Introduction

Aquatic animals cover many different species and taxa across the world, of greatly varied phylogenetic ages and linkages (Hästein, et al., 2005). Fishes, invertebrates, reptiles, amphibians, and mammals are some of the many aquatic animals living in human care and in the wild, in fresh, brackish, or saltwater, rivers, lakes, estuaries, seas, and oceans among other environments. They have different anatomies, physiology, behaviour, and affective states. Just fishes alone cover 34,000 species according to FishBase (2021). Different chapters in this book cover aquatic animals in a variety of systems such as aquaculture (Chapter 10), hunting, fishing, and whaling (Chapter 16), commercial fisheries (Chapter 17), and those housed in zoos and aquariums (Chapter 15).

This chapter will only briefly cover fishes kept as companion animals, henceforth referred to as pets. It aims to cover a variety of topics and subtopics, to give a sense of various aspects to consider when housing fishes at home, as well as implications for fishes housed elsewhere in human care such as zoos and aquariums. This will consider not only the direct care, monitoring, and assessing of animal welfare, but much of the whole process of how these animals came to a home or facility. The terms ‘animal welfare’ and ‘animal well-being’ have both been used over the years to describe the state of the animal (Moberg and Mench, 2000, p. 1), and are used in this chapter interchangeably.

While research on assessing animal welfare for terrestrial animals has been ongoing for many decades, the field of assessing aquatic animals is more recent. For an excellent overview of a science-based assessment of aquatic animal welfare, see Hästein et al. (2005), who identified the following issues in addressing aquatic animal welfare in a consistent manner: the sheer diversity of species of vertebrates and invertebrates, the relative paucity of scientific information, and varying philosophical approaches, policies, guidance and regulations that may influence the provision of optimal welfare and humane practices for aquatic animals. This chapter will cover general fish welfare, fish owners, sourcing, transport, pet stores, care, nutrition, environment, environmental enrichment, and behaviour for fishes as pets.

Companion fish

In 2010 it was estimated that over 350 million fishes were traded annually within the ornamental fish industry (Saxby et al., 2010), however, a more recent estimate is 1.5 billion ornamental fishes handled within trade (Stevens et al., 2017). Ploeg (2012a) indicated that, on a global basis,
freshwater and marine organisms such as fish, invertebrates, and plants comprise the greatest numbers of animals traded.

Fishes are popular companion animals – both fresh and saltwater species – with many reports and popular publications on why they make such excellent and easy pets (Pets WebMD, 2021). Some aquariums also promote the keeping of certain species of fishes, highlighting that one should first consider if resources, time, and the ability to care for them are available for the duration of their lifetimes. Despite increasing research into the welfare of fish farmed in aquaculture, and the popularity of keeping aquarium fish (‘ornamental fish’) at home, there is very little research into the optimum living conditions and general welfare of fishes kept as pets.

Warwick (2015) reported that of the 45 million pet fish in the UK, at least 90% will be dead within one year in the home. While worldwide figures could not be located at the time of writing, these could number in the billions, with 150 million in the USA alone (Warwick et al., 2018).

Many different species of fishes and amphibians are kept as companion animals, such as Siamese fighting fish (Betta splendens), angelfish (Pterophyllum scalare), different species of minnows, including the white cloud mountain minnow (Tanichthys albonubes), and the zebraﬁsh (Danio rerio), neon tetras (Paracheirodon innesi), tiger barbs (Barbus tetrazona), goldﬁsh (Carassius auratus), guppies (Poecilia reticulata), and Corydoras catﬁsh (Corydoras spp.). Most of the species covered in this chapter are freshwater species, and a few marine species are also mentioned.

**General fish welfare**

The acquisition process, initially used to source and transport pet fish, has been described as a ‘pipeline of death’ (Warwick, 2015). He noted that, for pet fish, wild-capture mortality can reach almost 100%, especially at the initial stage.

