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Author(s): Thomas, R.

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polymerase working.

We are now trying to go on from this work, using an ion exchange resin to try and clean up the DNA from museum specimens prior to both the DNA extraction and the PCR stage. We are also using EDXA and mass spectrometry to try and fingerprint museum samples and this will give us an idea of the chemicals used in preservation. Then we will be able to relate that to possible inhibition effects and be able to try and solve that by different clean up methods.

We are also working on repeated, non-destructive sampling for DNA. One of the projects we are looking at involves bird skins. Many of these skins do not have bones and we have been using feather, with about a 30% hit rate in terms of amplifying the DNA. What we are now trying to do, rather than taking the feather off the skin, is to actually do the DNA extraction on the skin by introducing the extraction buffer through the shaft of the feather and incubating the skin at a slightly elevated temperature of about 35 degrees. By doing this, we can sample several feathers and only put a very small whole in the feather shaft. The results from this seem to be quite encouraging, but that is as far as we have got at the present time.

Guidelines for Destructive Use of Biological Material

Richard Thomas
Natural History Museum

I'm going to talk about guidelines for the destructive use of biological material. Effectively there are two versions of this talk I could give you. There's the short version. There is really no difference in principal between destructive sampling of specimens for molecular work and any other kind of destructive sampling. In fact, as you have probably gathered from some of the stuff that Alan was saying earlier, destructive sampling for molecular work is sometimes much less destructive than some of the techniques standardly used by morphologists when they are doing some of their techniques. I'll give you the slightly longer version of the talk which is derived from an article in a now extinct publication called 'The Ancient DNA Newsletter' six years ago, and written by ????? Havow (?), Bob Wayne and myself and much of the material in that article has subsequently been incorporated in the NHM's policy document on sampling for molecular purposes from the collections.

The somewhat longer version. I think we need the somewhat longer version because there is this cultural difference between molecular biologists and museum curators. Curators often see molecular biologists as sort of evil interlopers who soak up valuable resources and take up space that could be better used for storing collections. Some of the molecular biologists see curators as traditionalists who don't recognise or are incapable of recognising the path-breaking importance of their research. There needs to be some way of mediating between those two sorts of cartoon extremes. Specifically you need criteria for evaluating requests for the use of material and that pre-supposes having somebody around who is qualified to evaluate the requests. You also need to consider what a museum or holders of a collection should expect to get back from a loan of material.

In 1992 we came up with five criterior for evaluating requests for destructive sampling of specimens. The scientific value and the feasibility of the project, the qualifications of the investigator or the lab to do the work, could they possibly get this material some other way other than destroying specimens like from captive populations or wild populations. The volume of the material required relevant to what is in the collections, so if they are going to grind up half of the single existing individual of something it would probably not be a good thing. And finally, the staff effort required to fulfil the terms of the loan. I will go through all of these in slightly more detail.

Feasibility and scientific value. Is it of sufficient interest to justify the damage done

to the collections? A lot of ancient DNA work initially started out looking a little bit like stamp collecting, saying ooh, we got the oldest sequence and that is about as far as it went. If some question of general importance is not being asked you might ask yourself whether it is worth destroying the specimen. Is it technically feasible? We have heard a lot about what is and isn't feasible today. It is a rapidly moving field. Techniques are improving. I think PCR was probably the one big thing and there is not much we are going to be able to do with specimens where the DNA is just no longer there. Hence there are limits, and I would be extremely sceptical for requests for material over a few tens of thousands of years at the very outside. Also, be very sceptical of projects requiring intact DNA of more than, at the very outside, a few hundred base pairs. Evaluation of the scientific value and feasibility usually requires having somebody around with a little bit of experience in this and I realise that most smaller museums don't have any in-house experience. The NHM and some of the other larger museums that do have that type of experience are generally willing to help evaluate the requests for the use of material.

