Introduction: The Care and Animal Welfare of All Species

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1.1 Introduction: Concepts in Companion Animal Welfare

Owners have a duty of care to their companion animals. This is an ethical obligation, a vital part of good owner-pet relationships, and a legal duty in many countries. The broad aim of this book is to provide an introduction to the welfare of companion animals. This chapter covers the key concepts in animal welfare, general principles of care, and signs of welfare that can, and should, be applied to our pets. Given the wide range of animals kept as pets and the limited amount of scientific data on some animals, this book focuses on certain groups of animals. For other animals, owners can use Chapters 2, 6, 12, 14, 18, and 22 or cautiously apply data from similar species. However, this chapter provides general guidelines that can apply to all species.

1.1.1 Natural Histories

Pets are *animals* and so are members of species with wild or feral relatives that may share many characteristics with their captive counterparts. We can therefore use information about animals' natural biology and motivations to predict what pets need (in practice, this may sometimes be difficult when wild populations are rare or extinct). Where this information exists, it needs to be used intelligently, and there are several

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caveats to consider. First, animals may suffer welfare compromises while in the wild that owners should *not* replicate (e.g. predation and disease). Second, animals' motivations and needs may depend on their personal experiences and learning (e.g. natural early life experiences) and the captive environment in which they are kept (e.g. animals may need extra ultraviolet [UV]-B or vitamin D supplementation to compensate for insufficient sunlight). Third, many animals have been altered significantly from their wild ancestors, and animals kept as pets may have needs that differ from those of their wild ancestors (e.g. an altered tolerance of human company or a need for medical care to treat breed-related diseases).

1.1.2 Domestic Histories

Pets are also *companions*. Humans have kept pets for at least 12 000 years (Serpell 1986), and some species are popular and widespread (Table 1.1). Some companion animals have been adapted to human company or captivity by 'domestication' through selective breeding and 'taming' through exposure and training. Knowing about this history may also help to determine what care these companions should receive. However, this information also needs to be used intelligently, and there are other caveats to consider before trying to domesticate or tame animals. First, animals may suffer welfare compromises during those processes (e.g. as a result of dystocia, fear of humans, starvation, or separation from their mother). Second, changes from artificial selection are not necessarily associated with improved welfare (e.g. breeding animals for different colours may be irrelevant to their welfare, and some breeding may create breed-related diseases). Third, selective breeding may mean animals have particular needs that are harder to meet (e.g. stronger motivations for company).

1.1.3 Sentience and Welfare

The expression *animal welfare* has two distinct uses. The first is a factual description of what animals experience. The second is an ethical prescription of what animals *should* experience. These two concepts overlap because we are concerned with understanding how our actions can harm or benefit animals. There are several different concepts of animal welfare. A classic division is among 'feelings', 'function', and 'naturalness' (Fraser et al. 1997; Fraser 2008). *Function* refers to the efficiency and effectiveness of biological processes, with particular regard to deviations from normality, disease, and injury. *Naturalness* refers to how animals live unaffected by human control. *Feelings* are subjective experiences of sentient animals.

Sentience may be defined as the ability to experience 'feelings that matter' (Webster 2005). These include affective feelings (e.g. pain and pleasure), motivations (e.g. wanting something), or moods (e.g. depression or happiness). Such feelings might matter more if they are more intense, long-lasting, or frequent. Ultimately, companion animal welfare is about whether pets suffer or are happy, although scientific papers often avoid those terms.

Animals' feelings depend on the interaction between each animal and their environment. The external environment acts on various senses (usually mediated by chemicals, movement, or electromagnetism) and animals' bodies stimulate other senses (e.g. gastric stretching and proprioception). These external and internal inputs prompt various responses that may be pathological (e.g. diarrhoea), physiological (e.g. stress hormone

Table 1.1 Estimated pet populations worldwide.

	Approximate Estimated Numbers (in Millions) of Owned Pets (2011–2016)								
Group	Australia	Brazil	China	Europe[b]	Japan	New Zealand	South Africa	UK	USA
Carnivorans[a]	8	45	80	185	21–25	2	9	17	145–179
Glires[a]	—		—	27		2		2	18
Ungulates[a]	—		—			3		0.4	8
Birds	5		—	55		5		2	21
Reptiles[a]	—		6	7		—		1	12
Amphibians	—		—			—		0.2	—
Fish	11		—	17		9		40–45	159
Humans	24	200	1382	508	126	5	55	65	324

Source: American Health Alliance (Australia) (AHA 2014), American Pets Product Association (APPA 2014), Caixong (2015), Dray (2016), European Union (EU 2016), European Pet Food Industry Federation (FEDIAF 2017), Goldman Sachs (2014), New Zealand Companion Animal Council (NZCAC 2011), Pet Food Institute (PFI 2014), Pet Food Manufacturers Association (PFMA 2014), Zenoaq (2008).

[a]Carnivoran figures based on reports on cats and dogs numbers; Glires figures for New Zealand are specifically for rabbits; Ungulates figures generally exclude 'farm' or 'working' animals (i.e. often relate to horse numbers); Reptile figures for China are specifically for tortoises. All figures to nearest whole million (except where less then 1)

[b]Historic figures for Europe include the UK (accepting the discrepancy regarding fish).

levels), or behavioural (e.g. aggression). These responses may then alter the animal's environment (e.g. scaring off a competitor) and internal states (e.g. filling their stomach). These changes may, in turn, further affect the animal's future interactions with their environment. Such perceptions and responses may be associated with pleasant or unpleasant feelings.

Exactly what feelings each animal experiences, and how they respond, may depend on their particular needs, senses, and cognitive processes – and these may depend on their species, breed, age, sex, reproductive status, personality, abilities, learning, and personal preferences. This means animals cannot be treated as all the same. It also means there is debate about what forms of suffering different animals may experience and when. In fact, the ability to experience suffering need not actually require a high level of conscious cognitive reasoning, and there is increasing scientific evidence of subjective feelings such as pain in reptiles (e.g. Liang and Terashima 1993; Bennett 1998), amphibians (Machin 1999), and fish (e.g. Sneddon 2011, 2013). The evidence for invertebrates is less clear, but all pets should be given the benefit of the doubt (Figure 1.1).

The fact that all species differ in how they interact with their environment may also limit our ability to understand how other animals may be feeling. Our experiences of the world are probably different to our pets'. Animals' senses may have greater sensitivity (e.g. the ability to detect low concentrations of chemicals or quieter noises), extend outside humans' ranges (e.g. the ability to detect UV, infrared, ultrasound, and infrasound) or be senses that humans lack completely (e.g. the ability to detect particular chemicals or magnetic fields). Animals' responses may also differ, depending on their mental processes and their natural motivations. This makes it important to observe animals carefully, to avoid oversimplistic or uncritical anthropomorphism, and to have our views constantly challenged by ongoing scientific findings.

Figure 1.1 Pet invertebrates such as Giant burrowing cockroaches (*Macropanesthia rhinoceros*) should be treated as if they may suffer (*Source:* courtesy of Robert Johnson).

1.1.4 Stress and Suffering

Animals may be subjected to challenges, such as infections or the presence of potential predators. Within animal welfare, the term *stress* is used in a strict physiological sense, but in everyday language it is also used to refer to an unpleasant feeling. A stress response is related to a particular challenge and may not be associated with poor welfare as defined by feelings. Animals may attempt to adapt to challenges in their neurological (e.g. activation of the sympathetic nervous system), hormonal (e.g. secretion of glucocorticoids), immune (e.g. production of antibodies), or behavioural (e.g. elicitation of aggression) processes – all of which may or may not be associated with subjective experiences. Some responses return the animals to a set normal point (e.g. blood oxygen levels), but some lead the animal to a change (e.g. to survive periods of decreased food availability or low temperatures). When the animal's body is unable to re-establish acceptable levels, the animal's welfare may be seriously compromised.

Of particular significance to animal welfare are general physiological responses, including the release of hormones (e.g. cortisol, corticosterone, and noradrenaline), altered (e.g. heart rate), and associated changes behavioural changes (e.g. readiness for flight). These responses may occur in a wide range of situations and may also have a wide range of short- and long-term biological effects. However, the exact responses an animal makes may depend on the nature of the challenge (e.g. Maier and Watkins 2005; Lucas et al. 2014) and the animal (e.g. NRC 2008). For example, an animal's immunity may depend on the type of infection, animal (e.g. mammal versus reptiles), the animal's previous exposure (e.g. after vaccinations), and the presence of other challenges (e.g. malnutrition or pregnancy). This makes it impossible to find a single measure that universally and definitively indicates the absence or presence of stress in the everyday sense of poor welfare.

