

NAME: **FERGUSON**, Hugh William

QUALIFICATIONS

Bachelor of Veterinary Medicine and Surgery (*BVM&S*). Royal (Dick) School of Veterinary Studies, University of Edinburgh. October 1967 - July 1972

Member of the Royal College of Veterinary Surgeons (*MRCVS*). 1972

Doctor of Philosophy (*PhD*). University of Stirling, Scotland. 1975

Diplomate American College of Veterinary Pathologists (*Dipl ACVP*). 1983

Fellow of the Royal College of Pathologists (*FRCPath*). 1995

APPOINTMENTS HELD

September 1972 - April 1975. Research Fellow at the Institute of Aquaculture University of Stirling, funded by a Wellcome Research Fellowship.

May 1975 - January 1976. Senior Scientific Officer at the Fish Disease Laboratory, M.A.F.F., Weymouth, Dorset, England. Employed as Head of Pathology Department.

February 1976 - June 1979. Veterinary Research Officer in the Veterinary Research Laboratories, Stormont, Belfast. Employed as a Pathologist by the Department of Agriculture for Northern Ireland.

July 1979 - Aug. 1998. Professor in the Department of Pathology, Ontario Veterinary College, University of Guelph, Ontario, Canada. Status - Assistant Professor 1979-1983; Associate Professor 1983-1989. From 1989 to 1998, Full Professor with tenure.

Sept. 1998 - present time. Professor and Chair of Diagnostic Pathology and Microbiology, Institute of Aquaculture, University of Stirling, Scotland. Employed to coordinate delivery of veterinary diagnostic services.

EXPERIENCE

- Laboratory diagnosis and disease investigation in all animals.
- Research, both basic and applied.
- Administration, advisory and consultancy work, usually on a fee-for-service basis.
- Teaching, discipline training, and continuing education of undergraduates and postgraduates.
- Problem solving, mainly in an aquatic context.

RESEARCH

Fundamental research interests include comparative pathology, pathophysiology, and defence mechanisms in lower vertebrates, especially fish. Maintaining research relevance through close ties with industry has always been important; hence maintaining a strong presence in diagnostics, worldwide.

1972-75 PhD supervisors: Professor A.E. Stuart FRCPATH, formerly Reader in Pathology, Medical School, University of Edinburgh, and Professor R.J. Roberts FRCPATH, University of Stirling.

Mapping out the reticulo-endothelial system of teleost fish using different markers and different methods; a morphological and functional study.

Ultrastructure of the reticular organs of teleost fish in both normal animals and in those injected with markers.

Ultrastructure of the white blood cells of teleost fish.

Light and electron microscope study of acid and alkaline phosphatase and peroxidase activity in the liver and heart of cyprinid fish. (This work was carried out in the Department of Electron Microscopy, Medical School, University of Leiden, Holland.)

Kinetics of blood clearance of radio-isotope labelled bacteria in plaice. (This work was carried out in the Department of Veterinary Physiology, University of Glasgow).

Diagnostic investigation into the cause of mortality amongst intensively reared turbot (*Scophthalmus maximus*) at an atomic power station, resulting in the discovery of a new sporozoan parasite, *Haemogregarina sachai*.

1976-79 Studies into the pathology and virulence mechanism of *Aeromonas salmonicida* as it affects salmonids.

Studies on the pathology, pathogenesis, epidemiology and control of proliferative kidney disease (PKD) of rainbow trout.

Research into the possibilities of immunological sterilization and early spawning in rainbow trout.

Routine diagnosis of fish viral disease, specifically infectious pancreatic necrosis.

I was the pathologist on a large team involved in investigating the causes of bovine abortion in Northern Ireland.

Diagnostic investigations into dysentery in pigs.

1979-09

Investigating the effect of water temperature and temperature stress on the ability of the reticuloendothelial system of rainbow trout to clear bacteria.

Haematological and histopathological assessment of rainbow trout fed oxidized diets with varying levels of anti-oxidants.

Investigation into the cause of glomerulonephritis in a white perch population in the Great Lakes.

Ultrastructure of renal portal reticuloendothelial activity.

Assessment of water quality parameters as they relate to pathological changes in fish gills; specifically the effects of suspended solids and ammonia on trout gills.

Effects of vitamins A and D and selenium toxicity in rainbow trout.

Pathological assessment of a variety of fish species from several heavily polluted locations in the Great Lakes and associated tributaries, including Love Canal, high in dioxins (work in conjunction with Department of Fisheries and Oceans).

Chemotaxis in fish neutrophils.

Cell kinetics in fish gills.

Fixation methods for gills.

Pathology, pathogenesis, and microbiology of bacterial gill disease.

Use of erythromycin in the control of bacterial kidney disease.

