HELP MENU
IPEZ PROGRAM

CONTENTS

I. Introduction

The main aim of the *IPez* program is to identify adult fish at the species level using morphometric variables. The discrimination method of the program is based on the morphological differences between the different taxa. For this purpose, a mathematical treatment has been designed, based on *Machine Learning* techniques, which allows identification of the best variables for differentiating between the different taxa at a specific level (order, family, genus or species). Once these variables have been identified, the most probable taxon can be estimated from the values for morphological variables of the individual fish, using logistic regressions.

Identification can be carried out using the data existing in a file or by direct interactive data insertion. In interactive identification, the identification of the order, family, genus and species is complemented by a photograph that, particularly at the species level, allows comparing the individual to be identified with the photograph in the database. For each taxon, there is direct access to the *FishBase* web page, where there is specific information about that particular taxon.

Besides identification, the program permits the measurement of individuals in a convenient way, by connecting a digital calliper that automatically introduces the measurements into a spreadsheet file format.

In short, the *IPez* program has the following functions:

1. Taking morphometric measurements of an individual in a rapid and convenient way, instantly introducing the data from the calliper to the computer.
2. Creating a data file that can be saved, and to which data can subsequently be added.
3. Creating a different template for each type of morphological variable to be measured.
4. Identifying species using specific morphometric variables, by interactive data input or from a file.
5. Viewing the list of all species and photographs included in the database.
6. Finally, there is a direct link to the *FishBase* web page for each one of the orders, families, genera and species that are in the *IPez* database.

II. Configuration

In *IPez* it is possible to configure the language, the serial port for callipers without USB connection and the way to update the database, photographs, images etc. of the

program. The following menu appears, when "Configuration" option is selected in the main menu.
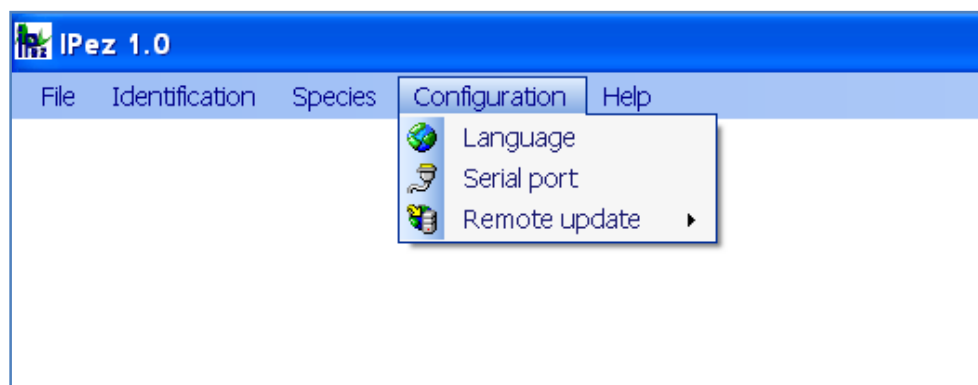
II.1. Language

The *IPez* program does not work in a single language, but has a multilanguage option. The following window appears, when the "Language" option is selected in the configuration menu.
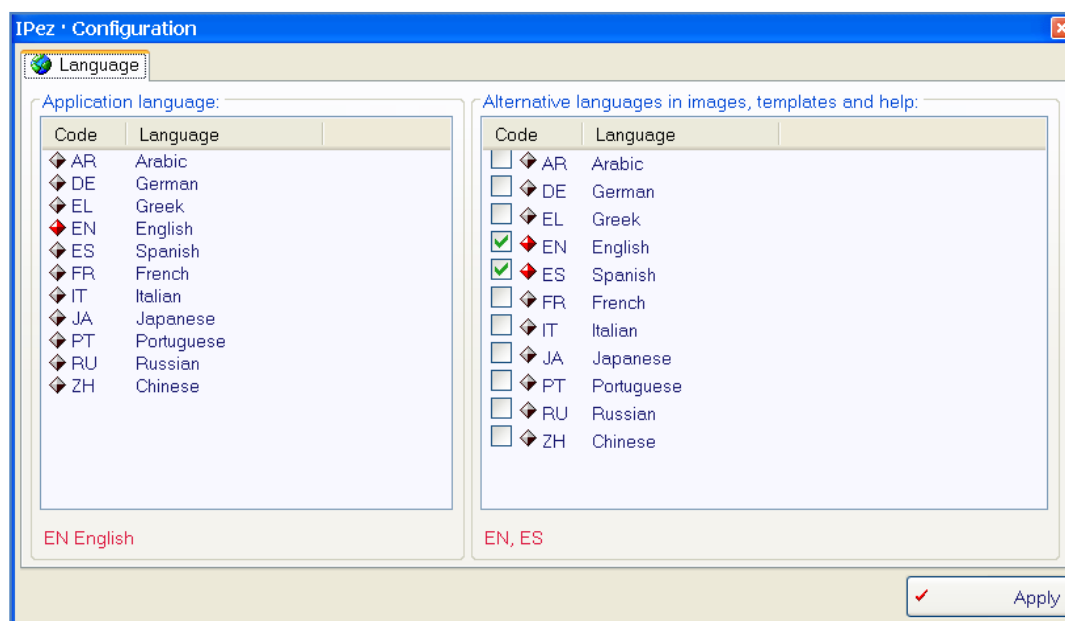
The language you wish to work in can be selected at "Application language", and then confirmed by "Apply", and the program is reset in the selected language.

At "Alternative languages", it is possible to select the languages in which the server will download images, templates and the help file when using automatic update. Hence, it is possible to download files in one or several languages.

II.2. Calliper serial port

When a digital calliper is used with a RS232 connection rather than through a USB port, the characteristics of the calliper and the port to which it is going to be connected can be set up and saved, so that they do not have to be specified each time. Click on to "Configuration" and then on to "Serial port"; the following window will appear in which the characteristics of the calliper can be specified.
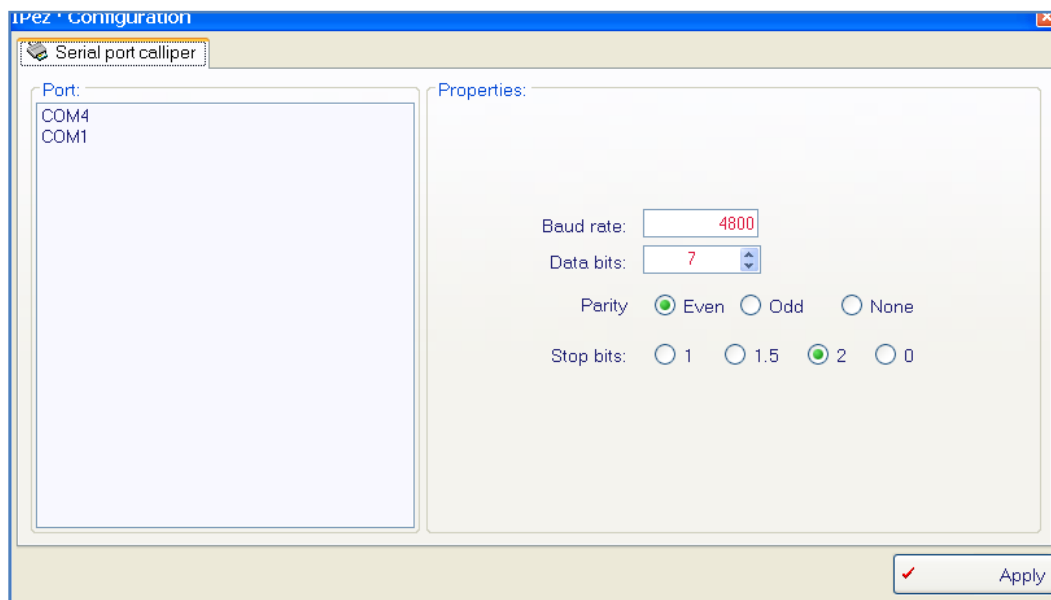
It should be stressed that if the calliper is not always connected to the same COM port, the port connection will have to be specified each time for the calliper to function.

II.3. Update management

The *IPez* database is continually expanding with the incorporation of new species. The program allows the database to be updated in an automatic or manual way. To choose between automatic and manual update, select "Configuration" and then "Remote update".
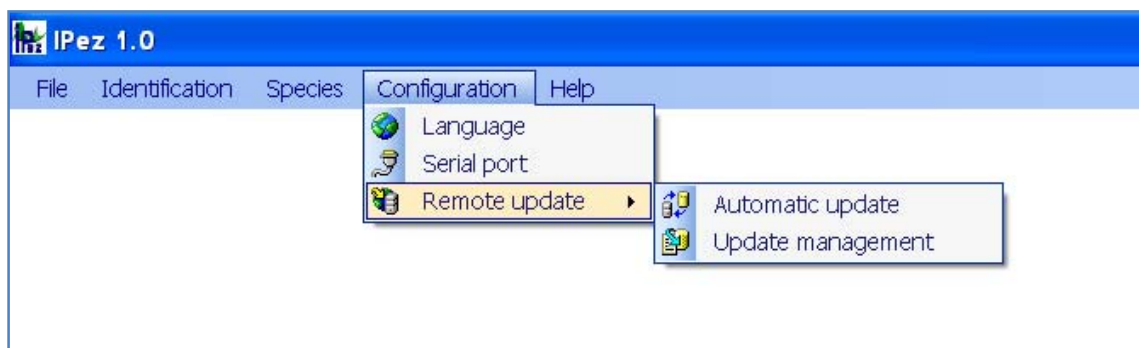

II.3.1. Automatic update

The following window appears in automatic update, where by selecting the "Activate" option, the program will automatically update each time it is started. In

addition to programming automatic update, the option "Do now" can be selected and the program will be updated immediately without having to close and reopen it.

It is possible to define the number of "Downloaded files" for each update. This option is particularly useful when installing *IPez* for the first time. The program downloaded from the web page (www.ipez.es) does not have the photographs that are in the database. Therefore, if the Internet connection is not very fast, the update process could take a long time, and it is possible to divide the downloading over several days.
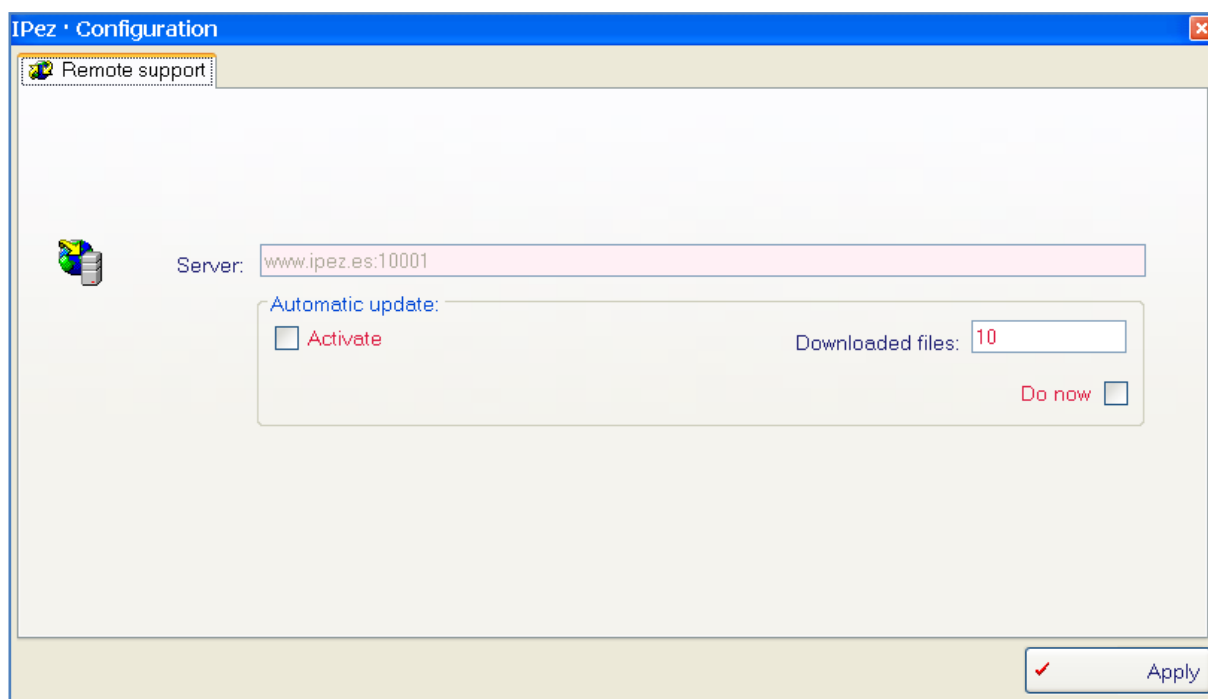
II.3.2. Manual update

The following window appears in manual update. If "Search IPez server" is selected, all the new files will be shown and can be downloaded to the computer.
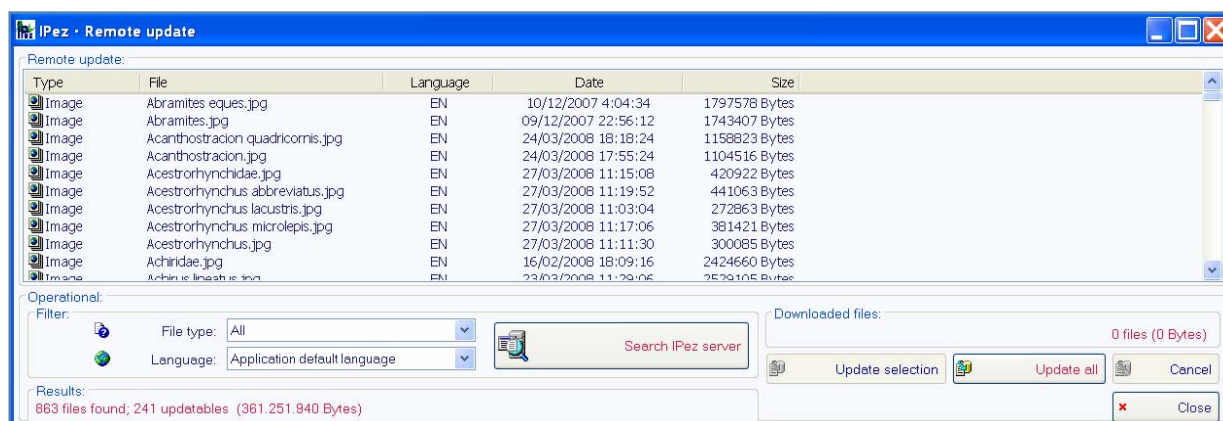
Among the different options of the menu, it is possible to select only some files and then click on "Update selection" or to go directly to "Update all"; thereby downloading all the new files available.

The most practical choice is to leave the default option "All" selected in "File type", so that all the files of *IPez* can be updated. In the "Language" option, it is possible to specify that only the files in the language that *IPez* is working in ("Application default language") are to be downloaded, or alternatively "Multiselection" can be chosen. In the latter case, the program will find in the server all the files of the selected languages in the language configuration menu (see section II.1).

III. Templates

The "Templates" section can be accessed from "File", as is shown in the following window. In this section of the program, templates can be created, which are a sequence of images that show the measurements to be taken. It is a useful tool that makes measuring fish morphometry easier, although it can also be used to measure any other type of organism.
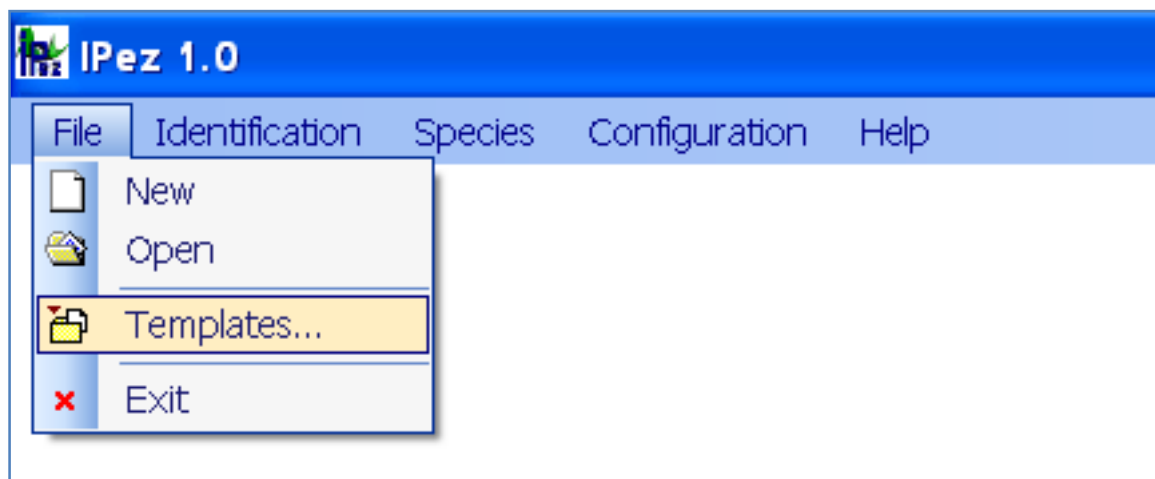
Once in "Templates", the following window appears, where a template can be created, edited or deleted.
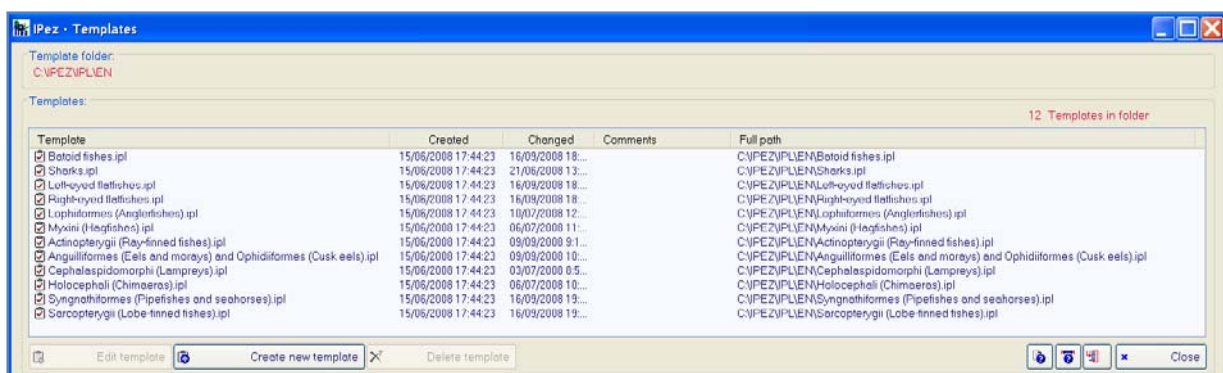
There are a series of templates already defined for fishes that belong to the class Actinopterygii, for those in the orders Pleuronectiformes, Anguilliformes, Ophidiiformes, Lophiiformes and Syngnathiformes of the class Actinopterygii with a morphology slightly different from the rest of the fishes in that class, for the Batoid fishes and sharks of the class Ellasmobranchii, for the class Cephalaspidomorphi, for the class Myxini, for the class Holocephali and, finally, for the class Sarcopterygii.

Using the buttons indicated in the following screen, it is possible to display the information from the files of each one of the templates.
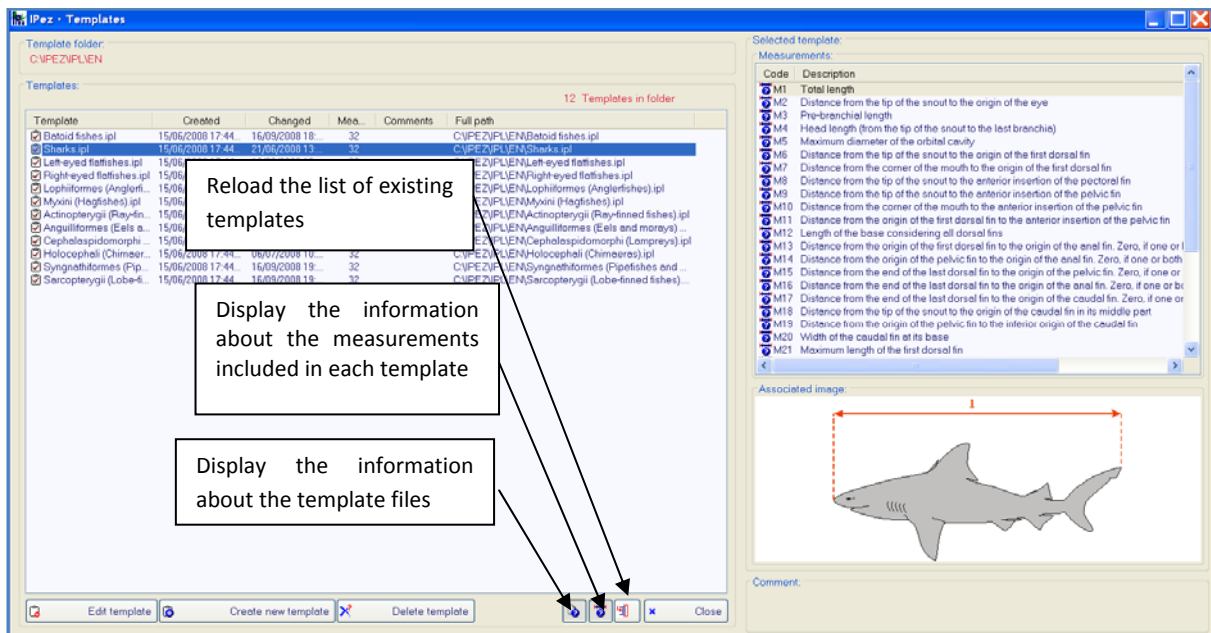
Information can be obtained about their content and, if modifications have been made in the number of existing templates (for, example if a new template has been created), it is possible to reload the new list of templates in the "IPL" folder, which is where all the templates that are being generated should be saved by default.

