

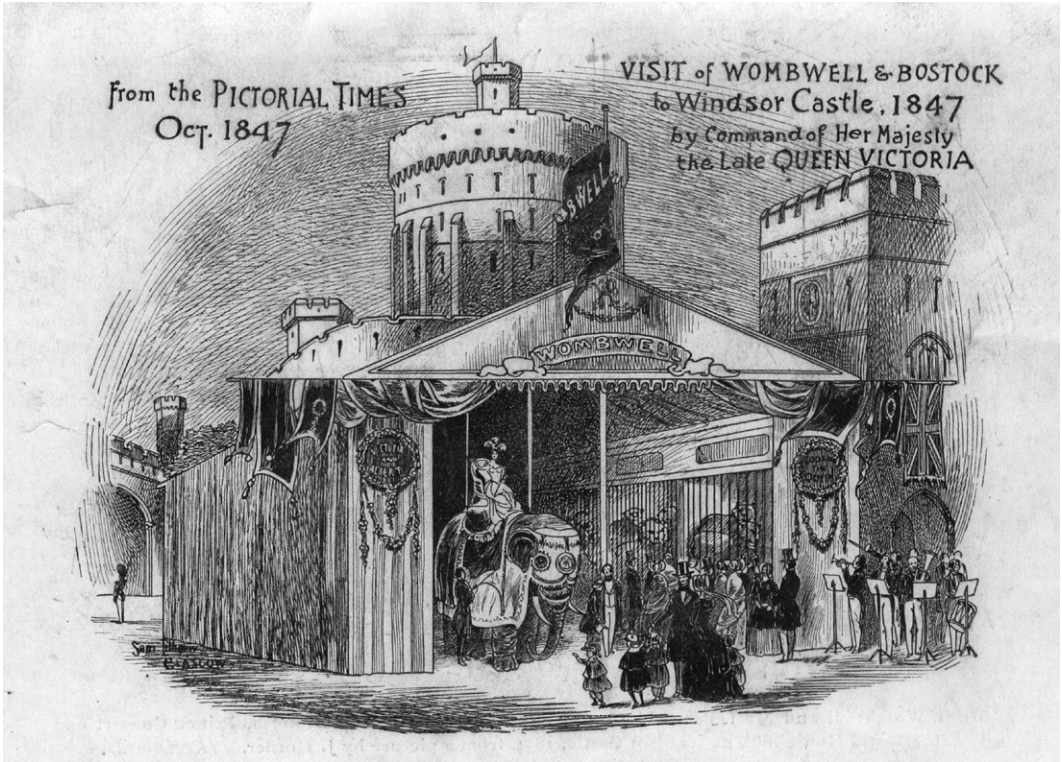
DICTIONARY OF  
**ZOO BIOLOGY  
AND ANIMAL  
MANAGEMENT**

PAUL A. REES

 WILEY-BLACKWELL



# Dictionary of Zoo Biology and Animal Management



The back cover of the catalogue of Bostock and Wombwell's Royal No. 1 Menagerie (1917 edition), illustrating a visit to Windsor Castle in 1847. (Courtesy of Chetham's Library, Manchester.)

# Dictionary of Zoo Biology and Animal Management

*A guide to terminology used in zoo biology, animal welfare,  
wildlife conservation and livestock production*

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 **WILEY-BLACKWELL**

A John Wiley & Sons, Ltd., Publication

This edition first published 2013 © 2013 by John Wiley & Sons, Ltd.

Wiley-Blackwell is an imprint of John Wiley & Sons, formed by the merger of Wiley's global Scientific, Technical and Medical business with Blackwell Publishing.

*Registered office:* John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

*Editorial offices:* 9600 Garsington Road, Oxford, OX4 2DQ, UK  
The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK  
111 River Street, Hoboken, NJ 07030-5774, USA

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*Library of Congress Cataloging-in-Publication Data*

Rees, Paul A.

Dictionary of zoo biology and animal management / Paul A. Rees.

pages cm

Includes bibliographical references and index.

ISBN 978-0-470-67148-1 (cloth) – ISBN 978-0-470-67147-4 (pbk.) 1. Zoology–Terminology. 2. Wildlife conservation–Terminology. 3. Animal welfare–Terminology. 4. Livestock–Terminology. I. Title.

QL10.R44 2013

590.3–dc23

2012031386

A catalogue record for this book is available from the British Library.

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

Cover image: Male western lowland gorilla (*Gorilla gorilla gorilla*)

Cover design by Simon Levy Associates

Set in 8/10 pt Meridien by Toppan Best-set Premedia Limited

# Contents

<b>Preface</b>	<b>viii</b>
<b>Acknowledgements</b>	<b>x</b>
<b>How to use this book</b>	<b>xi</b>
<b>A note on classification</b>	<b>xii</b>
<b>Alphabetical entries</b>	<b>1</b>
<b>Acronyms and abbreviations</b>	<b>315</b>
<b>References</b>	<b>321</b>





## For Katy, Clara, Mum and Dad

*'There's nothing more interesting than an orangutan'.*

Terry Maple (in a lecture given at a symposium held at Detroit Zoo 6 – 7 August 2011: *From Good Care to Great Welfare – Advancing Zoo Animal Welfare Science and Policy*).

An entry from the journal of Princess Victoria, aged 17 years, following a visit to the Zoological Gardens in Regent's Park, London on Saturday 18 June 1836, the year before her coronation. (An extract from Lord Esher's typescripts of Queen Victoria's Journals, volume 2, page 19, The Royal Archives.)

*'At 10 we went with Lehzen to the Zoological Gardens to see the Giraffes. There are four; they are young and not full grown, though already very tall, and are in very good health. There is a Frenchman and 3 Nubians with them. The Frenchman, from having been a long time in Africa, has adopted the costume of a native and wears a long beard. The natives are of a dark mahogany complexion, and wear red caps like the Turks. Two wore long, loose linen robes, which reached to above their ankles; the youngest, who was only 18 years old, had his face tattooed and wore a blue calico dress. The Giraffes have beautiful large black eyes, and are very good tempered.'*

# Preface

This book is intended, in part, as a companion to my previous work, *An Introduction to Zoo Biology and Management* (Wiley-Blackwell). It focuses on zoo animals, farm animals and companion animals and covers a wide range of topics from animal anatomy to zoo history. I hope it will be useful as a source of information for students studying a wide range of courses concerned with the management of animals, and professionals working in these areas.

In addition to entries directly concerned with the management of animals, I have also included terms which readers may encounter in the course of their studies or words which will help them to appreciate the context in which animal management occurs. For example, I have included definitions of legal terms and entries describing particular laws (including international treaties) which are relevant to agriculture, conservation, companion animals, hunting, sport and zoos. I have also included a number of ecological terms which, although they might be better placed in a dictionary of ecology, are important in understanding interactions within natural populations and in describing the habitats that zoos often attempt to simulate in naturalistic exhibits, or to which they may refer in the interpretation of their exhibits.

Zoo biology is a relatively new discipline and I have placed considerable emphasis on terms used in this field. The academic journal *Zoo Biology* only came into existence as recently as 1982, although the concept of a science devoted to the study of animals living in zoos can be traced back to the work of Heini Hediger. He wrote a number of important books including *Studies of the Psychology and Behaviour of Captive Animals in Zoos and Circuses* (1955), *Wild Animals in Captivity: an Outline of the Biology of Zoological Gardens* (1964) and *Psychology and Behaviour of Animals in Zoos and Circuses* (1969). I have attempted to include a very wide range of terms that anyone studying zoo biology or animal management, or a related subject, might encounter. In total there are over 5000 entries, including terms used in:

- Agriculture
- Animal behaviour
- Animal husbandry
- Animal welfare
- Biochemistry
- Cell biology
- Companion animal studies
- Ecology

- Experimental design
- Histology
- Law
- Nutrition
- Parasitology
- Physiology
- Reproduction
- Statistics
- Veterinary science
- Wildlife conservation
- Zoo biology

Some of the terms defined in this book may have additional meanings in common usage and other specific meanings in other disciplines which have been omitted. For example, 'saltation' has a meaning in relation to genetics and evolution, and is also a method of locomotion. Both of these definitions are of interest in the context of this book. However, the term also has a meaning in geology which is unlikely to be of interest to readers of this work, so this has been omitted. I have attempted to give only brief definitions of terms likely to be explained elsewhere (e.g. in a biology dictionary) and more detailed accounts of terms which are the proper concern of a specialised dictionary of zoo biology and animal management.

A number of references are made to the laws of various countries. By its very nature, law changes over time and the reader should not assume that any legal references necessarily relate to current law. In some cases I have made specific reference to laws which are no longer in force because of their historical importance. In other cases I have referred to legal definitions to illustrate the differences between the meaning of words between legal jurisdictions and the differences between the scientific and legal meanings of a particular term.

Several years ago my daughter and an ex-student both independently gave me the same small poster with a picture of an elephant and a speech bubble declaring 'Those of you who think you know everything are annoying to those of us that do.' I prefer to think that these gifts were selected because of my fondness for elephants rather than the sentiment expressed by the text. There is nothing more humbling than writing a dictionary and finding that you have to look up the meaning of most of the words you want to include. However, I remember reading J. Z. Young's *Life of Vertebrates* many years ago as a young undergraduate and

being surprised that he did not already know everything he had written in his book. In his preface he wrote: *'A glance through the book will show that I have not been successful in producing anything very novel . . . However, I have very much enjoyed the attempt, which has provided the stimulus to try to find out many things I had always wanted to know.'* Young's book was just about vertebrates. This book is about many subjects and it has been impossible for me to include all of the things I

should like to have included. A colleague once advised me never to buy a tool that purports to serve more than one function, as it would perform none of them properly. In writing a book that attempts to explain words used in such a very wide range of disciplines I hope I have not made this mistake.