Pathology and clinical chemistry of quaternary ammonium compounds in fish.

Pathology and clinical chemistry of "pancreas disease" in farmed salmon.

Pathology of "cardiomyopathy syndrome" in Norwegian salmon.

Investigations into an epizootic of hepatic carcinomas (probably aflatoxin-induced) in trout in Brasil.

Pharmacokinetics of oxytetracycline in trout.

Clinical chemistry of bacterial kidney disease in trout.

Pathology of experimentally induced bacterial gill disease, and the attachment mechanisms of the causative bacteria.

Immune mechanisms of mucosal diseases, especially the “yellow pigmented bacteria” such as *Flavobacterium branchiophilum*.

Pathology and pathogenesis of hemorrhagic kidney syndrome (ISA virus) in the Canadian Maritimes, Scotland and Norway.

Pathology and pathogenesis of several “new” bacterial diseases of farmed fish, notably *Pasteurella salmonicida* in Atlantic salmon and *Edwardsiella ictaluri* in *Pangasius* catfish in the Mekong delta.

Pathology and ultrastructure of iridoviral infections in several species of tropical fish.

Pathology of experimental “*Pasteurella salmonicida*” infection in salmon.

Diagnosis of *Piscirickettsia* infection in seabass.

Pathology of nodavirus in a range of species, including cod.

Pathology of reovirus infections in farmed halibut.

Pathology of *Pseudomonas anguilliseptica* in farmed cod.

Heart diseases of salmonids.

Pathology and pathogenesis of “strawberry disease” in trout.

Pathology and pathogenesis of “summer enteritis syndrome” in rainbow trout.

Pathology of light-induced retinopathy in salmon and cod.

Acute phase proteins in farmed tilapia.

Jellyfish as vectors of bacterial diseases for farmed fish.

LABORATORY DIAGNOSIS AND DISEASE INVESTIGATION

1972-75 As a member of staff at the Unit of Aquatic Pathobiology, I was involved in the diagnosis of bacterial, viral and parasitic diseases and water quality problems associated with both freshwater and marine species of fish under both natural and farmed conditions. Similar work was performed at Fish Disease Laboratories (MAFF), Weymouth.

1976-09 The detailed post-mortem examination of farm livestock, small animals, laboratory animals, poultry, exotic species, wildlife and especially fish. Up until 1998 I was the Director of the Fish Pathology Laboratory (Ontario Veterinary College), and as such, screened all of the diagnostic material and checked diagnoses that funnelled through this service (see below). As Chair of Diagnostic Pathology & Microbiology I am presently responsible for co-ordinating the delivery of all veterinary diagnostic services for the Institute of Aquaculture.

The histopathological examination of tissue samples as an adjunct to diagnosis. The selection of material for further examination by other Departments as an aid to diagnosis. The collation of results and the preparation of reports.

Investigation of problems associated with the diagnosis, epidemiology and control of animal diseases in the field – farmed, wild, laboratory and aquarium animals all included.

ADMINISTRATION, FELLOWSHIPS, ADVISORY AND CONSULTANCY WORK

- 1972-75 Research Fellowship from the Wellcome Foundation, investigating the reticulo-endothelial system of teleost fish. Based at the University of Stirling.
- 1976-79 Responsible for the health of fish stocks in Northern Ireland and as such, closely involved with water pollution, mortalities from disease in wild stocks and in farmed fish. Certification of stocks for export and general advice on the movement of stocks within Northern Ireland. There was close involvement with all aspects of the fish farming industry there, and as such, I attended meetings in London and liaised with English and Scottish scientists and administrators concerning a redrafting of the G.B. legislation on fish diseases. There was also close liaison with the Dublin government on fish disease matters of mutual interest. Frequent consultation by workers in other European countries led to co-operative diagnostic investigations, and to further work in the fields of bacteriology, virology and pathology.
- 1976-79 Pathology consultant for the Norwegian aquacultural industry through Dr. Tore Håstein, National Veterinary Institute, Oslo, Norway.
- 1979-98 Responsibility for supervising and directing the Fish Pathology Laboratory (OVC) on a day-to-day basis. The Fish Pathology Laboratory, which usually comprised at least 2 veterinarians, (graduate students) 1 post-doctoral fellow, 1 non-DVM graduate student and 1 technician, plus myself, was run on a cost-recovery basis with its own operating budget, and was involved in all aspects of fish disease diagnosis and research for the aquacultural and aquarium industries, as well as private owners, consulting firms and government agencies. Latterly we saw heavy commitment to environmental toxicology and carcinogenesis. Revenue from this service in 1998 was roughly \$160,000.00.
- 1983-1986 Consultant for the fish program at the Atlantic Veterinary College, Prince Edward Island, Canada. Advised on course content, equipment, and facilities. Responsible in the early planning phases for the overall concept of the fish program and facilities in this new veterinary college.
- 1989 Consultant for International Development and Research Council (IDRC) and Bureau of Fisheries and Aquatic Resources (BFAR), Manila, Philippines. Advising on current research, and discussion on long term goals, and advising on procedures for establishing diagnostic service.
- 1989 Consultant for Canadian Executive Service Organisation (CESO) in Lages, Santa Catarina, Southern Brasil. Advising the Agro.Vet. Centre, Universidade Para O Desenvolvimento do Estado de Santa Catarina on fish diagnostic procedures.