III.1. Creating a template

When "Create new template" is selected the following window is shown, where a sequence of morphometric variables to be measured can be defined.

In the sequence of variables included in the template, the code assigned to the variable and the description of the variable can be indicated; it is also possible to assign an image to a morphometric variable, so that it can be seen on screen.

The image is imported into the template by clicking on the button "Image", and it is possible to import file formats, such as jpg, tif, wmf, emf, etc.

By clicking on the button below with a question mark, it is possible to select whether or not the images associated to each variable are shown on the screen.

Choice of showing or not showing the images associated to the template
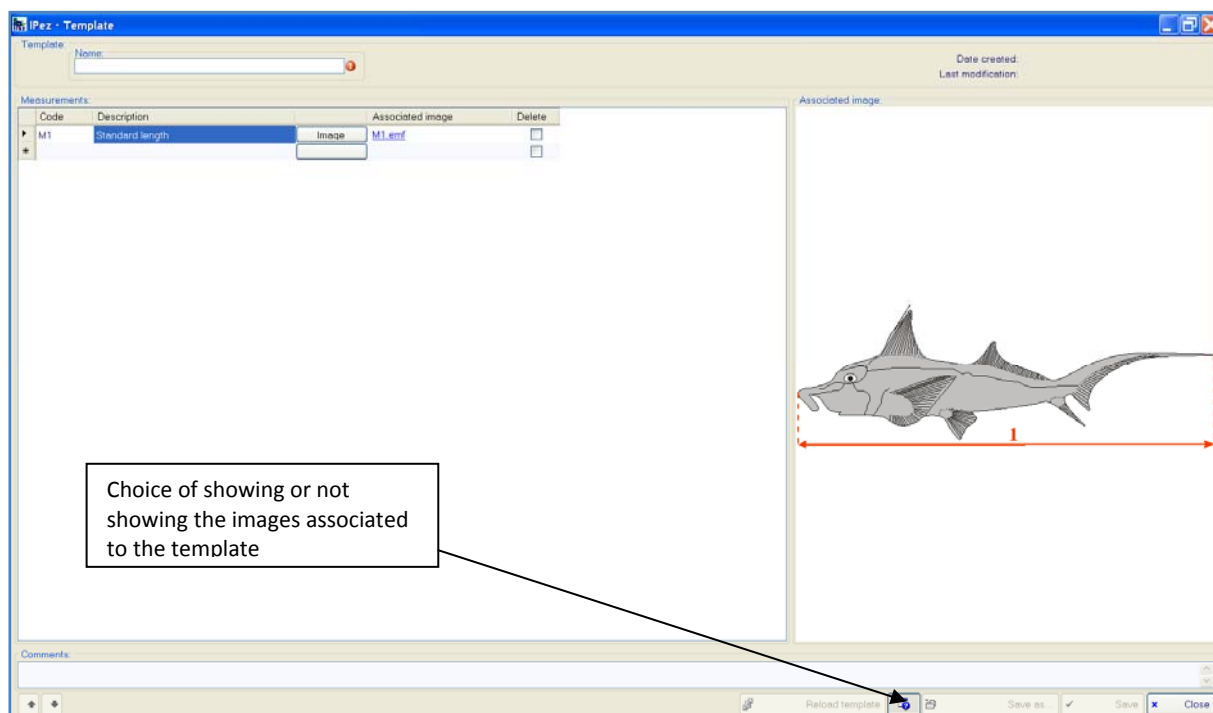
The variables will appear in the same sequence as they were introduced. The order of the variables can be changed after they have been introduced by using the arrows on the left of the screen.

Any of the variables can be eliminated by positioning the cursor on the variable and pressing the delete key. Several variables can be eliminated at the same time selecting the variable in "Delete"; once "Save" has been selected, the template is recorded excluding the variables selected for deletion.

It is also possible to insert a comment into the template and reload the characteristics of the last template saved at "Reload template", if the modifications that have been made since the last time the template was saved are not wanted.

III.2. Editing a template

Once a template has been created, it can be edited by going again to "Templates" and "Edit template" to make the changes. Variables can be deleted, new variables introduced, while the descriptions of variables, the associated images, the order of appearance of the variables etc. can all be modified. Therefore, any template can be modified using template editing.

IV. Measurement of morphometric variables

The created templates make it possible to take fish measurements using the sequence of morphometric variables that has been defined in the template. To do this, go to "File" and then select "New" to create a new data file. The first thing to appear is the following window, where the data file has to be assigned to the relevant template.
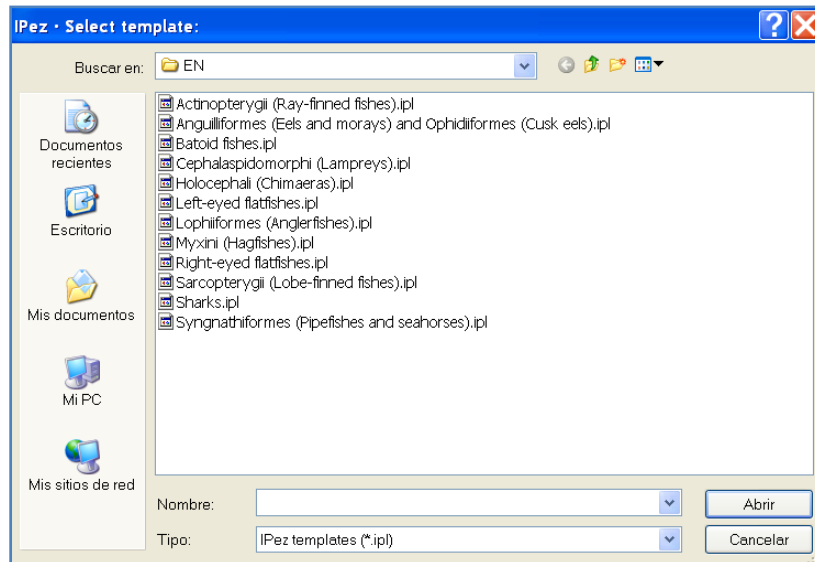

Once the template is selected, the following window appears, where it is possible to introduce the data manually or with the calliper. Each time that the cursor is positioned in a column, the image associated to the variable to be measured is shown. When the value of a variable is taken by default as zero, no associated image appears.
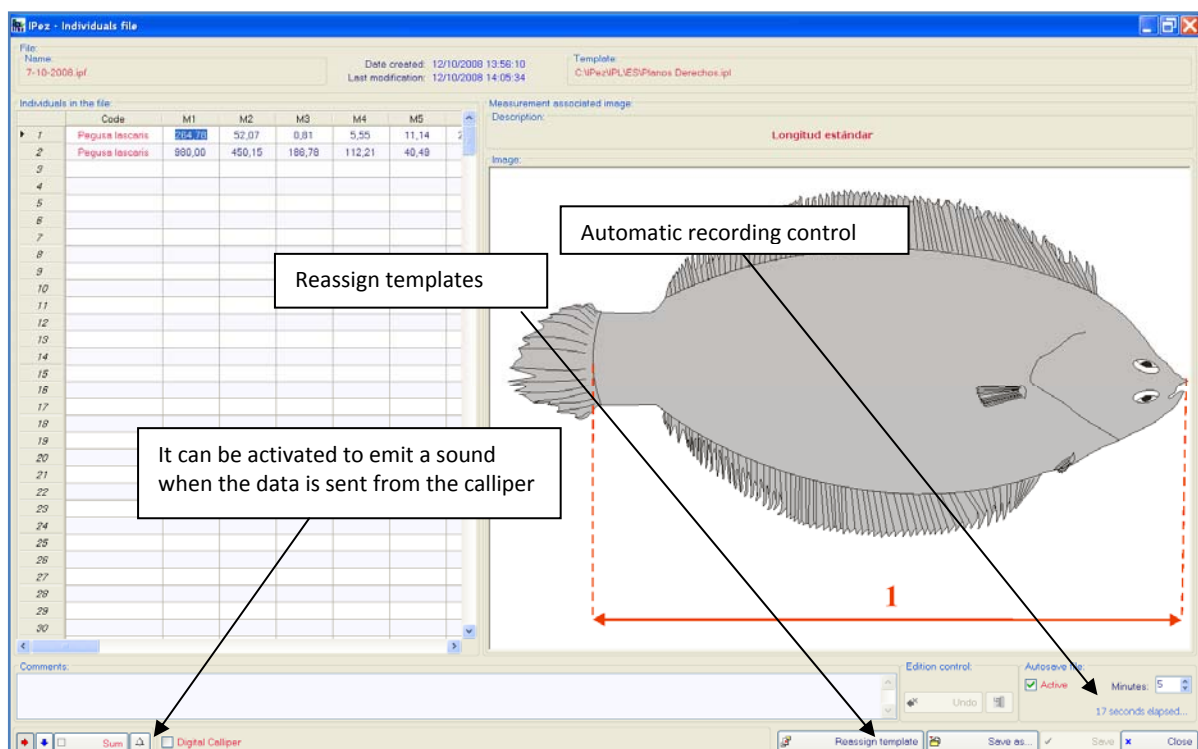
At the bottom left of the screen, the arrows indicate the direction in which the data are to be introduced. The position in red on the above screen shows the arrow towards the right, which indicates that once the data are introduced it moves to the following column within the same row (different variables are measured for the same individual). If the red arrow is the one pointing downwards, this would mean that once data were introduced it would move to the next row within the same column (the same variable is measured for different individuals). Hence, the same measurement can be taken for a group of fishes or all the measurements can be taken for the same fish.

The program also allows the reassignment of a new template to the data. For instance, when data are being taken about flatfishes and then another type of fish is also to be included in the same data file. In "Reassign template", a new template can be selected. In addition, it is possible to automatically save data after a certain period of time, thereby, not wasting time repeatedly having to save data.

Small changes can be made, such as to copy and paste the content of a cell, but if the templates are to be used like spreadsheets, the template has to be opened with Excel or TextEdit. As is shown in the following screen, to do this the cursor is positioned on the name of the file and, by clicking the right mouse button, a small window appears where the data file being generated with Excel or TextEdit can be opened, and the data editing facilities available in either program can be used.
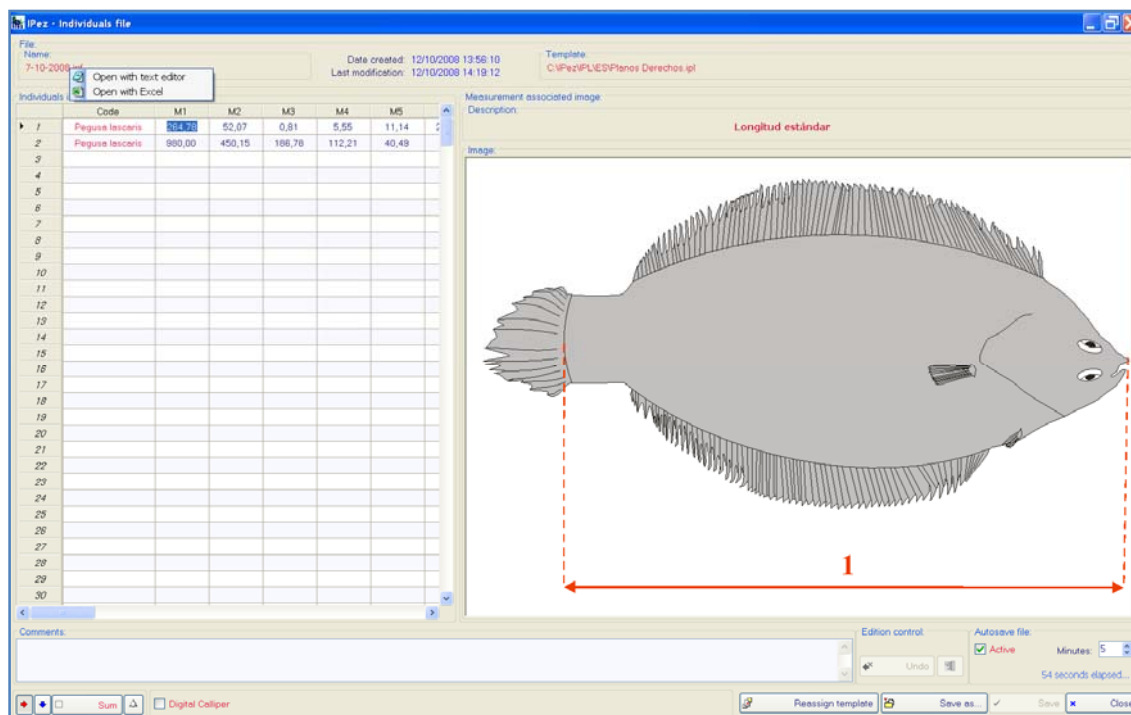

Other changes that can be made without having to open Excel are to undo the last data that have been introduced. To delete the last data inserted simply click on "Undo". If changes prior to the recording are to be deleted, click on the button next to "Undo",

and the following window will appear, where it is possible to choose the data to be deleted from those already introduced.
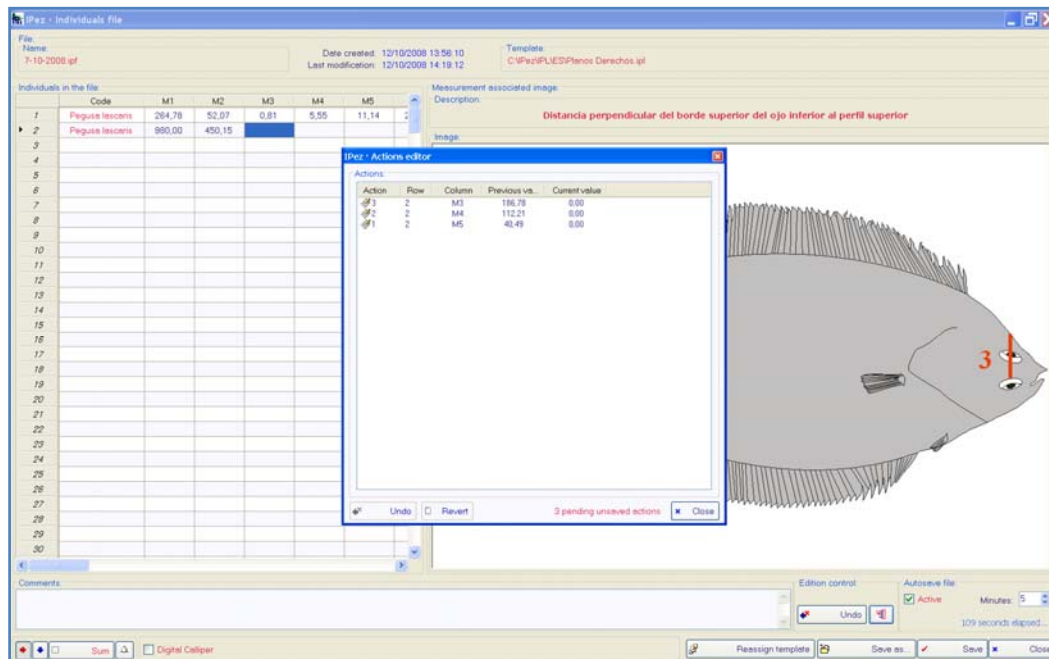
Changes can also be made to the template from the data file. For example, suppose an error has been detected, or a variable is to be deleted or a new morphometric variable entered. Position the cursor on the name of the template, in the top right of the screen, double click on the template name and the template will appear on the screen, as is shown in the following window. The necessary modifications can be made and, once saved, the new changes will appear included in the data file currently in use. It should be stressed that these changes also remain recorded in the modified template and, therefore, if a new data file is opened with this template, it will include the changes made.
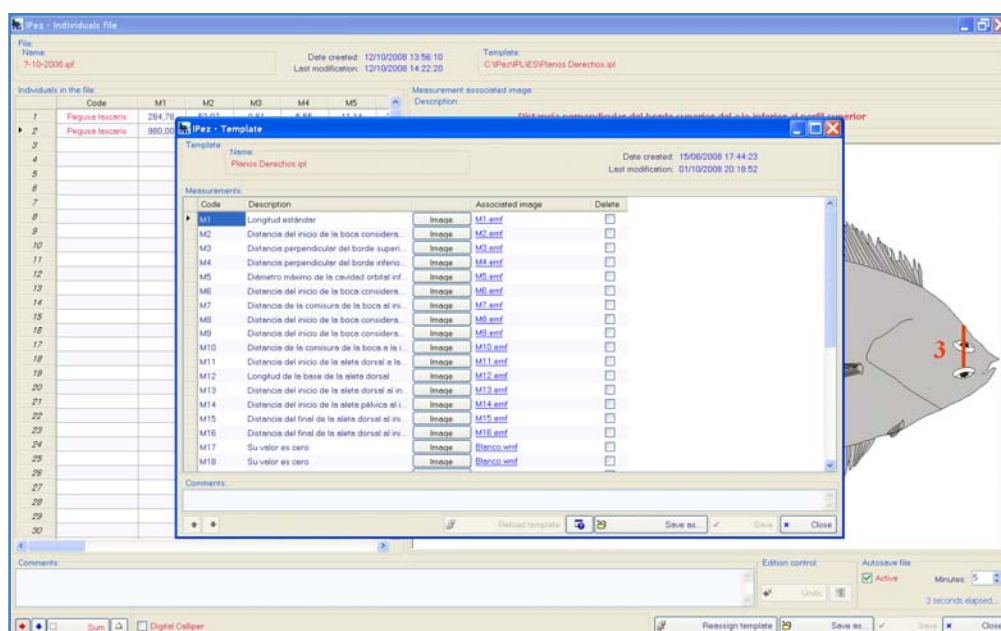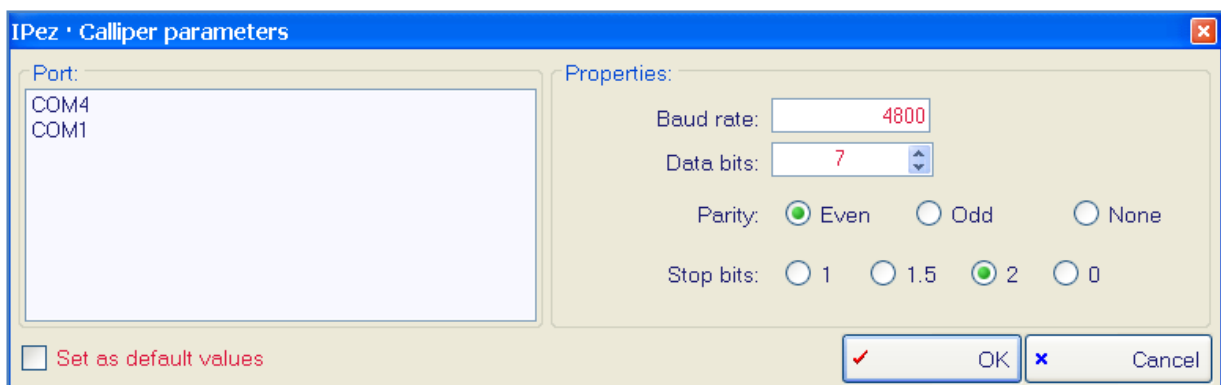
There is a possibility of adding the data up while working, whether they are introduced with the calliper or manually using the keyboard. Suppose that a measurement is larger than the maximum the calliper can measure. In the bottom left of the screen select "Sum" and each time that data are introduced with the calliper or keyboard, they are added to the previous data. When "Sum" is selected, data delivery by the calliper does not automatically send it to the following cell and, therefore, this has to be carried out manually with the mouse or the keyboard. Once positioned on a new cell, start the adding process again from scratch.

