Manual of Specimen Database Management System (SDBMS)

This manual has been developed for the **Fair Biodiversity Data Stewardship Guidelines** with regard to the use of the Specimen Database Management System (SDBMS) for the **Biodiversity Data Management Workflow** (Chapter 4). The description of SDBMS and further explanation of the rationale and standards for each step listed in this manual can be found in the Fair Biodiversity Data Stewardship Guidelines.

Prepared by

Assoc. Prof. Dr. Liew Thor Seng
Institute for Tropical Biology and Conservation (ITBC), Universiti Malaysia Sabah
thorseng@ums.edu.my

Sheikh Muhammad Arif Shaifuddin Sh Zulrushdi
Centre for Research in Biotechnology for Agriculture (CEBAR), Universiti Malaya

Table of Contents

Preparing the Database for First Time User

For first-time users and before using the SDBMS, it is important to check all the fields in all the tables of the SDBMS and change the tables, forms and reports of the SDBMS if necessary. At the same time, the user may already have data that has been cleaned and normalised according to the data standard and format. In this case, the user can import this data, especially staff profile information, taxonomy information and sampling information, into the SDBMS. However, it is advisable to import this data only once before using the SDBMS in a repository institution. Subsequent data entry should be done manually directly into the SDBMS.

After the SDBMS has been adapted and modified accordingly, you can create multiple copies of the SDBMS depending on the needs of the depository institutions, e.g. each collection with a separate SDBMS depending on the taxa group, e.g. with a different collection code (see **Procedure H**).

a) Cataloguing data from specimens

The data of the newly collected specimens from the field and the data from the existing collection are to be treated differently. While it is possible to impose a stricter requirement for completeness of data for new data, it is not realistic to apply the same requirement to backlog specimens as many old collections sometimes do not have complete data. However, the data attached to old specimens are still valuable for many purposes. It is important to remember that suboptimal data is better than none at all, and that the perfect should not be the enemy of the good. As long as the level of variable completeness and precision is clearly stated, the data can still be useful.

Data that were recorded in a physical logbook or are only available on the label of the specimen can be manually entered into the database. If the data are available in a digital spreadsheet, normalisation of the data in the spreadsheet is required. If the normalisation processes cannot be done, the data can still be entered manually into the SDBMS.

i) Personnel Profile Information

Throughout the workflow of managing biodiversity data, many personnel play different roles: as collectors of specimens from the field ("Recorded By" in the Sampling Information Table) and as curators who prepare and preserve the specimens (“Prepared By"), identify the specimens to species level ("Identified By") and then catalogue the specimen data in a database ("Catalogued By"), all of which should be recorded in the Collection Information Table. One person can play all these different roles and therefore it is important to have a master list that contains the information of all the people in the workflow. The Personnel Profile Information Table in the SDBMS is used to store and manage all the profiles of the personnel in terms of their personal information, namely, "First Name", "Last Name", and "Name Initial". It is important that there is only one entry in the table for each person. Other profile information such as "Affiliation" and "Other Personal Information" must also be filled in the Profile Information Table, which can provide additional unique identification of users.

Procedure A. Add new fields to the table (example - Personnel Profile Information table)

1. Double-click on the "Personal Information" Table (**Step 1**) (**Figure 1**).

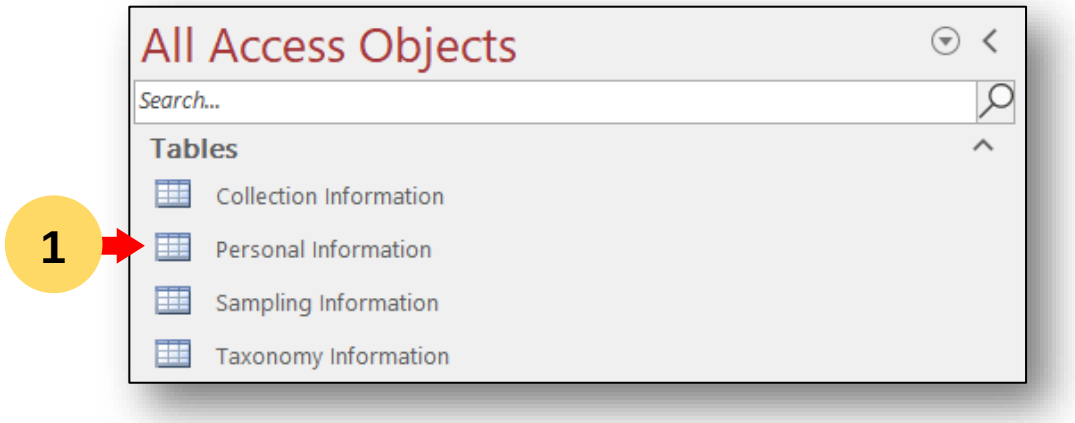


Figure 1. Information tables in the MS Access Database.

2. Once you have opened the Personnel Profile Information table, you will find a list with 5 fields for entering Personnel Profile Information. "ID" is automatically generated by the Table (**Figure 2**).

3. The user can add more fields to the Personal Information table if needed. Right-click on "Personal Information" and select "Design View". (**Step 1**) (**Figure 2**).

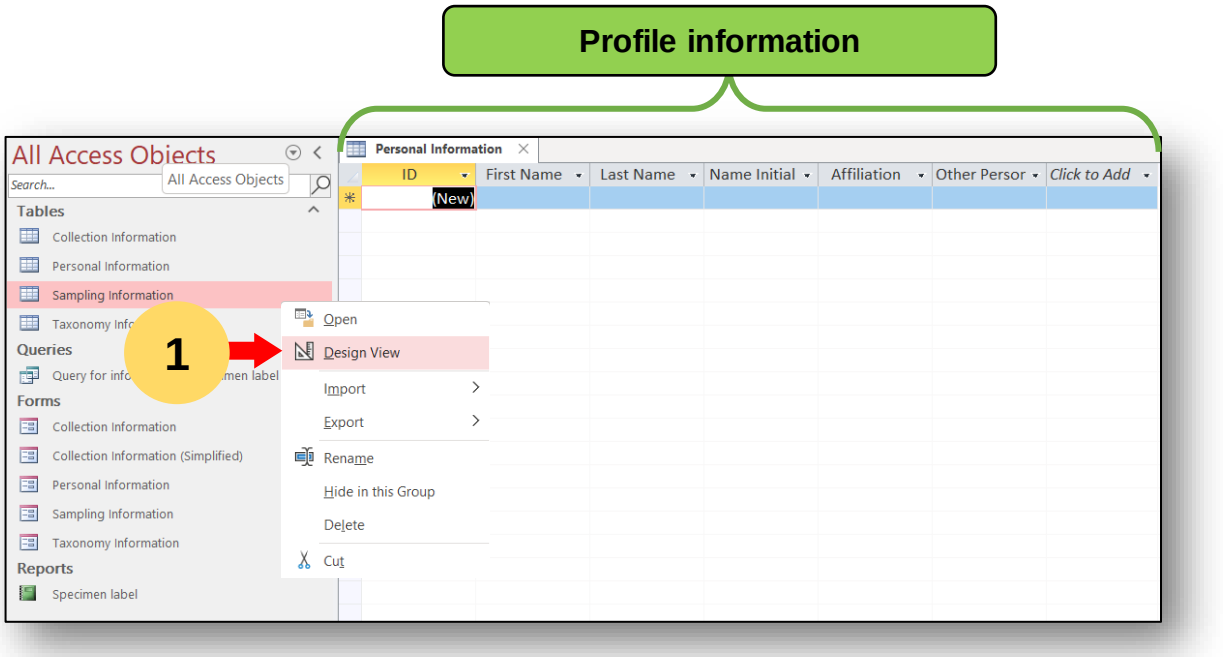


Figure 2. Master list table for profile information.

