# EML for Mere Mortals: A Guide to using Ecological Metadata Language to Document Ecological Data

## Who should read this?

This document is designed for ecologists, ecological information managers, and ecology students.

Assumptions about the reader:

Is computer literate.
Has an understanding of ecological terminology.
May or may not know anything about XML

Definitions and Formating Conventions

XML

XML Schema

EML document: to say that a document is an EML document means that it is a valid XML document; that the document follows the structure defined in a series of xml schema documents. When EML (all caps) is used, it is used as an abbrivaiation for Ecological Metadata Language. When <eml> (lower case, inside < > ) is used, it refers to the the top level element of an EML document.

EML: abbreviation for Ecological Metadata Language.

<eml> : shorthand notation for <eml:eml> </eml:eml>

NOTATION CONVENTIONS. Since EML documents are XML documents, they use XML taggng notation. Throughout this document, you will find references to EML elements. Unless otherwise stated, all of the examples will refer to documenting data objects. EML can also be used to document literature citations, research protocols, or software independent of any dataset. The following notations will be used when refering to an EML element: ..<xxxx> or ...<xxxx>. The .. means that the element is a the third level of an EML document. In effect, .. means <eml>/<dataset>. So ..<coverage> in the actual xml document would look like

</eml>

A reference in the form of ...<xxxx> means that the element in question is an arbitrary number of levels deep in the EML structure.

XMLtags are case sensitive. For example, the tags <species> and <Species> are not the same.

## Introduction

Ecological Metadata Language (EML) is a content standard for documenting ecological data.

This standard is implemented using XML Schema to define the structure of XML documents that conform to the standard. EML has been designed for two major uses. The first and most important use is to define a common structure that all ecologists can use to document ecological data so that other ecologists can correctly interpret the data.

The second purpose for EML is to provide a structure so that software applications can be developed. The kinds of applications anticipated range from a basic tool that allows a user to perform very specific targeted searches for datasets to advanced applications that could perform automatic integration of datasets.

```
<eml>

        <dataset>
                <coverage></coverage>
        </dataset>
</eml>
```

A reference to ..<coverage>/<geographicCoverage> would be interpreted as:

```
<eml>
        <dataset>
                <coverage>
                        <geographicCoverage></geograhicCoverage>
                </coverage>
        </dataset>
```

## A Taxonomy of EML

The two purposes of EML can be looked at as forming the two basic branches in the taxonomy of EML. As can be seen in Figure 1, EML has both a scientific description “kingdom” and a “kingdom.” The scientific description branch contains those modules that answer questions like:

Who did the research? <creator>

In general terms, what is the research about? <abstract>

What are some of the key concepts that refer to the data? <keywords>

Where was the research done? <coverage>/ <geographicCoverage>

What time periods are covered in the data? <coverage>/<temporalCoverage>

What species are represented in this research/data? <coverage>/<taxonomicCoverage>

What methods were used? <methods>/<methodStep>, <sampling>,<qualityControl>

Is the data being documented part of a larger project <project>

The data representation branch contains modules that are used to describe:

What kind of data entity is it? <entity>/<dataTable>,<spatialVector>, <spatialRaster>

How is the actual file structured? <physical>/<dataFormat>

How would I retrieve this file? <physical>/<distribution>

Who will I allow access to the data? <access>

## Anatomy of an EML Document

While most EML users will probably be using a tool such as Morpho or Xylographa or Xanthoria which take care of the formating chores, that is, assuring that all of the metadata documents produced are valid EML documents, it helps to know what an eml document looks like “under the skin”.

While there are some people who take pleasure in documenting (providng metadata for research data), most people are more interested in doing the research than documenting it.

**Cast of Characters:**

Pat Ecologist: Pat is an ecologist. S/he knows that providing metadata is important, but has never done so in any organized way. Pat is computer literate, but has never worked with XML, “It’s like HTML right?”

