

On the distribution, ecology and management of non-native reptiles and amphibians in the London Area.
Part 2. Disease impacts, perspectives, trade exploitation and finding ethical solutions

TOM E. S. LANGTON

Triton House, Bramfield, Halesworth, Suffolk IP19 9AE

CLIVE HERBERT

67a Ridgeway Avenue, East Barnet, Hertfordshire EN4 8TL

Abstract 157

Introduction 157

Impacts of disease 159

Perspectives on non-native species 160

Better management of trading and home-keeping 162

Ethical solutions 165

Final thoughts 169

Acknowledgements 171

References 171

Appendix. The freshwater terrapin and turtle trade, and rehousing problems — a case history 172

Abstract

The release of non-native herpetofauna, together with associated pathogens appears to be increasing. Since 1990 awareness has grown to the threat that new or latent pathogens and diseases can hold for native species. The problem is the result of their sale as pets and for laboratory use and irresponsible release. Abandonments have been a consequence of a lack of educational instruction and enforcement of legislation aimed at promoting animal welfare and nature conservation. For some time the government duty, that is also required by the CITES International Convention better to inform the public and to discourage abandonment has been grossly ineffective. There has also been inadequate effort by national government and non-government organizations to establish and promote good standards in the pet trade, home-keeping and in rehoming of amphibians and reptiles. Some confusion with negative effects of non-natives is linked to unscientific reasoning. The bulk of irresponsible trading to the uninformed public is based upon highly exploitative large-volume sales with very low survival rates. Ethical issues relating to poor survival and ill treatment by the public and rehoming issues are described with examples. Aspects of pet keeping and trade exploitation, including nature conservation and welfare issues are reviewed including ways to reduce and to try to end the growth of non-native species and pathogen abandonment.

Introduction

Worldwide, the extent of invasive amphibians and reptiles is becoming better documented (Lever 2003, Kraus 2009). There has been an all too slow realization of the change and harm that non-native species release, interacting with other major forces such as habitat destruction, can bring to both ecosystems and economies. Across the world, the cost of trying to control the harm caused by the international transport and exploitation of wild and some captive reared/bred animals sufficiently are escalating. As damage minimization becomes increasingly important there is need for a range of widely adopted policies and practices to regulate exploitation and to revolutionize our approach to managing wild animals. The first advice sheet on

non-native herpetofauna in Britain was produced by the charity Froglife, with support from the Environment Agency (Froglife 1997) on managing exotic species in the wild. A national policy defining native herpetofauna was also a voluntary sector initiative, being approved by Herpetofauna Groups of Britain and Ireland (HGBI 1996).

Recently in Britain, a national strategy has been established by government to try to begin to document non-native species impacts. These impacts collectively cost the UK economy an estimated £1.7 billion per year (Non-native Species Secretariat Website 2011 www.nonnativespecies.org). The cost of what may be irreversible change to species and habitats can be hard to assess technically without greater research. The NNSS now has responsibility for helping to coordinate information relating to invasive non-native species and has a website to assist those interested in and working on this subject. This involves a method to try to categorize the level of relative economic and ecological threat from species.

To date (mid 2011) NNSS information sheets called Risk Assessments, that attempt to describe impact and threat levels of invasive non-natives have been prepared for herpetofauna, including red-eared terrapin *Trachemys scripta elegans*, American bullfrog *Rana catesbeiana*/*Lithobates catesbeianus*, African clawed frog *Xenopus laevis* and Italian crested newt *Triturus cristatus*. A number of others are under preparation. Concern has grown about the impact of these species both from their direct interaction with native species and also from potential pathogenic organisms, e.g., protozoan, bacterial, viral or fungal disease. The impact of disease transfer in wild animals, but the better known and devastating ones as an emerging problem (Cunningham 1996) adds great additional weight to old and often unheeded calls not to allow the proliferation of international trade in wild animals. Exploitation continues to develop under its own momentum in place of an accessible yet tightly regulated and heavily monitored trade. Modern trade should recognize that animals are not just standard commodities. Their exploitation should be based upon the reverse listing of suitable species on nature conservation and welfare grounds, with competence-related licensing to promote good standards. The impact of continued importation of exotic herpetofauna was predicted to be high-risk in respect of disease transfer (Cunningham and Langton 1997) and this has proved to be correct. Further concerns have grown about animal welfare issues from the illegal dumping of unwanted captive amphibians and reptiles due to factors such as stress, starvation and hypothermia, sometimes in combination with disease and other problems associated with an animal being placed in unfamiliar climate and habitat.

Today there are blatantly insufficient systems in place to prevent the continued invasion of traded or otherwise transferred species, and the movement of animals across continents and into the wild is commonplace. One basic cause is the removal of general trading barriers across nations, such as is seen in the enlarged European Union area. The achievement of sustainable utilization in traded wildlife is highly case-specific and demands flexible feedback mechanisms to retain a high degree of market control. It can also be heavily undermined in practice by trade forces (often unlawful or unethical) that have a deregulatory effect. In practice, sadly, the success stories in the reptile and amphibian trade of all kinds are an exception and represent a tiny contribution to any aspiration to reverse species declines through exploitative management. While the process is a theoretical solution to over-exploitation, it can only function when the market is sufficiently regulated to prevent the forces that undermine it. To create 'fair trade' in this area is difficult or arguably impossible (and has always seemed so since the 1980s) because their commodity and profit value to private traders has been valued more highly by government (even if just by light-touch management) and amazingly has, in effect, been protected with greater care than welfare and nature conservation

needs and considerations. Consumer choice is insufficiently discerning as the target purchaser for the bulk trade is not a discerning buyer. After twenty-five years CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora, also known as the Washington Convention) has not induced the form of sensible and caring yet tightly managed regulation that could in theory enable a low-impact exploitative trade to exist.

CITES and interpretations of it within regional regulations and national/state laws is slow and sluggish where rapid fine tuning and micromanagement are needed for it to complement environmental protection. Equally international crime is traditionally difficult to prosecute for a range of reasons, including cost, language barriers and legal complexities. International, and to some extent national wildlife crime detection and prosecution have been pushed further down as a priority since 2001 when the newer obligation of 'terror' crime prevention added to the duties of international and national enforcement agencies, already struggling with the illegal drug and weapon trade, human trafficking, computer crime and other crime growth areas. Our natural world lags behind in the queue for resources to solve world conflicts.

Impacts of disease

In the 1980s, those concerned with and working on disease in herpetofauna were relatively few in number. This is despite the fact that, as a basic ecological process, disease has been a centre-stage driver of community structure, species richness and diversity and hence evolution. A mass outbreak of virulent disease in common frog *Rana temporaria* in London and parts of south-east England in the early 1990s influenced frog numbers that had built up high densities in garden environments over the previous thirty years (Langton 1991). The efforts to initiate a response to disease, that was finally identified as a new virus, was even met by scepticism (Beebee 1996), but the impact of disease transfer from non-native animals has also gained much more interest over the last twenty years and better, quicker and cheaper molecular technologies can be used to investigate. These further reveal that disease is clearly not a fringe factor, something that the international Declining Amphibian Populations Task Force was quick to recognize in issuing hygiene guidelines to fieldworkers.

Disease may be particularly influential, as are the other main forms of mortality upon small, declining, fragmented populations. It can function like predation forces on population numbers, causing significant reduction in small, spatially constrained or stressed populations that may not always be short term. It can cause or contribute to dramatic declines and even extinctions through exacerbating factors such as speeding up inbreeding, that might not happen or that would be slower or recoverable in larger blocks of habitat. The first major investigation of disease in amphibians in the UK, the London-based Frog Mortality Project, identified an iridovirus from the ranavirus family (Cunningham et al. 1996). Previously, amphibians seen dead or alive in various haemorrhagic-reddened states were considered crudely in a catch-all category of 'red leg'. Frog iridovirus origin and spread in the UK in recent decades is not fully understood but is circumstantially linked to the release of non-native species of cold-blooded vertebrates (including fish and chelonians) that carry a very similar type or the same virus. Most of the amphibian species mentioned in this review and particularly Water Frogs are listed as having cytrid fungus or ranavirus infections. These were reported in a review of major disease threats to European amphibians, alongside another category of 'additional pathogens' (Duffas and Cunningham 2010).

