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PROFESSOR ANNE SMITH (BROWN) BSc, PhD, AIEEM

Nationality: British
Year of Birth: 1951
Marital Status: Married, two grown up children

KEY EXPERIENCE

Anne Smith has 30 years of experience in assessing the impacts of the environment and water quality on fish health and their physiology and assessment of fish stress in the wild or in aquaculture. Anne's expertise focuses on monitoring the health and welfare of farmed fish and development of practical welfare indices. She is an associate member of the Institute of Ecology and Environmental Management and has expertise in ecological surveys and environmental impacts on protected species. Key areas of expertise are:

- Welfare indices and health of farmed fish and shellfish
- Impacts of pollutants and water quality on stress and welfare of adult and larval fish
- Stress responses of teleosts to salinity, hypoxia, parasites and pollutants
- Osmoregulation and salinity adaptations in migratory and non-migratory teleosts and elasmobranchs
- Education and communication
- Algal identifications
- Behavioural and physiological studies of non-native fish to assess risks of dispersal
- Impacts of oil and gas fields on fisheries
- Ecological inputs for Habitats Regulations screening and Appropriate Assessment for Natura 2000 sites (Special Areas of Conservation: SACs and Special Protection Areas: SPAs)

ACADEMIC QUALIFICATIONS

1976 PhD University of Sheffield
1972 BSc Hons Zoology, First Class, UCNW, Bangor.

CAREER

2000 - present Director of Aquatronics Ltd
2005 (continuing) Emeritus Professor, School of Biosciences, University of Exeter
2000 -2005 Professor of Fish Physiology, School of Biological Sciences, University of Exeter
1988 -2001 Lecturer, then Reader in Department of Biological Sciences, University of Exeter
1979 -1988 Lecturer, Department of Zoology, University of Hull.
1976 -1979 Research Fellow, Department of Zoology, University of Sheffield.

MEMBERSHIP OF PROFESSIONAL GROUPS

Associate Member of the Institute of Ecology & Environmental Management
Member of the Fisheries Society of the British Isles
Member of the Marine Biological Association

CONSULTANCY WORK (SINCE 2005)

2011

Seafield Partnership Ltd

Report on fish issues for an Addendum to the Environmental Statement for a new Power Station at Hunterston, Ayrshire Power

Commercial Client

Advice on impacts of low pH on fish in a freshwater site after a spill from an industrial site

PB World & Cornwall Council

Fish population survey to assess the impacts of North Quay development at Copperhouse Pool, Hayle

Monitoring the impacts of a tidal exclusion on fish in the low water pool at Copperhouse, Hayle

Report on potential impacts on water quality and effects on fish resulting from proposed alteration to tidal regime

Report on monitoring of suspended solids during construction activities and potential impacts on fish

Marine Bio-images

Statistical analysis of biological data

Commercial Client

Assistance with ecological and chemical survey of a river in NW England

Hill Dickinson & Andrew Jackson (solicitors)

Assessment of potential impacts of dredging on cockle condition in the Thames fishery (continuing)

2010

Waterman Energy & Design Ltd

Ecological appraisal and advice of site for potential development – assessment of key habitats as habitats for invertebrates.

Marine Bio-images and Scottish Natural Heritage

Assistance in analysis of diver cores and grab samples from Lamlash Bay, Arran (the first No Take Zone in Scotland).

PB World & Cornwall Council

Ecological surveys of intertidal mudflats, hard substrates, wader prey and contaminants in Copperhouse Pool, Carnsew and Lelant at Hayle, Cornwall.

Algal identifications linked to hard substrate surveys and surveys of the boundaries of selected biotopes.

Fish survey (with APEM) of Copperhouse Pool, Hayle.

Commercial Client

Assistance with ecological and chemical survey of a river in NW England.

Scottish Aquaculture Research Forum (SARF) and Defra

Development of behavioural, physical and physiological welfare indices for cod.

Environmental Sciences Ltd, Trinidad

Advice on development of a Fisheries Complex in Trinidad
Assistance with fisheries aspects of EIAs for oil and gas industry in Trinidad.

