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CEQA and Fossil Preservation in California

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CEQA and Fossil Preservation in California

Paleontologic resources – fossils – are the fossilized evidence of past life found in the geologic record. Fossils are preserved in sedimentary rocks, which are the most abundant rock type exposed at the surface of the earth. Yet despite the abundance of these rocks, and the vast numbers of organisms that have lived through time, preservation of plant or animal remains as fossils can be an extremely rare occurrence. This is not always the case; some fossil deposits are made up of the remains of millions upon millions of organisms, in such abundance that mining rock exposures for the fossil remains of those organisms does not deplete the resource too rapidly. Fossil fuels are mined on just such an assumption as this. However, in many cases fossils of animals and plants occur only in limited areas and in small numbers relative to the distribution of the living organisms. In particular, fossils of vertebrates – animals with backbones – are generally very rare. Such fossils are sufficiently rare to be considered nonrenewable resources. These resources are the focus of this review.

Figure 1. A plaster jacket encasing vertebrate fossils at a locality near Lake Mathews in Riverside County, California. Note that true north ("TN") is marked on the jacket, to enable proper orientation of the fossils later in the laboratory. Note also that fossils encased within the sediment have been diagrammatically represented on the surface of the jacket, enabling preparators in the laboratory to better assess where fossils will be encountered during curation.

Because of their rarity, and because of the scientific information they can provide, fossils are highly significant records of ancient life. They provide information about the interrelationships of living organisms, their ancestry, their development and change through time, and their former distribution. Progressive morphologic changes observed in fossil lineages provide critical information on the evolutionary process itself – that is, the ways in which new species arise and adapt to changing environmental circumstances. Fossils also serve as important guides to the ages of the rocks and sediments in which they are contained, and may prove useful in determining the temporal relationships of rock deposits from one area to another and the timing of geologic events. Time scales established by fossils provide chronologic frameworks for geologic studies of all kinds.

THE CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)

The stated intent of the California Environmental Quality Act (CEQA) is to "[d]evelop and maintain a high-quality environment now and in the future, and take all action necessary to protect, rehabilitate, and enhance the environmental quality of the state" (PRC §21001a). The "environment" in the sense of CEQA is defined as "the physical conditions which exist within the area which will be affected by a proposed project, including land, air, water, minerals, flora, fauna, noise, [and] objects of historic or aesthetic interest" (PRC §21060.5).

Paleontologic resources are explicitly afforded protection by CEQA, specifically in Section V(c) of Appendix G, the "Environmental Checklist Form", which addresses the potential for adverse impacts to "unique paleontological resource[s] or site[s] or … unique geological feature[s]". This provision clearly covers fossils of signal importance – remains of species or genera new to science, for example, or fossils exhibiting features not previously recognized for a given animal group – as well as localities that yield fossils significant in their abundance, diversity, preservation, and so forth. Mitigation of adverse impacts to resources such as these is therefore mandated by CEQA. However, while such fossils and such localities are indeed important, the emphasis of CEQA on resources of this nature is in some ways unfortunate, for it perpetuates a stereotypical perception that only unique fossils are important, and that more common paleontologic remains are less so. This perception is a holdover from the early days of paleontology, when scientists did focus on looking for one-of-a-kind fossils, particularly those providing superlatives – the biggest, the oldest, the fiercest, the most complete, and so forth.

Yet the science of paleontology has advanced since those early days, and paleontologists no longer focus so intently on finding new, rare or unique extinct animals. Rather, paleontologists today are more concerned with elucidating the relationships of extinct organisms, both in an evolutionary sense – how species and higher groupings of organisms are related to one another, and how new species have arisen through time – and in an ecological sense, interpreting how different paleobiological communities may have functioned at specific points in time and in particular geographic regions. Of course, no biota is made up of only unique plants or animals, and evolution is not restricted to unique organisms; so the emphasis of CEQA on uniqueness belies the advances made by paleontology over the past several decades.