Once sourced and kept, extrapolating general ‘rules’ for optimum water quality and many other determinants of welfare is made difficult or impossible due to variability between species, and a lack of research in necessary areas. For example, for the extremely popular ornamental Siamese fighting fishes, it is unknown how much waste is produced per fish (Pleeging and Moons, 2017). This study identiﬁed that for these fish, aquaria of limited dimensions, the prevalence of Mycobacterium spp. infections, and the lack of environmental enrichment in the form of sheltering vegetation, are common concerns. The barren environment, and the limited ability to escape, as well as potential for stress due to prolonged visual contact between males in shops and during shows, and aggression to and from conspeciﬁcs or other species in the same aquarium, were all listed as factors creating welfare problems. Keeping different species and group sizes together is also a common occurrence. Sloman et al. (2011) concluded that setting scientiﬁcally determined guidelines on appropriate species assemblages or stocking densities for ornamental ﬁsh is complicated by the plethora of group sizes and combinations found within home aquaria, and noted that many welfare issues could go unnoticed when focusing on single-species studies.

A crucial part of understanding fish welfare and promoting optimal care for fishes at home is understanding characteristics of ﬁsh owners and the perceived beneﬁts and challenges of being a ﬁsh owner.

**Fish owners**

Fishes are kept in approximately 10% of Western households and are the most numerous type of pet (Sullivan, 2014). Kidd and Kidd (1999) interviewed home aquarium owners in local stores, comprising 50 men and 50 women, about the beneﬁts and problems of being a ﬁsh owner. The
expense of the equipment, especially the tanks and equipment to control water temperature, circulation, and chemical balances, tank maintenance, and ensuring tank cleanliness, were all reported as major problems. The calming, relaxation, and stress-reduction and serenity-inducing effects of just watching fish were reported as major benefits by 70% of the respondents. The authors reported that 72% of the respondents considered their fish to be family pets, 32% deemed them to be part of their education, 22% saw them as room decorations, 10% considered them a hobby, and 4% regarded them as companions. This diversity of factors provided insight into the reasons for the contemporary popularity of live inhabitants of home aquaria.

In 2004, Sullivan conducted a survey with fish owners to gain more insights of their perceptions of the main welfare issues affecting their pet fish. Among the 534 owners the most common causes for the death of their fishes were disease and old age. There is likely an underestimation of the role of water quality in fish health. Of all respondents, 27% of fish owners admitted they had limited knowledge of fish care, and rarely sought information or social support for their fish care. Almost all respondents provided structural enrichment such as gravel and shelters for their fish. More knowledgeable owners were more likely to provide real plants, rather than artificial ones.

A study by Jacobson et al. (2000) revealed that participants named their fish within the first week of ownership, and while they were not able to physically interact with them, they were still able to identify personality traits and form a semblance of a relationship with their fish. Recommendations by therapists, counsellors, and other human well-being professionals regularly promote the purchase and care of a pet to improve human well-being. Langfield and James (2009) noted that more interactive pets might not be an option for all people, and reviewed fish ownership as an alternative. Their research used in-depth, semi-structured interviews of nine participants, enquiring about the reasons for and benefits of owning fish as pets, as well as the care and environments of the fish. They discovered that pet fish ownership is a meaningful occupation, providing both a purpose and enjoyment in life, and suggested that fish may be an alternative to a more interactive pet to recommend, if clients wished to own a pet. Taken together with the research mentioned previously conducted in pet stores – highlighting the common lack of up-to-date information and/or staff training – it is clear that considerably more emphasis needs to be placed on providing correct in-store advice and support, to reduce premature death and/or suffering of fishes as pets.

Sourcing

Millions of fishes make their way to people’s homes every year. Warwick et al. (2018) discuss how labelling in pet stores could be a possible risk factor – mis-selling exotic animals as “easy” or “beginner” pets could result in new fish owners purchasing pets without appreciating the complexity of their biology and needs. The authors propose that a system should be required that facilitates decision-making at the interface between sale and purchase, and that uses clear, evidence-based labelling. They discuss the development of a pet labelling scheme as a preventative and educational approach, with categories ranging through “easy, moderate, difficult”, to “extreme” (“EMODE”).