Hill Dickinson & Andrew Jackson (solicitors)

Assessment of potential impacts of dredging on cockle condition in the Thames fishery (continuing)

2009

Scottish Aquaculture Research Forum (SARF) and Defra

Development of behavioural, physical and physiological welfare indices for cod (continued).

Hill Dickinson & Andrew Jackson (solicitors)

Assessment of potential impacts of dredging on the Thames cockle fishery (continued).

Falmouth Boat Construction

Assistance with ecological surveys for proposed pontoon development, Fal estuary.

AECOM

Ecological survey of an intertidal site near a proposed marina on the Torridge estuary, Devon.

Buro Happold

Surveys of intertidal and subtidal habitats at Mill Bay, Plymouth.

EAD & Dart Harbour & Navigation Authority

Ecological survey of intertidal site at Hoo Down, near Kingswear on the Dart estuary.

Commercial Client

Ecological and chemical surveys of a river in NW England. Survey repeated Autumn 2009.

2008

Scottish Aquaculture Research Forum (SARF) and Defra

Development of welfare indices for farmed cod, Shetland (continued).

Hill Dickinson & Andrew Jackson (solicitors)

Assessment of potential impacts of dredging on the Thames cockle fishery.

ING Real Estate & Buro Happold

Assistance with Biotope mapping of the Hayle estuary complex, Cornwall.

The Marine Hotel, Salcombe

Ecological surveys of the foreshore to assess possible impacts of a proposed pontoon.

2007

Enfusion

Ecological input for Habitat Regulations Appropriate Assessment of Local Development Framework Core Strategies for Dartford and Gravesham Borough Councils (Thames Estuary and Marshes and Medway Estuary and Marshes SPAs).

Marine Bio-Images

Statistical analysis of data from diver surveys of *Modiolus* (horse mussel) populations for Scottish Natural Heritage.

Enfusion

Ecological input for Habitat Regulations Appropriate Assessment of Minerals and Waste Core Strategies for Wiltshire County Council and Swindon Borough Council (River Avon and North Meadow and Clattinger Farm SACs).

URS Corporation Ltd/BioLab Ltd

Member of team responsible for repeat ecological survey of an English river following a fire and chemical spill.

Environmental Perspectives

Strand line survey and protected species' surveys of tidal habitat at Brentford, Thames.

The Environment Practice and ING Real Estate

Member of team responsible for intertidal survey of Carnsew Pool and Penpol, for the Hayle Harbour development, Cornwall.

NoCatch Ltd (funded by Scottish Aquaculture Research Forum (SARF) and Defra)

Continued development of practical and meaningful welfare indices for farmed cod by on-farm assessments and laboratory analyses of blood samples.

2006

Johnson's Seafarms (funded by Scottish Aquaculture Research Forum (SARF) and Defra)

Pilot studies to assess viable behavioural, physical and physiological parameters as welfare indices for cod farmed in Shetland.

URS Corporation Ltd

Ecological survey of an English river following fire and release of contaminants.

Ecological Planning and Research

Team member in survey of intertidal habitats at Lyme Regis as part of the ecological impact assessment of Phase IV of the sea defence programme.

Environmental Resources Management

Part of the team undertaking a repeat ecological survey of a stream and river affected by a diesel spill.

2005

Assessment of cause of fish deaths at a trout farm linked to an insurance claim

APPOINTMENTS IN PROFESSIONAL BODIES

2004 -2008	Fisheries Society Council & Studentship Awards Committee
2006 -2007	Convenor for Fisheries Society Symposium on Non-Native Fishes
2002 -2005	Marine Biological Association, Council & Education Committee
1998 -2005	Editorial Board & Sub-Editor - General & Comparative Endocrinology
1996 -1997	Environment Agency, South West Regional Fisheries Advisory Committee
1992 -1995	Natural Environment Research Council: (i) Marine & Atmospheric Grant Committee; (ii) Aquatic Life Sciences Grant Committee
1992 -1993	British Council: Joint Research Programmes Adviser
1990 -1993	Nuffield Foundation, Bursaries Review Panel
1985 -1991	Society for Experimental Biology, Council Member; Osmoregulation Group Convenor

