Aspects of the design of a new birdhouse at the University of Glasgow's Faculty of Biomedical and Life Sciences

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Introduction

Glasgow University has maintained Australian zebra finches (*Taeniopygia guttata castonotis*) for behavioural research for over twenty-one years.

In the field, University ornithologists have been active for over forty years investigating a multitude of areas that affect both bird and human life. Captive observations in a situation where temperature, social environment, photoperiod and food can be carefully controlled, provides a useful platform to test theoretical and behavioural models, augmenting the knowledge we already have on species in the wild.

However, keeping any animal in captivity brings with it a responsibility to provide it with a species' appropriate environment that is stimulating, comfortable and free from extraneous stress. It is also in the researchers' interest for captive birds to show as natural behaviour as possible.

Each time a new facility is designed, an opportunity is presented to maximise the welfare potential of the environment for the animals concerned.

Environments for animals kept in a laboratory setting, do not need to exactly copy the wild in order to be considered a success. They do, however, need to offer the animal a situation where it can perform essential components of its behavioural repertoire. These are behaviours that if not given an outlet, can lead to the animal developing problems such as stereotypic behaviours. We know that animals kept in inappropriate environments have reduced physical and mental capabilities, a situation worth avoiding from both an ethical and experimental standpoint. Another aspect worth considering is that the benefits of keeping an animal in an enriched environment cascades from one generation to the next and this benefit can be conferred to the offspring at the embryonic stage (Arai *et al*, 2009).

To be successful at designing captive environments requires a good knowledge of the animal's natural behaviours, a fact that is not always taken into account. As such, a radical shift away from typical laboratory conditions can be represented by relatively minor but thoughtful additions to a facility.

Materials and Methods

Temperature control, reproduction and sleep

Animal houses that are subject to Home Office regulations are expected to be able to maintain set temperature ranges appropriate for the species involved. This is normally thought to have been achieved if the temperature the system is set at can be maintained with as little variation being recorded as possible.

However, from a welfare point of view it may be of benefit for some species to experience a reduced temperature during the night, as they would in the wild. For instance, it is known that the temperature ranges for zebra finches can vary greatly from night to day and from season-to-season. As a desert bird they can experience very high temperatures, but also occasionally endure light frost for the whole day and they have been observed breeding when minimum temperatures were as low as 4°C (Zann, 1996).

Furthermore, we know that some bird species deal with lower temperatures by fluffing up their feathers and, if in a communal roost, clustering closer together. Does this have an effect on group bonding, aggression or hormone production? Do birds have better sleep patterns when subjected to a cool evening temperature, rather than being maintained at a monotonous unnatural constant? We know that sleep patterns can be radically altered in mammal species by what we may discern as a minor aspect of their environment such as the nature of the surface available to sleep on. For instance Crouse *et al* 1995, demonstrated, by looking at rapid-eye-movement sleep patterns in domestic cats, that those given soft surfaces to sleep on had longer, deeper sleep patterns associated with rapid-eye-movement sleep (REM) than those resting on hard surfaces. Although we know much less about the structure of sleep in birds than in mammals, we do know that birds exhibit REM sleep (Low *et al*, 2008). In addition we know that disrupted sleep patterns can affect the ability of birds to learn tasks (Rattenborg, *et al*, 2004) a finding that must be of importance to all of those involved in cognitive research. In addition it has been demonstrated in rats that those living in enriched environments have longer sleep times than those living in an impoverished situation (Tagney, 1973).

If this is the case in birds, then it is essential that correct conditions be provided to optimise sleep.

It seems more than plausible that temperature variation from night to day will have positive welfare implications for many species. Therefore, it was decided to choose an environmental management system that would allow the temperature to be controlled to be lower in the night than during the day.

Sound

Noise in the animal house is a contentious subject (Paterson-Kane & Fanworth, 2006). Many animal facilities are awash with the sound of plant and machinery such as ventilation systems, cage-wash machines and trolleys bumping and banging around the building. In bird facilities this is not always the case. Birds are often kept in areas that are quiet, and in some cases, very quiet. Private bird breeders in the UK often play a radio during daylight hours, at a low level to break up the background monotony of silence (Bob Haste pers com). Moreover, it has been noted that '*Music may have the benefits of masking sudden, artificial noises that are potentially stressful to the animal and breaking silence or a monotonous auditory environment known to affect the development of normal cognitive abilities,*' (Paterson-Kane & Farnworth, 2006).

In the new Glasgow birdhouse each room has been fitted with a loudspeaker to facilitate this. Each speaker is controlled by a time switch. When radios were initially used in the old bird facilities after many years of being radio free, the staff were asked if they noticed any positive or negative changes in the behaviour of the birds. The first comment by one of the longest serving bird keepers was that the level of aggression in the bird groups had substantially reduced. This equated with him having far fewer instances of having to separate birds into rest/hospital cages after others had bullied them in the flock (Alastair Kirk, pers com.). This observation was reinforced by a dramatic reduction in the number of rest cages, which have to be maintained in the bird rooms from five to one. A credible aside to this may also be the fact that music can have a relaxing effect on staff, resulting in a reduced level of stress for the animals (Paterson-Kane & Farnworth, 2006). Music and animal behaviour have been looked at by a number of researchers. Wells and Irwin (2008) discovered that Asian elephants (*Elephas maximus*) reduced their level of stereotypic behaviour when exposed to auditory stimulation in the form of classical music. Gorillas (*Gorilla gorilla*) indulged in more behaviour associated with relaxation when exposed to classical music than they did when exposed to naturalistic sounds (Wells *et al.*, 2006). Results of a study carried out on the effect of music on captive chimpanzees (*Pan troglodytes*) suggested a significant positive result on their behaviour with among other things a decrease in their aggression and an increase in their social behaviour (Videan, 2007).