- 1990 Consultant for Canadian International Development Agency (CIDA) in San Jose, Costa Rica, visiting the veterinary school in Heredia, and the aquaculture industry throughout the country. Advising on disease problems in freshwater and saltwater systems, and the development of the veterinary curriculum to reflect the importance of aquaculture to the country as a whole.
- 1990 Consultant for Port Hardy Marine Resources Society (British Columbia) re the feasibility of setting up a diagnostic centre on Vancouver Island.
- 1990 Consultant for the Asian Development Bank/Network of Aquaculture Centres of Asia (NACA) concerning fish health matters in Asia.
- 1991 Elected to roster of consultants for the Consultative Group on International Agricultural Research (CGIAR - World Health Organization and World Bank).
- 1991 Consultant for IDRC, visiting Bureau of Fisheries and Aquacultural Resources (BFAR) in Manila, Philippines, and also South East Asian Fisheries Development Centre (SEAFDEC) Iloilo, Philippines, working with scientists from both institutions on their pathology and research programs involved with diseases of fish raised intensively and semi-intensively in freshwater, saltwater, and brackishwater systems.
- 1992 Fellowship from the Norwegian Government (NLVF) for 4 months (March to June) based at the National Veterinary Institute in Oslo, in the Department of Aquaculture and Fish Diseases. In addition to the research work, which involved investigating various aspects of the pathogenesis of "pancreas disease", a new bacterial eye disease, and systemic hexamitosis, I gave a series of lectures and "mystery slide" sessions on systemic pathology of fish, and helped to screen the diagnostic material coming through the laboratory.
- 1993 Consultant for Canadian International Development Agency (CIDA) concerning the development of fish disease pathology expertise in Colombia, visiting the veterinary school in the Universidad Nacional, plus several of the aquacultural facilities throughout Colombia, and discussing with faculty and students disease problems associated with farmed fish (salmonids, catfish, tilapia and red pacu or "cachama").
- 1993-94 Consultant for Paprican (Pulp and Paper Research Institute of Canada), advising on histopathology for some of their toxicology trials.
- 1994-98 Awarded Visiting Professorship in Queen's University of Belfast, Northern Ireland, UK (in the School of Agriculture and Food Science).
- 2000 Consultant for Ministry of Agriculture of Barbados, relating to *Streptococcus iniae* infection round this and other Caribbean islands.
- 2000-04 Consultant for OKIOC (Offshore Kazakhstan Oil Company) relating to fish pathology in the Caspian Sea, and the decline of the beluga sturgeon population.
- 2002-04 Consultant for Nippon Oil Corporation (feed additives).

- 2006 Consultant for University of Pennsylvania, regarding the future and importance of the aquatic animal programme within the Veterinary School.
- 2007-09 Consultant for the veterinary pathology program in the veterinary school, National University, Bogota, Colombia.

TEACHING

- 1972-75 Involved with teaching post-graduate veterinary students and supervision of MSc. projects.
- 1978-79 Part-time lecturer in Loughry College of Agriculture, Northern Ireland, teaching poultry diseases.
- 1979-98 Helping to teach "General Pathology" to Doctor of Veterinary Medicine (DVM) undergraduates in the laboratory component. Solely responsible for teaching a course on Aquatic Animal Diseases, plus other teaching duties within the Pathology Department of OVC (eg. ultrastructural pathology) including supervision of undergraduate and graduate students in the general post-mortem room (including screening duties for all histopathological diagnoses) and teaching DVM undergraduate and graduates about aquatic pathology. I also co-ordinated an undergraduate course on aquaculture, involving many faculty in other Colleges.
- 1979-09 Presenter of many courses and workshops on diseases of aquatic animals. Many of these have been overseas assignments, and some have entailed working through interpreters.
- 1998-09 Involvement with teaching MSc students, and with supervision of research projects. Acting also as a resource for research projects in which pathology is a component. Presently I have 2 MSc students, 2 PhD students and 2 post-doctoral students, although I help and advise with many others.

