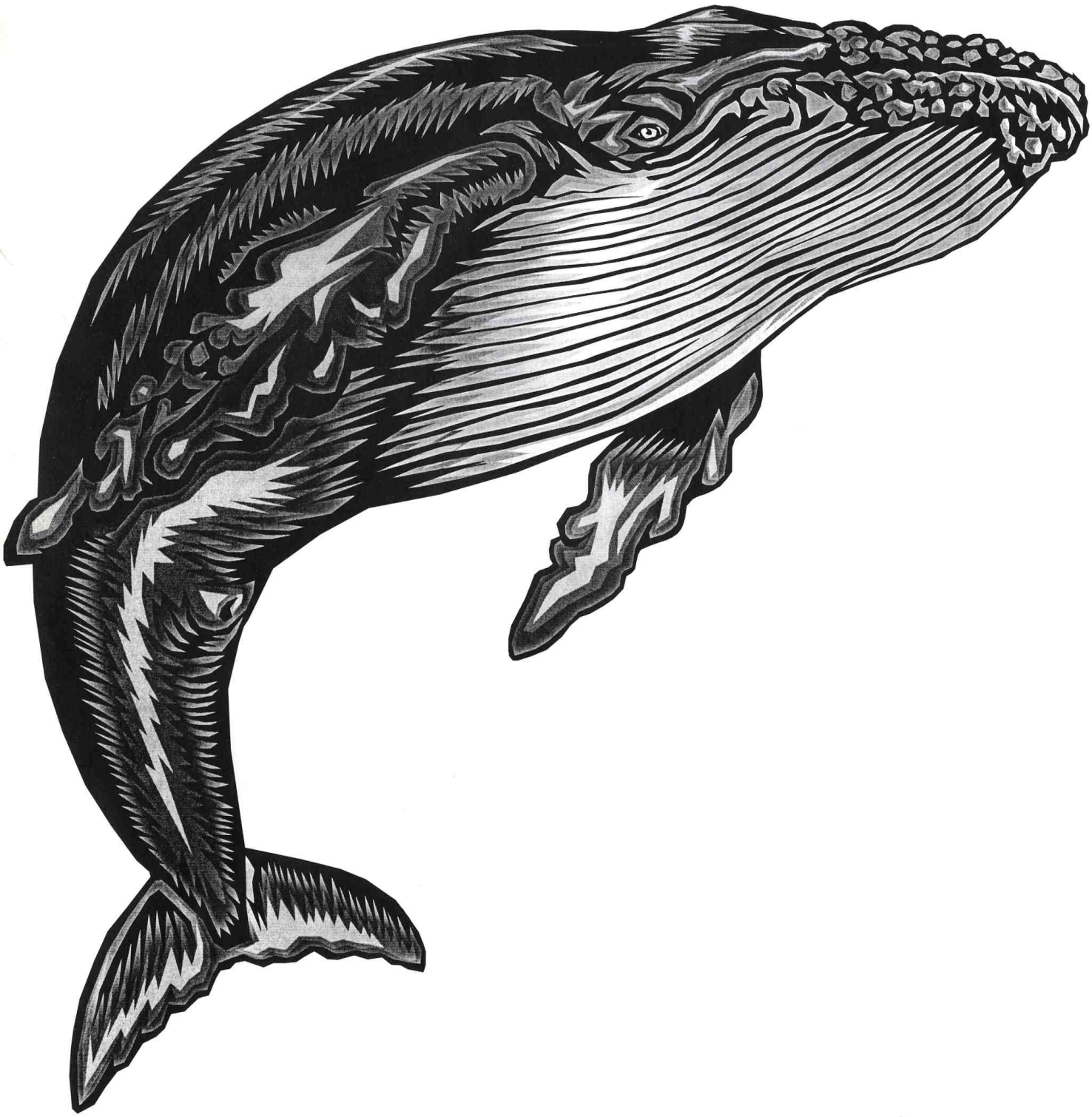
The Biology Curator

Issue 22 May 2002



Mammal Collections -Curation, Conservation and Uses
Re-hydrating Agents for Archnida & Myriapoda
High Temperature Pest Eradication

News

Study Trip to Kenya, 2003

There is to be no study trip at the end of 2002 because of the US trip in February. We are currently looking at one or two options for the end of 2003. The destination I am most interested in at present is Kenya, being based in Nairobi. I am hoping that the basic cost of the trip (return flight and six nights accommodation) will be similar to or less than that for the US trip (c. £500). There may well be additional costs, (transport inside Kenya, jabs (possibly not necessary), etc). I would expect to spend 6 days in Kenya, and hopefully visit one of the sites outside of Nairobi. This is a trip that will take a considerable amount of organising, even with help at the Kenya end, (which I now have). I do not intend to follow this up in detail if there does not seem to be sufficient interest, so I am asking those of you who would be seriously interested in such a trip to contact me, before the end of June, to say that you would like to go. Phone (01724 843533), e-mail (*steve.thompson@northlincs.gov.uk*), or write (North Lincs Museum, Oswald Road, Scunthorpe, North Lincs, DN15 7BD).

For those of you who would like to see what the potential is, below is a list of the most relevant departments within the National Museums of Kenya in Nairobi, and also a list of some of the outlying sites. Their web site is *www.museums.or.ke*. I am hoping that we will get out of Nairobi to see at least a little of what Africa is about.

Departments. Of the 21 departments listed on the website, the following would seem to be of particular interest to natural scientists.

Education, Herbarium, Phytochemistry, Invertebrate Zoology, Herpetology, Osteology, Library, Ichthyology, PGRWG (Plant genetics Resources Working Group), Palaeontology, Centre for Biodiversity, Palynology and Palaeobotany, Mammology, Ornithology, Institute of Primate Research Molecular Genetics, RPSUD (Research Programme on the Sustainable Use of Dryland Biodiversity), Casting.

Outlying sites. Of the twelve outlying sites listed, the following appear to have a natural science interest, the one's with a * being of particular interest to biologists.

Kisumu Museum*, Hyrax Hill Museum, Lamu Museums (Lamu Fort Environment Museum*), Kitale Museum*, Meru Museum*, Kabarnet Museum*, Kariandusi Museum, Gede Museum*.

Steve Thompson
BCG Secretary.

Resource News

Resource have recently issued issued a number of publications which may be of interest to BCG members.

Preserving the Past for the Future: Towards a national framework for collections management.
Outlines the issues associated with the management of cultural heritage assets in the museum, archive and library sector

Benchmarks in Collection Care for Museums, Archives and Libraries
The UK's first cross-domain standard describing how we should care for our portable cultural heritage

Guidelines For Handling Collections
Resource commissioned research to assess whether it is feasible and practical to urge museums to consider the objects that they currently hold in store and assess whether more could be made available for handling.

All these publications will be reviewed in the next Biology Curator and are available through the Resource website at :

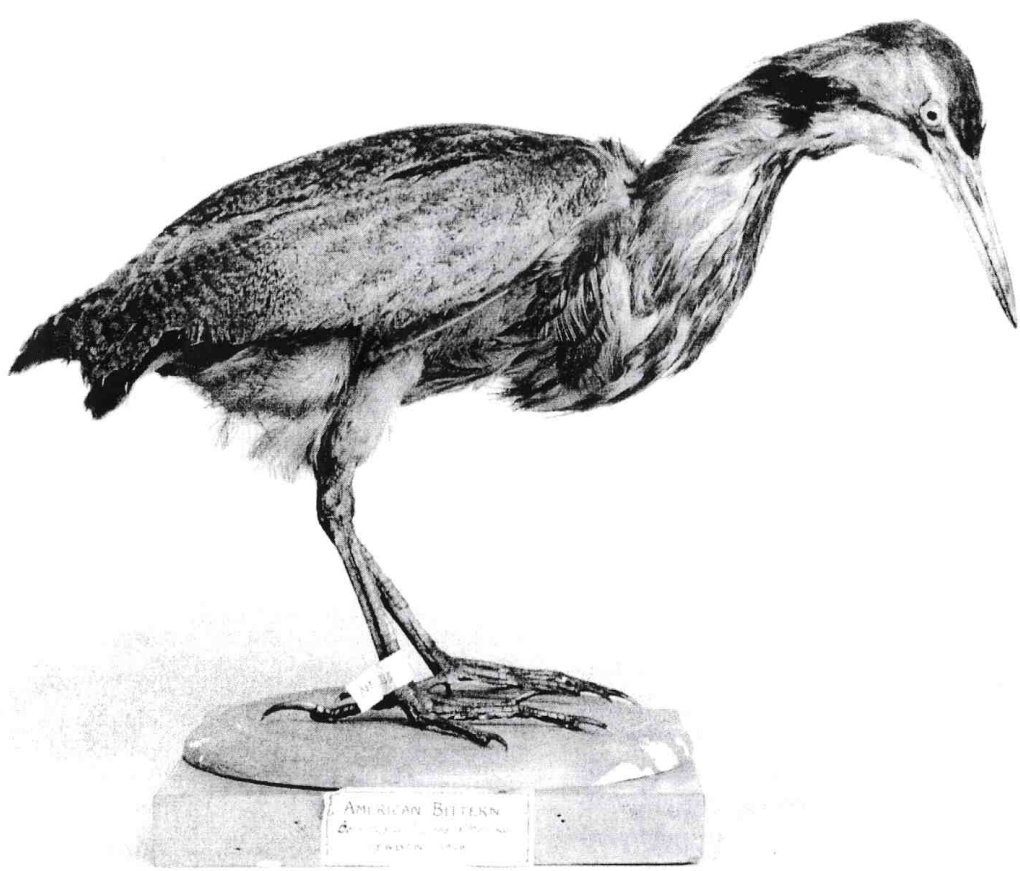
www.resource.gov.uk

First Record of an American Bittern in Essex

Eighteen months of research at Saffron Walden Museum by Nick Green and other members of the Essex Birdwatching Society investigating manuscript documents and bird specimens, have now been rewarded. After 175 years of obscurity, a rare American Bittern in the museum's historic collections has been recognised by the British Ornithologists' Union Rarities Committee (BOURC) as the first record of this bird to be found in Essex. The American Bittern is a rare visitor to Britain, and the museum's specimen, dating from 1826, is only the second on record. Since it was first seen in Dorset in 1804, there have been only 63 British sightings. By coincidence bitterns were in the news recently when three Common Bitterns were spotted at Barnes Wetland Centre in London during January 2002.

When the bird was shot in 1826 at Wendens Ambo in Essex, it was thought to be a Common Bittern. Local taxidermist William Travis mounted the specimen for Jabez Gibson, who was a member of the Saffron Walden Natural History Society. This society's collections formed the basis of the Saffron Walden Museum, which opened in 1835. The mounted specimen was correctly identified as an American Bittern in the museum's 1883 catalogue of birds and mammals. However, its historic significance was not discovered until 1999, when members of the Essex Birdwatching Society (EBS) visited Essex museums while researching for a new edition of 'Birds of Essex' (editor Simon Wood). **(Please refer to The Biology Curator March 2000, issue 17, page 5, Birds of Essex – A Request for Information).** Nick Green, chairman of the EBS, and Sarah Kenyon, Saffron Walden Museum's natural sciences curator, traced the history of the specimen using the museum's extensive 19th century archives. Due to the rarity of the bird, and the importance of this historic record, the BOURC has validated the research.

On Saturday 2nd February 2002 museum visitors and birdwatchers were able to meet the American Bittern and discuss the discovery with Nick Green and Sarah Kenyon at Saffron Walden Museum. The American Bittern is now on display in a recreated Victorian naturalist's study at Saffron Walden Museum.



MA Council News

Steve Garland (Bolton Museums, Art Gallery & Aquarium/ MA NW Regional Councillor/ member of the Professional Development and Equal Opportunities Committee)

As you will have seen, the MA is now happily installed in its new offices. Anyone who knew the old offices will remember that space was somewhat limited. The new place is a big improvement, with cats swinging all over the place!

The new unified Code of Ethics for the profession has just been produced after a lengthy consultation process. It combines the old separate individual and corporate codes.

The MA is now on a sound financial footing and a new Business Plan has been developed and discussed. Some of the elements of this have sprung from the results of the questionnaire completed by members, others from a workshop involving MA Council Members. The Association is aiming to become more market focussed, so the needs of individuals, organisations, partners etc will be paramount. There were lots of interesting figures pulled together as part of the planning process, though much that may have been expected, such as:

- lower paid members are under-represented at MA Conference
- Museum Practice is mostly subscribed to by higher paid and overseas members
- 45% of Conference delegates are not individual members
- between 48 and 92% of Seminar attendees are non-members

Major issues discussed in the Business Plan include:

- the role of the Conference (still attended by mainly higher grade officers, but is that maybe its role?) and the need for more accessible meetings in more locations around the UK
- the need for more events to cater for the specialist, technical and junior elements of the profession (closer working with specialist groups was discussed at the Council meeting)
- further campaigns for recruitment (membership is climbing steadily and healthily, topping 4,600 in 2001, but certain areas and groups within the profession are not well represented)
- Publications, especially the role, future and development of Museum Practice

The MA has commented on the future of the Designation Scheme. We discussed the need for the Designation Challenge Fund to be maintained or increased. Partnership bids were discussed and a number of difficulties were identified around them. Also a there was concern that a major increase in new Designated Collections (especially if Libraries and Archives are added) would spread the DCF funding more thinly. An increase in transparency over identification of collections, with a peer review element would be welcomed.

Other hot issues on the agenda at present are Renaissance in the Regions (surprise, surprise!) and the new Freedom of Information Act and its implications for Museums. The latter has major implications for the workings of all public bodies.
Steve Garland

COLLECTIONS MONITORING

Mike Palmer has now stood down from committee after many years hard work, especially his stirling efforts heading up the Collections Monitoring Cell.

The cell monitored threats to Natural History collections, which typically arise when posts are lost, departments or museums closed. This is one of the most important roles of BCG and we are searching for someone to take over Mikes role. The job involves acting as a main contact person for anyone wishing to report or discuss collections at risk, making or organising initial contact and monitoring the situation as it progresses.

Full support is given through the committee and much of the work can be delegated to other committee members. If you would be interested in helping with this position please contact Steve Thomspon on: 01724 843533 e-mail (*steve.thompson@northlincs.gov.uk*),

Minutes of the BCG Annual General Meeting

Held on Wednesday, April 10th, 2001 at University of Newcastle Upon Tyne

1. Apologies for Absence:
Adrian Norris, Charles Pettit, Alan Howle

1. Minutes of the last AGM:
The minutes of the year 2001 AGM were accepted as an accurate record of the meeting.

1. Matters Arising:
Included in other agenda items.

1. Chairman's report:
This has been a very interesting and active year for BCG. Two major issues arose from last years AGM at Oxford. The first was as the result of a presentation by Stuart Davies, Director of Strategy and Planning at *Re*:source about the activities of the Regional Museums Task Force during which it became clear that we would have to act quickly if our views were to be taken into account. This resulted in a hurriedly convened special meeting at The Natural History Museum to discuss how we could usefully contribute. After considerable work by several members, but particularly Steve Thompson and Nick Gordon, a submission was sent to the Task Force and this was published in last August's issue of the Biology Curator.

The second issue was that of a possible merger with the Natural Sciences Conservation Group. Following lively discussions at the AGM's of both groups, a special meeting was convened at The Natural History Museum to discuss the issue further and as a result, both groups conducted a 'straw poll' of their memberships. As both groups received a strong vote in favour of taking the matter forward, we shall be voting on this very issue in a few minutes time. I am personally delighted that we have made so much progress over this matter and look forward to the result of today's vote.