The general consensus regarding sound in animal facilities is that more research needs to be done in order to clearly establish its beneficial effects (or otherwise). But a tentative suggestion is that used in an appropriate manner it can have beneficial results.

Photoperiod and lighting control

Nowadays it seems impossible to have a modern lighting system installed that does not rely on a computer programme to run it. It is also often the case that the programme has not been specifically designed for the user's requirements and contains many elements of programme possibilities that are not needed. This can lead to the systems not being user friendly, requiring only those that have been trained and are computer literate to make changes to the programmes. The system fitted in the Glasgow birdhouse is computer driven. However, from a welfare point of view a number of positive aspects have been built into the lighting system. At the start of the day the lights brighten gradually over a fifteen-minute period, starting from 10% to their maximum brightness. At the end of the day the lights fade out in a similar reverse pattern. The fade-in and -out periods can be set at various rates. The reason for the gradual rise/decrease in light levels is because the sudden coming on and going off of the lights can stress the birds. In fact it has been suggested that the fade-out period, leading to night, should be longer than that of the fade-in at the start of the day, as this gives ample indication to the birds to roost and prepare for the darkness ahead. This prolonged fade-out regime will be adopted in the new birdhouse.

It is often the case that animal house buildings have no windows as this can frustrate any attempt to manipulate behaviour by changing photoperiod. As such, animal rooms can be totally dark in the night with absolutely no discernible light. Absolute darkness, other than for cave-dwelling species, is rare in the wild and could well be stressful for animals such as zebra finches that have full colour and ultraviolet vision and that rely on good light levels to see their way around. From conversations with private bird breeders we ascertained that some of them kept nightlights on during the night as they felt the birds were not comfortable in total darkness. It was also thought that birds can stumble from their perches, as they sometimes do when asleep, or panic, and may not find their way back to their perch because of the total absence of light. Bird keepers also talked about 'night fright', a situation where a loud unexpected noise frightens the birds kept in total darkness, resulting in them dropping their flight feathers (Bob Haste, pers com).

With this information in mind, we fitted each of our new bird rooms with two tiny roof-mounted nightlights to provide some illumination during the hours of darkness. The question then arose as to how bright a nightlight could be before it affected the overall photoperiod that the birds are subjected to. In the absence of solid information on this aspect of captive bird husbandry, it was decided to use 0.01lux, which is the same as the light emitted by a quarter moon.

Enriching the cage environment

Maximising the potential of a small cage for zebra finches is a challenge. But it can be done. Captive birds that have constant access to food and very little exercise will become fat. And yet getting confined birds to work harder and fly more is difficult. This is especially the case when larger numbers of birds are being held, so any system that is intended to exercise the birds must be technician as well as bird-friendly or there will simply not be enough time to standardise husbandry across the animal unit.

Perching

Birds have the ability to grip perching of many different diameters. If the same size of perch is provided throughout a bird's life, then it is likely that some of the foot muscles will never be used. In the wild, finches land on thin flexible grass stalks, shifting their body posture to maintain their balance as the stalk weaves and shifts in response to the wind and the stresses supplied by the weight of the bird.

In such a situation the bird's sense of balance stimulates the use of a multitude of muscles as the bird shifts its posture in reaction to its constantly changing position. Such complex movement patterns cannot be achieved using perches that are fixed in a rigid position.

However, a variety of perches are now available for birds to use. Standard wooden and plastic perches of fixed diameter (circa 12mm), can be augmented by using twist perches manufactured from tapered plastic or wood. These perches have the added advantage of only being fixed at one end and so the perch bounces as the bird lands and takes off, in a similar fashion to natural perches in the wild.

Using different styles and sizes of perching for the birds is simple and effective. Most of the birds that are housed in cages in Glasgow have access to a minimum of four perches and each can be different in size and style. When the twist perches dip, as the birds land, the birds alter their body posture to maintain balance before settling down. Conversely, if more than one bird is on the perch, as one takes off, the rest move to compensate as the perch rises (Plate 1).

Plate 1. *Birds landing and taking off from twist perch*

This complex chain reaction of movement and muscle use does not occur when using perches that are rigidly fixed in position. In addition the birds seem to enjoy the movement supplied by the bouncy perches, as they appear to use them in preference to those that do not move (Anke Rehling, pers com). After 12 months of using them, only two of the flexible perches have broken, apparently owing to too many bouncing zebra finches on the one perch.

