AFORO: An interactive shape analysis and classification system for fish otoliths

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Outline of Talk

- Objectives
- Morphological Descriptors. An overview
- Where we are?
- Software Tools used
- Entity-RelationShip Diagram
- How to Populate the Database?
- Logical Web Application Flow
- Shape Analysis
- Browsing the Database

Objectives

Develop tools to manage, search and visualize multimedia data on DataBases (Internet) based on its contents.

1) To **build an otolith database of well identified and catalogued samples**. We will start from the documental base existing in the *Institut de Ciències del Mar (CMIMA-CSIC)*. The database is regularly updated and at present (07/04/2004) it contains a total of 908 high resolution images corresponding to 182 species and 71 families from the Western Mediterranean and Antartica.

2) To provide a **system to automatically extract the shape contours and compute some numerical descriptors**.

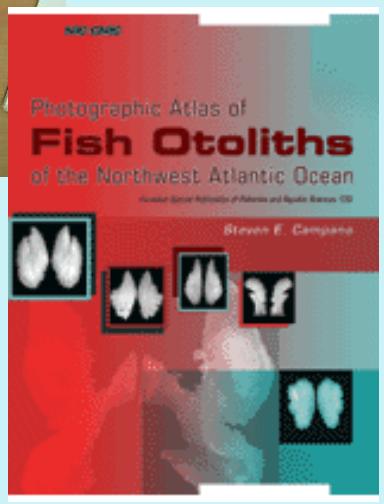
3) To develop an expert **system to classify and search among the database** based on contours descriptors (in development).

Morphological Description of Otoliths (I)

Otoliths are characterized by specific morphological characters

Graphic representation using drawn lines appears in publications of:

taxonomy
phylogeny
paleontology
paleoecology
trophic relationships
archeology



Recently, digital photographs are incorporated into otolith description

Morphological Description of Otoliths (II)

Otolith measurements are used in:

- taxonomy (species identification)
- fisheries (stock identification, ageing)
- functional morphology and ecomorphology

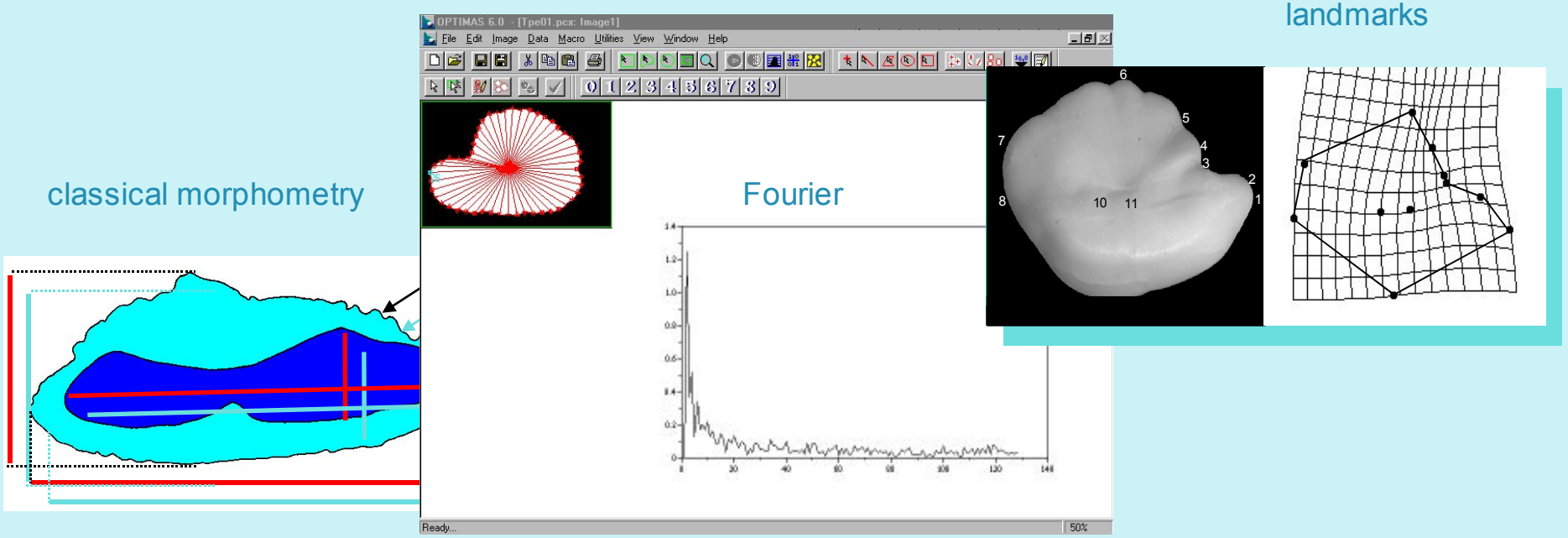
In the last years, the application of digital image processing and analysis techniques in otolith studies has increased