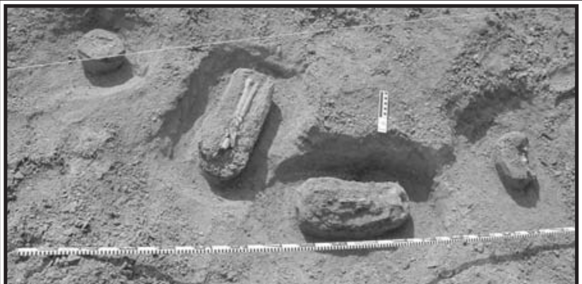

Figure 2. A quarry yielding fossils of an extinct camel near Lake Mathews in Riverside County, California. The quarry has been cleared, and each fossil has been isolated on a pedestal of sediment. The meter rod and scale bar will assist in mapping and photodocumenting this locality. Note that extensive preparation of the exposed fossils was not conducted in the field. Rather, the fossils were exposed to delimit their boundaries. More detailed preparation and stabilization is conducted in the laboratory, where detailed efforts will not derail excavation schedules.

This emphasis also fails to take into account the technological and procedural advances that have taken place in paleontology and related disciplines in recent years. The advent of radiometric dating techniques, the increasing ability to recover molecular data – including isotopes and even DNA – from fossil remains, the application of taphonomic techniques and interpretations to paleontologic localities, and the digital revolution are just a few of the means by which old fossils can be interpreted in new ways. Yet many of these advances can only be brought to bear if the fossils under consideration are collected in certain ways and under special conditions … and existing paleontologic collections do not always meet these criteria. The importance of new fossil discoveries, including both unique and more common resources, is consequently emphasized.

Nor is uniqueness a characteristic of a paleontologic resource that can be readily recognized or assessed. Determining whether a fossil or a locality can be considered unique requires extensive study that is generally beyond that which can be performed in the field. Further, the very concept of "uniqueness" is problematic, in that it can be taken to extremes when considering paleontologic resources. Uniqueness can be interpreted loosely, for example, in which virtually every fossil encountered is unique in some fashion and so should be preserved. Interpreting uniqueness too strictly, in contrast, would exclude many scientifically significant fossils from consideration under the auspices of CEQA – although to do so is clearly at odds with the stated intent of CEQA. The correct interpretation lies between these extremes, and can be reached by considering a resource's significance as well as its potential for uniqueness.

A prerequisite to determining whether a fossil is unique is an accurate identification of the fossil to a reasonably precise level. In some rare cases, accurate identifications of distinctive fossil elements to the genus or species level can be made in the field, at the time of discovery. In most cases, however, accurate genus- or species-level identifications of fossil remains are not possible in the field for the following reasons: 1.) the resource(s) are generally not sufficiently well-exposed and visible to permit accurate field identification; 2.) the resource(s) have generally suffered damage from heavy equipment activity, which makes field identification(s) much more difficult; 3.) many bones of comparably-sized animals (for example, limb bones and vertebrae of camels and horses) are very similar in overall appearance, and are difficult to discriminate without the aid of a well-provisioned comparative osteological collection; and 4.) in the context of an excavation that is proceeding according to a defined schedule, precise identification in the field is neither efficient nor cost effective. Microfaunal remains offer an additional challenge, as these elements are generally not visible to the naked eye in the field; rather, they are recovered in the laboratory through processing of bulk samples of fossiliferous sediments.

In order to comply with the explicit recommendations of CEQA, therefore, determinations of the uniqueness of a fossil, or of a paleontologic locality, require the recovery, preparation, and analysis of paleontologic resources from the area of potential impact. Treatment programs designed to mitigate impacts to significant resources must therefore incorporate such recovery and analysis. Only in this manner can the explicit requirements of CEQA be effectively realized, and compliance with these recommendations be achieved.