Responses may allow the animal to adapt to the challenge (e.g. by flight) or to reduce its effects (e.g. by forming an abscess around an infection). Over time, animals may get better at meeting repeated challenges, through learning or adapting their physiology (e.g. their bone density, hormonal sensitivity, or immune system) or behaviour (e.g. through learning). Some unpleasant challenges may therefore help animals to cope with future stresses in the long term. Concern for companion animal welfare therefore does not mean that pets should never be challenged, but that the challenges should be the right ones, with which the animal can cope.

However, companion animals may be unable to cope with challenges if they are too severe, multiple, unpredictable, or uncontrollable; if the animal lacks particular capacities (e.g. juveniles may be immunologically or psychologically naïve); or if owners prevent them from responding (e.g. by confinement or limited resources). Others may face chronic or cumulative stress, which may lead to harmful changes such as muscle break down, gastric ulceration, and skin problems or to animals learning *not to* respond because previous attempts have proved useless.

In everyday language, *suffering* is a general term (like 'enjoyment') that includes a wide range of different unpleasant feelings. More specifically, pain is an unpleasant sensory and emotional experience usually associated with actual or potential tissue damage. Fear is an unpleasant psychological emotion, usually associated with an actual or potential threat to the individual (although some fear occurs without real threat, e.g. in some hyper-anxiety syndromes). Malaise is the feeling associated with illness

(in addition to any more specific feelings such as pain, nausea, etc.). Frustration is the feeling from unsatisfied motivations. Boredom is the feeling directly associated with a lack of challenge, interest, or stimulation.

The amount of suffering might be considered in terms of intensity, duration, number of animals affected, and frequency, while recognising that it is ultimately a subjective experience. Nevertheless, it is possible that animals may suffer while attempting to cope with challenges and may suffer more if they cannot cope or if challenges are sustained. Some processes may make animals more sensitive to suffering, for example when animals' injuries make animals more sensitised to pain or induce depression-like or anxiety-like moods. Conversely, drugs may also alter animals' propensity to suffer; for example, medical painkillers may reduce pain and tranquillisers may reduce anxiety.

1.1.5 Achievement and Enjoyment

Keeping pets is not all about avoiding them suffering. Owners want their pets not merely to cope but to flourish and to experience pleasant feelings. Animals may have positive motivations to achieve an outcome such as obtaining palatable food. They may experience short-term feelings of pleasure or enjoyment or longer-term moods that make them tend towards perceiving stimuli as positive (e.g. optimism). Such positive welfare may be associated with everyday sensational pleasures: engaging with their environment, their conspecifics, and their handlers and realising their own goals (Yeates and Main 2008). Many animals appear to play, including reptiles (Burghardt 2013) and fish (Burghardt 2014a, 2014b; Burghardt, Dinets, and Murphy 2014), and this may be associated with enjoyment.

Animals' capacity for pleasant experiences may relate to their genetics (Yeates 2010), although all species in this book can probably have enjoyable experiences. Capacity for pleasant experiences may also depend on animals' individual histories. Some processes may make animals more or less sensitive to pleasant experiences (e.g. optimistic cognitive biases) or to particular motivations (e.g. a pet may learn to associate human company with food). Perhaps most importantly, animals' enjoyment may depend on their opportunities to engage with rewarding stimuli. Animals need resources to be provided and not to be too inexperienced, scared, or ill to interact with them.

Often, pleasant experiences occur in the absence of suffering (Fraser and Duncan 1998; Spinka et al. 2001). Conversely, some positive experiences may reduce suffering, by improving animals' biological functioning and ability to cope with challenge and stress (Pressman and Cohen 2005; Kikusui, Winslow, and Mori 2006). Sometimes minor challenges may lead to pleasant experiences, for example in relief or the enjoyment of learning, and some stressors may be beneficial (e.g. Selye 1975). In other cases, achieving pleasant experiences may lead to later suffering; for example, the short-term enjoyment of high-energy foods may cause later obesity, and these competing issues need to be balanced.

1.2 Principles of Companion Animal Care

Humans determine most aspects of our pets' lives: often including their parentage, diet, environment, transportation, company, reproduction, health care, and death. Animals are given certain resources while being prevented from obtaining others.

This control makes it important for keepers to get it right by adequately meeting animals' needs while they are in the keepers' care.

Animals' needs may be considered using a framework such as the Five Freedoms. These were produced for assessing farm animal welfare but are also useful for companion animals if used alongside considerations of positive welfare and human company (Table 1.2). For each principle, there are a number of potential 'hazards' (good or bad) that risk suffering or enjoyment (Table 1.3). These are the bases for the principles around which this book's chapters are laid out. However, each principle cannot be considered in isolation because animals' needs may interact in complex ways. For example, how animals use environmental resources may depend on other animals, particularly if there is competition (e.g. in overstocked aquaria) or if animals are motivated to use facilities together (e.g. in communal nesting). There may also be conflicts between short- and long-term effects (e.g. eating versus obesity or surgery versus illness) or different principles (e.g. long-distance transportation versus being left at home alone). Mammals, birds, reptiles, amphibians, and fish are complex organisms with complex needs, which may depend on their species, personal history, and individual characteristics.

So how can keepers decide what is needed to meet animals' dietary, environmental, health, psychological, and other needs? There are three main approaches:

1) The first is to decide on specific provisions (e.g. providing hay to all rabbits).
2) The second is to let animals choose from a range of options (e.g. giving reptiles a thermal gradient).
3) The third is to assess the outcomes from the care given (e.g. monitoring body condition and behaviour).

Table 1.2 Five Freedoms and five opportunities.

Five Freedoms and Provisions	Five Opportunities and Provisions
Freedom from hunger and thirst – by ready access to fresh water and a diet to maintain full health and vigour	***Opportunity for dietary preferences*** – by provision of a varied diet from which to choose
Freedom from discomfort – by providing an appropriate environment and a comfortable resting area	***Opportunity for control*** – by allowing the achievement of motivations that alter the animal's environment
Freedom from pain, injury, and disease – by prevention or rapid diagnosis and treatment	***Opportunity for pleasure, development, and vitality*** – by providing enjoyable and beneficial interactions
Freedom and Opportunity *to express normal behaviour* – by providing sufficient space, proper facilities, and the company of the animal's own kind	
Freedom from fear and distress – by ensuring conditions and treatment which avoid mental suffering	***Opportunity for interest and confidence*** – by providing conditions and human interactions that allow mental enjoyment

Source: Adapted from Farm Animal Welfare Council (1993); Parker and Yeates (2012).

Table 1.3 Risks and hazards (good and bad) to companion animal welfare under each principle.

Principle	Hazard	Risk	Examples
Diet	Undernutrition	Hunger	Starvation in hibernating tortoises
	Overnutrition	Obesity-related disease	Type II diabetes in cats
	Specific malnutrition	Ill health	Calcium disorders in lizards
	Lack of enrichment	Boredom, frustration	Oral stereotypies in horses
Environment	Insufficient substrate	Frustration, fear	Inability to dig in gerbils
	Glass vivaria walls	Injury and pain	Rostral injuries in dragons
	Lack of security	Fear	Lack of hides for hamsters
	Extreme confinement	Frustration	Zebra finches in small cages
	Unpredictability	Anxiety	Variable light schedules in mice
	Barren environment	Boredom	Unenriched rat cages
	Toys	Play	Dogs playing with ball
Animal Company	Lack of company	Loneliness, fear	Isolation of rabbits
	Bullying	Fear, hunger	Bearded dragons of mismatched size
Human Company	Poor handling	Fear	Rough handling of parrots
	Pleasant handling	Tactile enjoyment	Stroking dogs and cats
Health	Poor hygiene	Infectious disease	Pigeon parasite infections
	Lack of foot care	Pain	Lameness in horses
	No vaccination	Infectious disease	Parvovirus in puppies
Euthanasia	Overhandling	Fear	Overhandling stray cats
	Stressful method	Pain, distress	Drowning kittens or freezing dragons

Which is the best approach depends on how much we can trust our judgement compared to that of the animals'. The first approach may be best when there is reliable scientific information about the necessary resources. The second may be best when the animals have evolved or learned adaptive behaviour. The third may be best when our information needs to be more tailored to the animal. We may also use the third approach to work out what resources to provide in the first two approaches.