MAJOR PRESENTATIONS/WORKSHOPS/COURSES

- Feb 2009 Invited lectures on "Emerging Diseases of Farmed Fish" at Alagappa University, Namil Nadu, at Madras Veterinary College, Chennai, and at Aligarh Muslim University, India.
- Nov 2008 Invited series of lectures on systemic pathology of fish to in-service MSc students (roughly 25) at the Veterinary School, Karditsa, Greece.
- Aug 2008 Invited lectures and practical sessions in histopathology (2 days) at the Second International Conference in Fish Pathology, Nacional University, Bogota, Colombia.
- Mar 2008 Invited lectures and workshops on histopathology to faculty and students at the Veterinary School, University of Bologna, and in Cessanatico, Italy.
- Nov 2007 Invited lectures (3) at the Pan-Commonwealth Veterinary Association meeting, Barbados, West Indies.
- Jan 2007 Invited series of lectures on systemic pathology of fish to in-service MSc students

(roughly 25) at the Veterinary School, Karditsa, Greece.

- Aug 2006 Invited keynote address and lectures at 5 day Symposium and Course on Aquatic animal health and disease, "*I curso – seminario internacional de patologia y sanidad piscicola*", Veterinary School, National University, Bogota, Colombia.
- Nov 2005 Workshop (half-day) to American College Veterinary Pathologists' annual meeting in Boston, "*Systemic Pathology of Fish*". Co-presented with Dr E. Noga.
- July 2005 Presenter at European College of Veterinary Pathology (ECVP/ESVP) Marie Curie Training Course in Padova, Italy, on Fish Diseases. Over 100 attendees.
- June 2004 Invited plenary lecture "*Gill diseases of Fish*" to the 16th annual joint meeting of Portuguese and Spanish veterinary pathologists, Famalicao, Portugal.
- Apr. 2004 Invited paper to New England Farmed Fish Health Management workshop, on "*Eye Diseases of Fish*", University of Maine at Eastport.
- Apr. 2003 Invited paper to New England Farmed Fish Health Management workshop, on "*Emerging diseases in Scottish Aquaculture*", University of Maine at Machias.
- June 2002 Invited keynote address (*The Reg Thomson lecture*) on "*Gill Diseases of Fish*" presented to staff and students of the Atlantic Veterinary College, University of PEI, Canada.
- Mar. 2002 Invited seminar on "*Emerging Diseases of Fish*" to faculty and staff at Can-Tho University, Vietnam.
- Mar. 2002 Invited lecture on "*Musculo-skeletal diseases of Fish*" at the 10th annual meeting New England Farmed Fish workshop, Eastport, Maine, USA.
- Mar. 2002 Invited keynote address on "*Gill Pathology*" to the Association of Veterinary Teachers and Research Workers, Scarborough, UK.
- May 2001 Invited plenary speaker at the inauguration of the new specialization school, Institute of Pathology, Faculty of Veterinary Medicine, University of Padova, Italy. "*Pathology of the most important diseases in European Aquaculture: an update, with particular attention to zoonoses*".
- Apr. 2001 "*Emerging diseases worldwide*". Invited presentation to the 9th annual New England farmed fish health management workshop, University of Maine, USA.
- June 2000 "*Comparing diseases of fish in Scotland with those in the Maritimes*". Invited lecture in St Andrews, N. Brunswick, Canada, at the Annual Fish Farming Conference.
- May 2000 "Inaugural lecture" University of Stirling, on "*Systemic Pathology of Fish*".
- Nov. 1999 Invited workshop co-ordinator ("Fish Pathology") and co-presenter (along with Dr. G. Johnson, UPEI) at the 50th Anniversary Meeting of the American College Veterinary Pathologists, Chicago, Illinois, USA.