Eco Informatics: Eco is an information manager with a strong interest in designing advanced software tools to help Pat with the analysis and modeling of ecologically interesting data.

emlMaven: emlMaven is an expert in EML

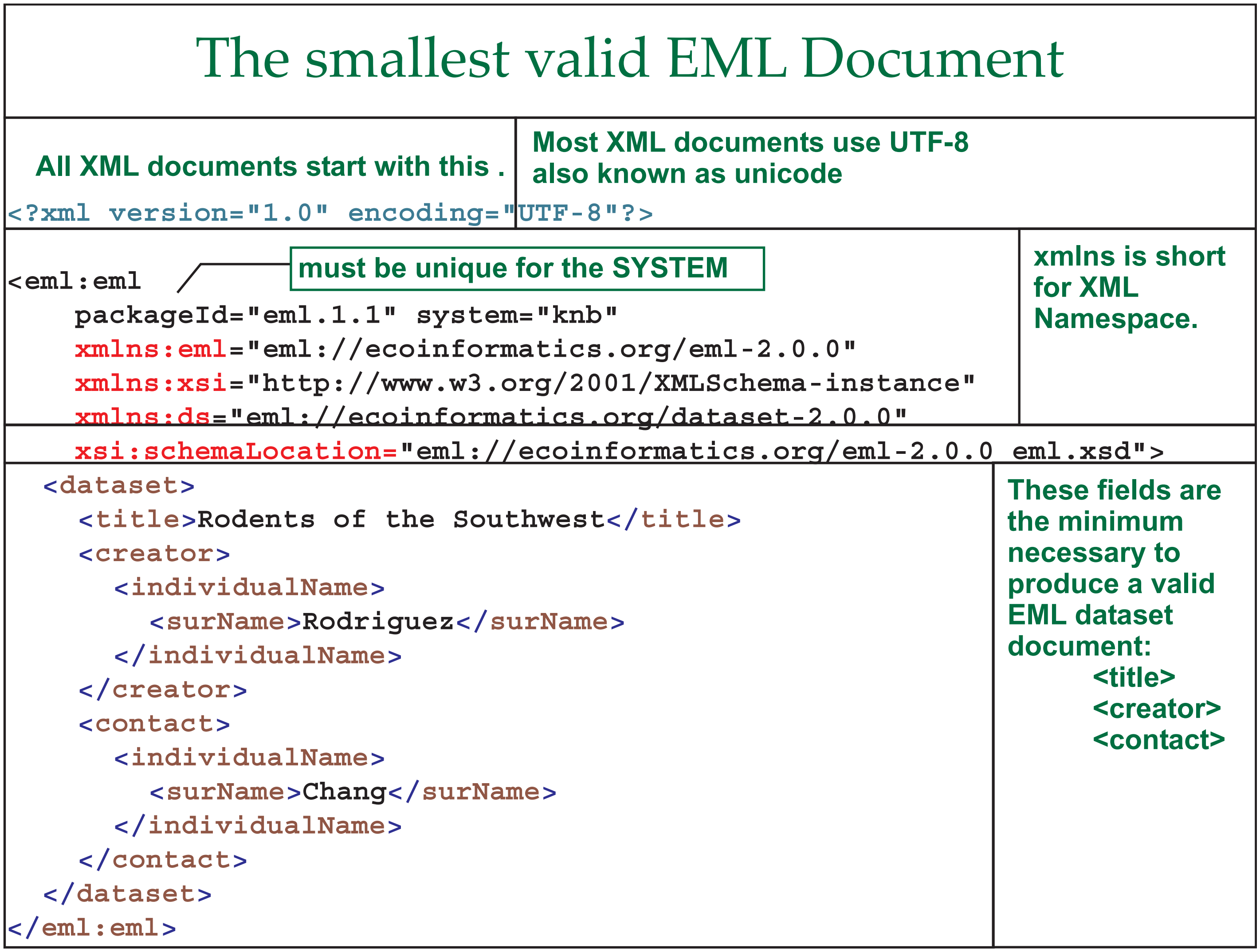
Arc Gis: Arc is a GIS (geographic information system) specialist. Arc often works with both Pat and Eco Informatics.