Alongside animal well-being, possible conservation implications and threats to wild populations is another serious concern, and the collection of fishes for the pet trade has been flagged as a major threat in these areas. Only a few studies give a glimpse of the potential impact when considering the many countries fishes are sourced from. Early studies like Chao and Prang (1997) report that nearly 20 million live fishes are exported from the Amazon annually. A first assessment by Raghavan et al. (2013) specifically focused on the trade of endemic and threatened freshwater fishes sourced from two global biodiversity hotspots in India, identifying...
30 threatened species comprising 1.5 million individuals which were exported between 2005 and 2012, including endangered species such as *Botia striata*, the vulnerable-listed dwarf puffer-fish (*Carinotetraodon travancoricus*), and two species of endangered red lined torpedo barbs (*Puntius denisonii* and *Puntius chalakkudensis*). The authors reported that several threatened and conservation-concern species were routinely exported from India, with local regulations on fish trade and aquarium collections poorly enforced and managed. They noted that such practices could pose a much more severe threat to freshwater biodiversity than previously recognised, and presented realistic options for better management.

While standards and codes of best practice for handling fishes have been established by the Ornamental Aquatic Trade Association (OATA), little scientific research has been conducted to understand well-being in ornamental fish species. However, lessons may be learned from other sectors involving fish, like aquaculture. Many of the same negative stressors occur in this sector, such as capture, handling, transport, poor water conditions, transport, disease, poor social and physical environment (Chapter 10), and directed research in this sector has resulted in some improvements in welfare standards (Stevens et al. 2017).

An extensive review by King (2019) notes that the ornamental aquatic industry continues to divide opinion in the scientific literature, with practices ranging from unsustainable and over exploitative, such as cyanide fishing – with negative effects on wild populations of reef fish, to more sustainable and responsible practices, that may offer ecological and socioeconomic benefits. King notes that there are differences in freshwater versus marine species, with breeding cycles of freshwater species being less complex. It is estimated that approximately 90% of traded freshwater fish are captive-bred. In contrast, marine species have much more complicated breeding cycles, resulting in 90–95% of traded marine fish being wild caught. The ornamental aquatic industry has a responsibility to ensure that wild caught fish are sourced sustainably, legally, and ethically.

### Transport

Fishes can experience high levels of stress and prolonged recovery from transport (Vanderzwalmen et al., 2020). When considering aspects related to transport these can include, for example, the effects of handling, water conditions including water quality, temperature, and social effects. Shaking, packing, hyper-oxygenation, and cold are all stressors associated with live fish transport, presenting a growing concern for fish welfare (Wu et al., 2021). All different types of transport should be considered: longer and shorter, including, e.g. after initial capture from the wild (if relevant), to wholesale and other housing areas, to the pet store, other shops, venues such as hotels, restaurants, or other businesses or homes.

Vanderzwalmen et al. (2020) trialled the addition of “Stress Coat®” – a commercially available water conditioner containing aloe vera, on fish health and behaviour, during both simulated and actual commercial transport. They found that using a water conditioner was associated with a reduction in biting behaviour post-transport in both the simulation and actual scenario and was also associated with a decrease in erratic swimming behaviour. However, no detectable impact of the water conditioner was found on water quality, visible injuries, or the rate of mortality post-transport, and mortality was low throughout. Particularly for reducing the occurrence of erratic swimming and biting behaviours the addition of Stress Coat® to the transport water of ornamental fishes appears to improve behavioural indicators of welfare.

To mitigate the effects of transport stress responses and promote better well-being, the addition of an extract derived from a Chinese herb, I-Tiao-Gung (*Glycine tomentella – GTE*) was tested during live transport of blood parrot cichlid (*Amphilophus citrinellus × Cichlasoma*...
Sabrina Brando

synspilum) and koi (Cyprinus carpio) (Wu et al., 2021). During transport, fish ventilation frequency and water quality were stabilised by GTE addition for blood parrot cichlids, and plasma cortisol was downregulated by GTE during the simulated transport in both species.