This also means we can continuously improve how we care for animals, starting with options we think will be appropriate and then learning more accurately what resources are chosen by animals and are beneficial. We learn more about types of animals through animal welfare science and more about individual animals through interacting with them. Keepers should combine information both from experience and scientific research in determining exactly what their animals need. Keepers may initially give animals a limited range of safe options, then refine them using knowledge of the individual and outcome-assessments. At the same time, we can work out what outcomes to assess by seeing how they change when different resources are provided.

However, given the range of species kept, there is limited information known or available about many animals to make reliably accurate guesses about how to care for them. This is a good reason to keep more common pets. But if rarer pets are kept, what information should owners use? Sometimes it is valid to use information about other animals (e.g. related species or how animals are cared for in zoological and laboratory conditions). Whatever one thinks about animal research, zoos, or nature, pets' welfare should be no worse than that of animals kept for other purposes. Alternatively, it may be best to replicate how those animals' relatives live naturally (Figure 1.2), while also minimising the risks to which wild animals are exposed (e.g. starvation or predation). However, owners' homes usually cannot perfectly recreate animals' natural environments. Owners' homes are set up for humans. They may lack animals' natural climates, ecosystem, and space. It is probably impossible for homes, kennels, or pet shops to meet animals' needs and motivations completely while containing them, especially within cages or tanks (Figure 1.3) – unless their enclosures are made so big and complex that they do not constitute containment. Keepers should therefore minimise any compromises.

Figure 1.2 Shingleback (*Tiliqua rugosa*) in a naturalistic outdoor enclosure (*Source:* courtesy of Robert Johnson).

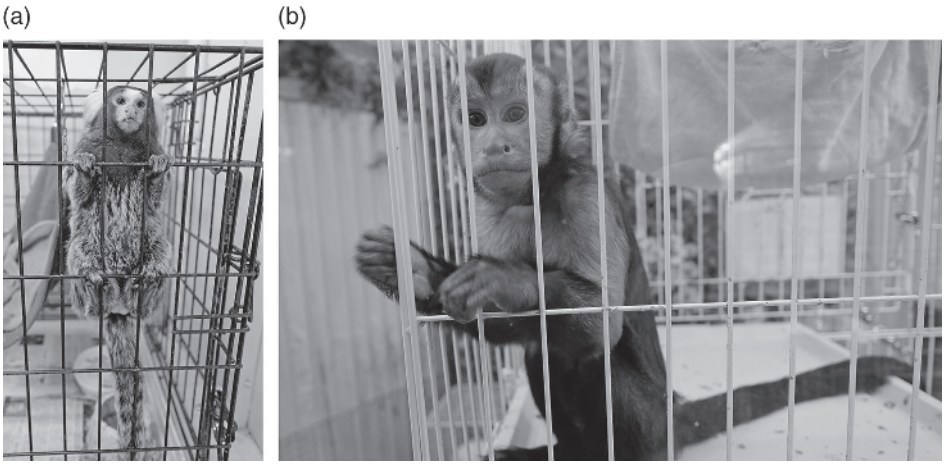

Figure 1.3 (a) Marmoset and (b) tufted capuchin in a pet shop in Hong Kong (*Source:* courtesy of Phillip Wilson).

1.2.1 Diet

All animals need a diet that ensures 'full health and vigour' and satisfies their motivations (Table 1.4). Pet animals may be carnivorous, omnivorous, or herbivorous, with the dietary proportion of meat comprising anywhere from 0% (excepting invertebrates in plants) to 100% (excepting vegetative matter in prey intestines). In general, each animal should take in a balanced supply of nutrients that is:

- Sufficient for the animal to maintain its body and meet any additional demands (e.g. reproduction and exercise),
- Ensures efficient, healthy digestion,
- Avoids excessive hunger and thirst,
- Adequately satisfies the animal's motivations to obtain and manipulate food, and
- Does no harm.

All animals require sufficient vitamins, minerals, amino acids (Table 1.5), and energy to meet their basal metabolic rate (for mammals and birds) or standard metabolic rate (for reptiles and amphibians) to avoid starvation and malnutrition. For example, many species need a particular amount of calcium, often linked to the amount of dietary phosphorus (i.e. the calcium-to-phosphorus ratio), the amount of vitamin D (from the diet or sunlight), and the calcium requirements (e.g. for growth and milk or egg production) to avoid metabolic syndromes that can affect bones and neurological functions (Figure 1.4). Many animals need adequate nutrients, particularly sufficient water and fibre, to allow their intestines to function properly. Animals also need to avoid excesses, both of particular nutrients (e.g. some vitamins, minerals, and carbohydrates) and of energy overall, which may lead to obesity, 'fatty liver', or insulin-resistance syndromes. Obesity often restricts animals' behaviour, particularly reducing exercise, thereby creating a 'vicious circle' of insufficient exercise and increased bodyweight.

Individual chapters have tables of nutritional requirements, where there is sufficient scientific evidence. When owners feed home-mixed diets, it is especially important to ensure

Table 1.4 Aims of suitable diets.

General aim	Specific aim	Example risks of failure
Ensuring health	Adequate nutrients	Starvation Vitamin deficiencies
	Avoids excessive nutrients	Obesity Vitamin excesses
	Is digestible	Gut blockages Poor absorption syndromes
	Matches biological process	Dental malocclusion Gut stasis
	Is safe	Toxicity Intestinal blockages
	Is delivered safely	Injuries from competing animals Food 'poisoning', e.g. salmonellosis
Allowing motivated behaviour	Sufficient quantity and type to satisfy hunger	Severe or chronic hunger Frustration
	Allow behaviours involved in obtaining and consuming food	Lack of appetite Oral stereotypies
	Sufficient 'pleasure' and interest	Inappetance Boredom

Source: Adapted from Webster 2011b.

a balance of nutrients. Alternatively, commercial diets may be available for many species, although they may not state the exact nutritional composition (beyond caloric value and raw protein, fibre, and ash contents). The availability of nutrients from the food also depends upon the nature of the ingredients, the presentation of the food (e.g. pelleting), and the conditions and duration of storage. For those species where nutritional requirements are not well known, the best option might be to offer a wide variety of foodstuffs from which animals can choose. Such a variety may allow animals to select nutritious foods (Manteca et al. 2008). However, animals may also selectively choose an unbalanced diet or food containing toxins, bacteria, or that may cause intestinal blockages in that species.

The principles also relate to how the food is provided, in particular in terms of frequency and method of provision. Although it may be impossible to avoid any feelings of hunger, these should be minimised by providing adequate fibre and feeding frequently often. The methods of provision also need to be suitable for the animal, for example whether they drink water, take it from foliage, or absorb it through the skin (Figure 1.5). Satisfying motivations requires a diet that allows feeding behaviours such as foraging, hunting, obtaining, grazing, manipulating, chewing, and storing food, especially because these motivations may be so strong that animals may choose to perform these behaviours rather than take freely available food. These behavioural needs may be met by activities that encourage physical activity (e.g. playing with toys or foraging) or mental activity (e.g. puzzle feeders and training), and for carnivorous pets, toys should be used instead of feeding sentient live prey.

Table 1.5 Key nutrients for many species.

Nutrient/requirement	Key functions
Energy	Fuel for biological processes, including active physiological processes and behaviour
Protein	Principal structural component of body organs, tissues (e.g. muscle), enzymes, signalling (e.g. hormones), and antibodies Energy production
Essential amino acids	Protein subunits that need to come from the diet
Carbohydrate	Short- and mid-term energy storage Source of glucose for energy and as building block of other nutrients
Fibre	Gut motility and water reabsorption; fermentation to short chain fatty acids and to help provide a feeling of stomach satiation
Fat/Lipid	Essential constituent of cell membranes, long-term energy storage, neuron and body insulation; production of steroid hormones; to allow absorption of fat-soluble vitamins
Calcium	Cellular signalling; ion gradients; body stability (bone and teeth); muscle contraction; blood clotting
Phosphorus	Production of DNA (for cell division), NADPH (for some body-building processes), and ATP (i.e. energy production); acid–base balance; body stability (bone, tooth enamel); muscle and reproductive functions
Magnesium	Skeletal and teeth structure, DNA and RNA metabolism, protein synthesis
Sodium	Acid–base balance, extracellular volume regulation; neuron/synapse functioning
Potassium	Acid–base balance; ion gradients for nerve transmission
Iron	Production of haemoglobin: Enzyme cofactor in O_2 transport and redox reactions
Copper	Production of enzymes (e.g. for respiration); iron metabolism and red blood cell production
Iodine	Production of thyroid hormones
Zinc	Enzyme component, cell replication, skin function, wound healing
Selenium	Antioxidant
Fat- and Water-soluble vitamins	Various enzymatic and transport functions
Water	Main solvent of life processes

ATP, adenosine triphosphate; NADPH, nicotinamide adenine dinucleotide phosphate.