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# Acknowledgements

A number of people have assisted with the supply of suitable photographs for this book. I am grateful to Radosław Fedaczyński, Andrzej Fedaczyński and Jakub Kotowicz of the Rehabilitation Centre for Protected Animals in Przemyśl, Poland, for allowing me to reproduce the photograph in Fig. S11 and to Jane Muskett who allowed me access to the archives of Belle Vue Zoo – at Chetham’s Library in Manchester – which include the material photographed for Fig. B7 and the frontispiece. I am also grateful to Shaun Williams, for allowing me to photograph a number of the facilities at Reaseheath College (Fig. F2, I2, L2, S9), and Louise Bell at Blackpool Zoo for access to the materials photographed for Fig. T4. My daughter Clara kindly took the image used for Fig. T6, and my colleague Sandra Hickman kindly allowed me to reproduce the image used for Fig. C6. The images used in Figs. C5 and J3 were obtained from the Library of Congress Prints and Photographs Division, Washington DC. Extracts of the law of the United Kingdom are reproduced

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At Wiley-Blackwell I am indebted to Ward Cooper (Senior Commissioning Editor, Ecology, Conservation and Evolution) for believing that this project was worthwhile, Kelvin Matthews (Project Editor) for his assistance and encouragement throughout the production process, and Kenneth Chow (Production Editor). This book could not have been produced without the efforts of Ruth Swan (Toppan Best-Set Premedia Limited), Brenda Sibbald and Joanna Brocklesby MRCVS, and I thank them for their patience and help during the production process.

I am grateful to many of my colleagues and students who have unwittingly given me ideas for terms to include in this dictionary. Finally, I must thank my wife Katy, for pretending not to notice that I have been too busy with this book to learn to use our new washing machine.

# How to use this book

Items are listed alphabetically by the first letter of the term described (headword), except where the first word is usually 'the' or 'a'. So, for example, 'The Royal Society for the Prevention of Cruelty to Animals' is listed under 'R' not 'T'. Plurals are included in the headwords and indicated with *pl.* and adjectives with *adj.* where these are not obvious. English spellings have been used for the headwords with American English spellings added after the first headword and cross-referenced. In some cases the main entry for a term appears under its abbreviation, especially where this is widely used, e.g. RNA. A list of acronyms and abbreviations is provided at the back of the book. Under each headword references to other entries are indicated in **BOLD AND SMALL CAPITALS**. I have

attempted to provide cross-references within each entry which are essential to the understanding of the text therein or which may be of particular interest. However I have not cross-referenced every single mention of common terms such as 'blood' or 'zoo' as this would have meant that some entries consisted almost entirely of cross-references. Terms which the reader may wish to consult for comparison are indicated in each entry after the word '*compare*' and additional entries that may be of interest are indicated after the words '*see also*'. The titles of legislation are followed by the name of the country where the law applies except where this is part or all of the United Kingdom, e.g. **Marine Turtles Conservation Act of 2002 (USA)**, **Wildlife and Countryside Act 1981**.

# A note on classification

This work is not primarily concerned with the classification of animals but I have included short entries on a wide range of taxa, particularly within the mammals, birds and fishes. The classifications used were based on those adopted by the following publications:

Nelson, J.S. (1994) *Fishes of the World*. Wiley-Interscience, New York.

Nowak, R.M. (1999) *Walker's Mammals of the World* (6<sup>th</sup> ed). Johns Hopkins University Press, Baltimore and London.

Peters, J.L., Mayr, E., Greenway, J.C. *et al.* (1931–1987) *Check-list of Birds of the World* (volumes 1–16). Museum of Comparative Zoology, Cambridge, Mass.



**Fig. A1** A is for aardvark (*Orycteropus afer*).

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**A** See **ADENINE (A)**

**aardvark (*Orycteropus afer*)** Traditionally the animal that represents the letter A in the alphabet. It is the only extant member of the mammalian family Orycteropodidae. Adults are the size of a small pig, with little body hair (Fig. A1). The aardvark is **NOC-TURNAL** and lives in underground burrows. It possesses large ears, a long snout and a long thin tongue which it uses for collecting insects. Its limbs are specialised for digging (see also **FOSSORIAL**). Aardvarks occur in Africa south of the Sahara.

**AAZK** See **AMERICAN ASSOCIATION OF ZOO KEEPERS (AAZK)**. See also **KEEPER ASSOCIATION**

**AAZPA** American Association of Zoological Parks and Aquariums, now the **ASSOCIATION OF ZOOS AND AQUARIUMS (AZA)**. See also **ZOO ORGANISATION**

**Abandonment of Animals Act 1960** An Act in Britain that made it a criminal offence to abandon an animal, or permit it to be abandoned, in circumstances likely to cause the animal any unnecessary **SUFFERING**. The Act was repealed and effectively replaced in England and Wales by the **ANIMAL WELFARE ACT 2006** and in Scotland by the Animal Health and Welfare (Scotland) Act 2006.

**ABC species** The species that visitors expect to see in a traditional zoo that are often used to illustrate letters of the alphabet, e.g. **AARDVARK**, bear, camel, deer, elephant, **ZEBRA** etc. See also **AMBASADOR SPECIES**

**abdomen**

**1.** The part of the body between the thorax and the pelvis in vertebrates, bounded by the diaphragm in mammals but not other classes. It contains the viscera (e.g. most of the organs of the digestive system, kidneys etc.).

**2.** The part of the trunk of the body which is posterior to the thorax in arthropods.

**abdominal skinfold** A method of measuring **OBESITY** by assessing the amount of excess fat under the skin around the **ABDOMEN (1)**. The method has been used in chimpanzees. See also **BODY CONDITION SCORE, BODY MASS INDEX (BMI)**

**abductor muscle** A muscle that moves a limb or other structure away from the centre line (midline) of the body. Compare **ADDUCTOR MUSCLE (1)**

**abiotic** Without life.

**abiotic environment** See **PHYSICAL ENVIRONMENT**

**abiotic stress** Stress caused by non-biological factors in the environment, e.g. heat and cold.

**abnormal behaviour** A general term for behaviour which is not part of the usual (normal) repertoire of a species, especially that which is exhibited in the wild. May occur as a result of a pathological condition, including **ANXIETY** and **STRESS**, and is sometimes observed in captive animals. See also **APATHY, STEREOTYPIC BEHAVIOUR**

**abomasal ulcer** An ulcer in the **ABOMASUM**. A common disease in cattle, especially milk-fed calves.

Causes loss of appetite, poor growth and, in extreme cases, death from bleeding.

**abomasum** In **RUMINANTS**, the fourth (and last) stomach. It is a 'secretory stomach' the lining of which produces hydrochloric acid and **PROTEOLYTIC ENZYMES**, and is therefore equivalent to the stomach of other mammals.

**aboral** Located on the side of the body opposite the mouth, especially in relation to **ECHINODERM** anatomy. Compare **ORAL**

**abortion, miscarriage** The natural or intentional termination of a pregnancy by the removal or expulsion of the **EMBRYO** or **FOETUS**. Spontaneous abortion (miscarriage) may result from a problem that arises during the development of the embryo or foetus (e.g. infection, **UMBILICAL CORD TORSION**, congenital defects) or abortion may be induced by a veterinary surgeon, e.g. to preserve the health of the pregnant female.

**abrasion**

**1.** A scraped area of the skin or a **MUCOUS MEMBRANE** which has been caused by an injury or irritation.

**2.** Pathological wearing away of the teeth by grinding.

**abscess** A swollen, inflamed area of the body containing a collection of **PUS** formed by the disintegration of tissue. May be caused by the presence of disease (e.g. bacteria, parasites) or a foreign object (e.g. a bullet wound, wood splinter). Depending upon the cause and condition, may be treated with antibiotics and may need to be surgically drained.

**absorption**

**1.** The uptake by cells of water by (**OSMOSIS**) and/or solutes (e.g. by **DIFFUSION** or **ACTIVE TRANSPORT**).

**2.** In the digestive system, the passage of water and solutes through the gut wall into the blood system.

**ABWAK** See **ASSOCIATION OF BRITISH AND IRISH WILD ANIMAL KEEPERS (ABWAK)**. See also **KEEPER ASSOCIATION**

**abyssal** Relating to the depths of the oceans. The abyssal zone is located between approximately 2000 and 6000 m below the surface of the sea, and is in perpetual darkness, cold and nutrient poor.

**academic journal** A periodical publication in which original scientific and other academic work is published after a process of **PEER REVIEW** (Table A1). See also **ACADEMIC PAPER**

**academic paper** A paper (article) published in an **ACADEMIC JOURNAL**, which describes the results of an original scientific study, discusses a scientific problem, reviews research published on a particular subject, or is an account of some other academic endeavour.

**acarasis** A skin condition caused by mites and ticks.

**acaricide, acaridicide** A substance which kills mites and ticks.

**accelerometer** An electronic device that detects movements by measuring acceleration. A tri-axial



**Table A1** Selected academic journals which publish original scientific studies of interest in zoo biology and animal management.