outline morphometry

geometrical morphology
landmarks

classical morphometry

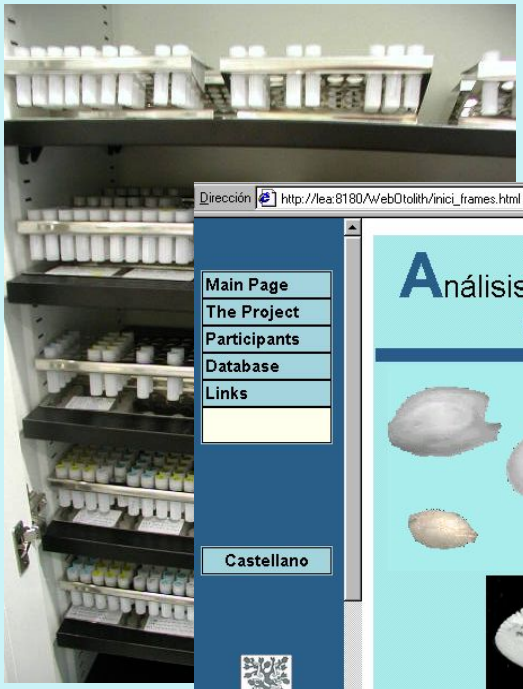
Fourier



From Collection to Aforo Web

AFORO database assembles image otoliths, morphometrics and shape analysis.