4. User **SHALL NOT** edit the existing "Field Name (A)" and "Data Type (B)" (Figure 3).

5. User can add new field (**Step 1**) with an appropriate "Field Name (A)" and "Data Type (B)".

6. After completed the update, click on the (×) icon to close the Table and click "Save".

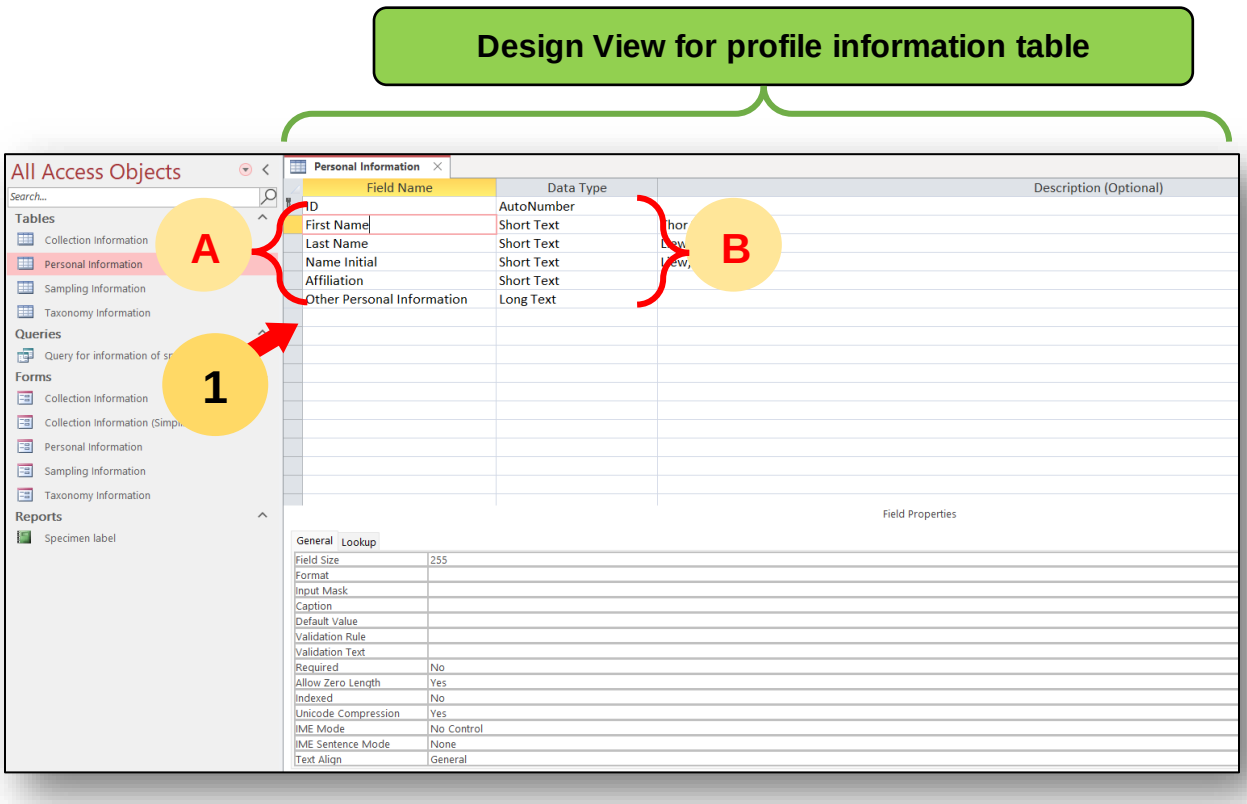


Figure 3. Design view of Profile Information table.

ii) Sampling Information

Procedure B. Add new fields to the table (example – Sampling Information Table)

1. Double-click on the "Sampling Information" Table (**Step 1**) (**Figure 1**).

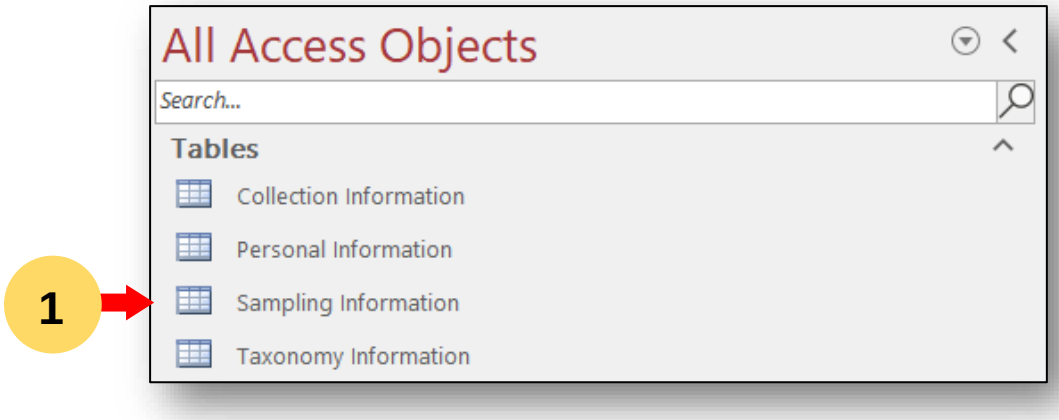


Figure 1. Information tables in the MS Access Database.

2. Right click on the "Sampling Information" and choose "Design View" (**Step 1**) (**Figure 2**).

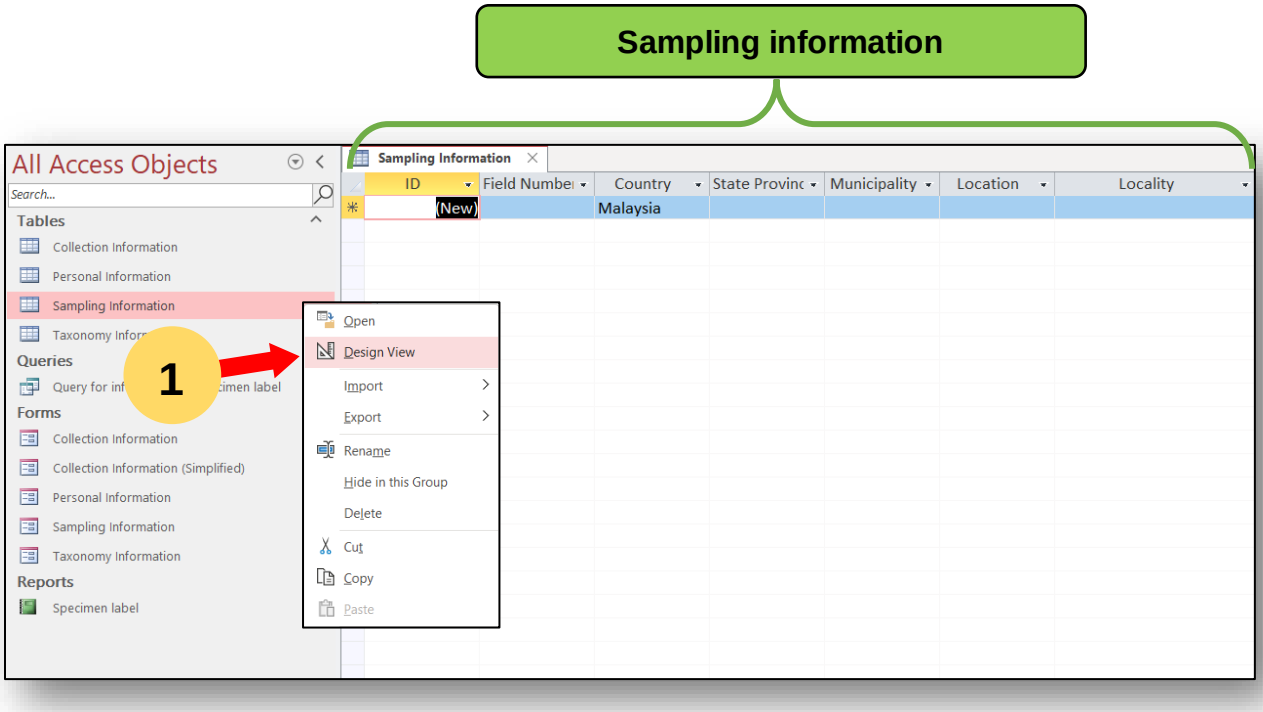


Figure 2. Master list table for sampling information.

3. User **SHALL NOT** edit the existing "Field Name (A)" and "Data Type (B)" (**Figure 3**).

4. User can add new field (**Step 1**) with an appropriate "Field Name (A)" and "Data Type (B)" according to user's application

5. Users can edit the "Field Name (A)" to an appropriate heading according to user's application of the database and define it by changing the "Data Type (B)" (**Figure 3**).

6. After completed the update, click on the (×) icon to close the Table and click "Save".

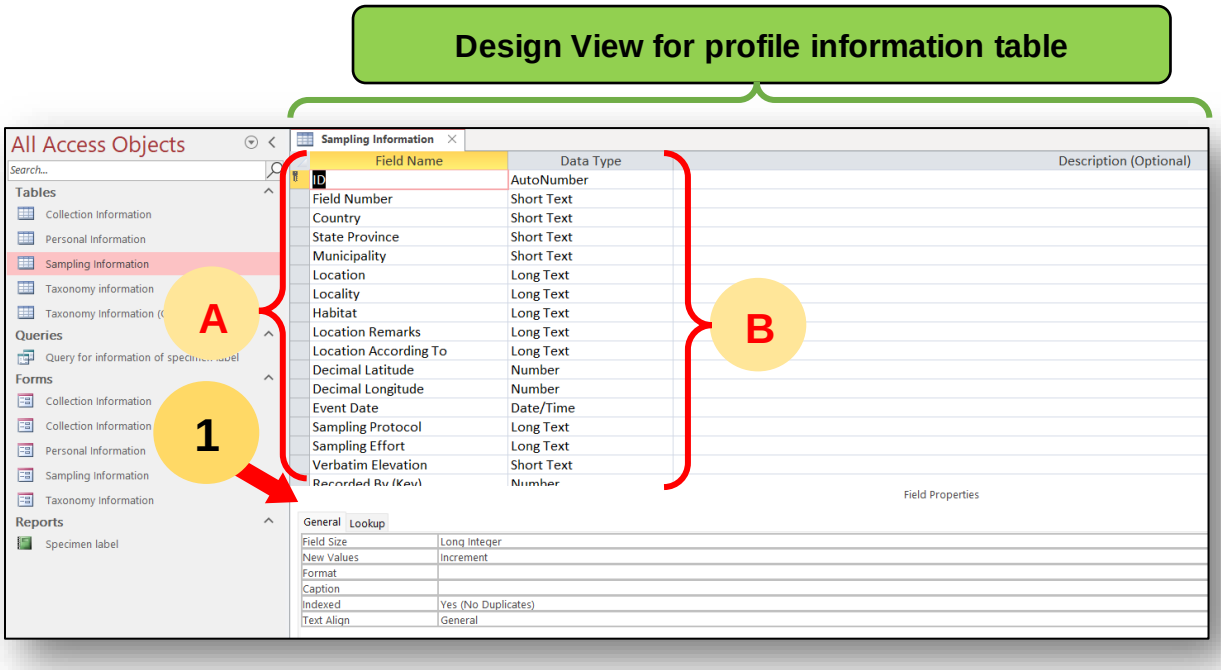


Figure 3. Design view of Sampling information table.