Disease in herpetofauna can occur without prior anticipation due to a lack of understanding or awareness of disease potential. In the mid 1990s keepers at London Zoo in Regent's Park, Camden, started to take in from the public small numbers of terrapins that were unwanted pets, keeping them in the Zoo's Pelican

Pool. From an initial group of twenty, numbers grew rapidly to about 180. At such density, many became ill and were infected with the protozoan *Hexamita* that can kill terrapins through immune-suppression. The risk then realized was the spread of *Hexamita* to the bird collection and the outcome was that all of the terrapins were euthanased. Euthanasia of terrapins is expensive. One method that has been frequently used in London begins with an initial injection of a relaxant such as Ketamine. Then the head is cut off and the brain and spine tissue macerated manually (pithing). For a single terrapin this might typically cost over £100 due to the costs of disposal of the animal that has been injected with drugs and then classed as clinical waste for controlled disposal.

Perspectives on non-native species

Richard Fitter first recorded British Herpetological Society (BHS) members releasing amphibians and reptiles in the wild on Hampstead Heath (Fitter 1949). From the 1970s the BHS published accounts of garden keeping and wasteland release of European species, and in addition to members several of its officials were part-time pet traders as well as keepers. The BHS even objected (unsuccessfully) to licensing measures that were brought in to monitor and control the sale of native UK species in 1988. It appointed a Trade Officer who was active in fostering aspects of the trade. The subsequent rapid growth of the current mass market more recently means that such groundwork has been influential in this regard. Its newsletter has taken on criticism of the RSPCA, for example when seeking severely to limit the import of large lizards, venomous snakes and crocodilians. The RSPCA is opposed to the trade in wild animals and to any degree of confinement which is likely to cause distress or suffering to the animals concerned. Research by the RSPCA (2004) demonstrated pet shops to be giving very poor advice to prospective purchasers of chelonians. The long-standing activities of London hobbyists in releasing European species in park areas, gardens and on wasteland seem to be associated with a relaxed approach to non-natives, biosecurity and animal welfare.

The most diverse assembly of non-native amphibians and reptiles in Greater London and the London Area in general has been in the Borough of Greenwich, on land in the Kidbrooke area. Here changes to urban land use over about ten hectares of land in the last thirty years or so have included demolition of buildings, road construction, its abandonment to vegetative overgrowth with some management and pond creation. Kidbrooke Green and Birdbrook Road Nature Reserve, together with adjoining garden areas, became effectively a focus for the experimental establishment of non-native European amphibians and reptiles. The site is well documented by Charles Snell in articles in the British Herpetological Society (BHS) *Bulletin* and in technical reports relating to road widening. In the late 1970s, edible frog, tree frog, yellow-bellied toad and wall lizard and possibly other species were established. Interchange of these and other species had occurred with adjacent gardens where amphibians and reptiles were released into enclosures in at least two gardens (Snell 1983).

Prior to the ban on release of non-natives in 1981 when such actions became unlawful, there was quite a strong movement within the BHS, if not to encourage then to try to protect the rights of the public to keep non-native European species in gardens (legally now 'the wild' unless escape-proof) and to tolerate and even to protect them if they spread into the wild. By 1993 (BHSCC 1993) the species that were also reported as present over one or more of the Birdbrook/Kidbrooke areas included pool frog, Alpine newt, marbled newt, parsley frog and sand lizard (sand lizard apparently of German origin). Ponds and wet areas were made for wildlife under the care of the Greenwich Nature Conservation Society, initially as part of compensatory

measures for loss of half of the area known as Kidbrooke Green to road works. Some local interests promoted a non-native species centre being built on part of the area. A twenty-four-foot pond was dug by Friends of the Earth volunteers on what was then called the Birdbrook 'Telecom' site, to replace one that had apparently been previously destroyed, to increase the traffic capacity of the adjoining A2 road. It was reported that the London Wildlife Trust and others wished to build reptile and amphibian enclosures and a captive breeding centre on a part of the site to act as a pool to colonize other sites (Snell 1981). Concerns raised by LWT to the Greater London Council and Fauna and Flora Preservation Society were that they wished only to maintain it for the native species, including the great crested newt *Triturus cristatus* which had remarkably appeared with subsequently the Italian version and possibly hybrids. By the 1990s tree frogs were being reported as being 'stolen', and possibly other species, probably due to repeated publicity for the site location, the long-known stimulus for collectors to descend.

One London-based frog breeder, who had lived in Sweden for periods in the 1980s, collected Water Frogs in Sweden and imported them in 1995 where they were bred in confinement in 1996. This was at around the time a Water Frog apparently collected from Thompson Common in Norfolk (where frogs were collected and possibly released unknown to the Norfolk Wildlife Trust managing the reserve by 'visits from herpetologists from London' in the 1980s) was being bred with Water Frogs that had previously somehow also been brought into Britain from Sweden, allegedly 'unofficially' in respect of government permissions for taking and international transport. These are probably not the same frogs that found themselves in the wild in Kidbrooke. However, it does seem that some of the various crosses of them with 'Water Frogs from Thompson Common' have been established at a location near Colchester. No clear account of this important background information was published by English Nature, perhaps because of the lack of clarity of the provenance of specimens and because the messy situation might reflect badly on the credibility of their scientific case regarding the historic status of pool frog.

This was a time when English Nature apparently felt that it badly needed some good news in herpetofauna conservation, if nothing else as some have suggested for other species, a 'PR' exercise in the light of the continued decline in the wild of most amphibians and reptiles and with the rarest species remaining in trouble; leathery turtle dying in UK fishing gear and diminishing in the Atlantic, great crested newt breeding sites in continued rapid decline, natterjack toad struggling in isolated inbreeding enclaves. The more-widespread species were largely neglected and heathland herps sites under continuing pressure despite some localized progress. Such a good news story might allow it to be seen to be successful at least in some respects while the big picture was looking bleak.

Releases of amphibian and reptile species into the UK wild from mainland Europe created debate in the 1970s and 1980s. Due to their geographic proximity, many of these species were extensively supplied in the pet trade in the 1960s and 1970s and also brought home from holidays in a period where few trade or transport restrictions were in place or effective.

At the time, many people on the BHS conservation committee felt that the 'pet trade' exploitation aspect was unsustainable and to some extent unethical, with most purchasers being poorly advised or informed and unable to offer suitable housing or care. The more obvious cruel aspects of the bulk tortoise trade resulted in RSPCA action and the early ban. More widely, as numbers and variety of available species increased in the 1970s, non-native herpetofauna became a novelty alternative to more traditional pet slow-worm, grass snake, and sand lizard or amphibian species collected for UK pet shop sale. Only a few children and enthusiasts had the real dedication and interest to keep them properly. Many escaped and died under floorboards or were also

released in unsuitable places. In several instances however colonies established and in a few cases such as the Water Frogs and midwife toad were seen to establish and spread.

With respect to European species however, Trevor Beebee went as far as lampooning the Nature Conservancy Council and the Wildlife and Countryside Bill in the BHS *Bulletin* (Beebee 1981) for listing northern European amphibian and reptile species on a Schedule making it unlawful to release them into the wild. In the BHS Conservation Committee report for 1980 he further wrote that he personally felt so strongly about it that on behalf of the committee he had pressed [government] to remove restrictions on edible frog, marsh frog and European tree frog, Alpine newt, yellow-bellied toad, midwife toad, wall lizard and European pond tortoise from laws to prohibit release in the wild (Beebee 1980). This was done 'since legislation to prevent or license casual release of these harmless species into garden ponds, etc. seems both unnecessary and unenforceable'. The inclusion of this statement in the report was a surprise to those members of the BHSCC at the time who had not been consulted.