It should be emphasized that the "Sum" button has to be deactivated for the program to stop adding data and move automatically from cell to cell. If it is not deactivated or the cell is not changed, the data will carry on been added. Moreover, the addition can be activated or deactivated by simultaneously pressing the ALT and S keys.

Finally, the program is designed for use with different types of callipers. If a calliper with a direct USB connection is used, the data will be directly introduced to the data file once they are sent by the calliper and move automatically to the following row or column, depending on the type of movement selected with the arrows.

It is worth mentioning that for some callipers with direct USB connection to laptop computers, the number control must be activated, by simultaneously pressing the **Fn** and **Num Lock** keys to be able to send the data.

If the calliper has a RS232 connection, "Digital Calliper" should be selected even if the computer is connected to a cable that changes the connection from RS232 to USB. The following window will appear, where it is possible to define the port to which the calliper is connected and its properties, as specified by the manufacturer. These properties can remain recorded by default for when the same calliper is used in the same port, without needing to redefine them.

IPez · Calliper parameters		
Port:	**Properties:**	
COM4 COM1	Baud rate: 4800	
	Data bits: 7	
	Parity: ● Even ○ Odd ○ None	
	Stop bits: ○ 1 ○ 1.5 ● 2 ○ 0	
☐ Set as default values	✔ OK	✖ Cancel

To know to which port the calliper is connected, go to "Control panel", then "System", followed by "Hardware", and "Device manager" within that window and, finally, into "Ports (COM & LPT)".

V. Identification of species

One of the most important aims of the *IPez* program is to make the identification of adult fish individuals easier. In the following screen, it can be seen how it is possible in the "Identification" menu to identify a species, by direct interactive data insertion or by using data from a file.
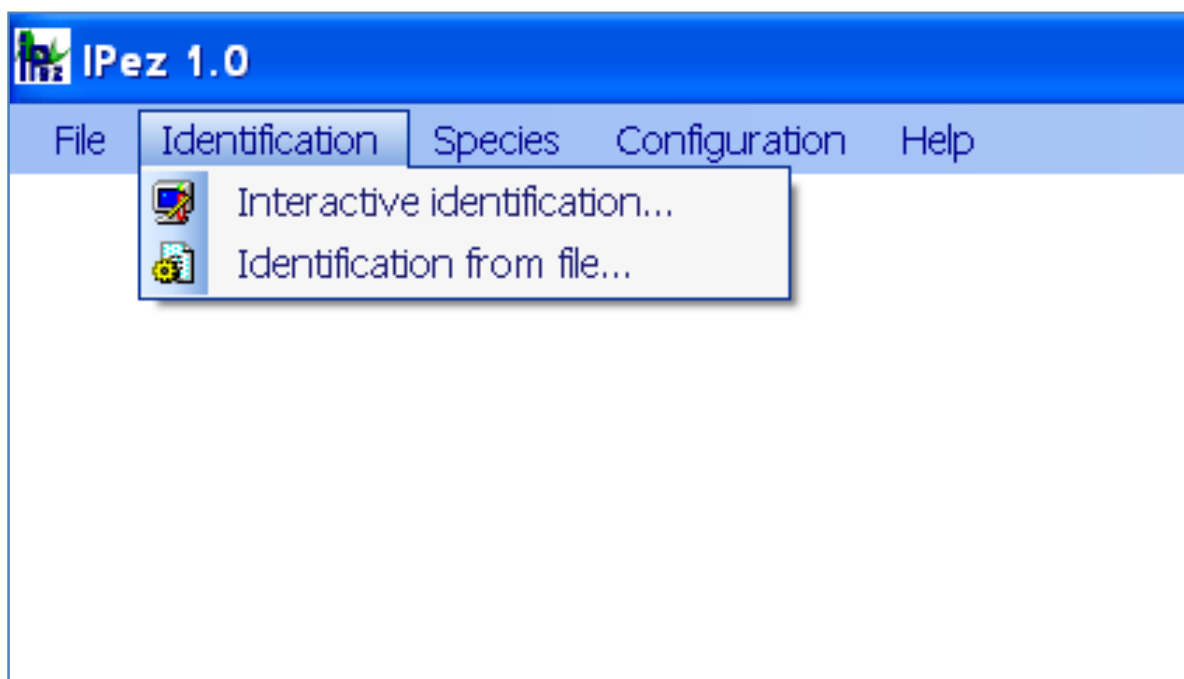

For both forms of identification, interactive or based on data from a file, a series of morphometric variables have to be measured. These are detailed in the Appendix at the end of this Help manual. This Appendix includes all the types of measurements for the fishes belonging to the class Actinopterygii, for those in the orders Pleuronectiformes, Anguilliformes, Ophidiiformes, Lophiiformes and Syngnathiformes of the class Actinopterygii with a morphology slightly different from the rest of the fishes in that class, for the Batoid fishes and sharks of the class Ellasmobranchii, for the class Cephalaspidomorphi, for the class Myxini, for the class Holocephali and, finally, for the class Sarcopterygii.

V.1. Interactive identification

The following window appears in the section "Interactive identification", where the program will request the different morphometric measurements that have to be introduced for each one of the levels to identify the order, family, genus and species.

The first task is to select the type of fish that is going to be identified, left-eyed flatfishes, right-eyed flatfishes, sharks etc. The measurements can be introduced by keyboard or by using the calliper. The procedure for introducing data with the digital calliper is the same to that used for templates. Hence, digital callipers can be used that

are directly connected to the USB port and activation of the calliper will not be necessary, but if digital callipers are used with a RS232 connection, it will then be necessary, as previously explained, to activate the calliper and to define the type of calliper used.
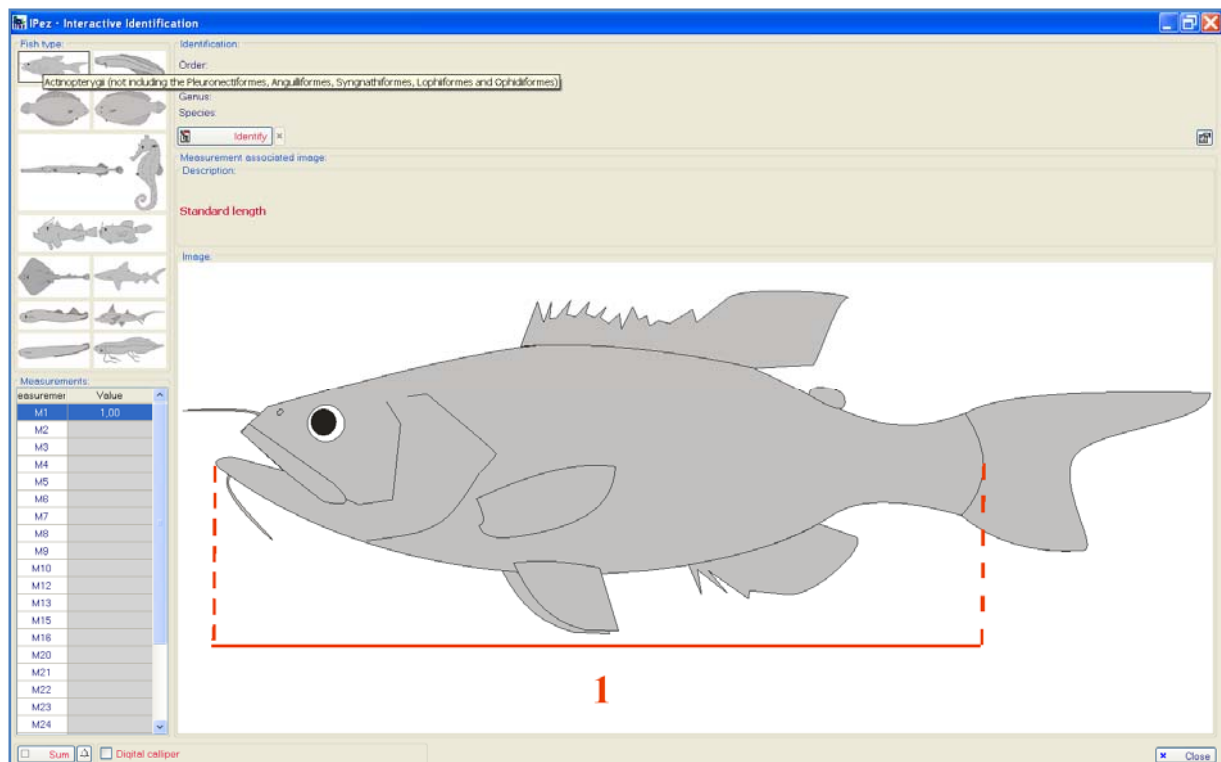

The measurements that have to be inserted to identify each level, order, family, etc., may change as more species are introduced into the database. The program will adapt to the new situation involving the new species, by searching for the measurements that give a better differentiation of the different taxa within each level. When the program updates, all the modifications are automatically incorporated.

Once all the variables are introduced, click on "Identify" to proceed with identification of each one of the levels. When at any level the measurements inserted do not coincide with any of the taxa in the database, the result will be "unidentified", and information can be obtained about the most probable taxon and which measurement deviates from it.

On the other hand, if there has been positive identification, that is, if the order, family, genus or species is identified as belonging to one of the taxa in the database, the most probable taxon to which that individual belongs will appear. If a photograph is available, it will be shown together with information about the taxonomic characteristics of the species.

In addition to identifying the order, family, genus and/or species, available information about any of the taxa can be accessed in the *FishBase* web page, by simply clicking on the relevant taxon, as shown in the following window.
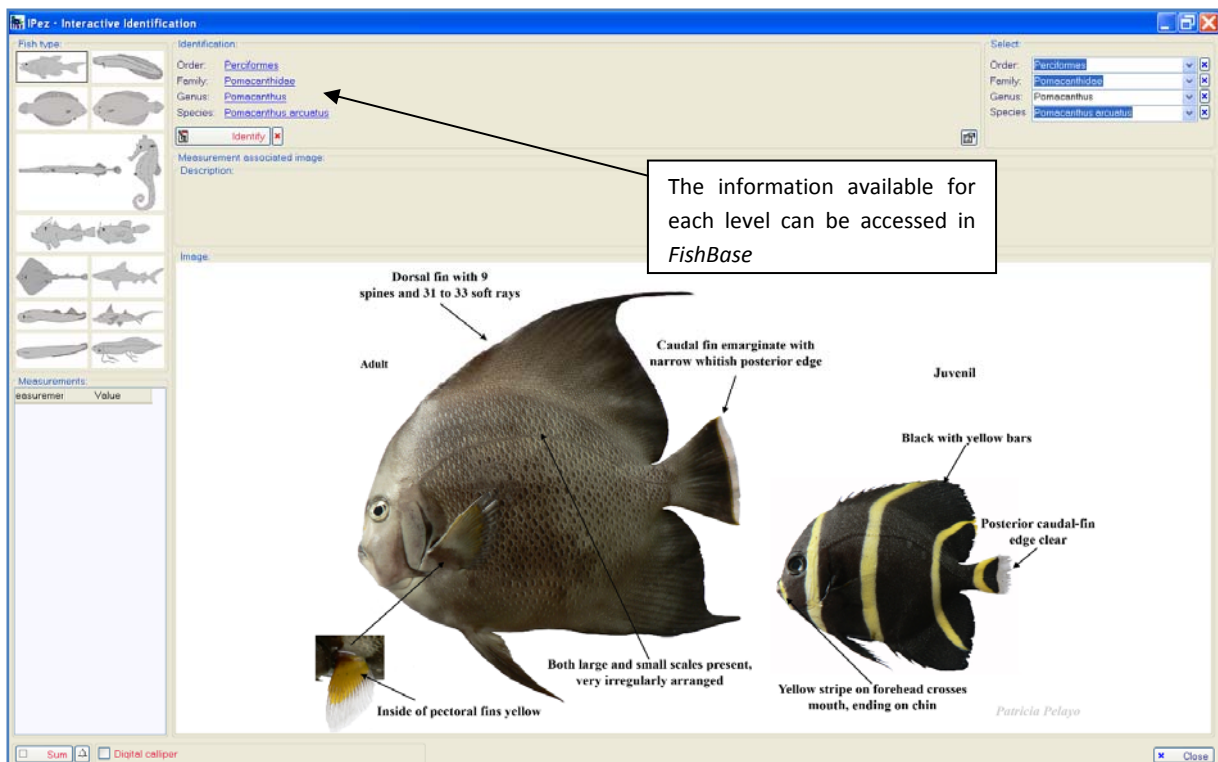

To make identification easier if you already know the order, family and/or genus, there is a direct access that allows the taxon to be specified, without having to insert all the variables necessary for identification at this level. Only the taxa available in the database appear, not all the taxa that exist at that level.
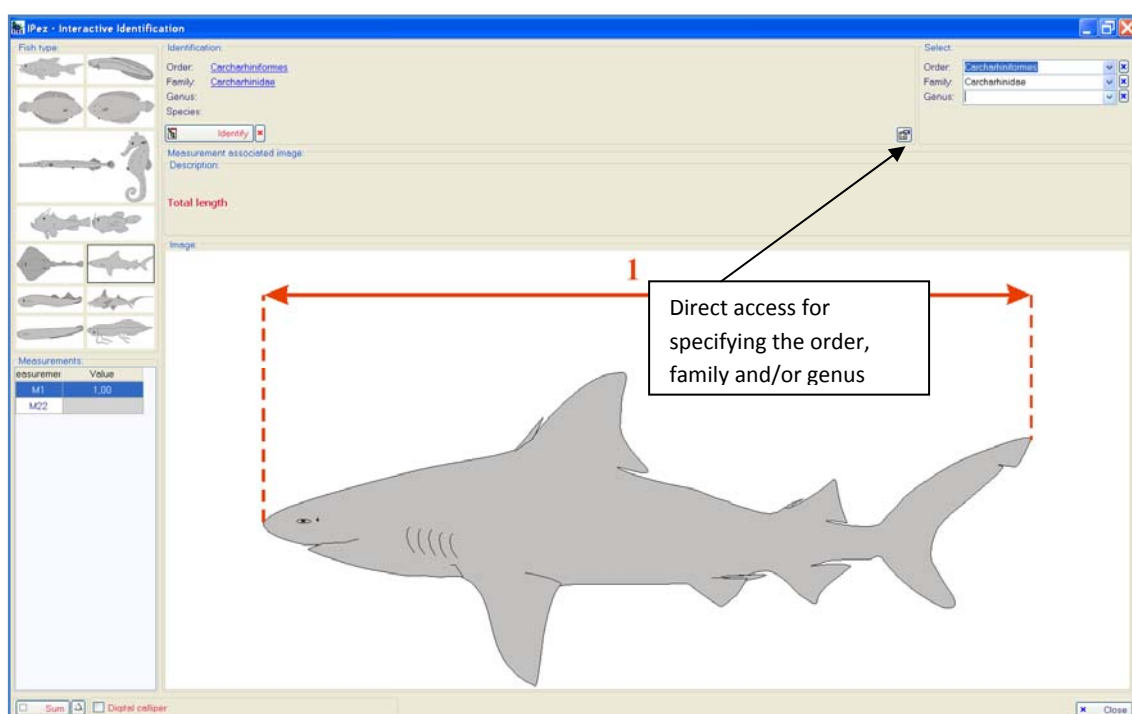
Once a level has been identified, for example the family, the photograph associated to that level can be seen on the main screen, if it is in the database, while the figures for each one of the morphometric measurements required to identify the next level continue to appear on the "Interactive identification" window.
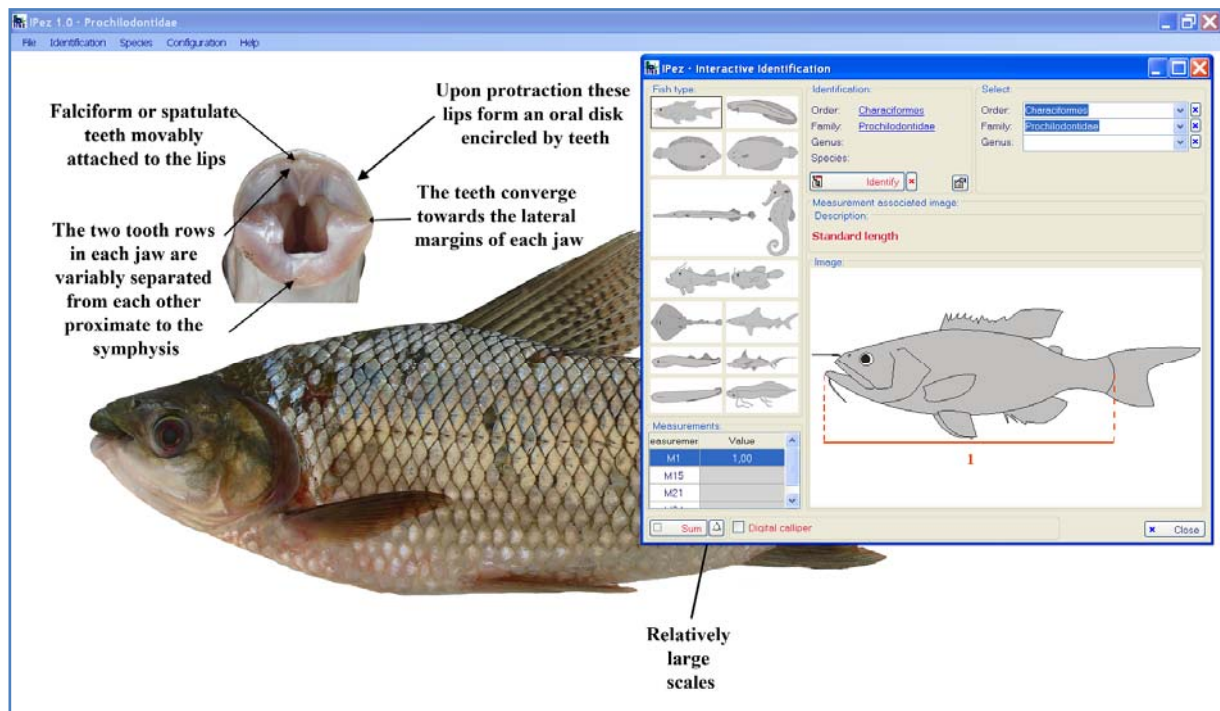

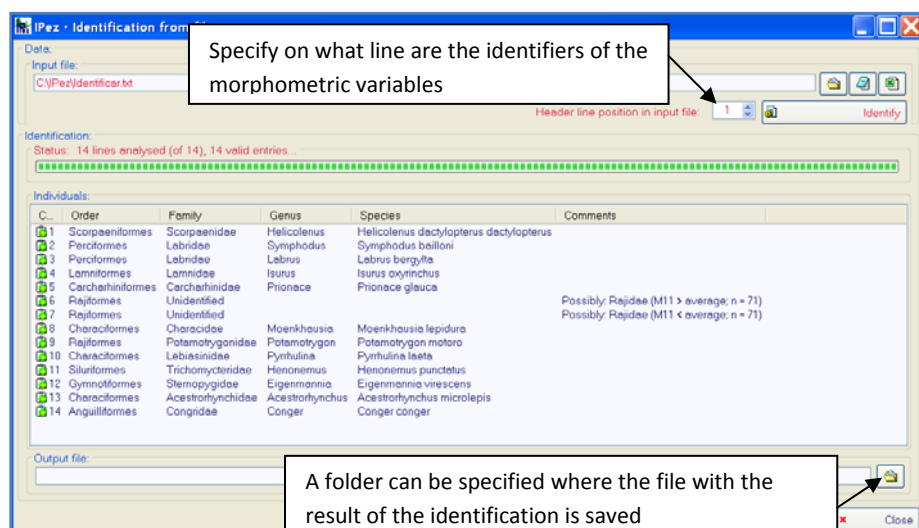
V.2. Identification from file

With this option, it is possible to identify species by introducing data into the program from a file. There are two important differences between "Interactive identification" and "Identification from file". In the former, it is only possible to enter one individual at a time, while in the latter a list of many individuals can be all simultaneously identified. The disadvantage of this second method is that the 32 variables indicated in the Appendix have to be available for each individual, whilst in the former less variables are required, because *IPez* makes a single selection as only one individual is being identified.

In the previously described "Identification" menu, on accessing "Identification from file" the window shown below appears. The name of the file with the individuals to be identified is entered into this window. This file can be one generated directly using some of the templates and that has an "ipf" file extension, or it can be a file generated using Notebook or Excel with a "txt" file extension. Later on, there will be a description of how to set it up. In the *IPez* folder C:/IPez/Docs/Help/ES, there is a file called "Identificar.txt" that can be used as an example.

Once the file is specified, it is possible to open it with Notebook or Excel, in a rapid and convenient way using the buttons marked on the screen, and to make the necessary modifications to the file.