- Oct. 1999 Invited public lecture on the Caribbean Fish Kill, Barbados, West Indies, given at UWI, Cave Hill, Barbados.
- Sept. 1999 Invited talk to British Trout Farmers Annual Conference, Sparsholt, Hampshire, talking on "*Common Disease Problems in Ontario Trout Farms*".
- Apr. 1999 Invited lecture at the New England Farmed Fish Health Workshop, Eastport, Maine, USA, on "*Gill Diseases in Farmed Salmonids*".
- Sep. 1998 Seminar on ISA/HKS to Scottish Salmon Farmers and industry reps. Given at the University of Stirling, Scotland.
- Nov. 1997 Invited presentation in St. Andrew's, New Brunswick, on Hemorrhagic Kidney Syndrome in Atlantic Salmon - Definition of the Disease.
- Aug. 1997 Invited plenary lecture to European Society of Comparative Physiologists and Biochemists in Barcelona, Spain, on "*Gill diseases - lesions and consequences*".
- July 1997 Invited paper presented at the Institute of Aquaculture, University of Stirling on Emerging Diseases in Canadian Aquaculture.
- Mar. 1997 Invited presentation to the New England Salmon Farmers on "*Emerging Diseases of Farmed Fish*", Eastport, Maine, USA.
- Mar. 1997 Invited presentation to faculty and students at the Virginia/Maryland College of Veterinary Medicine, Blacksburg, Virginia. Talking on emerging diseases of farmed salmonids in Canada.
- Mar. 1997 Invited presentation to faculty and students at the College of Veterinary Medicine, North Carolina State University, Raleigh, N. Carolina. Talking on emerging diseases of farmed salmonids in Canada.
- Nov. 1996 Invited presentations at the Canadian/Caribbean Veterinary Association meeting in Barbados, W. Indies. 1. A major fish kill in Barbados. 2. Zoonoses associated with Fish. 3. Environmental Diseases of Fish.
- Apr. 1996 Invited presentation to fish farmers, fish scientists, "*Emerging Diseases of Salmonids*", at the New England salmon farmers annual meeting, Eastport, Maine.
- Feb. 1996 Invited course (3 days) to fishery biologists and farmers on "*Diseases of Wild Fish*" presented at the WCVM, Saskatchewan. Sponsored by the CCWHC.
- July 1995 Invited presentation to staff and students at the Royal (Dick) School of Veterinary Studies, University of Edinburgh, Scotland on "*Respiratory Disease in Fish*".
- Mar. 1995 Invited presentation at Bradan '95 (Irish salmon farmers meeting) "*Pancreas Disease - the early days*". Given at Clifden, Co. Mayo, Republic of Ireland.
- Feb. 1995 Invited presentation to researchers, administrators and fish farmers on "*The Impact of Aquaculture: Global trouble shooting from a Canadian base*". Given at the Veterinary Research Laboratories, Stormont, Belfast, U.K.

- Dec. 1994 Invited shortcourse (5 days) "*Approaches to disease diagnosis in aquatic animals*" given to faculty & staff of the University of W. Indies, and personnel from the Vet. Diagnostic Lab. (Ministry Ag. & Food) plus fish farmers. Given at the Bellairs Research Institute of McGill University, Holetown, Barbados, W. Indies.
- Oct. 1994 Invited presentations to veterinarians and other fish health personnel at an International Conference "*Pathology and Nutrition in the Development of Aquaculture: Keys to Success*". Topics covered included "Gill disease: diagnostic consequences and interaction with feeding practices" plus, "*Cardiomyopathy syndrome, Pancreas Disease, and the Differential Diagnosis of Liver disease*", plus "*Eye Disease*". Organized by Fundacion Chile and held in Puerto Montt, Chile.
- Aug. 1994 Invited presentation at "Envirovet" on "*Diagnostic criteria in aquaculture medicine*". 5-6 hours of lecture\laboratory at University of Michigan\University of Illinois, at Duluth, Minnesota, USA.
- May 1994 Invited presentation on "*Fish Pathology*" (4 hours) to veterinary pathologists at Charles Louis Davis Foundation course on fish and wildlife pathology at College of Veterinary Medicine, Blacksburg, Virginia, USA.
- Sep. 1993 Invited 1 day workshop on "*Histopathology of liver and heart*" at the European Association of Fish Pathologists' 6th International meeting in Brest, France.
- Aug. 1993 Invited presentation at "Envirovet" on "*Diagnostic criteria in aquaculture medicine*". 5-6 hours of lecture\laboratory at University of Michigan\University of Illinois, at Duluth, Minnesota, USA.
- Jun. 1993 Invited workshop (CIDA project) on pathophysiology of gill diseases, plus an overview of fish systemic pathology given to faculty, students and staff of the Universidad Nacional, Bogota, Colombia.
- Mar. 1993 Invited presentation "*Fish Diseases: Wild versus Cultured Fish*", given to fish farmers/fish health personnel, health management workshop, Maine, USA.
- Jun. 1992 Invited one day workshop on "*Gill diseases - diagnosis and treatment*", given to faculty from the University of Bergen, to personnel from the Fishery Institute, and from the veterinary diagnostic centre. Given in the Veterinary Diagnostic Centre, Bergen, Norway.
- Jun. 1992 Invited one day workshop (organized by Skretting, a fish feed company) on common diseases of farmed salmonids. Given to veterinary practitioners in Kristiansund, Norway.
- Jun. 1992 Invited lecture and seminar to faculty and students of the Veterinary Pathology Department, *Agricultural University of Uppsala*, Sweden.
- Apr. 1992 Invited seminar on "*Common diseases in Canadian Fish*", given to students and faculty of the Norwegian College of Fishery Science, University of Tromsø, and to members of the Veterinary Diagnostic Centre, Tromsø, Norway.
- Mar. 1992 Invited seminar (1 day) on gill diseases in fish - mechanisms and pathophysiology - to veterinarians from Norwegian veterinary diagnostic centres. Given in Na-

tional Veterinary Laboratory, Oslo, Norway.