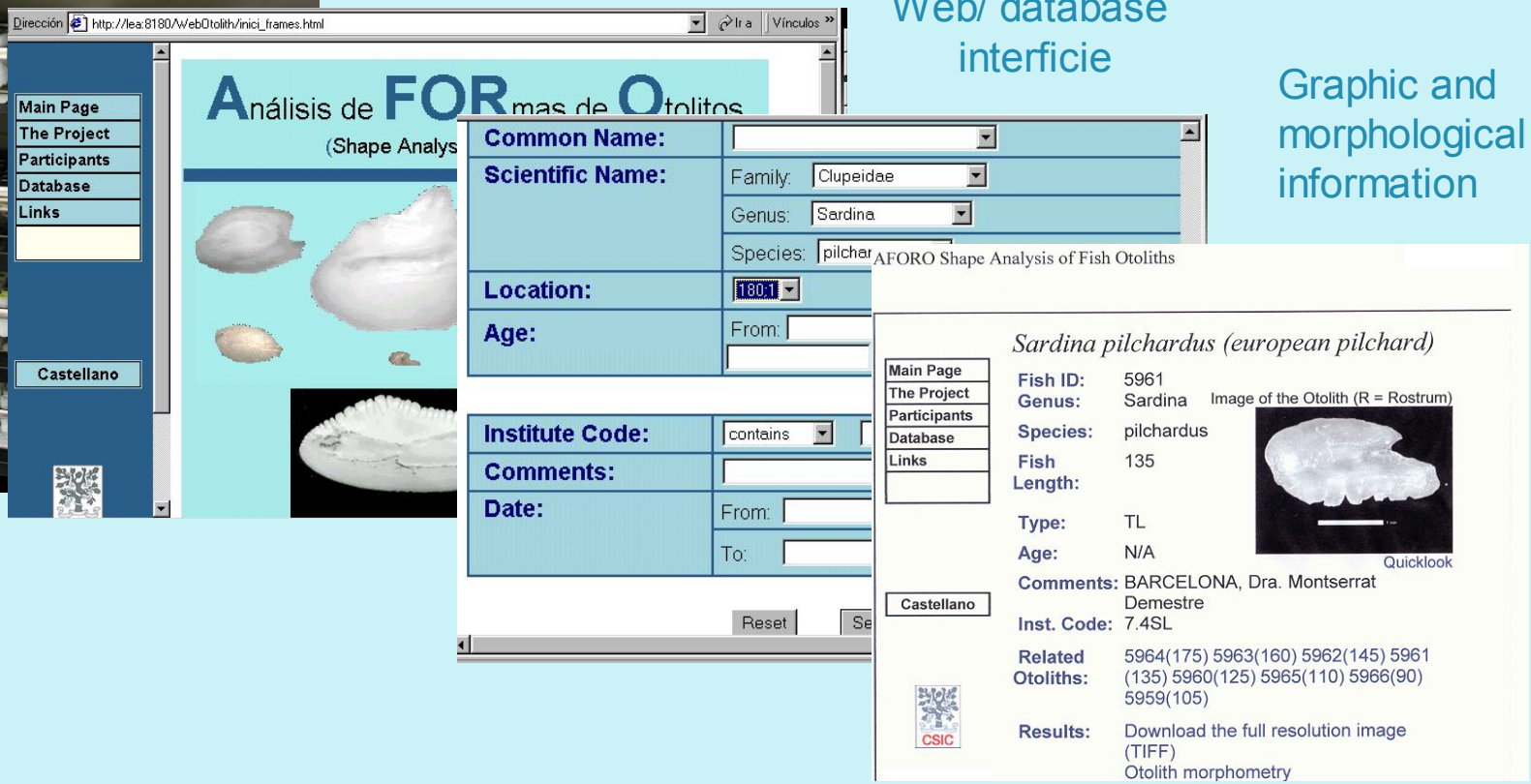
ICM Collection and database (908 sagitta images from 182 species, 71 families and 19 orders, mainly Mediterranean and Antartica at 2004/07/07)



Web AFORO

Web/ database interficie

Graphic and morphological information



Technical Overview

- AFORO database was developed under PostgreSQL 7.1.3-2 DBMS.