In 1981, in response to the impending restrictions on the release of non-native herpetofauna in Britain by the Wildlife and Countryside Act 1981, Trevor Beebee wrote again in the BHS *Bulletin* 'Though personally not in favour of introduction of non-European exotic species, there are some forms just across the Channel which do well in garden ponds and which I see no reason to discourage. I and no doubt many others, have successfully established thriving colonies of both edible frogs and Alpine newts, and quite probably there are other suitable candidates too. In my view since those species from Europe which are likely to be able to establish themselves in Britain are almost always from areas where our own native species also occur, destructive competition is improbable and our fauna is a little richer as a result'.

Continuing in the same way as an aside in his book on natterjack toad (Beebee 1983) commented 'With some species that have obvious capacities to become pests . . . cautious approach is readily justifiable. It seems rather less sensible with amphibians, though, as they are most unlikely to cause a nuisance to anybody or to have serious consequences for species already living in the sites to which they are moved. For example, the introduction of the marsh frog into England in 1935 has resulted in the establishment of several colonies; early fears that it would be detrimental to our native wildlife seem to have been groundless, and the British fauna is now a little richer in terms of amphibians than it was at the start of the century.'

Another BHS member was giving out signals in the 1980s that worried those wishing to have a far more cautious and clear-cut position on the trade and releasing of non-native species. John Buckley (1986), in 'Water Frogs in Norfolk' commented 'There has been some change in the available evidence during the last hundred years but nothing sufficient to cause us to alter his (Boulenger's) conclusion that they (Water Frogs) are not indigenous.' [Note this is a view that JB then changed, and] 'The species of Water Frog already established in the county (marsh, edible and pool) serve to enhance the county's native fauna and their continued existence should surely be encouraged.' Thus Buckley, and effectively the Society, appeared to reflect the views of Beebee and a few dozen UK hobby breeders and dealers on this issue, suggesting that release of some non-natives should not be restricted in the wild. The exact relationship between this confusion and a period of major escalation of the abandonment problem is hard to determine.

Better management of trading and home-keeping

The trade in wild animals as pets in London and in Britain in general has opened up over the last twenty years in a manner that leaves the concerns that

were expressed towards escalating international trade in the 1980s (e.g., Warwick 1990) a modest understatement. The outcome from relaxing European Union internal border controls in the 1990s, with faster more affordable international transport of people and goods, internet marketing, supply methods and quick electronic payment systems has been to enable increased access to exotic animals both legally and illegally supplied. At the bulk end of the market, this has reached levels of excess with the availability of some reptiles now as little more than cheap disposable toys for children in a manner not dissimilar to that of the 1950s and still prevalent today in the reduced but still practiced use of goldfish in fairgrounds. Some traders even have a term for the cheaper reptiles included with more valuable species in imported consignments as 'rubbish'. Tackling this issue is difficult because no organization has taken up a full and meaningful interest in the problems. Those most aware are involved somehow in the trade yet unwilling to do anything that might 'put the brakes on'. The industry has no effective representatives and appears at least interested in playing the very old record that claims that animal rights extremists are attacking some kind of human right to keep pet reptiles. The fact is that the trade is too fragmented and fluid to have an opinion. Any shift to regulation is to be resisted because without a mass trade reptile pet shops could not operate. Equally, moderate policy would see every child having the opportunity to study reptiles in the wild and in captivity, at least for the hardy reverse-listed species. Specialists could have licensed access to most species but outside a mass trade-based system.

Such a scenario however is unlikely to play out until all concerned better recognize the sensitivity of reptiles and the high mortality rates that are prevalent and fully take on board the level of responsibility that any wild animal keeper takes on in order to keep it properly. During the mid 1980s, in response to the trend of increase in the casual sale of reptiles and amphibians as pets, Dave Ball of the reptile house at London Zoo instigated a new public display regarding reptiles as pets. This was titled 'Thinking of keeping a reptile — think again', and featured pictures of specialized equipment needed to try to look after them properly. This display lasted for about ten years and may usefully have helped to forewarn many people about the level of expense, time and effort to keep such animals properly as well as perhaps informing those with a keen interest. It included indication of the cost of setting up a vivarium and the research and dedication needed to keep reptiles and amphibians alive. This is one of the few examples of provision of information to the public on how difficult reptile keeping can be, and probably the most important message that most members of the public fail to get before a casual purchase.

Balancing the 'right' of the public to keep animals is a difficult concept when the volume of animals now needed to supply the market and the levels if demand is further stimulated to keep growing. It seems fair to suggest that any such right is accompanied by the right of the animal to be looked after properly and in such a manner that its origin or disposal does not create nature conservation or animal welfare problems up and down the line. Children cannot always make these distinctions and neither can many adults. This is why in the absence of self-regulation that government now at last needs to take a new stance on wildlife trade and in an international as well as domestic context.

Consideration of the basic welfare aspects that might be expected in allowing the keeping of animals adapted to the tropics or subtropics should not go unmentioned, especially in the case of the freshwater turtles and terrapins that are particularly prevalent in London. A case history on the origin and disposal of these species is given in the Appendix because there is a particularly acute problem with chelonians at present. This gives further details showing how serious welfare and nature conservation problems have arisen from a failed rehabilitation scheme that flew unwanted terrapins to a reception centre. This

rehabilitation centre for terrapins was compared with Auschwitz in an open letter (Coleman to British Chelonia Group in 2003). Before that however, we present remarks on some aspects of the survival of these species in captivity and in the wild.

Terrapins and turtles that have been abandoned in London's rivers, canals, ponds and lakes are almost always badly compromised right from the start in terms of their health and survival chances. Water temperature is a key factor in terrapin survival, so depth and flow of moving water will be important, as is orientation of basking areas to the sun and extent of tree shade. In some places where temperatures are warmer due to the sheltering effect of the urban environment, and water flushes through a water body to keep it clean and oxygen levels high, it is suspected that terrapins may survive for longer. One such example is the urban Roath Park in Cardiff, which was the site in the UK reported by the National Terrapin Survey to have most terrapins in the 1990s. As a dammed watercourse in origin, it is flushed with water and has a sunny north-south axis. It has an islands area with submerged banks that are structurally suited to terrapin hibernation and shelter.

On release, a terrapin may not have access to suitable food and will not forage when temperatures drop below about sixteen to eighteen degrees Celsius. Terrapins have not been shown to breed unassisted in the wild in northern Europe because temperatures are too low for egg development, although so far there is some evidence of wild breeding in central Germany. To hatch, eggs need to be incubated at around thirty degrees for sixty days which is not possible even in a very hot UK summer. Ultimately the illegal act of abandoning terrapins is animal abuse and needs to be stopped. It has gone on too long and immediate steps need to be taken to prevent further releases.

In captivity, terrapins are not the easiest of pets to maintain, even for experienced specialists. They require a large enclosure, a lot of cleaning, particular food, food supplements and often expensive veterinary treatment. One of the regular problems among captive terrapins is caused by a high protein, low calcium diet which brings on a weak and spongy shell. Shell rot can either be caused by lack of calcium in the diet or lack of sunlight in which the terrapins can bask to synthesize the vitamin D3 which enables them to absorb the calcium in their food. Any one of a number of diseases arising from the relatively cold UK environment can reduce longevity; one of the commonest illnesses is vitamin A deficiency. Vitamin A plays an important part in the production of the epithelial tissues which cover the internal and external surfaces of the body. In terrapins a typical symptom is swollen eyelids. These can fuse together causing the animal to be unable to feed. Infections closely related to pneumonia may result in laboured breathing, discharges from the nose and mouth and swimming difficulty. In care, these need prompt treatment with antibiotics. Basically, the species currently widely in trade should not be sold to the public as they are unsuitable. Terrapins in trade under 100 mm (around four inches) should be banned immediately, as such trade is banned in North America. This should be done as a matter of urgency and such an act would remove from the casual keeper the most unsuitable animals.