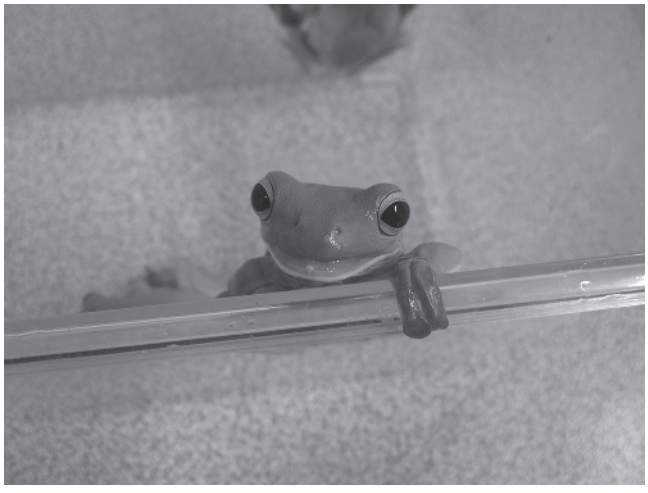

Figure 1.4 Green tree frog (*Litoria caerulaea*) with metabolic bone disease causing a deformed mandible (*Source:* courtesy of Robert Johnson).

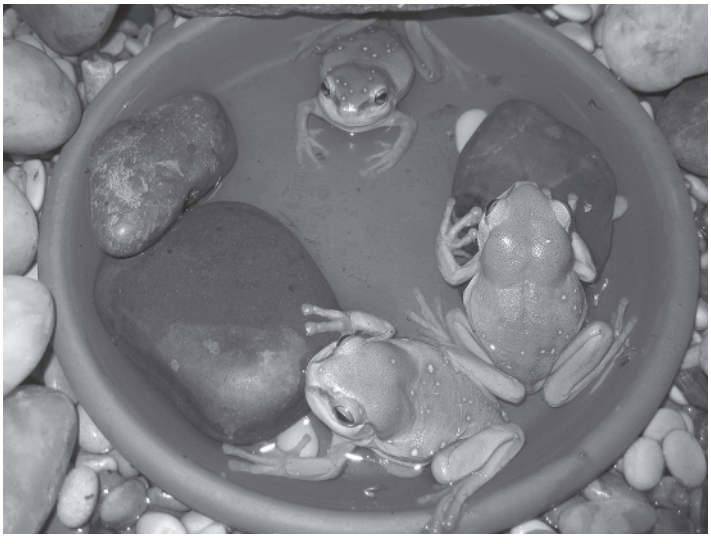

Figure 1.5 Magnificent tree frog (*Litoria splendida*) absorbing fluid through ventral drink patch (*Source:* courtesy of Robert Johnson).

Both nutritional needs and motivations may differ, depending on the animal's age, lifestyle, exercise, pregnancy, lactation, and diseases, whereas predation and competition may affect how much food each animal gets. So owners need to feed the right food in the right way. For rarer pets, a useful rule of thumb is to mimic natural diets as closely as possible. For more popular pets, owners can now buy commercial diets for many animals to reduce the risks of major errors or 'food poisoning' (e.g. salmonella

or botulism), although these animals still need to be fed correctly to prevent boredom, dental problems, and obesity. Owners should also monitor each animal's intake, body condition, and body weight and compare these to ideal values, expected growth rates, the animal's normal (seasonal) weight, or generic body-condition scoring systems. They should also look for behaviour and health measures that might suggest malnutrition, disease, or other problems, such as not eating, oral stereotypies, and eating nonfood items.

1.2.2 Environment

Owners should have four key aims regarding their pets' environment:

- To ensure safety: Avoiding threats both real and perceived;
- To maintain hygiene: Minimising the risks of infection and feelings associated with being ungroomed;
- To provide comfort: Facilitating animals' use of their senses, movements, and resting;
- To provide stimulation: Allow (nonharmful) motivated behaviour.

Each should be considered from the owner's and the animal's point of view; animals need both to *be* and to *feel:* safe, clean, comfortable, and stimulated and to minimise disease, stress, and frustration. Better environments may also make animals respond better, physiologically and behaviourally, and thereby cope with other challenges. Various provisions help to meet these needs (Table 1.6).

A general environmental requirement is sufficient three-dimensional space. All animals need sufficient space to stretch to their full length in all dimensions and for enough movement and exercise. For many animals, this includes swimming and climbing. The space also needs to be large enough to allow other needs to be met, such as hiding, digging, burrowing, foraging, scatter-feeding, and company. For example, animals need to be able to maintain adequate distances from one another when they choose, and resources need to be spaced out and positioned to minimise competition. Some animals may not use all the available space frequently; for example, some animals may choose to sleep in contact with one another or to hide within smaller units, but this is not a reason to prevent access to enough space to perform other, less common needs. Indeed, animals should be given smaller shelters in which to hide and feel safely enclosed *within* larger spaces. Many animals may divide their space into different areas (e.g. for eating, sleeping, and toileting).

Within this space, there are certain physical requirements, such as temperature, humidity, ventilation, and lighting. These often interact, for example temperature, humidity, and ventilation interact, and owners need to ensure all three are correct. Physical requirements sound simple, but they can actually be complicated. For example, the right lighting depends on many factors. In many cases, animals should not be given a single ambient climate, but be allowed to choose between different environments. Environments also need to be appropriate in terms of the animals' senses, allowing them to use their senses, avoiding excessive stimulation (e.g. overly loud noises or unpleasant smells), and maintaining some familiar smells. Cleaning therefore needs to ensure adequate hygiene without impoverishing or oversanitising the space.

Table 1.6 Example effects of provisions on animals' environmental needs (including company).

Provision \ Principle	Safety	Hygiene	Comfort	Stimulation
3-D Space	Opportunities for vigilance behaviours Width to turn around Ability to avoid and escape from others Ability to avoid perceived threats Ability to avoid unpleasant stimuli (e.g. bright lights or excessive noise) Cover and barriers Height for climbing Depth for diving or wallowing	Distances between toileting, bed, food, and water Dilution of pathogens Distancing between individuals Ability to groom	Ability to extend to full dimensions in all directions Ability to rest comfortably in any chosen posture Ability to groom Ability to maintain comfortable stocking density Opportunities to perform basic locomotion Thermal and humidity ranges for thermoregulation and hydroregulation	Environmental complexity Opportunities for exploration Opportunities to exercise and perform basic locomotion Opportunities to play alone Opportunities to interact with other animals Opportunities to interact with humans
Environmental Complexity	Vantage points and views for vigilance Barriers for escape Barriers and cover for hiding	Physical separation of areas for toileting, bed, food, and water Bathing areas Scratching areas	Thermal and humidity ranges	Opportunities to explore Toys for object play Barriers for social play Opportunities for locomotory play
Space to allow sufficient company	Reassurance of other animals' presence Shared vigilance Shared defence Minimised competition Minimised bullying	Mutual insect control Social learning about toileting Pathogens and parasites kept at low densities and away from feeding areas	Shared body-warmth Sufficient resources for each animal to use simultaneously	Social locomotory play Social toy play Social learning about how to interact with their environment Confidence in exploration, exercise, and interactions

Environments also need to be sufficiently complex to stimulate the animal. An impoverished environment may be cleanest, but it will not allow many behaviours to be met. In particular, environments should allow pets to play and interact with their environments. Many animals also benefit from opportunities to explore, for example by providing new areas or toys, to provide mental stimulation. This complexity needs to balanced with minimising stress resulting from unfamiliar objects. Animals should always be allowed to choose whether to interact with such enrichments, and owners should carefully observe their animals to ensure they strike the right balance. The correct environment often depends on the species and individual; for example, a captive-bred, precocious. and fast-learning juvenile carnivore may enjoy more excitement than a wild-caught, neophobic, and older prey animal.