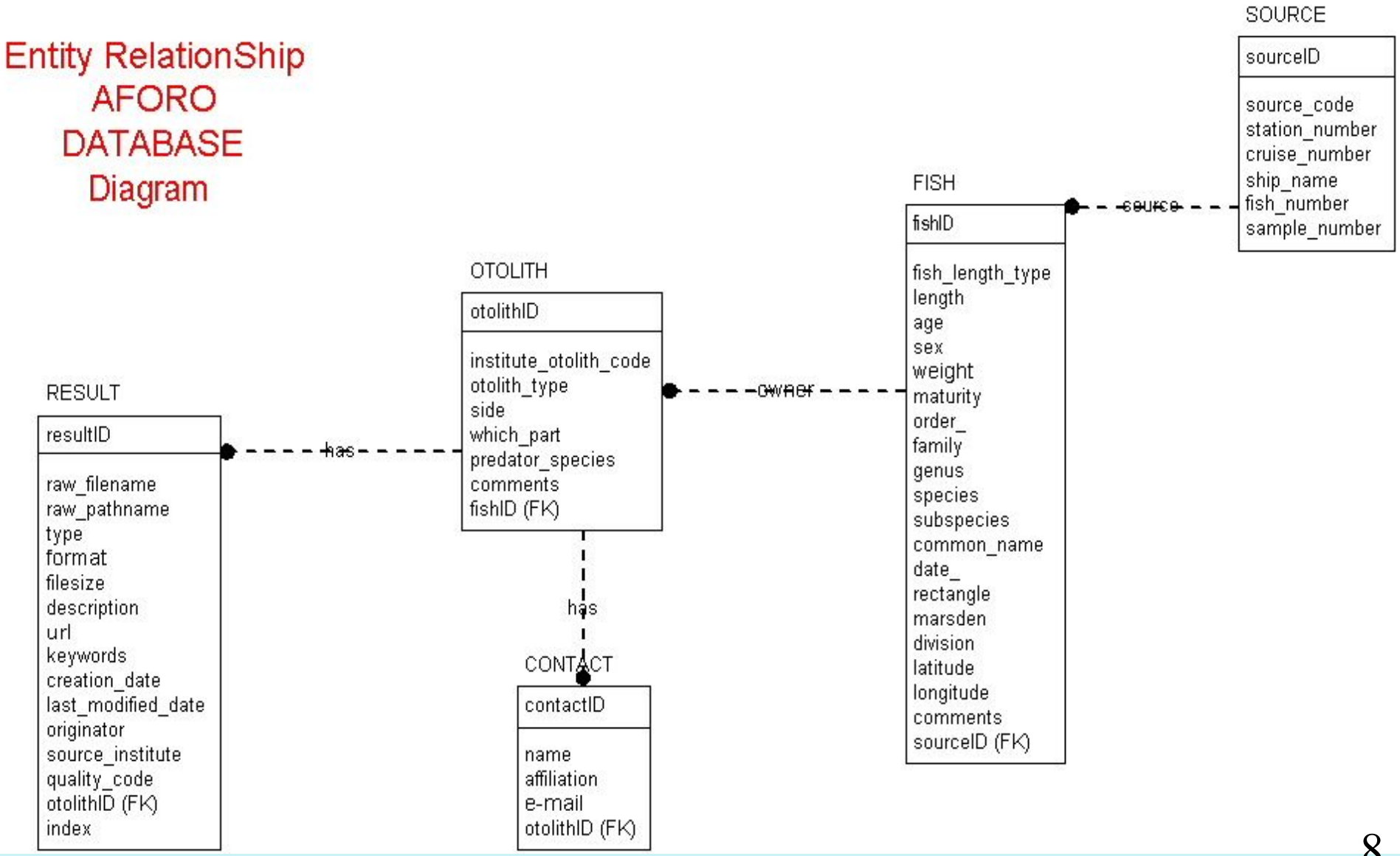
- The application was builded as a Java Web Application (as a Web ARchive WAR file) allowing an easy deployment in an application server like Tomcat 4.1.30.

- The application was developed using Java Server Pages (JSP) and JavaBeans but also HTML and, far below, JavaScript.

- Libraries used:
  - **JAI**(1) Java library (to create and convert from TIF to PNG the otolith images on the fly and also in otolith analysis)
  - **JDBC**(1) library (to connect Java app. to PostgreSQL DBMS)
  - **ImageJ**(2) (to extract otolith contour).

(1) Sun Microsystems (http://www.sun.com/)
(2) National Institutes of Health,USA. (http://rsb.info.nih.gov/ij/)

Entity-RelationShip Diagram



Populating Database

Populating all database information but result table (otolith image):

- Traditionally, most of the otolith information we have has been stored in formats compatible with Microsoft Excel files.
- It is easy to connect Microsoft Access to PostgreSQL database to populate data using an ODBC connector.