Procedure C. Convert text fields in the form into a combo box and create a list of values in the combo box (example – Sampling Information Table)

1. Double-click on the "Sampling Information" Form (**Step 1**) on the left pane (**Figure 1**).

2. The first four fields of the location details and the two fields of the sampling details can be standardised by providing the standard value list to avoid confusion due to different spellings or different names for the same place and same sampling detail (**A**) (**Figure 1**).

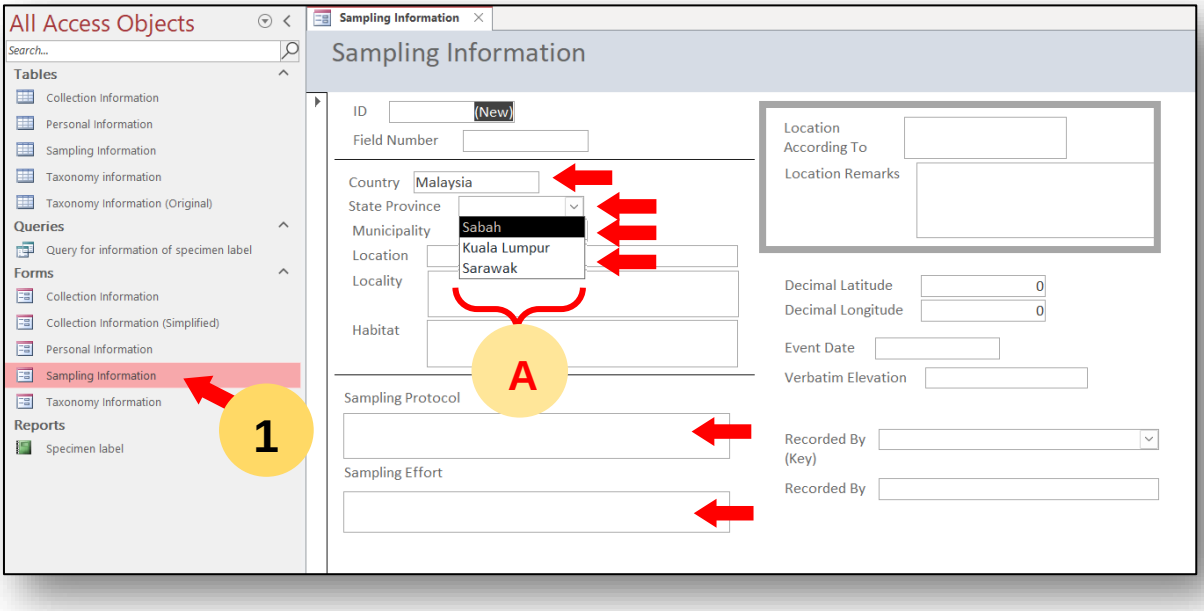


Figure 1. Fields in the Sampling Information form that can be converted to a combo box to allow selection of predefined data or values.

3. Right click on the "Sampling Information" (**Step 1**) and choose "Design View" (**Step 2**) (**Figure 2**). Right click at the "field" (**Step 3**) and select and chose "Change To" > "Combo Box" (**Step 4**).

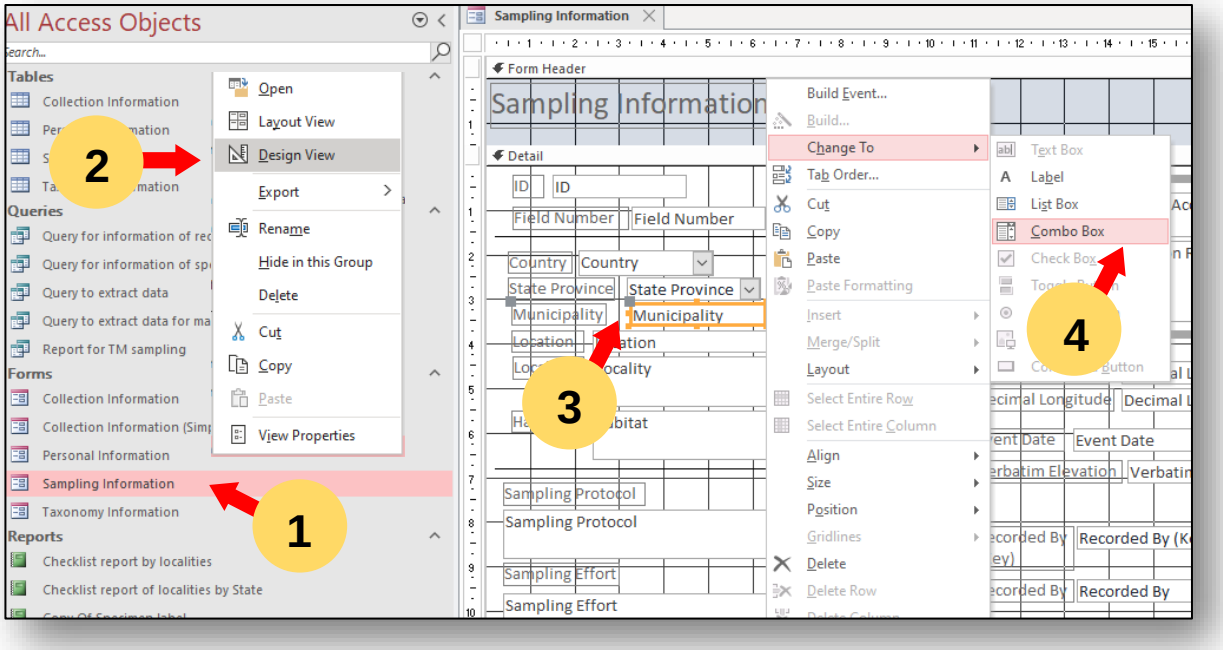


Figure 2. Convert text field to Combo Box in Sampling Information form.

4. Double click on at the "Field" (**Step 1**) to open "Property Sheet" of the "Field" and choose "Data" Tab (**Step 2**) (**Figure 3**). Select "Value List" in "Row Source Type (**Step 3**). Enter list of value in "Row Source", with each value in quote - " " and separate each value with a semicolon - ; , for example, "Kulai";"KotaKinabalu";"Rawang" (**Step 4**).

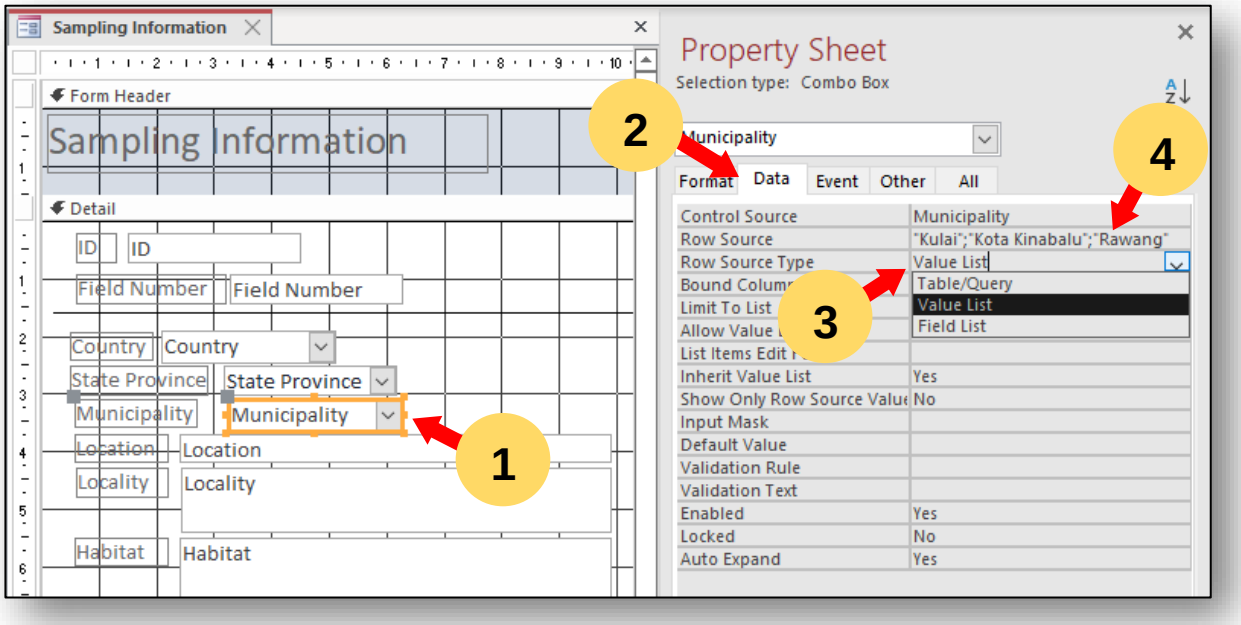


Figure 3. Add values in the list of the Combo Box.