- Oct. 1991 Invited 1 week course (IDRC project) on basic pathology and mechanisms of disease in fish. Given in Manila, Philippines. Given to scientists from government institutions (BFAR and SEAFDEC) and to faculty from University of the Philippines. Also seminar "*Gill Diseases of Fish*" to SEAFDEC, Iloilo, Philippines.
- Jun. 1991 Invited 2-day presentation on pathophysiology of aquatic animals, at "Envirovet", *University of Michigan\University of Illinois*, at Superior, Michigan, USA.
- Feb. 1991 Lecture tour of the United Kingdom, talking and lecturing about branchial pathology in fish. Institutions visited included University of Bristol (Dept. of Comparative Pathology), Plymouth Marine Laboratory, University of Stirling (Institute of Aquaculture), Veterinary Sciences Divn. of Dept. of Agriculture N. Ireland, and University of Aberdeen (Zoology Dept), Scotland.
- Oct. 1990 Invited lecture "*Overview of Fish Diseases in an Aquacultural Setting*" and international consultant at an *Asian Development Bank/NACA* workshop (10 days) on fish health control in Asia, at Pusan, South Korea.
- Jun. 1990 Invited lectures and labs. at "*Introduction to Aquaculture for Veterinarians*" held at *Atlantic Veterinary College*, University of P.E.I., Charlottetown, June 7-9th, 1990.
- Apr. 1990 Invited speaker at "Aquatech 90" in the University of Guelph on "*Major limitations on the expansion of Canadian Aquaculture: a review of current problems and early warnings*".
- Apr. 1990 One day workshop on diseases of fish in the tropics (CIDA project), given at the Veterinary School, *Universidad Nacional, Heredia*, Costa Rica.
- Jan. 1990 Seminar on Pancreas Disease and Cardiomyopathy Syndrome, at the Veterinary Research Laboratories, Stormont, Belfast, N. Ireland, UK.
- Jan. 1990 Seminar on "*Heart Disease in Fish*" at the Regional Veterinary Diagnostic Laboratory, Bergen, Norway.
- Dec. 1989 Invited seminar on "*Cardiac Diseases of Fish*" at Veterinary College, *University of California, Davis*, given to the Department of Medicine.
- Jul. 1989 Invited course (CESO funded) on fish diseases (4 days) to graduate extension veterinarians and faculty, at the Agro. Vet. Centre of the *Universidade Para O Desenvolvimento Do Estado De Santa Catarina*, Lages, Santa Catarina, Brasil.
- Jun. 1989 Invited speaker at World Association of Veterinary Laboratory Diagnosticians, Guelph, Ontario, speaking on "*Pathology of Fish Diseases - Current Developments*".
- Apr. 1989 Invited lecturer at Aquaculture shortcourse in Girona campus of the *University of Barcelona*, Spain; lectures and labs. on fish diseases.
- Mar. 1989 Keynote speaker at fish farming conference, St. Andrew's, New Brunswick, talk-

ing on "*Bacterial Diseases of Farmed Salmonids*".

- Mar. 1989 Invited shortcourse on fish diseases to students and fish farmers, at the Western College of Veterinary Medicine, *University of Saskatchewan*, Saskatoon.
- Feb. 1989 Invited shortcourse (IDRC funded) on "Pathology of Fish" to the Third Asian Fish Health meeting (joint International Development Research Council/UPM sponsorship) at *Universiti Pertanian Malaysia*, Malaysia.
- May 1988 Keynote speaker and course co-ordinator at Post-graduate Refresher course on Fish Diseases organized by the Post-Graduate Foundation Committee in Veterinary Science, *University of Sydney*, Australia.
- May 1988 Invited papers to salmon farmers in Hobart, Tasmania, and to students and faculty at the *Tasmanian State Institute of Technology*, Launceston, on "*Common diseases of cultured fish in Canada*".
- Nov. 1987 Invited paper (the *D.L.T. Smith* lecture) on "*The role of the Veterinarian in Fish Diseases*", at the Western College of Veterinary Medicine, Saskatoon, Saskatchewan. Also, "*Diseases of Aquarium Fish*" to the pathology department, WCVM.
- Sept. 1987 Invited workshop on "*Diseases of Aquarium Fish*" at 125th OVC celebrations, Guelph, Ontario.
- Aug. 1987 Invited paper on "*Common diseases of fish kept in the laboratory*" World Veterinary Congress, Montreal.
- Aug. 1987 Invited paper on "*Pancreas disease of Atlantic Salmon*". Pacific Biological Station, Nanaimo, B.C.
- Feb. 1987 Invited seminar on "*Common diseases of farmed salmonids*". Technical University of Nova Scotia workshop on fish farming in the Maritimes, Halifax, Nova Scotia.
- Feb. 1987 Invited seminar at Atlantic Veterinary College, U.P.E.I., on "*Interesting Protozoan diseases of Fish*".
- Nov. 1986 Invited papers on tropical aquaculture and diseases of aquarium fish. Joint Caribbean/Canadian Veterinary Association meeting in Barbados, W. Indies.
- Mar. 1986 Invited seminar on "*Pancreas disease of Atlantic salmon*" at Microbiology Dept., University of Galway, Republic of Ireland.
- Jan. 1986 Invited seminar on "*Important diseases of fish in Canadian Aquaculture*" at Institute of Aquaculture, University of Stirling, Scotland, UK.
- Oct. 1985 Invited paper on "*Important protozoal diseases of fish*" presented at annual Scottish Veterinary Investigation conference, Pitlochry, Scotland, UK.
- Sept. 1985 Invited 2 week course on fish diseases, presented in Wellington, N. Zealand, to Ministry of Agriculture veterinarians.

