

The life and work of Rosemary Lowe-McConnell: pioneer in tropical fish ecology

Michael N. Bruton

J.L.B. Smith Institute of Ichthyology, Private Bag 1015, Grahamstown, 6140 South Africa

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Synopsis

Rosemary Lowe-McConnell is one of the pioneers of tropical fish ecology. During a colourful and eventful career spanning over 45 years, she has worked in the tropical waters of Africa and South America and contributed significantly to our understanding of the ecology, zoogeography, phenology, evolution and taxonomy of tropical fishes. She has also assisted countless young ichthyologists and fisheries scientists and stimulated ichthyology through her lucid books on fish ecology. She continues to play an active role in the promotion of ichthyology and ecology from her home in Sussex in the English countryside. A brief biography and tribute is given so that her contributions to tropical fish ecology can be more widely appreciated.

Early training and the Africa experience

Rosemary Helen Lowe was born in Liverpool, England, on 24 June 1921 and educated at Howell's School, Denbigh, in Wales. She received her B.Sc., M.Sc. and D.Sc. degrees from the University of Liverpool and from 1942–1945 worked as a biologist on the staff of the Freshwater Biological Association on the migrations of anguillid eels in freshwaters.

Her career in African ichthyology started after the Second World War when she was employed to conduct a survey of the tilapias and their fisheries in the southern part of Lake Nyasa (now Lake Malawi). This study was financed by the United Kingdom Colonial Development & Welfare Fund and was a continuation of a previous survey by Ethelwynn Trewavas, Kate Ricardo Bertram and John Borley in 1939. In 1945 Ro was the only person conducting research on the fishes of Nyasaland (now Malawi) and had to work under arduous conditions with no fisheries research organisation to support her. On the lake she used an old diesel, inboard en-

gine boat, the 'Pelican', with an auxiliary sail, and remembers having 'to plunge flaming bits of newspaper into the engine to get it started'. With the assistance of local fishermen she traversed large tracts of the lake and soon became familiar with the fishery.

In a remarkably short time (three years) she produced, virtually single-handedly, a valuable account of the tilapias and their fishery that laid the foundation for subsequent studies of Malawian cichlids. Five tilapiine species were distinguished and found to have distinct breeding seasons and places. Other economically important fish were also studied, including the endemic potamodromous cyprinid *Labeo mesops*.

In 1947 Ro returned to England via Jinja in Uganda, travelling down the Nile, through Lakes Kyoga and Albert, across the Nile Sudd, and down the Nile River to Alexandria. After writing up the Nyasa work at the Freshwater Biological Association laboratory at Windermere and the British Museum (Natural History) in London, she returned to Afri-



Fig. 1. Portrait of Rosemary Lowe-McConnell by Hubert Williams in 1948.

ca by flying boat, touching down in Sicily, Alexandria, Luxor and Port Bell on Lake Victoria. She arrived at the newly opened East African Fisheries Research Organisation laboratory in Jinja in 1948 as one of the founder members of E.A.F.R.O. Her arrival was preceded by a telegram from Barton Worthington which read: 'Miss Lowe in hands of Death. Up to you to make suitable arrangements'. (Steven D'Eathe had been detailed to meet her on arrival.) The E.A.F.R.O. was very ably directed by R.S.A. Beauchamp at the time; later members of staff included P.H. Greenwood (doing work on haplochromine cichlids) and P. Corbet (studying the food of non-cichlids).

From 1948–1953 Ro was employed as a Research Officer by the British Overseas Research Service at the Jinja laboratory (Fig. 1, 2), where her main task was to investigate the biology of the various tilapias in East African lakes. In Lake Victoria the two endemic tilapias were studied in collaboration with the then Lake Victoria Fisheries Service from their research vessels operating out of Mwanza, Kisumu



Fig. 2. Ro in Jinja in about 1950.

and Entebbe. She studied the biology of *Oreochromis niloticus* in waters in which it occurred naturally – Lakes Rudolf (now Turkana), Albert (Mobutu) and Edward/George, and in several smaller lakes, ponds and dams into which it had been stocked. E.B. Worthington (Fig. 3, 4) had previously found that *O. niloticus* dwarfs in lagoons connected to Lake Albert and in crater lakes in Lake Rudolf. This switch from growth to reproduction, so significant in fish culture, was investigated further by Ro and other E.A.F.R.O. staff in this and other tilapia species.