Acta Primatologica	Journal of Environmental Education
Acta Zoologica	Journal of Equine Veterinary Science
African Journal of Ecology	Journal of Experimental Psychology
American Journal of Primatology	Journal of Experimental Zoology
American Naturalist	Journal of Field Ornithology
Animal	Journal of Herpetology
Animal Behaviour	Journal of International Wildlife Law and Policy
Animal Conservation	Journal of Mammalogy
Animal Genetics	Journal of Medical Primatology
Animal Production Science	Journal of Parasitology
Animal Welfare	Journal of Reproduction and Fertility
Anthrozoös	Journal of the Bombay Natural History Society
Applied Animal Behaviour Science	Journal of Theoretical Biology
Aquatic Conservation: Marine and Freshwater Ecosystems	Journal of Tourism Studies
Auk	Journal of Veterinary Behavior
Avian Diseases	Journal of Veterinary Epidemiology
Behaviour	Journal of Veterinary Science
Biodiversity and Conservation	Journal of Wildlife Diseases
Biological Conservation	Journal of Wildlife Management
BioScience	Journal of Wildlife Rehabilitation
Bird Study	Journal of Zoo and Aquarium Research
British Poultry Science	Journal of Zoo and Wildlife Medicine
Canadian Journal of Animal Science	Journal of Zoology
Canadian Journal of Zoology	Laboratory Animal Science
Companion Animal	Laboratory Primate Newsletter
Consciousness and Cognition	Leisure Studies
Conservation	Mammal Review
Conservation Biology	Molecular Ecology
Conservation Genetics	Museum Studies
Conservation Letters	Nature
Copeia	Oryx – The International Journal of Conservation
Current Trends in Audience Research	Parks and Recreation
Ecology and Evolution	PLOS Biology
Environment and Behavior	Primate Report
Equine Veterinary Journal	Reproductive Biology and Endocrinology
Ethology	Restoration Ecology
Fisheries Research	Science
Folia Primatologica	Scientific American
Folia Zoologica	Sexuality, Reproduction and Menopause
Frontiers in Zoology	Social Cognitive and Affective Neuroscience
Herpetological Journal	Society and Animals Journal
Human Dimensions of Wildlife	South African Journal of Wildlife Research
Ibis	The Bulletin of Zoological Nomenclature
Insect Conservation and Diversity	The Veterinary Journal
International Journal of Fisheries and Aquaculture	Trends in Ecology and Evolution
International Journal of Livestock Production	Trends in Neurosciences
International Journal of Primatology	Tropical Animal Health and Production
International Journal of Zoonoses	Veterinary Ophthalmology
International Zoo Educators Journal	Veterinary Pathology
International Zoo Yearbook	Veterinary Quarterly
Journal of Agricultural Science	Veterinary Record
Journal of Animal Ecology	Visitor Behavior
Journal of Animal Physiology and Animal Nutrition	Visitor Studies
Journal of Animal Production	Wildlife Society Bulletin
Journal of Animal Science	Zoo Biology
Journal of Applied Animal Welfare Science	Zoologica
Journal of Aquatic Animal Health	Zoological Journal of the Linnean Society
Journal of Biological Macromolecules	Zoonoses and Public Health
Journal of Comparative Psychology	Zoos' Print Journal
Journal of Dairy Science	

accelerometer can detect movement in three dimensions. May be used to detect movements of animals and sometimes built into a collar incorporating a **DATA LOGGER** or wireless transmitter. Accelerometers have been used to study swimming behaviour in sharks, walking in zoo elephants, 'flying' behaviour in colugos (**DERMOPTERA**: flying lemurs), and movements of cattle on farms.

**acceptable daily intake** The daily amount of a substance (e.g. a nutrient, vitamin, food additive or pollutant) that an animal may safely consume throughout its life.

**accidental** An animal which occurs in a particular location by accident. Often applied to birds blown off course so that they appear in an area which is outside their normal range.

**acclimation** See **ACCLIMATISATION**

**acclimatisation, acclimation** A reversible adjustment made by an organism to the local environmental conditions. Usually occurs in nature in response to seasonal climate changes. Also occurs in fish when introduced to a new tank. See also **NEW TANK SYNDROME**

**accredited herd** In the UK, a herd of animals that has been registered as being free from certain diseases, e.g. **BRUCELOSIS**, Johne's disease, **LEPTOSPIROSIS**.

**accredited vet** See **APPROVED VET**

**accredited zoo** A **ZOO** which is accredited by a zoo organisation, e.g. AZA-accredited zoo. Accreditation is conditional upon the zoo conforming to a number of standards in relation to, for example, **ANIMAL WELFARE**, **ENCLOSURE DESIGN**, provision of **ENVIRONMENTAL ENRICHMENT** etc.

**acetylcholine (ACh)** A **NEUROTRANSMITTER** which creates an **ACTION POTENTIAL** across the membrane of a neurone, thereby propagating a nerve impulse.

**acid** A chemical which produces hydrogen ions when dissolved in water. Acid solutions have a **pH** below 7.0.

**acidity** The relative concentration of hydrogen ions in a solution. Acid solutions have a high concentration of hydrogen ions and a **pH** of less than 7.0.

**acidosis** A condition in which there is a high proportion of acid waste such as urea in the blood. This may be the result of a number of conditions, for example **DIABETES MELLITUS**, kidney disease, respiratory acidosis (caused by **HYPOVENTILATION**), or lactic acidosis (when oxygen levels in the blood fall).

**Acipenseriformes** An order of fishes: sturgeons and their allies.

**acoelomate** Possessing no body cavity. Compare **COELOMATE**

**acoustic signalling** The use of sound as a method of communication in animals. Sound allows animals to produce a great variety of signals by varying frequency, pitch, loudness and temporal pattern. See also **ALARM CALL**

**acoustic tag** A small electronic device that emits radio signals whose presence is detected by listening stations. These tags may be attached to aquatic animals (e.g. manta rays, sharks) and used to record their movements.

**acoustic-lateralis system, lateral line system** A system for sensing the external environment in fish and some amphibians which consists of the **INNER EAR** region (which responds to sound and gravity) and lateral line organs in the skin (which respond to changes in water pressure and displacement).

**acrosome** A **LYSOSOME** in a sperm that contains enzymes capable of digesting a path through the covering of an egg during the process of **FERTILISATION**.

**Act of Congress** A statute enacted by the Congress of the United States of America (or other legislature called a congress), e.g. **ASIAN ELEPHANT CONSERVATION ACT OF 1997 (USA)**, **WILD BIRD CONSERVATION ACT OF 1992 (USA)**.

**Act of Parliament** Primary legislation of the UK and some other jurisdictions with a legislature called a parliament (especially countries within the Commonwealth). Many Acts are concerned with the welfare or conservation of animals, e.g. the **ANIMAL WELFARE ACT 2006** (England and Wales), **ZOO LICENSING ACT 1981** (Great Britain), **HEALTH OF ANIMALS ACT 1990 (CANADA)**.

**ACTH** See **ADRENOCORTICOTROPHIC HORMONE (ACTH)**

**actin** See **MUSCLE**

**actinomycosis** This disease occurs mainly in cattle and is one of several conditions known as 'LUMPY JAW'. It is caused by an anaerobic bacterium, *Actinomyces bovis*, which probably only becomes pathogenic by invading tissues through a wound. It commonly occurs when the permanent cheek teeth are erupting. Typically, lesions occur on the cheeks, pharynx and the jaws. Swelling in bone and other tissue may cause interference with mastication, swallowing or breathing depending on the location of the lesion. Antibiotics are rarely an effective treatment. Other *Actinomyces* species can cause infections in dogs, pigs, sheep, horses, reptiles and humans.

**Actinopterygii** A subclass of bony fishes: ray-finned fishes.

**action potential** The condition in which the inside of an **AXON** is positively charged and the outside is negatively charged which occurs when the nerve membrane is depolarised. This is the reverse of the situation when the axon is exhibiting the **RESTING POTENTIAL** (i.e. the electrical polarity is reversed). A nerve impulse is the result of the movement of this depolarised area along the axon. A similar process occurs in muscle cells when excited.

**activated charcoal** A highly porous form of carbon which has been processed to produce a very large surface area. Formed by heating wood and other

materials in the absence of oxygen. The large surface area makes the material suitable for the removal of unwanted chemicals by adsorption. Used in some filters in aquariums.

**active site** The region of an **ENZYME** that binds to the substrate when it catalyses a chemical reaction and gives the enzyme its specificity.

**active sleep** The part of the sleep cycle in mammals and birds during which **RAPID EYE MOVEMENTS (REM)** or ear movements occur and during which a characteristic **ELECTROENCEPHALOGRAPH (EEG)** is produced along with signs of **DREAMING**. Thermoregulatory mechanisms in animals do not respond to thermal stress during active sleep. This may be problematic for small mammals as their body temperature is influenced by ambient temperature much more than is the case in large mammals.

**active transport** The movement of molecules or ions across a biological membrane, against a chemical or electrochemical gradient, with the use of energy. The process uses 'pumps' made of **PROTEINS** which cross the **CELL MEMBRANE**.

**activity budget, behaviour budget** A description of the amount of time an individual animal spends on various activities during the day (e.g. feeding, sleeping, resting, walking, etc.) as defined by an **ETHOGRAM**. Usually expressed as a percentage (or proportion) of the total amount of time the animal is observed (Table A2). Data is often collected by instantaneous **SCAN SAMPLING**.

**acupressure** A treatment similar to **ACUPUNCTURE** but which involves the gentle massage of acupuncture points and channels.

**acupuncture** An ancient Chinese treatment that involves placing needles into special locations on the body to treat the pain associated with a wide variety of illnesses including **ARTHRITIS**, **HIP DYSPLASIA** and **SPONDYLOSIS**.

**acute condition** A disease or disorder which appears rapidly, lasts a short time, has distinct signs, and which may require short-term treatment and care. It may or may not be severe. *Compare* **CHRONIC CONDITION**

**ad lib** *See* **AD LIBITUM**

**Table A2** Activity budget: mean proportion of time active coyotes (*Canis latrans*) kept in outdoor pens spent exhibiting different behaviours (based on Shivik *et al.*, 2009).