NSF: a mythical federal agency that gives out money, but always has strings attached.

Knowledge Network for Biocomplexity( KNB): KNB is a mythical assocaition of ecological organizations. It has high standards and is commited to making ecological data available to researchers aound the world. For the purpose of this drama,, Eco Informatics, is a representaive of KNB.

,Pat: I have just completed a research project. NSF tells me that I have to provide EML compliant metadata tp document my research, but I want to get back to the field as soon as possible. What is the minimum I have to do to produce a valid EML document?

emlMaven: The document in Figure 2 shows the the smallest valid EML dcoument.



The smallest valid EML Document

All XML documents start with this .

Most XML documents use UTF-8
also known as unicode

```
<?xml version="1.0" encoding="UTF-8"?>
<eml:eml
    packageId="eml.1.1" system="knb"
    xmlns:eml="eml://ecoinformatics.org/eml-2.0.0"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xmlns:ds="eml://ecoinformatics.org/dataset-2.0.0"
    xsi:schemaLocation="eml://ecoinformatics.org/eml-2.0.0 eml.xsd">
  <dataset>
    <title>Rodents of the Southwest</title>
    <creator>
      <individualName>
        <surName>Rodriguez</surName>
      </individualName>
    </creator>
    <contact>
      <individualName>
        <surName>Chang</surName>
      </individualName>
    </contact>
  </dataset>
</eml:eml>
```

must be unique for the SYSTEM

xmlns is short for XML Namespace.

These fields are the minimum necessary to produce a valid EML dataset document:
<title>
<creator>
<contact>

Eco Informatics: That doesn't tell me very much. How can I design any useful tools with just a title and a last name?

Pat: I know I said minimal, but I know that NSF won't be satisfied with that. Even from my own selfish perspective, people won't know which Ecologist did this study. Ok. So, let me rephrase my question. What would an EML document look like that contains enough information that another ecologist would be able to understand.

emlMaven: That is a longer story. To tell this story requires some definitions and some detailed explanations. Before telling the full story, it will help to look more closely at the strucute of the minimal EML document.

## Documenting a dataset

**XML Key terms:** xmlns, schemaLocation, URI, URL

xmlns: This is a reference to an XML namespace. A namespace can be thought of as a way to specify where the element definitions come from. Since anyone can define their own tags, the use of namespaces allow XML processors to identify the specific vocabulary being used. A namespace is uniquely identified usinf a Uniform Resource Identifier (URI). A URI should be gloabally unique. Thus far, there is no method of enforcing this uniqueness, that is, there is no central registry of URIs. Often a URI is expressed as a URL (Uniform Resource Locator).

The schemaLocation

**For the curious or obsessive:** the technical specifications for URI, URL and the even more abstract URN (Uniform Resource Name) can be found at:

**EML Key terms:** eml, dataset, packageID, system, creator, contact, title

eml: As mentioned earlier, XML uses a hierarchical approach to representing information. All documents written to conform to Ecological Metadata Language standard (valid EML documents) have a top level element called <eml>. That is, all EML documents start with <eml:eml> and end with </eml:eml>.

packageId and system: A packageId is a unique identifier for a given system. The term **system** refers to the catalog or storage system that the metadata document is being contributed to. Examples of systems are:

> KNB: the Knowledge Network for Biocomplexity. Any metadata document from an LTER, OBFS, or California NRS site should be considered to be contributed to KNB.
>
> ESA Data Archive: The ESA data archive repository could be considereed to be a system for EMLpurposes.

**<dataset>**: The term dataset means different things to different people. In EML, the term dataset refers to one or more data entities. The most common data entity is a **<dataTable>**. A data table is something that looks like this:

| OBSERVATION_DATE | OBSERVATION_LOCATION | SPECIES | SPECIES_COUNT |
|---|---|---|---|
| 2002-10-29 | FCE_001 | ALLIGATOR | 1 |
| 2002-10-29 | FCE_002 | ALLIGATOR | 2 |
| 2002-10-29 | FCE_003 | ALLIGATOR | 0 |

Data tables are produced by people using software applications like text or word processors, and often saved as text files (ascii), or spreadsheets (Excel), statistical packages (SAS, SYSTAT, SPSS) by database systems (MS Access, My SQL, Oracle, MS Sql Server), or by certain kinds of sensors (data loggers).