1.2.3 Animal Company

The third key principle of companion animal welfare is to ensure social animals get the right company of other animals and that all animals avoid inappropriate company. Depending on their natural motivations, species are often described as 'social' or 'solitary'. Such descriptions may be oversimplification, especially when ascribed to whole groups such as 'reptiles' or where individual animals' experiences affect their responses to other animals. Nevertheless, these labels may be useful rules of thumb for pet owners to ensure they provide appropriate company for the former and not for the latter.

For social animals, company may be valuable both in itself and because of its impact on other sources of stress. Animal company may be pleasant and may also provide a necessary buffer against other challenges and increase resilience. Such company may provide mutual protection, improved predator vigilance, play, affiliation, thermoregulation, fly-swatting, mutual grooming, cooperative activities, learning, and (if allowed) mating and the care of offspring. However, animal company may also be unpleasant and may also exacerbate other challenges and increase vulnerability (Table 1.6). Such company may create competition for resources, social stress from overcrowding or social defeat, disease risks, cannibalisation, or aggression. More specifically, breeding also brings risks during intercourse (e.g. sexually transmitted infections), pregnancy (e.g. nutritional imbalances), birth (e.g. dystocia), and raising offspring (e.g. cannibalisation).

The value of company may depend on each individual, the relationships between them, group stability, the resources provided, and any external threats (Table 1.7). Even animals of 'social species' may become unsociable as a result of pain, previous unpleasant experiences, or mismanaged introductions, and any animals' relationships may be strained by insufficient space and resources. When keeping animals together, owners should therefore:

- Ensure that animals are healthy, vaccinated, socialised, and minimally stressed;
- Match animals carefully for size and gender, neutering before puberty when safe;
- Manage introductions carefully (Table 1.8) and maintain stable groups (excepting deaths);
- Give opportunities for animals to avoid, escape, and communicate with each other;
- Provide sufficient resources for all animals to use at the same time;
- Maintain appropriate (and not excessive) hygiene; and
- Closely observe the animals and have contingency plans in place.

Table 1.7 Factors that affect the value of animal company.

Factor	Description and examples
The Animals	
Species	Animals of species that have evolved to be social may suffer from isolation. Animals of species that have evolved to be more solitary may suffer from company. Most pet species are rarely naturally sociable with other pet species. Some pet species are potential predators or competitors of others. Some species may transfer infections between species.
Age, gender, and reproductive status	In some species, males or females or adults or juveniles may be more or less social. Some may show aggression during reproductive periods. Neutering may alter some levels of aggression or other interactions.
Patho-physiological conditions	Infectious diseases present risks of infection. Birthing, disease, or pain may decrease sociability. Breeding of animals with extreme shapes may lead to problems giving birth.
Personal histories	Learning that other animals may be safe or dangerous Learning how to determine which animals are safe or threatening Learning how to communicate with other animals
Matching	Discrepancies in size may lead to bullying. Some personalities may be incompatible. Animals of mixed genders (if unneutered) may mate (even if related).
Personal relationships	Siblings and offspring may be more compatible. Some animals may fear particular species, breeds, or genders. Some individuals may form particular pleasant or unpleasant relationships.
Animals' responses	Each animal may signal to others about their state or preferences. Each animal may read others' signals.
Context	
Space	Space may affect how well animals can observe one another. Space may affect how well animals can avoid or carefully approach one another.

(*Continued*)

Table 1.7 (Continued)

Factor	Description and examples
Environmental design	Light, vantage points, and shelters affect animals' abilities to see each other and hide. Barriers and high perches can prevent or permit escape or chasing.
Resources	Insufficient resources can lead to bullying or competition. Poorly located resources can allow individual to prevent others' access to resources.
Cleanliness	Lack of hygiene can lead to disease spread. Excessive cleaning can remove familiar, reassuring smells. Cleaning can remove or transfer smells of other animals.
Owners	Owners can worsen problems through inappropriate interventions.

Table 1.8 General principles for introducing unfamiliar animals humanely.

Factor to consider	Good general principles
Area	Neutral to both animals, i.e. not either's territory Familiar to each animal Quiet and calm No specific sources of stress No dangers during flight (e.g. sharp edges or clear barriers) No dead ends Plenty of escape routes and visual barriers Introduction of sensory stimuli (e.g. mixing smells first)
Resources	Sufficient basic resources (e.g. space) No highly valued resources that might cause competition Plenty and well spaced-out resources as distractions
Humans	Experienced and knowledgeable Relaxed Carefully observing Unseen by the animals but close to intervene Contingency plans in place
Animals	Well fed Relaxed and otherwise not fearful anxious or stressed Healthy Matched (e.g. similar size) Good temperament Not in heat (and, for some animals, neutered)

Figure 1.6 Mixed species freshwater tropical aquarium (*Source:* courtesy of Peter Burgess).

Owners may be poor judges of how their animals respond to company and may fail to notice signs of isolation or of incompatibility. However, some more obvious signals may be useful. For example, owners may notice positive signs (e.g. animals voluntarily spending more time together, playing and engaging in mutual grooming) or signs of incompatibility (e.g. avoiding one another). Fighting may indicate an incompatibility or a lack of resources. However, animals usually fight only when other strategies such as avoidance or threats have failed, so a lack of fighting is not evidence of compatibility.

Some animals may enjoy or tolerate the company of other species, for example, in 'community tanks' of fish (Figure 1.6), but mixing species may cause problems for one or both animals. Some infectious diseases may spread between species. Predator species may enjoy hunting potential prey animals (if permitted), but the prey animals may be caused fear (especially if unable to escape). There is some suggestion that deliberately inducing mild fear of predators may improve welfare overall (e.g. tamarins, Chamove and Moodie 1990), although this is controversial (Roush et al. 1992). Predator animals may also experience frustration through being unable to reach their prey. The safest rule is to keep predators and prey – and their smells and sounds – completely separate.

1.2.4 Human Interactions

The third key principle is to ensure human interactions are suitable. As 'companions' to humans, pets often interact with humans more than with other animals. Some animals appear motivated to interact with humans or find particular interactions rewarding, such as stroking, tickling, and praise. Others may associate humans with other rewards

(e.g. food). Some social animals may also find human company directly rewarding, although not necessarily in ways similar to that of their own species (so human company is not an appropriate substitute for company of their own kind). However, human company may also be stressful for many animals. Humans may be unfamiliar or natural predators for some species and may also be noisy, unpredictable, and interfering.

Some animals do not want to be handled at particular times, such as reptiles during shedding or during the daytime for nocturnal animals (unless owners reverse the daily lighting schedules). Some animals simply do not enjoy human presence or contact. In such cases, owners should minimise stressful interactions, perhaps allowing animals to feel hidden while still being visible by using hidden video cameras, camouflage netting, one-way glass, peep holes, mirrors, by red lighting and handling these animals only when necessary. Owners' desires to interact with their animals should not compromise the animals' welfare by failing to allow them to perform their natural motivations.

All handling should be gentle, calm, and predictable. Handlers should also avoid anything that might be stressful for the particular species, such as lifting animals to fear-inducing heights, acting like that species' natural predator (e.g. not coming from above) or like an aggressive competitor (e.g. approaching from the front for some species). Handlers should also ensure they do not hold animals in a way that causes pain or discomfort (e.g. lifting animals only by their limbs, tail, or head) or that risks injury (e.g. from escape attempts). Owners should also not use methods that rely on stress, such as prey showing immobility as a response to predators. In some cases, stress may be minimised by tranquillisers that reduce animals' anxiety and the length of handling.

Breeders and owners should ensure their animals are used to all types of humans with whom they are likely to come into contact (e.g. male, female, adults, and children), in ways that do not cause additional stress. Positive 'socialisation', especially early in life, may mean some animals find human company rewarding. Other animals may be 'tamed', so they may at least tolerate human interactions. In either case, this process should minimise stress, so that animals do not simply learn that it is useless to respond. Unpleasant interactions may actually increase animals' fear of humans and lead to problematic behaviours such as fear-related aggression if animals use that as a last resort after escalating efforts to escape or deter humans or learn that it is the only successful tactic to avoid stressful handling.

Handling may also be improved by training animals to perform certain behaviours such as walking onto their owner's hand, walking on a lead, or to enter animal carriers voluntarily. Owners may also want to train animals to perform certain behaviours. Active punishment or attempts to 'dominate' animals may cause pain or fear (and be ineffective or counterproductive), and animals may then associate that pain or fear with humans or their owners. Instead, owners should reward the desired behaviours, while not rewarding any unwanted behaviours (even with attention when animals find that rewarding). Owners should expect gradual improvements and not expect animals to perfectly mind-read what their owners want them to do. Instead, owners should respect animals' own preferences as much as possible, by training animals to perform behaviours that are as close as possible to their natural behaviour and own motivations.