Recently there has been a reaction that is a very interesting new development in one group of biologists in the front line and receiving end of these problems. Britain's vets are presented with sick and dying wild exotic animals sold as pets so frequently that in 2010 they considered it one of their major national concerns. It was debated at the British Veterinary Association meeting in 2011 at Regent's Park. Here one key-note speaker and senior veterinarian indicated that training of vets in exotic species at UK's universities and teaching departments was, 'frankly rubbish', and there was a dilemma in the large amount of time that would be needed to train vets to be able to do the job well. At the meeting, in a recorded vote, ninety-five per cent of those attending voted in favour for a complete ban of the trade in wild-caught reptiles and for

the majority it would be unconditional. Such powers are beyond their control but if the senior professional group in the subject are prepared to stand up in this manner in such a united way, the message is clear to government on the overdue need for a fresh approach on the mass supply of unsuitable animals to the public.

A few enforcement operations by government Customs officials resulted in fines and custodial sentences for reptile smuggling in the 1980s and early 1990s and since. Although some degree of deterrent, this had little overall effect on volumes entering London and the UK as a whole, probably because detection rate and enforcement action have addressed just a tiny proportion of criminal activity and fines, and penalties were lower than for other illegal trades. Trade has generally become less well controlled since movement of the public and 'commercial goods' within the European Union countries as border controls between nations were relaxed in the early 1990s and less heavily policed. Equally, more-subtle frauds have become more difficult to detect and enforce against.

Ethical solutions

One of the most important points for educationists regarding the management of non-native species issues is not to let public perception somehow demonize wildlife by establishing artificial 'nice' and 'nasty' categories. All concerned must work hard not to let any need to remove or cull animals diminish responsible attitudes towards species in the mind of the general public. This can be difficult when animals appreciated in their native habitat are reduced to 'pest' status in the one that they have invaded and this produces a paradox for animal rights protagonists who support the individual animal, whether it is in or out of its 'evolutionary environment'. That the 'rights' of a released animal and its offspring are compromised by the person releasing it is hard for some to accept, but it is the releaser who creates the paradox.

When animals are removed from the wild and/or culled to reduce measured or suspected damage this should remain a sincere act, done with maximum care and not trivialized. Teaching young people responsible, sympathetic approaches to non-natives control as a last resort is vital. This manifested itself recently to one author (TESL) when children at a local primary school showed him how to kill 'bad' (harlequin) ladybirds to help protect 'nice' (native) ladybirds. The lads in question, in error then squashed a large native ladybird and were, sadly, excited about being encouraged by grown-ups to kill ladybirds. Pest controllers may sometimes develop a mind-set that culled animals are bad and give their worst example to impress their clients. The potential harm of some of the more frequently removed native and naturalized species are often over-emphasized.

It is important to stress that the public should not see bullfrogs, terrapins and similar as bad or frightening as they can sometimes be portrayed. This may happen, as when any story is simplified, offered to the press and 'spun' to create sensationalism. One of our members, Bill Oddie, has made the point that non-natives, even those causing human disease and or economic damage can be attractive and interesting. Such thoughts help to suppress anti-animal rhetoric and to foster understanding and knowledge. This humane approach may seem sentimental and be scorned by some who kill regularly professionally or as a hobby but it does seem the best approach if we are to gain generally sympathetic attitudes that the public can share in. Presented carefully it does not contradict the fact that wildlife management other than in remote wild areas involves controlling the density and distribution of animals and plants. An understanding of killing with compassion and high regard for animal welfare are things that every person should be encouraged to believe in.

Better education of the public on non-natives issues will be a costly mission to sustain and requires careful handling with scientific principles. It requires a shift of emphasis on presentation of the natural world from scariness, deadliness or weirdness from the early years of television and magazines (that is creeping back from the 1960s) in favour of more informative concepts, effectively more public information on important wildlife issues, and a new series on 'threats to the wild' is needed. There is also a need for more of the informed natural 'wonderment' approach that Bill Oddie, Chris Packham and others have developed. There are however challenges, as illustrated by media reports that the BBC1 television programme *Life in Cold Blood* (2008) narrated by David Attenborough was so effective in making people appreciate amphibians and reptiles, that its showing stimulated pet trade sales. Other BBC presentations and those of other channels have been more sensationalist, using animal issues to entertain, sometimes with incorrect or distorted information which may in fact in many cases undermine or undo the good work of other programmes. The TV industry needs to take a good look at this problem and avoid becoming an electronic circus in the future, in the manner of some of the tackier programmes being made (e.g., *I'm a Celebrity*). The care with which wild animal information and messages are put out is increasingly important to the appreciation and protection of wildlife as our communication technology becomes more sophisticated.

More recently the existence of a number of examples of apparently benign wildlife introductions have been offered and a school of thought suggests that always taking a negative view is misleading (Hamilton 2011). Cases have also been made that the impact of plant introductions has been overstated. There may be a number of cases where no obvious harm and some perceived benefit may accrue from introduced species but largely the approach appears borne from a genuine potential to use non-natives in a positive way rather than a denial of the massive harm caused by many species. To be valid it requires a much deeper understanding of subjects such as disease transfer and management and how plant and invertebrate communities are impacted when new species are released.

One apparently benign release is the brown hare *Lepus europaeus*, an old UK introduction that now even has its own government-promoted national conservation target. In Patagonia in South America, on some managed wild areas, brown hares now probably form a significant part of the prey of puma *Felis concolor* and Geoffroy's cat *Leopardus geoffroyi*, where they have partly displaced the mara *Dolichotis patagonum* (a large cavy). But if hares were culled or eradicated it might put the now much smaller mara populations under serious pressure, as they are easier prey. In one area a management decision was taken not to intervene (World Land Trust, pers. comm.). Clearly the reaction of any natural community to a new species may be hard to observe, take time to happen and have minor or major consequences over both short and long periods. These are hard or perhaps impossible to predict and it is difficult to argue that a precautionary approach to avoiding them completely is not by far the best policy.

The optimism in respect to rebuilding badly damaged habitats with species from outside the 'native extent' of any natural habitat however must surely be handled only with extreme care. It may not be a flawed concept for many areas but strict guidelines need drawing to determine how and when biodiversity restoration compromises into the broader concept of constructed communities which are an untested concept. Despite being unproven, 'intelligent' and low chemical/carbon dependency agriculture with animal species a part of the community could well become rapidly more relevant within thirty to fifty years as global climate and weather patterns shift more dramatically and animals and plants shift distribution in response. The irony is that non-native species translocation could soon become essential to delay climate-induced extinctions

— a true sign of how desperate matters are becoming in nature conservation. Any advance approach on rewilding destroyed areas of the world in such a manner would require both stringent internationally accepted rules and monitoring to establish continuity and to prevent abuse. In such a scenario, the danger of arguments that man-made communities are as valuable as natural ones, even if the exceptions can prove the rule, should not be taken out of context to devalue protection of what little natural habitat remains, nor be at the expense of restorable communities. However, the world is full of ‘damaged’ land that requires remediation and in urgent need of revegetating, not least to help attempts to offset carbon emissions. Keeping the two future approaches separate yet in a complementary form is vital for a future where agricultural production and biodiversity protection work in harmony.

There are specific issues that might benefit from new thinking or at least acceptance of concerns that appear to have been ignored. As an example, in the case of Water Frog this may be the time for a fresh start in order to clear the air. Assuming that government will not spend to eradicate Water Frogs, which in theory could be attempted in most areas given a large amount of effort, under the circumstances it is surely time to accept them as ‘here to stay’, if indeed they prove able to survive in the long term. The various species and hybrids should continue to spread, moving into northern England and more widely in Wales via dispersal and human transfer over the next fifty years or so. The Norfolk Broads, Fenland and other wetlands will be home to Water Frogs of mixed types and particularly the dominant marsh frog types. The possibility of retaining small enclaves of isolated ‘pure’ Water Frog species looks rather unlikely because their spread to a genetically robust distribution will bring their downfall as they form contact zones with other species or hybrids. This predictable outcome should have been realized earlier so as to avoid wasted resources.