INVITED PAPERS AT CONFERENCES

Research results have been presented in International and European conferences and workshops including: Defra Review of the Animal Welfare R& D programme (London 2010), EU COST 867 Fish Welfare Workshop (Varese, Italy 2007), International Congress on the Biology of Fishes (St John's Newfoundland: 2006; Vancouver, 2002), SETAC-Europe (Prague 2004), International Workshop on Biological Invasions (Florence,

2005), International Symposia on Fish Endocrinology (Spain, 2004; Seattle, 2000; Japan, 1996; Saint Malo, 1992), International Symposia on Comparative Endocrinology (Japan, 1997; Spain, 1989; Hong Kong, 1981); Society for Experimental Biology Symposia on Welfare (Glasgow, 2007) Society for Experimental Biology Symposia on Stress (Canterbury, 2001), European Comparative Endocrinology Conferences (Portugal, 2000; UK, 1983); International Symposium on Produced Waters (Norway, 1995) American Physiological Society (San Diego, 1994; Orlando, 1990); International Union of Biological Sciences, (Japan, 1991); Fish Physiology Symposia (Denmark, 1991; UK, 1981); Symposium on Ecophysiology of Acid Stress in Aquatic Organisms, (Belgium, 1987).

POSTGRADUATES SUPERVISED DURING PhD RESEARCH

Almost 30 students have been supervised during research. Some are listed below, with their funding.

Physiological monitoring of welfare for conservation of Arabian oryx, *Oryx leucoryx*. Mansoor AlJahdhami (Diwan of the Royal Court, Sultanate of Oman)

Integrated non-invasive investigations of captive Abyssinian colobus monkeys (*Colobus guereza*): behaviour, stress and parasitism. Jo Rabineau

Impact of environmental contaminants on thyroid function in fish. Helen Crane (NERC & Astra Zeneca)

Stress sensitivity of eels parasitised with *Anguillicola crassus*. Matt Gollock (NERC)

Molecular physiological investigation of trout renin-angiotensin system Jonathan Aust (BBSRC)

Integrative regulation of trout renal function. Shaun Pope (BBSRC)

Branchial toxicity of aluminium in brown trout. Simon Collins (NERC)

Physiological stress responses of European eels parasitised with *Anguillicola crassus*. Cheryl Kelly (NERC)

The effects of petroleum hydrocarbons on early life stages of turbot. Susan Stephens (NERC & Amerada Hess)

Molecular analysis of the renin-angiotensin system in the trout. Richard Paley (SERC)

Endocrine control of perfused fish kidney. Shehla Amer (ORS award, Pakistan)

The effects of water-soluble fraction of crude oil on fish. Abdulaziz AlKindi (Sultan Qaboos Univ., Oman).

Endocrine and physiological responses to acid stress in brown trout. Denise Edwards (NERC)

RESEARCH

Research by 40 grants funded by UK Research Councils, EU, Defra, Nuffield Foundation, Leverhulme Trust and appropriate industries, totalled almost £1 million between 1983 and 2007. This work has focussed on understanding the impact of environmental changes and water quality on fish, their tolerances and their stress responses. Insights into the impact of environmental pollutants have been gained including an appreciation of the plasticity of their responses. Work on saline tolerances and behaviour of fishes has included investigation of the risk of dispersal of non-indigenous (alien) fish species. Recent work has developed practical welfare indices for use in assessing the welfare of farmed fish. More than 100 journal papers or book chapters have been published (as J. Anne Brown). Selected examples (since 2000) are listed below:

SELECTED SCIENTIFIC PAPERS IN JOURNALS, BOOK CHAPTERS

More than 100 chapters or journal papers have been published (primarily as J. Anne Brown). The selection listed below includes most recent publications and those in applied areas.

Smith P., Snook, D., Muscutt, A. and **Smith, A.** (2010). Effects of a diesel spill on freshwater macroinvertebrates in two urban watercourses, Wiltshire, U.K. *Water and Environment Journal* 24: 249-260.

Brown, J. A., Watson, J., Bourhill, A., Wall, T. (2010). Physiological welfare of commercially reared cod and effects of crowding for harvesting. *Aquaculture* 298: 315-324.