1.2.5 Health

The fifth key principle of companion animal welfare is to keep the animal as healthy as possible. All animals may suffer from infections or infestations such as viruses, bacteria, fungi, protozoa, worms, flukes, insects, or arthropods (Table 1.9). In many cases, some parasites may carry other diseases. Sometimes multiple species may be susceptible to different microorganisms, although different species may be affected in different ways. Some infections may spread to humans, particularly to owners who live in close contact with their pets and elderly, young, or immunocompromised people. Important zoonotic diseases include rabies, plague, salmonellosis, pasteurellosis, chlamydiosis, toxoplasmosis, and mycobacteriosis.

Owners should source healthy animals, screening and quarantining animals to reduce the spread of infections. They should also provide adequate hygiene and preventative

Table 1.9 Selected health issues in companion animals.

Condition	Causes	Generic examples
Infectious/ Parasitic	Viruses (V)[a]	Influenza
		Retroviruses
		Parvoviruses
	Bacteria[a]	Coliforms
		Rickettsial
		Clostridial
	Fungi[a]	Aspergillus
		Yeasts
	Protozoa[a]	Intestinal protozoa
	Internal Parasites[a]	Worms
		Flukes
	External Parasites[a]	Fleas
		Ticks
		Mites
		Lice
Noninfectious diseases	Hormonal disorders	Hyperadrenocrticoidism
		Diabetes mellitus
	Neoplastic	Benign tumours
		Malignant tumours
	Inherited	Genetic disorders
		Extreme shapes
	Degenerative/Geriatric conditions	Dental disease
		Osteoarthritis
	Toxic	Heavy metals
		Drug overdoses
	Traumatic	Road accidents
		Being dropped

(V) denotes vaccines are available in some countries for some strains.
[a]Denotes the potential for spread to humans.

care, such as vaccinations, anti-parasitics, and neutering, as appropriate. Owners should also ensure animals are otherwise well cared for generally because stress may also increase animals' susceptibility to infectious diseases, or mean animals' may lack the resources to fight off infections. When problems are identified, they should be rapidly diagnosed, isolated, if appropriate, and treated. The risks of zoonotic diseases may be reduced by simple precautions such as avoiding contact with wild animals, regular veterinary examinations, and good hygiene while handling any animals (especially dead or sick animals) and while preparing food and thorough cooking of food. Where appropriate and possible, owners should try to use specialist veterinary practitioners (Table 1.10).

Because pets often live longer than many wild or farm animals, they also experience a number of age-related or degenerative conditions (although sometimes such conditions may occur in earlier life). Many animals experience dental disease (except those without teeth), particularly if they are not fed adequate material to chew. Dental disease may be painful, may cause damage to the oral cavity, and may reduce animals' ability to eat food. Some carnivores may cope without teeth, but herbivores often need to be able to chew their food for adequate digestion. Many animals may also suffer from arthritis, which may cause pain and reduced mobility, although this may be mistaken as animals simply slowing down in old age. Animals may also experience cancers, such as skin, fatty tissue, mammary glands, or womb tumours.

Breeders should avoid breeding animals who have an increased likelihood of experiencing health problems, that is, from animals with genes for heritable conditions. These conditions might be intrinsically associated with the animal's physical characteristics that breeders want to achieve, such as exaggerated body shapes. Alternatively, they might be conditions that are coincidentally associated with the breed's ideal because the genes for both are closely linked or because the animals that have these conditions are seen as the best show animals. Animals should not be bred if they are too genetically similar because this may increase the risk of their offspring having recessive genes that encode physical abnormalities and mean that breeds are less biodiverse. Owners should therefore avoid breeding from animals who are closely related, part of a small, closed breed, or overly bred (e.g. males being mated to many females) and should match mates who have the lowest risks of heritable health problems (UFAW 2016).

Companion animals may be subjected to various surgeries not aimed at treating a particular condition (Table 1.11). Some owners may want their animals to be altered aesthetically by cosmetic 'mutilations' that may cause pain and prevent locomotory or communicative behaviours. Although some surgery may be clinically necessary for the health of the animal (e.g. neutering may bring health benefits for many animals), other surgery may instead be aimed at the benefit of the human (e.g. removing vocal cords, claws, teeth, or horns to reduce noise, damage to property, or injuries to humans). Other elective, nontherapeutic surgeries are aimed at making animals fit a management system, for example, pinioning birds' wings so they cannot fly away. Each chapter has a table of such interventions (unless there are no justifiable surgeries for those species). In all cases, other methods should be used instead of surgery, except where these would lead to greater welfare compromises.

Table 1.10 Examples of veterinary specialisations.

Recognising organisation	Example veterinary specialties
American Veterinary Medical Association	American Board of Veterinary Practitioners in Avian Practice American Board of Veterinary Practitioners in Canine and Feline Practice American Board of Veterinary Practitioners in Equine Practice American Board of Veterinary Practitioners in Exotic Companion Mammal Practice American Board of Veterinary Practitioners in Reptile and Amphibian Practice American College of Animal Welfare American College of Veterinary Behaviourists American College of Veterinary Nutrition American College of Zoological Medicine
European Board of Veterinary Specialisation	European College of Aquatic Animal Health European College of Zoological Medicine European College of Animal Welfare and Behavioural Medicine European College of Veterinary and Comparative Nutrition European College of Animal Welfare and Behavioural Medicine
Australian and New Zealand College of Veterinary Scientists	Australian and New Zealand College of Veterinary Scientists: Avian Health Chapter Australian and New Zealand College of Veterinary Scientists: Animal Welfare Chapter Australian and New Zealand College of Veterinary Scientists: Veterinary Behaviour Chapter Australian and New Zealand College of Veterinary Scientists: Zoo and Wildlife Medicine Chapter Australian and New Zealand College of Veterinary Scientists: Unusual Pets Chapter
United Kingdom (RCVS)	Diploma in Animal welfare science, ethics, and law Diploma in Zoological Medicine RCVS Recognised Specialists in Animal welfare science, ethics, and law RCVS Recognised Specialists in Exotic animal medicine RCVS Recognised Specialists in Zoo and wildlife medicine

RCVS, Royal College of Veterinary Surgeons.

Table 1.11 Examples of elective nontherapeutic surgery in companion animals.

Rationale	Examples	Possible alternatives	Key chapters
Reduction of reproductive behaviour/breeding	Spaying Castration	Chemical suppression Isolation	2, 6, 12 2, 6
Reduction of noise or scent production	Removal of vocal chords Removal of scent glands	Training	4 6
Reduction of damage to human property	Removal of claws Nose-ringing to reduce rooting	Provision of specific enrichments to allow behaviour	3 12
Making animals easier or safer to handle	Removal of antlers or horns Nose-ringing to attach rope	Training Halters etc.	12 12
Improvement of performance	Surgery on upper respiratory tract	Medical treatment Retirement	13
Prevention of escape	Pinioning or clipping of wings to prevent flight	Training to return Housing design to allow safe, contained flight	14
For identification	Ear-notching	Microchipping	12
Cosmetic	Tattooing Tail-docking and ear-cropping	Microchipping	4, 22 4

1.2.6 Euthanasia

Animals should receive timely and humane euthanasia when in their welfare interests. Owners are often responsible for when and how pets die (but not whether they do) and should try to provide a humane death when their animal would otherwise suffer severely (and then still die eventually). Shelters also need to provide euthanasia when death is better than other realistic options available, given any limitations in resources or potential adopters. In such cases, euthanasia is better than continued suffering. In some countries, companion animals are also culled in an (often unsuccessful) attempt to control populations or slaughtered to eat.

The best euthanasia method is one that minimises the duration and the intensity of any suffering involved and risks of error or ineffectiveness. The ideal procedure is one that causes immediate death or at least immediate unconsciousness followed by death before consciousness is recovered. Where unconsciousness is not immediate, methods should be minimally irritant, painful, malodorous, or otherwise aversive. All methods

of pet euthanasia should be performed by a competent veterinary surgeon, except where delay or transportation would cause increased suffering, to minimise the risks of error. Those performing euthanasia should also ensure they minimise risks to human safety, for example as a result of free gases, needle injuries, or ricocheting bullets. With any method, death should be ensured by using an irreversible method and by checking for the absence of life signs. For example, 'pithing' involves using a needle or rod to macerate the brain tissue (in the correct location), thereby ensuring death.