In addition to data tables people using database applications may also produce a **<view>** or a **<storedProcedure>**.

People using GIS (geographical information system) applications generate both **<spatialVector>** , also refered to as boundary or shape files and **<spatialRaster>**. A spatialRaster is a geo-referenced image usually produced by a camera on a satellite or other remote sensing device.

The final kind of data entity is **<otherEntity>**. An **<otherEntity>** is a data entity that cannot be represented by any of the previously defined data entity structures. A non-geo-referenced photograph is an <otherEntity>, e.g. a photograph of two different types of butterflies.

The **<title>** field provides a description of the resource that is being documented that is long enough to differentiate it from other similar resources. Multiple titles may be provided,  particularly when trying to express the title in more than one language.  If a title is in a language other than English, use “xml:lang” attribute. For example,

```
<title>Rodents of the Southwest</title>
<title> xml:lang=”de” Rodents des Südwestens</title>
```

In the second <title>, the text ‘xml:lang=”de”’ is an XML attribute that says: language = german (de = deutsche).

A clear discussion of the use of the language attribute can be found at: http://msdn.microsoft.com/library/default.asp?url=/library/en-us/prompting_beta2/html/SSML_Elements_lang.asp The actual language codes can be found at: http://www.w3.org/WAI/ER/IG/ert/iso639.htm.

A **<creator>** is a structure  for repesenting the owner of the data. A **<creator>** can be either a person, an organization, or an organizational role. Examples of organizational roles are: Executive Director, Department Administrator, Information Manager. A **<contact>**  is a structure for reprsenting the person, organization, or organizational role to contact regarding the use of the data. Without getting too deep into the language of XML Schema, we can say that both elements have the same structure, that is, both are “**of type responsibleParty**”.

There are two versions of ISO 639 language codes: two letter and three letter codes. The three letter system was designed to expand the list of languages that can be represented. Currently, January 2003, the two letter system is used more often. Over time it is likely that the three letter system will be embraced.

At this point, we can expand the minimal EML document to look at a few examples of creators and contacts.

```
<creator>
    <individualName>
        <salutation>Dr.</salutation>
        <givenName>Juan</givenName>
        <givenName>Carlos</givenName>
        <surName>Ecologist</surName>

    </individualName>
    <address>
        <deliveryPoint>Department of Marine Ecology</deliveryPoint>
        <deliveryPoint>University of the Oceans</deliveryPoint>
        <deliveryPoint>1514 San Ysidro</deliveryPoint>
        <city>Seaside</city>
        <administrativeArea>LA</administrativeArea>
        <postalCode>78890</postalCode>
        <country>USA</country>
    </address>
    <phone>709-345-8970 x 254</phone>
    <electronicMailAddress>pat.ecologist@oceans.edu</electronicMailAddress>
</creator>
```

```
<creator>
    <organizationName>USDA</organizationName>
    <address>
        <deliveryPoint>US Department of Agriculture</deliveryPoint>
        <deliveryPoint>Mailstop 3654 </deliveryPoint>
        <deliveryPoint>25 Federal Plaza</deliveryPoint>
        <city>Washinton</city>
        <administrativeArea>DC</administrativeArea>
        <postalCode>20025</postalCode>
        <country>USA</country>
    </address>
    <phone>phonetype=”voice” 709-345-8970 x 254</phone>
    <phone>phonetype=”fax” 709-345-8962</phone>
    <electronicMailAddress>dataservices@usda.gov</electronicMailAddress>
    <onlineUrl>http://www.usda.gov/ecoinformatics/</onlineUrl>
```

```
</creator>

<contact>
    <positionName>Information Manager</positionName>
    <address>
        <deliveryPoint>Oceans LTER</deliveryPoint>
        <deliveryPoint>Department of Marine Ecology</deliveryPoint>
        <deliveryPoint>University of the Oceans</deliveryPoint>
        <deliveryPoint>1514 San Ysidro</deliveryPoint>
        <city>Seaside</city>
        <administrativeArea>LA</administrativeArea>
        <postalCode>78890</postalCode>
        <country>USA</country>
    </address>
    <phone>709-345-8970 x 254</phone>
    <electronicMailAddress>pat.ecologist@oceans.edu</electronicMailAddress>
    <onlineUrl>http://oceanslter.lternet.edu</onlineUrl>
</contact>
```

