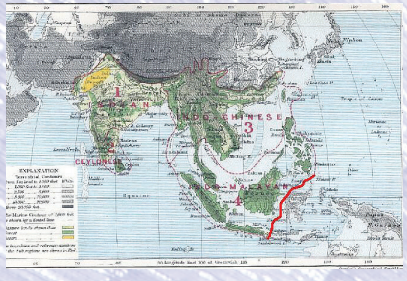
Wallace and biodiversity

Wallace first became interested in biodiversity while working as a surveyor in South Wales. This interest developed over the years and culminated in his first major field expedition to the Amazon and Rio Negro river basins. Though he lost virtually all of his specimens from this trip, he still managed to produce a number of books and papers describing, amongst other things, *'The Palm Trees of the Amazon and Their Uses'*.

In 1854, the Royal Geographical Society funded a second major field expedition, to the Malay Archipelago (modern day Indonesia). Over the course of his travels in Indonesia, he undertook about seventy different expeditions, travelling more than 22,000 km. He collected an incredible 125,660 specimens, including more than a thousand species new to science.

In addition to his contribution to *'On the Origin of Species'*, Wallace also studied the biogeography of the region. Wallace's most famous discovery was the faunal discontinuity that now bears his name: "Wallace's Line". This line marks the eastern limits of many Asian fauna and western limits of many Australasian fauna.

Early draft of "Wallace's Line"



How do we classify the biodiversity that surrounds us?

Scientist classify plants and animals according to characteristics that make them unique, as well as similar. This binomial classification system places organisms into discrete and hierarchical groups with other closely related species. These characteristics and relationships are the result of evolutionary processes acting over geological time.

The classification systems that scientists use today is based on the work of many different scientists and hundreds of years of work. However, as science advances and new knowledge and techniques are developed, our understanding of how such organisms are related is likely to change.

Physical features and, increasingly, molecular DNA techniques are used to assess the relatedness of organisms. Molecular DNA methods enable scientists to show relatedness without the problem of morphological convergence, that may hinder classification.

What is biodiversity?

"A definition of biodiversity that is altogether simple, comprehensive, and fully operational ... is unlikely to be found." (Noss, 1990)

A useful, working definition for biodiversity can be stated as:

"Biodiversity is the total of genes, species, and ecosystems in a region... Biodiversity can be divided into three hierarchical categories: i) genes; ii) species and iii) ecosystems. These categories describe quite different aspects of living systems and scientists must measure them in very different ways." (Global Biodiversity Strategy, 1992)

Genetic diversity refers to the variation of genes within species. This covers distinct populations of the same species (such as the thousands of traditional rice varieties in India) or genetic variation within a populations (high among Indian rhinos and very low among cheetahs).

Species diversity is the variety and abundance of different types of organisms which inhabit an area. Areas of the world with high species diversity include tropical rain forests and coral reefs.

Ecosystem diversity encompasses the variety of habitats that occur within a region or the mosaic of patches found within a landscape.