Something currently missing in invasive species management in London is the adequate provision of public information. This is required by International Convention but it has usually manifested itself as just short leaflets or web pages rather than any significant public information programmes. Research (Part 1) shows that many people have been blatantly caught releasing terrapins and frogs in parks around London. They normally seem unafraid to explain what they are doing as if it is the right thing to do and to plead ignorance of the law. The levels of understanding are poor because there is so little information offered in a proactive way and also because people tend to do what they like in the absence of advice and/or unless enforcement is seen to take place. There have been ample opportunities for prosecutions but with the collection of specialist evidence and complex case nature of investigations and prosecutions, nature conservation agencies, police constabularies and Crown Prosecution Service have not prioritized enforcement, even when preparatory work by volunteers has exposed good evidence.

The costs associated with any one case might seem unjustified, but as a result large numbers of people are abandoning animals all over our urban and rural countryside; the current effective ‘free for all’ needs carefully but rapidly taking in hand. After a public warning, a range of cases need prosecuting together with TV advertising or awareness programmes, so that people realize that abandoning non-native animals is wrong and can lead to a criminal record and other penalties. It is time for the government to alert councils and the police to enforce. Equally, government needs to take steps to ensure that there is a place to take every unwanted animal and for the costs of euthanasia to be available if proper rehoming cannot be achieved. This is in addition to prohibition of certain species and size-limit controls.

Sadly, there has been little regarding the nature of the pet supply and abandonment in London and elsewhere since its apparent increase over the last ten years that gives much hope of things getting any better. The problems

observed in the 1980s are as prevalent as ever and in particular with respect to infectious disease transmission. Species come and go in trade over a very short period (Tapley et al. 2011) with novelty value for the 'consumer' shifting and pathogens capable of moving to native species being transported around the world and abandoned in the wild with their host. It was realized by conservation bodies in the 1980s that harvesting of wild animals for the pet trade was going to be very difficult as a sustainable approach. This is due to the volatility of the market place and lack of an environment to enable fair trade. In the early experiments with captive breeding in northern Europe, economic forces were soon at play, reducing the value of animals mass-produced by dedicated breeders. As with ethically sourced food supplies, with fair prices for producers, the entire market chain would have to support and protect such sources for it to work. This is not going to happen unless interested parties (collectors, wholesalers, middlemen, dealers and customers) can create it. Commercial ranching and farming to create both nature conservation and commercial gain has only been shown to operate in any sense in a commercial way for crocodylians and in a few other cases. It will not occur when the average purchaser is a harassed parent, impulse buying for a child an animal that will probably only live for a few months. It will not happen while the use of wild animals as pets is considered a normal type of commercial trade. There would need to be a sea change in global perceptions to make sustainable exploitation work in practice and that has never been likely, yet is needed to avoid continued and escalating problems.

It is now interesting to see the desperate proposals to tackle the problems as they become more obvious for all to realize. One includes proposals for the application of a special taxation system with monies transferred to some form of complex local control system that will constrain release of non-natives and enforce voluntary codes of practice (Perry and Farmer 2011). The international trade systems just do not operate to enable such methods and in fact work against them. The suggested mechanisms appear naïve for the kind of world that has developed. It is time to recognize that insufficient work has been done and insufficient measures put in place to apply sustainable use to the wild animal pet trade. If the public and scientific community have not demanded it then governments must legislate toughly. This should include reverse listing (allowing trade only in species judged highly suitable for captivity) and enforce heavily on unlawful activities. Such tough revisions would actually be in the best interest of nature conservation, welfare and pet keeping if genuinely informed and truly representative officials from relevant bodies made serious efforts to support them.

There is, however, a real danger of a dichotomy between those who would see the mass pet trade continue and research it and those who want to see a fresh approach with far tighter controls. Is it acceptable to talk down moves to bring about greater trade control, involving wider bans as unenforceable and to talk of a day when some form of 'best practice' will bring sufficient solutions? This is a highly unlikely expectation other than with a few local demonstration cases. As CITES has not been able to deliver sustainable approaches then there is a need for a new convention or specific measures in existing ones, with the consequential national/economic zones enforcing legislation. To call for more research and just to hope for the best is asking for trouble at this unstable stage in species exploitation and extinction. More-determined administrative action is the priority. This is a test of human ability to manage one aspect of our rapidly deteriorating world.

There should be no confusion however that bans are sought for non-pet scientific and educational purposes. These require a supply system to be designed without exploitative loopholes and unhelpful leakage between the pet, zoo, food and science industries. If the pet industry problems in all their facets cannot however be controlled they must be dramatically shrunk. It would be

no bad thing for people to gain basic and advanced training qualifications before being allowed access to sell or keep non-native wild animals, much as people who handle protected species as volunteers or professionals must invest time and energy in knowing how to trap and handle them properly.

Final thoughts

We have reviewed the occurrence of non-native species of amphibians and reptiles in the London Area. Importation of terrapins, along with snakes and lizards has visibly expanded since 2007. Introduced and escaped exotic animal and plant species are now an increasingly debated issue in recent years in the UK. Issues raised often relate to science (are we sure about the facts?), nature conservation (how should we manage them/the situation?) and moral issues and welfare considerations (is the suffering they cause/endure acceptable/preventable?). Modern environmental teaching may encourage us not to confuse conservation and moral/welfare issues, but with the best available information, in the real world decisions must be made using an understanding of the needs and sometimes conflicting demands from these separate yet interwoven fields. The modern naturalist and conservationist needs to understand both and be involved in seeking practical intervention. Clear reasoning with well-produced policies and practices are needed to prevent confusion, misinformation and wasted resources.

Such is the way with London's exotic herpetofauna. This review shows how the natural history observation and other scientific approaches to various issues remain the guiding lights and how careful judgement must be applied 'in the field'. It shows in often incredible circumstances how some of the matters touch on fine philosophical approaches and perceptions towards exotic species issues.

Of perhaps greatest importance is people taking responsibility for actions relating to the various species concerned to bring about further research, to progress taking action against those continuing to abandon exotics in the wild, to teach people to be more responsible or to try to get government to take more concerted action. This applies at all levels, from the public to government administrators. There is clearly a need to limit (by licensing or other control mechanisms) the importation of species and sale as 'impulse buy' pets, to help to reduce the existing and potential nature conservation and welfare problems.

This review touches on a remarkable range of events, some nearly 200 years ago and some from the last two decades, that illuminate human relationships with wild animals. The complexities of attitudes towards the naturalness of communities and the revisionist debates concerning how we view and manage nature both within our urban green space and more distant wilder and remoter habitats are a reminder of the need for better and more prescriptive approaches.

With current alarm bells ringing over accelerated global climate change, we have experienced, in recent decades, a weather sequence that implies that we are in a short-term warming period that bucks the trend of gradual cooling of our climate since the Iron Age. If we are close to a major tipping point as some models suggest, that then quite rapidly sends UK climate into hotter (but possibly colder or possibly hot and then cold) or more extreme patterns in relatively quick succession, many aspirations will become immaterial. Tinkering by humankind will simply reflect its inability, despite technical innovation, to have managed our wider environment, species and habitats effectively for the benefit of humans and wildlife. An ending to activities that bring on diminished conditions for wildlife could be relatively straightforward, given political inspiration and wise government. As Gerald Durrell put it, 'We are only trying to prevent the human race from committing suicide'. The sensitivity of reptiles and amphibians is a reminder that temperatures control

biological processes and that across narrow thresholds, small fluctuations can bring profound change.

Over the years, factors contributing to uncertainty in this area have included contradictory advice from perceived authorities, with actions by individual government officials appearing maverick in approach for unclear or suspected political reasons. Strange positions have been cause-arguing inconclusive science regarding what constitutes a non-native and what should be released. Also unhelpful has been the lack of proper policies, backed by expert agency capacity for rapid review and concerted nature conservation lead action in import control and educational exercises. Ultimately, a body is needed with direct control over the specialist work that may require real expertise and resources. Non-native herpetofauna in the London Area provides a useful microcosm to show how there is need for much clearer and accountable approaches in the future if a coherent response to the problems that are described is to be ready in the planning of 'what happens next'.