Chemical stress is only one of the many stressors that fish may experience during transport. Mechanical stress like being moved in a carrier bag is unpredictable. Masud et al. (2019) investigated if carrier bags designed to reduce mechanical disturbance during transport can be used to decrease stress-induced immunosuppression. Guppies are among the most popular tropical ornamental fish traded, and Masud et al. experimentally infected some guppies and transported them. One group were transported in traditional carrier bags, and one group within “Breathing Bags™” designed to reduce mechanical disturbance. The study demonstrated how mechanical disturbance during transport can cause stress-induced immunosuppression and increase the likelihood of contracting infections. However, no significant reduction was found in parasite burdens of fish transported in the Breathing Bags™ compared to standard polythene carrier bags. The authors highlighted the need for specific management procedures which reduce the impact of infectious disease, following routine transport of ornamental fish.

Considering that millions of fishes are carried home from pet stores in plastic carrier bags annually, the negative stress caused by mechanical disturbance during transport warrants further research and attention, including the involvement of pet stores.

Pet stores

Millions of fishes are transported to pet stores across the world, where they are housed in a variety of different environments, handled, further transported, mixed with other species, fed, and are managed for disease in ways which either support or are to the detriment of their well-being. Diseases of aquarium fish are common, but there are very few surveys examining the health of fish exclusively in pet shops. Honglo and Jansson (2009) conducted a health survey on 720 freshwater fish from a total 30 Swedish pet retailers. It showed that the most common causes of diseases in the fish were infections with parasites and bacteria. The authors highlighted a need for prophylactic treatments while the fish are held in the pet retailers, and the need for improved hygiene routines, both whilst handling fish and when cleaning tanks and equipment, to minimise infections. Regular health monitoring and the timely separation of infected fish into designated special aquariums for treatment, are essential steps in improving overall fish health. A study in pet shops in New South Wales in Australia examined 108 fish that had evidence of morbidity or mortality, in 24 retail outlets. Most fish (70%) had lesions indicating bronchitis – inflammation of the gills, and/or evidence of bacterial infections. Many of the pathogens identified have low host specificity and/or direct life cycles, with potential risks of transmitting disease to native and commercial fish populations. Wickins et al. (2011) advise that those caring for sick ornamental fish should take appropriate precautions to prevent the spread of disease, and should investigate potential pathogens. This survey only examined fish that already presented with morbidity/mortality, so does not indicate the total percentage of fish that were sick, or the incidence of illness.

It continues to be relatively easy to buy fish from retailers. Many will now ask that a tank has already been set up and cycled/filtered for a period (usually one to two weeks) before they will sell fish, and some will offer to do a water test for purchasers. However, in most cases no proof is required to confirm all is in order, before selling any fish. Specialist aquarists likely have the knowledge to give accurate advice to prospective fish keepers, while larger-scale commercial pet retailers that also deal with other species (cats, dogs, etc.) are less likely to have aquarium specialists on staff and may not have the knowledge to adequately care for fish that are live stocked within the stores. This is improving in many stores, for example by offering aquatics training to
Companion fish

staff. However, they may still be unable to recognise signs of poor health and welfare in stocked fish, depending on their level of familiarity with the different species kept in store.