An obvious corollary of such an approach is that many fossils that are not unique will also be recovered as a consequence of

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such treatment programs. This unavoidable circumstance can seem to present a challenge: having spent time, effort and money to recover a sample of paleontologic resources, what is to be done with those (presumably many) fossils that are not technically unique? Fortunately, this question is easily answered, for uniqueness is not the sole trait by which a resource is to be interpreted. In addition to the explicit requirements of CEQA regarding paleontologic resources, there are also implicit guidelines. For example, CEQA provides that generally, a resource shall be considered "historically significant" if it has yielded or may be likely to yield information important in prehistory (PRC §15064.5). Paleontologic resources clearly fall within this broad category. Under these guidelines, the focus is less upon the uniqueness of a resource, and more upon its significance. The question then becomes: how does one determine whether or not a paleontologic resource is significant?

Figure 3. Paleontologists from the SBCM map a quarry of bones from an extinct mastodon, on a project outside of Hemet in Riverside County, California. Such mapping and documentation are essential in correctly recovering and preserving fossil resources in order to comply with CEQA. A fossil out of context has little or no paleontologic significance.

DETERMINING THE SIGNIFICANCE OF PALEONTOLOGIC RESOURCES

As stated previously, preservation of plant or animal remains as fossils can be an extremely rare occurrence. Because of the infrequency of fossil preservation, fossils are considered to be nonrenewable resources. Because of their rarity, and because of the scientific information they provide, fossils can be highly significant records of ancient life. Given this, fossils can be considered to be of significant scientific interest if one or more of the following criteria apply:

1. The fossils provide data on the evolutionary relationships and developmental trends among organisms, both living and extinct;
2. The fossils provide data useful in determining the age(s) of the rock unit or sedimentary stratum, including data important in determining the depositional history of the region and the timing of geologic events therein;
3. The fossils provide data regarding the development of biological communities or interaction between paleobotanical and paleozoological biotas;
4. The fossils demonstrate unusual or spectacular circumstances in the history of life; and/or
5. The fossils are in short supply and/or in danger of being depleted or destroyed by the elements, vandalism, or commercial exploitation, and are not found in other geographic locations.

As so defined, significant paleontologic resources are determined to be fossils or assemblages of fossils that are unique, unusual, rare, uncommon, diagnostically or stratigraphically important, and/or those that add to an existing body of knowledge in specific areas – stratigraphically, taxonomically, and/or regionally. They can include fossil remains of large to very small aquatic and terrestrial vertebrates, remains of plants and animals previously not represented in certain portions of the stratigraphy, and fossils that might aid stratigraphic correlations, particularly those offering data for the interpretation of tectonic events, geomorphologic evolution, paleoclimatology, and the relationships of aquatic and terrestrial species. (As noted earlier, dense concentrations of plant and/or invertebrate fossils remains may be so locally abundant that impacts to the resources do not appreciably diminish their overall abundance or diversity; in these cases, such impacts may be considered to be less than significant.)

Determinations of the significance of paleontologic resources can only be made by qualified, trained paleontologists familiar with the fossils under consideration. Such determinations are best advanced in the light of a well-conceived and clearly defined treatment plan. With an efficient sampling plan based upon such a treatment program in effect, the ability of the paleontologists to recognize, recover and preserve significant paleontologic resources is greatly enhanced.

The guidelines for significance identified above all have in common one basic assumption: that the fossils in question have been identified to a reasonably precise level, preferably to the generic or the specific level. *All identifiable paleontologic resources are always potentially significant.* In general, fossils are not considered to be significant unless they are *diagnostic* – that is, unless the fossils exhibit distinctive features permitting identification with some degree of precision. It is of course true that there are exceptions to this rule; for example, fossils that are not diagnostic, or fossil fragments, can nevertheless be significant when recovered from a sedimentary unit or formation that previously had not yielded fossils, or from an area with little or no history of paleontologic sensitivity. Fossils of animals that are rare in faunal assemblages may provide significant information even when only identifiable to class, ordinal or familial level (e.g., Carnivora). Fossil fragments exhibiting weathering, abrasion, wear, or other indications of significant taphonomic processes can also be important in reconstructing site-specific depositional processes. A research design that includes a complete taphonomic study may incorporate all fossil fragments (see Shaw, 1982 for one example). However, questions of evolutionary relationships, age of the deposit, and so forth – those questions that are generally employed to determine the significance of a paleontologic resource – cannot be reasonably addressed until the fossils under study have been identified to a relatively precise degree. Viewed in this light, fossils with little or no diagnosticity and/or fossil fragments can be seen to have little scientific significance.