Cobb, C.S., **Brown, J.A.**, and Rankin, J.C. (2010). Antidiuretic action of angiotensin II in the river lamprey *Lampetra fluviatilis*: evidence for endocrine control of kidney function in cyclostomes. *Journal of Fish Biology* 77: 1424–1431

Brown, J. A., Bourhill, A., Watson, J., Hodgson, D. (2009). Development of practical on-farm cod welfare indices (SARF 021). Scottish Aquaculture Research Forum
<http://www.sarf.org.uk/Project%20Final%20Reports/SARF021%20-%20Final%20Report.pdf>

Brown, J. A., Bourhill, A., Watson, J. (2009). Atlantic cod (*Gadus morhua*) fin erosion key. Scottish Aquaculture Research Forum
<http://www.sarf.org.uk/Project%20Final%20Reports/SARF021%20Atlantic%20cod%20fin%20erosion%20key.pdf>

Brown, J. A., Watson, J., Bourhill, A., Wall, T. (2008). Evaluation and use of the Lactate Pro, a portable lactate meter, in monitoring the physiological well-being of farmed Atlantic cod (*Gadus morhua*). Aquaculture 285: 135-140.

Scott, D. M., Rabineau, J., Wilson, R. W., Hodgson, D. J., and **Brown, J. A.** (2008). Can pikeperch colonise new freshwater systems via estuaries? Evidence from behavioural salinity tests. Marine and Freshwater Research 58: 694-702.

Scott, D. M., Wilson R.W., **Brown J. A.** (2007). Can sunbleak *Leucaspis delineatus* or topmouth gudgeon *Pseudorasbora parva* disperse through saline waters? Journal of Fish Biology 71: Supplement D: Non-native Fishes: Integrated Biology of Establishment Success and Dispersal 70-86.

Brown, J. A., Scott, D. M., Wilson, R.W. (2007). Do estuaries act as saline bridges to allow invasion of new freshwater systems by non-indigenous fish species? Chapter 21 In: Biological Invaders in Inland Waters: Profiles, Distribution and Threats. Invading Nature - Springer Series in Invasion Ecology Vol 2. Ed. F. Gherardi. Springer

Brown A., Bourhill, A., Watson, J., Wall, T., Ellis, T., Zuur, A., Ieno, E. N. (2007). Understanding the welfare of farmed cod under commercial conditions: integration of physiological, behavioural and physical approaches. Comparative Biochemistry and Physiology Part A 146: S75-86

Scott, D. M., Wilson, R. W., **Brown, J. A.** (2007). The osmoregulatory ability of the invasive species sunbleak *Leucaspis delineatus* and topmouth gudgeon *Pseudorasbora parva* at elevated salinities, and their likely dispersal via brackish waters. Journal of Fish Biology 70: 1606-1614

Scott, D. M., **Brown, J. A.**, Stakenas, S., Wilson, R. W., Copp, G. H. (2007). Pikeperch (*Sander lucioperca*) dispersion through brackish waters - can they and do they? Comparative Biochemistry and Physiology Part A 146 S77.

Butler, D. G., **Brown, J. A.** (2007). Stanniectomy attenuates the renin-angiotensin response to hypovolaemic hypotension in freshwater eels (*Anguilla rostrata*) but not blood pressure recovery. Journal of Comparative Physiology B - Biochemical Systemic and Environmental Physiology 177: 143-151.

Brown, J. A., Hazon, N. (2007). The renin-angiotensin system of fish and their role in osmoregulation. In Fish Osmoregulation. Eds. B. Baldisserotto, J. M. Mancera & B.G. Kapoor. Science Publishers, Inc. Enfield NH, USA & Plymouth, UK.

Crane, H. M., Pickford, D. B., Hutchinson, T. H., **Brown, J. A.** (2006). The effects of methimazole on development of the fathead minnow, *Pimephales promelas*, from embryo to adult. Toxicological Sciences 93: 278-285.