Button for identifying the file access path

Choice of opening the file with Notebook or Excel
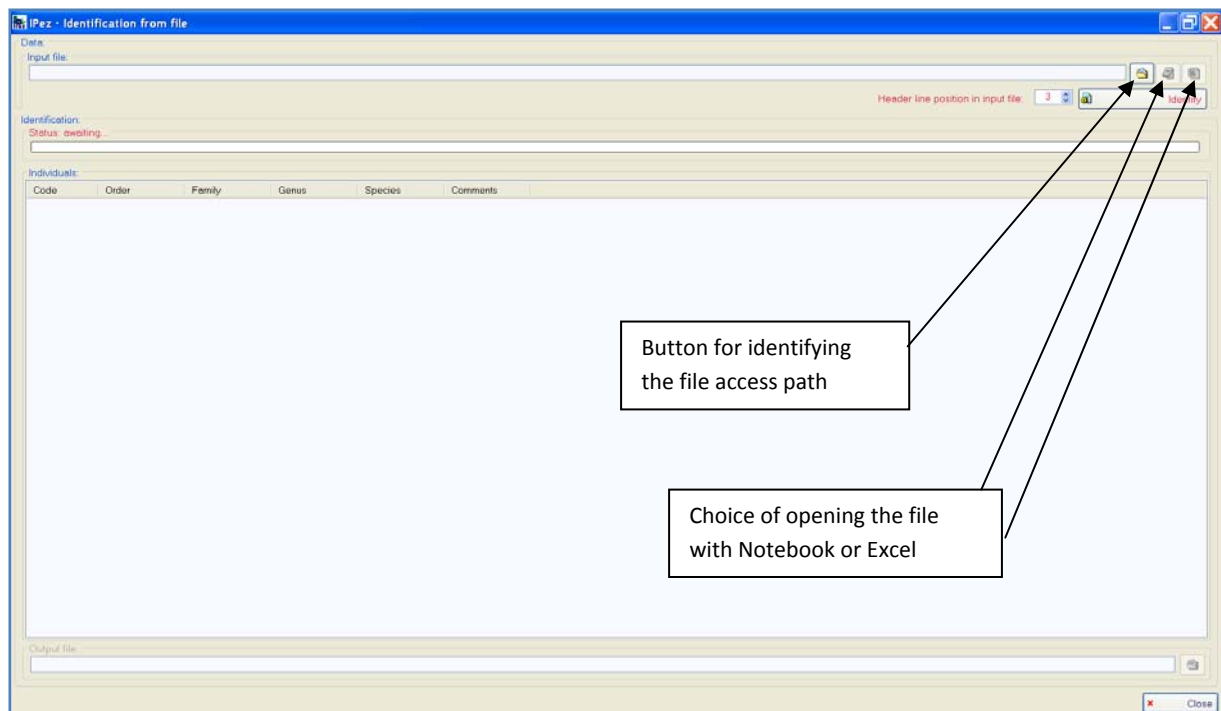
Finally, prior to identification, it is necessary to indicate in what line is the header where the codes of the morphometric variables are indicated, which should have the format M1, M2, M3, M4......M32.

Specify on what line are the identifiers of the morphometric variables

A folder can be specified where the file with the result of the identification is saved

As shown in the previous screen, the result of the identification is obtained, and if some individual was not identified at any level, the most probable taxon or taxa is indicated, when the probability of belonging to a taxon is higher than 0.2, together with the measurement that is outside the range for that taxon/taxa. In addition, information appears about the number of individuals that are in the database of that taxon. It could

be that this measurement was badly taken or that, due to the small amount of data for that taxon, the mean is not representative and, therefore, the measurement does not deviate from the taxon because it was badly taken, but because the amount of data for that taxon is insufficient to be able to correctly take that measurement for that particular taxon.
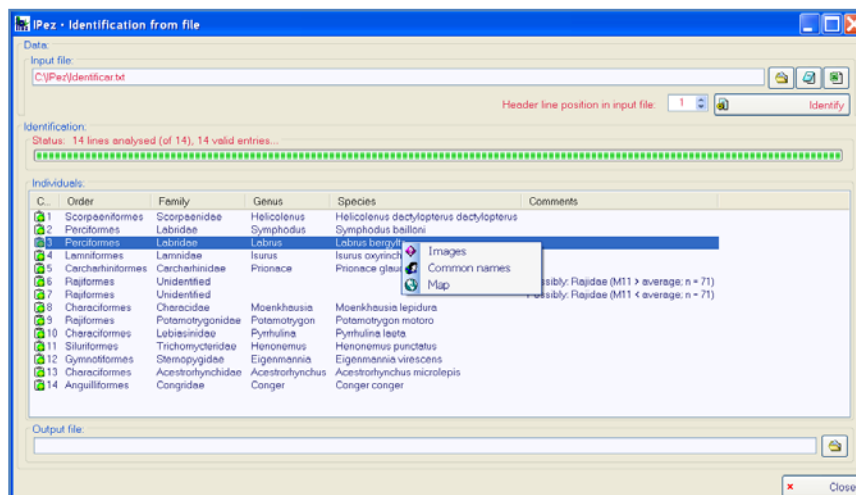

When the cursor is positioned on any of these lines, by clicking on it with the right mouse button it is possible to obtain information about common names (if the identification process has reached species level). After selecting common names, the following window is shown, with the names of that species as they appear in the *FishBase* web page, as well as in local languages and in the indigenous languages of different countries. These names can be ordered by common name, by where the name is used, and by language.
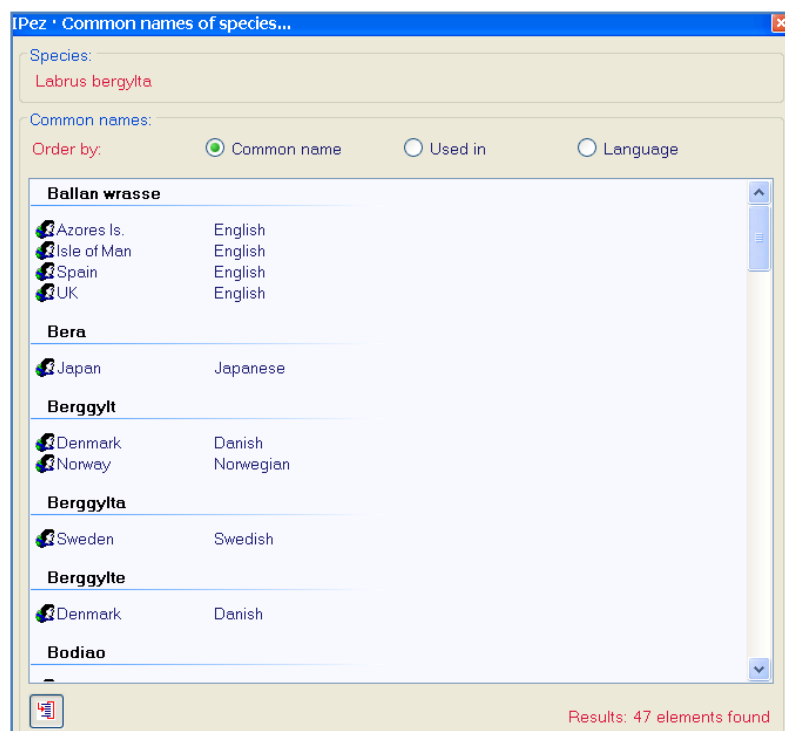
By selecting "Images" it is possible to see the photograph of the order, family, genus and/or species, if it has been identified and the photograph is available in the database, then the following window will appear.
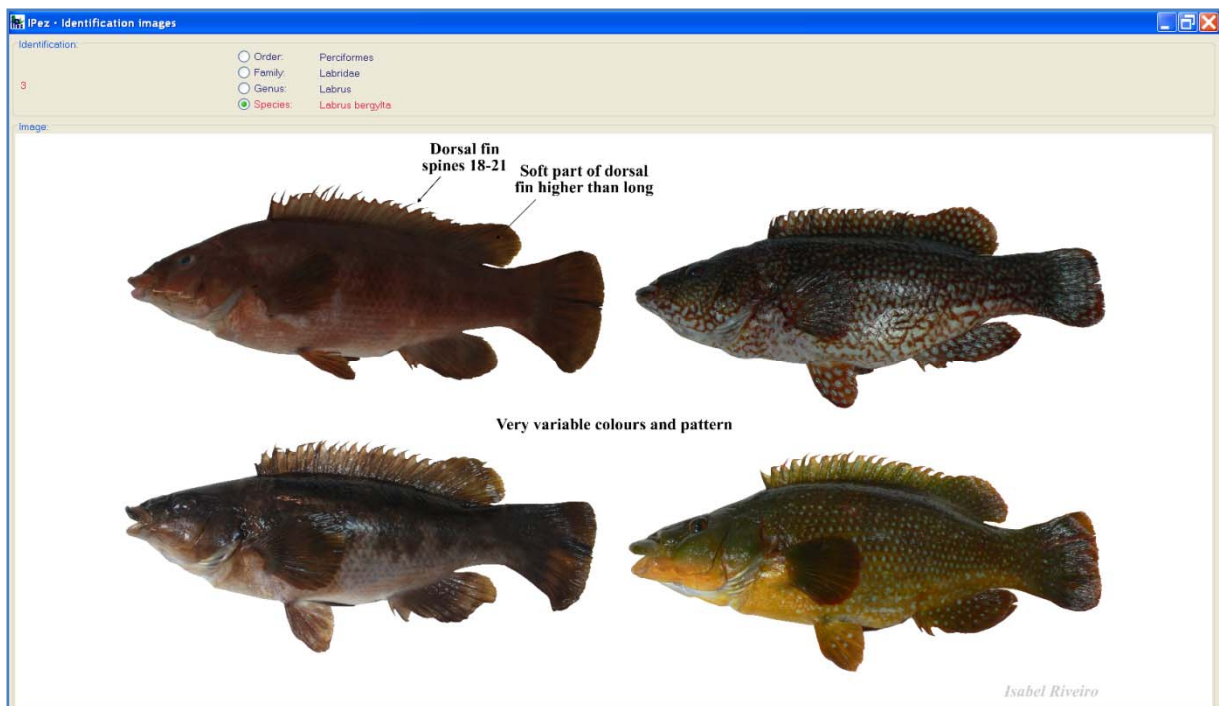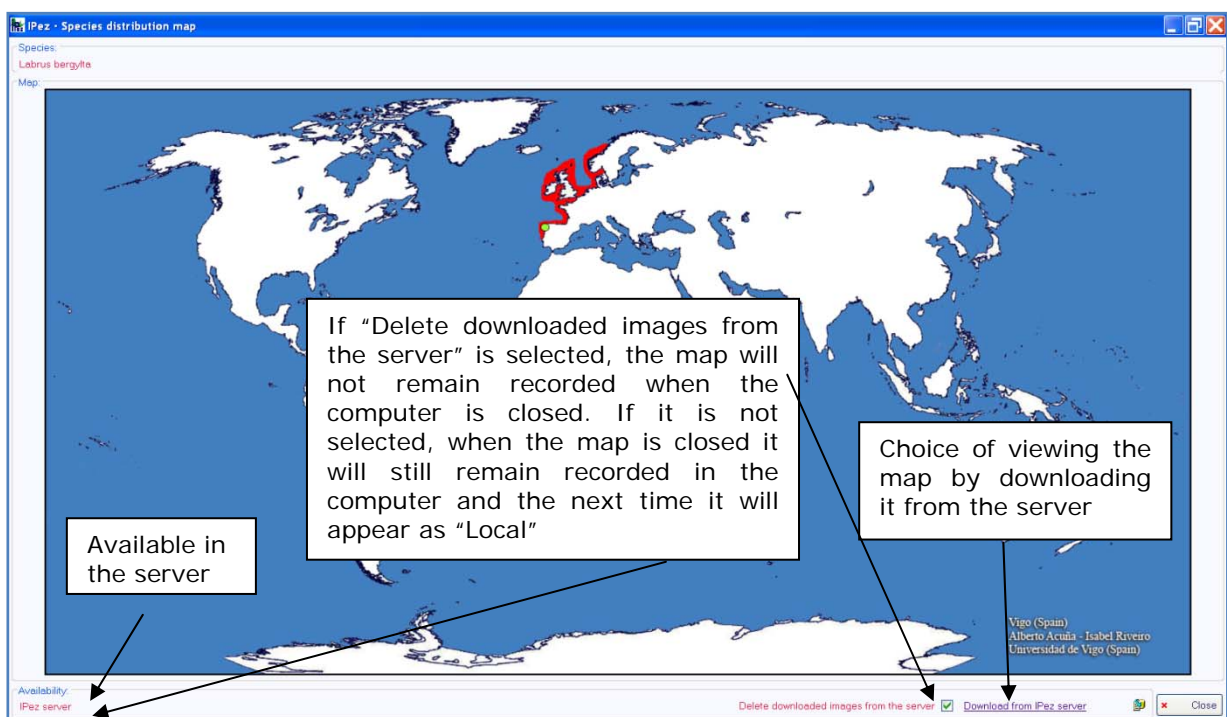

When it has not been possible to identify a particular taxon, the images then appear of the last taxon identified, as is shown in the following example.
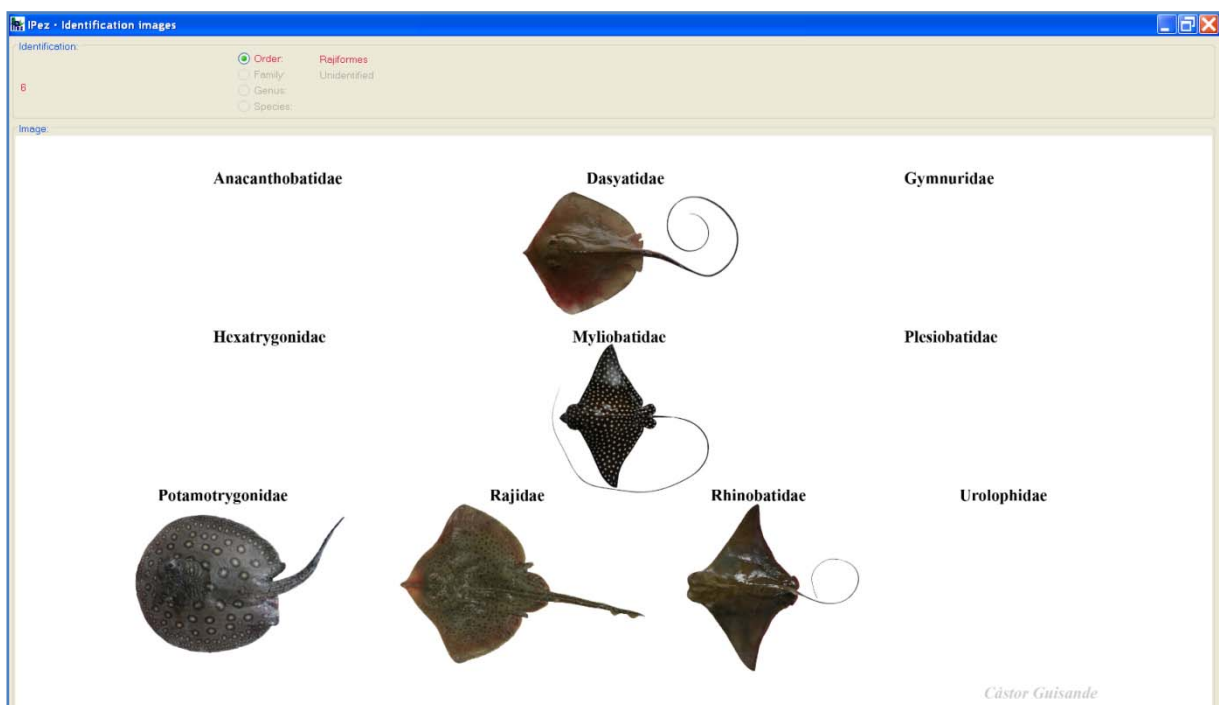
The species distribution map can also be seen, if it is available in the computer as "Local" or in the database of the "IPez Server". If it is available as "Local", the map will appear as shown in the following window.
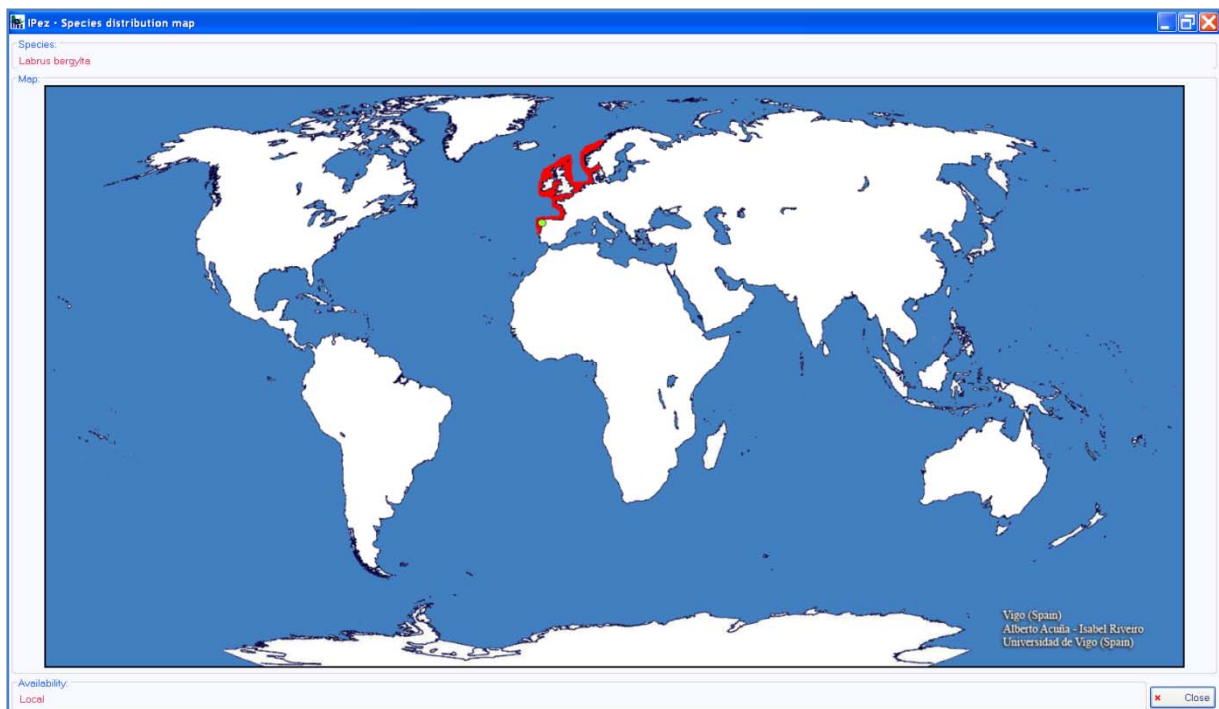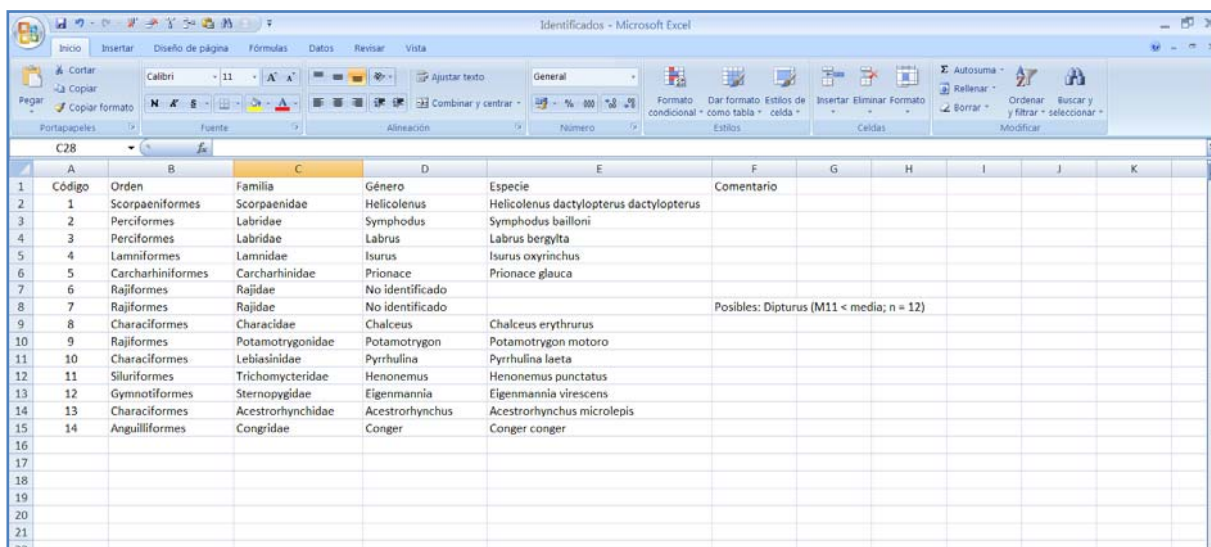
If the map is not available in the computer but is available from the server, it is possible to view it and download it from the server and when closing the map it can be saved in the computer if required.