2010 International Year of Biodiversity

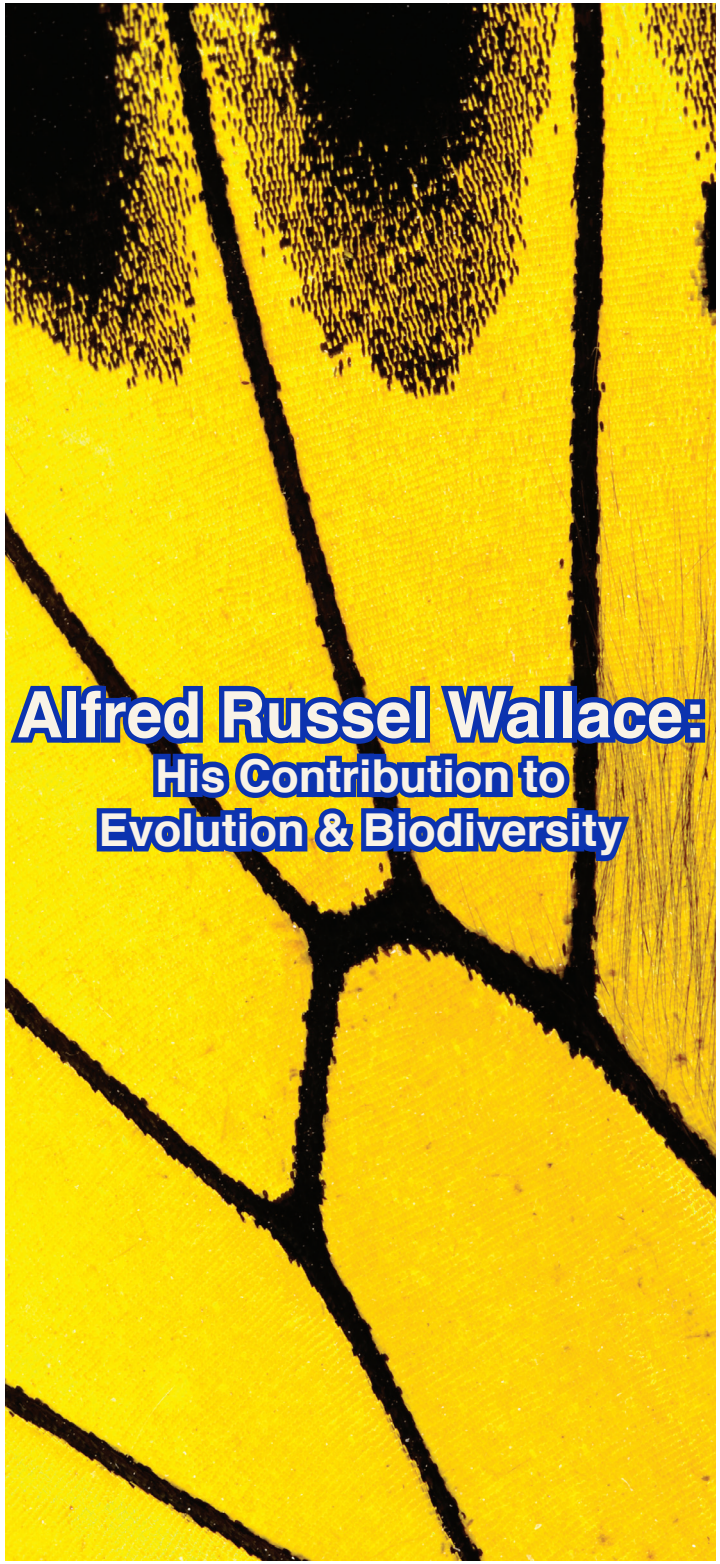
This year (2010) has been declared by the United Nations (UN) as the International Year of Biodiversity. The International Year of Biodiversity is a unique opportunity to increase understanding of the vital role that biodiversity plays in sustaining life on Earth and how biodiversity relates to you.

The International Year of Biodiversity aims to join people all over the world to work together to safeguard this irreplaceable natural wealth and reduce biodiversity loss. This is vital for current and future human well-being. We need to do more. Now is the time to act.

Get involved at http://www.cbd.int/2010/welcome/

Visit The Natural History Museum online for more on Alfred Russel Wallace and his contribution to biodiversity (http://www.nhm.ac.uk/nature-online/evolution/how-did-evol-theory-develop/evol-wallace/).

Created by Daniel Jones and Denis Murphy
School of Biology, University of Glamorgan
Images courtesy of Steve Pike and James Turner
University of Glamorgan and National Museum Cardiff
@DLJ/DJM



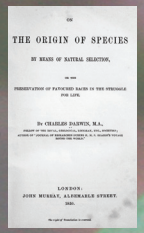
Alfred Russel Wallace:
His Contribution to Evolution & Biodiversity

Alfred Russel Wallace

Wallace was an explorer, collector, naturalist, geographer, anthropologist, geologist as well as a social and political campaigner. He founded the science of biogeography and was the co-discoverer, with Charles Darwin, of the process of evolution by natural selection. Although he is less well known than Darwin today, Wallace was equally celebrated during his lifetime. Indeed, it was only the wishes of the Wallace family that prevented him from being buried alongside Darwin in Westminster Abbey.

Wallace's interest in the natural environment, that ultimately led to the publication of perhaps the most well-known biology text ever, *'On the Origin of Species'* was fostered in his native country of Wales.