5. After finalised the list of value in "Row Source", click on the (×) icon to close the "Property Sheet" (**Step 1**) (**Figure 4**).

6. Right click on "Sampling Information" form (**Step 2**) and choose "Open" (**Step 3**) (**Figure 4**). Enter to the data in the field with Combo Box to check (**A**).

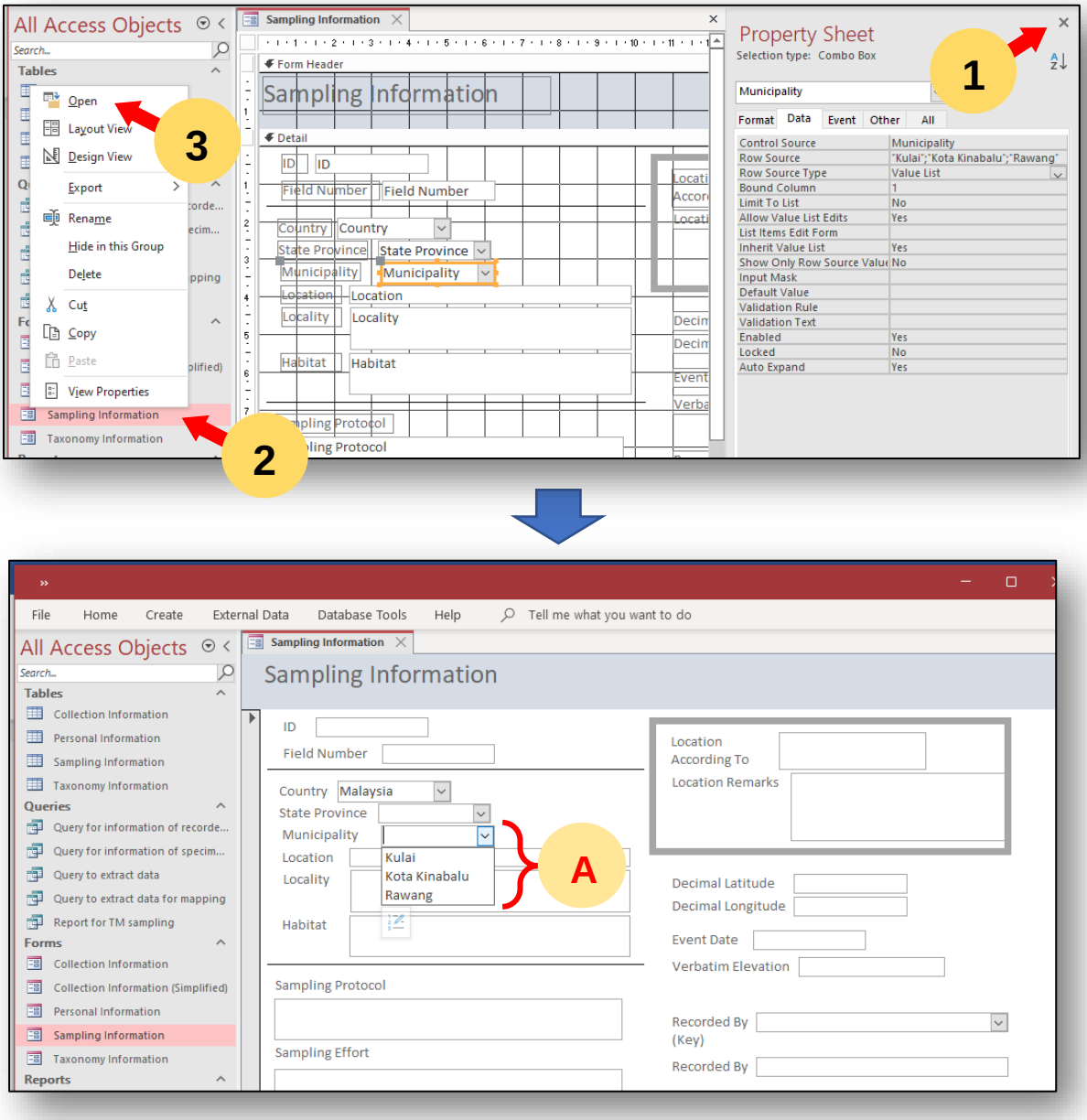


Figure 4. Fields in the Sampling Information form that can be converted to a combo box to allow selection of predefined data or values.

iii) Taxonomic Information

When users use the SDBMS for the first time, they can either enter the taxonomy information manually into the SDBMS or import tabular taxonomy information that follows the field names in the same format as the taxonomy information table directly into the SDBMS. Thereafter, the new taxa name can be added to the table from time to time by manual entry in the SDBMS. In addition to the default taxonomic classification level fields in the Taxonomy Information Table, users can add fields of other relevant classification levels according to the classification scheme for organisms. Whenever possible, the taxonomic information of each taxon (i.e., each entry) shall be provided at the lowest possible taxonomic level and at least at the "Kingdom", "Phylum" and "Class" levels.

In addition to taxa for which full taxonomic information is not available, it is worthwhile to establish a provisionally circumscribed genus or species name for a morphospecies in the Taxonomy Information Table for specimens that could not be identified to species or genus level during the cataloguing phase. In any case, the taxonomic information is considered curated data, as the taxonomic information may change, whether due to changes in taxonomic classification or misidentification of the collection. These are normal situations for many taxa, especially the invertebrates, whose classification is less stable compared to vertebrates. Therefore, the taxonomic information is not static and should be updated from time to time and it is important to jot down the reasons causing the changes.

Procedure D. Add new fields to the table and form (example – Taxonomic Information Table)

1. Double-click on the "Taxonomy Information" (**Step 1**) on the left pane (**Figure 1**).

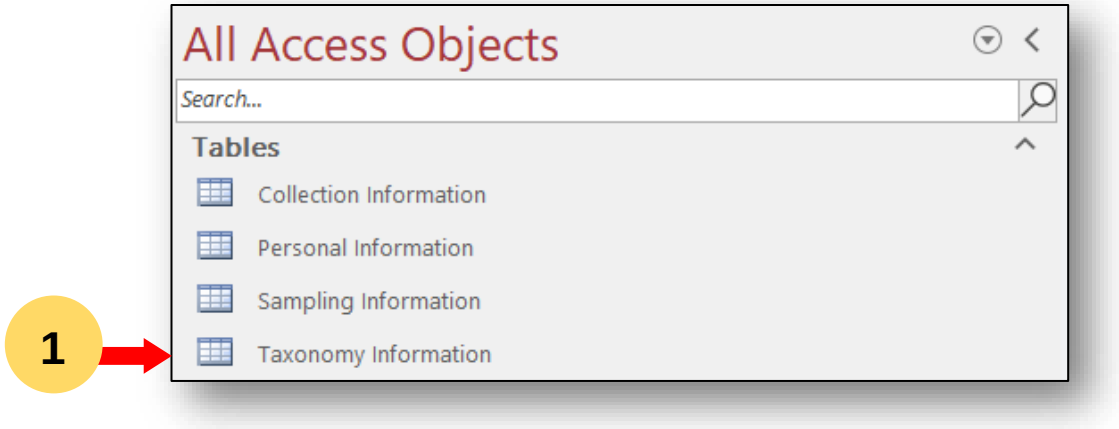


Figure 1. Information tables in the MS Access Database.

2. User shall check all the classification field in Taxonomic Information table (**Figure 2**). User can add more column by right-clicking (**Step 1**) at one of the columns and choose "Insert Field" (**Step 2**) (**Figure 2**).

3. Once user have added the "Field", right click on the "Taxonomy Information" (**Step 3**) and choose "Design View" (**Step 4**) to edit the "Field Name" and "Data Type" (**Figure 2**). User **SHALL NOT** edit the existing "Field Name" and "Data Type" in the Table, even if user do not need the fields in their workflow. However, user can create a duplicate of the complete form then simplify it by removing some of the fields in the new duplicated form by following the **Procedures E**.