If "Delete downloaded images from the server" is selected, the map will not remain recorded when the computer is closed. If it is not selected, when the map is closed it will still remain recorded in the computer and the next time it will appear as "Local"

Choice of viewing the map by downloading it from the server

Available in the server

As previously described, it is possible to save the file with the results of the identification. Clicking with the right mouse button on the created file, it can be opened with Excel as a spreadsheet and the result of the identification is obtained, as shown below.
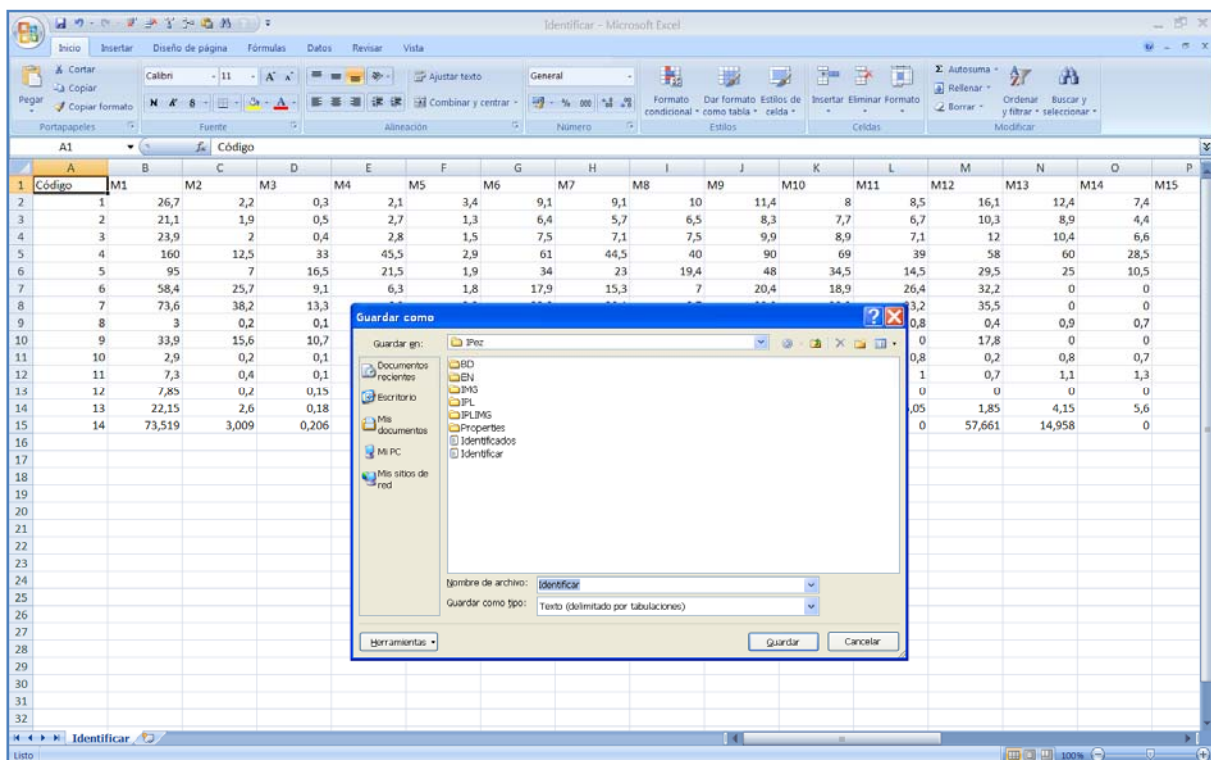

To create a file with a "txt" format from Excel, simply save the file as "TAB-separated text". In this file, the first column should indicate the code that has been assigned to the individual and the following columns should include all the previously described measurements. There is no limit for the number of files, so that all the necessary individuals can be identified.

VI. List of species

The "List of species" can be accessed from the "Species" menu. This list includes all the species recorded in the program for which data of morphometric measurements are available and, therefore, they can be identified.

The species are arranged by classes, orders, families, genera and species, and are alphabetically ordered within each level. If a photograph is available in the database, it is possible to see the photograph for each one of the levels (order, family, genus and species) in the small window and in the window of the main menu.

The most important characteristics that identify the family, genus and species are included in each one of these photographs. At the order level, photographs are shown of all the families in the order that are in the database.

The program can search by scientific names and by common names. In both cases, it is possible to search at all levels (selecting "Any") or at only the level of order, family, genus or species, or even a combination of 2 or 3 levels, quitting the selection "Any" and selecting the search levels. If "B" is selected, the program searches for coincidences at the beginning of the word, if "M" is selected it searches for coincidences in the middle of the word, and with "E" it searches for coincidences at the end of the word.
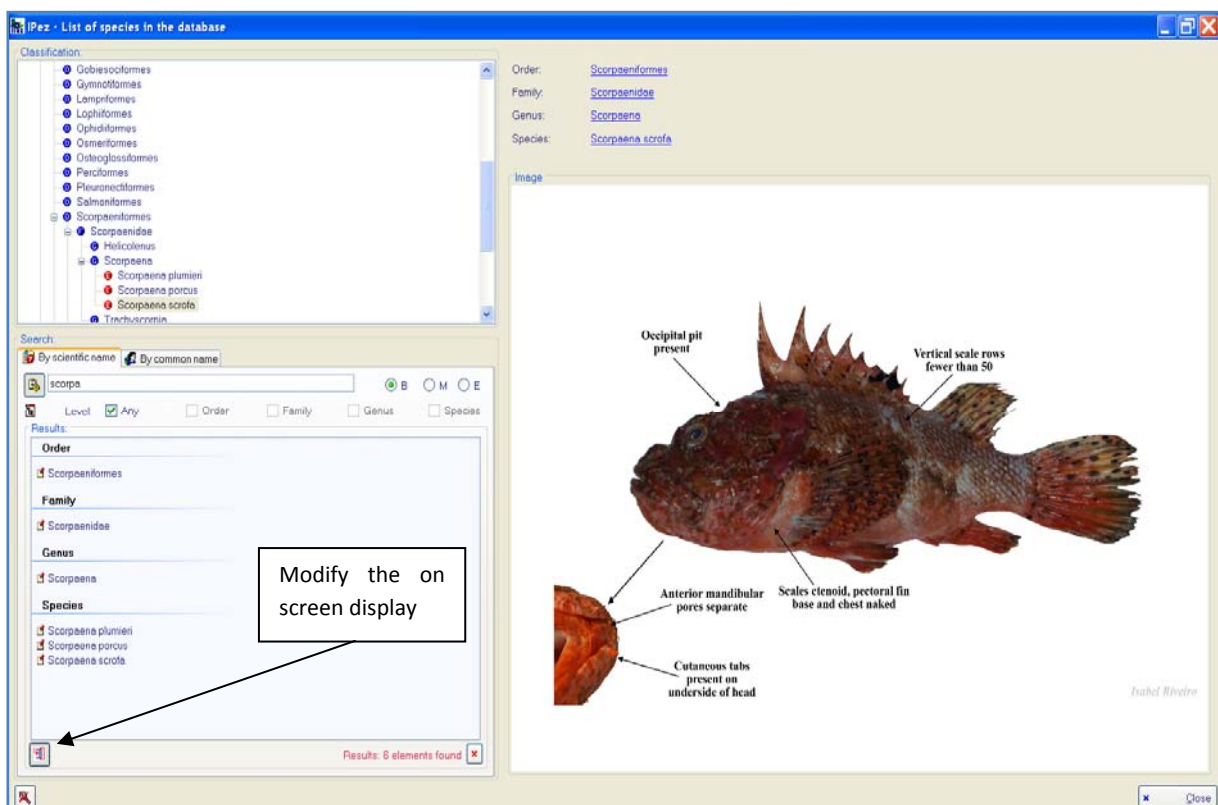
At the button indicated at the bottom left of the above screen, the display of the on screen search can be modified to a different format, which is shown on the following screen.
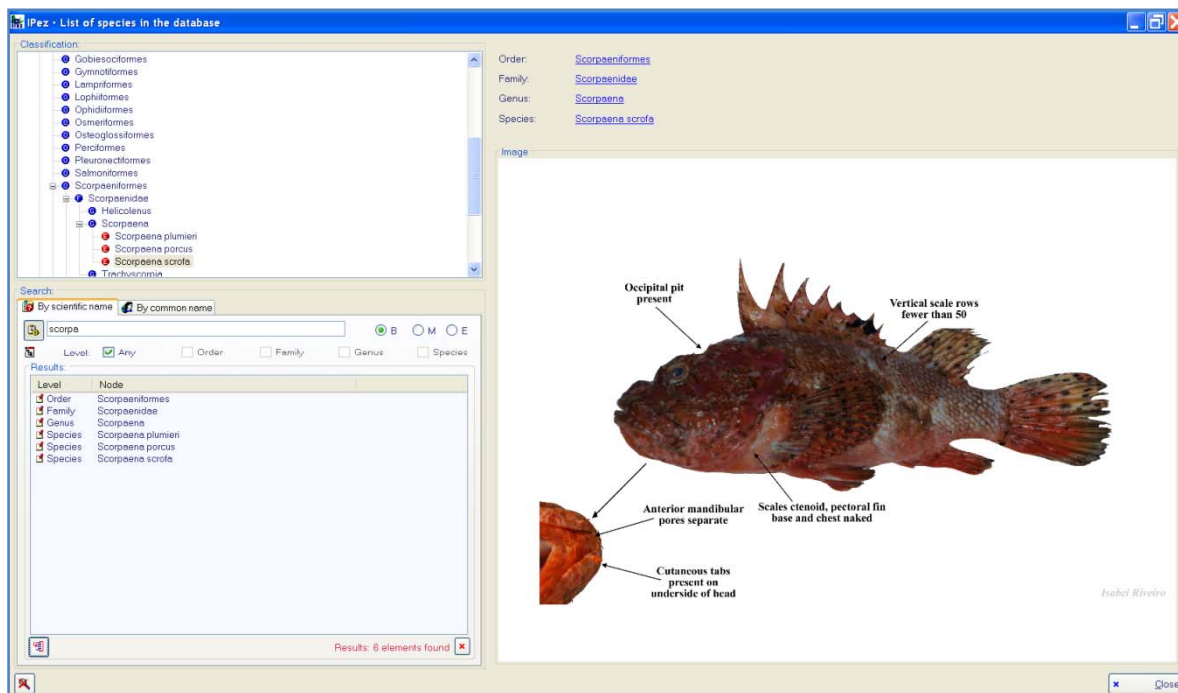
By clicking the right mouse button on the photograph of the species, besides being able to see the species distribution map as previously shown, all the common names can be obtained as they appear in the *FishBase* web page, as well as in local languages and in the indigenous languages of the different countries. These names can be ordered by common name, by the countries where the name is used, and by language.
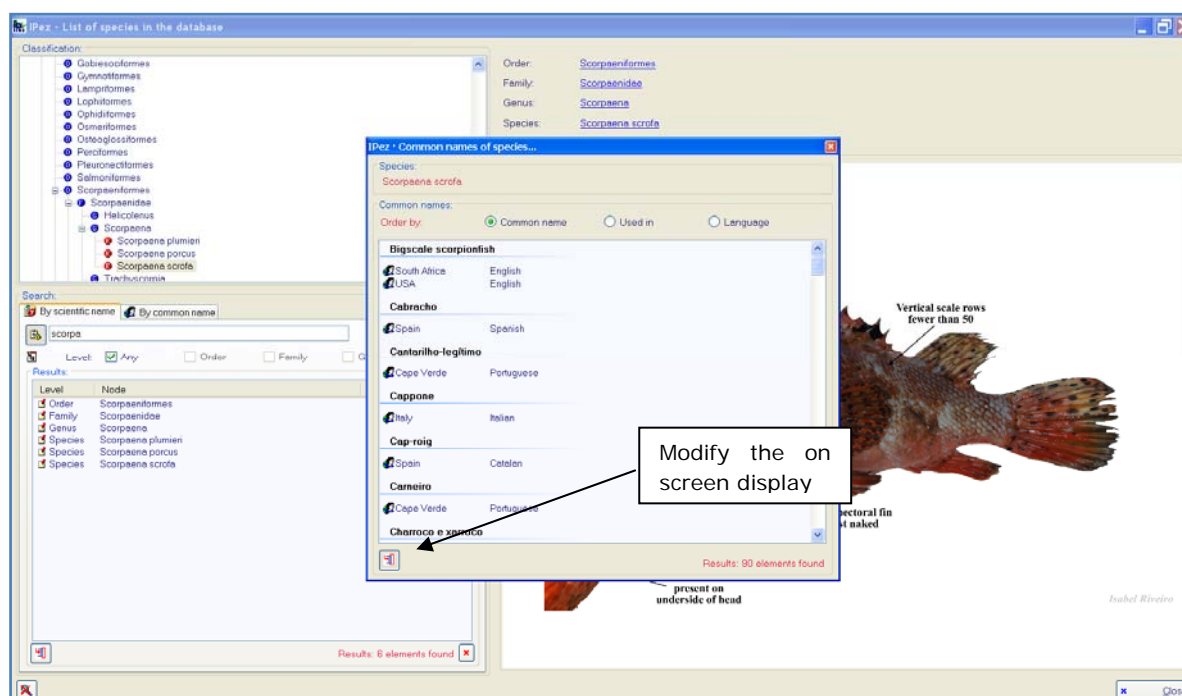
As before, the screen display can be modified to the format shown in the following window.
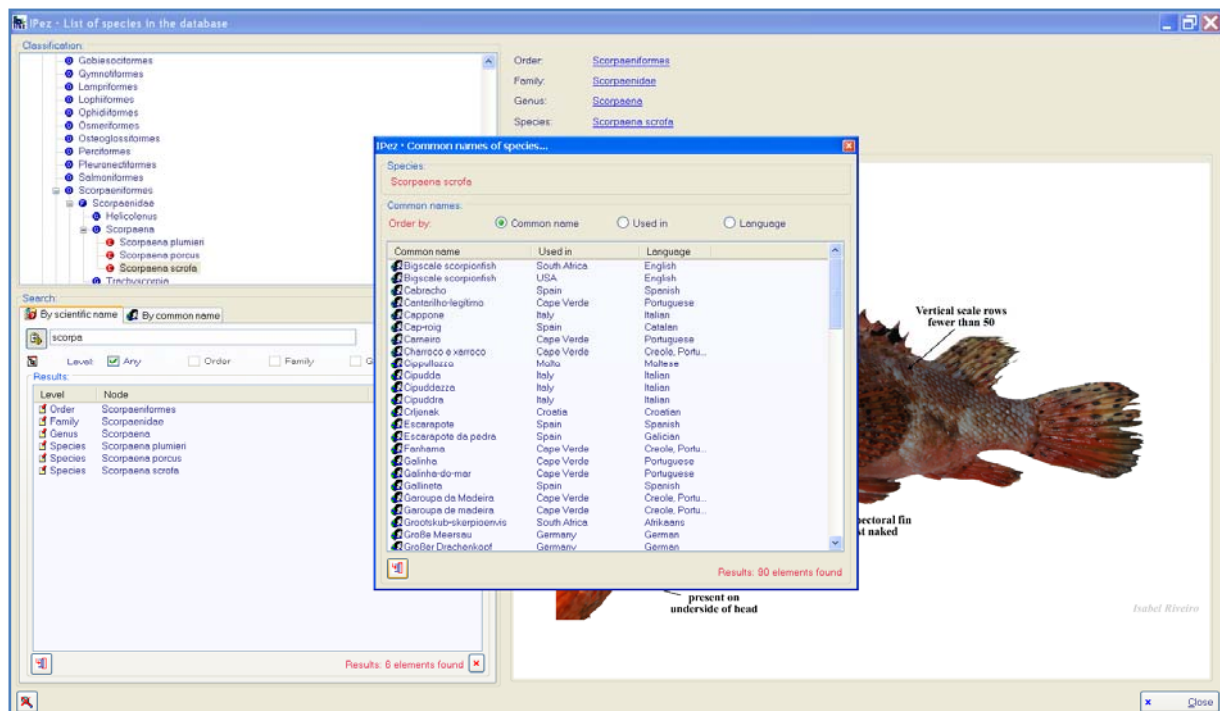
When searching by common names, the information can also be ordered by the names, by where they are used, and by the language to which it belongs.
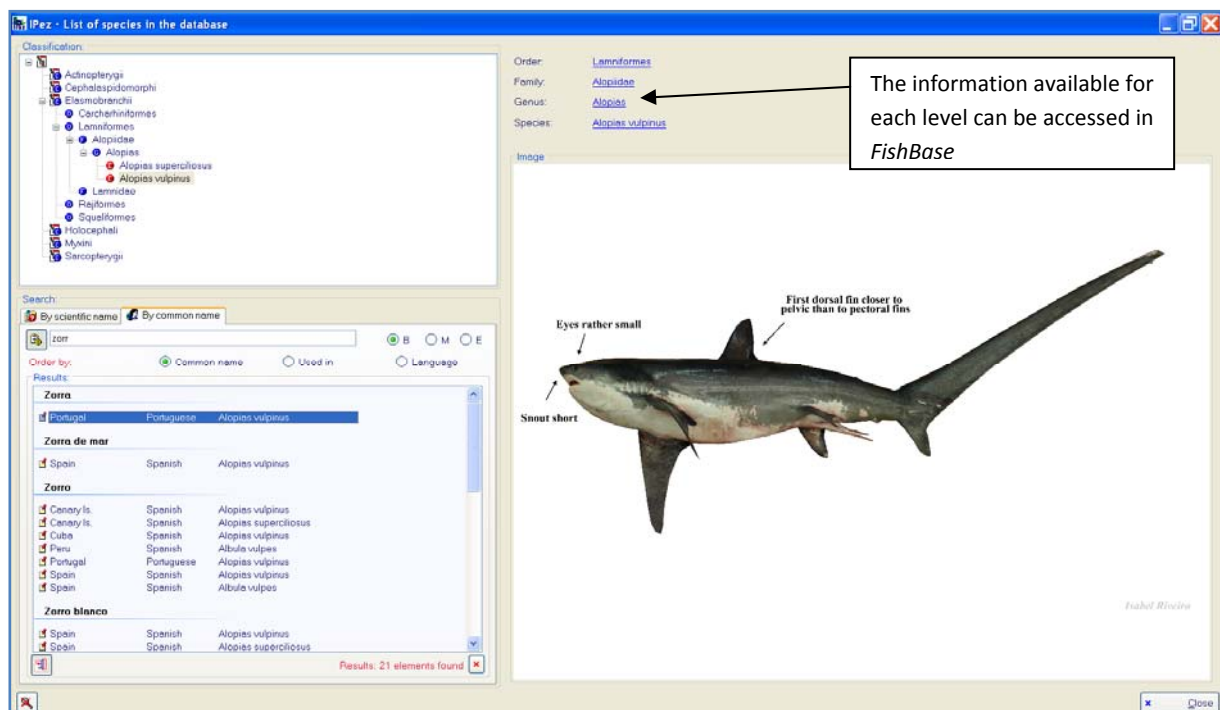
As shown in the above screen, the *FishBase* web page for that taxon can also be accessed by clicking on any of the levels (order, family, genus or species).
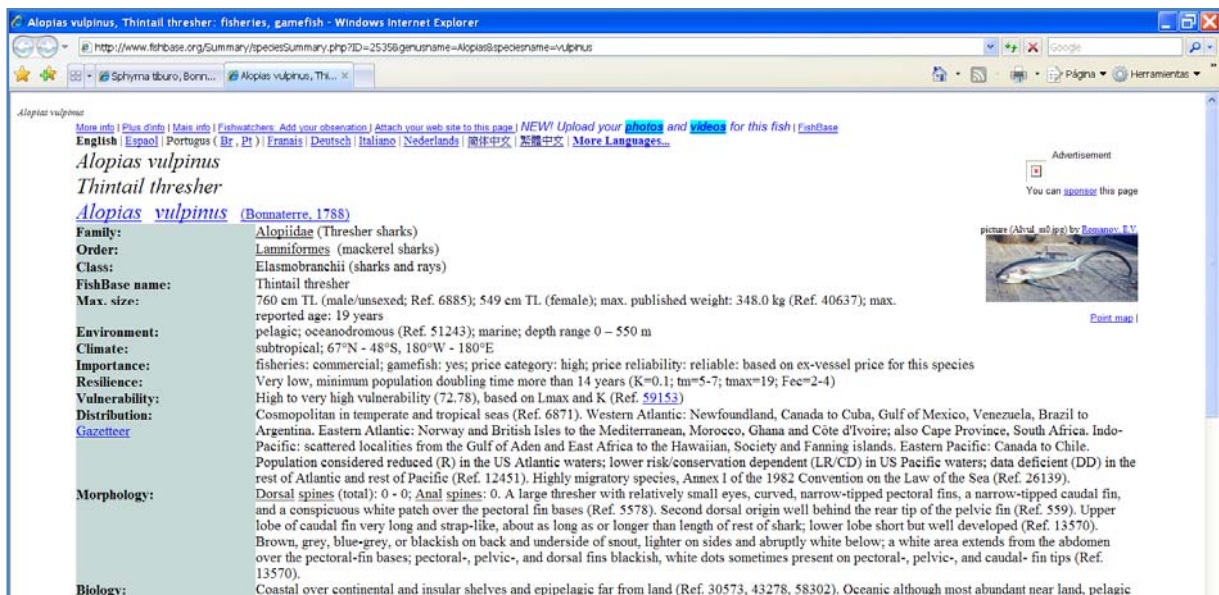
Finally, there is an option that allows viewing the photographs in different languages. If the cursor is positioned on the photograph, and then the right mouse button is clicked on it, the multilanguage option appears as can be seen in the following screen. This multilanguage option is also available for the photographs that appear in the main menu.
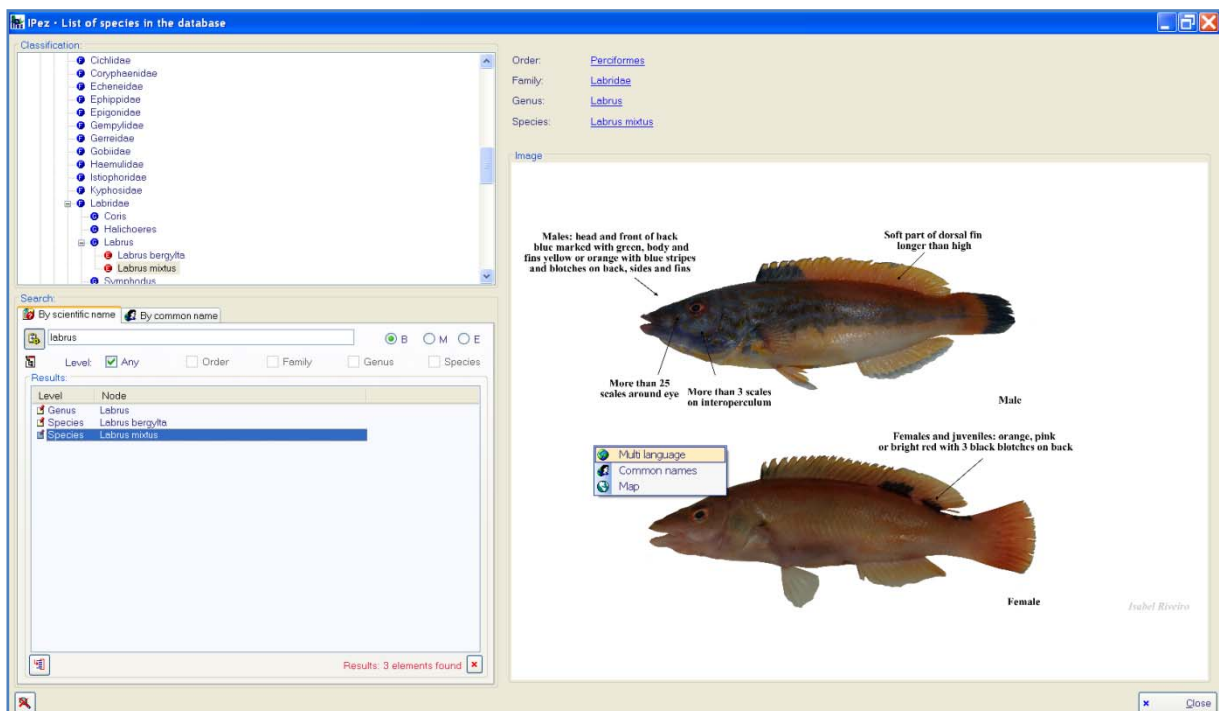
In the multilanguage option, the following window appears detailing the languages in which this photograph is available and whether the photograph is in the computer ("Local") or is available in the server. When it is available in the server, the photograph can be seen in that language. To do this, position the cursor on the image to be downloaded from the server, and then click on "Download from the server".
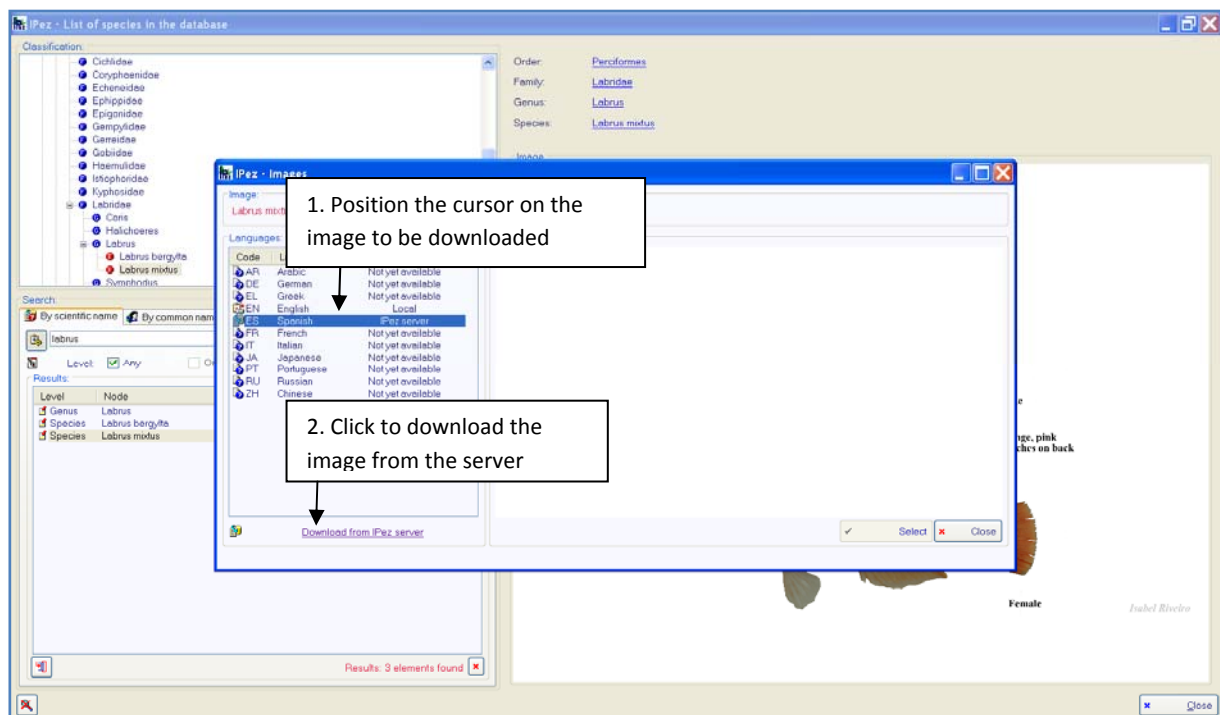
By clicking on the "Select" button and then on "Close", the photograph will then appear on the "List of species" screen, as shown in the following window. It would be the same process in the main screen.
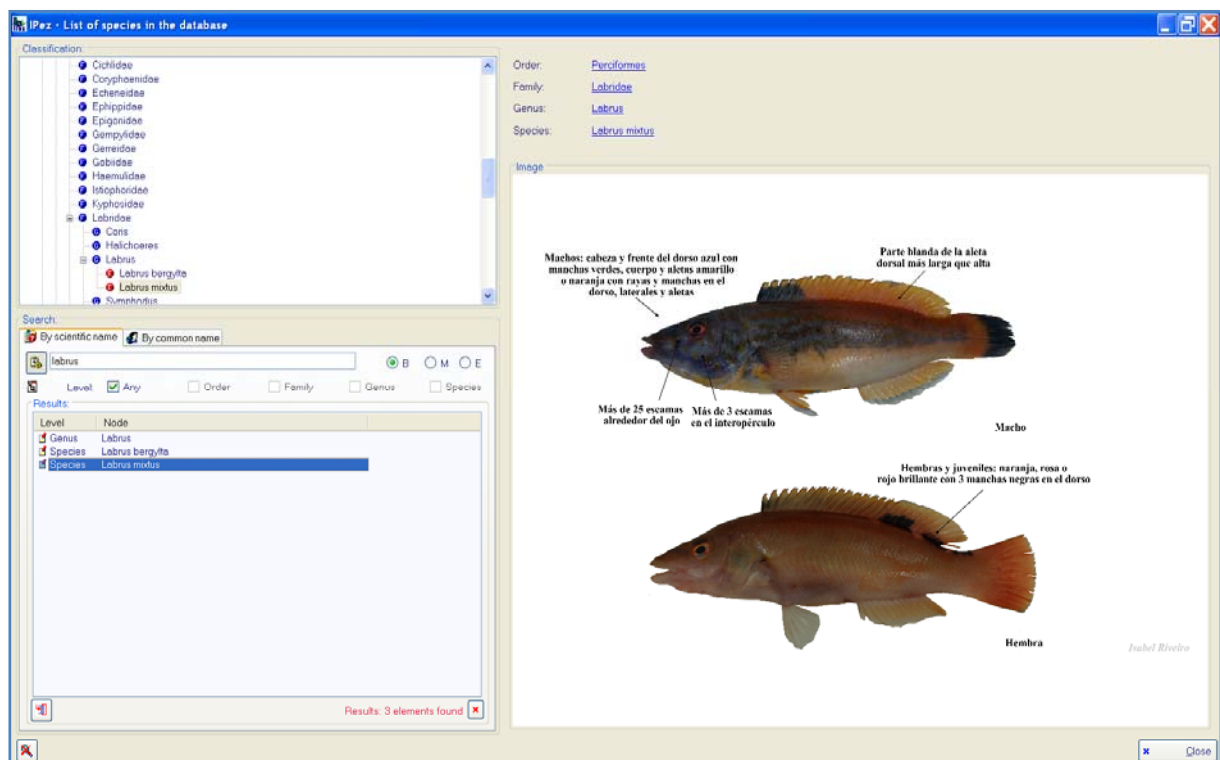
Using the same procedure, the photographs can be viewed in other languages without having to record them in the computer, in other words, using less computer storage space. However, if the photograph is to be inserted in the