In 2020, Alley et al. reported on a survey of pet stores regarding the medical advice provided for pet fish, and the potential impact on welfare, specifically focusing on the quality of advice regarding fish health given by US pet store employees. A random sample of 27 pet store employees in North Carolina were presented with a standardised scenario describing symptoms of a pigment cell tumour in a Siamese fighting fish, via telephone call. 85.2% provided a medical opinion, mostly suggesting an over-the-counter medication, with only 8.7% suggesting a husbandry or environment change, and 13% felt it was an abnormality that did not require medical treatment. Only one employee felt that it was a tumour that needed veterinary attention. Employees not offering any opinion comprised 3.7% of respondents, and 11.1% could not provide an answer and suggested a referral to a veterinarian specialised in exotic species. Even with limited information provided, many stores gave a presumptive diagnosis, including injury, bacterial infection, toxin, or genetic defect. Some considered it not to be a problem. The treatments offered also varied considerably between stores, and diagnoses were being given by untrained personnel. Only two employees requested additional information on water quality, and none of the participants asked about environmental enrichment – it may not have been seen as relevant to this case. Much existing research on aquarium fish focuses on transport, origins, etc., but very little work has been done on their welfare upon arrival at the home aquarium. Fish owners may rely on the point of purchase as a source of information on the care of their animals, so it is important that aquarium retailers provide relevant and up-to-date knowledge, and provide referrals to specialists when warranted.

Care

Freshwater fish are more adaptable and survive better in captivity, e.g. carp such as goldfish and koi, and have become more popular as pet fish. Cecil (1999) provided a broad overview which discusses proper setup and maintenance of equipment such as heaters, coolers, filters, etc., which are essential for long-term fish well-being, along with attention to key environmental variables, such as temperature, lighting, water quality, and pH balance. Cecil reviewed husbandry and husbandry-related diseases in ornamental fishes, including hypo- and hyperthermia from marked temperature changes, hypoxia (low dissolved oxygen), potentially caused by poor surface absorption of oxygen from improperly shaped tanks such as fishbowls, or due to increases in organisms using oxygen in the tank, through overcrowding, algal blooms, or too many plants. Other common concerns include ammonia toxicity, sometimes termed ‘new tank syndrome’, which can be caused by improper filtration resulting in a build-up of nitrogenous waste in the tank, which can chemically burn fins and gills. Nutritional disease due to improper feeding, and starvation, are especially common in wild-caught fish. Many marine fish have such specialised feeding requirements that it is difficult to adequately provide for them in a captive environment.

Nutrition

Considering the thousands of fish species kept as pets, another key area is nutrition. This includes both the quality and quantity of food provided, as well as presentation and effects on behaviour and general well-being of the fish. Burgess (2018) investigated if increasing the number of feeding locations reduced aggression in two popular species of marine aquarium fish: blue regal tangs (Paracanthurus hepatus) and yellow tangs (Zebrasoma flavescens). Increasing the number of feeding locations as an enrichment program was correlated with a decrease in aggressive behaviours. Knowledge of diet and feeding behaviour, as well as factors affecting the latter, is fundamental to
improving fish welfare (Martins et al., 2012). While this latter study was conducted on farmed fish, it still provides important insights when caring for pet fishes. Brandão et al. (2021) demonstrated that the biology of fish could be used to make detailed husbandry recommendations that are science-based, for individual species kept in captivity, including feeding recommendations. How fishes are fed, their species-specific needs and preferences, and impacts on health, behaviour, and social aspects, should all be considered within an environmental enrichment program.

Environment

While some standards or recommendations exist, such as a general rule to follow for tank size and stocking density of ‘one gallon for every one inch of fish’, this can be challenging for several reasons, such as varying width and height of fish, tank dimensions, species tolerance to crowding, amount of waste produced, loss of water volume due to addition of ornaments and decorations, etc. Many smaller species use different sorts of shelters, including plants, and/or prefer shade over open areas. Jones et al. (2019) provided two types of enrichment, above-tank shade, and artificial plants, to zebrafish and three-spined sticklebacks (Gasterosteus aculeatus). They observed behaviour and shelter preference to see whether shade is a viable method of providing enrichment to aquarium fish. Zebrafish showed no preference for either type of shelter, while the three-spined sticklebacks showed a preference for being in shelter over being in open areas, and preferred shade in preference to the plants. This study is a good example emphasising the importance of species-specific considerations for enrichment, as well as demonstrating that shade is a viable and meaningful enrichment option for certain fish species.