I have already mentioned the Biology Curator but I feel that I must highlight the excellent work that Nick Gordon has done as acting editor. In the last year we have had two fat issues with plenty of interesting content and I gather that Nick has another in the pipeline. A new development in the way that we communicate is through the development of our website. Thanks to the efforts of Lindsey Loughtman and Peta Hayes at Manchester, we now have an extremely attractive website which I hope that you will have all seen by now.

Amongst our other activities this year, the highlight must be the extremely successful study visit to Washington and New York in February. This was our most ambitious study trip so far and thanks to Kathie Way's excellent organisation, everyone enjoyed an extremely full programme of visits and tours. Nick Gordon has been busy again as our events organiser, setting up a well attended and very successful workshop on Mammal Collections held at the Grant Museum of Zoology at University College and also organising this conference here in Newcastle University.

I am pleased to say that we were represented at last years MA Conference in London last October where I chaired a session under the title Museums Biodiversity and Community. The speakers were Caroline Holmes from Leicestershire Museums Arts and Records Service, Trevor James, the Network Development Officer for National Biological Recording Schemes and our very own Nick Gordon. Although attendance was rather disappointing, we had a good response from those attending and rather managed to overrun our time as usual.

Finally I would like to thank all of our committee members for their efforts during this busy year. It seems to be an unfortunate fact of museum life that we are all required to do more and more in less and less time with less resources and I think I am a safe in saying that this applies to all of our committee members. Nevertheless, our committee meetings have been well attended and I would

particularly mention Steve Thompson's sterling efforts as Secretary and Jo Hatton's efficient handling of the minutes. If today's vote is in favour of merger, I visualise an even busier and more rewarding year ahead.

1. Secretary's report:

2001 / 02 has been a very busy year for everybody, and committee activities have been very much a part of that, despite the fact that committee members find themselves ever more stretched for time. All our activities have been maintained, and indeed, generally with ever increasing quality.

Mike Palmer, having returned to full time curatorial work, attacked the collections monitoring task with renewed vigour. It has to be said that we greet this with ever so slightly mixed feelings, as this section of the committee meetings rarely leaves us feeling more cheerful than we were at the beginning of the meeting. However, this is perhaps the most important role for the group, promoting the care of collections around the country and we never give up, with one or two collections coming repeatedly for discussion. The former Passmore Edwards collections have been on the agenda since I joined committee, and sadly, do not look as though they will be removed from it in the near future. Also sad is the fact that Mike has been forced to stand down from committee, and we will be looking for some enthusiastic, not to say masochistic, volunteer to take his place.

The Biology Curator is going from strength to strength, under Nick's caretaking hand, and has got both larger and posher over the last few issues. Nick has been particularly successful in persuading speakers at meetings to submit their papers for publication, and these have been printed in an unprecedented, indeed near miraculously, short time after the meeting has taken place.

Nick has also been doing a superb job on the meetings programme, and we are experiencing excellent attendances at the events we organise. This also includes the foreign trips, and the US trip in February was as well attended as ever, being fully booked as usual, despite our considerable fears over how popular it was likely to be, and turned out to be absolutely superb. Our many thanks to Kathie for doing the usual superb job.

It will have escaped no-one's attention that the last year has been filled with talk of the proposed merger of ourselves and NSCG, with an eye towards the possible joining forces with GCG at a later date. This followed a discussion and proposal that came quite out of the blue at last year's AGM. It has certainly raised passions, and there will undoubtedly be a few unhappy people whatever happens. However, our straw polls have showed a considerable majority in favour of a merger, and the committees, I can promise you, seeking to do what is best for both groups in what is looking to be an increasingly tough world for museums as a whole.

These are perhaps the most important issues that we have dealt with over the last year, but certainly not the only ones. An issue where we have yet to see what the effect will be on the collections in our care is that of the recent Renaissance in the Regions report. Because of the short deadlines allowed to us, it was difficult to formulate a formal response from the committee. I put in a response, as BCG Secretary but not on behalf of BCG, though I tried to get as much feedback as I could. This was published in The Biology Curator, and I would be happy to hear what other people have to say, and as a committee, we would be grateful for the comments of the membership, as indeed, we seek feedback on all issues that we seek to deal with. And as I usually end with a comment on that theme I will stop here today.

1. Treasurer's report: 01.04.2001 – 31.03.2002

I am pleased to report that this year end we are back in profit and the group's bank balance is looking healthy at over eleven and a half thousand pounds; however, it should be noted that we only paid for two issues of *The Biology Curator* during this financial year.

To my astonishment this year's study trip to the USA actually came in under budget and

even made a profit of £23! I have to say that this was due in large part to the heroic self-sacrifice of the noble few who endured bed bugs, cockroaches and other privations so that I could swan about in a penthouse suite. Thanks to Nick Gordon, last year's AGM and the Digital Learning meeting both made a profit; the final accounts for the Mammal meeting in December cannot be presented since there are still some delegates who haven't yet paid but it is expected that this meeting too will show a small profit.

The increased level of subscription revenue this year is mainly due to a sustained campaign of harassment of late payers which recovered a lot of arrears; despite this we are as usual well into April with around 17% of the membership in arrears for 2002. We are also about to lose another ten members who have not paid since January 2000, a list of their names is appended below.

Fourteen new personal members have exactly cancelled out resignations/deletions but only 5 new institutional and overseas memberships failed to halt the continued decline year on year.

Deletions for non-payment 2001/2002

Malgosia Atkinson, Oxford
Kelvin Boot, Exeter
Malcolm Herman, Powell-Cotton
Tony Irwin, Norwich
Gwyneth Jones, Cheshire
John Mathias, Leicester
Julian Porter, Bexhill-on-Sea
Simon Trodd, Peterborough
Ann Wood, Cardiff
Fatima Hernandez Martin, Tenerife

1. Other reports:
No other reports were given.

1. Proposed BCG /NSCG Merger:
After some initial discussion regarding the merger, it was decided to vote on the two proposals by show of hands from the floor.

Proposal 1: To merge Biology Curators Group and Natural Sciences Conservation Group to form a single organisation.
Proposed by David Carter, Seconded by Peter Howlett

Votes for: 24
Votes against: 0
Abstentions: 0

Proposal 2: Subject to both organisations voting in favour of the proposal to merge (above), the chairmen of the respective groups are directed to set up a joint committee to write a constitution for the combined organisation and recommend the mechanism for merging; to be presented to the Annual General Meetings in 2003 at a joint meeting (NSCG/BCG).
Proposed by David Carter, Seconded by Rosina Downe

Votes for: 24
Votes against: 0
Abstentions: 0

1. Election of officers:
Three committee members had resigned during the course of the year, Sam Hallett, Lindsey Loughtman and Mike Palmer. One nomination had been received for an ordinary committee post for Sankurie Pye from the National Museums of Scotland. Sankurie was duly elected onto committee through a unanimous show of hands from the floor. It was decided to leave committee membership at 11 for the current year, and await the outcome of the NSCG vote over the proposed merger. In the interim period co-option of temporary committee members could be utilised to carry out specific tasks as and when required.

1. Any other business:
No other business was raised.

1. Date and venue of next AGM:
To be announced.

DETAILS OF EXPENDITURE & INCOME FOR THE PERIOD 01.04.2001 - 31.03.2002

DETAILS OF EXPENDITURE & INCOME FOR THE PERIOD 01.04.2001 - 31.03.2002

INCOME	
Subscriptions	3483.00
2001 AGM	2301.05
USA Study Trip	19,000.00
Digital Learning Meeting	770.00
Interest on bank account	202.56
Sales/advertising/donations	48.75
TOTAL INCOME	**25,805.36**
EXPENDITURE	
2001 AGM	1721.64
50% of AGM profits passed to NSCG	289.70
USA Study Trip	18,977.23
MA Conference expenses	44.00
Digital Learning Meeting	378.45
Publicity materials	224.51
Annual Invoice mail out	41.24
Committee expenses	110.00
N. Gordon expenses	47.50
Treasurer (post/stationery/Xeroxing)	55.84
Biology Curator 20	1330.32
Biology Curator 21	1062.14
Total expenditure	**24,285.57**
Income over expenditure	**1,519.79**
Total at bank 31.03.2001	**10,149.24**
Total at bank 31.03.2002	**11,669.03**
MEMBERSHIP (Last two years' figures in brackets)	
Personal members	206(206)(227)
Institutional members (UK)	71(74)(67)
Overseas members	38(42)(50)
Exchanges	5(5)(5)
Total membership	315(322)(349)
Due to be deleted after AGM	10
Potential income from subscriptions	£3,283(£3,388)(£3,571)

Niks Aan-Spare Ribs: An interactive exhibition about skeletons

Sue Dale Tunnicliffe, Homerton College, Cambridge, UK
sue@sdtunnicliffe.demon.co.uk

Manon Laterveer-de Beer,
Zoologist, Exhibitions, Naturalis, Leiden, The Netherlands

Vertebrate skeletons are both important and frequent exhibits in natural history museums and sometimes in zoos (Tunnicliffe and Yonally, 1999). However, little has been written about the response of visitors to them and how museums endeavour to engage the visitors in what the skeletons can 'tell' them. Skeletons, particularly the human one, are studied in school from the earliest years and people build up a mental model of them. Moreover, knowledge of the composition of the vertebrate skeleton plateaus at a specific level amongst the public in which they know of bone units such as the ribs and the leg bones and have a vague idea of the overall pattern (Tunnicliffe and Reiss, 1999). Tunnicliffe (1998) found that visitors recognised the animal from which the skeleton came and referred to it as such.

Niks Aan - an interactive exhibition about skeletons

On July 29th the exhibition Spare Ribs (Niks Aans in Dutch) was opened at the National Museum of Natural History, Naturalis, in Leiden, the Netherlands. In this exhibition, the museum uses about 400 outstanding specimens of their skeletal collection to explain in a playful and understandable way the relationship between the skeleton and locomotion.

Of course, there are many ways to show such an enormous diversity of skeletons to the museum visitors. An obvious method would be a systematic approach, arranging all skeletons of the five classes of vertebrates according to order and family. Naturalis has used this taxonomic approach in their permanent exhibition 'Nature's Theatre' about present day diversity of life. For the skeleton exhibition, a storyline was used in order to explain processes that cause diversity in vertebrate skeletons. Since there is a strong relationship between the shape of the skeleton and locomotion, the exhibition team decided to arrange the skeletons according to different ways of locomotion. As a result, the diversity of skeletons was reduced to a number of basic skeleton shapes that correlate with locomotion types. A terrestrial animal for example, has to push itself off the ground in order to move forward, whereas, an aquatic animal has to have a streamlined body shape in order to reduce the turbulence of the water.

The next step in the exhibition design was to relate the adaptations of the skeleton to locomotion and translate this into a drawing of a simplified skeleton, the so-called 'prototype' that illustrated these characteristics. Also, the prototype had to illustrate the fact that the morphology of the skeleton of all vertebrates is generally the same. In every prototype the different parts that play a role in locomotion, the forelimbs, hind limbs, backbone, pelvic girdle and shoulder girdle, were given a particular colour. The graphic design of the simplified skeletons was carried out using similar shaped blocks and bars, without unnecessary detail. The result was a set of thirteen different, cheerfully coloured animal skeletons that seem to have run away from a toyshop.

For every locomotive type a certain animal species that matched the typical characteristics of the relationship between skeleton and locomotion was chosen as a model in order to create the prototype. In this way the dog was the model for the locomotion type 'walkers: quadrupeds' (figure 1); the pigeon for the 'flyers' (figure 2); the perch for the 'swimmers: fish' (figure 3), etc. The development of the prototypes was carried out in cooperation with the University of Leiden (biology, department ethological morphology).

The thirteen prototypes were built as small three-dimensional models and were shown in an exhibit with the real skeletons of the animals. The exhibit explained, in a simple

herdershond

Figure 1 The dog was used as the prototypes for the quadrupeds

torteldui f

Figure 2 The pigeon was used as the prototypes for the flyers

Figure 3 The perch was used as the prototype for swimmers

way, the adaptations of the skeleton to different ways of locomotion.

In the rest of the exhibition, skeletons of animals that have similar ways of locomotion are grouped together. Each group can be recognized by a drawing of the prototype that represents a certain way of locomotion. With a so called 'pointer bone' (a cast of a bone of a dog or baboon), that can be collected at the entrance of the exhibition, the visitor can touch the coloured parts in the drawing of the prototype. When touched, the corresponding bones in the skeletons in the exhibit are lit up by numerous small lights. In this way, the similarity of skeletons between animals that share the same way of locomotion, becomes clear at a glance.

Besides animal locomotion, there was also an exhibit about locomotion in humans. Form and function of the human skeleton is explained by a number of interactive exhibits about joints and muscles and an X-ray film of a moving human skeleton. A computer puzzle about the human skeleton, using different

bones to create a complete skeleton, is very popular with all visitors: young as well as old. An impressive wall of about twenty metres in length, decorated with about 200 animal skulls, completed this exhibition about bones and skeletons. The skulls were systematically arranged: mammals, birds, reptiles, amphibians and fish were grouped together. Within each group, the skulls were arranged according to food preference. At the mammal section, the visitor could find information about the adaptation of the skull (especially the teeth) to food preference. The wall with skulls comprised two interactive games that could be played with the pointer bones mentioned above. The dog game showed which skull belonged to which dog breed. The bird game showed the relation between human tools and the way different bird species used their bill. Finally, the visitors could test the knowledge they gained from visiting the skeleton exhibition by playing different computer games. Pictures of skeletons shown at the exhibition were to be categorised according to locomotion type in as few turns as possible. In the same way, the visitors were invited to categorise pictures of animal skulls according to food preference (carnivore, herbivore or omnivore). The memory game was about recognizing pictures of different animal species: the challenge to visitors was in how many turns could they you collect all pairs?

The gallery was quite dark creating a mystical atmosphere. The use of 'black light', which is frequently used in discos, added to this. The awe and wonder with which some visitors viewed the results of the interactives were very noticeable. Each interactive part of the skeleton is colour coded so that all the skeleton labels have the same colours but the overall arrangement is different according to the locomotory mode of the group, bipedal walkers for example have long hind limbs whilst wrigglers have no limbs. The dim lighting made it very difficult to read information labels and any other labels. Also the text type size was rather small, but had the font size been increased more of the glass would have been covered with text. The labels were in Dutch and in English.

The Response of Visitors

The Research

The museum was interested in the responses of the visitors to the skeleton exhibit in particular and whether the zoological messages of the exhibition were received and understood by the visitors. It was decided to carry out two pieces of work. First of all to video and record the conversations of visitors looking at the skeletons. Secondly to interview visitors before and after they visited the exhibition with an emphasis on form and function of the skeletons.

Videoing was carried out opposite the skeleton of an elephant and next to a case of 'flyers'. This location was chosen because there was an alcove in which the researcher (SDT) could sit with the video camera and not impede the flow of visitors. Visitors were also asked, in Dutch, by a visitor studies student to fill in questionnaire. The analysis of this was intended to elicit whether visitors had, firstly, understood and, secondly, found out new information from the exhibitions. The questionnaires would also indicate how much the public responded positively to the exhibition. The response to the questionnaire is reported elsewhere(Tunnicliffe and Laterveer -de Beer, submitted). Thirdly, the museum, hoped to find out how successful the advertising and other activities about the exhibit, Niks Aan, had been. Additionally, observations of visitors were planned to find out now long they stayed in the exhibition and which routes around the exhibition they chose for themselves.

The conversations at the exhibits were recorded on video and were subsequently translated. There were 42 audible conversations. The content of these conversations are reported elsewhere (Tunnicliffe and Laterveer -de Beer submitted) . Each incident was watched and re-watched until the behaviour was clear and this was recorded. The different behaviours were read and re-read and grouped into different categories. Twenty-nine visitors were observed in the exhibition over seven hours. Over ten hours were spent videoing singletons

or groups of visitors looking at the exhibits.