The qualifications of the investigating laboratory to do the research. Do they have the technical competence. You might ask if they have a relevant publication record or some other relevant experience that indicates that they have got the technical competence, the facilities and the ability to work carefully enough to maintain the sort of standards that we've heard from Alan. Working from ancient material or material out of collections is often a little bit hit and miss. The success rates are generally not anything like 100 percent and if somebody comes in and asks to have a sample of all 532 specimens from a particular family, you'd tell them that you could give them half a dozen or so and see how they get on before they come back and slash and burn there way through the rest of your collection.

Tape 1, side 2

Could they get this material some other way? Generally speaking, with the difficulties of working with material from collections people generally aren't going to treat your collection as a free candy store to go pick up anything they need rather than making a slightly greater effort to get it from a fresh source. There are quite a few situations in which sampling from a collection is definitely legitimate in my view, extinct and endangered taxa, increasingly in the world it is getting logistically or politically harder to sample from some groups of organisms in some places.

This might be a good point to bring up a point that I was hoping Alan would but didn't - Museums being repositories of specimens that maintain DNA in a very good state rather than in frozen tissue or other methods of preserving nucleic acids and other bio-molecules in a very high state of preservation. We maintain a small _____ point of frozen tissue collection at the museum which fairly opportunistically gets specimens from, for example collecting trips along the continental slope – fish that are fabulously expensive, each of these individual fish costs hundreds of pounds if you cost it out to collect. We take small samples of muscle tissue and freeze them at –80 degrees. Again, that not something a lot of museums are going to have the wherewithall in funds, space and expertise to do but there are places like our institution and a number in North America and increasingly some of them will be willing to take on specimens like that.

Volume of material relevant to what someone wants. I recall us having a request for somebody wanting a pretty sizeable fraction of a grasshopper that had been collected on one of the Cook voyages. That was a very unique and historically important specimen. Rightly in my mind the curators in the museum decided that they shouldn't really grind up most of this specimen for molecular purposes. But in many cases, like in our vertebrate collections, somebody wants a few square millimetres of hide or a few bits of muscle tissue it's not doing significant damage to the specimen. There is a huge grey area between these extremes and that's were the judgement of the curator comes in and consultation, where required, with people with the relevant molecular experience.

The staff effort required to fulfil the terms of the loan. Obviously you all work very hard and your funding is not adequate and you don't have time to do the basic stuff you need to do to maintain four collections so you don't have time to deal with molecular workers swanning in wanting huge amounts of your time and lop bits off your specimens. So molecular workers, in general should be willing to travel to collections and do the sampling themselves where that's appropriate under the eyes of the curator and at the convenience of the curatorial staff. I think fees for the loan requests and bench charges can be required where appropriate. I'm not suggesting they be required all the time but were appropriate it is a reasonable thing to ask. Molecular work tends to be regarded as expensive and is often supported by grants so it's a relevantly minor thing to include bench fees when processing fees for loans within a grant proposal.

What the museum or collection holder should get back from a destructive sample of a specimen. The NHM requires that people give back alloquots the extracted nucleic acids. We have a facility to store them, it's not a problem for us, some institutions it will be a problem and there needs to be more communication amongst curators about what to do with returns from molecular projects like this. We require, minimally, an electronic copy of any sequence data taken or derived from a specimen and hopefully the people that go to the trouble to do this are going to submit the information with a sequence data base where it will have a proper accession number and hopefully they will have included the specimen registration number in the record (in the sequence data bases there are facilities for that). Museums should get back copies of experimental protocols where they differ from already published protocols so that other people, if they are successful, can use them as well.

We are all trying to justify are existence to funding bodies. It is important that, where appropriate, museum staff are authors on publications or at bare minimum the use of the collections are acknowledged. Collections have to justify their existence in the eyes of funding bodies. Sampling for some of these molecular projects adds value to the collection. You should get back reprints, status reports on projects using material from the museum collection, keep track on people like Alan who sits on material for years without doing anything with it.