- Jan. 1985 Invited seminar to Department of Fisheries and Oceans, Halifax, Nova Scotia, on proliferative kidney disease.
- Nov. 1984 "*Veterinary involvement in aquaculture*". Invited presentation to the joint Canadian/Caribbean Veterinary Association, Trinidad, West Indies.
- July 1984 Invited seminar on "*Epidemiology and control of proliferative kidney disease in rainbow trout*" to American Fisheries Society, Fish Health Workshop, Arkansas, USA.
- June 1984 "*Renal phagocytosis in fish*". Agriculture Canada Animal Pathology Conference, Ottawa.
- May 1984 "*Intra-axonal protozoa in the common shiner *Notropis cornutus**" Mid-West Association of Veterinary Pathologists, Cincinnati, Ohio, USA.
- Feb. 1983 Invited seminar on "*Reactions of Fish Gills in Disease*" to the Division of Comparative Medicine, *Johns Hopkins University*, Baltimore, Maryland, USA.
- July 1981 Invited 3 day seminar/workshop on fish diseases at Western College of Veterinary Medicine, *University of Saskatoon*, Canada.
- July 1980 Invited one-day presentation (5 hours lectures) to the Canadian Association of Veterinary Pathologists on "*Diseases of Fish and Amphibia*" in Moncton, New Brunswick, Canada.
- June 1980 Paper presented to the Fish Health Section of the American Fisheries Society entitled "*Pathology and Control of Proliferative Kidney Disease in Rainbow Trout*" in Seattle, Washington, USA.
- Apr. 1978 Paper presented to the Association of Veterinary Teachers and Research Workers entitled "*Proliferative Kidney Disease*" in Scarborough, UK.
- Nov. 1977 "*Fish Disease in Northern Ireland*" presented at a meeting of Water Authorities and Veterinary Investigation Centres (MAFF) in Reading, UK.
- Apr. 1977 "*Furunculosis in Brown Trout*" presented at the OIE/EIFAC meeting on fish diseases in Brest, France. In addition, I chaired 2 sessions on kidney diseases and gave an additional paper on PKD in rainbow trout.
- Mar. 1976 "*Fish Diseases in Northern Ireland*" presented to the annual meeting of the Institute of Fisheries Management in Londonderry, Northern Ireland, UK.
- June 1975 "*Toxoplasma*-like organisms as the possible causative agents of a proliferative condition in farmed turbot (*Scophthalmus maximus*)". Joint paper presented at the Third International Wildlife Disease Conference, Munich, Germany.
- Apr. 1975 "*Relationship between ellipsoids and melano-macrophage centres in marine flatfish*" presented to British Society Immunology annual conference Brighton, UK.
- June 1974 "*A lymphomatous condition of farmed turbot in an atomic power station*", pre-

mented at a conference on Neoplasia in Aquatic Animals, Cork, Repub of Ireland.