computer, simply do not select the option "Delete images downloaded from the server".

Deactivate the delete option
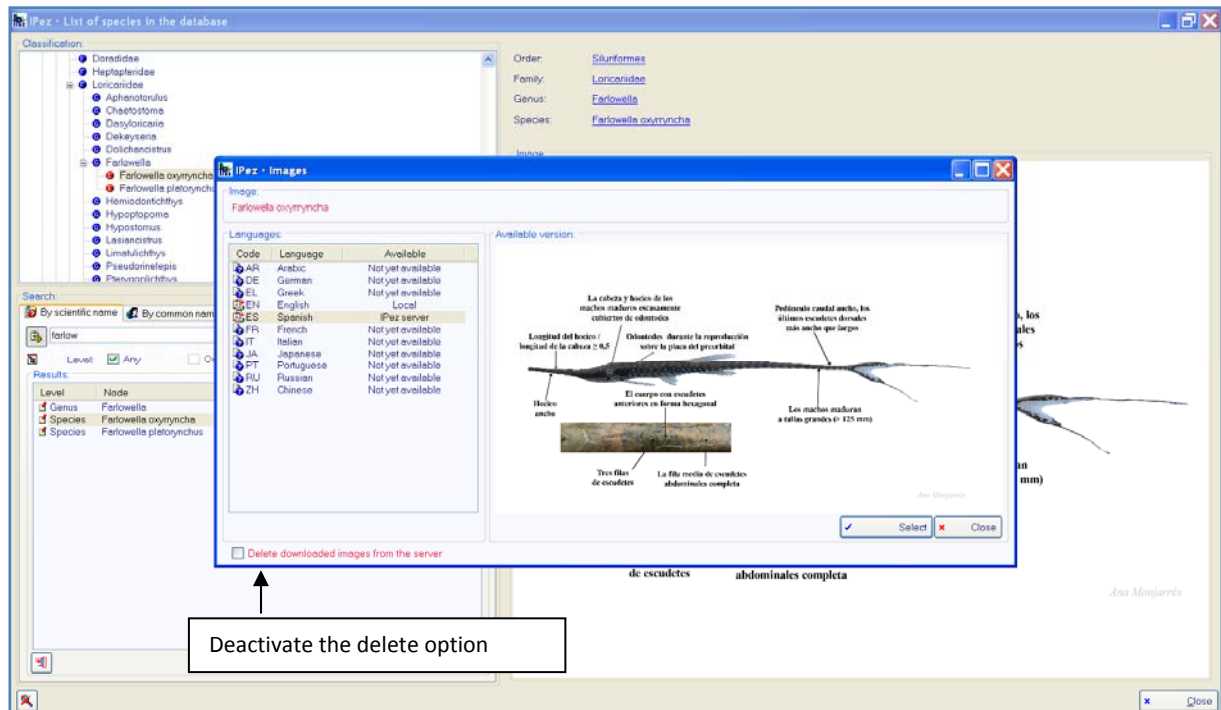
Quitting the multilanguage menu in this way, the photograph will remain recorded in the computer. The next time that this photograph is accessed, the version of the photograph in English will appear as "Local", that is, saved in the computer, whereas previously it was only available in the server.

Image now available in the computer
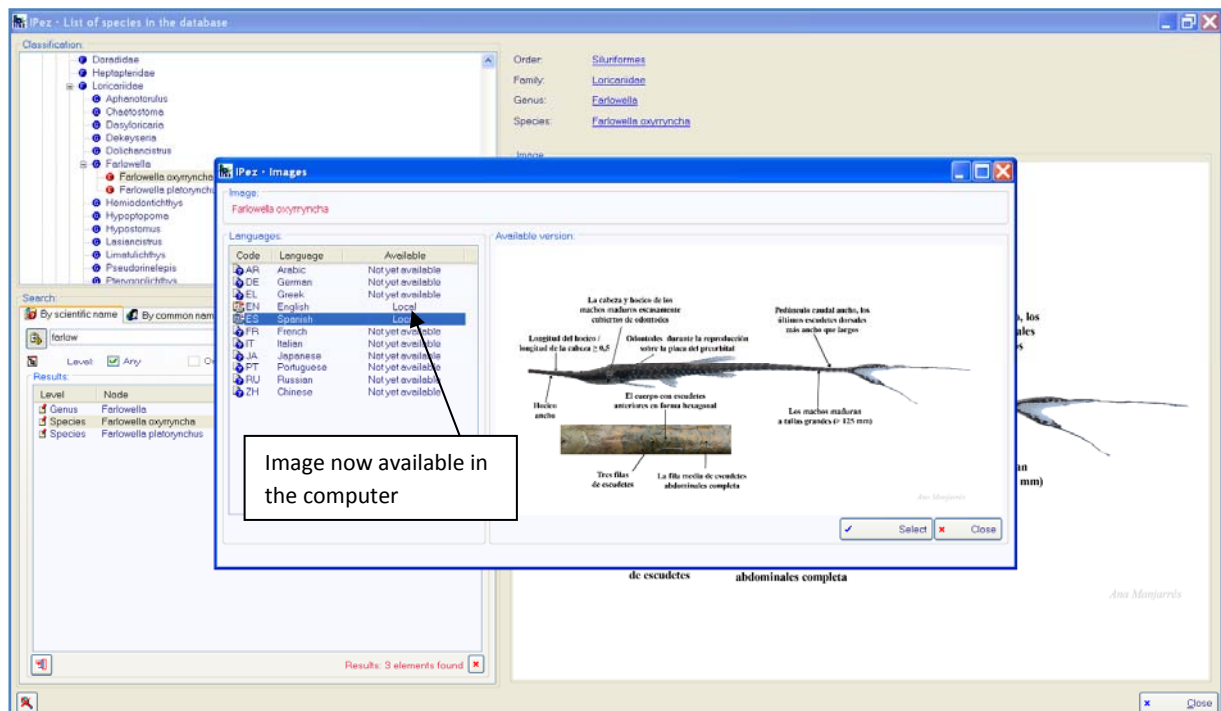
VII. Appendix

VII.1 Class Actinopterygii

For all species that do not belong to the orders Pleuronectiformes, Anguilliformes, Ophidiiformes, Lophiiformes and Syngnathiformes, which have their own templates that are described later, the measurements used for the identification of individuals are the following.

Measure 1. Standard length.

Measure 2. Distance from the origin of the mouth considering the centre of the premaxilla to the edge of the eye.

Measure 3. Perpendicular distance from the upper edge of the eye to the superior profile.

Measure 4. Perpendicular distance from the lower edge of the eye to the inferior profile.

Measure 5. Maximum diameter of the orbital cavity.

Measure 6. Distance from the origin of the mouth considering the centre of the premaxilla to the origin of the dorsal fin. Zero, if there is no dorsal fin.

Measure 7. Distance from the corner of the mouth to the origin of the dorsal fin. Zero, if there is no dorsal fin.

Measure 8. Distance from the origin of the mouth considering the centre of the premaxilla to the superior insertion of the pectoral fin. Zero, if there is no pectoral fin.

Measure 9. Distance from the origin of the mouth considering the centre of the premaxilla to the superior insertion of the pelvic fin. Zero, if there is no pelvic fin.

Measure 10. Distance from the corner of the mouth to the superior insertion of the pelvic fin. Zero, if there is no pelvic fin.

Measure 11. Distance from the origin of the dorsal fin to the superior insertion of the pelvic fin. Zero, if one or both fins are missing.

Measure 12. Length of the base of the dorsal fin considering all dorsal fins and pinnules.

Measure 13. Distance from the origin of the dorsal fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 14. Distance from the origin of the pelvic fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 15. Distance from the end of the last dorsal fin or pinnule to the origin of the pelvic fin. Zero, if one or both fins are missing.

Measure 16. Distance from the end of the last dorsal fin or pinnule to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 17. Distance from the end of the last dorsal fin or pinnules to the origin of the adipose fin. Zero, if one or both fins are missing.

Measure 18. Distance from the end of the adipose fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 19. Distance from the end of the anal fin including the pinnules to the base of the caudal fin. Zero, if one or both fins are missing.

Measure 20. Width of the caudal fin at its base.

Measure 21. Length of the longest dorsal fin radius, including modified rays.

Measure 22. Length of the longest pectoral fin radius, including modified rays.

Measure 23. Length of the longest pelvic fin radius, including modified rays.

Measure 24. Length of the base of all anal fins including the modified rays of spines and pinnules.

Measure 25. Length of the longest radius or pinnule of the anal fin, including modified rays.

Measure 26. Distance from the origin of the caudal fin in its middle section to the distal margin of the fin.

Measure 27. Length of the longest caudal fin radius, including modified rays.

Measure 28. Length of the superior barbels (maxillary and nasal). Select the largest.

Measure 29. Length of the inferior barbels (chin). Select the largest.

Measure 30. Interorbital width.

Measure 31. Width in the central part of the body taking standard length as a reference.

Measure 32. Width in the middle part of the peduncle. It will be zero if it does not have a peduncle.

VII.1.1. Orders Anguilliformes and Ophidiiformes
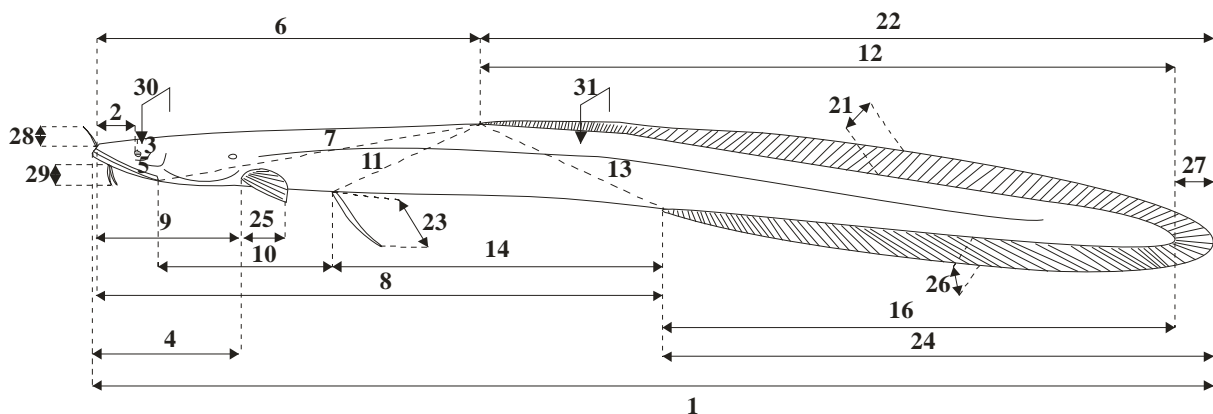
Measure 1. Total length.