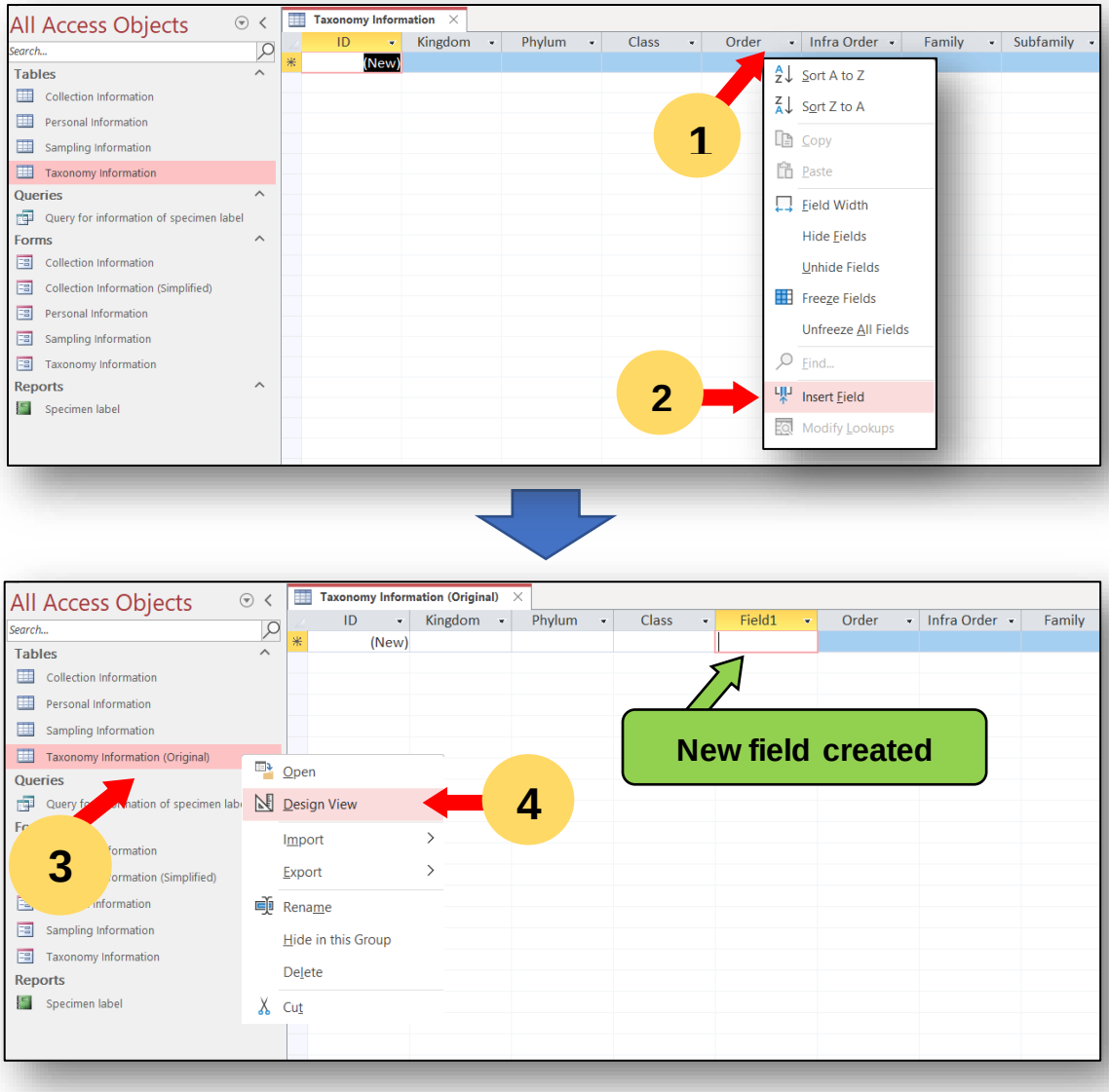


Figure 2. Add additional classification fields in Taxonomic Information table.

4. User can edit the new "Field Name" and define the "Data Type" (**Step 1**). For example, edit the "Field 1" to "Subclass" (**Step 2**) and define it as "short text" from the drop down options (**Step 3**) (**Figure 3**).

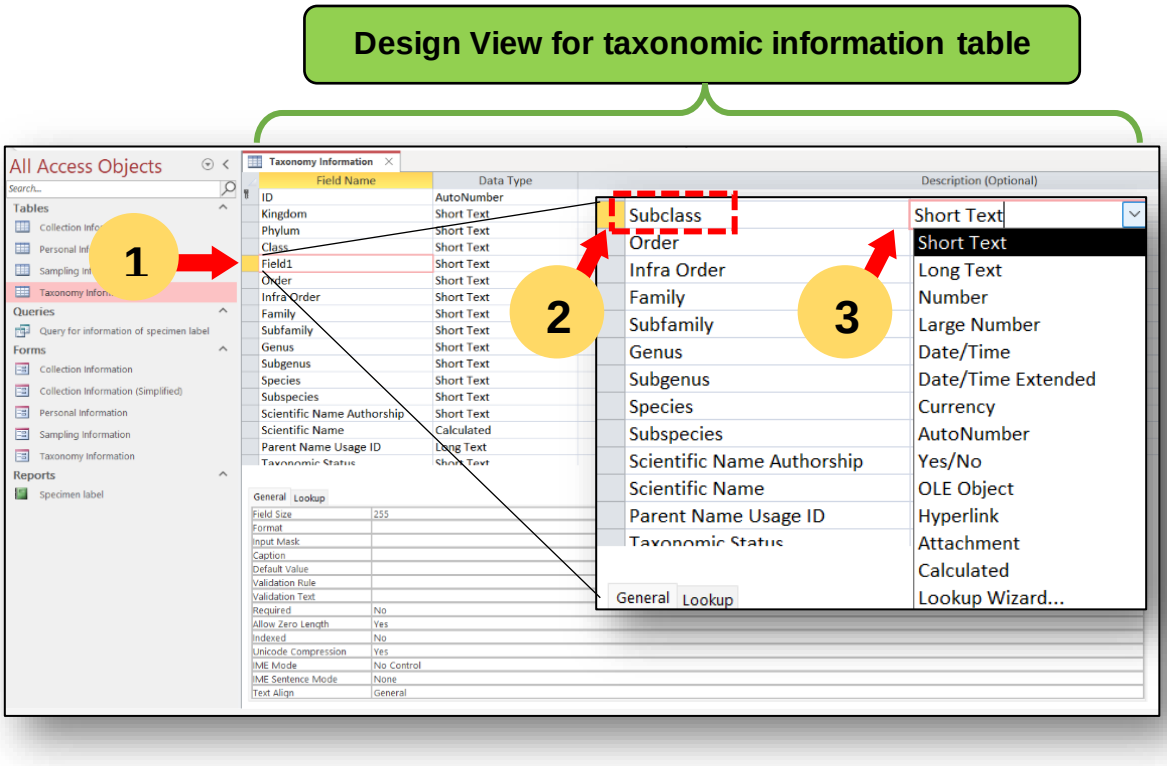


Figure 3. Design view of Taxonomic Information table

5. After finalised the update, click on the (×) icon to close the Design View and click "Save".

6. After finalised the settings of the additional fields in Taxonomic Information table, user need to update the Taxonomic Information form as well to add the new fields into the form.

7. Double-click on the "Taxonomy information" under the "Forms" panel (**Step 1**) to open the Taxonomy information form (**Figure 4**).

8. User can add a new field, for an example the "Subclass" of Taxonomy information table into the form. Right-click on the taxonomic information form and choose "Design View" (**Step 2**) (**Figure 4**).

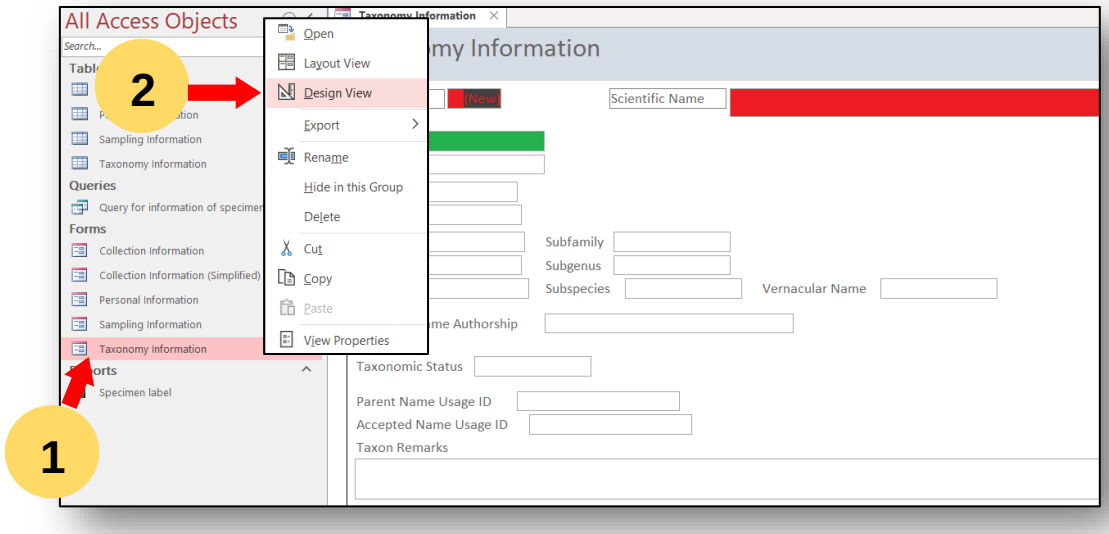


Figure 4. Taxonomy Information Form.

9. In design view, select to "Form Design" menu at the top (**Step 1**). Then, click on "Add Existing Fields" to open the "Field List" (**Step 2**) (**Figure 5**).