In 1955 she described four new species and subspecies of tilapias from Lake Jipe and the upper and lower reaches of the Pangani River in Kenya and Tanzania. Here too she produced probably the first account of the physiological switch from growth to reproduction of tilapias in ponds (following Worthington's pioneering field studies on *O. niloticus* in Lake Albert). In 1959 she published a major paper on the differences between the substrate-brooding and mouth-brooding species of tilapias that was subsequently used by Ethelwynn Trewavas as a basis for the division of the tilapiine fishes into different genera.

According to Ethelwynn Trewavas, Ro showed tremendous courage and determination during her field work. She found that many fish species were easier to capture at night, and readily braved the



Fig. 3. In retirement now, Barton Worthington settled not far from where Ro lives, in a 1200 year-old house near Furnace Green, in which he had the Roman hypocaust rebuilt. Photograph by E.K. Balon on 3. 6. 1990.

marauding hordes of insects and the risks of water-borne diseases in order to achieve her goals (Fig. 5).

Ro also found time to study the breeding behaviour of *Oreochromis karomo* and *O. variabilis* in the clear shallow waters of Lake Tanganyika (visited with Humphry Greenwood in August 1952) and in Lake Kyoga and the Victoria Nile (1950, 1952), respectively. This was in pre-scuba days, and even snorkels were rare in East Africa at the time. After snorkelling in Lake Tanganyika at Kigoma in

1952, Ro's first experimental SCUBA dive was made in Lake Kivu with André Capart's Belgian Expedition in 1953, using rocks tucked into her clothing as weights. She once encountered a large water snake *Boulengerina* sp. while snorkelling in the Malagarasi Swamps, and on several occasions saw crocodiles underwater. These diving experiences led to a passion for underwater fish watching, but later diving opportunities were mainly in the sea: on



Fig. 4. Reminiscing on past African days, we spent a charming afternoon at Barton's house.



Fig. 5. Ro and Major Gould, Fisheries Officer, Tanganyika, on one of the many field trips in 1950.

the East African coast, Great Barrier Reef, San Blas Islands in Panama, Seychelles and Maldives.

An important feature of life at the E.A.F.R.O. was the visits by experts from whom members of the resident staff learned a great deal. For example, the colourful Cambridge scholar, Hugh Cott, came to Uganda to work on crocodiles, and enlisted Ro's help in dragging the dead reptiles out of the lake

and examining their stomach contents. This work later led to a 'most romantic incident' on Lake Turkana when Ro and District Commissioner Dennis McKay were 'pinned together by one crocodile', their fingers caught in its (luckily small) mouth and only released when the DC's wife fetched a large carving knife. Early experiments to assist another distinguished visitor with the detection of electric signals from mormyrid fishes, by trailing wires from a small rowing boat, led to an exciting encounter with an inquisitive and highly vocal hippopotamus.

During this productive period Ro worked in all the East African territories of the United Kingdom, mainly on tilapias, and served as Acting Director of E.A.F.R.O. for a short while. She produced a steady stream of scientific papers and popular reports on the biology, ecology and taxonomy of cichlids and other fishes. Her ecological studies were remarkable for the way in which they combined scientific value with relevance to the fisheries. They provided the essential baseline for later studies that assessed the impact of fishing and other human pressures on the populations of valuable food fishes (Fig. 6).

When she married Richard McConnell, a geol-



Fig. 6. Ro (centre) in Jinja in 1953 with Humphry and Marjorie Greenwood.

ogist, on 31 December 1953 Ro was required to resign from the Colonial Service (because of the 'marriage-bar') but continued working as an Honorary Fisheries Research Officer. (Ethelwynn Trewavas and other women scientists had earlier campaigned against the 'marriage-bar' in the British Civil Service, which was eventually scrapped). Thereafter most of her research and editing was carried out on an expenses-only, voluntary basis, supplemented by occasional contracts, consultancies, teaching assignments and royalties. From 1954–1956 Ro lived in Botswana, where Richard extended his geological work and she collected fishes in the Okavango Delta.