Measure 2. Distance from the origin of the mouth considering the centre of the premaxilla to the edge of the eye.

Measure 3. Perpendicular distance from the upper edge of the eye to the superior profile.

Measure 4. Distance from the origin of the mouth considering the centre of the mandible to the superior insertion of the pectoral fin. It will be zero if there is no pectoral fin.

Measure 5. Maximun diameter of the orbital cavity.

Measure 6. Distance from the origin of the mouth considering the centre of the premaxilla to the origin of the dorsal fin. It will be zero if there is no dorsal fin.

Measure 7. Distance from the corner of the mouth to the origin of the dorsal fin. It will be zero if there is no dorsal fin.

Measure 8. Distance from the origin of the mouth considering the centre of the premaxilla to the origin of the anal fin. It will be zero if there is no anal fin.

Measure 9. Distance from the origin of the mouth considering the centre of the premaxilla to the superior insertion of the pectoral fin. It will be zero if there is no pectoral fin.

Measure 10. Distance from the corner of the mouth to the superior insertion of the pelvic fin. It will be zero if there is no pelvic fin.

Measure 11. Distance from the origin of the dorsal fin to the superior insertion of the pelvic fin. Zero, if one or both fins are missing.

Measure 12. Length from the origin of the dorsal fin to the end of the body excluding the caudal fin. It will be zero if there is no dorsal fin.

Measure 13. Distance from the origin of the dorsal fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 14. Distance from the origin of the pelvic fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 15. Distance from the origin of the pelvic fin to the end of the body excluding the caudal fin. Zero, if there are no pelvic fins.

Measure 16. Distance from the origin of the anal fin to the end of the body excluding the caudal fin. It will be zero if there is no anal fin.

Measure 17. Its value is zero.

Measure 18. Its value is zero.

Measure 19. Its value is zero.

Measure 20. Its value is zero.

Measure 21. Length of the longest dorsal fin radius, including modified rays.

Measure 22. Distance from the origin of the dorsal fin to the end of the body including to the tip of the caudal fin. It will be zero if there is no dorsal fin.

Measure 23. Length of the longest pelvic fin radius, including modified rays.

Measure 24 Distance from the origin of the anal fin to the end of the body including to the tip of the caudal fin. It will be zero if there is no anal fin.

Measure 25. Length of the longest pectoral fin radius, including modified rays.

Measure 26. Length of the longest anal fin radius, including modified rays.

Measure 27. Distance from the end of the body to the distal margin of the caudal fin in its middle part. It will be zero if there is no caudal fin.

Measure 28. Length of the superior barbels (maxillary and nasal). Select the largest.

Measure 29. Length of the inferior barbels (chin). Select the largest.

Measure 30. Interorbital width.

Measure 31. Width in the central part of the body taking standard length as a reference.

Measure 32. Its value is zero.

VII.1.2. Order Pleuronectiformes

For flatfishes, differentiation is necessary between left-eyed flatfishes and those with the opposite symmetry, right-eyed flatfishes. The measurements are the same in both cases, but the different symmetry makes a differentiated representation necessary to make the interpretation of the variables to be measured easier.

Measure 1. Standard length.

Measure 2. Distance from the origin of the mouth considering the centre of the premaxilla to the edge of the lower eye.

Measure 3. Perpendicular distance from the upper edge of the lower eye to the superior profile.

Measure 4. Perpendicular distance from the lower edge of the lower eye to the inferior profile.

Measure 5. Maximum diameter of the inferior orbital cavity.

Measure 6. Distance from the origin of the mouth considering the centre of the premaxilla to the origin of the dorsal fin. Zero, if there is no dorsal fin.

Measure 7. Distance from the corner of the mouth to the origin of the dorsal fin. Zero, if there is no dorsal fin.

Measure 8. Distance from the origin of the mouth considering the centre of the premaxilla to the superior insertion of the pectoral fin. Zero, if there is no pectoral fin.

Measure 9. Distance from the origin of the mouth considering the centre of the premaxilla to the superior insertion of the pelvic fin. Zero, if there is no pelvic fin.

Measure 10. Distance from the corner of the mouth to the superior insertion of the pelvic fin. Zero, if there is no pelvic fin.

Measure 11. Distance from the origin of the dorsal fin to the superior insertion of the pelvic fin. Zero, if one or both fins are missing.

Measure 12. Length of the base of the dorsal fin.

Measure 13. Distance from the origin of the dorsal fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 14. Distance from the origin of the pelvic fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 15. Distance from the end of the dorsal fin to the origin of the pelvic fin. Zero, if one or both fins are missing.

Measure 16. Distance from the end of the dorsal fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 17. Its value is zero.

Measure 18. Its value is zero.

Measure 19. Distance from the end of the anal fin to the base of the caudal fin. Zero, if one or both fins are missing.

Measure 20. Width of the caudal fin at its base.

Measure 21. Length of the longest dorsal fin radius, including modified rays.

Measure 22. Length of the longest pectoral fin radius, including modified rays.

Measure 23. Length of the longest pelvic fin radius, including modified rays.

Measure 24. Length of the base of the anal fin.

Measure 25. Length of the longest anal fin radius, including modified rays.

Measure 26. Distance from the origin of the caudal fin in its middle section to the distal margin of the fin.

Measure 27. Length of the longest caudal fin radius, including modified rays.

Measure 28. Its value is zero.

Measure 29. Its value is zero.

Measure 30. Interorbital width.

Measure 31. Maximum distance between the superior and inferior profiles of the body, excluding the fins.

Measure 32. Thickness of the peduncle. It will be zero if it does not have a peduncle.

VII.1.3. Order Syngnathiformes
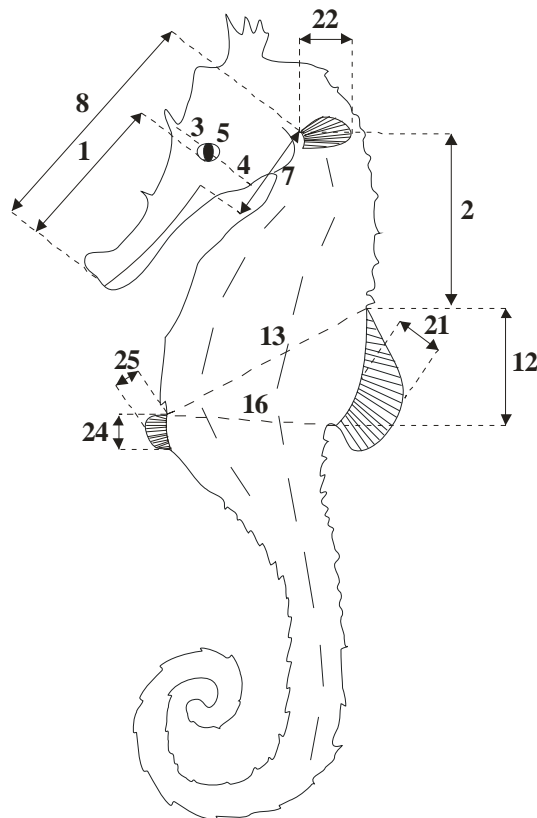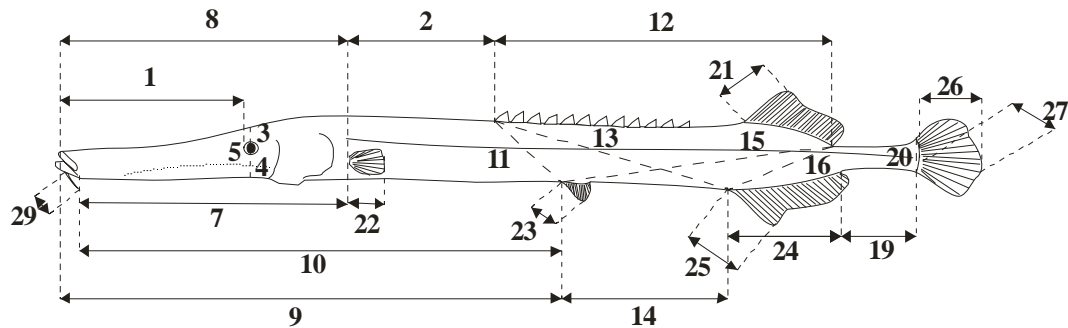
Measure 1. Distance from the origin of the mouth considering the centre of the premaxilla to the closest edge of the eye.

Measure 2. Distance from the superior insertion of the pectoral fin to the origin of the first pinnule or dorsal fin. Zero, if one or both fins are missing.

Measure 3. Perpendicular distance from the upper edge of the eye to the superior profile, excluding body appendices.

Measure 4. Perpendicular distance from the lower edge of the eye to the inferior profile, excluding body appendages.

Measure 5. Maximun diameter of the orbital cavity.

Measure 6. Its value is zero.

Measure 7. Distance from the corner of the mouth to the superior insertion of the pectoral fin. Zero, if there are no pectoral fins.

Measure 8. Distance from the origin of the centre of the premaxilla to the superior insertion of the pectoral fin. Zero, if there are no pectoral fins.

Measure 9. Distance from the origin of the centre of the premaxilla to the anterior insertion of the pelvic fin. Zero, if there are no pelvic fins.

Measure 10. Distance from the corner of the mouth to the anterior insertion of the pelvic fin. Zero, if there are no pelvic fins.

Measure 11. Distance from the origin of the first pinnule or dorsal fin to the anterior insertion of the pelvic fin. Zero, if one or both fins are missing.

Measure 12. Length of the base of the dorsal considering all dorsal fins and pinnules.

Measure 13. Distance from the origin of the first pinnule or dorsal fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 14. Distance from the origin of the pelvic fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 15. Distance from the end of the last dorsal fin or pinnule to the origin of the pelvic fin. Zero, if one or both fins are missing.

Measure 16. Distance from the end of the last dorsal fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 17. Its value is zero.

Measure 18. Its value is zero.

Measure 19. Distance from the end of the anal fin to the base of the caudal fin. Zero, if one or both fins are missing.

Measure 20. Width of the caudal fin at its base. Zero, if there is no caudal fin.

Measure 21. Length of the longest dorsal fin radius, including modified rays.

Measure 22. Length of the longest pectoral fin radius, including modified rays.

Measure 23. Length of the longest pelvic fin radius, including modified rays.

Measure 24. Length of the base of the anal fin.

Measure 25. Length of the longest anal fin radius, including modified rays.

Measure 26. Distance from the origin of the caudal fin in its middle section to the distal margin of the fin, excluding the caudal filament.

Measure 27. Length of the longest caudal fin radius including the caudal filament.

Measure 28. Its value is zero.

Measure 29. Length of the inferior barbels (chin). Select the largest.

Measure 30. Its value is zero.

Measure 31. Its value is zero.

Measure 32. Its value is zero.

VII.1.4. Order Lophiiformes
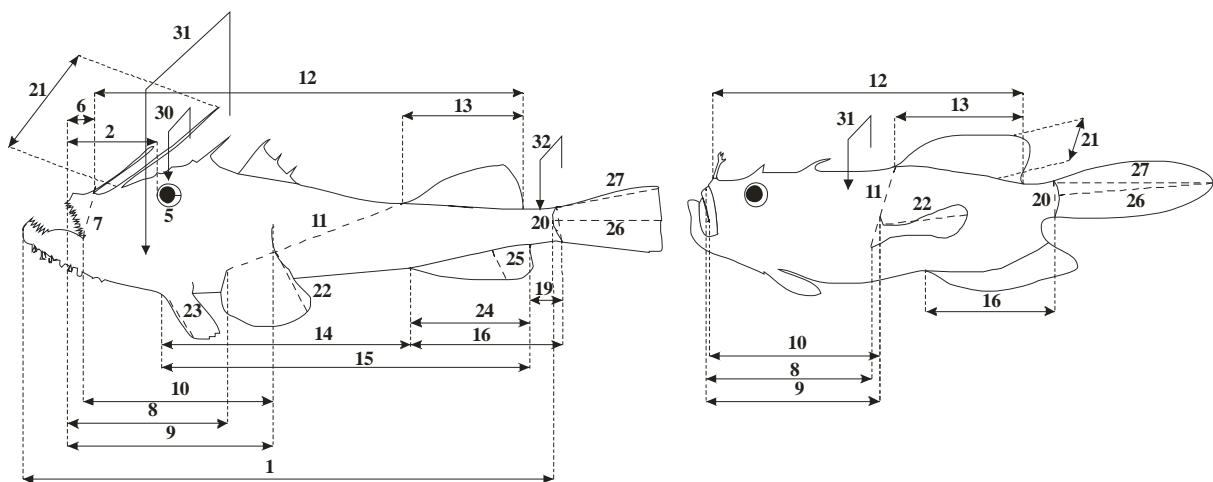
Measure 1. Standard length.

Measure 2. Distance from the origin of the mouth considering the centre of the premaxilla to the edge of the lower eye.

Measure 3. Its value is zero.

Measure 4. Its value is zero.

Measure 5. Maximun diameter of the orbital cavity.

Measure 6. Distance from the centre of the premaxilla to the origin of the first modified spine or fin of the dorsal.

Measure 7. Distance from the corner of the mouth to the origin of the first modified spine or fin of the dorsal.

Measure 8. Distance from the centre of the premaxilla to the anterior or inferior insertion of the pectoral fin.

Measure 9. Distance from the centre of the premaxilla to the posterior or superior insertion of the pectoral fin.

Measure 10. Distance from the corner of the mouth to the posterior or superior insertion of the pectoral fin.

Measure 11. Distance from the origin of the last dorsal fin to the anterior or inferior insertion of the pectoral fin.

Measure 12. Length of the base of the dorsal considering all the dorsal fins and modified spines.

Measure 13. Length of the base of the last dorsal fin.

Measure 14. Distance from the origin of the pelvic fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 15. Distance from the origin of the pelvic fin to the end of the anal fin. Zero, if one or both fins are missing.

Measure 16. Distance from the origin of the anal fin to the base of the caudal fin. Zero, if one or both fins are missing.

Measure 17. Its value is zero.

Measure 18. Its value is zero.

Measure 19. Distance from the end of the anal fin to the base of the caudal fin. Zero, if one or both fins are missing.

Measure 20. Width of the caudal fin at its base.

Measure 21. Length of the longest dorsal fin radius, including modified rays.

Measure 22. Length of the longest pectoral fin radius, including modified rays.

Measure 23. Length of the longest pelvic fin radius, including modified rays.

Measure 24. Length of the base of all anal fins including the modified rays.

Measure 25. Length of the longest anal fin radius, including modified rays.

Measure 26. Distance from the origin of the caudal fin in its middle section to the distal margin of the fin.

Measure 27. Length of the longest caudal fin radius, including modifed rays. This measurement can be equal to 26.

Measure 28. Its value is zero.

Measure 29. Its value is zero.

Measure 30. Interorbital width.

Measure 31. Maximum body width, including the head.

Measure 32. Width in the middle part of the peduncle. It will be zero if it does not have a peduncle.

VII.2. Class Elasmobranchii

VII.2.1. Batoid fishes
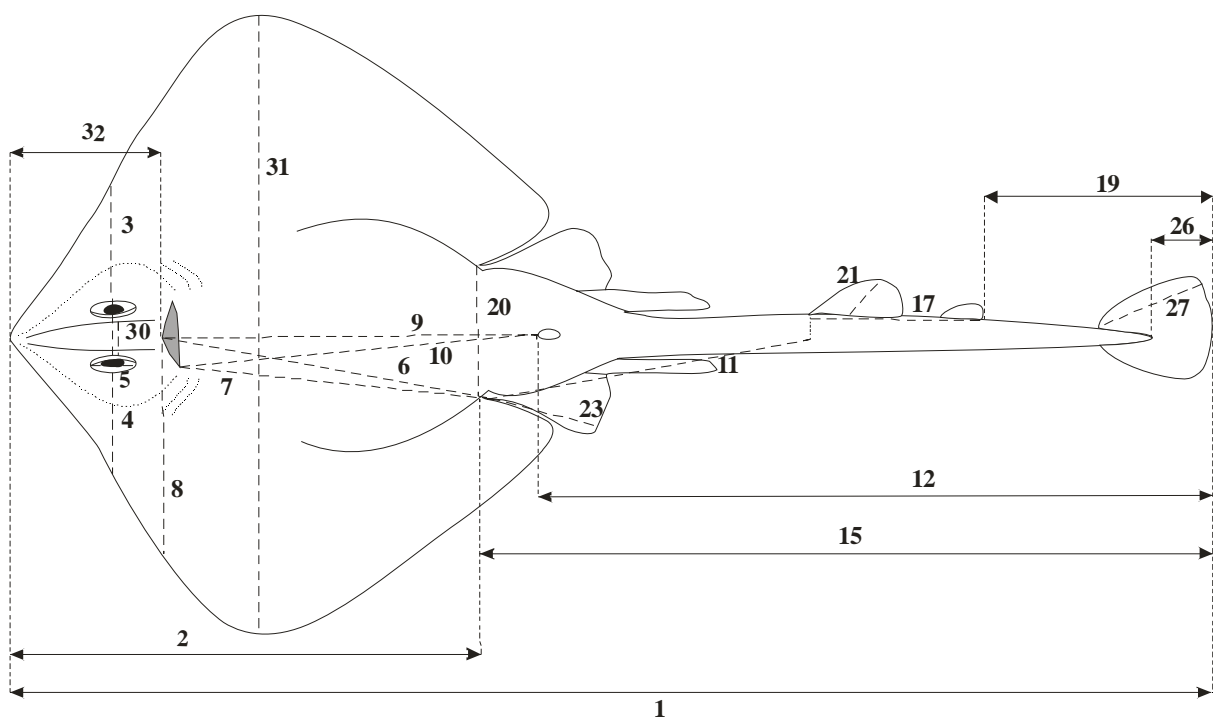
Measure 1. Total length.

Measure 2. Distance from the tip of the snout to the anterior insertion of the pelvic fin.

Measure 3. Perpendicular distance from the upper edge of the lower eye to the superior profile.

Measure 4. Perpendicular distance from the lower edge of the lower eye to the inferior profile.

Measure 5. Maximum diameter of the inferior orbital cavity.

Measure 6. Distance from the origin of the mouth to the anterior insertion of the pelvic fin.

Measure 7. Distance from the corner of the mouth to the anterior insertion of the pelvic fin.

Measure 8. Perpendicular distance from the origin of the mouth considering the centre of the premaxilla to the inferior profile of the body.

Measure 9. Distance from the origin of the mouth to the origin of the anus.

Measure 10. Distance from the corner of the mouth to the origin of the anus.

Measure 11. From the anterior insertion of the pelvic fin to the ventral projection of the dorsal fin. Zero, if one or both fins are missing.

Measure 12. Length from the origin of the anus to the end of the tail, including the caudal fin.

Measure 13. Its value is zero.

Measure 14. Its value is zero.

Measure 15. Length from the anterior insertion of the pelvic fin to the end of the tail including the caudal fin.

Measure 16. Its value is zero.

Measure 17. Length of the base of the dorsal considering all the dorsal fins. Zero, if there is no dorsal fin.

Measure 18. Its value is zero.

Measure 19. Distance from the end of the dorsal fin to the end of the tail including the caudal fin. Zero, if there is no dorsal fin.

Measure 20. Distance between the anterior insertions of the pelvic fins.

Measure 21. Maximum length of the largest dorsal fin.

Measure 22. Its value is zero.

Measure 23. Maximum length from the anterior insertion of the pelvic fin to its extreme distal margin.

Measure 24. Its value is zero.

Measure 25. Its value is zero.

Measure 26. Distance from the origin of the caudal fin in its middle section to the distal margin of the fin. Zero, if there is no caudal fin.

Measure 27. Maximum length of the caudal fin. Zero, if there is no caudal fin.

Measure 28. Its value is zero.

Measure 29. Its value is zero.

Measure 30. Interorbital distance.

Measure 31. Maximum distance between the superior and inferior profiles of the body, including the fins.

Measure 32. Distance from the tip of the snout to the origin of the mouth.