Environmental enrichment

Many home aquaria today feature plants, shelter, rocks, stones, sand, and other items, often referred to as environmental enrichment. While this chapter does not focus on the science and practice of environmental enrichment, contemporary approaches to optimising animal well-being include the provision of appropriate environments, as well as semi-independency from humans (Brando and Buchanan-Smith, 2018). Shelter, plants, and other aspects that create a good environment for animals would be seen as helping to provide good care, and environmental enrichment as helping ensure optimal care. However, many studies on fish welfare approach shelter, plants, and other aspects of the environment, as environmental enrichments, and for consistency they are considered as such, within this chapter.

It can be challenging to predict the effects of environmental enrichments, as species or group size variations may alter the way enrichment is used. For example, Sloman et al. (2011) found that the same item could be used to simply evade competitors, or as a resource worth aggressively defending. Environmental enrichment can mimic natural habitat. For example, Siamese fighting fish live in shallow waters that are densely vegetated, providing places to hide from predators. Enriched environments give the fish greater control over the environment and potentially reduce chronic stress. Interest in this topic is increasing for laboratory fish, but it remains understudied in pet fish (Pleeging and Moons, 2017). What might be the benefits of providing enrichment such as substrates and physical structures for fish? Naslund and Johnsson (2016) conducted a literature review highlighting different enrichment goals for fish kept in different captive environments. For display aquaria, the focus is on promoting natural and active behaviours, as well as encouraging fish to be present in parts of the tank where they are more visible. Making public tanks aesthetically and visually appealing to the public is also a common consideration. Different types of enrichment are outlined, as well as their benefits, for example structural enrichment or visual barriers to reduce aggression and/or wounding of fish,
due to ability to hide from aggressors. The authors suggest considering the natural environment of the species, and that more research is necessary to understand the different types of enrichment and these could affect the various species. Research published in 2021 by Jones et al. features a review spanning the last five years, of research into physical enrichment in fish. The authors concluded that enrichment is not adequately described in many studies, and that methodological descriptions are not always complete, e.g. the amount and dimensions of objects are often excluded. Additionally, the ecological relevance (or justification) of enrichment is often excluded, or not made explicit. They proposed a framework for reporting enrichment in captive fish: DETAILS (Dimensions, Ecological rationale, Timing of enrichment, Amount, Input, Lighting and Social environment). Most fish included in this review were salmonids or zebrafish, with a bias towards fish commonly used in aquaculture and research spheres. Ornamental fish were frequently neglected.

Environmental enrichment has been found to also be beneficial for ornamental fishes during transport. Vanderzwalmen et al. (2020) used plastic loops as enrichment for platyfish (Platypoecilus variatus) when being transported by road from UK wholesalers to pet stores, to investigate whether providing enrichment during transport impacted behaviour after transport. Behaviour was used as an indicator of welfare immediately following transport, and during a four-week follow-up period. Immediately after transport, the enriched group displayed significantly less erratic swimming behaviours, and in the four weeks after transport the enriched group also displayed less chasing behaviour. Enrichment during transport was found to reduce stress-related behaviours during recovery, and these simple implementations could reduce transport stress for millions of ornamental fishes.

**Behaviour**

Mixed-species assemblages, different species combinations and group sizes, indicate the diversity of popular approaches to the keeping of pet fishes at home. However, the effects of these practices on fish well-being are poorly understood. This also includes effects on behaviour, with only a few studies in this area. Saxby et al. (2010) investigated the effects on well-being in relation to group size, in four commonly held species, namely neon tetras (Paracheirodon innesi), white cloud mountain minnows (Tanichthys albonubes), angelfish (Pterophyllum scalare), and tiger barbs (Barbus tetrazona). Species-specific differences and variations between group size were found, including behaviours such as darting, aggression, shoaling, and latency to feed. White cloud mountain minnows and neon tetras demonstrated a decrease in aggression and an increase in shoaling behaviour in large groups, and improved well-being for larger groups for neon tetra, white cloud mountain minnows, and tiger barbs, but no clear link between welfare and group size in angelfish. While the behavioural impact of group size is species-specific, the combination of behavioural parameters may allow for the identification of optimal group sizes for improved welfare for individual species. Sloman et al. (2011) enquired if the size of shoals impacted the behaviour and welfare of fish kept in mixed-species tanks, and manipulated group sizes in mixed-species assemblages, using the same four species as the former study. They observed social behaviours such as shoaling, as well as aggression, in the whole enclosure. The presence of angelfish appeared to have a beneficial effect on the welfare of small shoaling species by reducing aggression, but had little effect on other behaviours. Larger group sizes resulted in an increased tendency to shoal in white cloud mountain minnows and neon tetras. Research as in this study serves to provide insights into welfare issues which may not become apparent within unrepresentative, single-species studies.