We must learn from events such as the removal of terrapins from Sheepwash Pond in Barnet where media reporting simply added to the confusion (Anon 2005, Galbinski 2005, Wallman 2005, Zachariou 2004). Despite some sound comment from the London Wildlife Trust (Cohen 2004), the average member of the public would have been left in the dark with respect to proper information on the incidence of non-natives at this important local nature reserve area.

Attitudes towards the live wild animal trade and potential conflicts between sustainability theories and the reality of impact of commercial exploitation also require re-examination. Will people continue to accept the premature death from neglect of large numbers of herps in addition to fish species that retain wild behaviour in captivity, on the basis that a very small number may care about it? Is casual possession of a huge range of wild animals by the public with no distinction for serious keepers healthy when there is an overwhelming need for better appreciation of their demise in the wild?

Over twenty years ago in an article on the pet trade, Langton (1989) wrote in a European context 'Pet keeping clubs and societies might benefit from considering how to enforce standards and codes of practice in their discipline. They must make the pet trade industries the champions of correct exploitation. This would demonstrate responsibility and assist legislators with the difficult task of designing suitable control mechanisms for trade. This in turn will speed a better application of the science and the rewards of successful wildlife management.' However, in respect of terrapins and freshwater turtles, one of the two focuses of this review, as one chelonian hobbyist consulted put it recently: 'What the hobby is guilty of is abject indifference and apathy. Coupled to that, the two leading chelonian societies are to all intents and purposes, wholly dysfunctional on this subject.'

To go into more-extended conclusions and recommendations on the problems of and plight of non-native herpetofauna is beyond the scope of this review. It is hoped that it gives information that will stimulate further considerations and practical improvements to the current situation. It seems unlikely that without significant government intervention there will be any change to both the releasing of non-natives by the public or relief of the welfare concerns surrounding the main focus of the controversies; the pet trade. Keeping of pets in principle is an ancient activity from which mankind and animals can benefit. It is not per se under threat, but those involved who do not now take steps to try to change animal trading and keeping into highly refined and responsible practices may well find in default a situation where cruder and less-flexible laws need to be rapidly introduced instead, in order to limit the negative impacts and to create a new order that has failed to emerge from free market forces.

Acknowledgements

Acknowledgements are included with those given in Part 1.

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APPENDIX

**The freshwater terrapin and turtle trade,
and rehoming problems — a case history**

As elsewhere in the UK and probably the world, pet terrapin sales in London in the late 1980s and early 1990s was prompted by a children's 'Teenage Mutant Ninja Turtles' craze that was created in the USA, initially as a comic strip. It quickly became popular and the name was changed to 'Teenage Mutant Hero Turtles'. The storyline surrounds four terrapins flushed down New York toilets as hatchlings, a fate falling to other pet reptiles according to press reports at the time. It was based in the sewer system where fancifully, the turtles mutate into super-heroes following contact with radioactive waste. They fight the 'forces of evil' and so are overtly positive role models but with aggressive crime-fighting activities and so are attractive to the pre-teen age group, particularly boys. A cartoon version ran from 1987 but it was the first film, launched in 1990 that is thought to have sustained and increased demand for pet terrapins worldwide (Tortoise Trust web site 2010). Only in the United States, where the terrapin is farmed, are export statistics available. Through the 1980s the annual exports of red-ears from the USA amounted to roughly one to two million, and during the first half of the 1990s was approximately three to four million per year. In 1990 three million red-ear hatchlings were exported from the USA. Japan was the biggest market (600,000), followed by France (500,000), Hong Kong (300,000), Spain (300,000), Britain (200,000), and West Germany (100,000), and other countries took smaller numbers.

In 1996, the reported total exports of red-ears from the USA were 7.9 million individuals, of which 2.2 million (twenty-eight per cent) were imported to Europe. Exports appear to have been constant since then and by 2007 most of the nine million reptiles exported each year from the U.S.A. were red-eared sliders (Laidlaw 2007), mostly from intensive production farms in Louisiana. Commercial intensive terrapin breeding farms in the USA usually consist of several artificial ponds each of which can contain up to 13,000 adults.

The UK was importing an estimated 300,000 red-ears by the time of the 1997 European Union ban. After this point, traders replaced red-ears with lookalike species, principally the yellow-bellied slider *Trachemys scripta scripta* alongside a range of other species and hybrids being bred in terrapin ranches and farms. More recently, and notably in China, over 300 million terrapins are captive in a total of around 2,000 commercial centres. A range of Asian and North American freshwater chelonians are being cheaply mass produced. They are imported into the EU in huge quantities and arrive typically through the cold-water fish trade. North American species originating from China include *Trachemys scripta scripta*, *Trachemys scripta troostii*, *Pseudemys concinna*, *Pseudemys nelsoni*, *Pseudemys peninsularis*, *Pelodiscus sinensis*, *Sternotherus odoratus* and *Sternotherus carinatus*.

In the USA today, commercial hunters of wild terrapins who supply replacement breeding stock for USA and Chinese farms are also responsible for collecting up to an estimated 1.5 million adult terrapins per year for export to foreign food markets, principally in the Far East. The USA exports hundreds of thousands of tons of terrapins (red-ear and other species) to China each year, with snapping turtle meat a particularly prized item, and a large female full of eggs is sold at a premium. Terrapin meat can even be found in Tesco supermarkets in China although this is apparently under review. A 2007 ban on collecting terrapins in the 200-mile-long Chesapeake Bay estuary of the north-east USA reflects the increased value of the meat; selling at \$20 per pound in China. Terrapin meat is popular amongst the growing immigrant community in New York City and many other cities. In 2007 the last major exporter of red-ears in Louisiana, Concordia Turtle Farm, exported terrapin

hatchlings to the value of US\$ 6.3 million. Few statistics seem to exist in Britain on the importation of terrapins. In 1985, 1,200 snapping turtles were imported to the UK, possibly for the soup trade. Statistics available from the City of London reception centre at Heathrow show that 4,000 common snapping turtles entered Britain through the airport between 1986 and 1990.

The problem of terrapin collecting in the wild for trade to those countries with high levels of economic growth is a part of the general problem of the unethical international 'bushmeat' trade around the world. It is escalating as food for the growing world population becomes more expensive and new ways to access and 'harvest', or more usually to plunder, wild areas in uncontrolled ways are developed. With many terrapins such as the red-ear taking up to seven years and often more to reach sexual maturity, whole populations can be largely cleared out by collecting and then may take decades or longer for the population to recover. A second collection 'sweep' for large sub-adults can then leave a situation where it may be fifty years or longer for recovery to happen, and with continued lower level taking and other cumulative effects, re-population may never be achieved and localized extinction is quite possible.

Back in London, the freshwater terrapin and turtle abandonment and rehoming issues that result from the trade are worth considering further, in addition to the problems being caused to wild populations by trade for human food. At Moorgate in the City of London from the mid to late 1980s a small-scale 'sanctuary' for abandoned terrapins was established in The Barbican. The Barbican Conservatory is a large, heated, glass-covered roof-garden area on the third floor, with tropical vegetation and pools. This apparently informal arrangement followed Corporation of London park keepers at West Ham Park nursery rehousing a small number of tiny hatchling red-eared terrapins that had been left in a paddling pool by members of the public. This preceded a steady stream of unwanted pet terrapins that were offered to The Barbican, or just left there. Due to a subsequent problem of the public adding terrapins to the pools and the children from the nearby Barbican estate taking them and reselling them at Whitecross Street market, a small purpose-built area was established away from easy interference. There were occasional escapes and deaths and additions of mainly red-eared and yellow-bellied sliders, plus other species and hybrids including a softshell turtle *Pelodiscus* sp. There are currently (July 2011) nine residents while the numbers previously were up to thirty-five individuals. Observations by the gardener that looks after them are that they survive on fish food and will only eat the ornamental fish in the pond that they share, as carrion, when a fish has died. They have however been thought to be responsible for fin biting of ailing fish. The Barbican Conservatory has in effect acted like a London park in receiving unwanted terrapins.