In the context of paleontologic mitigation, detailed collection practices (i.e. academically-driven research designs where every fossil and/or fossil fragment is analyzed) are not always feasible. Destruction of at least some paleontologic resources is an unavoidable consequence of development-related excavation. Clearly, then, the goal of the paleontologists(s) in this context is not to *eliminate* impacts to fossil resources, but rather to *mitigate* such impacts by protecting fossils from physical damage whenever possible, and by emphasizing collection of sufficient significant resources to constitute a representative sample of the entire potential assemblage. In this manner, adverse impacts are reduced to an insignificant level. In such cases, nondiagnostic fossils or fossil fragments may *not* be considered to be potentially significant in terms of the criteria presented above, since identification is usually an essential prerequisite to determining significance – and there may be little chance of ever supplementing these specimens with their missing portions or advancing more detailed identifications at some future date. Further, isolated fragments cannot always be placed in a sufficiently detailed three-dimensional context with their missing portions to enable taphonomic data to be advanced with any reliability.

For these reasons, nondiagnostic fossils and unidentifiable fossil fragments are determined to be scientifically significant only in a limited sense. In general, where exposed such elements should be employed by field paleontologists to indicate sediments or outcrops that demonstrably contain fossil resources; these areas can be examined and test-sampled to determine the presence of more complete – and therefore more significant – paleontologic resources. Fossil fragments encountered in quarry situations are an exception to this condition, as such elements may reattach to other broken fossils from the quarry. Such fragments might also assist in advancing taphonomic interpretations elucidating the formation of the assemblage. Fossil fragments exhibiting weathering, wear, abrasion, or other indications of significant taphonomic processes may also be collected. Microfossils are another evident exception. These elements are obtained through recovery of bulk samples of fossiliferous sediments that are washed and processed in the laboratory. Some unidentifiable microfossil remains are an unavoidable circumstance of this collection procedure (although most fossils recovered in this manner are readily identifiable).

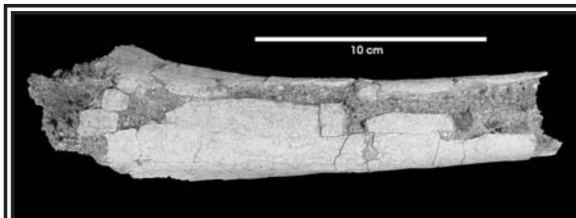

Figure 4. A fossil limb bone found in the Murrieta region of Riverside County, California, by scientists from the SBCM. The fossil was clearly both broken and incomplete, but was nevertheless collected because it seemed to exhibit features enabling identification in the laboratory. In fact, following extensive analysis, the fossil was determined to be a partial wing bone of an extinct large condor-like bird known as a teratorn. The bone was sufficiently diagnostic that it permitted erection of a new genus, Aiolornis. This find emphasizes the importance of focusing on field recovery of fossils that appear to be diagnostic, rather than attempting to determine in the field whether a fossil find is unique or significant.

Regarding those fossil remains that *are* diagnostic, it is reiterated that all identifiable paleontologic resources are always potentially significant. This being the case, the question of determining potential significance thus becomes one of where the identifications of the resource(s) are made – in the field, before physical recovery of the resource, or in the laboratory subsequent to recovery and preparation. As stated previously, while in some cases accurate identifications are possible in the field, most of the time such identifications are better made in the laboratory, subsequent to recovery. In this environment, recovered fossils can be cleaned and stabilized without delaying excavation activities, then identified using comparative samples and references that would not be available in a field context. Microfossils are also best processed in the laboratory.