South American experiences

From 1957–1962 the McConnells lived in British Guiana in South America, where Richard directed the Geological Survey. Through the timely visit of C.F. Hickling, Chief Fisheries Advisor to the U.K. Overseas Development Administration, she became associated with the Guiana Department of Agriculture and Fisheries in a survey of the freshwater (and later marine) fish and fisheries. Although she was appointed by the Guiana Department of Agriculture and Fisheries (Fig. 7) for the princely sum of only Guiana \$ 1.00 p.a., the appointment did provide her with working facilities, a laboratory, transport, flights to the interior (into which there were no roads) and accommodation on the research ship.

The most exciting freshwater work during this period was a survey on the Rupununi District of the huge floodplain connecting the Essequibo River system seasonally across to the Rio Branco (draining into the Rio Negro in the Amazon drainage), an area previously unsurveyed ichthyologically. Here she had the good fortune to be helped by the McTurk family and other ranchers and their Amerindian cousins, all very good naturalists, well versed in the ways of the fishes on which so many of them depended for their food. The biology of other freshwater fishes was also studied in rivers and estuaries on the coastal plain and in other parts of this fascinating rainforest country.



Fig. 7. Ro with Bertie Allsopp, Fisheries Officer, in British Guiana, 1960.

Later Ro was appointed as the ichthyologist on the R.V. 'Cape St Mary', a vessel that had been brought from West Africa by Hickling to carry out the first survey of the unexplored Guiana shelf between the West Indies and Brazil. This marine field work was supplemented by examining round-the-year catches of fishes on sale in the Georgetown fish market in order to determine seasonal trends in movements as well as breeding and feeding preferences of a variety of species.

During this phase of her career, which she calls her 'marine transgression', she became familiar with over 200 marine fish species in over 70 fish families and greatly expanded her knowledge of tropical fish biology. She studied food partitioning in sciaenid and other fishes, and published a series of papers and reports on the marine fishes of Guiana [one of which is regularly cited in ecology texts,

Lowe (McConnell 19)*]. She also extended her studies on breeding seasonality to egrets (Lowe-McConnell 25). On leaving Guiana in 1962 the then Prime Minister (now President) Chedie Jagan presented Ro with a gift at a formal dinner party in recognition of her contributions to fisheries research in Guiana.

After returning to England in 1968 Ro was appointed as the ichthyologist on the Royal Society of London/Royal Geographical Society Xavantina-Cachimbo Expedition to north-eastern Mato Grosso, Brazil. The aim of this expedition was to assess the environmental impact of a new road extending northwards along the Sierra do Roncador as part of the expanding Amazon highway system. This area was previously poorly explored ichthyologically and provided many challenges to the expedition members. She drew extensively on her field experience in Africa and Guiana during this expedition and made some of the first detailed studies of the synecology of Amazonian fishes. The Mato Grosso is an area of high endemism among the fishes, with very different ichthyofaunae in adjacent rivers. Ro was the first to attempt to explain the differences on ecological grounds, and subsequently became a prolific writer on South American freshwater fishes.

A graphic description of the working conditions in South America was contained in a letter written by Ro and quoted by Anthony Smith in his book on the Mato Grosso expedition (Smith 1971, pp. 203–204): ‘. . . Of course one was wet through from chest downwards every day and almost every night. I always worked in clothes, a habit developed in Guyana where piranha were bad. Therefore one kept cool while the soil scientists were finding it very hot. (. . .) Sweat bees used to swarm to the damp fish as I was measuring them, mixed with a few stinging feral “Europa” bees. Biting flies were also very bad near the streams. (. . .) One snag about the fish work was the amount of gear one had to carry to catch the fish and preserve them before they went bad, as they do so fast in the tropics. (. . .) One traipsed through the bush looking like the White Knight. (. . .) It was hard

work physically as we had to improvise and even set gill nets by swimming (in the absence of any boat) and with circumspection, as I was only too well aware what electric eels and piranha can do. However, the water was clear in many places and one could watch the fish (with polaroid glasses) and assess what there was before disturbing them by trying to catch them’. There were, however, some compensations for a keen angler. Three Brazilian assistants once caught 41 *Aequidens*, 14 *Hoplerythrinus*, 1 *Hoplias*, 6 *Leporinus*, 3 *Crenicichla*, 2 *Acestrorhynchus* and 1 *Moenkhausia* species using hook and line within three hours, as in these virgin waters each baited hook is taken almost immediately after it is thrown in!