Visitors overall responses to the exhibition

The average length of stay was 20 minutes. A number of visitors were not comfortable with the level of lighting.

Use of the Bone Accessory

Visitors responded in a variety of ways to the potential interaction. Some visitors' had no bone and just walked past the skeletons glancing as they passed. Others with no bone stood and looked and even tried to press the labels with their finger, we suspect modelling behaviour observed in other visitors' with bones. Those visitors with bones displayed a variety of behaviours, and some visitors' employed several. They did not use their bone and frequently the interactive bones were reported not to work. Of the visitors observed, 82% picked up a bone at some point in their visit and 65% did so at once.

There were 61 videoed encounters at exhibits containing skeletons.
Of these 19 were families, 5 adult singletons, 19 two or more adults and 12 children alone. Of these 37 used a bone, 7 used something else such as a pencil finger or a torch. Five people used the bone as a pointer and 12 used nothing.

The different actions of visitors were noted and totalled. Visitors used the bones in a variety of ways other then that for which they were designed. The variety of uses were as follows:

- 'Touchers and walkers' lightly tapping the label as they walked past
- Scribblers - visitors just 'scribbled with the bone on the label surface' without any meaning and if they lit up a skeleton it was a bonus, this was more a control need approach because it was possible to make the lights work. Often these visitors were working alone. Some visitors tried to light up every light. Others were content with one set illuminated.
- Controlled touchers carefully touched a part of the label and lit up a part.
- Extensive touchers systematically lit up one part after another either at random or in a planned controlled manner.
- Teachers - usually an adult with a child. More than one person pointed at the label and the skeleton and planned the lighting of the exhibits.

In summary visitors ignored, looked, touched and focused their interactions. Some visitors did all 4 responses and some varied their response at different exhibits.

Conclusions

Interactive resources for involving visitors with exhibits provide a means of bringing visitors into closer contact both physically and in 'minds on' terms. However, the interaction resource itself can become the exhibit and the main focus. Visitors do not know what is expected of them when they enter a gallery and, unless the instructions or information about interactive opportunities and the means of achieving this, are very prominently and carefully displayed, the visitors are likely to miss the information. Hence the missing of this vital information from the point of view of the curator's gives the opportunity for visitors to make up their own interactions as they progress around the exhibit or to realise they have missed out on something provided when they have started viewing.

References

Tunnicliffe, S. D.(1998) Skeletons- putting the flesh on the bones. *The Informal Science Review*- no 32. September/October 1, 8-11

Tunnicliffe, S.D. and Yonally, D. (1999) Do skeletons have a role in live animal collections? *Newsletter of International Association of Zoo Educators* Issue 2. page 8 and 9.

Tunnicliffe, S. D., & Reiss, M. J. (1999). Students' understandings about animal skeletons. *International Journal of Science Education*. . 21 (11), 1187- 1200

Tunnicliffe S.D and Laterveer -de Beer M. (submitted) An interactive exhibition about animal skeletons. Did the visitors learn any zoology?

Safe High Temperature Pest Eradication - is the answer in the bag?

Phil Ackery, Adrian Doyle,
The Natural History Museum.
David Pinniger,
Independent Pest Control Consultant.

When the dermestid beetle *Anthrenus sarnicus* first burst upon the scene in South Kensington around 1980, high temperature was used for eradication. To facilitate this, a modified slide oven [internal dimensions 210cms high x 65cms x 65cms] was purchased from LTE Scientific Ltd. Some hundreds of insect collection drawers and store boxes passed through the oven, heated to 52C for at least 3 hours.

While heating achieved total success in terms of 'kill', it soon fell out of favour because of obvious deterioration in the condition of the collection containers. Following treatment, cracking or warping of collection drawers and store boxes increased markedly rendering the contents even more susceptible to future pest attack! In addition, one type of collection drawer that had proved especially vulnerable to pest intrusion had a glazed lid in which the glass was held in place with putty. Subsequent loosening and cracking of the glazing putty is assumed to be attributable to exposure to this high temperature regime. Such experiences led to the adoption of low temperature treatments for routine eradication of pests in our collections (Ackery, Doyle & Pinniger, 2000).

But more recently, led by Tom Strang's pioneering work on high temperature pest eradication, (see for instance Strang, 2001) we have revisited this option. Practically, it has a clear advantage over 'freezing' - a three-hour treatment period compared to 72 hours for low temperature regimes. It is now widely appreciated that 'freezing' requires bagging of objects within a water-impermeable barrier to ensure rapid equilibrium in any water movement to or from the object, and to prevent problems with condensation as the temperature of the object returns to ambient. Our preliminary tests reported upon here investigated the likelihood of similar buffering effects of bagging in high temperature regimes.

Our Test 1 employed four Tinytag Ultra data loggers to record temperature and relative humidity within the oven itself, within an exposed drawer, within a drawer 'sealed' within a standard bin liner, and within a drawer 'sealed' within a heavy duty bin liner. The results with respect to relative humidity are tabulated in Table 1. Based upon an ideal natural variation of plus or minus 5%RH (see

	Ambient RH	Minimum RH	Maximum RH	Differential
Within chamber	32%	15%	37%	22%
Inside exposed drawer	37%	29%	45%	16%
Inside drawer/ standard bin	36%	34%	46%	12%
Inside drawer/ heavy duty bin liner	39%	39%	47%	8%

Test 1

	Ambient RH	Minimum RH	Maximum RH	Differential
Within chamber	32%	13%	35%	22%
Inside drawer/ standard bin liner	35%	32%	42%	10%
Inside drawer/ heavy duty bin liner	36%	36%	45%	9%
Outside drawer/ heavy duty bin liner	35%	34%	44%	10%

Test 2

Moore, 1992), we have assumed that a 10% differential between extremes is the maximum acceptable over the duration of the treatment. The test showed that the use of a heavy duty bin liner will ensure sufficient stability with respect to RH, with just an 8% differential between the maximum and minimum levels. Test 2 largely verified this finding although this time the recordings from within the standard and heavy duty bin liners approximated more closely. In Test 2 we did not monitor an isolated unbagged drawer; rather we took an additional reading from within the heavy duty bag but outside the contained drawer. This we felt was relevant to the problems that we had previously experienced with external glazing putty. At a 10% differential between maximum and minimum, it was within the acceptable limits.

Our methods were simple but practical. Obviously, the subjects of barrier films and methods of sealing can provide research programmes in themselves and are being investigated in other research areas (eg. A. Doyle and E. Lam, in preparation). We know nothing of the structure of our off-the-shelf bin liners beyond a thickness of 30-45 microns and 145-170 microns for the standard and heavy duty bags respectively. Sealing was simply with synthetic cord, tied as tightly as possible. But whatever these shortcomings, and the limited nature of our tests, it is clear that vapour barrier films have the potential to ensure that safe high-temperature treatments can be achieved without exposing the contents to unacceptable variation in humidity.

Suppliers:
Tinytag Ultra - Meaco, Unit 8, Smithbrook Kilns, Cranleigh, Surrey GU 6 8JJ.
Incubator - LTE Scientific Ltd, Greenbridge Lane, Greenfield, Oldham, Lancashire.

References

Ackery, P.R., A.M. Doyle and D. Pinniger. 2000. Are low temperature pest disinfestation procedures 'safe'? The Biology Curator 18: 28-30.

Morse, J. 1992. Insect collection conservation. Insect Collection News 8: 1-5.

Strang, T.J.K. 2001. Principles of heat disinfestation. Pp. 114-129 In H. Kingsley, Pinniger, D., Xavier-Rowe, A. and Winsor, P. [Eds], Integrated Pest Management for Collections. James & James, London.

A Comparison Of Trisodium Phosphate And Decon 90 as Rehydrating Agents for Arachnida And Myriapoda Dry Specimens

Janet Beccaloni, Curator, Entomology Department, The Natural History Museum, Cromwell Road, London SW7 5BD.

Introduction

The Entomology Department at The Natural History Museum (NHM) has a large main collection of Arachnida and Myriapoda specimens stored in 80% Industrial Methylated Spirit (IMS). There is also dry, pinned material dating back to the early 19th century. Over the last few years, there has been an on-going policy to remove type specimens from the dried collection and to house them in the main spirit collection, in order to make them more accessible. Traditionally, trisodium phosphate (TSP) was used as a rehydrating agent on Arachnida and Myriapoda specimens in the Department. However, I decided to undertake an experiment to compare the effects of trisodium phosphate, with that of Decon 90 (D-90), which is used in the Zoology Department at the NHM.

Aim

To determine the most appropriate chemical out of trisodium phosphate and Decon 90, to use as a rehydrating agent in order to prepare dried Arachnida and Myriapoda material for transfer into the spirit collection.

Methods

Dried specimens (without data) of different orders were selected (i.e. Pill millipedes, millipedes, centipedes, spiders and ticks). Two dilutions (2% and 5%) of both Decon 90 and trisodium phosphate were used on 'comparable' specimens - that is, specimens from the same genus. Where there was a lack of specimens, i.e. large tarantulas, I was only able to test one strength of chemical and chose 5% because of their large size. The specimens were fully immersed in the test chemicals in tubes or small jars and the results recorded after 17 hours. The specimens were then transferred into 80% IMS, and the results recorded after 4 hours and then again after 3 years.

Results

After 17 hours in the test chemicals

Decon 90 rehydrated 17 out of 20 specimens with no real side effects (see Tables 1-4). However, it did cause heavy leaching of colour in 1 specimen out of 20 rehydrated (see Tables 1 & 2), and heavy leaching of colour with bad breakdown of body contents in 2 out of 20 specimens rehydrated (see Tables 1 & 2). Trisodium phosphate rehydrated 13 out of 20 specimens with no real side effects (see Tables 1 – 4). However, although it caused very little leaching of colour, 6 specimens out of 20 showed breakdown of body contents, and 1 specimen out of 20 showed heavy leaching of colour with bad breakdown of body contents (see Tables 1 & 2). All specimens showed good flexibility. At the specimen level, the performances varied greatly depending on the group.

Results with the Pill millipedes varied greatly between the different dilutions of both test chemicals. In Decon 90 (at both dilutions), the results were good overall, although there was some leaching. However, in trisodium phosphate there was a breakdown of body contents (see Plate 1). For the millipedes, body breakdown was also much greater in trisodium phosphate (see Table 1). In both trisodium phosphate and Decon 90, the *Scolopendra* centipedes (see Table 2) were noticeably more badly leached and degraded than any of the other specimens. In Decon 90, only the legs were badly affected (see Plate 2), although in trisodium phosphate the cuticle of the body segments was flaking and there were chemical deposits all over the specimens. All three varieties of spider, i.e. large tarantulas, small tarantulas (*Atrax* sp.) and Sparassidae spp. were generally good in both chemicals at both dilutions, although the Sparrassidae specimens were slightly leached in both dilutions of Decon 90. The ticks were good in all dilutions of both test chemicals.

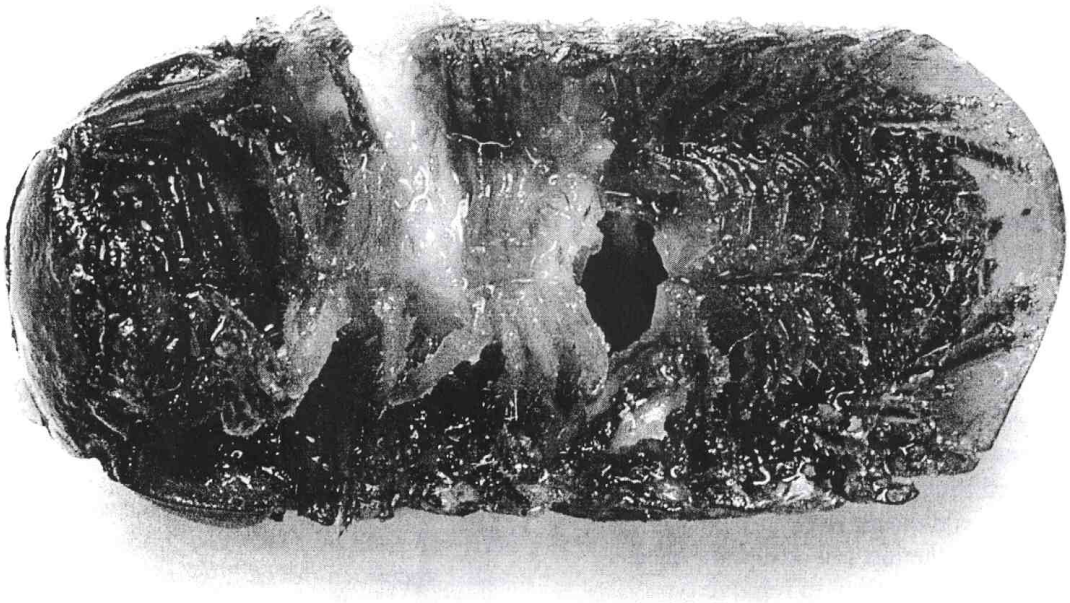


Plate 1

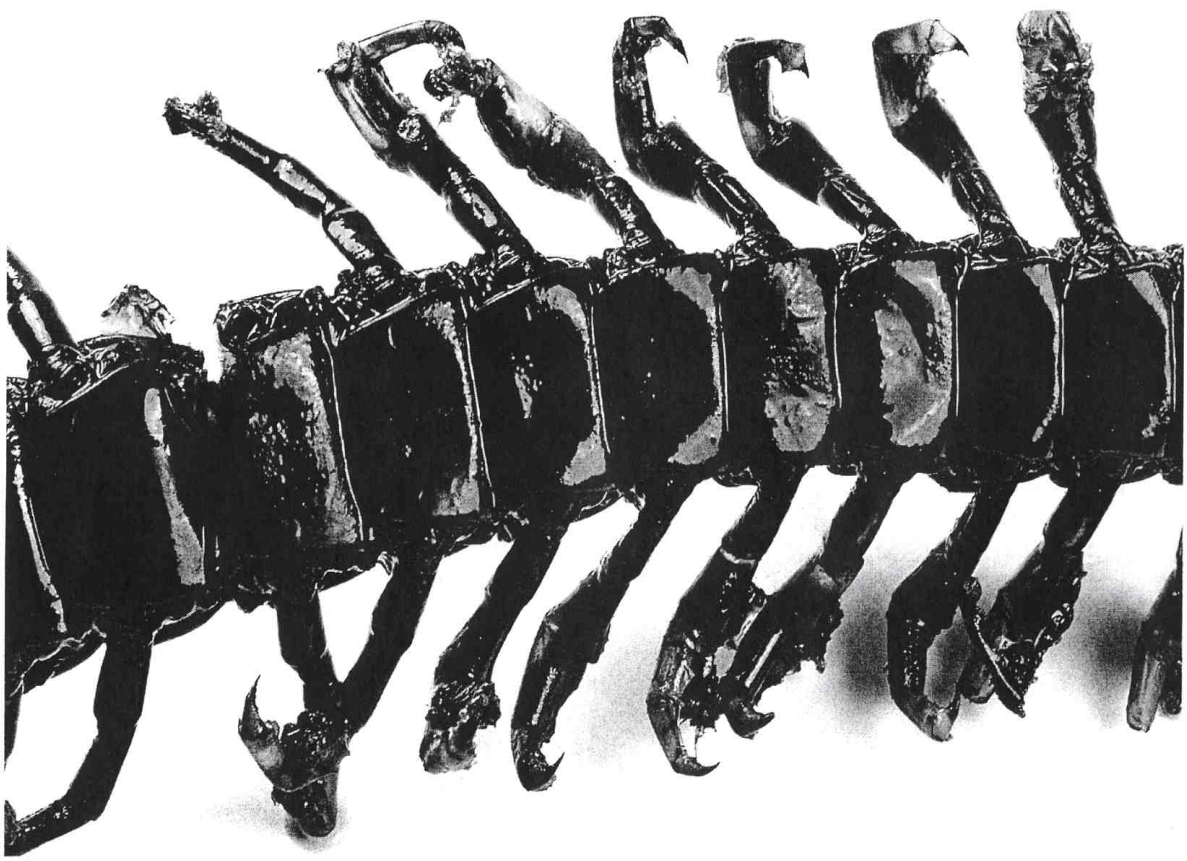


Plate 2

TABLE 1 - Millipede Results

Tube no.	Specimen	Chemical	Dilution	Results after 17 hours in test chemical	Results after 4 hours in 80% IMS	Results after 3 years
1	Pill millipede – large (*Arthrosphaera* sp.)	D – 90	2%	Slight leaching of colour, otherwise good	No further wetting req'd	Dried out
2	Pill millipede – large (*Arthrosphaera* sp.)	D – 90	5%	Quite heavy leaching of colour, otherwise good	No further wetting req'd	Dried out
3	Pill millipede – large (*Zephronia* sp.)	TSP	2%	Bad breakdown of body contents	Further wetting req'd	No further change
4	Pill millipede - large (*Zephronia* sp.)	TSP	5%	Start of breakdown of body contents	No further wetting req'd	No further change
19	Pill millipede - small (*Arthrosphaera* sp.)	D – 90	2%	Slight leaching of colour, otherwise good	Further wetting req'd	Some breakdown of body contents and fatty droplets in IMS
20	Pill millipede - small (*Arthrosphaera* sp.)	D – 90	5%	Slight leaching of colour, otherwise good	Further wetting req'd	IMS slightly cloudy
21	Pill millipede - small (*Arthrosphaera* sp.)	TSP	2%	Slight leaching of colour, otherwise good	Further wetting req'd	No further change
22	Pill millipede - small (*Arthrosphaera* sp.)	TSP	5%	Very bad breakdown of body contents	Further wetting req'd	Fatty droplets in IMS and on specimen