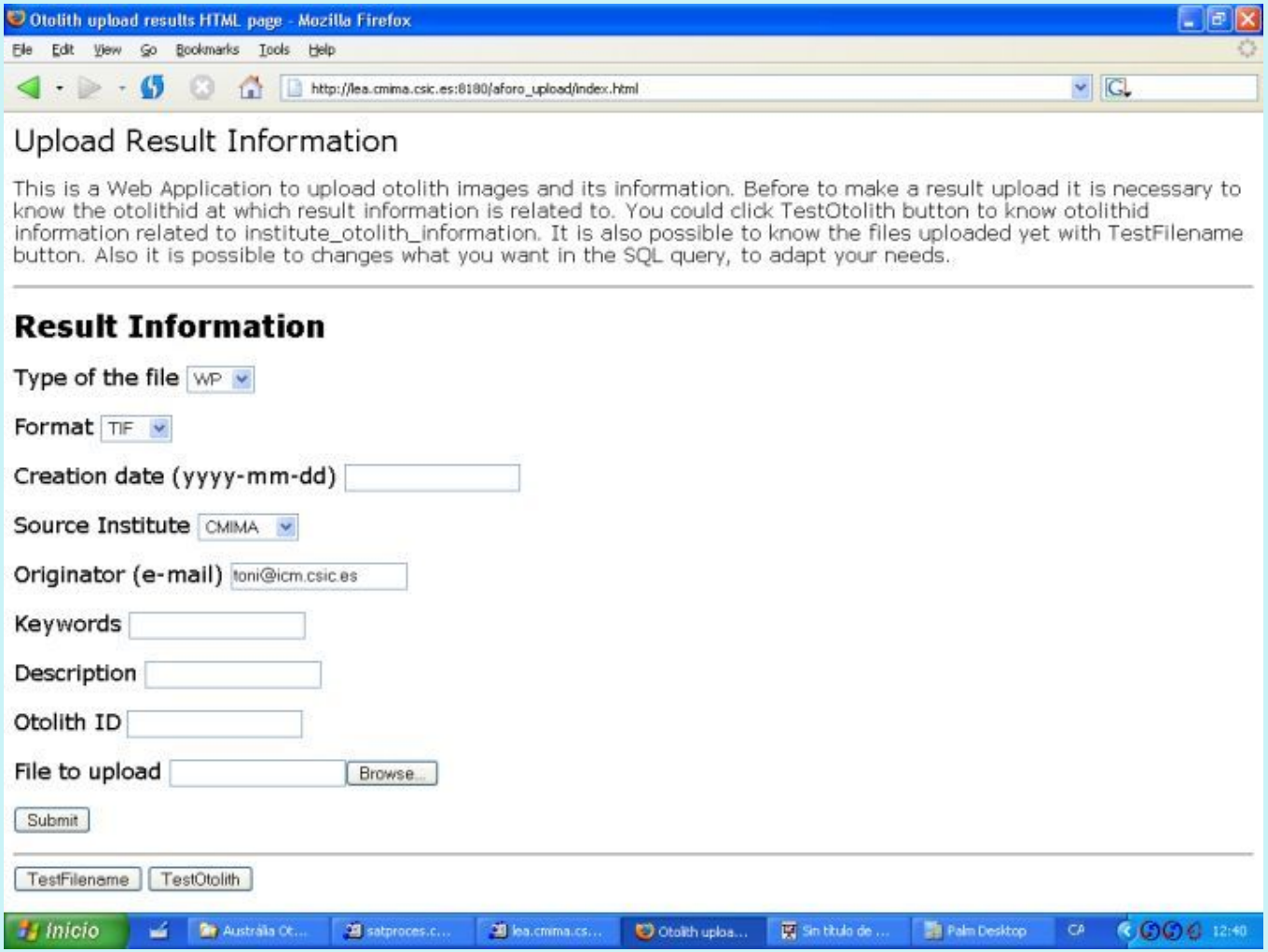
So, “cut and pasting” data from Excel to Access turned out to be a database population (SQL INSERT).