Given the above, field paleontologists in a mitigation context should be trained primarily for the collection of resources which exhibit distinctive features such as articular surfaces, bony spines, or prominent bony ridges that will enable detailed identifications to be made later, in the laboratory. Resources that do not appear to be *potentially* diagnostic in this manner are generally not collected, although their presence in the field may be recorded in field notes.

Any of the fossil resources that appear in the field to be diagnostic are *potentially* significant in that they could provide data crucial to resolving any number of research questions under consideration by paleontologic investigators – both presently and in the future. Since this significance in most cases cannot be accurately (or cost-effectively) determined prior to recovery of the resource(s), it is most reasonable and efficient to recover *all* diagnostic or potentially-diagnostic resources as they are exposed with the aim that these resources will, utilizing any number of techniques, be later demonstrated to be scientifically significant.

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The resolution of specific questions or issues (as outlined in the significance criteria presented above) can be attempted given certain volumes of certain types or kinds of fossil remains. However, while estimates of the sufficiency of data – that is, the number of specimens required to properly address a given question or issue – can be advanced *a priori*, such estimates should by no means be considered final. The acquisition of a quantity of specimens sufficient to address a given research question does not imply that no more specimens of a similar nature need to be collected. In most cases, the recovery of minimally sufficient numbers of specimens does not imply that "additional" remains are not significant. Rather, estimates of sufficiency should be employed only to determine that it has become possible to *begin* to address a particular question. Nor can such estimates be treated in isolation, without also considering estimates of "sufficiency of data" necessary for the resolution of other paleontologic questions.

Figure 5. Full curation of significant paleontologic resources in an established repository is an essential part of the mitigation process. In the absence of such curation, impacts to significant resources are not truly mitigated, but merely postponed.

FIELD RECOVERY

Although CEQA explicitly and implicitly mandates the recovery and preservation of paleontologic resources, it does not detail how these tasks should be accomplished. The following discussion of field, laboratory and curation techniques is therefore presented to document the key considerations involved in initiating, maintaining and completing a paleontologic resource mitigation and treatment program in order to comply fully with the requirements of CEQA.

The recovery in the field of paleontologic resources can generally be assigned to one of three collecting practices: research-driven fossil collection, cyclic prospecting, and mitigation salvage. Although each of these practices has its own distinctive approach, each also shares with the others certain basic requirements for correctly recovering and preserving fossil resources.

Permission: Where permits are required, fossils may only be recovered under the authority of a valid permit and with full written permission from the appropriate landowner. Due diligence in this regard is the first step in insuring the permanent preservation of fossil finds.

Field Notes: A fossil out of context has no scientific significance. Accurate and precise locality data is therefore extremely important. Localities should be mapped or recorded with an accuracy that will allow future researchers to locate the site, even after the land surface is altered. The integrity of the site – whether a fossil is *in situ* or whether the fossil is float – must be noted. It is also important to delineate distinct localities and avoid lumping of field sites, to avoid inadvertent mixing of closely situated but potentially distinct faunas.

Descriptive site data should be recorded with an eye to permanence, e.g., waterproof paper and ink or hard-lead pencil in the field; archival materials in the laboratory. Complete geologic descriptions should be made in the field using the appropriate standards of sedimentological description. Small samples of sediment can be recovered and preserved with the fossil(s) where deemed appropriate. Field maps, quarry sketches, and photographs should be made onsite and must always include scale, north arrows, and locality information. The fossils or fossil jackets should be marked in the field with cardinal directions, a field inventory number, north arrow, and stratigraphic and actual "up" direction to preserve the original orientation of the fossil for taphonomic studies.

Sampling: The most basic criterion for determining whether or not a fossil should be collected is its diagnosticity. As discussed above, fossils are not considered to be significant unless they can be identified with some degree of precision. Field collection should focus upon the recovery of those fossils that appear to be diagnostic – that is, those fossils that seem sufficiently complete or that exhibit sufficient anatomical characters so as to have some likelihood of being identified to a reasonable level of precision upon preparation and examination in the laboratory. Microfossils are an exception to this provision; recovery of bulk samples of fossiliferous sediments can yield some unidentifiable microfossils.