TABLE 1 - Millipede Results (continued)

Tube no.	Specimen	Chemical	Dilution	Results after 17 hours in test chemical	Results after 4 hours in 80% IMS	Results after 3 years
16	Millipede – large (*Spirobolus* sp.)	D – 90	2%	Slight leaching and breakdown of body contents	Further wetting req'd	IMS cloudy
15	Millipede – large (*Spirobolus* sp.)	D – 90	5%	Very bad leaching and breakdown of body contents	No further wetting req'd	No further change
17	Millipede – large (*Spirobolus* sp.)	TSP	2%	Slight leaching and quite bad breakdown of body contents	No further wetting req'd	Fatty deposits on specimen
18	Millipede – large (*Spirobolus* sp.)	TSP	5%	Very bad breakdown of body contents	Further wetting req'd	IMS quite clear, but fatty 'tide mark' on specimen
31	Millipede – small (*Paraiulus* sp.)	D – 90	2%	Good	No further wetting req'd	Fatty droplets in IMS and on specimen
34	Millipede – small (*Paraiulus* sp.)	D – 90	5%	Very slight breakdown of body contents, otherwise good	No further wetting req'd	Fatty droplets in IMS
33	Millipede – small (*Paraiulus* sp.)	TSP	2%	Very bad breakdown of body contents	Further wetting req'd	Fatty droplets in IMS and bad deposits on specimen
32	Millipede – small (*Paraiulus* sp.)	TSP	5%	Good	Further wetting req'd	Fatty droplets in IMS and on specimen

TABLE 2 - Centipede Results

Tube no.	Specimen	Chemical	Dilution	Results after 17 hours in test chemical	Results after 4 hours in 80% IMS	Observations after 3 years
39	Centipede - large	D – 90	2%	Slight breakdown of body contents, otherwise good	No further wetting req'd	No further change
9	Centipede – large (*Scolopendra* sp.)	D – 90	5%	Heavy leaching and bad breakdown of legs	No further wetting req'd	No further change
40	Centipede - large	TSP	2%	Very slight breakdown of body contents, otherwise good	No further wetting req'd	Very bad fatty droplets on specimen, IMS brown
10	Centipede – large (*Scolopendra* sp.)	TSP	5%	Quite heavy leaching and flaking away of cuticle on segments	No further wetting req'd	Alcohol brown due to leaching
24	Centipede – small (*Lithobius variegatus*)	D – 90	2%	Slight leaching and breakdown of body contents	No further wetting req'd	Fatty droplets in IMS and on specimen
23	Centipede – small (*Lithobius variegatus*)	D – 90	5%	Good	Further wetting req'd	IMS slightly cloudy
26	Centipede – small (*Lithobius variegatus*)	TSP	2%	Tips of legs beginning to breakdown	No further wetting req'd	Fatty droplets in IMS
25	Centipede – small (*Lithobius variegatus*)	TSP	5%	Slight leaching and breakdown of body contents	No further wetting req'd	Fatty droplets in IMS and on specimen

TABLE 3 - Spider Results

Tube no.	Specimen	Chemical	Dilution	Results after 17 hours in test chemical	Results after 4 hours in 80% IMS	Observations after 3 years
5	Tarantula - large	D – 90	5%	Good	Further wetting req'd	No further change
6	Tarantula - large	TSP	5%	Good	Further wetting req'd	IMS very cloudy with precipitate
7	Tarantula – small (*Atrax* sp.)	D – 90	5%	Good	Further wetting req'd	No further change
8	Tarantula – small (*Atrax* sp.)	TSP	5%	Good	Further wetting req'd	No further change
13	Spider (Sparassidae sp.)	D – 90	2%	Slight leaching – otherwise good	Further wetting req'd	No further change
12	Spider (Sparassidae sp.)	D - 90	5%	Leaching – otherwise good	Further wetting req'd	No further change
11	Spider (Sparassidae sp.)	TSP	2%	Good	Further wetting req'd	No further change
14	Spider (Sparassidae sp.)	TSP	5%	Good	Further wetting req'd	No further change

TABLE 4 - Tick Results

Tube no.	Specimen	Chemical	Dilution	Results after 17 hours in test chemical	Results after 4 hours in 80% IMS	Observations after 3 years
30	Tick – large (*Amblyomma variegatum*)	D – 90	2%	Good	Further wetting req'd	IMS cloudy with fatty droplets
29	Tick – large (*Amblyomma variegatum*)	D – 90	5%	Good	Further wetting req'd	IMS slightly cloudy
27	Tick – large (*Amblyomma variegatum*)	TSP	2%	Good	Further wetting req'd	IMS cloudy with fatty droplets
28	Tick – large (*Amblyomma variegatum*)	TSP	5%	Good	Further wetting req'd	IMS cloudy with fatty droplets
36	Tick – small (*Amblyomma variegatum*)	D – 90	2%	Good	No further wetting req'd	Fatty droplets in IMS and on specimen
38	Tick – small (*Amblyomma variegatum*)	D – 90	5%	Good	No further wetting req'd	IMS slightly cloudy
37	Tick – small (*Amblyomma variegatum*)	TSP	2%	Good	No further wetting req'd	IMS cloudy with fatty droplets
35	Tick – small (*Amblyomma variegatum*)	TSP	5%	Good	No further wetting req'd	IMS slightly cloudy

Plate 3

After 4 hours in 80% IMS
The specimens were studied four hours after immersion in 80% IMS, to see whether they needed further rehydration. All the spiders required further rehydrating because they still floated, along with three other specimens – a Pill millipede (tube number 3 – see Table 1), and two large millipedes (tube numbers 16 & 18 – see Table 2). All of the other specimens were sufficiently rehydrated to immerse fully in alcohol without floating.

Results after 3 years
There was clearly visible change - e.g. fatty droplets in the IMS, in 25 out of the total 40 specimens (see Tables 1 – 4).

Discussion
Due to the lack of availability of suitable material for experimentation, the sample size was too small to statistically analyse. However, I feel it is still possible to draw useful conclusions from those data collected. It is evident that in general, *both* chemicals are a compromise. Both chemicals affected specimens at both dilutions (2% & 5%). This therefore emphasises the need to question the motives behind rehydrating specimens in the first place.

I consider body contents or structure (i.e. legs and cuticle) breakdown to be a greater problem than colour leaching, so where there is a choice of preventing either one or the other by using a particular rehydrating agent, then I would choose to prevent body breakdown. I would therefore use Decon 90 in preference to trisodium phosphate, as more specimens - 17 out of 20, were relatively unaffected, compared to 13 out of 20 (see Tables 1 – 4). However, ideally I would use a combination of the two rehydrating agents (see 'Recommendations' section below).

After 17 hours in the test chemicals
It is evident that the condition of the specimen has an effect on the speed of rehydration. For example, those specimens that were broken into sections (i.e. all the millipedes) showed a quicker breakdown of body contents than the Pill millipedes. This is due to their body contents being openly exposed (see Plate 3), thus allowing more of the test chemical to enter the body cavity.

After 3 years
The fact that there was change even in those rehydrated specimens that were unaffected after 4 hours in 80% IMS (i.e. small tick, tube 37 - see Table 4), infers that the rehydrating agent may still have been working. This may have been due to insufficient washing after removal from the rehydrating agent, before being placed in the IMS.

Recommendations
Where there is an option for selectively using both rehydrating agents, I would recommend the following:

<u>2% Decon 90</u>
Pill millipedes (small & large) – although slight leaching, no body breakdown
Millipedes (small & large) – although slight leaching, no body breakdown
Centipedes (small & large) – Decon 90 at 2% appears least damaging to the specimens overall
Ticks (small & large) – good in anything, but 2% Decon 90 appears to be least damaging

<u>2% Trisodium phosphate</u>
Spiders (including small & large tarantulas) – no leaching

Further Work
The above data highlight the need for further, extensive tests on a greater number of specimens, using a greater selection of rehydrating agents and different immersion times. Specimens should then be studied at the tissue structure level for any possible effects.

Mammal Collections

Curation, Conservation and Uses

Grant Museum of Zoology, University College London, Gower Street
17th December, 2001

Mammals are one of the largest and more visible elements of many museum collections. This meeting at the end of 2001 brough together a wide range of speakers looking at the different uses, issues and opportunities relating to mammal collections.

Using Mammal Collections

Andrew C. Kitchener, Dept. of Geology and Zoology, National Museums of Scotland, Chambers Street, Edinburgh EH1 1JF.
E-mail: a.kitchener@nms.ac.uk

Mammals are among the most important specimens in our museums. They are immensely popular with our visitors, include our closest living relatives, the chimpanzees and other great apes, and are continually exploited in advertising and in symbolising commercial products, ranging from breakfast cereals to fast cars. However, in museums they have their problems. They are often big and, hence, take up a lot of space. Taxidermy is often perceived as out dated, ethically questionable and not as good as TV programmes. Also, the research value of mammal collections is considerably underestimated as it is often assumed that we know all we need to know about mammals.

Over the last 14 years at the National Museums of Scotland, we have been faced with these common assumptions and faced with this paradox of high public popularity, but putative low research need. However, we know more about the basic biology of lions and tigers than our own native species such as wildcats, polecats and red squirrels. As a result of these common misconceptions, we have created new kinds of mammal collection that complement our existing collections and which are more relevant to the research and conservation needs of today. This article is not intended to preach, but provides just a brief outline of the work we have been doing at the National Museums of Scotland using our mammal collections.

Taxonomy and Systematics

This is, of course, one of the traditional mainstays of larger mammal collections. Much of mammalian nomenclature is based on 19th and early 20th century literature, which is mostly non-scientific. As a result the plethora of species and subspecies names used today are based largely on small, unrepresentative, often aberrant samples with a dose of personal vanity. As natural habitats disappear or change and biodiversity is lost, so there is an increasing need to have a better understanding of basic mammalian taxonomy and systematics. At NMS we have been involved in a number of studies to look at geographical variation in endangered species (e.g. clouded leopard, tiger), which have drastically reduced the number of recognised subspecies, which has important implications for conservation in captivity and the wild (Kitchener, 1999; Kitchener & Dugmore, 2000; Kitchener, Richardson & Beaumont, in prep.). Under contact from Scottish Natural Heritage, we have also looked at geographical variation in

European beaver populations to compare with fossil British beavers (Kitchener & Lynch, 2000). From this study we were able to show that the skulls of extinct British beavers are most similar to those of extant Scandinavian ones, and hence recommend these for reintroduction. Scottish Natural Heritage is planning to reintroduce the beaver to Knapdale in Argyll in 2003 (Kitchener, 2001).

Anatomy

Although we carry out little research in comparative anatomy, we have extensive skeletal and wet collections, which are freely available. Despite the lack of interest in comparative anatomy today, there is still much that is unknown, or which has not been looked at since the early 20t^{h} century or before. For example, we have recently published the first anatomical description of the penis of the sperm whale (Bland & Kitchener, 2001), despite the many millions that have been killed in commercial whaling and the thousands that have stranded all over the world. Other anatomical studies carried out at NMS include the preputial gland of the coati (Shannon *et al.,* 1995) and the hindlimb adaptations of arboreal cats (in prep.).

Hybridisation

At NMS we have been collaborating with Scottish Natural Heritage for more than 15 years on the problem of hybridisation between wildcats and domestic cats. Most of this research has been directed to finding reliable morphological characters that can be used to distinguish wildcats from the rest (e.g. Daniels, *et al.*, 1998; Kitchener, 1998; Ward & Kitchener, in press) and correlating these with genetic data (Beaumont *et al.,* 2001). As a result of our expertise in this area we have been approached in recent years to look at similar problems in polecats and feral ferrets (Birks & Kitchener, 1999), Arctic wolves and huskies (Clutton-Brock *et al.,* 1994) and Ethiopian wolves and domestic dogs (in prep.). A most important aspect of research into hybridisation problems is having good time series with large sample sizes so that the progress of hybridisation can be tracked over time.

Comparing Populations

In recent years we have been involved in a number of studies, which have compared populations. These rely mainly on larger sample sizes from discrete areas, in order to examine differences using multivariate statistical analyses mostly of skull measurements. The studies we have carried out fall into two main categories. Firstly geographical variation within species, e.g. otters (Lynch *et al.* 1996), red squirrels (Kitchener, Peacock & Gurnell, in prep.), porpoises (Tolley, Lynch, Lynch and Herman, in prep,), and common dolphins (Murphy, Herman & Kitchener, in prep.). We are also currently involved in comparing the skulls of New Zealand's introduced mustelids (stoats, weasels and feral ferrets) with those of their ancestral populations in Britain (Grimshaw, Kitchener and Macdonald, in prep.)

The other main area of study is looking at the effects of captivity on wild mammals in zoos by comparison with wild populations. Owing to lack of activity, population bottlenecks and differences in diet there is a concern that many captive mammals populations may not resemble those in the wild, so that if reintroductions were proposed, the survival of the captive stock would be severely compromised. Also, there is a welfare issue if the lack of activity or inappropriate diet damage the health of captive individuals. Recently, we looked at the effect of captivity on the musculo-skeletal system of Rodrigues fruit bats (Kitchener, *et al.* 1999), which showed that wild-caught and captive-bred fruit bats adapt to captive life in the same way. We have measured gradually increasing amounts of subcutaneous fat throughout life until it reaches about a third of body weight at 20 years old, when the animals can probably no longer fly.

We have also recently begun a collaboration with San Diego Zoological Society and Liverpool University to look at the effect of captive diets and activity levels on the development of the teeth and skeletons of cheetahs.