GRANTS RECEIVED IN AID OF RESEARCH

- 1980-81 Title. "***The effect of temperature on reticuloendothelial clearance in rainbow trout***". Amount \$6,000.00 from the Research Advisory Board of the University of Guelph.
- 1980-81 Title. "***The effect of temperature on reticuloendothelial clearance in rainbow trout***". Amount \$8,000.00 from the Natural Sciences and Engineering Research Council (NSERC), Canada.
- 1981-82 Title. "***The effect of pH and starvation on reticuloendothelial clearance in rainbow trout***". Amount \$18,000.00 from NSERC.
- 1982-83 Title. "***Ultrastructural localization of bacteria in the kidney of rainbow trout.***" Amount \$18,000.00 from NSERC.
- 1980-83 Title. "***Bacterial Gill Disease***". Amount \$60,000.00 from the Ontario Ministry of Agriculture and Food Lottery Fund.
- 1984-86 Title. "***Cell kinetics in fish gills***". Amount \$30,000.00 from OMAF.
- 1984-85 Title. "***Point-source mutagen pollution in Ontario***". Amount \$40,000.00 from Ontario Ministry of Environment.
- 1985-86 Sabbatical leave. Awarded Wellcome Travel Fellowship, and Bull Fellowship.
- 1986-87 Title. "***Disease of caged fish in British Columbia***". Amount \$8,600.00 from Agriculture Canada.
- Title. "***Significance of neoplasia in wild fish populations***". Amount \$48,000.00 from Wildlife Toxicology Fund. Co-recipient with Dr. M.A. Hayes.
- Title. "***Pathology of neoplastic diseases of feral fish***". Amount \$64,000.00 from Ontario Ministry of Environment. Amount \$64,000.00. Co-recipient with Dr. M.A. Hayes.
- Title. "***Carcinogenic responses of wild fish from polluted sites in Lake Ontario***". Amount \$61,000.00 from N.S.E.R.C. Co-recipient with Dr. M.A. Hayes.
- 1987-88 Title. "***Causes of pollution-associated neoplasms on fish in Lake Ontario***". Amount \$140,500.00 from Ontario Ministry of Environment. Co-recipient with Dr. M.A. Hayes.
- 1986-91 Ontario Ministry of Agriculture and Food (OMAF) supports the fish disease research programme in Pathology at the level of \$157,665.00 per annum in 1990 dollars.
- 1990-93 Title. "***Impact of chemotherapeutic agents and aquacultural pollutants on fish: assessment using immune response in gills***". Amount \$77,500.00 from OMAF.

- 1991-1995 Ontario Ministry of Agriculture and Food support for fish disease work in the Pathology Dept. Amount roughly \$151,000.00 per annum after overhead.
- 1995-1998 Title. "***Indicators of Resistance to Bacterial Diseases of Salmonids***". Amount \$90,000.00 per annum for each of 3 years from NSERC as a Strategic Grant. Co-recipient with Dr. M.A. Hayes.
- 1996-1997 Title. "***Use of hydrogen peroxide in treating fish disease***". \$21,000.00 contract from Eko-Nobel, USA.
- 1997-2001 "***Sequential pathology of Hemorrhagic Kidney Disease in Atlantic salmon***". \$55,000.00 grant-in-aid of research from Salmon Health Consortium, New Brunswick, Canada.
- 2000-01 £5,000.00 from DFID (Department for International Development) UK. "***Investigation of a fish mortality problem affecting fish farmers in the Mekong delta, Vietnam***". Co-recipient with Drs. Crumlish, Turnbull, Shinn and Thompson.
- 2002 £160,000.00 equipment grant from Wellcome Trust (UK) for purchase of a confocal microscope. Co-recipient with Drs. Richards, Teale, and Sommerville.
- 2001-03 £150,000.00 from DFID (UK). ***Risk issues and management strategies for Bacillary Necrosis Disease (BNP) and other factors for Pangasius spp. farming in the Mekong Delta, Vietnam.*** Co-recipient with Drs. Crumlish, Turnbull, Shinn and Thompson.
- 2005-07 £94,000.00 from SARF for research into cardiomyopathy syndrome (CMS) and other heart diseases in Atlantic salmon. Co-recipient with Prof. A. Adams.
- 2005-2008 £100,000.00 for research into summer enteritis syndrome of rainbow trout. Co-recipient with Drs. J. Turnbull and M. Crumlish.
- 2007-2008 £54,000.00 from industry sources for research into Red Mark Syndrome/Strawberry Disease in rainbow trout.
- 2008-2011 NK6,000,000.00 from Norwegian research council plus industry sources (*Marine Harvest*). ***Cardiomyopathy syndrome: A multi-task approach to reduce losses and improve knowledge.*** Co-recipient (as named collaborator) with various researchers in Norwegian Veterinary College, and other Norwegian institutions.
- 1998-09 The Veterinary Diagnostic Service of the Institute of Aquaculture presently earns roughly £150,000.00 per annum, providing diagnostic services/investigations primarily for the European aquaculture industry, and referral fish pathology globally, as well as support pathology for other contract and research activities within the Institute. This money is used to support diagnostic investigations.

PUBLICATIONS

Ph.D. Thesis. The reticulo-endothelial system of teleost fish with special reference to the plaice (*Pleuronectes platessa*).

BOOKS and BOOK CHAPTERS

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