Back to England

In 1962, on returning to England, Ro was appointed as an Associate of the British Museum (Natural History) (1962–1967) and granted the Appleyard Bequest by the Linnean Society of London (£ 200 p.a.). At the BMNH she was provided with facilities to study the considerable collections of fishes that she had sent back from Africa and South America. She worked in a small office/laboratory with Ethelwynn Trewavas in the new spirit building (Fig. 8). I have fond memories of sharing crustless sandwiches and hot Marmite drinks with them over lunch during my postdoctoral year at the BMNH in 1977/1978. Their office was always a hive of activity, with a constant stream of visitors and non-stop discussions on the ecology and taxonomy of tropical fishes. Melanie Stiassny, Richard Vari and Augustine Baddokwaya were also doing postdoctorals at the British Museum at the time, and Humphry Greenwood, Jim Chambers, Gordon Howes and Keith Banister were just down the corridor. The magnificent BMNH fish collection and library, and this exciting group of people, added up to a most stimulating environment in which to work.

At the Natural History Museum, Ro wrote her first book synthesizing studies on the ecology of freshwater fishes from the tropics of Africa, South America and Asia, *Fish Communities in Tropical Freshwaters, Their Distribution, Ecology and Evo-*

* See the ‘Lifetime list of publications’.



Fig. 8. Ethelwynn Trewavas and Rosemary Lowe-McConnell in the British Museum (Natural History) in the summer of 1985.

lution (Lowe-McConnell 34). This was followed by another synthesis volume, *Ecology of Fishes in Tropical Waters* (Lowe-McConnell 38), which also treated marine fishes; by then she had become a leading authority on this subject. Ro later expanded both books into *Ecological Studies in Tropical Fish Communities* (Lowe-McConnell 50), the definitive title on this subject (Fig. 9). Her penetrating reviews, concise style of writing and generous use of illustrations have made her books accessible to readers of many cultures and educational backgrounds and have greatly stimulated ichthyology in the tropics. Her life-long interest in speciation culminated in the publication of the proceedings of a British Ecological Society/Linnean Society conference on *Speciation in Tropical Environments* (Lowe-McConnell 30), which she initiated and edited.

At this time Ro was able to become involved with many activities as she was not in fulltime employment. She visited Rome at the request of the F.A.O. where she helped to edit papers and participated in the World Symposium on Warm-Water Fish Culture (1966). She was actively involved in the 10-year long International Biological Programme (I.B.P.) from its inception in 1964, contributing a chapter to I.B.P. Handbook 3 on 'Methods for the assessment of fish production in freshwaters' (Lowe-McCon-

nell 28). She also attended I.B.P. regional meetings in Uganda, Malaysia and Latin America. The summary volume from the I.B.P./P.F. Productivity in Freshwaters programme, *The Functioning of Freshwater Ecosystems*, was co-edited with E.D. Le Cren (Le Cren & Lowe-McConnell 43).

During the post-colonial era man-made lakes massively altered tropical rivers, and provided the opportunity to study how riverine fish communities changed into lacustrine ones. These challenges did not escape Ro's attention. In 1964 she edited the proceedings of a conference of the Institute of Biology on man-made lakes (published in 1966, Lowe-McConnell 24), and in 1971 chaired a session in a conference on man-made lakes in Knoxville, U.S.A. (Lowe-McConnell 33). In 1964 she was part of a U.N.D.P. Mission to Ghana to plan research for a new man-made lake on the Volta River, and in 1965 took part in a pre-impoundment survey of Kainji Lake on the Niger River in West Africa. These field excursions led to the publication of a booklet by Ghana Universities Press on the fishes of Volta and Kainji lakes (Lowe-McConnell & Wuddah 32).