Pathological studies are also possible to look

at the incidences of diseases. For example, we have also been looking at the incidences of bone and dental diseases in captive bears (Kitchener *et al.*, 2001). The problem is that bears may live for up to 40 years in zoos, and perhaps only half that time in the wild, but many of the old bears donated to NMS had severe skeletal and dental problems. We have found that in bears of all species over 18 years of age there are signs of progressive painful bone disease and severe dental problems including abscesses in more than 93% of animals (Kitchener *et al.*, 2001). Therefore decisions must be made as to how best to manage these long-lived animals given that they may be in severe and increasing pain for up to half their lives in captivity.

There is great potential for carrying out studies on ageing using mammal collections, especially if they contain known-age individuals. One recent study at NMS involved establishing a method for ageing the highly endangered Sumatran rhinoceros using tooth wear (Kitchener, 1997). This established that the captive female at Port Lympne Wild Animal Park, who died in 1994, was probably at least 35 years old and hence was probably too old to breed when she arrived in Britain.

There are also a variety of spin-off studies that become possible from modern samples. For example, we have been able to supply samples for a variety of molecular studies, but also dietary, reproductive, toxicological and pathological research on polecats, wildcats, red squirrels and chimpanzees (see e.g. Alp & Kitchener, 1993; Shore *et al.*, 1996; Davison *et al.*, 1999; Birks & Kitchener, 1999).

Conservation and Legal Relevance

Much of the research that can be carried out on mammal collections may be of direct conservation relevance, such as taxonomic studies to determine subspecific and other geographical variation (Kitchener & Dugmore, 2000), hybridisation studies (see above), and reintroductions (e.g. beavers, Lynch & Kitchener, 2000). Development of reliable methods of identification also assist in the legal protection of endangered species. For example, we have appeared as expert witnesses in the identification of bushmeat items, taxidermy and wildcats, and have identified many items suspected of being illegally imported. Finally, modelling of the tiger's distribution based on museum locality records has allowed a new way of assessing the relationship between putative subspecies and may be of positive benefit in the conservation of some critically endangered populatons of this big cat (Kitchener & Dugmore, 2000).

Exhibitions

Last but not least, we are fortunate in having two excellent and active taxidermists and our exhibition efforts have been directed to preparing new taxidermy where possible. Our new mounts try and show mammals in dynamic poses to show behaviours not often seen in the wild or in zoos, or to show their key adaptations. Therefore mounts are produce to illustrate biological themes in order to facilitate the communication of the exhibitions' key messages.
Collecting policy

Our collecting policy does not allow for the killing of birds and mammals for exhibitions, so that we are totally reliant on the goodwill of our donors. This has required the creation of an extensive network of contacts and transport. methods for getting specimens to Edinburgh.

References:

Alp, A and A C Kitchener (1993). Carnivory in wild chimpanzees, *Pan troglodytes verus*, in Sierra Leone. *Mammalia* **57**, 273-4.
Beaumont, M., Barratt, E.M., Gottelli, D., Kitchener, A.C., Daniels, M.J., Pritchard, J.K. & Bruford, M.W. (2001). Genetic diversity and introgression in the Scottish wildcat. *Molecular Ecology* **10:** 319-336.
Birks, J.D.S. & Kitchener, A.C. (1999). *The distribution and status of the polecat* Mustela putorius *in Britain in the 1990s.* The Vincent Wildlife Trust, London 152pp
Bland, K.P. & Kitchener, A.C. (2001). The anatomy of the penis of the sperm whale (*Physeter catodon* L., 1758). *Mammal Review*

31(3): 239-244.
Clutton-Brock, J, A C Kitchener and J M Lynch (1994). Changes in the skull morphology of the Arctic wolf, *Canis lupus arctos*, during the twentieth century. *Journal of Zoology, London* 233, 19-36.
Daniels, M J, D Balharry, D Hirst, A C Kitchener and R J Aspinall (1998). Morphological and pelage characteristics of wild living cats in Scotland: implications for defining the 'wildcat'. *Journal of Zoology London* **244:** 231-247.
Davison, A, J D S Birks, H I Griffiths, A C Kitchener, D Biggins and R K Butlin. (1999) Hybridization and the phylogenetic relationship between polecats and domestic ferrets in Britain. *Biological Conservation* **87:** 155-161.
Kitchener, A C (1997). Ageing the Sumatran rhinoceros: Preliminary results. *International Zoo News* **44(1):** 24-34.
Kitchener, A C. (1998) The Scottish wildcat – a cat with an identity crisis? *British Wildlife* **9(4):** 232-242.
Kitchener, A. (2001). *Beavers.* Stowmarket: Whittet Books.
Kitchener, A C. (1999) Tiger distribution, phenotypic variation and conservation issues. *In:* Seidensticker, J., Christie, S. and Jackson, P. (eds.). *Riding the Tiger. Tiger conservation in human-dominated landscapes*. pp. 19-39. Cambridge: Cambridge University Press.
Kitchener, A.C. & Dugmore, A.J. (2000). Biogeographical change in the tiger. *Animal Conservation* **3:** 113-124.
Kitchener, A.C. & Lynch, J.M. (2000). A morphometric comparison of the skulls of fossil British and extant European beavers, *Castor fiber*. *Scottish Natural Heritage Review* No.127. 31 pp.
Kitchener, A.C., Kolter, L. & Brownstein, D. (2001). Problems with old bears in zoos. *In*: Hiddinga, B. & Brouwer, K. (eds). *EEP Yearbook 1999/2000, including the Proceedings of the 2000 EAZA Conference, Aalborg 19-24 September 2000*, pp. 625-628.
Kitchener, A.C., Merryweather, J. & Allchurch, T. (2000). The effect of captivity on the flight musculo-skeletal system of fruit bats (*Pteropus* spp.). *In*: Rietkerk, F., Hiddinga, B., Brouwer, K. & Smits, S. (eds). *EEP Yearbook 1998/99 including the Proceedings of the 1999 EAZA Conference, Basel 7-12 September 1999*, pp. 553-555.
Lynch, J. M, J W H Conroy, A C Kitchener, D J Jefferies and T J Hayden (1996). Variation in cranial form and sexual dimorphism among five European populations of the otter *Lutra lutra*. *Journal of Zoology, London* 238, 81-96.
Shannon, D, A C Kitchener and A. Macdonald (1995). The preputial glands of the coati, *Nasua nasua*. *Journal of Zoology, London* 236, 319-357.
Shore, R F, J D S Birks, P Freestone, A C Kitchener (1996). Second-generation rodenticides and polecats (*Mustela putorius*) in Britain. *Environmental Pollution* 91(3), 279-282.

The Educational Value Of Natural History Collections In Learning About Biodiversity

Dr Sue Dale Tunnicliffe
Homerton College, Cambridge and Institute of Education, University of London
email Homerotn@ sdtunnciliffe.demon.co.uk and s.tunnicliffe@ioe.ac.uk

Visitors to natural history museums see museum animals, models or those which have been taxidermically preserved. Do people have to see the 'real thing' in order to learn about animals? If the answer is 'Yes', what do the people who say that they do so mean by 'real'? In a zoo a viewer of animal specimens does indeed see a "real animal", albeit one that usually exists in an artificial setting, without any prey, predators or other natural threats. Hence the zoo animal is yet another type of image, live, but represented in a human constructed frame and constrained by this very design. The design of an exhibit sets a context in which the animal is seen and this artificially created surround helps form the image of the animal in the mind of the onlooker.

Studying images of animals in a natural history museum, of which the majority are mammals, is more effective in terms of what visitors notice and comment upon than looking at animals in zoos. I have focused on

primary age children and the accompanying adults. My studies have shown there is a similarity in content of the conversations generated at animal exhibits amongst both school and family groups, and for both groups, has a higher content of knowledge statements in museums than in zoos.

The Collins Dictionary as defines learning:

1. Knowledge gained by study, instruction or scholarship.

2. The act of gaining knowledge. It is synonymous with many words: acquirements; attainment; culture; education; erudition; knowledge; letters; literature; lore; research' scholarship; schooling; study; tuition; wisdom.

One of the huge problems in the museum world and that of visitors studies is that learning is taken to mean many of these definitions, hence we often talk at cross purposes. I take learning to mean the second definition. 'The act of gaining knowledge'. I take the 'gaining' to mean the learner actively constructing the knowledge and understanding. I consider that the term ' finding out' is far preferable to use when asking visitors what they 'have learnt' form an exhibit.

One way of investigating what children learn about animals is to examine the mental models they reveal through their talk when they come face to face with animal representations. Moreover, a museum's story is told mainly through its exhibits. However, this story may not be 'read' by visitors, who come with their own knowledge and understanding, and read a different one which makes sense to them and builds on what they already know. A visit to the natural history museum is part of many pupils' educational programme. One way of investigating what children learn about animals is to examine the mental models they reveal through their talk when they come face to face with animal representations.

Information is one of the necessary tools for education but the manner in which the new learning information is introduced, how the learner is aided in constructing meaning from the new information, and how the learner conducts a dialogue with the self are at the core of educational process. Conversations are key to education. The skilled teacher knows when and how to provide the key verbal links that lead a learner to the next stage in their understanding of concepts and skills. Such sensitivity and skills should be in the possession of museums and zoos.

There are a number of factors which are useful to consider before trying to assess learning or attention to museum exhibits. There exist a series of conditions or needs that must be identified before we consider the role the personnel of the group contribute. Firstly rationale for the visit. If the visit is part of the formal learning agenda for children it would be expect be that a high degree of 'teaching' by the teacher (or parent helper) and effective teaching by the exhibits, if they are specifically designed to 'teach' at curriculum level rather than at an everyday one, would be identified in the conversations. However, the exhibits are regarded by the visitors to provide a background for their personal social interactions and some incidental fact acquisition occurs. Secondly, there is a familiarity issue or an encounter level. How familiar are children with the topic? This links with rationale. If this is the first encounter with such specimens or indeed any animal specimens, children's observations may be at a familiarisation level. Does the amount of information heard depend on the ' encounter level' at which visitor approaches the exhibit? Does conversational content and function reflect encounter level? Thirdly, there is the issue of identifying science education in operation. Is a science conversation one that uses previous knowledge, one with 'science' content e.g. 'proper species names of animals (in English), order and phyla etc. appropriately used and one which relates form to function in non-anthropomorphic terms? Fourthly, can we identify teaching and learning dialogues? What is a teaching conversation? Are the content or form and the function, that is why speaker is using the words, apparent?

However, physical interaction is not necessarily mental interaction. What type of physical interaction is available at your

establishment? What do the visitors do? The interaction of the mind, 'Minds-on', is often limited and physical interaction where activity such as pushing a button is provided appear to mask any thinking interaction other than at a low level of ' This what I do with this button'.

However, physical interaction is not necessarily mental interaction What sort of physical interaction is available at your establishment ? What do the visitors do?

The interaction of the mind- Minds-on- is often limited and physical interaction where activity such as pushing a button is provided appear to mask any thinking interaction other than at a low level of ' This what I do with this button'. A summary of these interactions is shown in figure 1.

Museums and zoos have exhibits which have a message with which these institutions are familiar. However, *their* knowing what *they* expect *their* visitors to understand from the exhibits is only part of the picture. It is particularly important for science educators and museum and zoo personnel, educators, valuators, exhibit designers, graphic writers, to know:

- what visitors point out and tell each other - for they talk about that which interests them (Falk and Dierking, 1992) and in the case of schools - that aspect of the curriculum about which the visits is

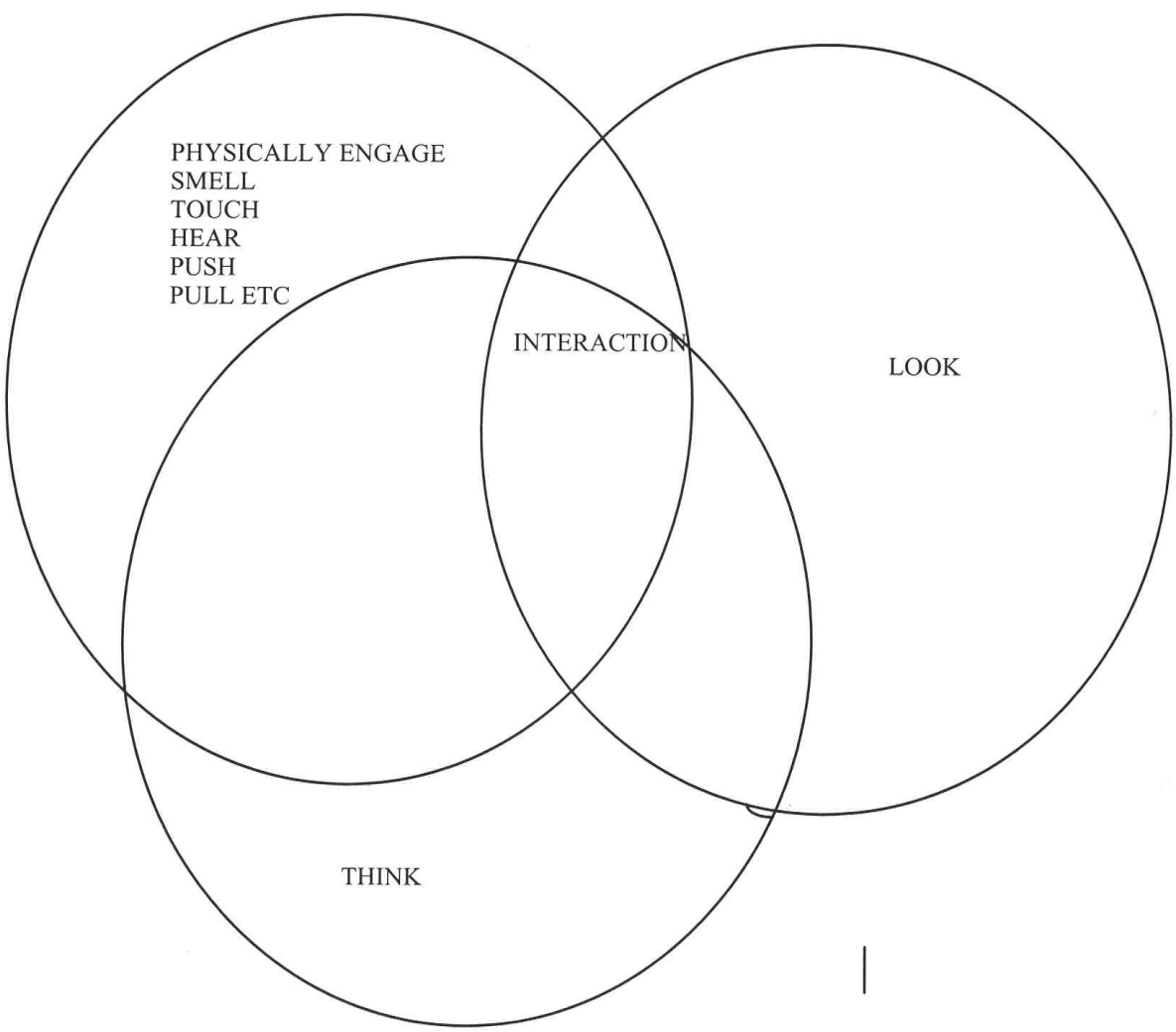


Figure 1 Interactions at animal exhibits.

designed e.g. classification, variety of life, movements, adaptation;
- how they interpret the exhibits;
- what catches their attention;
- the curriculum focus of the school visits - whether the visit is being used for overt science education with the teachers;
- whether the exhibits provide cues to develop the pupil's learning about animals and associated concepts such as the environment and conservation.
- whether teachers use the exhibits to teach the children. Do teachers (or other accompanying adults) read the labels to the children and help their pupils identify with which they are referring to? Do the adults ask the children learning questions? Do they initiate a learning dialogue?