The best method is also one that minimises any suffering during handling, transportation, and restraint before euthanasia. Some animals may benefit from their owners staying until they lose consciousness, so long as this is safe, and the owners' presence does not add to the distress. Injecting local anaesthetics at injection sites or catheters placed before the injection can refine the procedure. Tranquillisers and sedatives can reduce anxiety and make handling easier and speed up drug effects. They may sometimes be given at higher doses than would normally be considered safe, so that animals' last moments are more comfortable. Some animals can be fully anaesthetised beforehand – in which case, some other permanent methods may become acceptable if they reliably prevent animals regaining consciousness before experiencing any adverse effects. Any efforts to reduce suffering should be evaluated to ensure they do not actually increase distress compared to euthanasia alone.

Finally, the best method depends on the species (e.g. some burrowing species find hypoxic gas mixtures more aversive), age (e.g. the tolerance of high carbon dioxide [CO_2] levels by neonates), individual animal (e.g. their level of fear during handling), person (e.g. competence for different methods), circumstances (e.g. the degree of animal suffering during any delay), and any postmortem requirements (e.g. to ensure intact brain material or avoid anaesthetic chemicals precipitating within tissues or if the animal is going to be eaten). Some methods may be generally suitable for many pets (Table 1.12). Other methods may cause levels of suffering that are unsuitable for any pets (Table 1.13) except when they are the only available method to prevent greater suffering or where the animal is already unconscious. For example, CO_2 inhalation can cause pain (as a result of acidic reactions on eye and respiratory tissues), fear (by directly stimulating brain ion channels), feelings of breathlessness (by stimulating respiration while impairing gas exchange), signs of stress (particularly corticosteroid and catecholamine increases), and avoidance behaviours (in some cases) and should not be used for companion species.

1.3 Signs of Companion Animal Welfare

Good care requires owners to assess each pet's welfare carefully, primarily by recognising and interpreting signs of their pathology, physiology, and behaviour. Such signs may also help to determine what changes in the animal's care actually make a difference. Owners' familiarity with their pets may help them assess their welfare but may still allow owners to miss signs that are subtle, gradual, or shown only in their absence (e.g. separation-related behaviours). All assessors need to have adequate knowledge and understanding of the species and the individual, in particular to avoid ignoring signs that are normal in a breed or misinterpreting signs as if the animals were human.

Table 1.12 Methods of euthanasia suitable for (some) conscious companion animals.

Method	Restraint required	Welfare benefits	Welfare risks
Anaesthetic overdose injected into a vein	Tight handling for vein access Sedation advised	Fast	Minor pain of injection Pain from chemical in tissues if vein missed
Anaesthetic overdose injected into the liver, abdomen, or coelom	Handling Sedation or anaesthesia advised	Less tight restraint	Moderate to severe pain of injection (depending on chemical used and whether pH buffered or local anaesthetic added) Slow if accidentally placed into intestines, bladder, or air sacs
Overdose of volatile anaesthetic inhaled	Containment in chamber	Reduced handling	Odour may be unpleasant (depending on chemical, concentration, and species) Relatively slow (depending on chemical, concentration, and species) May induce breath-holding, further slowing loss of consciousness
Immersion (for aquatic or amphibian species) in anaesthetic overdose	Containment in tank	No handling Animal may be left in familiar environment	Relatively slow Irritation (depending on chemical, concentration, and species) Risk of ineffectiveness because of underdosage
Head or brain trauma	Restraint of head and body to ensure accuracy (where possible)	Instantaneous prevention of any experiences	Severe pain if inaccurate
Neck dislocation	Tight handling	Very fast	Severe pain if ineffective

1.3.1 Pathophysiological Signs

An animal's pathology and physiology may indicate various welfare compromises (Table 1.14). Additionally, insofar as other welfare compromises may increase diseases risks, pathophysiological signs may also suggest other, noninfectious welfare compromises. For example, stress may predispose some pets to particular pathophysiological signs such as hair loss, gastric ulcers, or urinary tract disease.

Because different animals respond differently, animals (like us) may suffer without any observable physical signs. Conversely, some pathophysiological changes may not

Table 1.13 Methods of euthanasia not (usually) suitable for conscious companion animals.

Method	Restraint required	Welfare risks
Carbon dioxide (CO_2) inhalation	Containment	Slow respiratory distress and pain as a result of acidic reactions in mucous membranes
Drowning	Handling or containment within vessel	Slow Severe distress
Hanging	Noose restriction	Slow when death as a result of asphyxiation Distress, pain, and respiratory distress
Neuromuscular blocking agents[a]	Handling for injections	Slow Distress and confusion Respiratory distress
Decapitation	Handling or restraint to allow incision	Pain and distress May be especially long duration in animals able to tolerate hypoxia
Exsanguination	Handling or restraint to allow incision	Slow (depending on method and species anatomy) Pain and distress
Electrocution[a]	Restraint to allow application	Pain Inaccuracy may allow continued or regained consciousness Inappropriate parameters may lead to ineffectiveness
Freezing in commercial freezer	Containment in freezer	Slow Thermal discomfort Pain resulting from ice-crystal formation within tissues
Poisoning	None (if oral)	Depending on chemical, species, and dosage

[a] NB Some methods may be acceptable if performed under anaesthetic or in conjunction with or after another method to ensure death.

correspond to suffering (e.g. normal hibernation or season changes in reproduction) or even correspond to pleasant feelings (e.g. stress hormones may rise during play). Owners therefore need to interpret pathophysiological signs in relation to the context, the individual in which they occur, and other signs, in particular their pet's behaviour.

The choice of pathophysiological signs should depend on the context and the decisions being made. Some measures may themselves stress the animal (e.g. handling or restraint for blood sampling), making it harder to interpret the cause of their results. Other measures may be more remote (e.g. breathing rate or faecal cortisol, Palme 2012) but may provide limited information. Many of the pathophysiological signs used by scientists are hard to measure in the home without expensive scientific equipment or training or be hard to interpret where we lack reliable baseline (i.e. normal

Table 1.14 Potential welfare signs in companion animals.

Type of measure	Examples
Pathophysiological signs	
Hormone levels	Plasma glucocorticoids (+ metabolites)
	Faecal, salivary, and urinary glucocorticoids (+ metabolites)
Blood chemical levels	Lactate dehydrogenase
	Glucose
	Creatine kinase
	Plasma osmolarity
	Albumin concentrations
	Globulin concentrations
	Measures of particular antibodies
Blood cell levels	White blood cell counts
	Packed cell volume
Physiological responses	Heart rate
	Heart rate variability
	Respiratory rate
	Urination rate
Immune responses	Signs of inflammation
	Body temperature
	Specific clinical signs
Biological performance	Body weight
	Size
	Body condition
	Fertility
	Lactation
	Exercise tolerance
	Gastric ulceration
	Hair or plumage condition
	Shedding and skin condition
	Longevity or mortality
Behavioural signs	
Activity levels	Sleeping
	Exercise
Levels of maintenance behaviours	Eating
	Drinking
	Grooming
	Seeking high temperatures
Repetitive behaviours	Stereotypies
	Obsessive compulsive disorders

Table 1.14 (Continued)

Type of measure	Examples
Interactions with pleasant stimuli	Social interactions
	Play
	Engagement
	Appetite
Interactions with unpleasant stimuli	Vigilance
	Hiding and voluntary isolation
	Flight
	Marking
	Aggression
Sickness behaviours and signs of injury	Vomiting
	Diarrhoea
	Limping
Species-specific signs of stress	Particular postures (for the species)
	Types of mouth licking (dogs)

reference ranges for the species). Owners should therefore record normal measures for their own animals (e.g. body weight) to assess trends over time, such as growth rates or weight loss.

1.3.2 Behavioural Signs

Animals use behaviour to respond to their environment. At its simplest, an animal's behaviour may represent an animal's choices (e.g. approach or avoidance). Behaviour may indicate an animal's particular neuromuscular or other health issues (Table 1.15).

Some behaviours may suggest particular welfare states. Indeed, some are characterised as 'sickness behaviour' or 'pain-related' or 'fear-related' behaviour in a particular species. Stereotypies or other repetitive behaviours may be caused by strong, unmet motivations, excitement or anticipation, attempts to cope with previous welfare compromises, and neurological conditions. Aggression may indicate pain, fear, or neurological disorders. Owners should get to know what is normal for the species and the individual. For example, animals may stop or reduce the time spent eating, grooming, or playing when they are ill. Owners should also try to assess their animal's overall behaviour or demeanour.