Fossil trackways provide unique challenges for field sampling. In many cases, such trackways are preserved in sedimentary blocks so massive as to defy effective removal or recovery. In these cases, sampling should entail molding the exposed trackways in a nondestructive manner, so that a record of the resource(s) can be preserved. Preservation of trackways left in the field should be based upon avoidance where possible.

As stated, all of these guidelines are always applicable in field collection of fossil resources. In paleontologic mitigation and salvage these guidelines are perhaps most critical, as construction and development so completely rework a region as to render it impossible to revisit localities or exposures. In these cases, if the appropriate contextual data is not recorded at the time the fossils are recovered, there are rarely any second chances. It is therefore essential that the above listed guidelines be kept clearly in mind when collecting vertebrate fossils.

Collection strategies should be based upon a well-defined, pertinent research design wherever possible. Research-based collection strategies, if sufficient in scope and number, will examine similar numbers of outcrops and recover similar numbers of fossils as compared to cyclic prospecting. Research-based collecting has the added benefit of providing data useful in answering specific inquiries. Questions of species abundance and diversity, population dynamics, age of the assemblage, depositional conditions, paleoenvironmental conditions, and evolution of lineages through time, to name just a few concepts, can and should provide a strong foundation for field investigations.

Although a research design is strongly recommended, there are cases where such a foundation might not be essential. Paleontologic mitigation activities, for example, endeavor to salvage significant fossils from areas where development, construction, and/or excavation will impact and possibly destroy paleontologic resources. Fossil salvage in these cases is most correctly interpreted as representing the initial observation stage that is the beginning of any scientific investigation. Paleontologic mitigation is challenged by the potential weight of future investigations – sufficient fossils and contextual information must be recovered to provide data for a wide variety of future research questions – and encumbered by the immediacy of salvage needs, as any delay will result in the complete loss of nonrenewable resources. In effect, mitigation based fossil salvage can be seen as conservation enabling research, not necessarily as research in and of itself. The lack of a research design, or hypotheses to be tested, at the outset of paleontologic mitigation and salvage should not be seen to constrain these conservation activities in any way.

CURATION

Field recovery of vertebrate fossils is clearly only the first step in fossil preservation. Curation of recovered fossils is a critical requirement for proper stewardship of these resources.

Preparation: Some degree of preparation is usually required to stabilize fossil resources to the point of permanent preservation. Preparation should be suited to the fossil and its place in a research framework, but long-term stability and preservation of the fossil should always be primary factors. Matrix recovered from this cleaning should be preserved for later washing, screening and examination for microfossils. Glues, hardener, or other stabilizing agents should be reversible, must provide long-term stability, and should be non-reactive.

Preparation also includes processing of fossiliferous sediments. This sedimentary matrix can be water-washed through mesh screens to facilitate disaggregation of clays and fine silts. Mesh size should be determined in advance based upon the research framework and the size of the specimens that might be recovered. The resulting clean concentrate should be visually examined – when necessary with the aid of magnifying lenses and/or binocular microscopes – and hand-picked to remove fossil specimens.

Preparation can also include reconstruction of broken elements. This is a point of critical concern. Unless a broken fossil has had each of its elements thoroughly cleaned and hardened, it may not reassemble easily or correctly. Also, many fossils suffer distortion due to pressure and other geologic factors. Given these facts, and recalling that preparation should be aimed primarily at long-term stability, thought must be given to the purposes that would be served by reconstruction of the fossil(s). A specimen intended for exhibition might very well have different reconstruction and preservation requirements than a fossil intended for research, and so the degree to which a fossil should be repaired needs to take this into account. Further, a fossil intended for display at the outset may in future years be removed and returned to the collections. It is important in this eventuality that modifications that may have been made to the fossil(s) for the sake of exhibition should be reversible if at all possible, so that the value of the specimen(s) in research is not diminished. Reconstruction should be as accurate as possible; poorly reconstructed fossils only make more work for investigators.