FACTORS AFFECTING A VISIT ENCOUNTER

VISITOR ZONE (RECEIVE FROM MUSEUM BUT GIVE TO SELVES)	VISITOR ZONE (RECEIVE FROM MUSEUM BUT GIVE TO SELVES)	MUSEUM ZONE (TRANSMIT TO VISITORS)
What the visitors already *know* about topic	The exhibit- its attractor factors:- Physical features—colour, size Value—monetary and emotional realness Links with visitors	The message of: museum designer curator others e.g. sponsors
In what they are *interested*	How close can they get	How message is tried to be given- insurrections/labels
The *task* visitors has at exhibit	What sensory stimulants are used?	
Visit rationale	Planned physical interactions	Mission of museum as in this exhibit
Space for visitors around exhibit	Views of exhibit according to position	Size and other spatial dimensions other physical features Site of exhibit background ambience- music, decor, seating
Social groups in which exhibit is viewed	Opportunities for group discussion	How designer planned visitor to interact see touch hear move
Age of group members	Is shared looking etc. possible	Is message layered?
Time budget	Are there opportunities for triggered talk? Are they used?	Other planned interaction explainers, CD Rom self guided tours, guide books
Route they take	Can exhibit be viewed at a number of levels of interaction?	
Stage of visit when they encounter specific exhibit	Are visitors using cues to explore the exhibit?	
Visitors *use* of facility		

Aspects of visitors' responses to exhibit	Data obtained from study of a whole visit	Data collected during part of a visit at individual and unrelated exhibits individual and unrelated exhibits
Behaviour of visitors	Tracking (Melton 1936) Intervention Studies (Taylor 1993)	Timing at exhibits (Falk, 1982, 83) Visitor Studies (Riddle 1980)
'Learning' focused on the process	Listening - in (Cooper 1995) Tunnicliffe (in Prologue in 1995)	Listening - in (McManus 1987) Observations (Tulley and Lucas 1991)
'Learning'- focused on the product or outcome in terms of what is noticed or what is remembered	Memory prompt and recollection studies (Stephenson 1991) Pre and post testing (Linn 1980)	Intervention Studies by 'museum 'expert' (Tulley and Lucas 1991) Listening-in (Tunnicliffe 1995)

Table 1 Summary of research methodology used in visitor studies

Category of Behaviour	Action	Resultant Interaction With Exhibit
WALK PAST	Minimal visual interaction or ignore	No effective interaction
PASSING COMMENT	Walk by but remark on some feature	Slight interaction Slight response to message of exhibit. Choose to ignore
EXPLORE	Stop. interpret features using own experiences, 'expert of everyday'	Direct interaction by talking to animal , touching exhibit, seeking a response aware of noises etc. of exhibit
STUDY	Stop. Interpret using message of exhibit or own story	Mental interaction- through physical movements and talk- Show and tell Re-enact or teach back.

Table 2 Range of visitor behaviour at exhibits

All animals, as exhibits, be they alive, preserved or animatronics are but ' images'. How can we find out about attention and learning of visitors to these images? Various techniques that have been employed to learn about visitor behaviour, the process of visitors' learning or the product or outcome of the exhibit encounter. Listening in' (Cooper, 1995) and part-visit listening, (McManus, 1987), timing at exhibit, (Falk, 1982, 83), intervention studies, (Taylor, 1993), memory prompts and recollection studies (Stevenson, 1991) and observations (Tulley and Lucas, 1991). If we are to find out in which topics

visitors are interested when they look at animals as exhibits, we need to devise a technique for so doing. Analysing the content of conversations of visitors is a useful method (Tunnicliffe, 1995). Likewise there are a range of behaviors shown by visitors at exhibits. These are summarised in Table 2.

We can analyse the talking which occurs. Such a process gives us insight into responses of visitors and helps us gauge the importance of museum animals to the visitors with whom we are concerned.

The levels of talking which I have observed at museum animals are shown below. The data also shows that there are three levels of dialogue in terms of focus of the content and the form and function of the exchanges.

These are:

Level 1	*social* - which could occur anywhere and are unrelated to the animals;	
Level 2	*prescience observations and comments* - which occur in everyday conversations as people categorise their observations;	
Level 3	*pedagogic/ science dialogue* - through which one person is trying to teach another about the focus of their observations. This in turn has three levels:	1. *Ostensive*- where the child's attention is drawn to an object and an appropriate piece of information provided by another, or the child responds with a focused observation.
		2. *Directed commentary*- didactic or declarative information linked with the object. This commentary may include question-answer sequences but all at an observational or direct recall level e.g. What is that animal? What does it eat?
		3. *Logical discour*se. This involves the visitor, child or adult, in abstract thought and in justifying the statements that s/he makes. e.g. Teacher: What is that ? Response: 'It is a reptile' (level 2 comment) Question: 'Why? response (*because understood*) *It has* a dry scaly skin' . Alternatively a child may introduce logical discourse e.g. 'It is not snake it is a lizard *because* it has legs'.

In order to assess the responses of visitors we need to observe them and their physical actions as well as listen to them. How can this be effectively be? We can watch and listen. I consider that there are three level of encounter and each one of these is assessed in several ways.

In the research findings reported in this paper conversations were listened to and analysed. Other observations of visitors were not made.

Methodology

This descriptive ethnographic study was concerned with providing and explaining the observations collected in the zoo and museum. The research was not seeking to manipulate the experience of the children but to listen to their conversations. I recorded the conversations in person, by using a hand-held microphone, and moving with the children as they walked around exhibits. I stood behind groups of children who did not know they were being recorded although permission had been sought from the teacher in charge. In some cases I followed the children from exhibit to exhibit until the group had a break and in other instances, e.g. in the Creepy Crawlies Gallery in the Museum or the Giant Panda at the Zoo, I stood at the exhibits in turn and recorded different groups as they viewed. The name of the school was requested but the anonymity of the participants was preserved. Where it was possible schools were selected so that there was a spread of the primary age range and the type of animal observed. The demographics of the schools visiting both locations were similar, although by its nature, the study was not an experimental analysis assigning groups at random to treatments.

Units of conversations provided the raw data of this study. A unit is defined as the 'group

FIRST LEVEL PHYSICAL — actions	
WHAT DO THEY DO?	Count how many exhibits visited
	Time at each exhibit etc.
	Track path (and time too)
	Observe - schedule or video
SECOND LEVEL — expressed models	
What do they say?	
MENTAL SPONTANEOUS TALK	eaves dropping, recording, radio mikes
INTERVIEW RESPONSES	before
	after
	both
	time lapse later
THIRD LEVEL	INTEGRATED
Talk	
observe	
interview	

conversation' at any one exhibit from the start of the viewing to their moving away'. The transcribed conversations provide qualitative data but because quantifiable data is an extremely useful and meaningful descriptive tool, a means of converting into this was sought. A systemic network was drawn up. This is a means of grouping or categorising things, in this case conversations (Bliss, Monk and Ogborn 1983), to be a parsimonious representation of the data, whilst preserving the relationships between categories in such a way that comparisons can be made between groups. The network can be regarded as the sets of boxes into which the researcher puts each part of the conversation. At one extreme of the continuum of categorising the conversations are highly specific items identified as terminals in the network and numbered. The terminal numbers at the right of the figure are the most

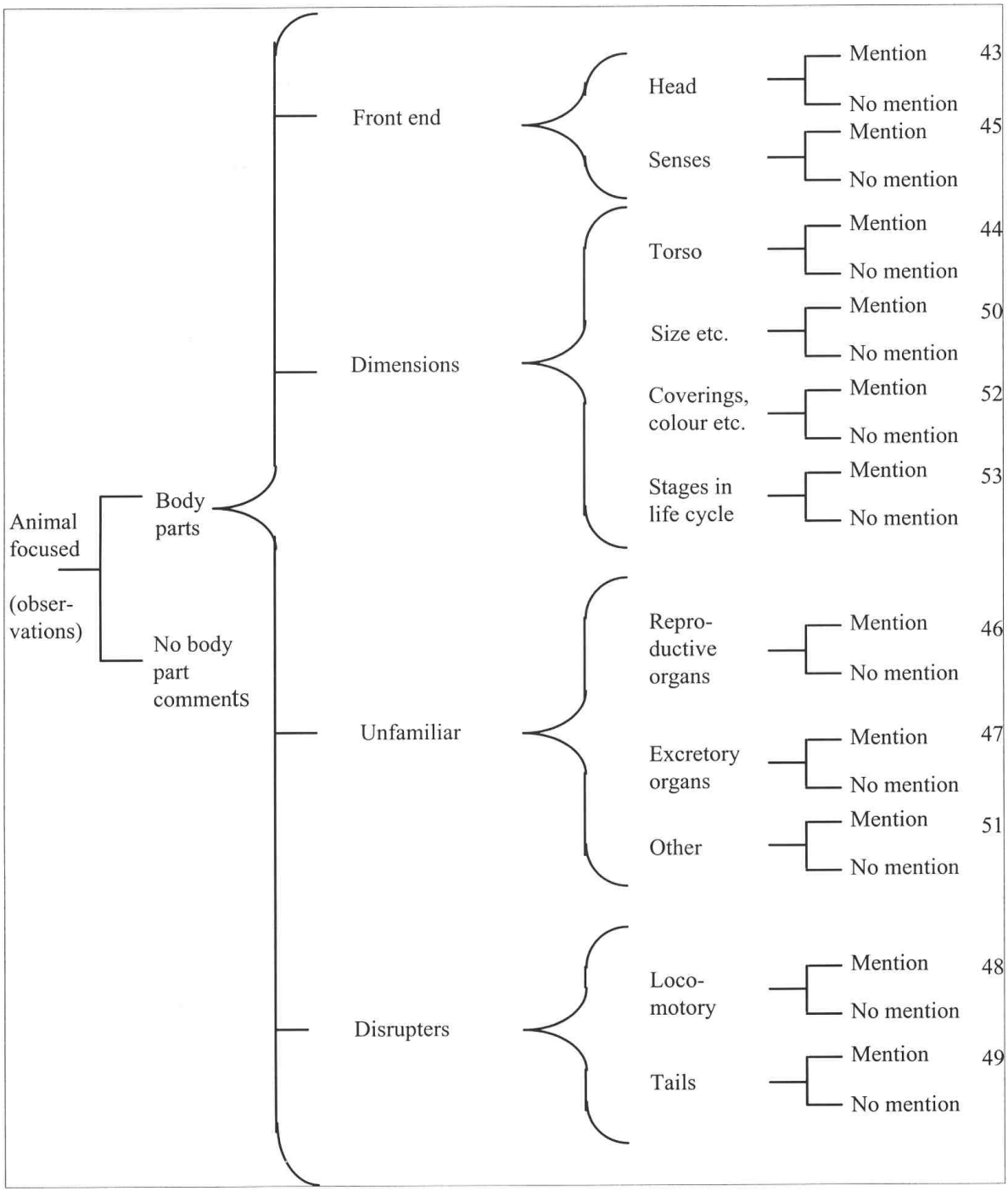


Figure 2: Body parts Segment of network

specific level of table categorisation and a category was either 'mentioned' or 'not mentioned'. At the other end is the main descriptor, in this case 'children's comments' (see fig 1). Terminals are grouped into superordinate categories. For example head, torso, sense organs and other comments about body parts each have a terminal number but are grouped in the Body Parts category. 'Body parts' is a subordinate category of Direct Animal comments which is a category of comments at animal exhibits.|

In the diagrammatic representation of the network (fig 2) a bar, '[', indicates that an attribute may or may not be a member of the subordinate categories, whilst a bracket, '{', indicates that the comment categories are not mutually exclusive. Hence, a conversation either does or does not contain a direct reference to an animal (Bar categories). Direct comments about animals can be in one, two or all of the body part categories (bracketed categories). Further details of the theory and reliability of the network are in Tunnicliffe (1995).

The major categories of the network were 'affective attitudes'. which included like (L) and dislike (D) comments and related noises (L- and D-noises), e.g. 'Ah!' or 'Urg'; 'exhibit comments' about the content of the exhibit and labels; 'welfare comments'; 'direct identification of the animal';'knowledge source' comments. These comments were questions or opinions or definite declarative statements together with reference to other knowledge sources such as TV, worksheets, books and lessons. The categories about the animal were divided into three, 'body part' e. g. shape, size, colour of the animals, head, legs;'behavioural' comments referred to any actions of the animals such as feeding, moving, excreting; 'taxonomic comments', were those parts of the conversations which named the animals, e.g. 'Bird!', ' It's a cat!'.

Categories of other attitudinal comments were identified. The 'anthropomorphic' category contained explanations and comments about the animal in human terms, but not comments about structures such as, 'That chimp's hand is

Group of children according to age	Conversations in Zoo [n=459] shown for each age group	Number of conversations of age group expressed as % of total conversations	Conversations in Museum [n=407] shown for each age group	Number of conversations of age group expressed as % of total conversations
Group 1 (Five years & under-reception, nursery and kindergarten)	133	29	8	2
Group 2 (Year 1 & 2, six & seven year olds)	160	35	123	30
Group 3 (Year 3 and 4 , eight & nine year olds)	84	18	77	19
Group 4 (Year 5 and 6 , ten & eleven year olds)	39	9	186	46
Group 5 (Year 7, twelve year olds)	43	9	13	3

Table 3 Distribution of Children in Age Groups

like mine'. Comments which referred to human/animal interactions such as, 'Is it dangerous?';'I'd like to ride that animal', were grouped in a category whilst remarks related to the live or dead state of the animal were grouped in one category, 'animism'. Other descriptive demographic data such as the types of animal observed, the type of adult accompanying the group, were also recorded. Age was noted and the ages grouped.

Each conversation unit was scored with the appropriate number from the networks. The data was entered into a worksheet of a Minitab statistics package. There were 150 columns in the worksheet including all the terminals of the network and additional columns for demographic data and for the results of the consolidation of categories in the analysis of the data. A '1' was scored on the spreadsheet in each category of topic which was recorded in a conversation unit.

EXAMPLE OF ANALYSED UNIT OF CONVERSATION.
Location: Mammal Gallery 6 year olds

22 / 40 / 56
Teacher: The one/ over there/ is a cheetah.

56
Boy: Cheetah!

22 / 15 / 53
Boy 2: All these animals/ are real, / well they were,

3 / 70
Teacher: And yes , some of them / were very dangerous.

12
Boy : They're not now!

The overall categories of conversation are shown in tables 4 and 5.

All conversations heard at animal exhibits in the museum were about the exhibit. A break down of the of conversational content is shown in table 4 . The actual data are shown in table 6.

The predominant topic of comment heard is the naming of the specimen.

The animal focussed conversations are further subdivided as shown in table 5.

Consideration of the distribution of comments about a body part or behaviour showed that there were four categories of comment within each section. Comments about body parts can be grouped into four categories:

- the front end (head and sense organs), e.g. Eight year old girl at small primate said, 'They have a small nose and a small mouth';
- the body dimensions -shape size and colour; e.g. a five year old at the giraffe remarked "Is it really that tall?'.
- unfamiliar bits , e.g. horns, excretory and reproductive organs particularly with unexpected colours, e.g. a seven year old boy remarked at the baboons, 'Look at their pink bottom!'
- disrupters ,which break the pattern of familiarity, e.g. tails, legs. An eleven year old girl at the elephants commented, ' Its got like a long nose'.