With respect to a further problem associated with trade, that of rehoming, there seems to be yet another extensive set of issues. In 1991 the British Chelonia Group (BCG), a voluntary group particularly involved in aspects of pet tortoise and terrapin keeping in Britain, reported on the increased sale of red-ears from North America. These were sometimes packaged in a small sealed plastic 'bubble' container to 'sell or die' and some countries had banned their importation. At the time it was the Trust for the Protection of Reptiles (TPR) headed by Clifford Warwick that took the lead, calling and actively campaigning for the UK government to ban the large-scale terrapin importations. By the end of 1991 BCG had adopted the position of favouring an import licensing system with a ban on unlimited importation. At a meeting of interested non-government bodies in early 1992 however, not all parties favoured an outright ban. The RSPCA called for more data, and the Association for the Study of Reptiles and Amphibians for a quota system.

With BCG previously taking a role in the rehoming of lost or unwanted tortoises it perhaps seemed natural that they might address the problem of lost

or abandoned terrapins. 'Homes for terrapins' was advertised in the BCG *Bulletin* and they were soon reporting being besieged with people wanting to give up their terrapins. BCG started a fund-raising appeal, raising £2,200 in 1992 to assist in the matter and with the specific aim, apparently hardening to the TPR aim of 'bringing an end to the import of these terrapins'. It appears however, that there was no subsequent action to follow the fund-raising pledge through. There were then talks of fund-raising for a new turtle sanctuary in Birmingham. Funds were raised but efforts to liaise with Birmingham City Council to build a terrapin pool at their Nature Centre proved unsuccessful.

In 1996, as the European Union 1997 ban on mass importation of red-eared terrapins to EU countries approached, following agreement with BCG around fifty or so rescued red-ears from both abandoned recaptures and from unwanted pets were sent to Secret World, an animal rescue centre in Somerset. Here they were kept and monitored three days per week by BCG members Paul and Maggie Coleman, alongside Secret World staff at other times. The following information is based largely on their observations and record keeping.

Terrapins were initially kept at a private house for assessment and initial rehabilitation. On arrival, many showed signs of poor husbandry, vitamin deficiency and poor diet with several having deformed carapaces due to a combination of poor diet and poor ultraviolet light availability. Terrapins were mainly kept in a large pool that was open to the public to visit. A report on the six years of involvement shows that in the four years from 1996–2000, Secret World took in ninety-six terrapins from the public, of which in 2000, fifty-three remained; thirty-eight red-ears in the Secret World pond and fifteen in quarantine. This fifty-five per cent survival in the transition mainly from small aquarium to a managed small pond indicates both their unsuitability as pets for the general public and the difficulty of rehabilitating terrapins tank-reared often in isolation to a larger environment.

Initially, suffering shock and stress from their change in ownership/environment, many died within weeks of arrival. Stress and contact with new bacteria were thought to be main causes, and over-exercise in a larger outdoor enclosure environment. Weakened by a combination of factors, many contracted infections and died. Initially they were kept in small batches of six or eight, with plenty of individual care, respite time in indoor ponds for those cases losing weight, and were slowly acclimatized over three to six months for life in an outdoor/seasonal pond. Prior to this they were kept in warm, shallow tanks, but their taking to the exterior pond even in the middle of summer proved problematic and mortality increased.

Once released into the outdoor pond they were found to be disoriented. Some treated the slightly cooler water conditions of the outdoor pond as being autumn and as a cue to stop feeding or were otherwise unable to find food. Some released in the outdoor pond vanished but no corpses were ever found. At Secret World, escape and/or theft were suspected and the facility was closed to the public from 2003. Acclimatization was clearly hard for these terrapins, but the records showed quite clearly that for every year that each terrapin survived, their survival became more assured. With thirty-eight remaining at Secret World in the summer of 2002, BCG involvement effectively ended. The experiment had shown that even with dedicated people and huge resources the rehabilitation of terrapins in numbers was highly problematic.

Roman Muryn has numerous experiences from a lifetime of keeping terrapins from around the world. In Somerset he built a deep garden pond to keep terrapins but he also found that rescued terrapins, including those from a park lake, did not survive well upon release into his outdoor pond, for the same reasons as were experienced at the Secret World project. He feels that red-eared terrapins *Trachemys* in general have a poor survival ability in UK ponds as they are a riverine animal that require good levels of oxygenation in order for their

system to absorb oxygen during the long winter submersion. With ice covering a shallow garden pond the onset of anoxic conditions occurs quickly and the *Trachemys* capability for surviving these conditions is limited to ten or so days (one reason why the Cardiff 'population' has been successful is that it is river fed). The cooters *Pseudemys*, have similar capability but the painted terrapin *Chrysemys*, a pond dweller from the more northern States, has had to adapt to ponds the freeze over for months and can resist anoxic conditions for over a hundred days under anoxic water and longer in good oxygen conditions (Jackson 2011).

In respect of rehoming, despite the ban on EU importation of red-ears in 1997, there was still from that time a massive lack of rehoming facilities for them in London and southern England and the rest of the UK in general. The BCG turned to the possibility of exporting unwanted UK terrapins to Italy to a project at Massa Maritima in Tuscany, not far from Rome. This was called the CARAPAX project, established and managed in 1989 by the manager, a Belgian national, within a fifteen-hectare visitor centre and thirty-five-hectare reserve. CARAPAX had opened with a series of small, partly connected river-side ponds and flooded ground named 'Florida' where terrapins were released in a fenced-off area. The theory was that the warm conditions potentially reduced greatly the annual care costs from any heated terrapin pond facilities in northern Europe. Initially, hundreds of terrapins were sent to the centre from Italy, Holland, Belgium, Germany and France. The stated capacity of the 'Florida' pools was 4,000 terrapins. BCG started to send turtles to the 'Florida' ponds. Clearly none of the donor organizations had researched what was going to happen to the terrapins in the enclosures offered as the natural maximum density of them in the wild is 350 per hectare with an average of around 160 per hectare (see Ernst, Lovich and Barbour 2009).

Sending a turtle from the UK via the handling system established by BCG cost £25. This was to pay for individual micro-chipping, veterinary checks and towards long-term care, including a fifteen per cent general overhead towards other CARAPAX running cost. In 2001 came the planning of a new pond called 'Louisiana'. Plans were made for a new purpose-built pond next to the first area. BCG appealed for funds in early 2002. With the collaboration of Virgin Express Airlines (Heathrow to Rome) and much national publicity, the first of many flights took place on 29 April, 2002 (nine red-eared terrapins) relocating unwanted BCG-collected terrapins from all over the country (Zachariou 2004). From 2002 to 2005 over 350 terrapins were sent with funding for long-term care, and by 2007 over 800 had been sent with around £20,000. However, in November 2005 flash floods, not untypical of the terrain, caused many terrapins to escape out of the retaining pond areas. Further floods and dry weather conditions were reported to have delayed the finishing the 'Louisiana' pond project until 2007, where from that year terrapin conditions are reported to have become much worse and strong comments on aspects of the project were being more openly aired (Vetter 2006). The escape, death and suffering of terrapins sent from London and elsewhere in the UK alongside the many thousands from other sources remains a protracted debate because of a complication; a major dispute that developed between CARAPAX and the owners of the site.