Populating result files:

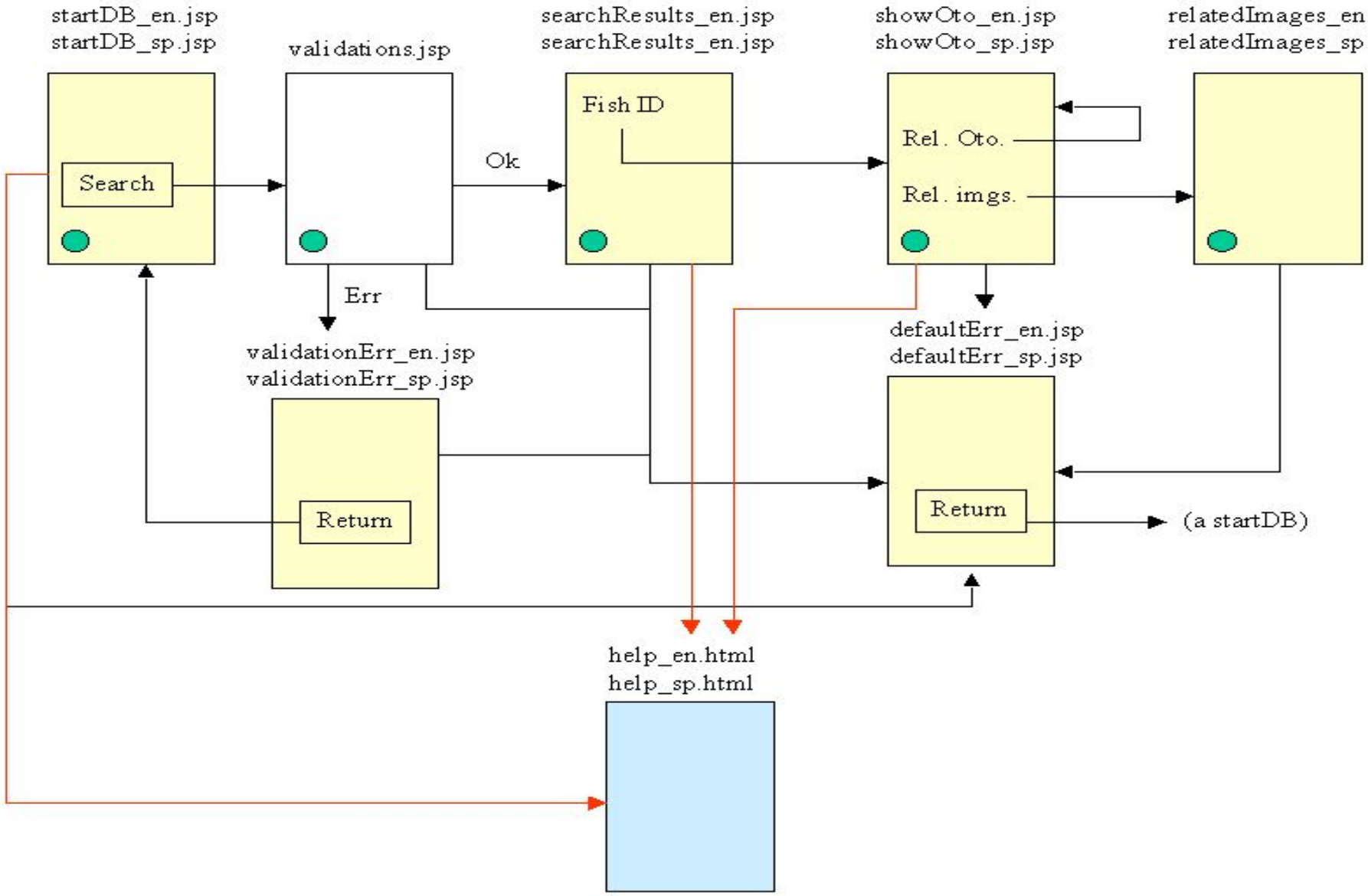
- For result files (now devoted only to TIF images corresponding to Sagitta Otolith) it is developed a small Web Application (HTML file + Servlet to upload the file and update the result table).

- Libraries used:
  - commons-fileupload (http://jakarta.tomcat.org)
  - JDBC.

Upload Otolith Image App.



Web Application Logical Flow



Shape Analysis

- Shape analysis is a set of descriptors obtained from otolith contour:

- Fourier descriptors
- Wavelet coefficients(1)
- Curvature Scale Space(1) (related to inflection points of contour found at different smooth levels).