The four categories of behaviour comments are:

- movements, e.g. a seven year old at the gerunuk 'It looks as if it is stretching up'
- position in the enclosure e.g. this seven year old girl was telling her friend where to find a tortoise (turtle) Girl 1: You can see that, uhm, red thing, that red thing behind that rock. Girl 2 replied, 'Where up there ?';
- feeding e.g. eleven year old children looking at gerunuk , 'Look, its eating a branch';
- attention attractors. These are any activities, e.g. excretion, play, which are modelled in the position of the animal or a

EXHIBIT FOCUSED CATEGORIES	EXPLANATION
EXHIBIT ACCESS	Making sense of the exhibit and finding something to observe e.g. 'Look !' 'Where is it?'
EXHIBIT FOCUSED i. EXHIBIT SETTING ii ANIMAL FOCUSED	 The 'exhibit furniture' and setting Observing the structures and behaviours of the animal and seeking to categorise it. (table 2)
MANAGEMENT	Organising the group by behaviour and dialogue e.g. 'Come here', 'Let's move on'
SOCIAL	Responses to conversations 'Yes', names and titles of individuals, 'Michael', 'Mum', 'Miss', so that the other categories of conversation flow smoothly, also 'irrelevant' social conversations incidental to animal exhibits, e.g. 'family gossip'

Table 4: Categories of Exhibit Focused Conversations

A. Direct animal focused conversation Topics	B. Indirect animal focused conversations Topics
1. Body Parts e.g. '.....at it's pink nose'	1. Memories ' We had bats in our garden ...'
2. Behaviours e.g. 'it's playing'	2. Plans ' We'll go and buy a book'
3. Names and relationships e.g.' It's a lizard'	
4. Affective and emotive attitudes to the animals 'Ah!, I like that'	
5. Enclosure observations and comments 'read on the label' 'under that log..'	
6. Interpretative comments e.g. 'I think it is a..'' What is it?'	

Table 5: The Content of Animal Focused Conversation

physical feature e.g. eight year old boys at the bison (no longer on display) were fascinated by the seemingly patched bullet hole in the flank of the specimen.

The proportions of conversations about body parts and behaviours are shown in Tables 3 and 4 where the significance of the number of comments is expressed both as a proportion of the total number of conversations but more importantly as *proportion of the category of body part conversations*. A contingency table was constructed for each category. The Chi-square was calculated with 1 degree of freedom.

The children in both sites expressed their preferences for animals in terms of liking,

disliking and the results of the count of such comments are given in table 6. Opinions about other aspects of the animals such as interpreting its behaviour in human terms were also expressed and the results of the count of conversations in which such a comment appeared at least once are given in Table 6.

The results provide an account of what interests these visitors, gauged through their spontaneous conversations, when looking at animal exhibits. The zoo is more popular with school groups of younger primary aged children. The proportion of comments about the animals was similar in both locations except for a higher number of conversations with at least one comment about behaviours from observing the live animals and more comments about unfamiliar structures in the museum. There were significantly more

Main Categories of Conversations (topic heard at least once within conversation)	Zoo n=459	%	Museum n=407	%	Chi-square values (1DF) total conversation
Management / Social	354	77	270	66	12.46 p <0.005
Exhibit Access	289	63	219	54	7.46 p < 0.01
Exhibit Focus	459	100	407	100	N/A*
Other exhibits comments e.g. labels, furniture	227	50	220	54	1.18 not sig
Animal focused	458	100	405	100	N/A*
i. body parts	280	61	243	60	0.151 not sig
ii. behaviour	301	66	152	37	68.92 p <0.005
iii. names	401	87	344	86	1.45 not sig
Emotive attitudes Affective Attitudes [emotive + others)	143 193	31 42	145 219	35 54	1.94 not sig. 11.96 p<0.005
Knowledge sources	254	55	296	72	28.15. p <0.005
* cell numbers insufficient to proceed with analysis					

Table 6 The Main categories of Conversation Topics (topic mentioned at least once in a conversation)

conversations containing at least one 'management and social' comment, 'exhibit access' and 'behaviour' comments at the zoo. The differences in attitude comments and knowledge source comments were also significant. More conversations that contained at least one comment related to sources of knowledge were made in the museum and more conversations mentioning affective attitudes, L or D comments and noises or noises in the 'other' category such as 'Oh', at least once were heard in the zoo. Other attitudes toward animals are significantly different in the two contexts. The museum visit elicits more comments about human domination or the effect the animal may have on the child, whilst the live animals stimulate anthropomorphic comments. Interestingly, the children in the museum comment about the 'realness' of the specimens significantly more

The data and my experience gained through working in many zoos and museums suggests that primary school and family visitors:

- need to identify the specimen to their satisfaction, not in accordance with scientific nomenclature or zoological taxonomy. These 'basic' terms used by visitors to name the animals are at genus, family, order, class and phylum level.

- rarely refer to labels unless they can not name the animal from within their own experience.

- come to the museum holding a basic concept of the animal that results in their remarking predominantly about the dimensions of the specimen; the head and sense organs; legs and tails and other items that disrupt the outline and a parts of the anatomy, such as excretory organs.

- comment about the behaviours, particularly the position of the animal in its enclosure, locomotory movement, feeding and any other behaviour such as parental care that attracts the attention of the observer.

The data from this study suggest that the collection of preserved animals affords a more educationally effective resource for helping primary children construct an understanding about animals because of the nature of the exhibits and the perceived predisposition for learning within a museum.

The natural history collection offers visitors:

- the opportunity to view animals with ease.

The specimens are 'framed' within an exhibit, their location and behavioural position is known to visitors if they have made a pre visit.

This relative ease of accessing the exhibit and observing the animal specimens facilitates the observation and learning of criterial attributes for taxonomy and other aspects of biology.

School groups:

- make significantly fewer management and social comments in the museum

- discuss unfamiliar attributes significantly more (horns, reproductive and excretory organs for example).

Museum visitors discuss the behaviour of the animal, even though the animals are not alive, especially the behaviour portrayed in the scenario or position in which the animal is exhibited.
Over 1/3rd of school groups looking at the museum specimens commented about behaviour, at least once in a conversation; the rate is 2/3rds in the zoo.

Dioramas of mammals, based on listening at a number around the world in Natural History museums- are superior to just animals in a display case or mounted free standing and to live animals in zoo because they have an authentic background- i.e. naturalistic context in which they are viewed. There is both a spiritual, moral and cultural aspect to the dioramas too as well as the scientific. I consider them all just beautiful- the visitors want to 'read' the exhibits with their words/ language and, as the museum's role is to entice the visitors into reading the museum's story thus fulfills their mission.

The Natural History Museum elicits more

content about the animal specimens within the conversations of their visitors, school or family. That about which people speak is an indicator of the content of their thinking, which in turn reflects the topics about which they are interested.

Museums should build on this deeper observational level of activity amongst their visitors compared to the zoo experience and develop the observation of animal specimens into a learning encounter, based on the observations that we now know these visitors, primary school and family groups, generate.

It is however of interest that the basic pattern of content of comments is so similar, indicating that the visitors share a basic concept of animals about which they comment when observing animal exhibits, be it in a natural history museum or zoo. The challenge is to use this foundation of knowledge and construct the knowledge and understanding of visitors using the messages of the museum.

References

Tunnicliffe S. D.(1995) Talking about animals: studies of young children visiting zoos, a museum and a farm. Unpublished PhD thesis. King's College, London.

Tunnicliffe S. D. (1996d). Conversations within primary school parties visiting animal specimens in a museum and zoo Journal of Biological Education 30 (2) 130- 141

Tunnicliffe S. D. (1996l) The relationship between pupil's ages and the content of conversations generated at three types of animal exhibits. Research in Science Education. 26(4), 461-480.

Tunnicliffe S. D. (1996 m) How well did we do? Assessing the quality of the learning provided in museums. GEM newsletter Autumn.

Tunnicliffe, S. D. (1997a) The effect of the presence of two adults- chaperones or teachers - on the content of the conversations of primary school groups during school visits to a Natural History Museum, Journal of Elementary Science Education. 9 (1) , 49-64

Tunnicliffe S. D., 1997b) Yet another missed opportunity? Primary school visits to natural history museums. Journal of Education in Museums no 18, pp 20-23

Tunnicliffe S.D. and Reiss M.J. (2000) What sense do children make of three-dimensional, Life-sized "representations" of Animals? School Science and mathematics 100(3).128-138

Tunnicliffe S. D., and Osborne J. F..(1995) What do zoos and museums have to offer young children for learning about animals. Journal of Education in Museums 16: 16-18

Tunnicliffe S. D., Lucas, A. M. & Osborne, J. F. (1997) School visits to zoos and museums: a missed educational opportunity? International Journal of Science Education a. 19(9), 1039-1056.

Collecting Under Contract: Balancing The Needs Of Museum Reference Collections And The Requirements Of The 'Client'.

Richard C. Sabin
Curator and UK Cetacean Strandings Co-ordinator
Mammal Group, Department of Zoology
The Natural History Museum
London SW7 5BD
Tel: 020 7942 5206
Fax: 020 7942 5572
Email: r.sabin@nhm.ac.uk

Introduction

Museums are increasingly seeking to generate additional income through commercial contract work. This type of work often necessitates the collection and examination of comparatively large quantities of material. With staff shortages and limited resources being an issue in virtually all museums, there are obviously a number of important factors that need to be taken into consideration, ideally before such work is taken on. This paper examines the results of a staff discussion held in the Department of Zoology at the Natural History Museum (NHM) about increasing curatorial involvement in contract and consultancy work. The NHM's national cetacean strandings contract is used to illustrate the benefits and drawbacks of such work.

Discussion

In the year 2000, the Department of Zoology at the NHM generated a net figure of £176,000 through its involvement with contract work. By the end of 2001, 27 contracts were either ongoing, planned or had been completed. Curatorial involvement with contract work in the Department of Zoology is widespread, with every division in the Department committing some staff resources in one form or another. Contracts are an inescapable part of the Department's work and are increasingly important to the NHM as a whole, particularly in light of the recent changes to government funding, such as removal of admissions charges etc. The Contracts Group (known officially as Facilities and Services) exists as a separate body within the Department of Zoology and is responsible for seeking out and maintaining scientific and commercial contract work. As they are not directly linked to the organisation of curation or collections management within the Department, this is where logistical problems can occur.

As a result of talking to curators and collection managers across the Department, the following points were made regarding involvement with contract work:

Advantages (apart from financial):

- Contract/consultancy work can be viewed as a mechanism for staff development.
- It can help to develop your knowledge of a particular taxonomic group and expand your identification skills.
- It offers the opportunity to take on further training
- It allows you to become directly involved in fieldwork.
- It allows you to utilise the knowledge and training you came to the Museum with (e.g. biology, zoology and other related subjects), or that you have acquired since working at the Museum.
- It adds to overall job satisfaction and can give you the feeling that you are actively contributing to potentially important areas of research and conservation work.
- It can lead to useful collaborations in other areas not directly associated with a specific contract, and may provide the opportunity to generate publications.
- It can lead to the acquisition of new material for the collections, and allow us to collect in geographical areas we may not otherwise have access to.
- It can not only help raise the public profile of the Museum, but also in the scientific community and in the media.

Disadvantages:

- The work is very time-consuming.
- It can seriously impact upon core curation activities.
- Often, involvement in contract work is poorly timetabled, with unrealistic deadlines set.
- It can be extremely stressful.
- It can lead to the acquisition of bulk samples or collections that ultimately become the responsibility of the curators.
- Holding such collections for the duration of the analyses can place demands on valuable storage space.
- Curation of material acquired from contract work can be problematic and very time-consuming, with the necessary data needed for proper accession and incorporation often difficult to extract from published reports and field data (e.g. it may have been collected/recorded in a way that is inconsistent with Museum requirements).
- There needs to be greater liaison between the contracts manager and collection managers in those instances where it is anticipated that curatorial input will be

required to complete a job, or in fact to take a job on in the first place.

- We cannot carry out contract work effectively if our reference collections are split between South Kensington (main site) and Wandsworth (NHM's off-site storage facility)

Case study

The UK Cetacean Strandings contract awarded to the NHM by the Department of the Environment, Food and Rural Affairs (DEFRA) in 1990, generates the largest single annual income for the Department of Zoology. This work (originally begun by the Museum in 1913) occasionally places great demands on curatorial staff time and other resources. Aside from the financial benefits, the strandings programme allows us to obtain specimens for the Museum's research collections, helps us to improve our exhibitions and develop public understanding of marine science and biodiversity at all levels.

When a stranded cetacean is reported to the NHM, as much information as possible is obtained over the telephone on the precise location, species, size and condition of the animal. If the animal is dead, a decision is made on whether to collect the carcass for detailed examination by veterinary surgeons (under the supervision of the Institute of Zoology at London Zoo), to conduct a post-mortem investigation on the beach, to retrieve material for the Museum or to arrange for the immediate disposal of the carcass. Cetacean stranding information is collated and entered into the Natural History Museum's national strandings database, which is then used to produce distribution maps and information about the biology and ecology of each species. These are presented as regular reports for DEFRA, the Welsh National Assembly, and when suitable are published in the scientific press. The Museum's strandings database holds all reports made from 1913 to the present day, and this information is now being made available over the internet.

Of course, strandings are very unpredictable and can often occur in large numbers. However, trained staff within the Department of Zoology have to be found who can attend strandings at very short notice. This may involve tense negotiations with line-managers and result in an absence from the Museum of one or more days. Additionally, on return, preparation and examination of samples obtained from the strandings episode can prove difficult to fit in to an already heavy work schedule.

Conclusions

As mentioned earlier, staff time is precious and resources are thinly spread. My own time is not devoted 100% to co-ordination of the national strandings programme, making it difficult to balance this with other curatorial work. The internal discussion exercise clearly highlighted a number of shared concerns that curatorial staff at all levels, have in the Department of Zoology. Accepting that involvement in contract work was an increasing part of their work, it was felt that the following points should be considered by all parties concerned at the outset:

- Do you have the time (realistically) to take on and complete the work by the given deadline?

- Do you have the staff and other resources (tools, reference materials, suitable storage and examination space etc) to carry out the work?

- Have you considered the impact of introducing the 'contract' material into the museum environment (pest control, health and safety, space constraints)?

- Have you liased with the museum's collections manager/curator(s) regarding all of the above?

- Have you drafted a 'collections impact statement' if the contract material is to be subsequently accessioned into the main museum collections?

These points represent desired 'good practice', and may seem like common sense to most. However, past experience has taught us that

common sense and good practice can often be brushed aside in the rush to secure financially attractive contract work. Hopefully, the results of this discussion exercise may prove thought provoking to those responsible for the care and maintenance of other museum reference collections.

To report a stranded whale, dolphin or porpoise, please telephone the NHM on: 020 7942 5155

How do you Value Specimens?

Richard Harbord
Curator, Mammal Group
Department of Zoology
The Natural History Museum
London SW7 5BD

This article talks about the way we value specimens. I see science as our "legitimate" valuation of specimens, the way we describe officially their value to our funding bodies. Specimens are scientific documents linked to a specialist theory, Taxonomy. My premise is that there is more to specimens than science, there are other ways of relating to specimens. I see a problem in that specimens are no longer seen as the central interpretative tool for exhibitions. In the Predators exhibition at the Natural History Museum (NHM) the designers have placed animatronic models at the centre of the exhibition rather than specimens. The exhibition is good and there are some very interesting specimens on display but they exist as examples rather than the focus.

For my MA in Museum Studies entitled; A neorenaissance episteme for the natural history specimen: Breaking the fixity of "legitimate" valuation, I interviewed staff at the Natural History Museum. I asked them how they valued specimens, for their subjective opinion, their personal feelings. I found the most spontaneous responses from people when they described behind the scenes tours.

> "I love the specimens but that's me, I love working here, I think others wouldn't give a monkey's [sic]... I'm curious,... they're beautiful, even the ugly ones,... amazing we've got them... I suppose maybe average people who came into the Museum... might think 'that's a dodo' (meaning that it is nothing)... a sterile animal... just a scientific object... I don't, I see them as totally amazing, that you can look at them in complete detail... I love to show them to people" (NS, administrators, NHM).