**Things to notice and guidelines:**

The element names may seem unfamiliar. You might be wondering, why did the developors of EML use such strange names? These elements have been taken from the International Standards Organization (ISO), schema for reprsenting people: iso-party.

A person can have more than one <givenName>, but only one <surname>.  EML does not have a specific tag for middle names.  Since <givenName> is optional, <surName> would be used for "Cher" or "Madonna"

An address can have more than one <deliveryPoint>. A <deliveryPoint> is that part of an address that precedes the CITY. The most common <deliveryPoint> is a street address, Other examples are company names, department names, post office box, mailstop. Because XML does not recognize "carriage returns", the way to enter that part of an address that precedes the city is to use a separate <deliveryPoint> element for each item that you would want to appear on a separate line when displayed on a web page or printed report. An <administrativeArea> is the tag that would be used in the United States to represent a STATE.

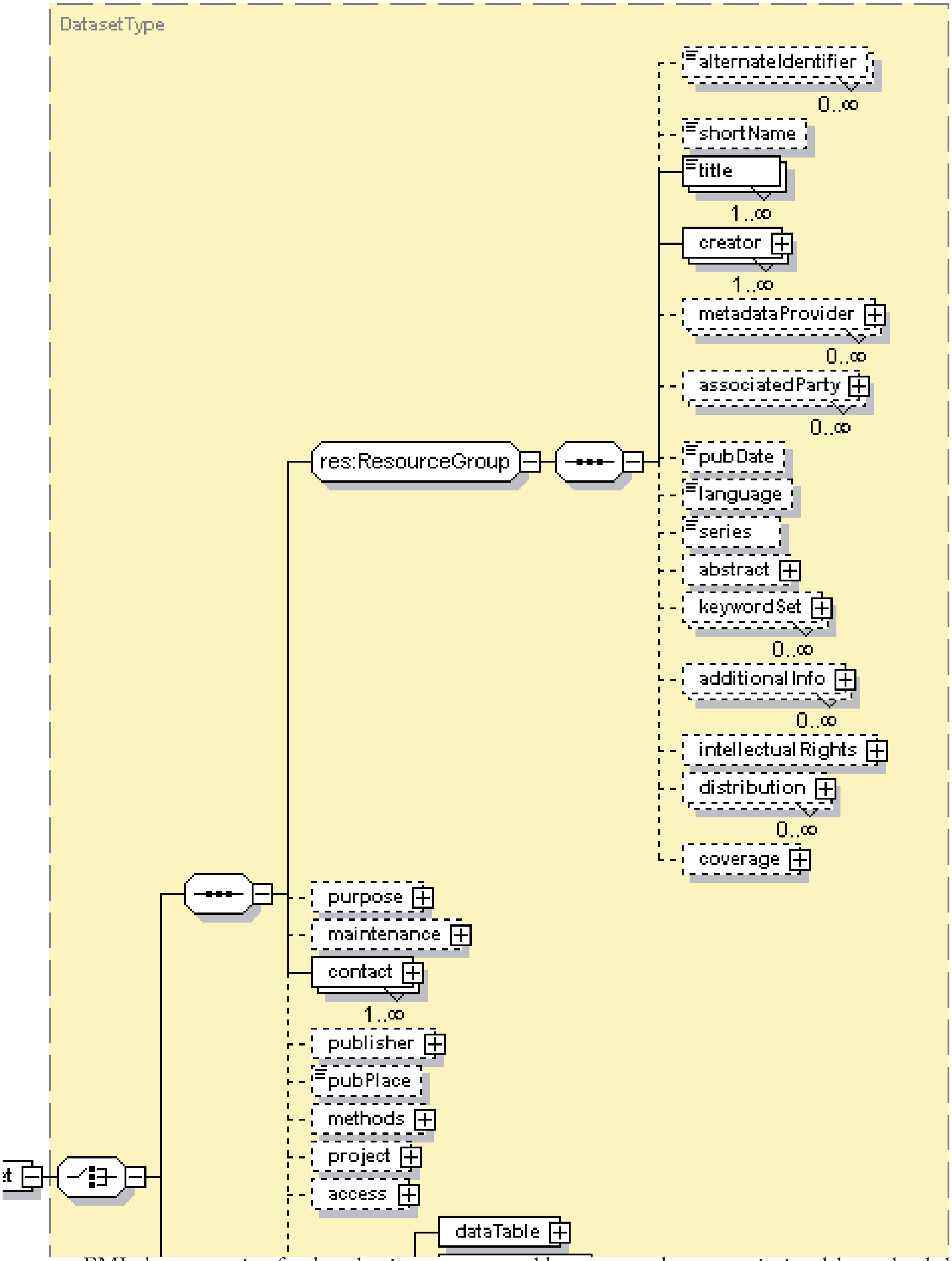
A <creator> or <contact> can have more than one address. Each address must be contained in its own set of <address></address> tags. (see below)

```
<creator>
    <individualName>
            <givenName>Sam</givenName>
            <surName>Ecologist</surName>
    </individualName>

    <address>
            <deliveryPoint>25 Oceans Avenue</deliveryPoint>
            <city>Oceans</city>
            <administrativeArea>CA</administrativeArea>
            <postalCode>98025</postalCode>
    </address>

    <address>
            <deliveryPoint>Department of Ecological Sciences</deliveryPoint>
            <deliveryPoint>University of the Oceans</deliveryPoint>
            <city>Oceans</city>
            <administrativeArea>CA</administrativeArea>
            <postalCode>98025</postalCode>
    </address>
 </creator>
```