VII.2.2. Sharks
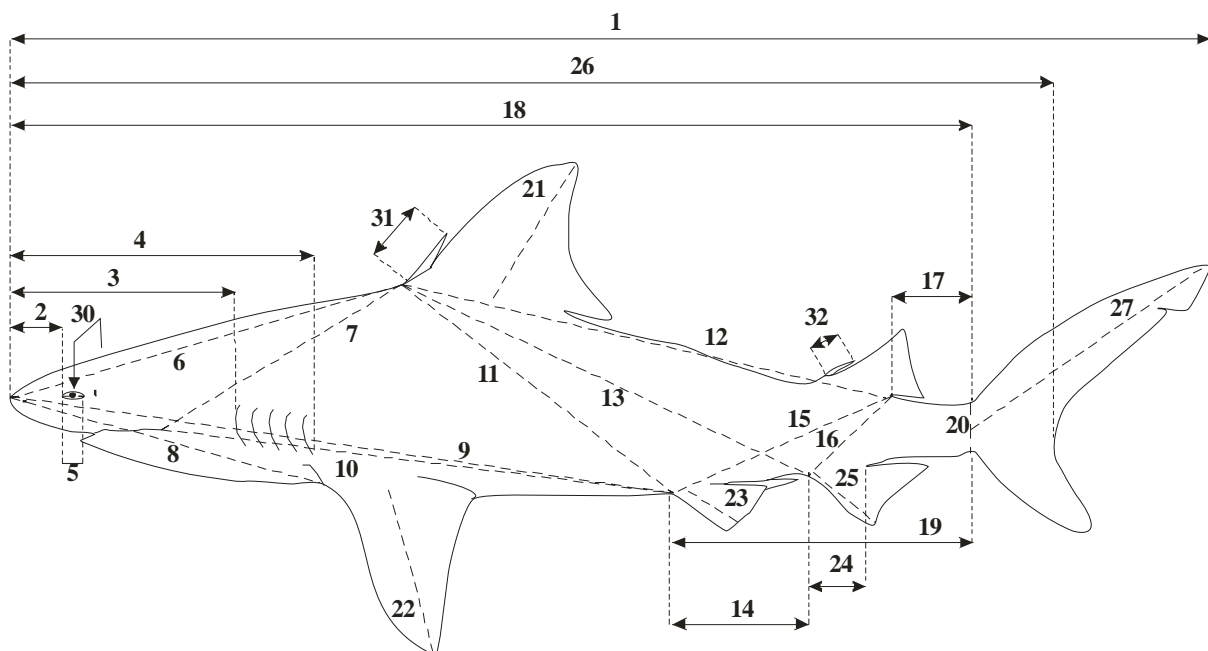
Measure 1. Total length.

Measure 2. Distance from the tip of the snout to the origin of the eye.

Measure 3. Pre-branchial length.

Measure 4. Head length (from the tip of the snout to the last branchia)

Measure 5. Maximum diameter of the orbital cavity.

Measure 6. Distance from the tip of the snout to the origin of the first dorsal fin.

Measure 7. Distance from the corner of the mouth to the origin of the first dorsal fin.

Measure 8. Distance from the tip of the snout to the anterior insertion of the pectoral fin.

Measure 9. Distance from the tip of the snout to the anterior insertion of the pelvic fin.

Measure 10. Distance from the corner of the mouth to the anterior insertion of the pelvic fin.

Measure 11. Distance from the origin of the first dorsal fin to the anterior insertion of the pelvic fin.

Measure 12. Length of the base considering all dorsal fins.

Measure 13. Distance from the origin of the first dorsal fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 14. Distance from the origin of the pelvic fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 15. Distance from the end of the last dorsal fin to the origin of the pelvic fin. Zero, if one or both fins are missing.

Measure 16. Distance from the end of the last dorsal fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 17. Distance from the end of the last dorsal fin to the origin of the caudal fin. Zero, if one or both fins are missing.

Measure 18. Distance from the tip of the snout to the origin of the caudal fin in its middle part.

Measure 19. Distance from the origin of the pelvic fin to the inferior origin of the caudal fin.

Measure 20. Width of the caudal fin at its base.

Measure 21. Maximum length of the first dorsal fin.

Measure 22. Maximum length of the pectoral fin.

Measure 23. Maximum length of the pelvic fin.

Measure 24. Length of the base of the anal fin.

Measure 25. Maximum length of the anal fin.

Measure 26. Distance from the tip of the snout to the notch.

Measure 27. Maximum length of the caudal fin.

Measure 28. Its value is zero.

Measure 29. Its value is zero.

Measure 30. Interorbital width.

Measure 31. Maximum length of the spine of the first dorsal fin. It will be zero if there is no spine.

Measure 32. Maximum length of the spine of the second dorsal fin. It will be zero if there is no spine.

VII.3. Class Cephalaspidomorphi
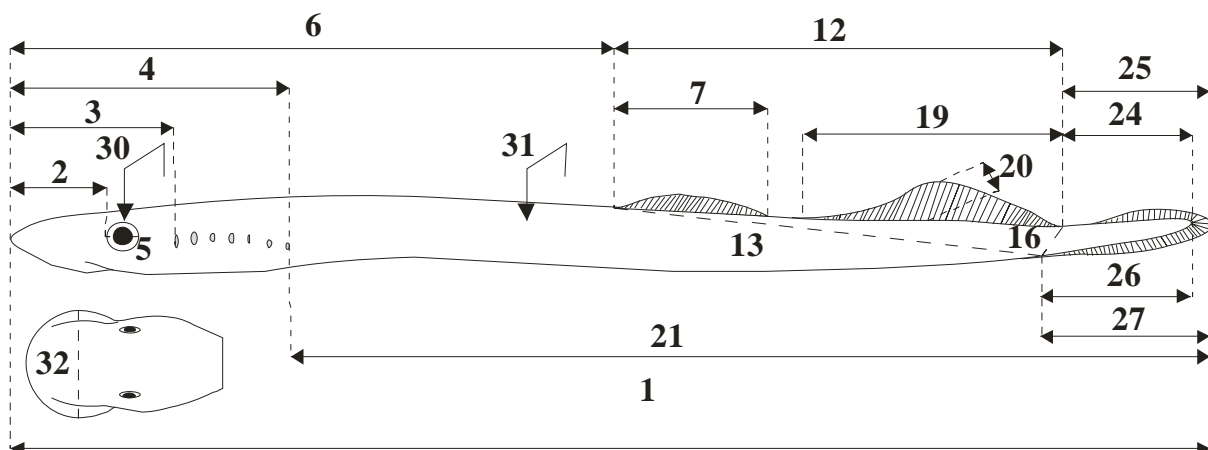
Measure 1. Total length.

Measure 2. Distance from the origen of the body to the origin of the eye.

Measure 3. Distance from the origen of the body to the origin of the first branchial slit.

Measure 4. Distance from the origen of the body to the end of the last branchial slit.

Measure 5. Maximun diameter of the orbital cavity.

Measure 6. Distance from the origen of the body to the origin of the dorsal fin.

Measure 7. Length of the base of the first dorsal fin.

Measure 8. Its value is zero.

Measure 9. Its value is zero.

Measure 10. Its value is zero.

Measure 11. Its value is zero.

Measure 12. Length of the base considering all the dorsal fins. This measurement can be equal to measurement 7 if there is only one dorsal fin.

Measure 13. Distance from the origin of the dorsal fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 14. Its value is zero.

Measure 15. Its value is zero.

Measure 16. Distance from the end of the last dorsal fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 17. Its value is zero.

Measure 18. Its value is zero.

Measure 19. Length of the base of the second dorsal fin. Zero, if there is no second dorsal fin.

Measure 20. Maximum length of the second dorsal fin. Zero, if there is no second dorsal fin.

Measure 21. Length from the end of the last branchial slit to the end of the body including the caudal fin.

Measure 22. Its value is zero.

Measure 23. Its value is zero.

Measure 24 Length from the end of the last dorsal fin to the end of the body excluding the caudal fin.

Measure 25. Length from the end of the last dorsal fin to the end of the body including the caudal fin.

Measure 26 Length from the origin of the anal fin to the end of the body excluding the caudal fin.

Measure 27. Length from the origin of the anal fin to the end of the body including the caudal fin.
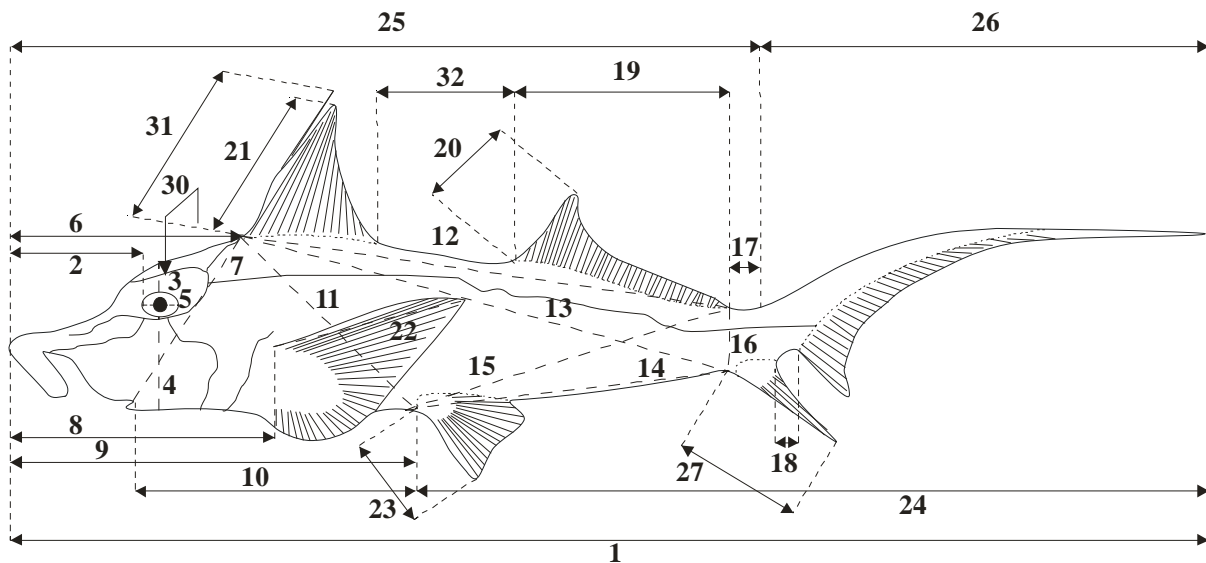
Measure 28. Its value is zero.

Measure 29. Its value is zero.

Measure 30. Interorbital width.

Measure 31. Width in the central part of the body taking total length as a reference.

Measure 32. Maximum diameter of the sucker.

VII.4. Class Holocephali

Measure 1. Total length.

Measure 2. Distance from the tip of the snout to the edge of the eye.

Measure 3. Perpendicular distance from the upper edge of the eye to the superior profile.

Measure 4. Perpendicular distance from the lower edge of the eye to the inferior profile.

Measure 5. Maximum diameter of the orbital cavity.

Measure 6. Distance from the tip of the snout to the dorsal fin.

Measure 7. Distance from the corner of the mouth to the origin of the dorsal fin.

Measure 8. Distance from the tip of the snout to the superior insertion of the pectoral fin.

Measure 9. Distance from the tip of the snout to the anterior insertion of the pelvic fin.

Measure 10. Distance from the corner of the mouth to the anterior insertion of the pelvic fin.

Measure 11. Distance from the origin of the first dorsal fin to the anterior insertion of the pelvic fin.

Measure 12. Length of the base considering all dorsal fins.

Measure 13. Distance from the origin of the first dorsal fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 14. Distance from the origin of the pelvic fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 15. Distance from the end of the last dorsal fin to the origin of the pelvic fin. Zero, if one or both fins are missing.

Measure 16. Distance from the end of the last dorsal fin to the origin of the anal fin. Zero, if one or both fins are missing.

Measure 17. Distance from the end of the last dorsal fin to the dorsal origin of the caudal fin. Zero, if one or both fins are missing.

Measure 18. Distance from the end of the anal fin to the origin of the caudal fin. Zero when the two fins overlap.

Measure 19. Length of the base of the second dorsal fin. Zero, if there is no second dorsal fin.

Measure 20. Maximum length of the second dorsal fin. Zero, if there is no second dorsal fin.

Measure 21. Maximum length of the first dorsal fin, excluding the spine.

Measure 22. Maximum length of the pectoral fin.

Measure 23. Maximum length of the pelvic fin.

Measure 24. Distance from the anterior insertion of the pelvic fin to the end of the body including the filament.

Measure 25. Distance from the tip of the snout to the dorsal origin of the caudal fin.

Measure 26. Distance from the superior origin of the caudal fin to the end of the body including the filament.

Measure 27. Maximum length of the anal fin.

Measure 28. Its value is zero.
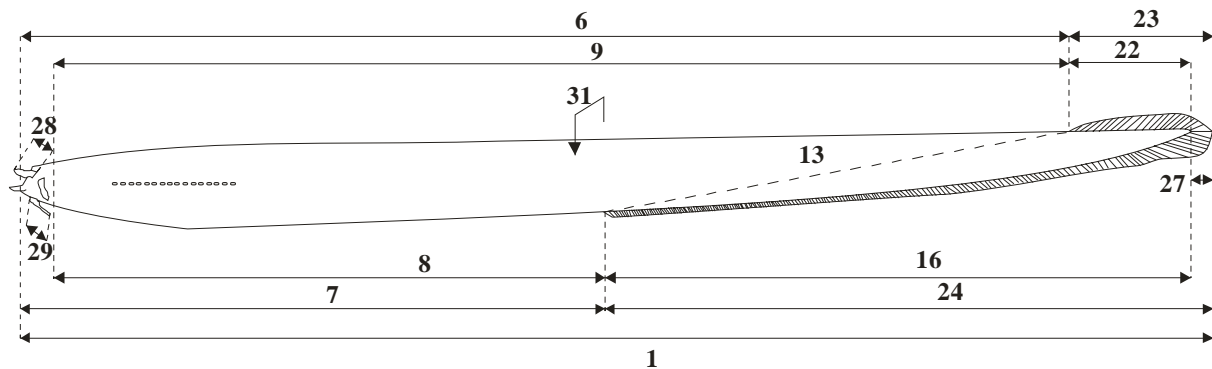
Measure 29. Its value is zero.

Measure 30. Interorbital width.

Measure 31. Maximum length of the spine of the first dorsal fin. It will be zero if there is no spine.

Measure 32. Distance between the dorsal fins.

VII.5. Class Myxini

Measure 1. Total length (from the base of the most anterior barbell to the posterior tip of the caudal fin).

Measure 2. Its value is zero.

Measure 3. Its value is zero.

Measure 4. Its value is zero.

Measure 5. Its value is zero.

Measure 6. Distance from the base of the most anterior barbel to the dorsal origin of the caudal fin.

Measure 7. Distance from the base of the most anterior barbel to the ventral origin of the caudal fin.

Measure 8. Distance from the corner of the mouth to the ventral origin of the caudal fin.

Measure 9. Distance from the corner of the mouth to the dorsal origin of the caudal fin.

Measure 10. Its value is zero.

Measure 11. Its value is zero**.**

Measure 12. Its value is zero.

Measure 13. Distance from the dorsal origin to the ventral origin of the caudal fin.

Measure 14. Its value is zero.

Measure 15. Its value is zero.

Measure 16. Distance from the ventral origin of the caudal fin to the end of the body excluding the end of the caudal fin.

Measure 17. Its value is zero.

Measure 18. Its value is zero.

Measure 19. Its value is zero.

Measure 20. Its value is zero.

Measure 21. Its value is zero.

Measure 22. Distance from the dorsal origin of the caudal fin to the end of the body excluding the end of the caudal fin.

Measure 23. Distance from the dorsal origin of the caudal fin to the end of the body including the end of the caudal fin.

Measure 24 Distance from the ventral origin of the caudal fin to the end of the body including the end of the caudal fin.

Measure 25. Its value is zero.

Measure 26. Its value is zero.

Measure 27. Distance from the end of the body to the distal margin of the caudal fin in its middle part.

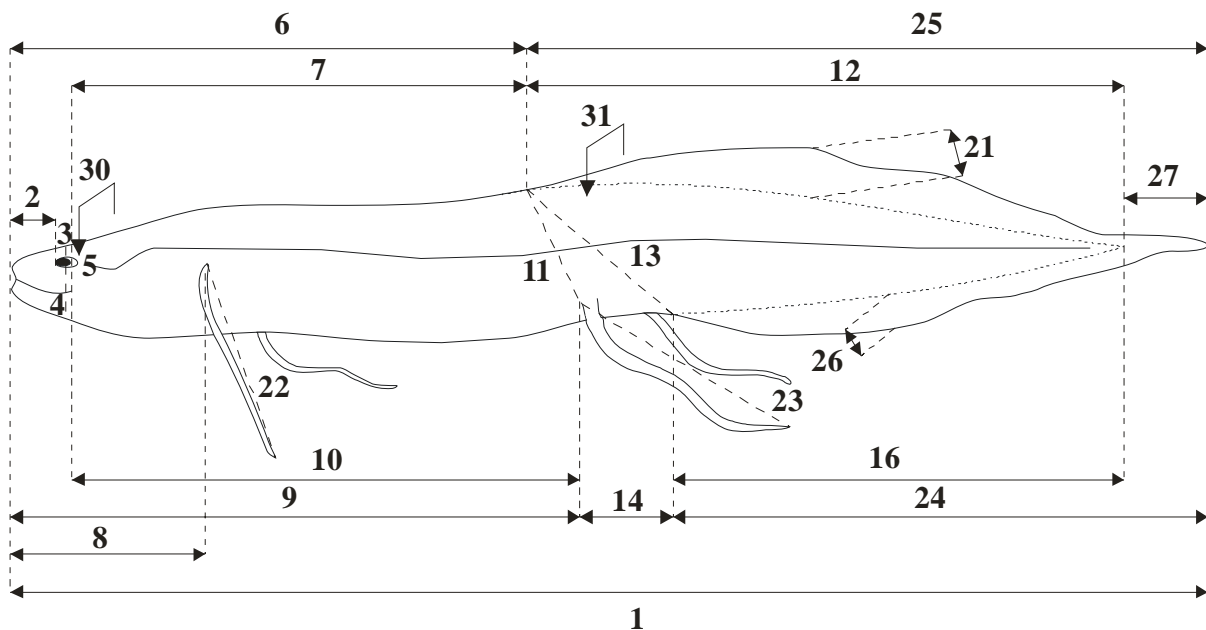**Measure 28.** Length of the superior barbels. Select the largest.

Measure 29. Length of the inferior barbels. Select the largest.

Measure 30. Its value is zero.

Measure 31. Width in the central part of the body taking total length as a reference.

Measure 32. Its value is zero.

VII.6. Class Sarcopterygii

Measure 1. Total length.

Measure 2. Distance from the origin of the mouth considering the centre of the premaxilla to the edge of the eye.

Measure 3. Perpendicular distance from the upper edge of the eye to the superior profile.

Measure 4. Perpendicular distance from the lower edge of the eye to the inferior profile.

Measure 5. Maximun diameter of the orbital cavity.

Measure 6. Distance from the origin of the mouth considering the centre of the premaxilla to the origin of the dorsal fin. Zero, if there is no dorsal fin.

Measure 7. Distance from the corner of the mouth to the origin of the dorsal fin. Zero, if there is no dorsal fin.

Measure 8. Distance from the origin of the mouth considering the centre of the premaxilla to the superior insertion of the pectoral filament. Zero, if there is no pectoral filament.

Measure 9. Distance from the origin of the mouth considering the centre of the premaxilla to the superior insertion of the pelvic filament. Zero, if there is no pelvic filament.

Measure 10. Distance from the corner of the mouth to the superior insertion of the pelvic filament. Zero, if there is no pelvic filament.

Measure 11. Distance from the origin of the dorsal fin to the superior insertion of the pelvic filament. Zero, if there is no pelvic filament.

Measure 12. Length from the origin of the dorsal fin to the end of the body excluding the end of the caudal fin.

Measure 13. Distance from the origin of the dorsal fin to the origin of the anal fin.

Measure 14. Distance from the pelvic filament to the origin of the anal fin.

Measure 15. Its value is zero.

Measure 16. Distance from the origin of the anal fin to the end of the body excluding the caudal fin.

Measure 17. Its value is zero.

Measure 18. Its value is zero.

Measure 19. Its value is zero.

Measure 20. Its value is zero.

Measure 21. Maximum height of the dorsal fin.

Measure 22. Maximum length of the pectoral filament.

Measure 23. Maximum length of the pelvic filament.

Measure 24 Distance from the origin of the anal fin to the end of the body including to the tip of the caudal fin.

Measure 25. Distance from the origin of the dorsal fin to the end of the body including to the tip of the caudal fin.

Measure 26. Maximum height of the anal fin.

Measure 27. Distance from the end of the body to the distal margin of the caudal fin in its middle part.

Measure 28. Its value is zero.

Measure 29. Its value is zero.

Measure 30. Interorbital width.

Measure 31. Width in the central part of the body taking total length as a reference.

Measure 32. Its value is zero.