Identification: If a fossil's significance is based to some degree upon whether or not it can be identified with any degree of precision, as discussed above, then it follows that fossil identification is a key element in resource stewardship. Many academic research institutions and professional repositories house their fossils organized by taxon and by element, and so identification is a central part of the curation process, as well. Finally, paleontologic research of any kind demands correctly identified fossils as a *minimum* requirement if it is to actually advance science in any way. As in the field, notes should be kept to record the detailed observations of the researcher that may not otherwise be available.

Specimen storage: This is one more of the critical components in correct, professional stewardship of fossil resources. Vertebrate fossils are unique, *nonrenewable* resources, and if not cared for they will eventually be lost, never to be replaced. Further, fossils form the basis for many scientific studies, and if an investigation is truly scientific then it must to some degree be repeatable. If this is to happen, then scientists must have access to fossils employed in prior studies. Finally, paleontology as a science has grown and evolved – much faster than the once-living organisms it studies – and as new techniques and new philosophical perspectives come into play it is imperative that fossils form a cohesive core, an enduring chain of consistency linking older studies to newer interpretations.

Paleontologic resources must be housed in professional, academic repositories with databases capable of preserving and manipulating specimen and locality data (see below). Repositories should be accredited by the American Association of Museums (AAM) to ensure long-term stability and compliance with established museum procedures and guidelines. In keeping with AAM standards, fossils should be stored in dust-proof steel cabinets. These cabinets should be housed in a dedicated, climate- and humidity-controlled collections area, separate from office and laboratory space. Exceptionally large

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specimens may be stored on heavy-duty steel shelving where necessary, but in such cases efforts must be made to ensure that such shelving is also relatively dust-free. Catalogue and locality data should be recorded in permanent ink on archival-quality tags or labels associated with each specimen. Resin or plaster cradles may be constructed to provide additional support for large, bulky and/or fragile specimens. Catalogue numbers for large fossils should be written on the bone in permanent ink.

Microfossils present unique challenges for proper long-term storage. These small specimens are generally very delicate and can be extremely easily misplaced. Microfossils should be stored in a manner that will prevent the fossils from being separated from the identifying data. Unique numbers that identify the specimens should be attached to the specimen or its container to prevent the loss of critical provenience data.

<u>Data storage</u>: In addition to storage of the fossils themselves, contextual data recovered must also be housed and preserved. Computer databases are extremely effective virtual storehouses for all of the data that can be associated with fossils. A computerized collections management database should therefore be considered an essential commodity for institutions intent upon acting as repositories for paleontologic resources.

All data pertaining to recovered fossil specimens should be recorded in the collections database of the pertinent repository. This data should be cross-referenced and easily manipulated in virtual space. Resource locality information should also be entered into the specimen database. Localities should be plotted on standard topographic maps for convenient hard copy. Field notebooks should be housed in the selfsame repository as holds the fossils, as should photos, maps and other site records.

The preservation of paleontologic resources is a long-term endeavor. The job does not end when the fossils are placed on display or locked away in cabinets. Despite the most painstaking care and patient work, fossils by their very nature are likely to deteriorate through time. For this reason, it is important that repositories for vertebrate fossils are prepared, in terms of maintaining a secure physical environment, a competent collections management staff, and a stable financial outlook, to maintain fossils in the long term.

DISSEMINATION

Paleontologic research is not conducted in a vacuum. As with any science, the whole point of studying fossils is to advance humanity's knowledge of the natural world. Unless the information and interpretations gleaned from paleontologic investigations are made broadly available, however, the potential benefits of such investigations are limited. For this reason, dissemination of data information regarding the newly preserved resources, as well as the results of any research performed, is an essential function for all professional paleontologists.