In 1974 she attended the First International Congress of Ecology in The Hague and subsequently edited (Fig. 10) with W.H. van Dobben the proceedings of the plenary sessions as a book entitled *Unifying Concepts in Ecology* (Van Dobben & Lowe-

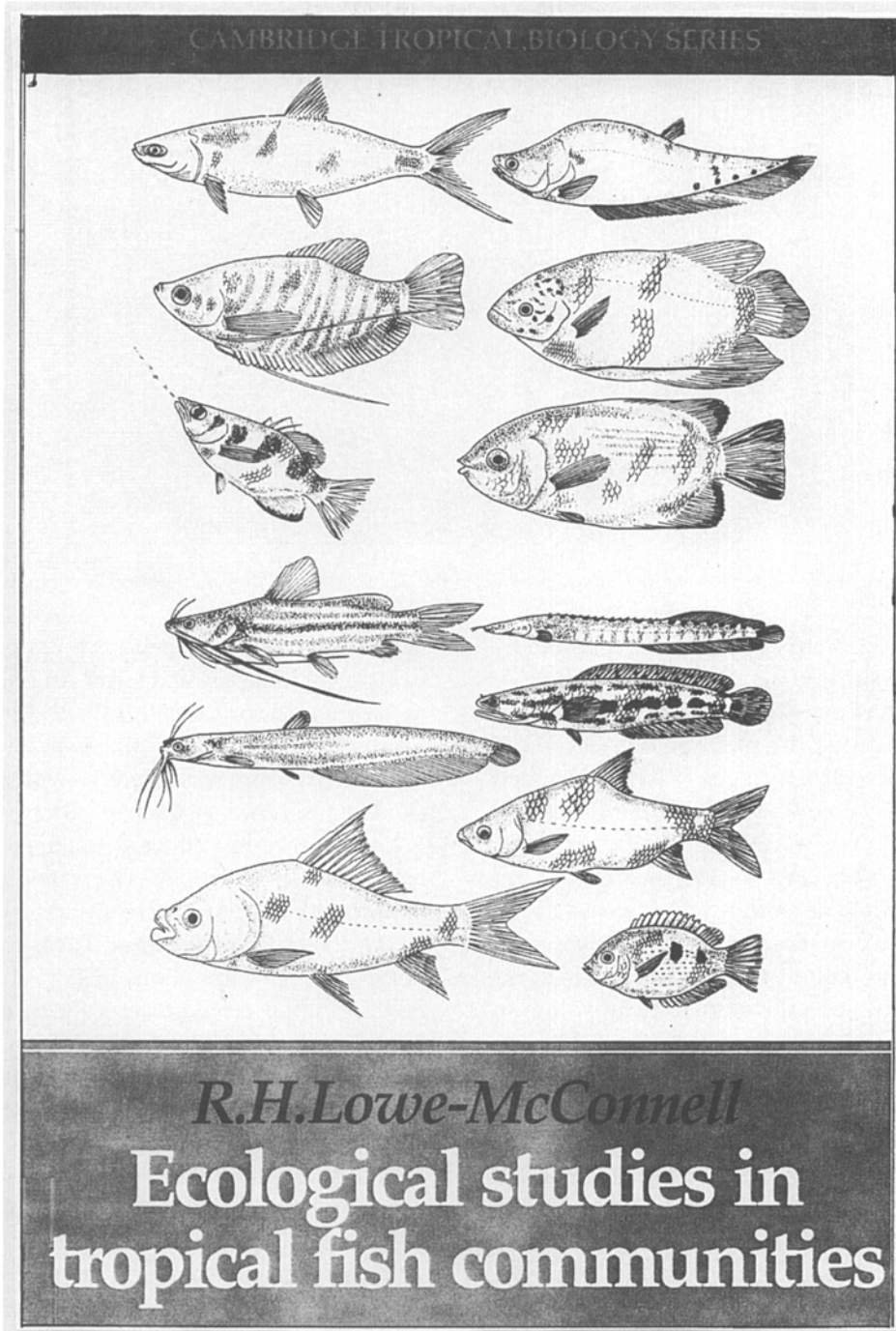


Fig. 9. The title page of Ro's latest book.

McConnell 36). This book, which was translated into Spanish, was a masterful compilation of the latest in ecological thinking, especially with respect to the comparative productivity, diversity and stability of

natural ecosystems. The paragraph written by the editors at the end of the Preface summarises their world view: 'We sincerely hope that the results of the First International Congress of Ecology will



Fig. 10. Ro in 1975 against the background of the house 'Streatwick' during editing of the proceedings of the First International Congress of Ecology (36), holding the logo and wearing a Dr W. Junk Publishers T-shirt.

emphasize that the maintenance of vulnerable natural resources demands long-term policies with a sound scientific basis, and that neglect of ecological rules for the sake of immediate profit spells disaster.'