The absence of behavioural signs of problems – or at least the absence of owners' noticing them – does not mean that an animal has perfect welfare. Solitary or prey animals may be less likely to show behavioural signs of poor welfare, including in the presence of humans they perceive as potential predators. For example, immobility may be a stress response rather than an indication that the animal tolerates human contact. Owners may also make some animals less able to show certain behaviours (e.g. as a result of breeding or surgical mutilations). A particular behaviour may also suggest several possible underlying feelings. Animals may jump and move around when frustrated, in anticipation, during play, or when trying to escape. Owners need to interpret behaviours in relation to the individual (e.g. species, previous experiences), the context (e.g. time of day and what prompted the behaviour), and other current or previous behaviour and physiological responses.

Table 1.15 Key behavioural signs of possible welfare compromises in companion animals.

Aspect of behaviour	Specific responses
Altered activity or responsiveness	Increased vigilance or activity
	Attention to particular threats
	Startling
	Reaction on palpation or withdrawal of body part from contact
	Lethargy, immobility, or decreased mobility (e.g. less movement or play)
	Playing dead
	Slow or absent reflexes (e.g. righting reflex)
	Altered performance
Avoidance	Avoiding particular areas
	Hiding
	Immobility or 'freezing'
	Preparation for flight
	Escape attempts during handling
	Flight
Altered posture or expression	Altered head, neck, body, tail, or ear position
	Altered hair, colour, or feathers
	Altered eye opening (e.g. wide or closed eyes)
	Looking 'smaller' or 'bigger'
	Tongue or tail movements
	Open-mouthed threats
	Particular repetitive movements (e.g. head bobbing)
Altered metabolic processes and maintenance or other common behaviour	Increased respiratory rate
	Altered appetite
	Increased swallowing
	Increased drinking
	Urination or defaecation
	Altered toileting
	Altered grooming or bathing
	Altered time spent resting or sleeping
	Reduced time spent playing or hunting
Altered interactions with the environment or other animals	Manipulating environmental objects
	Altered social interactions
Vocalisations	Social calls
	Alarm calls
	Pain-related sounds

Table 1.15 (Continued)

Aspect of behaviour	Specific responses
Attack or preattack behaviours (NB may often be employed defensively)	Preparation for attack 'Fake' or 'symbolic' attack behaviours Actual attack behaviours Spraying urine, scent, or faeces
Abnormal or repetitive movements	Circling or pacing Pecking at particular spots Spinning or flipping Self-mutilation Regurgitation
Specific local signs of local pain	Hunched or tucked up abdomen Rigid posture or area Biting or scratching a specific area Lameness

All behavioural responses may also indicate other welfare issues than those listed, and the absence of any particular sign in any individual does not mean they are not experiencing that welfare compromise.

1.4 Action Plans

1.4.1 Ethics and Values in Companion Animal Welfare

Concern for animal welfare is a moral principle. Most humans are moral 'agents' who have moral responsibilities and who *can* and *should* act morally. People may obtain animals altruistically, particularly when adopting animals needing homes but may also obtain animals for other reasons (Table 1.16). Whatever the reason, owners and those who have responsibility for animals have a duty of care for the animals in their charge.

1.4.2 Setting Priorities

The most common and severe welfare compromises vary depending on species and country. Most animals can suffer from overfeeding, nutritional deficiencies, inappropriate temperature and lighting, insufficient space or places in which to take refuge or hide, inappropriate company or isolation, insufficient socialisation, mishandling, punishment, inherited disorders, insufficient preventive health care or health checks, and a failure to provide timely euthanasia.

Good breeding, capture, and raising is a priority for all species. Where animals are wild-caught, priorities include using humane catching methods, better transportation, or simply reducing the numbers of wild animals kept captive. For captive-bred animals, priorities include breeding animals with fewer inherited disorders and infectious

Table 1.16 Reasons other than 'companionship' for keeping 'companion animal species'.

Reason	Common examples
Hunting	Dogs
Pest control	Cats
Herding	Dogs
Transportation	Horses
Communication	Horses
	Pigeons
Assistance	Dogs
Guarding	Dogs
Weapons or threats	Dogs
	Horses
Owner appearing 'exotic'	Var. (rare species)
Owner appearing 'expert'	Var. (difficult species)
Symbols of owner's social class or club membership	Horses
	Var. (pedigree animals)
	Var. (expensive animals)
Owner decoration	Handbag dogs
Entertainment	Horses
	Parrots
Sport and show success	Dogs
	Horses
Home ornamentation	Fish
Zoological collections	Marine fish
Species conservation	Various
Scientific research	Rats or zebra fish
Meat	Dogs
	Rabbits
	Guinea pigs
	Horses
Profit	Var. (as above)
	Var. (breeding for above)

diseases, ensuring breeding animals get sufficient care, and that vulnerable young animals get their immediate needs met (e.g. for maternal care) and are prepared for their later lives as pets (e.g. taming or socialisation). For all animals, trade practices should avoid starvation, transportation, exposure or heat stress, isolation, social stress, handling, injury, and disease.

The numbers of animals abandoned, straying, or entering shelters needs to be reduced, and those who are abandoned or lost should be humanely helped by government or nongovernment organisations. Rehoming allows animals to have an additional life; this is expected to be of a good quality of life but may itself involve significant welfare compromises during kennelling, particularly in unfamiliar or overcrowded

environments. Widespread culling should be avoided wherever possible, and if done, should use humane methods and be done alongside other efforts such as neutering to prevent populations increasing again. However, shelters that are under resourced or overcrowded might be worse for the animals than being left on the street or euthanised. Charities also have a responsibility to set good examples (e.g. in providing timely neutering and euthanasia) and to ensure they adopt only to good owners.

1.4.3 Methods of Achieving Welfare Improvements

Improving companion animal welfare needs to both promote good care by owners and keepers and to promote companion animal welfare in society at large. Situations may differ between species, owner sociodemographics, countries, and continents, but many themes are surprisingly consistent.

Education is important both to supply knowledge and to correct *mis*information or inappropriate attitudes, such as outdated behavioural theories, perceptions that certain species are easy, or assumptions that purebreds are better quality. Owners need to get the right information, taking care to ensure that self-appointed 'authorities' really do have the required expertise. This should help owners ensure they have the resources and commitment needed for animals' whole lives *before* getting them (and ideally before the emotional event of meeting them). In particular, owners should choose suitable animals in terms of species, breed, and individual. Owners need to use resources such as UFAW's (2016) guidance on inherited disorders or the Swiss federal veterinary office's information for adults (www.meinheimtier.ch; www.animauxdecompagnie.ch; www.animalidacompagnia.ch) and children (www.neutierig.ch; www.passibete.ch; www.animalando.ch).

Those involved in the supply chain of pets should check and educate would-be owners before selling a pet, prevent impulse purchases, or animals being bought as gifts or prizes. Breeders and vendors should also ensure they only sell animals whose needs can be met by their future owners and avoid adding to problems of overproduction and oversupply or breeding 'fancy' animals with inherited disorders or extreme conformations. The pet 'industry' requires an adequate profit, but profit may be increased by marketing better-quality products (e.g. vaccinated and well-socialised animals or welfare-friendly products). Consumers could drive such changes in their consumer behaviour, particularly if there were reliable assurance schemes.

Societies at large should develop the infrastructure to assist breeders and owners, such as veterinary services, animal training, and behaviourist services. Veterinary professionals need to educate and advise on their patients' health, diet, environment, company, and interactions. Behaviourists need to use only welfare-friendly methods and avoid outdated or inaccurate theories about animals' 'natural' relationships. Some countries need more basic infrastructure (e.g. the first commercial veterinary practices in Malawi). Others need increased expertise in shelter medicine and in 'exotic' species of increasing popularity, with increasing development of specialists who owners should preferentially use (Table 1.10).

Finally, appropriate legislation is needed to protect animals' welfare. Specific legislation should aim to prevent cruelty (e.g. dog fighting), licence certain activities to competent individuals (e.g. veterinary services, breeding, transportation, and sale), and ensure animals are kept as companion animals only in ways that meet their needs.

Governments also need to ensure their commercial and public laws do not cause unnecessary welfare problems, for example, by preventing dogs interacting with other dogs off the lead. All such laws need to be properly interpreted and enforced, which requires adequate resources and training, and keep pace with scientific progress.

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