Dissemination of data acquired from the study of paleontologic resources is particularly important in light of the stated intent of CEQA. In order to "take all action necessary to … enhance the environmental quality of the state" (PRC §21001a), it is essential that the data gleaned from fossil resources be made available to those individuals involved in working to fulfill the requirements of CEQA, as well as to the public at large. Environmental impact statements, mitigation and treatment reports, and other project-related documents may contain substantial data, but such documents are often either confidential or lack a sufficiently wide distribution to constitute true dissemination. Government agencies and land management personnel need access to such data in order to make more informed decisions regarding land use; professional researchers require data in order to fully realize the significance of the resources; and Californians in general should be provided with what data can be made available in order to arrive at a better appreciation of their environment in all its aspects.

In order for this dispersal of paleontologic information to be effective, the data collected have to be accurate. The guidelines discussed here are presented with that focus clearly in mind: that paleontologic resources are excavated carefully and professionally, with contextual data fully recorded, and are safely housed in secure repositories, so that this unique and irreplaceable data set is preserved as completely and accurately as possible. If all the time and trouble invested in these efforts is to be truly worth taking, research should be equally carefully conducted, with full consideration of all pertinent data, and results thoughtfully presented, if our stewardship of these fossils is to move beyond just collecting and preserving.

FINAL THOUGHTS

The foregoing has been a brief review of the procedures, requirements and philosophy of thought for proper stewardship of paleontologic resources in order to comply with the recommendations of CEQA. As California continues to grow and the pace of development increases, it is important to emphasize the ways in which CEQA protects significant paleontologic resources, and to highlight some of the basics of the practice of paleontologic resource management as a foundation from which to continue to build. The future holds the promise of new discoveries and new interpretations; if we are to make the most of them, we must not lose sight of the fundamentals of our profession.

The recommendations provided here are by no means complete, but rather are intended to provide a "bare bones" (so to speak) perception of how best to act to recover, preserve and properly manage significant paleontologic resources in compliance with CEQA. While CEQA does effectively require preservation of significant paleontologic resources, the time is ripe to act to strengthen and augment the Act. Official guidelines requiring many or all of the procedures delineated herein would provide a level of support for paleontologic research not previously available. If we are to ensure that nonrenewable paleontologic resources are properly cared for, the recommendations presented herein should as deemed necessary be weighted with official sanction. Only if the procedures discussed here cease to be suggestions and become requirements can we ensure that we are all on the same page, working towards the same goals, with the same sense of care and concern for the resources under our care.

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☐ 16. Economic
☐ 17. Engineering
☐ 18. Other____________________

CHAPTER REGIONS & MEMBERSHIP

AEP Code of Ethics

1. Conduct myself and my work in a manner that will uphold the honor, integrity, and dignity of the profession.
2. Uphold the stated intent as well as the letter of environmental policies, laws, and regulations which are adopted by governmental bodies or agencies.
3. Not engage in, encourage, or condone dishonesty, fraud, deceit, discrimination, or misrepresentation in the solicitation , preparation, or use of work prepared by me or under my direction.
4. Fully disclose to my employers and my prospective clients any economic or ethical interests which could reasonably be interpreted as a conflict of interest by them or by other affected parties with regard to my professional work.
5. Ensure a good faith effort at full disclosure, technical accuracy, sound methodology, and objectivity in the collection, analysis, interpretation, and presentation of environmental information by me or under my direction.
6. Achieve the highest level of professional competency, for myself and for those I supervise.

____
Signature

Signature acknowledges full understanding and acceptance of the AEP Code of Ethics and Professional Conduct Guidelines.

OFFICE USE ONLY Co. ____ P. ____ Date ________ Amount ________ Check # ________

Status		Please Check
New Member Application		☐
Change of Address, Etc.		☐

Membership Category	Annual Dues	Please Check
Full Member	$100.00	☐
Sponsor	$180.00	☐
Student Member*	$ 35.00	☐

*application must include current full time, 12 units or greater, student schedule.

Region

☐ 1. Channel Counties
☐ 2. Inland Empire
☐ 3. Los Angeles
☐ 4. Monterey Bay Area
☐ 5. Superior California
☐ 6. Orange County
☐ 7. San Diego
☐ 8. San Francisco

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