Richmond Loh Publishing, Perth.

Roberts, HE. 1999. Fundamentals of Ornamental Fish Health. Wiley-Blackwell.

Wildgoose, WH. 2002. BSAVA Manual of Ornamental Fish. 2<sup>nd</sup> ed. BSAVA.

### **Crustaceans**

Bell, TA & Lightner, DV. 1988. A Handbook of Normal Penaeid Shrimp Histology. World Aquaculture Society Publication, Allen Press, Ic, Lawrence, Kansas.

Lightner, DV. 1996. A Handbook of Shrimp Pathology and Diagnostic Procedures for Diseases of Cultured Penaeid Shrimp. World Aquaculture Society, Baton Rouge, LA. 304p.

Alday de Graindorge, V & Flegel, TW. 1999. Diagnosis of Shrimp Diseases, with emphasis on the black tiger shrimp. Multimedia Asia Co., Ltd, Bangkok. (Electronic publication)

Evans, LH & Jones, JB. (Eds). 2001. Proceedings, International. Symposium on Lobster Health Management, Adelaide, September 1999.

Muresk Institute of Agriculture, Curtin University Publication. pp 75-87.

[http://espace.lis.curtin.edu.au/archive/00000270/01/International\\_symposium\\_on\\_rock\\_lobster\\_health\\_management.doc.pdf](http://espace.lis.curtin.edu.au/archive/00000270/01/International_symposium_on_rock_lobster_health_management.doc.pdf)

### **Molluscs**

Elston. RA. 1999. Health Management, Development and Histology of Seed Oysters. World Aquaculture Society, Baton Rouge, LA 70803 USA.

Fisher, WS. 1988. Disease Processes in Marine Bivalve Molluscs. American Fisheries Society, Special Publication 18, Bethesda, Maryland.

### **Pearl oysters**

Humphrey, JD and Norton JH. 2005. The Pearl Oyster *Pinctada maxima* (Jameson, 1901). An Atlas of Functional Anatomy, Pathology and Histopathology. Northern Territory Government Printing Office.

Bondad-Reantaso, MG., McGladdery, SE. & Berthe, FCJ. 2007. Pearl Oyster Health Management – A Manual. FAO, Rome.

### **Giant Clams**

Norton JH & Jones GW. 1992. The giant clam: an anatomical and histological atlas. Australian Centre for International Agricultural Research, Canberra. Printed Watson Ferguson & Co, Brisbane.

### **Abalone**

Bevelander, G. 1988. Abalone: Gross and Fine Structure. Boxwood Pr.

Handler, J. 2000. (Ed). Abalone Histology Atlas (CD format). Marine and Freshwater Resources Institute, Victoria.

### **Text Books - not essential but useful for reference if available**

Bayne, BL. 1976. Marine Mussels: Their Ecology and Physiology, Cambridge University Press, Cambridge.

Bliss, DE. (Ed.) 1982. The Biology of Crustacea. Vol 6 Patho-Biology. Academic Press, New York.

Brown, L. 1993. Aquaculture for Veterinarians. Pergamon Press

Buller NB. 2014 Bacteria and Fungi from Fish and other Aquatic Animals: A Practical Identification Guide. CABI Publishing, Wallingford.

Dall, W. 1990. The Biology of the Penaeidae. Advances in Marine Biology Vol. 27. Academic Press, London.

Ellis AE. 1988. Fish Vaccination, Academic Press, London.

Evans, DH, Claiborne, JB (Eds). 2006. The physiology of fishes 3<sup>rd</sup> edition. CRC Taylor & Francis.

Factor, JR. 1995. Biology of the Lobster *Homarus americanus*. Academic Press, San Diego, California.

Hallegraeff GM. 1991. Aquaculturists' Guide to Harmful Australian Microalgae. CSIRO Division of Fisheries and Fisheries Industry Training Board of Tasmania, Hobart.

Kennedy, VS. Newell, IE. & Edle, A F. 1996. The Eastern Oyster: *Crassostrea Virginica*. University of Maryland Sea Grant Publications.

Leatherland, JF & Woo, PTK. 2010. Fish- Diseases and Disorders- Volume 2: Non-infectious disorders 2<sup>nd</sup> edition. CABI Oxfordshire, UK.

Loh, R. 2013. Aquatic Veterinary Medicine – Specific to cultured, display and wild aquatic life. ISS Institute. (download free at <http://www.tinyurl.com/tfv-fellowship-rpt> ).

Moller H and Anders, K. 1986. Diseases and Parasites of Marine Fish, Moller Kiel.

National Research Council. 1981. Nutrient Requirements of Coldwater Fishes No. 16. National Academy Press, Washington D.C.

Post Graduate Committee in Veterinary Science, Sydney.

Proceedings No. 106, 1988. Fish Diseases

Proceedings No. 117, 1989. Invertebrates in Aquaculture

Proceedings No. 128, 1990, Fin Fish Diseases

Proceedings No. 182, 1992. Fin Fish Workshop

Proceedings No. 265, 1996, Fish Health Workshop

Reddacliff, GL. 1985 Diseases of Aquarium Fish, Post Graduate Committee in Veterinary Science, Sydney

Roberts, R J and Bullock AM. 1989. The Nutritional Pathology of Fishes In: Fish Nutrition J. E. Halver (Ed.) Academic Press, London. pp.423 - 473.

Sidransky, H. 1985. Nutritional Pathology (Biochemistry of Disease Series, Vol 10). CRC .

Stirling, HP. 1985. Chemical and Biological Methods of Water Analysis for Aquaculturists. Institute of Aquaculture, Stirling.

Thorsen, JC. (1994) Bluebook. Suggested procedures for the detection and identification of certain finfish and shellfish pathogens. Fish Health Section of the American Fisheries Society

Untergasser, D. 1989. Handbook of Fish Diseases. T.F.H. Publications, Inc.

### **Useful Journals and Proceedings:**

Aquaculture

Aquaculture Nutrition

Bulletin of the European Association of Fish Pathologists

Diseases of Aquatic Organisms

Journal of Aquatic Animal Health

Journal of Fish and Shellfish Immunology

Journal of Fish Biology

Journal of Fish Diseases

The Aquatic Veterinarian



## Other Key Websites

Anon 2000. *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, Volume 1, The Guidelines (Chapters 1-7). **Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ). Paper No. 4 - Oct 2000.**

<http://www.environment.gov.au/water/quality/nwqms/volume1.html>

Herfort A. *Aquatic Animal Diseases Significant to Australia: Identification field guide*. Fourth edition 2004. Agriculture, Fisheries and Forestry – Australia, Canberra. <http://www.disease-watch.com/documents/CD/index/index.htm>

[http://www.agriculture.gov.au/animal/aquatic/guidelines-and-resources/aquatic\\_animal\\_diseases\\_significant\\_to\\_australia\\_identification\\_field\\_guide](http://www.agriculture.gov.au/animal/aquatic/guidelines-and-resources/aquatic_animal_diseases_significant_to_australia_identification_field_guide)

National Aquatic Animal Health Technical Working Group – Standard Operating Procedures and advisory documents. <http://www.scahls.org.au/NAAH-TWG/index.htm>

World Aquatic Veterinary Medical Association. <http://www.wavma.org/Education>

## FURTHER INFORMATION

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