Behaviour	Proportion of time
Resting	0.58
Locomotion	0.21
Standing	0.16
Foraging	0.03
Social	0.02
Eating	0.01

**ad lib feeder** An animal feeder designed in such a way that the animal may obtain food whenever desired.

**ad lib sampling, opportunistic sampling** In the context of studying behaviour, *ad libitum* sampling refers to opportunistic observations which are made at the convenience of the recorder or when the opportunity arises. This is especially important for some relatively rare behaviours (e.g. mating) which might be missed during other types of sampling, such as instantaneous **SCAN SAMPLING**. *Compare* **ONE-ZERO SAMPLING**

**ad libitum, ad lib** Latin for 'at one's pleasure'.

**Adamson, George (1906–1989) and Joy (1910–1980)** A game warden and his artist wife who lived in Kenya and became famous as a result of their successful rehabilitation of an orphaned lion cub (*Elsa*) who was returned to the wild, mated with a wild lion, and produced her own cubs. Joy Adamson wrote a book about Elsa entitled **BORN FREE** which became a bestseller and was made into a film of the same name. Bill Travers and Virginia McKenna played the Adamsons in the film and as a result of their experiences working with lions established the **BORN FREE FOUNDATION** and **ZOO CHECK**.

**adaptation**

1. A beneficial character possessed by an organism as a result of **EVOLUTION**, e.g. the ability to survive for long periods without water.
2. An adjustment made by a **SENSE ORGAN** to changes in the strength of stimulation; a reduction in the sensitivity of a sensory receptor due to use.
3. A behavioural change caused by **LEARNING** which allows the animal to adjust to a variety of environmental changes.
4. A physiological change which allows the animal to adjust to a change in climate, food quality etc. *See also* **ACCLIMATISATION**

**adaptive heterothermy** A physiological adaptation to heat stress found in some mammals that inhabit arid areas, e.g. camels, **ARABIAN ORYX (ORYX LEUCORYX)**. These animals allow their core body temperature to increase during the heat of the day, reducing evaporative losses by storing body heat. This excess heat is then lost to the environment at night.

**adaptive radiation** The evolutionary process which causes diversification from a single ancestral type which results in descendant **POPULATIONS** occupying increasing numbers of **ECOLOGICAL NICHES**.

**adductor muscle**

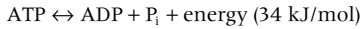
1. A muscle that moves a limb or other structure towards the centre line of the body. *Compare* **ABDUCTOR MUSCLE**
2. A muscle that closes the valves in a bivalve mollusc.

**adenine (A)** A **NUCLEOTIDE** base which pairs with T (thymine) in **DNA** and is also found in **ADENOSINE TRIPHOSPHATE (ATP)**.

**adenohypophysis** See **ANTERIOR PITUITARY**

**adenosine diphosphate (ADP)** See **ADENOSINE TRIPHOSPHATE (ATP)**

**adenosine triphosphate (ATP)** The energy 'currency' of the cell; a chemical which moves energy around the cell by releasing an inorganic phosphate ion (as a result of hydrolysis) and becoming adenosine diphosphate (ADP). ADP may combine with an inorganic phosphate ion ( $P_i$ ), using energy, to form ATP.



**adipose** Relating to cells or tissue where fat is deposited. See also **ADIPOSE TISSUE**

**adipose fin** A fatty, fin-like lobe located behind the **DORSAL** fin of some male **SALMONID** fishes.

**adipose tissue** A type of **CONNECTIVE TISSUE** which contains fat.

1. Brown adipose tissue (brown fat) appears to be concerned with the release of heat in neonate mammals and occurs around the neck and between the scapulae in these and hibernating mammals.

2. White adipose tissue occurs widely in animal bodies.

**adoption scheme** A method of fund-raising which involves visitors paying an annual subscription for the right to 'adopt' an animal kept in a zoo. The adopter may receive an adoption certificate, a photograph and updates on the animal's activities at regular intervals. The adopter's name is often displayed in a prominent place near the animal's enclosure. Similar schemes are used by wildlife conservation **NON-GOVERNMENTAL ORGANISATIONS (NGOs)** and animal **SANCTUARIES** to raise funds for conservation or animal welfare.

**ADP** See **ADENOSINE TRIPHOSPHATE (ATP)**

**adrenal cortex** The outer region of the adrenal gland which produces a number of hormones including **CORTISOL** and other glucocorticoids, aldosterone (which promotes water retention by the kidneys) and some sex (mainly male) hormones.

**adrenal gland** A hormone-secreting gland located near each kidney in most vertebrates. Consists of an inner **ADRENAL MEDULLA** and an outer **ADRENAL CORTEX**.

**adrenal medulla** The central region of the **ADRENAL GLAND** which secretes **ADRENALINE** (epinephrine) in response to **STRESS**. It also secretes a little **NORADRENALINE** (norepinephrine).

**adrenaline, adrenalin, epinephrine** A hormone secreted by the **ADRENAL MEDULLA** and to some extent by sympathetic nerve endings. It is secreted in response to fear, excitement and anger. Adrenaline increases heart rate and blood pressure, and diverts blood from the intestines and towards the muscles, preparing the body for 'flight or fright'.

**adrenocorticotrophic hormone (ACTH)** A hormone secreted by the **PITUITARY GLAND** which stimulates the release of a number of glucocorticoid hormones from the **ADRENAL CORTEX**, especially

**CORTISOL**. These stimulate the conversion of amino acids into glucose to provide energy.

**advertisement** A visual, oral or chemical display used by an individual to indicate the possession of a territory by a male, the fertility state of a female, or for some other reason. See also **ADVERTISEMENT CALL**

**advertisement call** A **VOCALISATION** used by animals, especially male frogs, during rivalry and **COURTSHIP**.

**aerial census** See **AERIAL SURVEY**

**aerial gunning** The use of aircraft to pursue and shoot animals. See also **AIRBORNE HUNTING ACT OF 1971 (USA)**

**aerial photography** The process of producing a film or digital image of the ground taken from an aircraft. May be used to count and record the location of wild animals (especially colonial birds or large grassland mammals), and to map vegetation types. See also **REMOTE SENSING, SATELLITE IMAGE**

**aerial survey, aerial census** A survey undertaken from the air, usually from a light aircraft. Often involves flying along invisible **TRANSECT** lines and counting animals within a strip of land of known length and width, sometimes utilising **AERIAL PHOTOGRAPHY**. Often used to count large mammals in **SAVANNA** habitats. See also **ELTRINGHAM**

**aerobic**

1. Of a chemical process which requires free oxygen, e.g. **AEROBIC RESPIRATION**.

2. Of an organism which requires oxygen to survive.

**aerobic respiration** The biochemical process by which cells extract the energy from sugars using oxygen. This begins with the splitting of glucose into two three-carbon sugars in the process of **GLYCOLYSIS**, thereby producing **ADENOSINE TRIPHOSPHATE (ATP)**. Each of these sugars enters the **KREBS CYCLE** and produces additional molecules of ATP. The **NAD** (an electron carrier) produced during glycolysis and the Krebs cycle generates further ATP via an **ELECTRON TRANSPORT SYSTEM** within the **MITOCHONDRIA**. The entire process produces 36–38 molecules of ATP from a single molecule of glucose, along with carbon dioxide and water.



Compare **ANAEROBIC RESPIRATION, FERMENTATION**

**aerosol delivery system** See **METERED DOSE INHALER (MDI), NEBULISER**

**aestivation, estivation** A dormant condition exhibited by some animals (e.g. lungfish) which allows them to avoid excessive heat during the summer or a dry period. Commonly occurs in desert species. See also **HIBERNATION**

**aetiology, etiology** The study of the cause or origin of a phenomenon, especially a disease or an **ABNORMAL BEHAVIOUR**, e.g. the aetiology of **STEREOTYPIC BEHAVIOUR** in a particular animal.

**AEWA** See **AGREEMENT ON THE CONSERVATION OF AFRICAN–EURASIAN MIGRATORY WATERBIRDS 1995 (AEWA)**

**affective states** Emotional states, e.g. happy, sad, excited, calm, aroused, alert.

**afferent** Conduction towards. For example, an afferent blood vessel carries blood towards the heart, an afferent nerve conducts impulses from the **SENSORY RECEPTORS** towards the **CENTRAL NERVOUS SYSTEM (CNS)**. Compare **EFFERENT**

**affiliative behaviour** A form of social behaviour which involves an animal's tendency to approach, interact with and remain near a **CONSPECIFIC**. Behaviour between animals which promotes group cohesion, e.g. **GROOMING**, touching, positive gestures.

**affiliative exhibit** An exhibit which encourages **AFFILIATIVE BEHAVIOUR** among and between people and other animals in the arrangement of activities, space and features of the design, in collaboration with management practices. For example, food, shelter, shade, water and **ENVIRONMENTAL ENRICHMENT** features are provided throughout the exhibit to reduce confrontation and competition between individuals; focal points are provided for collaborative activities, e.g. an artificial termite mound for apes, located near public viewing areas; visual access is provided between holding and isolation areas so social contact can be maintained between animals.

**afforestation** The process or practice of planting trees (or tree seeds), to create new forest from open land, often to replace that which has been removed by **DEFORESTATION**.

**AfiFarm** Management software used for dairy farming and herd management which analyses information from individual cows using pedometers and milk meters.

**Africa USA** The first drive-through **SAFARI PARK** in the USA, which opened in Florida in 1953 and closed in 1961. Visitors travelled around the artificially created African landscape in a 'Jungle Train'. See also **LAND TRAIN**

**African Elephant Conservation Act of 1989 (USA)** A US law whose purpose is to assist in the conservation and protection of the African elephant by financially supporting the conservation programmes of African countries and the **CITES** Secretariat, and to restrict trade in ivory.

**Aftrotropical region** See **FAUNAL REGIONS**

**aftershaft** A second feather growing from the main shaft at the base of the vane. Important in insulation in some taxa, e.g. grouse and quail.

**agar plate** A Petri dish containing agar as a growth medium for microbes. Used to culture microbes and to test for the presence of infection.

**age class** A category into which individual animals in a population are grouped based on their age. For example, we could count all animals that are 1 year old and place them in a single class, and all animals

that are 2 years old and allocate them to the next class. Alternatively we could group together animals aged 0 to less than 4 years into one class, and then those between 4 and up to 8 years in the next class and so on. A population of animals must be separated into age classes in order to construct a **LIFE TABLE** or **AGE PYRAMID**.