The above is a quote from someone who works in museums but not with specimens. I think that it is revealing that the word "just" is used to describe a scientific object, it suggests that there is more. I suggest that there are clues to how we value specimens in the relationship between behind the scenes tours and exhibitions. We need to give the audience more points of access into specimens, encouraging a social, an aesthetic and an emotional response, incorporating "alternative" value systems that seem so present in behind the scenes tours, and whilst doing so legitimise these alternative value systems.

Social values are becoming more appreciated and legitimised particularly with respect to social history. Exhibitions such as the Voyages of Discovery at the NHM are an example of this, where specimens can be put on display for being themselves, significant as historic objects. Yet the social also includes the personal or sentimental attachment to specimens. Do you know anyone who doesn't have a favourite specimen? Guy the gorilla is a brilliant example of how relationships can exits between people and scientific documents. Guy was a notorious character at London Zoo, smoking people's cigarettes and eating their ice creams until 1978 when he died. He was transferred to the NHM but although the NHM waited until 1982 before trying to display him, there was public uproar due to people's feelings for Guy and he was put away out of sight. I occasionally come

across him in the NHM store at Wandsworth; he is an imposing figure when you're alone in semidarkness.

Specimens seem to be unable to attain the individual value that is attributable to art objects, unlike an 'art object' specimens remain a 'sample' or 'example'. Scientists appreciate specimens for the beauty of their form and function related to their developmental evolution, but they argue that this beauty isn't **aesthetic**. Yet artists like Damien Hirst challenge this relationship. This is not the first time art has shown us different ways of looking at things, African paintings on shields and ceramics were considered primitive by ethnographic establishment thinking, but when Pablo Picasso used these media as a source for his Primitivist period, he destabilised the legitimate viewpoint. Rather than evidence of a primitive society, African painting became creative, it became a communication

between people, and became art. The more you look at specimens the more you see the "unnatural" representation of nature. What you see is the person who created the object - the taxidermists have added something of themselves. Specimens are evidence of a society, and they are a communication of our relationship with nature.

Science comes out of the revulsion from what was seen as the chaotic thinking of the Renaissance. At that time, early protomuseums existed in the form of Cabinets of Curiosity, where the emotive was as important as objectivity to an observer's examination of the universe, but secular authority came to pin this examination down to an objective basis. This objectivity has made the observer unaware of the unusual and macabre nature of the specimen. We take beautiful living creatures and turn them into something that invariably looks macabre by adding preservative and storing them in a museum. Yet this quality of museums' has drawn people who are repelled and yet fascinated by specimens, by the atmosphere, by the aura of death. Modern museums brighten up the atmosphere with modern displays, but by removing the macabre image we are stripping the material of some of its quality. As an alternative we create plastic and palatable exhibitions, with make up, glass eyes and benevolent expressions.

Science is a palatable 'mask' for the 'face of nature' that literally hides the subjective context of our relationship with specimens. Can museums utilise alternative values without negating science? Science already lends legitimisation to the BBC's programme 'Walking with Beasts', which mixes science fiction and science fact. Museums already paint specimens and construct false animatronic models that tantalise the observer with visions of living motion. I am not suggesting that museums should invite the audience to view horrors but allowing the audience to relate to specimens in freer way might make them more alive for them.

Leaching and Degradation of Lipids in Zoological Fluid-preserved Collections.

Simon Moore,
Conservator of Natural Sciences, Hampshire County Council Museums Service, Chilcomb House, Chilcomb Lane, Winchester, Hampshire S023 8RD.

Most, if not all, of us have to maintain fluid-preserved collections of natural sciences material. There are many problems associated with maintenance of such collections and where the problem of lipid leaching occurs, mammals, including Damien Hurst's lamb, invariably head the list. Those that come from polar regions of the world, cetaceans especially, are among the worst offenders and during the early stages of fluid preservation these should be stored in an area where they can be observed by passing members of staff.

The preparation of specimens for freeze-drying requires defatting either through solution in acetone - in which case all traces need to be washed out following treatment or the solvent action of the acetone will damage the freeze drier unless you happen to have an in-line charcoal filter. Alternatively, the fat

bodies can be physically cut out and replaced with modelling clay to prevent the skin from collapsing. Lipocytes emptied through solution of their contents, will similarly collapse upon drying and require rehydration to fill the empty lipocyte spaces with water [Fig. 1].

Other lipid-problematic specimens include fish which contain much lipid-bearing oil, especially in their livers and many of us may remember those days of dissecting dogfish for A level and having to root around in a bin of specimens redolent of formaldehyde and the vile smell of gradually oxidising lipids.

How does such a problem occur? Bear in mind that lipids are only preserved by fixatives such as formaldehyde/formalin and osmium tetroxide, so that they tend not to stay *in situ* but gradually seep out into the fixative or preservation fluid. Alcohol will dissolve them and then, as the alcohol gradually evaporates, the lipids start to re-appear as an emulsion. Since most lipids float, they travel to the top of containers which have probably been lovingly enshrouded with external labels, hiding the escaped lipids from view for long periods. The lipids slowly react with air at the top of the jar and oxidise turning to fatty acids, a problem written up by Dingerkus (1982). Such a reaction, especially if catalysed by a warm storage area, can also lead to denaturing of alcohols to carbon dioxide and water!

To understand this better, look at the molecular structure of some typical lipids. A molecule of monoglyceride lipid has a typical single chain hydrocarbon structure, whereas a triglyceride comprises a triple chain - 3 times the molecular weight [Fig. 2]. Note the oxygen atoms at the linkage end of each chain; it doesn't take much for these to acquire extra oxygen atoms resulting in an all-too-familiar -COOH fatty acid anion, such as that on the end of the linolenic acid structure [Fig. 3].

Over time, the lipids continue to leach, accumulate and oxidise and slowly the fluid changes colour through yellow to orange, brown and finally a lipid-saturated cloudy brown: a mixture of emulsifying lipids and animal tissues that are being slowly denatured by the fatty acids. I have treated a stoat preserved in such contaminated alcohol that the fluid actually gave a pH reading of 3.6. The acidity of the solution, not surprisingly, had the undesirable effect of decalcifying the stoat's skeleton, so that after several changes of fresh alcohol to remove the lipid clogging the fur, the stoat just sat in an untidy heap at the bottom of the museum jar!

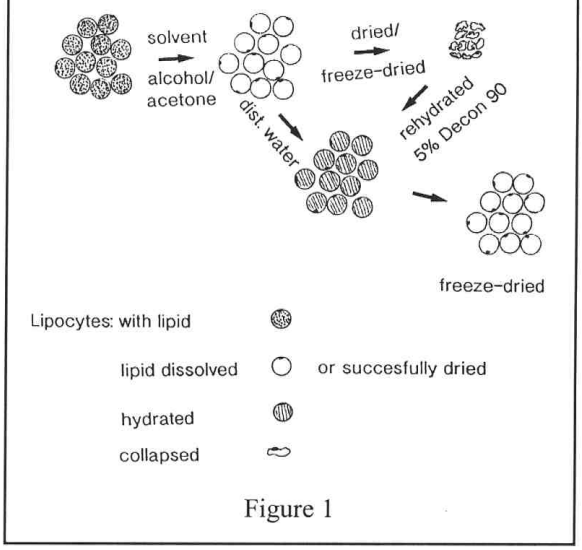


Figure 1

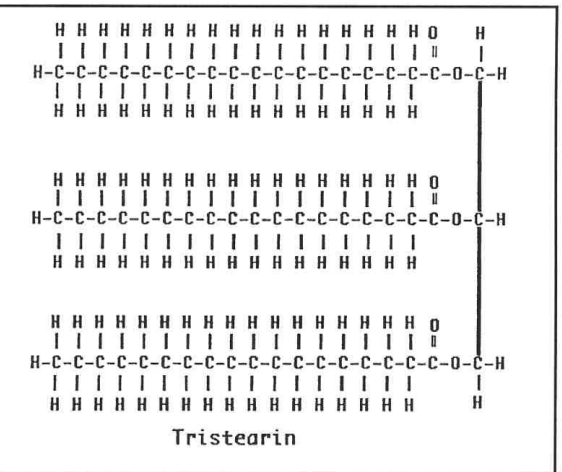


Figure 2

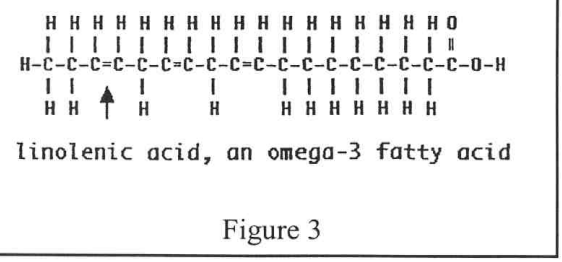


Figure 3

To show the effect of lipid removal from tissues using alcohol, Figs 4-5 show frozen-sections of rat liver with the ring-like lipocytes filled with lipids, stained red by the Herxheimer oil-red 0 technique. After a brief dunk in alcohol, the lipid dissolves into the alcohol leaving the lipocyte empty.

To test preserving fluids for lipid content, simply pipette some of the fluid into water, if there is any trace of turbidity, due to lipids coming out of solution to form an emulsion, it will show that lipid contamination has taken place.

Fluid-preserving fresh organ specimens, such as a pig's liver, can present its own leaching problems since such an organ contains bile salts including large amounts of sodium tauro- and glycochollates, together with a fair amount of lipid which all seep out into the preserving solution over the first month or so of preservation, following fixation, and producing an undesirable yellow tinge to the fluid combined with a whitish gelatinous suspension!

Back street taxidermy often results in fat burn to skins of vertebrates combined with other lipid-related problems, due to short-cutting and non- removal of fat bodies. Such a case in point is the Ganges Dolphin displayed in Tring Zoological Museum, prepared in haste, I suspect, by a local (Ganges) taxidermist. On a fairly recent visit I observed lipid pooling on the skin which had been burned dark brown or even black where the fatty acids had degraded the skin Fig. 6. Even the tail flukes, resting against the old-fashioned hessian cloth had stained it with a pool of lipid.

Finally, another problem can arise with contaminated preservatives -fungal hyphae will form in diluted alcohol, even if only diluted to about half of its normal strength. The only answer to obviate all of these problems is regular checking.

Now that you understand the signs of and reason for this type of degradation I am sure that with next year's reduced budgets and staffing levels you will still be able to check your collections with some regularity?

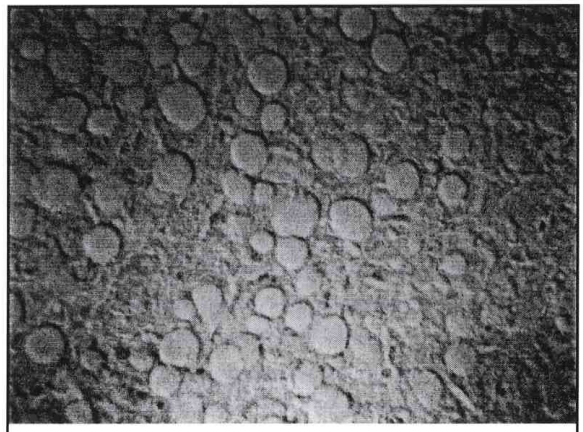


Figure 5

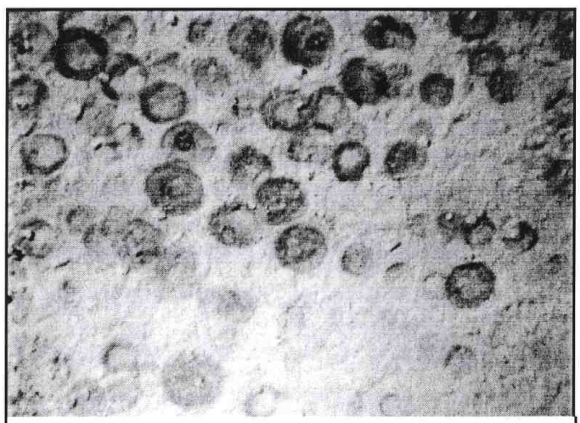


Figure 4

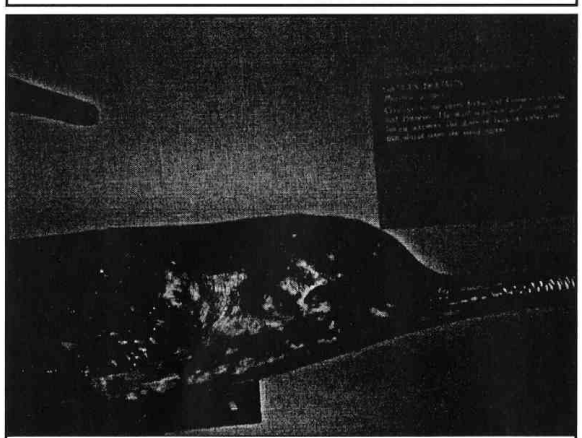


Figure 6

Reference.

Dingerkus, G. Preliminary observations on acidification of alcohol in museum specimen jars. Curation Newsletter of American Society of Icthyologists and Herpetologists 5: 1-3.

Biology Curators Group Committee Contact List

Chairman	David Carter, Collections Manager, Dept. of Entomology, Natural History Museum, Cromwell Road, London, SW7 5BD. Tel: 020 7942 5716, Fax: 020 7942 5229 e-mail: d.carter@nhm.ac.uk
Secretary	Steve Thompson, Scunthorpe Museum, Oswald Road, Scunthorpe, S. Humberside, DN15 7BD. Tel: 01724 843533 Fax: 01724 270474 e-mail: Steve_Thompson@northlincs.gov.uk
Treasurer/Membership	Kathie Way, Department of Zoology, Natural History Museum, Cromwell Road, London, SW7 5BD. Tel: 020 7942 5186 Fax: 020 7942 5084 e-mail: kmw@nhm.ac.uk
Events Organiser & Editor	Nick Gordon, New Walk Museum, New Walk, Leicester, LE1 7EA. Tel: 0116 247 3030 Fax: 0116 247 3084 e-mail: gordn001@leicester.gov.uk
Collections Monitoring	Post Vacant
Biological Recording	Howard Mendel, Dept. of Entomology, Natural History Museum, Cromwell Road, London, SW7 5BD. Tel: 020 7942 5079 e-mail: h.mendel@nhm.ac.uk
Conservation	Julian Carter, Dept. of Biodiversity, National Museum of Wales, Cathays Park, Cardiff, CF1 3NP. Tel: 029(20) 397951 Fax: 01222 239009 e-mail: julian.carter@nmgw.ac.uk
Committee	Jo Hatton, Grant Museum of Zoology, Dept. of Biology, Darwin Building, University College London, Gower Street, London, WC1E 6BT, Tel: 0207 679 2647 Fax: 0207 679 7096 e-mail: joanne.hatton@ucl.ac.uk
	Sarah Kenyon, Saffron Walden Museum, Museum Street, Saffron Walden, Essex, CB10 1JL Tel: 01799 510333 Fax: 01799 510333 e-mail: skenyon@uttlesford.gov.uk
	Steve Moran, Inverness Museum, Castle Wynd, Inverness, IV2 3ED. Tel: 01463 237114 Fax: 01463 225293 e-mail: Stephen.Moran@highland.gov.uk
	Douglas Russell, Dept Information and Library Systems, Natural History Museum, Cromwell Road, London SW7 5BD
	Sankurie Pye, Geology and Zoology, National Museums of Scotland, Chambers Street, Edinburgh, EH1 1JF Tel: 0131 247 4174 e-mail: skp@nms.ac.uk

The Biology Curator is published and printed by the Northern Whig Ltd, Belfast, For the Biology Curators Group

Contributions should be sent to:
Nick Gordon, New Walk Museum, New Walk, Leicester, LE1 7EA
Tel: 0116 255 4100 Email: gordn001@leicester.gov.uk

Copy deadline for next issue: September 1st

The Biology Curator Issue 22 May 2002

Contents