The topic of behaviour is closely connected to all other topics mentioned in this chapter, as different behaviours, next to physical health parameters, are key animal-based indicators used in animal welfare assessments.
Conclusions

This chapter has provided an introduction into the complexities of considering and caring for aquatic animals, specifically fishes – both fresh and saltwater species – as popular companion animals. Fishes are kept in approximately 10% of Western households, and are the most numerous type of pet, with 1.5 billion ornamental fishes handled in trade. Difficulties arise in all aspects of fish well-being, from sourcing and transport, to the moment they arrive in the home as a pet, and during ongoing husbandry thereafter. The frequently marginalised status of fish is based on bias rather than science, and seeing fishes as sentient beings changes how they are perceived. More importantly, it highlights the need to reform how fishes are sourced, traded, managed, and kept.

Despite increasing research into the welfare of fish farmed in aquaculture, and the popularity of keeping aquarium fish at home, there is very little research into optimal living conditions, and the general welfare of fish kept as pets. Unlike aquaculture, ornamental fishkeeping involves hundreds of species, with diverse care requirements, and companion animal caregivers may not have the knowledge or access to the required knowledge to provide appropriate care. The mis-selling of fishes as exotic animals labelled as ‘easy’, or ‘beginner’ pets can result in new fish owners purchasing pets without appreciating the complexity of their biology or needs. Hobbyist fish owners tend to rely on non-scientific manuals, their own experiences, and information shared with other fish keepers. There are many online forums where information is shared, but such forums often struggle with debates over contrasting opinions, or present conflicting information. Both online and physical pet retailers complicate the issue by presenting fish keepers with a wide variety of aquarium tanks in different shapes and sizes, multiple types of technical equipment (heating, lighting, filtration systems), and aquarium accessories (live plants, plastic ornaments, rocks, etc.). Such products may be available with or without relevant information as to which species they are considered suitable for. Consequently, ornamental fish can be kept many ways. ‘Decorative’ tanks such as vases and fishbowls were once considered the norm for at-home fishkeeping, despite not providing adequate water circulation for filtration and oxygenation, space for the fish to swim, and being difficult to maintain at appropriate temperatures. This resulted in cities and countries such as Rome, Sweden, and Mexico, banning fishkeeping in bowls.

Available evidence on topics such as transport, environment, enrichment, and behaviour, suggest that fishes require and benefit from the same considerations regarding their well-being as birds and mammals. While not included in this chapter, further evidence for pain and fear in fish, as well as play behaviours and positive interactions with their caregivers, highlight the need for a holistic approach, which includes physical and psychological aspects, to safeguarding fish well-being. Understanding the challenges posed at each phase, will allow for a constructive approach to conducting more research, as well as implementing changes that can benefit fish well-being everywhere. This does include the necessary cessation of current practices which threaten fish welfare. All efforts to apply scientifically meaningful findings to the improvement of fish well-being and protection should be a high priority. This should include communication aimed at the positive evolution of legislation and standards, and enforcement benefitting fish well-being everywhere, including for fishes kept as companion animals.

Acknowledgements

I would like to thank Max Norman for their help during the preparation of this chapter.
Companion fish

References