Working harder for food

Zebra finches are primarily ground feeders (Zann, 1996). However, they also perch on grass seed heads, showing remarkable agility as they feed. With this idea in mind and in an effort to increase exercise and the energy outlay the birds expend for a feed, we decided to hang all millet sprays beyond the reach of the perching birds. To achieve this, we needed to attach a clothes peg to the centre of the roof between the perches. The pegs are neutral in colour as zebra finches find strong colours attractive (e.g. red), and we did not want to risk influencing their behaviour. The easiest method was to use Velcro pads and a small cable tie as shown in plate 2. Now, for the birds to feed, they have to fly and hang onto the millet at an angle (Figure 1).

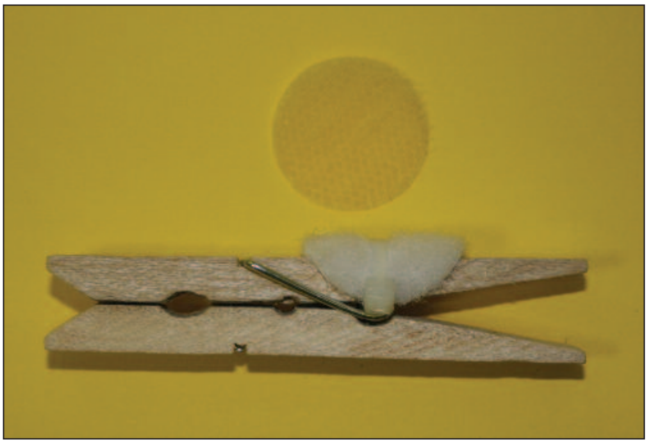

Plate 2. *Peg, cable tie and velcro pads millet holder*

Figure 1. *Illustration of millet spray, bird and velcro millet holder*

As they feed, they increase energy outlay and muscle use. Initially, as the birds were offered seed on the ground alongside the hanging spray, they chose to avoid the rigours of suspended feeding. A decision was then made to reduce the amount offered in daily floor feeds, which had been wasteful, with lots of scattered seed remaining uneaten. Only after the birds began to work on the suspended food for a period of time, were the floor dishes replenished lightly, creating a good balance between food intake and exercise. Having more exercise and a higher energy outlay for the calorific reward received may have additional benefits, other than having just more physically fit birds. We know in humans, for instance, that exercise can promote the feel good factor (Folkins & Sime, 1981; Steinberg *et al*, 1998). Indeed, exercise is recommended for people with mild depression. If the feel good factor linked to exercise is present in humans, then there is a distinct possibility that it is also present in the Animal Kingdom and if it is, then it is an extremely powerful tool that we have in our possession, and it is a tool that we cannot afford to ignore.

Working harder for nesting material

In order to meet new cage-size proposals (Council of Europe ETS 123, Appendix A, page 92, 15/6/06), the University purchased new metal cages with enamelled easy-to-clean surfaces. These metal cages allow us to use magnetic tape to hold nesting materials against the cage walls (Plate 3). This meant that the birds had to fly and pull the nesting materials from behind the tape, involving a higher energy outlay than simply picking it up from the floor, where it had traditionally been placed. In fact the finches snatch the nesting

Plate 3. *Nesting material held by magnetic strip*

materials while on the wing, using beak, eye and flight in a complex combination hitherto not required.

Although Zebra finches are known to be able to detect magnetic fields and some postulate that they use this sense for short-distance orientation (Voss *et al.,* 2007), we do not think that the presence of a small magnetic tape would impact upon their behaviour in any detrimental way. In any case we will be monitoring behavioural and other welfare parameters as we introduce this new enrichment device.

Conclusion

All the methods mentioned above involve the birds working harder for their requirements and having more mental and physical interaction with the environment. The fact that the birds need to manipulate their flight, foot and beak use should improve both their mental and physical welfare. In mammal species it has been shown that individuals that have a high level of mental and physical interaction with an environment have heavier more complex brains than those who do not (Ferchmin *et al* 1975).

Furthermore, it has been proposed that animals that have to face appropriate challenges have a higher standard of welfare (Meehan & Mench, 2007). Thus, modern housing and husbandry techniques should reflect a move away from minimum effort on the part of an animal to acquire its daily requirements and reflect more closely the challenges the animal has been designed by evolution to deal with.

Pilot studies already carried out at the University of Glasgow, involving a comparison of the birds that need to work for their seed by flying onto a suspended millet spray compared to birds fed millet in dishes on the floor, have shown that birds feeding on suspended millet-sprays are measurably physically fitter than those feeding on the floor. In addition when these birds were given cognitive tests to perform, the birds feeding on suspended millet spray were measurably faster at learning and performing the tasks than those given the easy life of feeding on the floor (Nager *et al*., 2009 in prep.)

The new bird facilities at Glasgow University represent an amalgamation of ideas from numerous sources that we think offers better welfare standards for our birds. Our policy is, however, to constantly assess, update and improve our husbandry practices as new possibilities arise. Welfare does not have a fixed end-point in the husbandry of captive animals; and the theme of animal welfare is an evolving creature in the world of science and animal technology.

The pursuit of a final conclusion is laudable, but frustratingly elusive in nature. The closer you think you are to it, the further away it seems.

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