**age pyramid** A diagrammatic representation of the **AGE STRUCTURE** of a population that uses horizontal bars to represent the number of males and females in each **AGE CLASS**. Useful for comparing the age structures of different populations and for predicting future changes in the size and structure of a population.

**age structure** The relative numbers of animals of different ages present in a population. See also **AGE PYRAMID**, **LIFE TABLE**

**age-specific mortality rate** The death rate of a specific age class within a population (e.g. individuals that are 1 year old), especially in the context of a **LIFE TABLE** (Table L1).

**agglutination** The process of sticking together, especially in bacteria and blood cells. See **BLOOD GROUP**

**aggregation** A group of animals which has formed as a result of each being individually attracted to the same place, e.g. birds attracted to a food source, woodlice attracted to a location with high humidity.

See also **GREGARIOUSNESS**

**aggression** See **AGONISTIC BEHAVIOUR**

**aggressive mimicry** The resemblance of a predator (the mimic) to a harmless animal or object (the model) that is attractive to a third organism (the dupe) on which the mimic preys, e.g. the angel fish possesses a dorsal spine that mimics a small organism which acts as a lure for its prey. Compare **AUTOMIMICRY**, **BATESIAN MIMICRY**, **MÜLLERIAN MIMICRY**

**Agnatha** A superclass of vertebrates which are fish-like but jawless and possess sucker-like mouths: lampreys, hagfishes and allies.

**agonistic behaviour** The complex of agonistic behaviours which may occur when two individuals of the same species encounter one another: Aggression, competition, threat, **APPEASEMENT BEHAVIOUR**, **RECONCILIATION**, avoidance, retreat/flight, offensive attacks, defensive fighting. This often includes species-specific **DISPLAYS**. See also **REDIRECTED BEHAVIOUR**.

**Agreement on the Conservation of African–Eurasian Migratory Waterbirds 1995 (AEWA)** An international agreement requiring parties to engage in a wide range of conservation actions for waterbirds including species and habitat conservation, management of human activities, research and monitoring, education and the provision of information. Also known as the African–Eurasian Waterbird Agreement (AEWA).

**Agreement on the Conservation of Bats in Europe 1991 (EUROBATS)** A regional agreement on the

protection of bats concluded under the auspices of the **CONVENTION ON THE CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS 1979 (CMS)**.

**Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area 1996 (ACCOBAMS)** A regional agreement on the protection of **CETACEANS** concluded under the auspices of the **CONVENTION ON THE CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS 1979 (CMS)**. It covers all Odontoceti and Mysticeti. Its purpose is to prohibit and, where possible, eliminate any deliberate taking of cetaceans and to create and maintain a network of specially protected areas to conserve cetaceans, and to promote education, research and the management of human–cetacean interactions.

**Agreement on the Conservation of Polar Bears 1973** An agreement between Canada, Denmark (for Greenland), Norway, the Union of Soviet Socialist Republics (now Russia) and the USA which prohibits the taking of polar bears, except for scientific or conservation purposes, to protect other living resources, or by indigenous peoples according to their traditional rights. It requires the parties to protect polar bear habitat (especially denning and feeding sites, and migratory routes), conduct research and cooperate in the management and conservation of migrating populations.

**Agreement on the Conservation of Small Cetaceans of the Baltic, North East Atlantic, Irish and North Seas 1991 (ASCOBANS)** A regional agreement on the protection of small **CETACEANS** concluded under the auspices of the **CONVENTION ON THE CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS 1979 (CMS)**. Originally called the Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas but extended and renamed in 2008. It covers all toothed whales (Odontoceti), except the sperm whale (*Physeter macrocephalus*) and requires parties to prohibit the taking and killing of small cetaceans, control marine pollution, conduct research, take measures to reduce and collect data on bycatches, and educate the public.

**Agricultural Revolution** A series of changes that took place in the agricultural practices used in England and later across Western Europe between 1700 and 1850 (and possibly earlier), including the intensification of land use, the enclosure of land and the development of scientific animal breeding.

**agricultural show** An event at which farmers exhibit their animals to the public and compete for prizes awarded in recognition of the quality of their livestock. May also include exhibitions of pet animals, agricultural machinery, countryside skills (e.g. **SHEEP DOG TRIALS**) etc. In the UK often organised as a county show, e.g. Cheshire Show, Great Yorkshire Show (Fig. A2).

**Agriculture and Agri-Food Canada (AAFC)** The department of the Canadian government responsi-

ble for agriculture and food (formerly the Department of Agriculture). It provides information, research, policies and programmes to achieve environmentally sustainable and competitive agricultural products.

**agri-environment scheme** A payment system which rewards farmers for environmentally sensitive land management.

**agronomy** The scientific study of the use of plants for food, fuel, fibre and other purposes; the study of soil science and crop production.

**AI** See **ARTIFICIAL INSEMINATION (AI)**

**air bladder** See **SWIM BLADDER**

**air flow** The movement or exchange of air. Adequate air flow is important in regulating the environment by providing **VENTILATION (3)** within a cage, vivarium, animal house, cow shed or other space or building containing animals. It prevents the build-up of noxious gases and helps to control temperature and humidity. Air flow may be achieved naturally as a result of the design of an enclosed space or 'forced' using fans. Ventilation is important in preventing the spread of airborne diseases. Air flow should be proportionate to the density of animals, i.e. the higher the density the more air exchanges necessary per unit time. See also **VENTILATION SHUTDOWN**

**air sac** One of several air-filled sacs which form part of the respiratory system of birds and assist in creating a one-way air flow resulting in **VENTILATION (1)** of the lungs.

**air stone** A block of porous material which produces a column or curtain of fine air bubbles that aerate aquarium water when it is connected to a pump via a plastic tube (Fig. A3).

**Airborne Hunting Act of 1971 (USA)** An Act in the USA which bans the shooting, harassing, capturing or killing of any bird, fish or other animal from aircraft, except for legitimate wildlife management purposes.

**airplane wing** See **ANGEL WING**

**air-stripper** See **PROTEIN SKIMMER**

**airway** The route through which oxygen reaches the **LUNGS**, i.e. via the nose or mouth and **TRACHEA (1)**.

**AKAA** Animal Keepers' Association of Africa. See also **KEEPER ASSOCIATION**

**alarm** A device for generating a sound during an emergency. Some zoos use alarms with different sounds for emergencies in different sections of the zoo. This ensures that staff respond appropriately. See also **ALARM CALL**, **ALARM PHEROMONE**, **ALARM RESPONSE**, **DETECTOR BEAM ACTIVATED SURVEILLANCE SYSTEM**

**alarm call** A **VOCALISATION** made by an animal (particularly a social animal, especially birds and mammals) to indicate the presence of danger to others of the same species (particularly the same social group). In some species, for example prairie dogs (*Cynomys* spp.) and some primates, distinctive



Fig. A2 Agricultural show. Two Prizewinning British Blue cattle at the Cheshire Show in the UK.

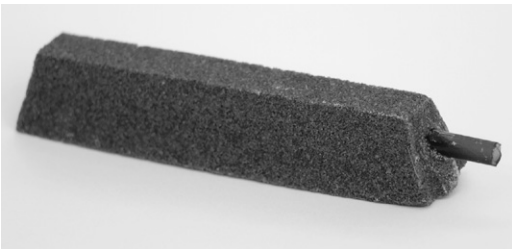


Fig. A3 Air stone.

calls are used to indicate different types of predator, e.g. snake, bird of prey. *See* **ALARM RESPONSE**, **SENTRY**

**alarm pheromone** A short-lived chemical signal released by an animal to indicate the presence of danger to conspecifics, e.g. by ants, bees and other insects.

**alarm response** A response made to a sign of danger by an individual animal to warn others. It may be visual, olfactory or auditory. An animal may draw the attention of a predator to itself when giving an **ALARM CALL** to assist others. This type of **ALTRU-**

**ISM** occurs when the animal giving the warning is closely related to those it is trying to warn. *See also* **ALARM PHEROMONE**

**albinism** A condition in which the pigment **MELANIN** fails to develop in the hair, skin and iris. Individuals have pale skin, white hair and pink pupils. Albinism in mammals is inherited via an autosomal recessive gene. Albinos are homozygous for the gene. *Compare* **LEUCISM**, **MELANISM**

**albino** An animal that exhibits **ALBINISM**.

**Albuliformes** An order of fishes: bonefishes and their allies.

**albumen** Egg white. The fluid contained in an **AMNIOTIC EGG** that contains large quantities of **ALBUMIN**.

**albumin** One of a group of soluble proteins found in blood, **ALBUMEN** and many other tissues.

**aldosterone** *See* **ADRENAL CORTEX**

**alertness** A state of readiness, in an animal, to detect environmental changes. *See also* **VIGILANCE BEHAVIOUR**

**alevin** A newly hatched fish, especially a salmon or trout.

**Alex the African grey parrot** An African grey parrot (*Psittacus erithacus*) who was the subject of a 30-year

study by Irene Pepperberg. She taught him to recognise words, colours, objects and some numbers and could communicate with him using words.

**alfalfa** See **LUCERNE**

**algal bloom** An increase in the number of algae in a body of water. May be seasonal or caused by **EUTROPHICATION** as a result of pollution, especially fertilisers. See also **BLUE-GREEN ALGAE**

**alien species**

1. A species which occurs in a location which is not part of its normal geographical range. Often established as a result of accidental or intentional introduction by humans, e.g. **FERAL CATS**, goats, rats.

2. In the US, Executive Order 13112 of February 3, 1999 defines alien species as ‘... with respect to a particular ecosystem, any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem’.