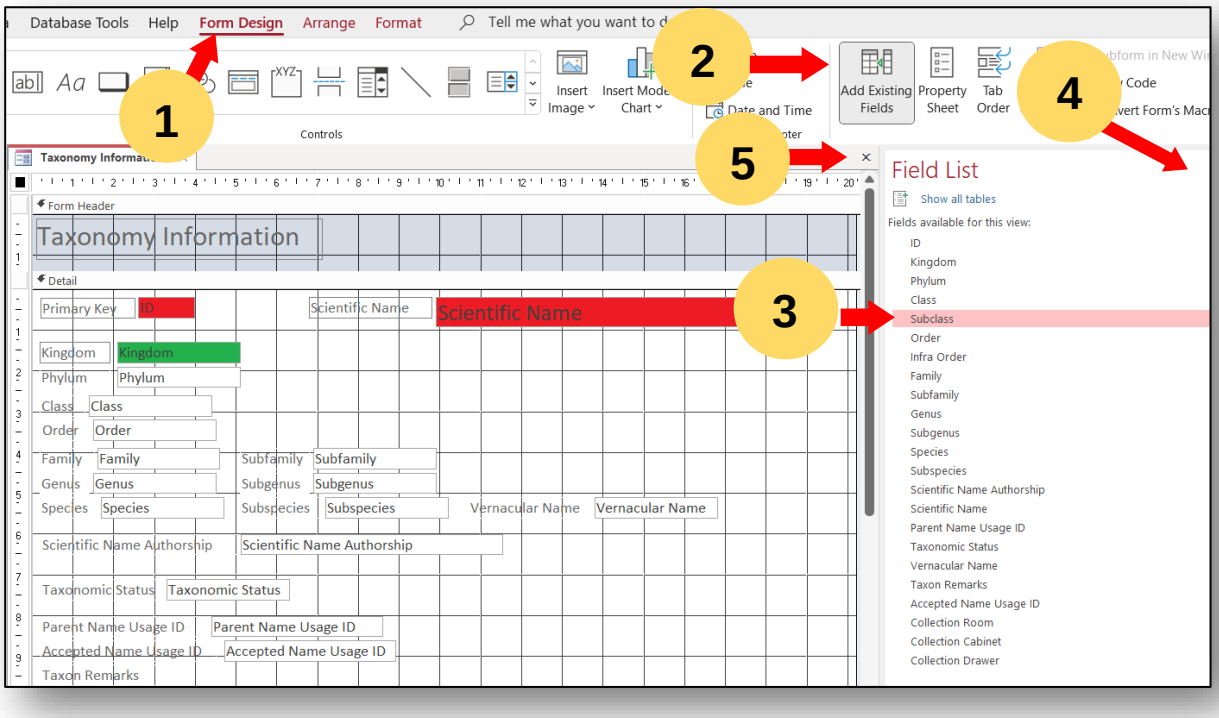


Figure 5. Taxonomy Information Form design view.

10. Select the new field by double-clicking on the "Subclass" (i.e., the new field) and it will appear in the form" (**Step 3**). Click on the (×) icon to close the "Field List" (**Step 4**) (**Figure 5**).

11. User can freely adjust the new field by click and dragging it into a preferred position in the form. Click on the (×) icon to close and click "Yes" to save (**Step 5**) (**Figure 5**).

Procedure E. Create a duplicated and simplified form (example – Taxonomic Information Table)

1. User can create a duplicate of the complete form then simplify it by removing some of the fields in the new duplicated form (**Figure 1**).

2. Right click on the form (**Step 1**) and select "Copy" (**Step 2**) (**Figure 1**). Then, right click again on the form (**Step 3**) and click "Paste" (**Step 4**). Update the name of the newly duplicate form (**Step 5**) and click "OK" to save it (**Step 6**).

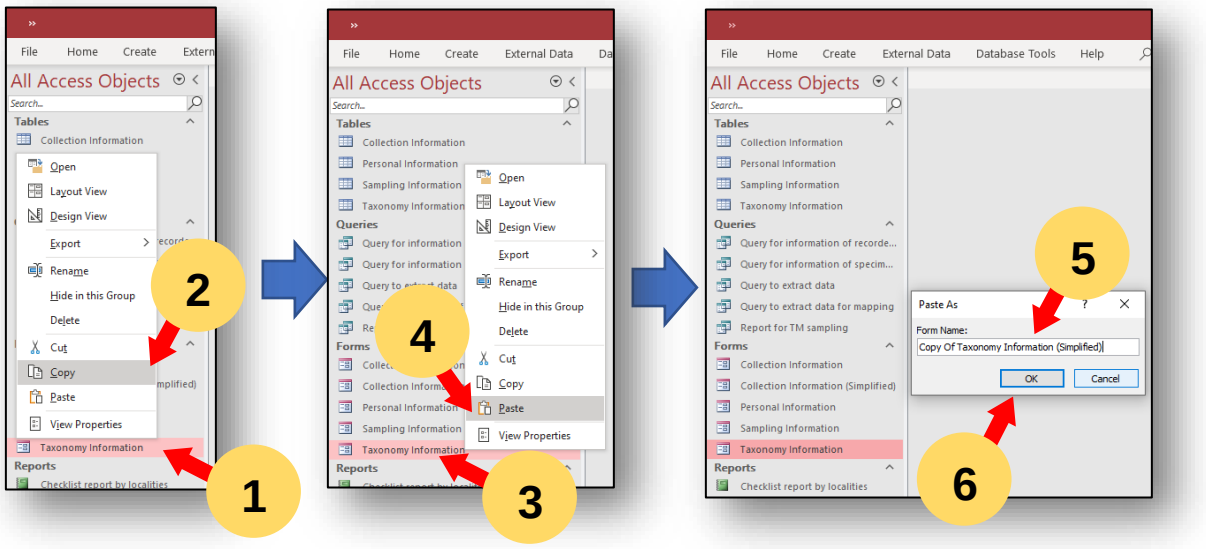


Figure 1. Create a duplicate form for editing and modification without changing the original field in the Tables.

3. Select and right click on the new duplicate form (**Step 1**) and select "Design View" (**Step 2**) (**Figure 2**).

4. Click and drag to select the field that to be removed (**Step 3**) and the selected field will be highlighted in orange once selected (**Figure 2**).

5. Right click on the selected fields (**Step 4**) and select "Delete" (**Step 5**) (**Figure 2**).

6. After finalised the modification of the form, click on the (×) icon (**Step 6**) to close the form and click "Yes" to save the form (**Figure 2**).

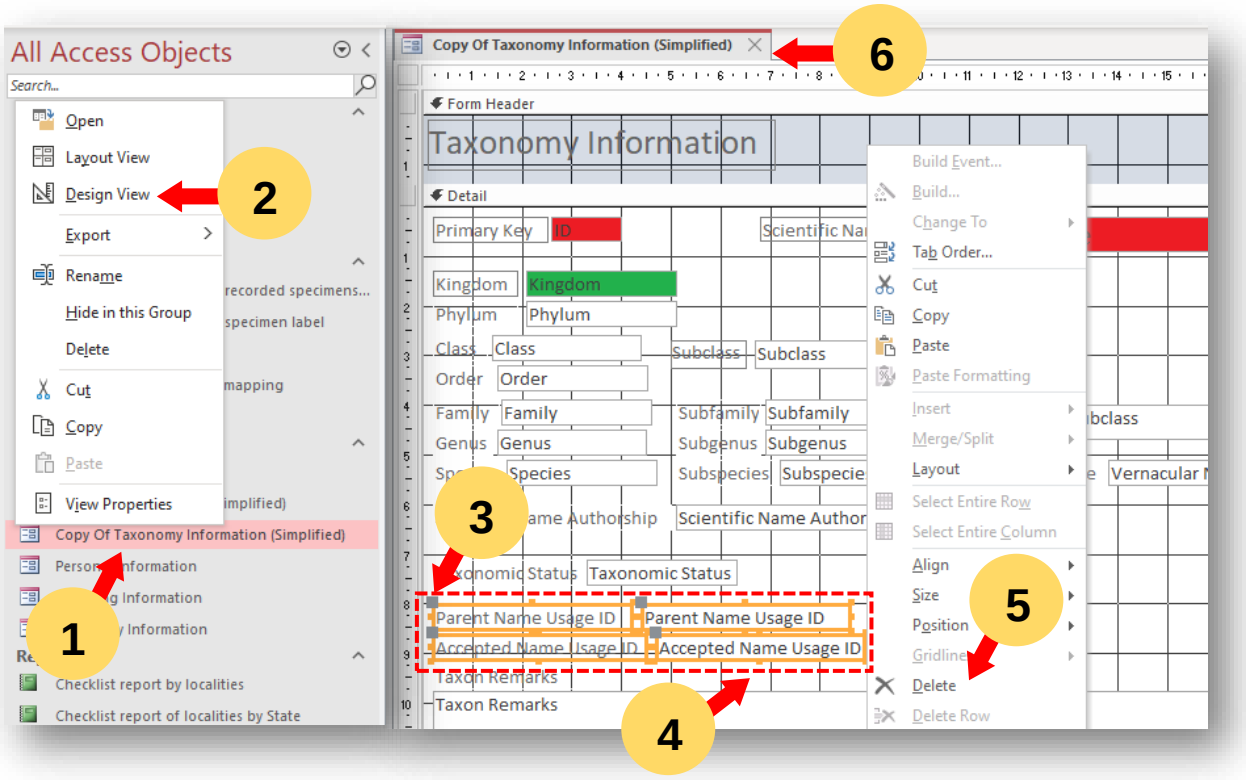


Figure 2. Removing field in the form to simplify the form.

Procedure F. Import a new table with data to replace the original table in SDBMS (example – Taxonomic Information Table)

There are two methods to insert field data to the database. The first method is to insert data manually one by one using the information table or form after **Procedures D**. The second method is by importing toxonomic information that were compiled by the user into SDBMS. However, this can be done only once.

1. Right click on the Table (**Step 1**), click "Export" (**Step 2**) and select "Excel" (**Step 3**) (**Figure 1**).

2. Choose the location in the computer to save the Excel Template of Taxonomic Information table (**Step 4**), click "OK" (**Step 5**) and then click "Close" (**Step 6**) (**Figure 1**).