Crane, H. M., Pickford, D. B., Hutchinson, T. H., **Brown, J. A.** (2005). Effects of ammonium perchlorate on thyroid function in developing fathead minnows, *Pimephales promelas*. Environmental Health Perspectives 113, 396-401

- Gollock, M. J., Kennedy, C. R., **Brown, J. A.** (2005). European eels, *Anguilla anguilla* (L.), infected with *Anguillicola crassus* exhibit a more pronounced physiological stress response to severe hypoxia than uninfected eels. *Journal of Fish Diseases* 28: 429-436.
- Gollock, M. J., Kennedy, C. R., **Brown, J. A.** (2005). Physiological responses to acute temperature increase in European eels (*Anguilla anguilla* L.) infected with *Anguillicola crassus*. *Diseases of Aquatic Organisms* 64: 223-228.
- Brown, J. A.**, Cobb, C. S., Frankling, S. C., Rankin, J. C. (2005). Activation of the newly-discovered cyclostome renin-angiotensin system in the river lamprey, *Lampetra fluviatilis*. *Journal of Experimental Biology*. 208: 223-232
- Gollock, M. J., Kennedy, C. R., Quabius, E. S., **Brown, J. A.** (2004). The effect of parasitism of European eels with the nematode, *Anguillicola crassus* on the impact of netting and aerial exposure. *Aquaculture* 233: 45-54
- Crane, H. M., Pickford, D. B., Hutchinson, T. H., **Brown, J. A.** (2004). Developmental changes of thyroid hormones in the fathead minnow, *Pimephales promelas*. *General and Comparative Endocrinology*. 139: 55-60.
- Cobb, C. S., Rundle, J., Frankling, S. C., & **Brown, J. A.** (2003). Angiotensin I-converting enzyme-like activity in a cephalochordate. *Journal of Marine Biological Association UK* 83: 1307-1308
- Quabius, E. S., **Brown, J. A.**, Nolan, D. T., Wendelaar Bonga, S. E. (2002). Organic pollutants and their effects on the stress response in fish. *Comparative Biochemistry & Physiology Part A*. 132: S3.
- Aust, J. G., Anderson, W. G., Hazon, N., Fahle, S. R., Aves, S. J., **Brown, J. A.** (2002). The osmoregulatory role of the dogfish renin-angiotensin system. *Comparative Biochemistry & Physiology Part A*. 132: S44 A6.9.
- Cramb, G., Cutler, C. P., Lignot, J-H, Martinez, A-S., Chesman, B. S., Frankling, S. C., **Brown, J. A.** (2002). Expression of multi-drug resistance (MDR) p-glycoprotein and associated proteins (MRPs) in the flounder: effects of exposure to the polyaromatic hydrocarbon, benzo(a)pyrene. *Proceedings of the International Congress on Biology of Fishes. Aquatic Toxicology: Mechanisms & Consequences* (Eds. C. Kennedy, A. Kolak, D. MacKinlay). American Fisheries Society.
- Quabius, E. S., **Brown, J. A.**, Nolan, D. T., Wendelaar Bonga, S. E. (2002). Dietary exposure to PCB 126 and B(a)P interferes with the stress response of teleost fish at the pituitary level of the HPI axis. *Proceedings of the International Congress on Biology of Fishes. Endocrine Disruptors: Mechanisms and Impacts* (Eds. M. Vijayan, A. Hontela, D. MacKinlay) American Fisheries Soc.
- Cobb, C. S., Frankling, S. C., Rankin, J. C., **Brown, J. A.** (2002). Angiotensin -converting enzyme-like activity in tissues from the river lamprey or lampfern, *Lampetra fluviatilis*, acclimated to freshwater and seawater. *General & Comparative Endocrinology* 127: 8-15.
- Brown, J. A.**, Moore, W. M., Quabius, E. S. (2001). Physiological effects of saline waters on zander. *Journal of Fish Biology* 59: 1544-1555.
- Kelly, C. E., Kennedy, C. R., **Brown, J. A.** (2000). Physiological status of wild European eels (*Anguilla anguilla*) infected with the parasitic nematode, *Anguillicola crassus*. *Parasitology* 120: 195-202.
- Stephens, S. M., Frankling, S. C., Stagg, R. M., **Brown J. A.** (2000). Sub-lethal effects of exposure of juvenile turbot to oil produced water. *Marine Pollution Bulletin* 40: 928-937.
- AlKindi, A. Y. A, **Brown, J. A.**, Waring, C. P. (2000). Endocrine, physiological and histopathological responses of fish and their larvae to stress with emphasis on exposure to crude oil and various petroleum hydrocarbons. *Science and Technology, Special Review* 1-30.