**alimentary canal** The gut.

**alkalage** A fodder produced by preserving whole-crop (grain, stem and leaves) using a process of ammoniation, which involves spreading an additive pellet containing urea and urease. This is a means of storing cereal crops as forage which helps to retain the nutrient qualities of the fodder. See also **SILAGE**

**alkali** A hydroxide of any of a number of metallic elements, e.g. sodium hydroxide, that dissolves in water to produce an alkaline solution: a solution with a **pH** above 7.0 as a result of an excess of hydroxyl ions, which neutralises acids to form salts.

**alkaline** Possessing the properties of an **ALKALI**.

**allantois** A cavity, formed by a membrane, which stores metabolic wastes and assists with gaseous exchange through the egg shell in birds and reptiles. Also forms part of the **PLACENTA** in mammals.

**allele, allelomorph** Any of a number of different forms of a gene that may exist at a specific **LOCUS** on a chromosome, each of which produces a different variety of the same trait. In diploid organisms, each individual normally possesses two alleles (one from each parent), for each gene in each **SOMATIC CELL**. See also **DOMINANT ALLELE**, **RECESSIVE ALLELE**

**allele fixation** See **FIXATION**

**allele frequency** See **GENE FREQUENCY**

**allele retention** The expected proportion of founder X's alleles that have survived to generation *t*. This is a measure of the extent to which a population has been able to retain the alleles originally present in the founder individuals. Conservation management should attempt to maximise allele retention.

**allelomorph** See **ALLELE**

**Allen's rule** A rule in biology which states that endotherms that have evolved in warmer climates have longer appendages or extremities than related forms that have evolved in colder climates. The rule may apply to different, related species or to individuals of the same species that originate from different

parts of its geographical distribution. The rule is named after Joel Asaph Allen who proposed it in 1877. Long, thin appendages (e.g. ears or legs) have a high **SURFACE AREA:VOLUME RATIO**, resulting in high heat loss. Animals that live in cold climates need to conserve heat so should evolve short appendages. The reverse is true in warm climates. The red fox (*Vulpes vulpes*) of temperate latitudes has relatively small ears, whereas the fennec (*Fennecus zerda*) and bat-eared fox (*Otocyon magalotis*), that both inhabit areas of Africa with a warmer climate, both have very large ears (Fig. A4). See also **BERGMANN'S RULE**

**allergen** Any foreign substance (usually a protein) which induces an **ALLERGIC REACTION** in the body of an animal who is hypersensitive to it.

**allergic reaction** An **IMMUNE REACTION** with no purpose which occurs when the body responds to a non-threatening foreign substance (usually a protein). Results in the release of **HISTAMINE** which causes allergic signs including **INFLAMMATION**. See also **ANAPHYLACTIC SHOCK**, **ANTI-HISTAMINE**

**allergy** An immune response to an **ANTIGEN** which is otherwise harmless. See also **ALLERGIC REACTION**

**alligator farm** A facility where alligators are bred commercially for their meat, skins and other products. Some are open to the public as visitor attractions, particularly in the southern United States.

**allocarer** See **ALLOPARENT**

**allogrooming** Social **GROOMING**. The grooming of one individual by another within a social group. May have hygienic and **SIGNALLING** functions, e.g. appeasement. Occurs widely in primate societies (Fig. A5). See also **ALLOPREENING**, **APPEASEMENT BEHAVIOUR**

**allometry** The study of biological scaling: the differential effect of changing the linear, area and volume dimensions of organisms, and the impact this has on their evolution and ecology. Allometric relationships may be studied during the growth of a single organism; between different organisms within a single species; or between individuals which belong to different species. For example, the allometric relationship between brain size and body size is such that animals with bigger bodies tend to have bigger brains.

**allomother** See **ALLOPARENT**

**alloparent, allocarer** A ‘false’ or ‘other’ parent or mother (allomother). An animal who assists in providing **PARENTAL CARE** to an individual who is not its offspring and may not even be related, e.g. cow elephants (allomothers) may take care of the offspring of others. See also **ALTRUISM**, **SURROGATE (1)**

**allopatric** Having non-overlapping distributions. Two species are said to be allopatric if their distributions do not overlap in time and space. Often refers to a mode of evolution caused by the geographical separation of members of a population which then





**Fig. A4** Allen's rule. Bat-eared fox (*Otocyon megalotis*), left; red fox (*Vulpes vulpes*), right.



**Fig. A5** Allogrooming. Hamadryas baboons (*Papio hamadryas*).

diverge into separate species. *Compare* **PARAPATRIC, SYMPATRIC**

**allopatric speciation** The formation of new species as a result of the geographical separation of populations of the ancestral species such that each evolves independently, adapting to local conditions and eventually becoming genetically isolated from other populations and unable to interbreed. This may occur when habitats become fragmented or when

major dispersal barriers such as mountains or oceans separate populations. *Compare* **PARAPATRIC SPECIATION, SYMPATRIC SPECIATION**

**allogrooming** Mutual **PREENING** that occurs between birds. May have a hygienic function in removing **ECTOPARASITES** and also a social function in helping to maintain social bonds. It may also replace aggressive behaviour in some species. *See also* **ALLOGROOMING**

**all-terrain vehicle (ATV)** *See* **QUAD BIKE**

**alpaca farming** The rearing of alpacas (*Vicugna pacos*) for their fleeces, most of which are processed into yarn for knitting or weaving. Alpacas are **CAMELIDS** used as pack animals in South America and also bred in North America, Australia, New Zealand, South Africa, China, the UK and throughout Europe. Some alpaca farm owners also offer 'alpaca walking' and 'alpaca trekking' experiences. *See also* **BRITISH ALPACA SOCIETY (BAS)**

**alpha ( $\alpha$ ) diversity** The biological diversity within a particular area or **ECOSYSTEM** (usually expressed as the number of species in that ecosystem, i.e. species richness). *See also* **BETA ( $\beta$ ) DIVERSITY, BIODIVERSITY, GAMMA ( $\gamma$ ) DIVERSITY**

**alpha male** *See* **ALPHA STATUS**

**alpha predator** *See* **APEX PREDATOR**

**alpha status** The status afforded to the most dominant or important individual in a group of animals, to which all other individuals are subordinate. The

alpha male is the most dominant male animal in a **DOMINANCE HIERARCHY**. See also **BETA STATUS**  
**alpha-tocopherol** See **VITAMIN E**

**alternating tripod gait** A walking pattern found in insects in which three alternating legs support the body at any one time.

**alternative hypothesis ( $H_1$ )** See **NULL HYPOTHESIS ( $H_0$ )**

**altricial** Referring to a species (especially a mammal or bird) in which very young animals are helpless and incapable of caring for themselves at birth or when they hatch, e.g. canids, rodents. In relation to birds, a young bird which is incapable of moving around on its own soon after hatching. Altricial chicks possess little or no down, hatch with their eyes closed and are incapable of leaving the nest. They are fed by their parents. All **PASSERINES** produce altricial chicks. Compare **PRECOCIAL**

**altruism** The act of unselfishly helping or showing concern for another. An animal may suffer some detriment as a result of engaging in an altruistic act. See also **ALARM CALL**, **INCLUSIVE FITNESS**, **INDIRECT FITNESS**, **PROSOCIAL BEHAVIOUR**, **RECIPROCAL ALTRUISM**

**altruistic behaviour** See **ALTRUISM**

**alula (alulae pl.)** The first digit on a bird's wing.

**alveolus (alveoli pl.)**

1. A minute air sac in the lungs over which **GASEOUS EXCHANGE** occurs. These sacs have the effect of increasing the total surface area of the **LUNGS** substantially.

2. A milk reservoir in a **MAMMARY GLAND**.

**ambassador species** A species kept by a zoo which may have little conservation value, e.g. common zebra (*Equus burchelli*). Visitors may expect to see such species and they may help to generate interest in conservation in general. See also **ABC SPECIES**, **EDUCATION OUTREACH ANIMAL**

**ambient temperature** The surrounding air temperature.

**ambivalent behaviour** A behaviour which is typical of conflict situations and in which an animal appears to be trying to perform two incompatible activities at the same time, e.g. pecking at food while moving away from it. This is the result of motivational conflict and the behaviour may have evolved into a stereotypical display as a result of **RITUALISATION**. See also **STEREOTYPICAL BEHAVIOUR**

**ambush behaviour** A form of hunting whereby a predator lurks (often camouflaged) in a place which prey are likely to frequent, rather than actively hunting.

**ambush predator** See **AMBUSH BEHAVIOUR**

**amebiasis** See **AMOEBIASIS**

**amenorrhoea** The absence or suppression of **MENSTRUATION (OVULATION)**. Lactational amenorrhoea is the suppression of menstruation when the mother is producing milk and prevents her from becoming pregnant while nursing a young infant. See also **MENSTRUAL CYCLE**

**amensalism** An ecological relationship between two organisms of different species in which one is adversely affected and the other is unaffected.

**American Anti-vivisection Society (AAVS)** The first non-profit animal advocacy and educational organisation in the USA (founded in 1883) dedicated to ending experimentation on animals in research, testing and education. It also opposes other forms of cruelty to animals. See also **VIVISECTION**

**American Association of Zoo Keepers (AAZK)** A professional organisation for zoo keepers and aquarists, which supports keeper education and education of the public in conservation.

**American Association of Zoo Veterinarians (AAZV)** An association of veterinary surgeons whose aim is to advance programmes for preventive medicine, husbandry and scientific research in the field of veterinary medicine dealing with captive and free-ranging wild animals. It disseminates research by publishing the *Journal of Zoo and Wildlife Medicine*.

**American Association of Zoos and Aquariums** See **ASSOCIATION OF ZOOS AND AQUARIUMS (AZA)**

**American Birding Association (ABA)** An organisation which represents the North American **BIRDING** community. It supports birders through publications, conferences, workshops, tours, partnerships and networks.