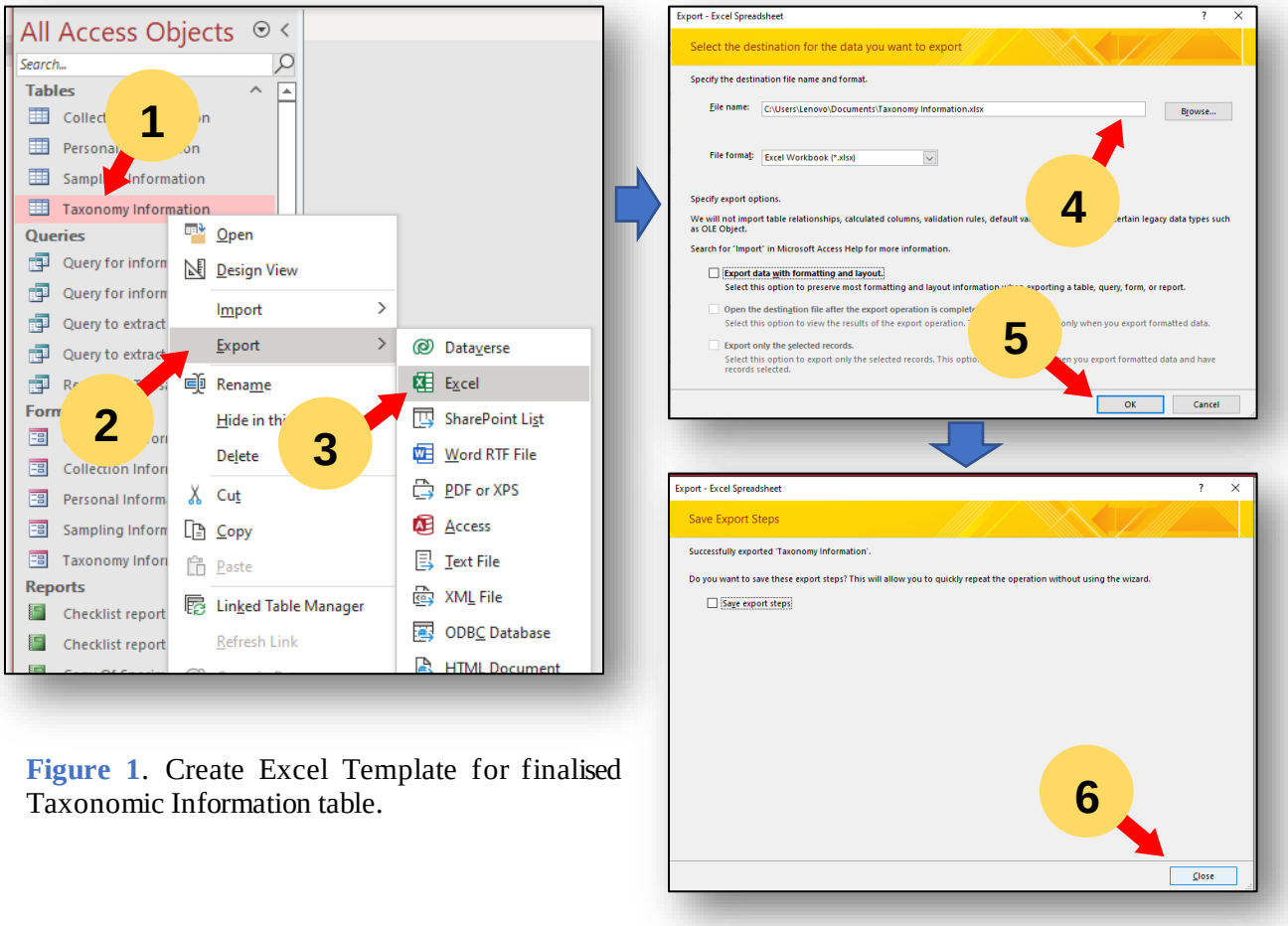
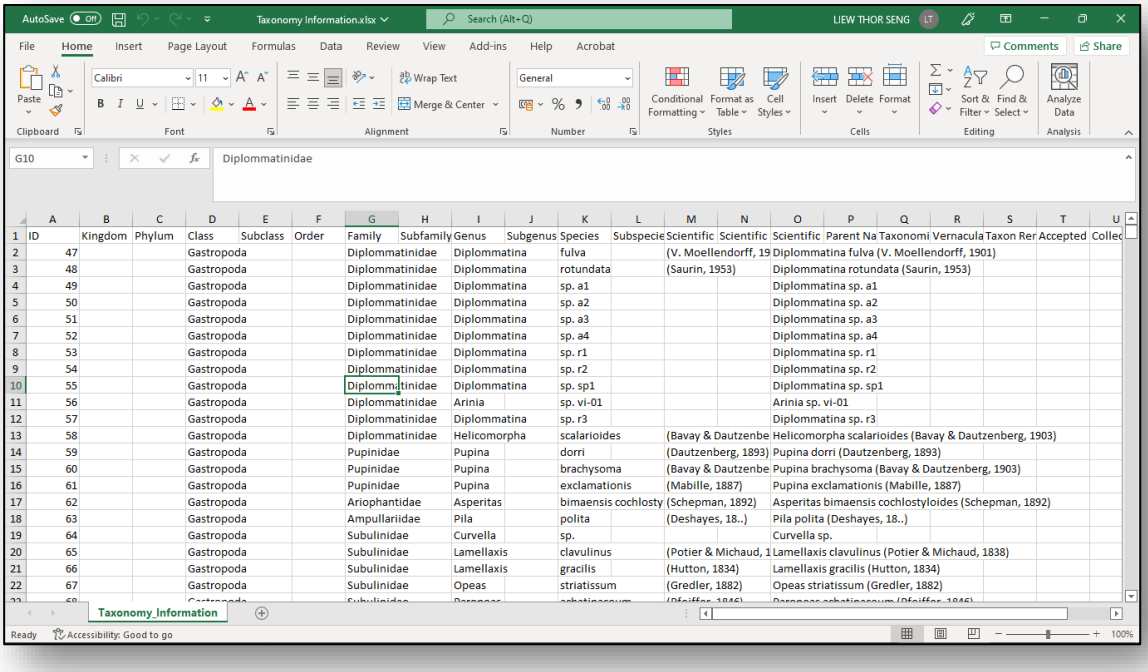


Figure 1. Create Excel Template for finalised Taxonomic Information table.

3. Open the Excel Template and complete the data for Taxonomic Information (**Figure 2**).



	ID	Kingdom	Phylum	Class	Subclass	Order	Family	Subfamily	Genus	Subgenus	Species	Subspecie	Scientific	Scientific	Scientific	Parent Na	Taxonomi	Vernacula	Taxon Ran	Accepted	Collec
2	47			Gastropoda			Diplommatinidae		Diplommatina		fulva		(V. Moellendorff, 19		Diplommatina fulva (V. Moellendorff, 1901)						
3	48			Gastropoda			Diplommatinidae		Diplommatina		rotundata		(Saurin, 1953)		Diplommatina rotundata (Saurin, 1953)						
4	49			Gastropoda			Diplommatinidae		Diplommatina		sp. a1				Diplommatina sp. a1						
5	50			Gastropoda			Diplommatinidae		Diplommatina		sp. a2				Diplommatina sp. a2						
6	51			Gastropoda			Diplommatinidae		Diplommatina		sp. a3				Diplommatina sp. a3						
7	52			Gastropoda			Diplommatinidae		Diplommatina		sp. a4				Diplommatina sp. a4						
8	53			Gastropoda			Diplommatinidae		Diplommatina		sp. r1				Diplommatina sp. r1						
9	54			Gastropoda			Diplommatinidae		Diplommatina		sp. r2				Diplommatina sp. r2						
10	55			Gastropoda			Diplommatinidae		Diplommatina		sp. sp1				Diplommatina sp. sp1						
11	56			Gastropoda			Diplommatinidae		Arinia		sp. vi-01				Arinia sp. vi-01						
12	57			Gastropoda			Diplommatinidae		Diplommatina		sp. r3				Diplommatina sp. r3						
13	58			Gastropoda			Diplommatinidae		Helicomorpha		scalarioides		(Bavay & Dautzenbe		Helicomorpha scalarioides (Bavay & Dautzenberg, 1903)						
14	59			Gastropoda			Pupinidae		Pupina		dorri		(Dautzenberg, 1893)		Pupina dorri (Dautzenberg, 1893)						
15	60			Gastropoda			Pupinidae		Pupina		brachysoma		(Bavay & Dautzenbe		Pupina brachysoma (Bavay & Dautzenberg, 1903)						
16	61			Gastropoda			Pupinidae		Pupina		exclamationis		(Mabille, 1887)		Pupina exclamationis (Mabille, 1887)						
17	62			Gastropoda			Ariophantidae		Asperitas		bimaensis cochlosty		(Schepman, 1892)		Asperitas bimaensis cochlostyloides (Schepman, 1892)						
18	63			Gastropoda			Ampullariidae		Pila		polita		(Deshayes, 18..)		Pila polita (Deshayes, 18..)						
19	64			Gastropoda			Subulinidae		Curvella		sp.				Curvella sp.						
20	65			Gastropoda			Subulinidae		Lamellaxis		clavulinus		(Potier & Michaud, 1		Lamellaxis clavulinus (Potier & Michaud, 1838)						
21	66			Gastropoda			Subulinidae		Lamellaxis		gracilis		(Hutton, 1834)		Lamellaxis gracilis (Hutton, 1834)						
22	67			Gastropoda			Subulinidae		Opeas		striatissum		(Gredler, 1882)		Opeas striatissum (Gredler, 1882)						

Figure 2. Excel template for taxonomic data to be completed and then imported into SDBMS.