In 1989 to 1991 the European Commission funded, as part of the former 'MEDSPA' programme, an international project for the conservation of Mediterranean turtles. The organization carrying out the CARAPAX project was a Belgian-registered organization called 'RANA', significantly financed from 1988 to 1993 by the European Community nature conservation funds. The funds were used for 'structural works' in the area of Massa Marittima (Grosseto), to enable the conservation, reproduction and study of turtles as well as for the modernization and reconversion of existing buildings into a research and visitor centre. The basis for the contest was that funds meant for

restoring buildings were used as revenue. A row that had started with complaints regarding terrapin homing welfare at CARAPAX in 2003 came to a head at a meeting in 2009 when three BCG members were expelled for complaining about a project that in their eyes was unethical. BCG persisted with their support and there was a BCG Jan./Feb. 2009 appeal for new nursery building at the CARAPAX centre. However, a European Union ruling in 2010 found against CARAPAX. The legal dispute between the manager of the centre and the local authorities of Tuscany was judged by the Italian national courts. In April 2010 in Italy, the government ruling was that the centre be returned to the local authority, with remaining animals to be taken over by the University of Pisa. In parallel to the land and buildings dispute there were also criminal proceedings in the Grosseto court that gave a six months' suspended custodial sentence to the manager for a number of violations relating to licensing of some of the rarer chelonians at the centre. The centre was then zoned as a hazardous area due to many observers describing the terrapins' release area in terms of being a 'dangerous bacterial soup' of faecal matter and dead decaying terrapins.

Indications are that the Community Montana will continue the work of the CARAPAX centre, ensuring its future development. In March 2010, CARAPAX announced the intention to open a new centre somewhere else but some BCG members began to show concern. During a BCG visit to CARAPAX, red-eared terrapins were seen to be cannibalizing each other and observers felt that that they were overcrowded and not being looked after properly. The lake water was mud brown with algae and sediment with no water-plant life. The density of the terrapins was perhaps a hundred times greater than in the wild. Paul Coleman reported on a web posting 'My 25 large terrapins are fed 110 g of food three times per week. For 4,000 terrapins this would require in excess of 48 kg (106 lb) per week. To distribute this to the terrapins evenly, bearing in mind that each terrapin only has a feeding area of 75 cm square, each would require a boat. I am not assured that any of this is being done, and that any discrepancies in the feeding regime must account for the signs of starvation in the UK terrapins (which, note, are freshly arrived, and many, presumably, still with good energy reserves). For the above reasons, I do not believe that the Louisiana project could be as successful in keeping terrapins alive as at Secret World. Indeed, one might reasonably expect the death rate to be doubled without the ability to weigh, measure and health-check the terrapins on a regular basis. This, scaled up to CARAPAX, suggests a minimum of 400 deaths per annum, and more realistically, this figure could be nearer 600–800 animals'. In fact one of the keepers was reported collecting many dead terrapins every week and also finding the external fence insecure and terrapins escaping into the surrounding countryside.

Another former BCG member comments 'Regrettably most seem to have died. If there were say 4,000 or more deaths, at 1 kg each that would make about four metric tonnes of rotting flesh in the water over the years. It is surprising that anything survived with the bacterial bloom that would have occurred. The water supply downstream was threatened. Various organizations stated that there was no salmonella and papers were quoted stating that turtles don't spread salmonella. Unfortunately those papers dealt with the captive conditions for pets and not hundreds of animals festering in a pond that might be within the watershed supplying the town downstream. The CARAPAX organization must also have known that the saturation point was reached early in the programme, yet it would seem that the pond continued to be loaded with animals provided by those donating organizations.'

This situation has been a disaster for BCG UK terrapin rehabilitation efforts and a welfare tragedy for terrapins. It underlines the hopeless difficulties of trying to clear up after complex, well-meaning but poorly informed mass-housing of pet-trade abandonments. The problems compounded an initial pet

trade that is based on high mortality rates, avoidable cruelty and abuse of animals. The situation that developed reflects badly on government and one consequence of the current pet trade industry. Many observers now agree with the RSPCA policy to euthanase unwanted terrapins, even though the occasional tortoise is mistakenly killed through lack of general understanding of the problems. Effectively this is the evidence needed to enable massive changes to the way that the terrapin trade and terrapin keeping is managed. The Italian authorities need to take strong action to remove the red-eared and other terrapins now roaming in Tuscany where they can both breed and potentially spread disease. How they allowed the project to begin in the first place will now apparently be the subject of an official enquiry.

Book review

Trees of Britain and Ireland. History, folklore, products and ecology. Edward Milner. Natural History Museum, London. 2011. 224 pp. 200 colour photographs. Hardback, £20. ISBN 978 0 565 09295 5.

Edward Milner is probably best known to the Society as our esteemed and very active spider recorder. He also has a passion for trees. Back in 1992 he produced and directed the widely admired television series 'Spirit of Trees'. His first book, *The Tree Book*, accompanied this series and I reviewed it in 1993 (LN 72: 122). In the current book, he builds on the earlier one and explores some of its original themes in more detail. As before, Edward has called upon the knowledge and experience of a wide range of people including Oliver Rackham, George Peterken, Keith Kirby, Alan Stubbs, Ted Green, Roy Vickery and many other tree experts. From this roll call of the 'great and good', Edward has succeeded in distilling (with due acknowledgement), much of the essence of his new book. The result is a very enjoyable and instructive read.

The book concentrates on our native trees (including sycamore and sweet chestnut as 'honorary natives'). Three introductory chapters include a brief account of the post-glacial history of selected trees, a description (by Peterken) of 'trees and woodlands as habitat', a feature (by Keith Alexander) on the importance of dead and decaying trees for fungi and invertebrates, and an account of the ecological strategies of trees (based on the classic work of Philip Grime and the Unit of Comparative Plant Ecology at Sheffield University).

The main body of the book covers individual accounts of tree species in alphabetical order from alder through to yew, treating whitebeams as a group of very similar trees, and subdividing the willows into four separate sub-groups. For each tree (or group) there is a brief description of its appearance, its distribution in Britain and Ireland, and its reproductive biology. This is followed by paragraphs covering the uses (to man) of each species, any associated folklore, and a particularly useful account of the roles each tree plays in the ecosystem. The latter includes notes on associated fungi and invertebrates. A range of photographs accompanies each tree illustrating features mentioned in the text. These photographs (around 200 in total) were mainly taken by the author and are of excellent quality, with a number of very striking images. A couple have printed a little too dark to make out the detail (e.g., the ash tree on page 35 and the leaf-roll gall on page 38). Other photographs, including many close-up portraits of invertebrates, were taken by specialists and are also of high quality. These are all duly acknowledged and it was good to see the work of a number of LNHS members on display. However, one of the most striking photographs (p. 34) purports to show a waxwing eating alder buckthorn berries. Unfortunately, the berries are those of a cotoneaster.

Three closing chapters cover: the management of native trees and tree products; the folklore of trees; and the future of our native trees. Under this last heading the author considers the possible destiny of some of our trees under the influence of climate change. He notes that in cities such as London where an urban 'heat island' occurs, certain introduced exotic species like the tree-of-heaven *Ailanthus altissima* and the holm oak *Quercus ilex*, can have a distinct competitive advantage over indigenous species and are becoming widely established. Most recent climate predictions suggest increased temperatures in the UK as a whole (especially in the south-east), so such trees may spread further and could displace native species. In the same chapter the author discusses conservation issues and argues strongly for more *in situ* conservation of vulnerable tree populations to complement that provided by seed banks (which can only preserve seeds from a particular moment in time).

At the back of the book are nine tables setting out various attributes of native trees. These usefully complement the main text and provide much additional information. There is, for example, a listing of thirty-six whitebeams *Sorbus* species, including all the recently named native apomictic species (although *S. admonitor* is listed twice). A further list includes all eighteen native willows (but, understandably, not their hybrids). Table 4 covers 'herbivorous insects associated with native and naturalized tree genera.' Here we discover that a total of 839 insects (and mites) have been found in association with willows *Salix* spp., of which 314 (37 per cent) are restricted to the genus. By contrast, only thirty-two such invertebrates have been recorded in association with holly *Ilex aquifolium*, of which just two (6 per cent) are restricted to that plant. This data, and much more besides, has been painstakingly derived from the Database of Insects and their Food Plants (DIFP) maintained by the Biological Records Centre. It is very useful to have such information immediately to hand, although unfortunately a few minor errors have crept in here and in some of the other tables. These easily corrected slips should not detract from the overall high quality of the book.

This is a tree book with a difference and the author's passion for his subject shines through its many fascinating pages. It deserves to be widely read and enjoyed.