- Contour is obtained from original image applying Otsu algorithm (Otsu,1979). This method is very sensitive to a well processed, so well contrasted images separating clearly the otolith than background information.

- Classification system is in progress(1)

(1) attend next presentations from Dr. Jaume Piera and Dr. Vicenç Parisi if interested

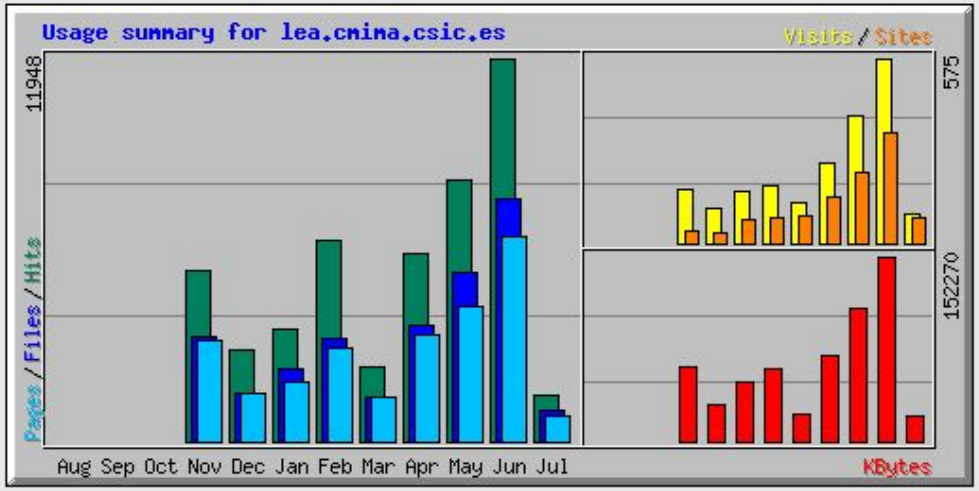
AFORO Browsing Session

This recorded browsing web session shows the possibilities of AFORO Database.

Aforo Browsing Session

Usage Statistics for AFORO Project hosted in lea.cmima.csic.es

Summary Period: Last 12 Months
Generated 05-Jul-2004 04:04 CEST



Summary by Month

Month	Daily Avg				Monthly Totals					
	Hits	Files	Pages	Visits	Sites	KBytes	Visits	Pages	Files	Hits
Jul 2004	292	198	162	18	80	20686	92	814	992	1464
Jun 2004	398	252	212	19	344	152270	575	6360	7585	11948
May 2004	262	169	136	12	222	110069	394	4224	5246	8137
Apr 2004	194	119	111	8	145	71004	247	3352	3598	5835
Mar 2004	74	43	43	4	83	21874	127	1355	1357	2309
Feb 2004	223	115	104	6	78	60100	181	2917	3226	6254
Jan 2004	117	76	61	5	76	48976	159	1854	2281	3513
Dec 2003	97	51	51	3	32	30562	109	1497	1486	2829
Nov 2003	242	148	143	7	36	61556	169	3152	3271	5331

AFORO Info

• AFORO WEB PAGE
http://aforo.cmima.csic.es/

(old link still working:http://lea.cmima.csic.es:8180/aforo)

• For any question, comment... related to data collection
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• For tech questions
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Acknowledgments

People participating in AFORO project:

- Dr. Antoni Lombarte Carrera (ICM-CSIC)
- Mr. Antoni Cruz Folch (ICM-CSIC)
- Mr. Roger Olivella Pujol (ICM-CSIC)
- Dr. Vicenç Parisi Baradad (UPC)
- Dr. Jaume Piera Fernández (UPC)
- Dr. Emilio García Ladona (ICM-CSIC)
- Mr. Oscar Chic (ICM-CSIC)

Thanks also to:

Dr. Manuel Graña coordinator of AVG-ION (Aforo project) and
Dr. Beatriz Morales-Nin coordinator of IBACS project

AFORO has been funded by Ministry of Science and Technology (code TIC2000-0376-p4-04)