- Brown, J. A.**, Rankin, J. C. (1999). Lack of glomerular intermittency in the river lamprey, *Lampetra fluviatilis* acclimated to seawater and following acute transfer to iso-osmotic brackish water. *Journal of Experimental Biology* 202: 939-946
- Waring, C. P., **Brown, J. A.** (1997). Plasma and tissue thyroxine and triiodothyronine contents in sublethally stressed, aluminium-exposed brown trout (*Salmo trutta*). *General and Comparative Endocrinology* 106: 120-126.
- Stephens, S. M., AlKindi, A. Y. A., Waring, C. P., **Brown, J. A.** (1997). Corticosteroid and thyroid responses of larval and juvenile turbot, *Scophthalmus maximus* L. exposed to the water soluble fraction of crude oil. *Journal of Fish Biology* 50: 953-964.
- Stephens, S. M., **Brown, J. A.**, Frankling, S. C. (1997). Stress responses of larval turbot, *Scophthalmus maximus* L., exposed to sub-lethal concentrations of petroleum hydrocarbons. *Fish Physiology & Biochemistry* 17: 433-439.
- AlKindi, A., **Brown, J. A.**, Waring, C. P., Collins, J. E. (1996). Endocrine, osmoregulatory, respiratory and haematological parameters in flounder *Pleuronectes flesus* exposed to the water soluble fraction of crude oil. *Journal of Fish Biology* 49: 1291-1305.
- Brown, J. A.**, Waring, C. P. (1996). The physiological status of brown trout exposed to aluminium in acidic soft waters. In: *Toxicology of Aquatic Pollution. Physiological, Cellular and Molecular Approaches*. Ed. E. W. Taylor, Society for Experimental Biology Seminar Series Vol 57, pp 115-143, Cambridge University Press.
- Stephens, S. M., **Brown, J. A.**, Ferguson, M. A. (1996). Sub-lethal effects of oil-produced water on the early life stages of turbot. In: *Produced Water 2: Environmental Issues and Mitigation Technologies* Eds. M. Reed & S. Johnsen, pp. 101-112, Plenum Press, New York.
- Waring, C. P., **Brown, J. A.**, Collins, J. E., Prunet, P. (1996). Plasma prolactin, cortisol and thyroid responses of the brown trout (*Salmo trutta*) exposed to lethal and sublethal aluminium in acidic soft waters. *General and Comparative Endocrinology* 102: 377-385.
- Brown, J. A.**, Whitehead C. (1995). Catecholamine release and interrenal response of brown trout, *Salmo trutta* exposed to aluminium in acidic water. *Journal of Fish Biology* 46: 524-535.
- Waring, C. P., **Brown, J. A.** (1995). Ionoregulatory and respiratory responses of brown trout, *Salmo trutta*, exposed to lethal and sublethal levels of aluminium in acidic soft waters. *Fish Physiology & Biochemistry* 14: 81-91.
- Brown, J. A. (1993). Endocrine Responses to Environmental Pollutants. In 'Fish Ecophysiology' (Ed. J C Rankin & F B Jensen) pp 274-294. Chapman & Hall, London.
- Brown, J. A.**, Tytler, P. (1993). Hypoosmoregulation of larvae of the turbot, *Scophthalmus maximus*: drinking and gut function in relation to environmental salinity. *Fish Physiology & Biochemistry* 10: 475-483.
- Brown, J. A.**, Whitehead, C., Edwards, D. (1989). Cortisol and thyroid responses to acid stress in the brown trout, *Salmo trutta*. *Journal of Fish Biology* 35: 73-84.
- Whitehead, C., **Brown J. A.** (1989). Endocrine responses to acid stress in brown trout held in a soft water Welsh stream. *Journal of Fish Biology* 35: 59-71.