Ro has also been involved with the International Center of Living Aquatic Resources Management (ICLARM) and actively participated in their workshops on tilapias in Bellagio, Italy, 1980 (editing the proceedings with R.S.V. Pullin) and Bangkok in 1987. In 1987 she attended a workshop on 'Community structure and function in temperate and tropical streams' in Flathead, U.S.A. She also contributed a typically incisive overview chapter entitled 'Broad characteristics of the ichthyofauna' to the proceedings of the U.N.E.P. conference on 'African limnology' held in Nairobi in 1979.

Ro has retained her interest in African fishes and in 1987 co-convoked the Societas Internationalis Limnologicae (S.I.L.) African Great Lakes Group meeting at a symposium in Burundi on 'Resource use and conservation of the African Great Lakes'. She contributed to the 'First International Conference on the Conservation and Biodiversity of Lake Tanganyika' in Burundi in 1991, and attended a workshop on Lake Tanganyika research in Kuopio



Fig. 11. Ro and Robin Welcomme study the original E.A.F.R.O. visitors book, signed by many old friends, in Jinja, 1992.

in Finland in 1991. Also in 1991, she contributed to a meeting of the S.I.L. Tropical Group in Hong Kong and chaired a session on the 'Conservation and management of tropical inland waters'.

In March 1992 she participated in a conference on 'Biodiversity, fisheries and the future of Lake Victoria' in Jinja, Uganda (Fig. 11), and in August 1992 helped to organise the 'African Great Lakes' session at the S.I.L. congress in Barcelona. She also presented a paper on 'Fish communities in Lakes Malawi, Victoria and Tanganyika' at a seminar on 'Biodiversity – fish populations and communities in Lake Tanganyika' held at the University of Kyoto in Japan in November 1992. Her year was concluded with the presentation of a paper at a conference on 'Biodiversity, production and conservation of African aquatic ecosystems' at the University of Zimbabwe in December 1992. In March 1993 she presented a paper at a workshop on 'Speciation in ancient lakes' in Belgium. In 1993 she also participated in a Great Lakes meeting at the University of Guelph in Canada (Fig. 12) and in the Symposium on the Ecology of Latin American Fish at the A.S.I.H. meeting in Texas.

Throughout her career Ro has been driven by the need to understand the ecology of fishes in order to ensure their sustainable utilisation. She is a respected writer on fish conservation and was invited by the Fisheries Society of the British Isles to summar-



a



b



c

Fig. 12. In May 1993 Ro was one of the invited speakers at the 'Symposium on the Great Lakes of the World': a – she listens with great concentration to the other speakers, and b, c – later enjoys herself at the Niagara Falls. Photographs a, b by E.K. Ballon and c by D.L.G. Noakes.

ise the proceedings of the international conference on 'The biology and conservation of rare fish' held at the University of Lancaster in England in 1990 (Lowe-McConnell 57).

Rosemary Lowe-McConnell has held important positions in several scientific societies, including serving for five years as Honorary Secretary of the Tropical Group of the British Ecological Society, and as Vice-President of the Linnean Society of London (1967), a member of the editorial board of the *Biological Journal of the Linnean Society*, and as Convenor of S.I.L.'s African Great Lakes Group (1987–1989). She was also an original member of the Association for Tropical Biology, and was elected a Fellow of the Linnean Society in 1957.

Her teaching duties have included courses on fish ecology at Makerere University in Uganda, the tropical fisheries component of M.Sc. courses at Salford University in the U.K., and ecology and environmental concern 'further education' courses at Sussex University. She has also acted as a Ph.D. supervisor at the Open University, U.K., and has been external examiner for numerous higher degree theses from universities in various parts of the world.

Concluding comments

Rosemary Lowe-McConnell has named six new

Table 1. Fish species and subspecies described by Dr Rosemary Lowe-McConnell.