**American Farm Bureau** An NGO in the USA that promotes the wellbeing of farm and ranch communities and acts on behalf of these communities in dealings with the government and others at local, county, state, national and international levels. Each state has its own State Farm Bureau. See also **WYOMING FARM BUREAU FEDERATION V. BABBITT (1997)**

**American Horse Council** An organisation that represents all aspects of the horse industry in the United States.

**American Humane Association** An organisation that exists to protect children, pets and farm animals from abuse and neglect in the United States. It was founded in 1877.

**American Kennel Club** An organisation, founded in 1884, which registers dog breeds and whose aim is to advance the study, breeding, exhibiting, running and maintenance of purebred dogs. See also **AMERICAN RARE BREED ASSOCIATION (ARBA)**, **KENNEL CLUB**

**American Livestock Breeds Conservancy (ALBC)** A non-profit membership organisation, founded in 1977, which works to protect over 150 breeds of livestock and poultry from extinction, including asses, cattle, goats, horses, sheep, pigs, rabbits, chickens, ducks, geese and turkeys. See also **RARE BREEDS CONSERVATION SOCIETY OF NEW ZEALAND**, **RARE BREEDS SURVIVAL TRUST (RBST)**

**American Museum of Natural History** A major natural history museum in New York which was founded in 1869.

**American Rare Breed Association (ARBA)** An organisation which provides a registration system and show venues across the USA for 'rare breeds' of dogs which are not recognised by the **AMERICAN KENNEL CLUB**.

**American Society for the Prevention of Cruelty to Animals (ASPCA)** The first humane organisation in the Western Hemisphere. It was founded by Henry Bergh in 1866. Its aim is to prevent cruelty to animals and it works to rescue animals from abuse, and pass humane laws. It operates animal shelters and animal adoption schemes.

**American Society of Animal Science** An organisation which fosters the discovery, sharing and application of scientific knowledge regarding the responsible use of animals to enhance human life and well-being. It publishes the *Journal of Animal Science*.

**American Stud Book** The registry maintained by the **JOCKEY CLUB (USA)** for all **THOROUGHBREDS** foaled in the United States, Puerto Rico and Canada and for all thoroughbreds imported into the United States, Puerto Rico and Canada from countries that have a studbook approved by the Jockey Club and the **INTERNATIONAL STUD BOOK COMMITTEE**.

**American Veterinary Medical Association** A non-profit organisation founded in 1863 to represent the interests of veterinary surgeons in the United States. It works to advance veterinary medicine, including its relationship to public health, biological science and agriculture.

**Amiiformes** An order of fishes: bowfin.

**amino acid** A subunit of a protein which contains an amine group and an acidic carboxyl group, along with a side chain that varies between different amino acids. There are 22 different types of standard amino acid.

**amnion** A fluid-filled cavity formed by a membrane which encloses the embryo of birds, reptiles and mammals.

**amniote**

1. Possessing an **AMNION**.

2. A vertebrate (mammal, bird or reptile) in which the embryo possesses an **AMNION**.

**amniotic egg** The egg of an **AMNIOTE** (2).

**amniotic fluid** Fluid contained within the amnion formed in reptiles, birds and some mammals. Provides a buffer against mechanical damage and helps to stabilise temperature, especially in placental mammals.

**Amoeba** A genus of sarcodine **PROTOZOANS**, members of which consist of a single irregular-shaped cell which moves and feeds using pseudopodia (cytoplasmic extensions). Some cause disease. See also **AMOEBIASIS**

**amoebiasis, amebiasis** An infection caused by the **AMOEBIA** *Entamoeba histolytica*.

**Amphibia** A class of chordates; **POIKILOTHERMIC**, mostly terrestrial **TETRAPOD** vertebrates. Most species return to water to lay eggs which develop

into tadpoles, but some are **VIVIPAROUS**. Fertilisation is internal or external but there is no **INTROMITTANT ORGAN**. The skin is soft, naked and glandular (being rich in **MUCUS** glands) and used for gaseous exchange. Some species possess poison glands in the skin.

**amphibian** Member of the class **AMPHIBIA**.

**Amphibian Ark (AARK)** An organisation which was established as a joint effort between the **WORLD ASSOCIATION OF ZOOS AND AQUARIUMS (WAZA)**, the **IUCN/SSC CONSERVATION BREEDING SPECIALIST GROUP (CBSG)** and the **IUCN/SSC Amphibian Specialist Group (ASG)**, and other partners around the world, aimed at ensuring the global survival of amphibians. Since 2006, AARK has been assisting the *ex-situ* conservation community to address the captive components of the Amphibian Conservation Action Plan of the **INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE AND NATURAL RESOURCES (IUCN)**. This involves taking species at immediate risk of extinction into captivity in order to establish captive-survival assurance colonies. The survival of many amphibian species is threatened by **CHYTRIDIOMYCOSIS**.

**amplexus** The mating embrace in frogs in which the male grasps the female from behind and both sexes release gametes (Fig. A6).

**ampulla (ampullae pl.)**

1. A bulge at the end of each semi-circular canal in the **INNER EAR** containing hair cells that detect the acceleration of the head.

2. A reservoir in the water vascular system of **ECHINODERMS**.

3. A low-frequency electroreceptor found in some fishes.

**amputation** The removal of a limb, usually as part of a surgical procedure.



**Fig. A6** Amplexus in glass frogs (Centrolenidae).

**amylase** An enzyme found in saliva in some taxa, which breaks starch down into simple sugars. It is also released into the small intestine from the pancreas.

**anabolic**

1. Relating to **ANABOLISM**.

2. Describing a substance which promotes the growth of body tissue, e.g. **ANABOLIC STEROID**.

**anabolic steroid** A drug that simulates the effect of male sex hormones and increases tissue growth, especially in **SKELETAL MUSCLES**. Sometimes used to enhance performance in racehorses and greyhounds.

**anabolism METABOLISM** in which complex organic molecules are synthesised from simpler ones, storing energy, e.g. carbohydrate anabolism involves the conversion of glucose to glycogen; protein anabolism involves the creation of complex proteins from amino acids. *Compare* **CATABOLISM**.

**anachoresis** The avoidance of predators by living in a crevice, hole or other retreat. Species which exhibit this behaviour are called anachorettes. Some live entirely in a burrow (e.g. some polychaete worms), while others emerge at night (e.g. rabbits, badgers).

**anadromous** Migrating from the oceans to freshwater for **SPAWNING**. Anadromous fishes are those that are born in freshwater, spend most of their lives at sea, and then return to freshwater streams and rivers to spawn, e.g. salmon, trout, lampreys. *Compare* **CATADROMOUS**, **DIADROMOUS**

**anaemia, anemia** An abnormal reduction in the amount of **HAEMOGLOBIN** in red blood cells resulting in reduced oxygen-carrying capacity. This causes fatigue and breathlessness. It may be caused by blood loss, iron deficiency, red cell destruction or an inability to produce a sufficient quantity of red cells (as in pernicious anaemia caused by vitamin B<sub>12</sub> deficiency).

**anaerobic** Relating to conditions in which no oxygen is present, e.g. **ANAEROBIC RESPIRATION**. *See also* **ANOXIC**

**anaerobic respiration** The cellular process by which energy is released from food molecules (e.g. **GLUCOSE**) in the absence of oxygen. **ADENOSINE TRIPHOSPHATE (ATP)** is generated from an **ELECTRON TRANSPORT SYSTEM**. *See also* **LACTIC ACID FERMENTATION**

**anaesthesia, anesthesia** A loss of sensation which may affect the whole body, and involve a loss of consciousness (general anaesthesia), or a localised area (local anaesthesia). *See also* **ANALGESIA**

**anaesthesia induction chamber** A container used for anaesthetising small animals which usually consists of a sealed transparent plastic box with a gas inlet and a waste gas outlet.

**anaesthesia vaporiser** A device attached to an **ANAESTHETIC MACHINE** which delivers a specific concentration of a volatile anaesthetic agent, which is liquid at room temperature but vaporises easily.



Fig. A7 Anaesthetic machine.

**anaesthesiologist** *See* **ANAESTHETIST**

**anaesthesiology** *See* **ANAESTHETICS**

**anaesthetic, anesthetic**

1. A drug that causes a temporary loss of sensation (**ANAESTHESIA**). *See also* **ANALGESIC (1)**

2. Relating to or inducing a loss of sensation.

**anaesthetic machine** A device used to support the administration of anaesthesia (Fig. A7). It generally consists of a ventilator, a gas delivery system (for oxygen, air and anaesthetic), including a vaporiser, flow meters and monitors to measure and record the patient's vital signs, e.g. **BLOOD PRESSURE (BP)**, **HEART RATE**, **OXYGEN SATURATION** etc.

**anaesthetics, anaesthesiology** The study and application of anaesthetics. *See also* **ANAESTHETIC (1)**

**anaesthetist, anaesthesiologist** Someone who is expert in the use of anaesthetics. *See also* **ANAESTHETIC (1)**

**anal glands** Paired sacs located either side of the anus in many mammals including most carnivores. Their secretions contain chemicals which allow individual animals to identify other particular **CONSPECIFICS**. *See also* **SCENT GLAND**

**analgesia** Pain relief without loss of consciousness. *See also* **ANAESTHESIA**

**analgesic**

1. A drug that provides pain relief. *See also* **ANAESTHETIC (1)**

2. Having the effect of providing pain relief.

**analogous**

1. An anatomical structure in one type of animal is said to be analogous with a structure in another type of animal when both have the same function and when they are not **HOMOLOGOUS (1)**, i.e. they have a different evolutionary origin such as the wings of insects and those of birds. *See also CONVERGENT EVOLUTION*

2. The term may be used to describe structures with a similar function whether or not these structures are **HOMOLOGOUS (1)**.