Wallace quote: *"Now, I have some reason to believe that this was the turning point of my life, the tide that carried me on, not to fortune but to whatever reputation I have acquired, and which has certainly been to me a never-failing source of much health of body and supreme mental enjoyment."*


ON
THE ORIGIN OF SPECIES
BY MEANS OF NATURAL SELECTION,
OR THE
PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.
By CHARLES DARWIN, M.A.,
LONDON:
JOHN MURRAY, ALBEMARLE STREET.

Wallace's name is now inextricably linked with his travels in the Malay Archipelago (modern Indonesia). During his time in Indonesia he undertook about seventy different expeditions, traveling more than 22,000 km. He collected an incredible 125,660 specimens, including more than a thousand species new to science.

Beyond his travel and collecting activities, Wallace's time in the Malay Archipelago was marked by the 1858 event that would assure his place in history. In February of 1858, while suffering from an attack of malaria, Wallace formulated the concept of the "survival of the fittest," in which those individual organisms that are best adapted to their local surroundings are seen to have a better chance of surviving, and of passing their traits (both physiological and behavioural) to their progeny.

Excited about his ideas, Wallace wrote an essay on the subject and sent it to Darwin. Darwin had similar ideas for nearly twenty years, however, he had not published his work. It was decided to present Wallace's essay, along with some unpublished fragments from Darwin's writings on the subject, to the next meeting of the Linnean Society on 1 July 1858. Darwin's well known book *'On the Origin of Species'* was published less than eighteen months later, in November of 1859.

Wallace was especially known for his studies on the biogeography of Indonesia, including his discovery and description of the faunal discontinuity that now bears his name: "Wallace's Line". This line marks the eastern extent of many Asian fauna and western extent of many Australasian fauna.

Visit The Alfred Russel Wallace Website (http://wallacefund.info/) for further information.

Evolution

Evolution, by natural selection, is the change that occurs over generations of animals, plants and other living organisms over time. The incredible diversity of life on Earth is a result of these evolutionary processes acting on individual organisms.

Wallace and Darwin spent years studying plants and animals in great detail to test their ideas on this theory. There are several key ideas which make up the theory.

The drive to survive

For most organisms, life is a struggle. The need to find food and avoid predators is key to survival.

Many simple organisms produce a large number of offspring as a way of ensuring at least one survives to have offspring of its own. Conversely, longer-lived organisms such as humans invest more resources into the production of fewer offspring, that are likely to have an increased chance of survival and reproduction.

Variation – different can be good

By looking closely and recording carefully, Wallace and Darwin noticed differences between animals and plants of the same species. Wallace studied a wide range of organisms, including the beetles that you can see here. Sometimes having features different to others of your kind can increase your chance of surviving long enough to reproduce, while the rest don't.

This is happening all the time in nature. Darwin called the process natural selection, but it is often described in the famous phrase 'survival of the fittest'

It is natural selection which drives the process of evolution.

The birth of a new species

During his work in the Amazon basin, Wallace came to realise that geographical barriers—such as the Amazon and its major tributaries—often separated the ranges of closely allied species, and he included these observations in his 1853 paper 'On the Monkeys of the Amazon'.

Both Wallace and Darwin came to the conclusion that geographic separation of species can lead to the evolution of new species, a process termed "speciation".

Evidence for evolution: Light and dark forms of the Peppered Moth.

The Peppered Moth has two colour forms, light and dark. Prior to industrialisation, light coloured individuals were more common as this helped camouflage them against light coloured lichens on trees.

Widespread pollution during the Industrial Revolution of the 19th century killed lichens and blackened trees. The light coloured moth was then at a disadvantage, as it was no longer camouflaged against the blackened trees. Numbers of the light coloured moth declined and the dark coloured (melanic) form flourished instead.

Colour change in animals, as a result of pollution is known as 'industrial melanism'. More recently, light coloured Peppered Moths have become more common as pollution has been reduced.

The Peppered Moth (*Biston betularia*)

Updating Darwin

Science is always in a process of evolution: as new ideas and technologies develop, our understanding of how our world and the life within it expands.

Since the publication of 'On the Origin of Species', leaps forward in technology and understanding have led to important discoveries have improved our understanding of how evolution works :

It is a testament to the strength of the theory of evolution that all the recent discoveries have provided more support for it.

Get involved in the Evolution MegaLab Project that is investigating evolution in the common banded snail (*Cepaea* spp) right now! http://www.evolutionmegalab.org/