Order	Family	Species	Reference
Perciformes	Cichlidae	<i>Tilapia saka</i>	Lowe (1953)
		<i>Tilapia girigan</i>	Lowe (1955)
		<i>Tilapia jipe</i>	
		<i>Tilapia pangani</i>	
		<i>Tilapia mossambica karogwe</i>	
Carcharhiniformes	Mustelidae	<i>Mustelus higmani</i>	Springer & Lowe-McConnell (1963)

species or subspecies of fishes (Table 1), including a new *Tilapia* (now *Oreochromis*) from southern Lake Malawi, three tilapia species and one subspecies from the Pangani River system in East Africa, and the smallest member of the genus *Mustelus*, the smooth dogshark, from the Atlantic coast of South America. Two species of aquatic organisms have been named after her, a pelagic catfish from Lake Malawi (*Bathyclarias loweae* Jackson, 1959) and an ephemeropteran (*Afroptilum loweae* Kimmins, 1949). During her fieldwork she collected many other new species of African and South American fishes that were lodged in the British Museum (Natural History) and subsequently sent to specialists throughout the world to be described and named. In the Mato Grosso alone she probably collected at least 50 species of fishes that were new to science.

Her career has been characterised by an indomitable spirit, a rare ability to identify trenchant bi-

ological traits in a fish, and a disregard for personal comfort and well-being in the pursuit of her goals. She is an energetic fieldworker, efficient laboratory scientist and enthusiastic conference-goer. Probably no other freshwater fish biologist has made such good use of opportunities to study the ichthyofaunas of different parts of the tropics (Fig. 13). Ichthyologists and fisheries scientists in developed and developing countries will always be grateful to her for the way in which she has combined her extensive field experience and thorough knowledge of theory to produce a series of outstanding books on tropical fishes, and contributed numerous voucher specimens to museum collections for later study.

Ro's wide travels and outgoing personality have resulted in her establishing a wide network of collaborating ecologists and taxonomists. These colleagues have aided her greatly in her work and made her multidisciplinary approach possible. Her



Fig. 13. Ro snorkel-diving in the Maldives on a fishwatching holiday in 1989. Photograph by Peggy (M.E.) Varley (née Brown).



Fig. 14. Ro was a frequent visitor to ET even after the latter moved to live with her sister in Reading. Photograph by E.K. Balon in 1990.



Fig. 15. Ro among the magnolias at the Sheffield Park Gardens on 3 June 1990. Photograph by E.K. Balon.



Fig. 16. Rosemary Lowe-McConnell resides in the south of England near Hassocks in a lovely house (a) overlooking a wide valley (b). Photograph by E.K. Balon, June 1990.

partnership with Ethelwynn Trewavas has, in particular, been most fruitful and enduring (Fig. 14, 15, 16). During her career she has worked on many of the great waterbodies of the world – lakes Malawi, Victoria and Turkana, the Okavango Swamps, Amazon and Niger rivers, and has tackled some of the most problematic fish groups, such as the tilapias, loricariids, sciaenids and characids. But her greatest contribution has been her ecological syntheses, the pulling together of threads on a diverse array of themes ranging from seasonality, evolution, predation pressure, reproductive cyclicality,

population dynamics, the effect of environmental fluctuations on fish biology and the impact of man-made lakes. She has always regarded ecology and behaviour as opposite sides of the same coin, and is fascinated by the way that they have contributed to evolution. She has gone to considerable lengths to bring fish ecological studies to the attention of general ecologists so that the vast array of data on fishes could be incorporated into the ecological mainstream. Although she worked on such a broad canvas, her contribution has been striking – rarely is a paper on tropical freshwater fishes published with-

out citing her work. Her life's work has truly contributed to unifying concepts in ecology.

Acknowledgements

I am grateful to Ro for the hours of enjoyable discussions and for the letters that we have exchanged during the preparation of this brief biography, which by no means does her accomplishments justice, but is perhaps a starting point for a more comprehensive biographer. I am also grateful to Ethelwynn Trewavas, Peter Jackson, Eugene Balon, Humphry Greenwood, David Noakes, Jean Pote, Carolynn Bruton, Margaret Crampton, Sheila Cou-touvidis and Kathy Holden for their assistance.

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Rosemary Lowe-McConnell and Mike Bruton at the Freshwater Biological Association's laboratory at The Ferry House, Ambleside, Lake Windermere, England, in July 1990. Photograph by Paul Skelton.