**analysis of variance** *See ANOVA*

**anaphylactic shock** A fall in **BLOOD PRESSURE (BP)** caused by an extreme **IMMUNE REACTION**.

**anapsid** A vertebrate, especially a reptile, which does not possess a temporal opening in its skull.

**anatomical terms of location** Standard terms of anatomical location used within **ZOOLOGY** (Fig. A8).

**ancient forest** *See PRIMARY FOREST*

**ancient woodland** *See PRIMARY FOREST*

**androgen** A **STEROID** hormone which has masculinising effects, e.g. **TESTOSTERONE**.

**anemia** *See ANAEMIA*

**anesthetic** *See ANAESTHETIC*

**anestrus** *See ANOESTROUS*

**anestrus** *See ANOESTRUS*

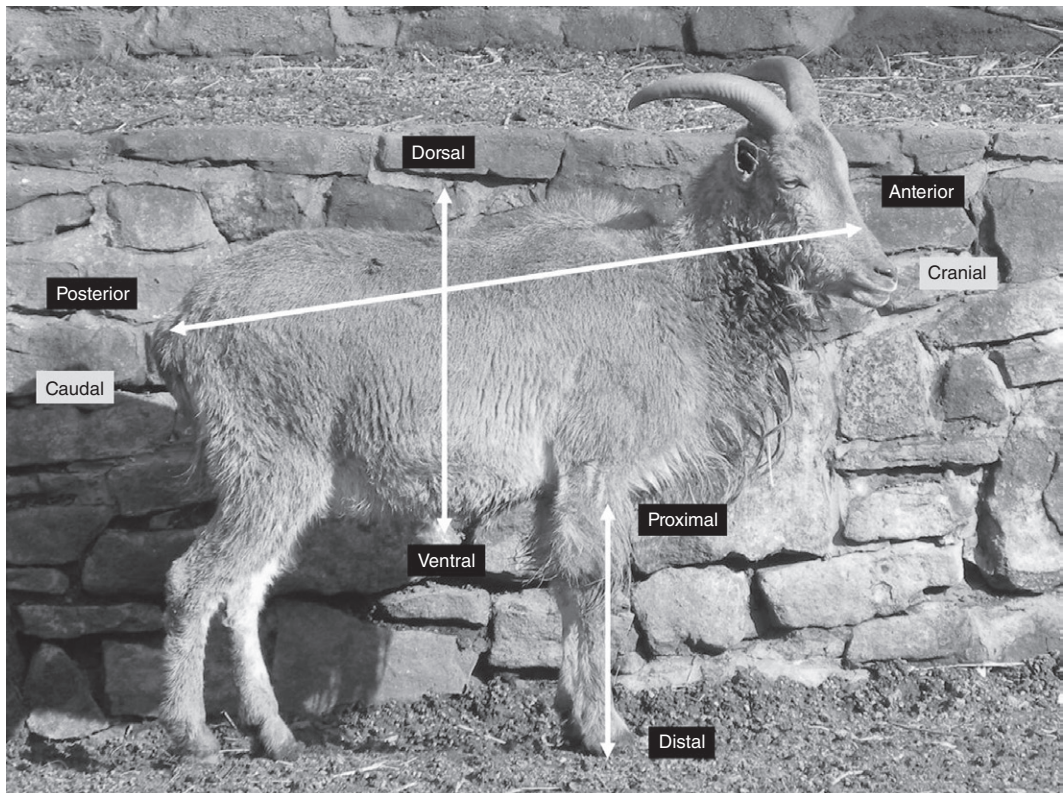
**angel wing, airplane wing** A deformity of the scapulae in which they bow outward as a result of the pull of the scapular muscles (*see PECTORAL GIRDLE*). Caused by a condition called osteodys-trophia fibrosa. Occurs particularly in kittens.

**Anguilliformes** An order of fishes: eels.

**animal**

1. An organism which belongs to the animal kingdom (Animalia) and is characterised by being **MOTILE** (in some stage of its life cycle), multicellular, made of **EUKARYOTIC** cells which are almost always **DIPLOID**, and usually arranged into **TISSUES**, **HETEROTROPHIC**, possessing cells without cell walls, usually reproducing sexually, and with an embryo which has a **BLASTULA** stage. In law, animals are divided into **DOMESTIC ANIMALS**, **CAPTIVE ANIMALS** and **WILD ANIMALS**. In addition, the general term 'animal' may have a specific meaning within a particular piece of legislation which is different from the zoological meaning.

2. In English law, in the **PERFORMING ANIMALS (REGULATION) ACT 1925**, the **PET ANIMALS ACT 1951** and the **ANIMAL WELFARE ACT 2006**, 'animal' means a **VERTEBRATE**.



**Fig. A8** Anatomical terms of location. Barbary sheep (*Ammotragus lervia*).

3. In the **ZOO LICENSING ACT 1981**, s21(1), “‘animals’ means animals of the classes **MAMMALIA**, **AVES**, **REPTILIA**, **AMPHIBIA**, **PISCES** and **INSECTA** and any other multi cellular organism that is not a plant or a fungus . . . ;’ (i.e. the legal definition is essentially the same as the zoological definition).

4. In the **PROTECTION OF ANIMALS ACT 1911** the expression ‘animal’ means any **DOMESTIC ANIMAL (2)** or **CAPTIVE ANIMAL (2)**.

5. Under the Animal Boarding Establishments Act 1963 (s.5(2)), “‘animal’ means any dog or cat’.

6. In the USA, the **ANIMAL WELFARE ACT OF 1966 (USA)**, (USC § 2132 (g)), ‘The term “animal” means any live or dead dog, cat, monkey (nonhuman primate mammal), guinea pig, hamster, rabbit, or such other warm-blooded animal, as the Secretary may determine is being used, or is intended for use, for research, testing, experimentation, or exhibition purposes, or as a pet; but such term excludes (1) birds, rats of the genus *Rattus*, and mice of the genus *Mus*, bred for use in research, (2) horses not used for research purposes, and (3) other farm animals, such as, but not limited to livestock or poultry, used or intended for use as food or fiber, or livestock or poultry used or intended for use for improving animal nutrition, breeding, management, or production efficiency, or for improving the quality of food or fiber. With respect to a dog, the term means all dogs including those used for hunting, security, or breeding purposes;’

7. In New York State, under the Agriculture and Markets Law § 350 (1) “Animal,” . . . includes ‘every living creature except a human being.’

**animal £** The amount of money the public is prepared to donate to (spend on) charities which support animals. Much of this is given to organisations concerned with animal cruelty, animal **SANCTUARIES** etc., rather than those that support wildlife **CONSERVATION**.

**animal actors** Animals which are used in the entertainment industry. They are usually taken from their parents at an early age and trained to perform in films, television programmes and advertisements. In many cases social animals, such as apes, are forced to live alone. When they become too large and difficult to handle many in the USA live out the rest of their lives in **ROADSIDE ZOOS**. See also **ANIMALS IN FILM**, **CHEETAH**, **FLIPPER**, **LASSIE**, **SKIPPY THE BUSH KANGAROO**

**animal advocate** A person who acts for or speaks on behalf of animals, usually in relation to animal welfare issues. See also **LEGAL PERSONALITY**, **LOCUS STANDI**

**Animal Aid** An animal rights group founded in the UK in 1977. It campaigns peacefully against animal abuse and promotes a cruelty-free lifestyle.

**Animal and Plant Health Inspection Service (APHIS)** The Agency of the **UNITED STATES DEPARTMENT OF AGRICULTURE (USDA)** responsible for protecting and promoting agricultural health, the regulation of genetically engineered organisms, and

carrying out wildlife damage management activities. It administers the **ANIMAL WELFARE ACT OF 1966 (USA)** and inspects zoos.

**animal ark** See **ARK (2)**, **POULTRY ARK**

**Animal Behavior Society (ABS)** A society whose purpose is to promote and encourage the biological study of animal behaviour, including studies at all levels of organisation using both descriptive and experimental methods under natural and controlled conditions. It encourages research studies and the dissemination of knowledge about animal behaviour through publications, educational programmes and activities. See also **ANIMAL BEHAVIOUR**

**Animal Behaviour** An academic journal which publishes original work on animal behaviour. Published by the **ASSOCIATION FOR THE STUDY OF ANIMAL BEHAVIOUR (ASAB)** in collaboration with the **ANIMAL BEHAVIOR SOCIETY (ABS)**.

**Animal Boarding Establishments Act 1963** An Act which regulates animal boarding establishments (for dogs or cats) in Great Britain by a system of licensing and inspections.

**Animal By-Products (Enforcement) (England) Regulations 2011** A statutory instrument which regulates the collection, transportation, storage, handling, processing and disposal of animal by-products in England, in compliance with EU law.

**animal carer** Alternative name for an animal **KEEPER (1)**.

**animal cognition** The study of the mental life of animals. See **COGNITION**

**Animal Conservation** A scientific journal which publishes research on the conservation of species and their habitats, published by the **ZOOLOGICAL SOCIETY OF LONDON (ZSL)**.

**animal cruelty** Treating an animal in such a way as to cause pain or suffering either intentionally or by **NEGLECT**. Apart from **CRUELTY** caused by neglect many instances of gratuitous cruelty towards animals have been recorded: a kitten killed by being heated in a microwave oven, a dog dragged behind a car, a deer killed by dogs, a hamster attached to a firework rocket, a cat boil-washed in a washing machine, a puppy kicked to death. See also **ANIMAL CRUELTY LAWS**, **ROYAL SOCIETY FOR THE PREVENTION OF CRUELTY TO ANIMALS (RSPCA)**

**animal cruelty and violence towards humans** In the USA the Federal Bureau of Investigation (FBI) has recognised animal cruelty as an indicator of violence against people since the 1970s, including children, partners and elders. In a study of serial killers the FBI found that most had killed or tortured animals as children.

**animal cruelty as a component of domestic violence** There is a strong association between domestic violence between people and cruelty to animals. In America the **HUMANE SOCIETY OF THE UNITED STATES (HSUS)** estimates that nearly 1