There are two additional optional types "creator" types that can be described by EML, <metadataProvider> and <associatedParty>. A <metadataProvider> can be used when the person, (organization, or organizational position) who provided the metadata is not someone who "created" the data being documented. A <metadataProvider> could be a LTER information manager, a student, or a researcher who may or may not have been part of the the data creation process. While this field is optional, it is recommended that is be used if the metadata was provided by someone other than the <creator>. It is also a good idea to use this if there are multiple creators, but one of the is the primary source of the metadata. It is especially important to use this structure if the metadata is being constructed after the fact. For example, someone decides

Figure xxx

Structure of a Dataset Document



to create EML documentation for data that is twenty years old; some metadata may exist in a lab notebook, but the documenter is developing new metadata.

An <associatedParty> is a person, (organization, or organizational position) that is involved in the creation of the data, but is neither a <creator> or <metadataProvider>. An associated party could be a researcher,statistician, a technician or an advisor or consultant. If research data is developed by a team of researchers, the principal investigator might be the <creator> while her associates could be described by <associatedParty>.

As mentioned earlier the structure of an EML document is defined by a series of XMl schemas. The schema determines not only the names of valid tags, but also the order of the various structures. As can be seen in Figure xxx, a <creator> must be described before a <metadataProvider>, and a <metadataProvider> before an <associatedParty>. While <contact> followed <creator> in the minimal EML document, a close look at figure xxx reveals that <creator>, <metadataProvider>, and <associatedParty> are part of a larger structure called <ResourceGroup>. Any elements that are used in the <ResourceGroup> must be entered before the next set of elements <purpose> (optional), <maintenance> (optional) and <contact> (required).