4. Select and right-click on the Table (**Step 1**), select "Rename" (**Step 2**) and rename the original Table (**Step 3**) (**Figure 3**).

5. Select and right-click on the Table again (**Step 4**), select "Import" (**Step 5**) and select "Excel" (**Step 6**) (**Figure 3**) to open "Get External Data- Excel Spreadsheet" (**Figure 4**).

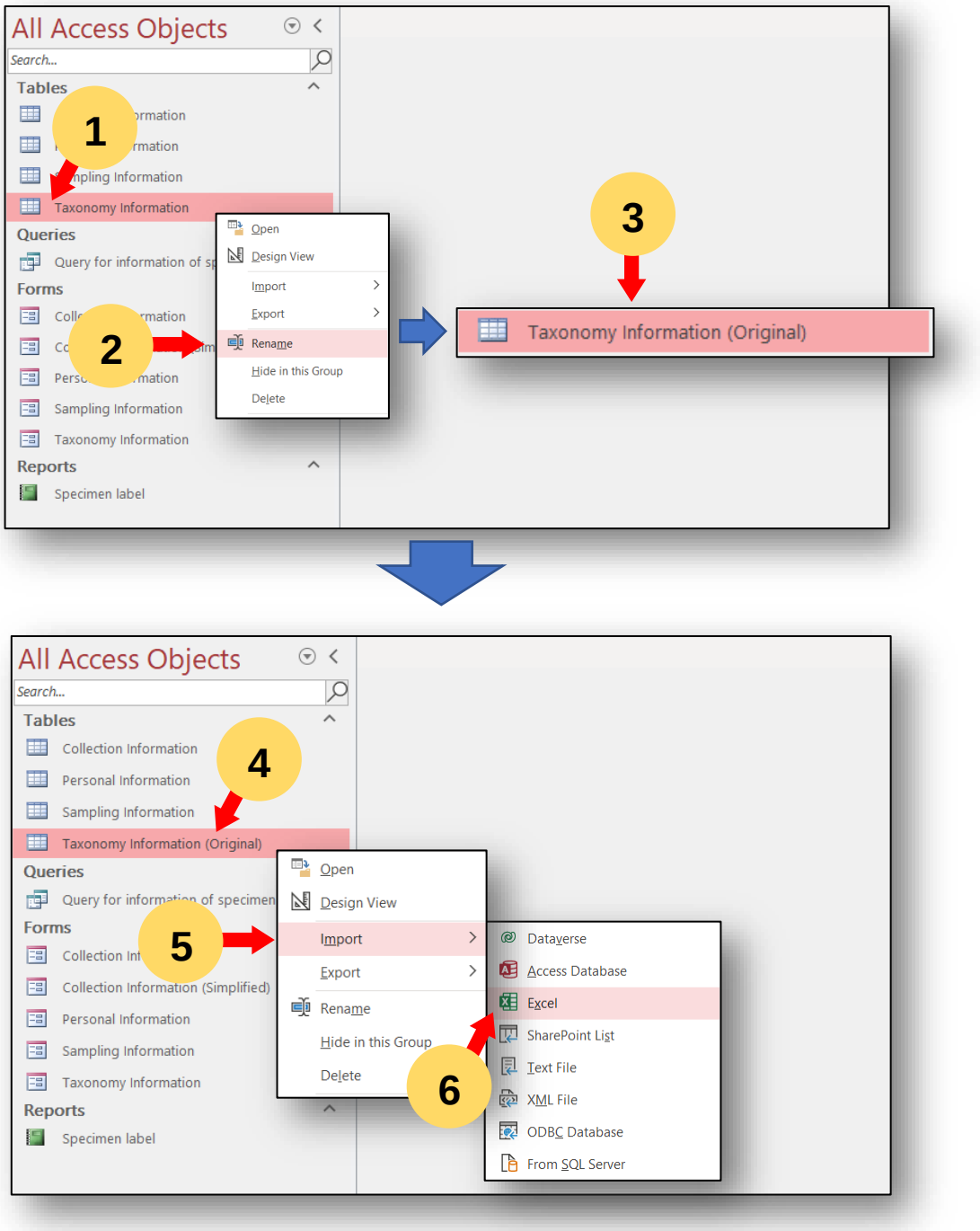


Figure 3. Rename the original Taxonomy Information table and create a new Taxonomic Information table by importing data from Excel template into SDBMS.

6. In "Get External Data- Excel Spreadsheet", browse (**Step 1**) to select the Excel file and click "Open" (**Step 2**) (**Figure 4**).

7. Select "Import the source data into a new table in the current database." (**Step 3**) and then click "OK" (**Step 4**) (**Figure 4**).

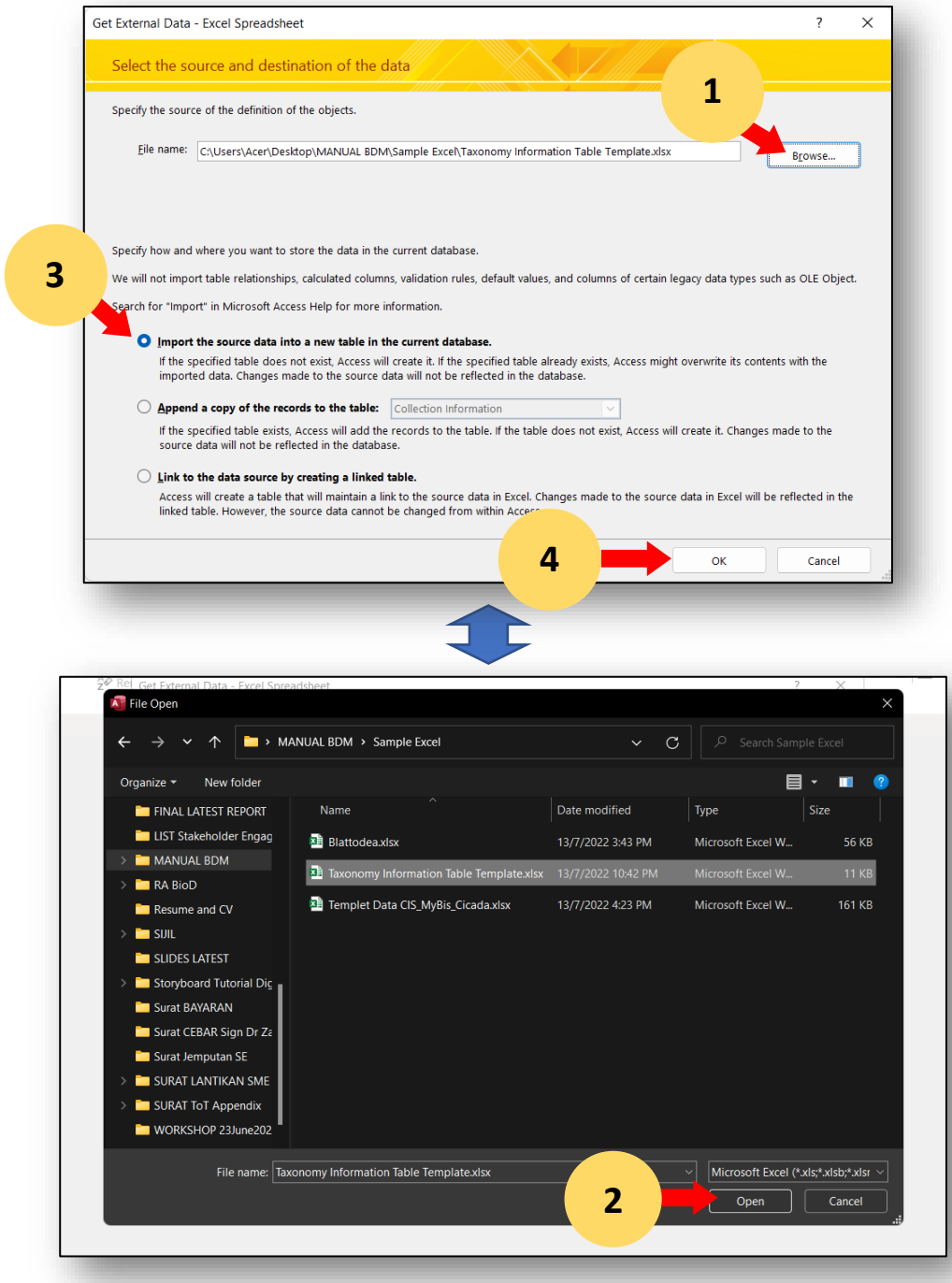


Figure 4. Import new table to SDBMS. "Get External Data - Excel Spreadsheet" and "File Open" popup windows.

8. Check the "First Row Contains Column Headings" box (**Step 1**). Then, click "Next >" to proceed (**Step 2**) (**Figure 5**).

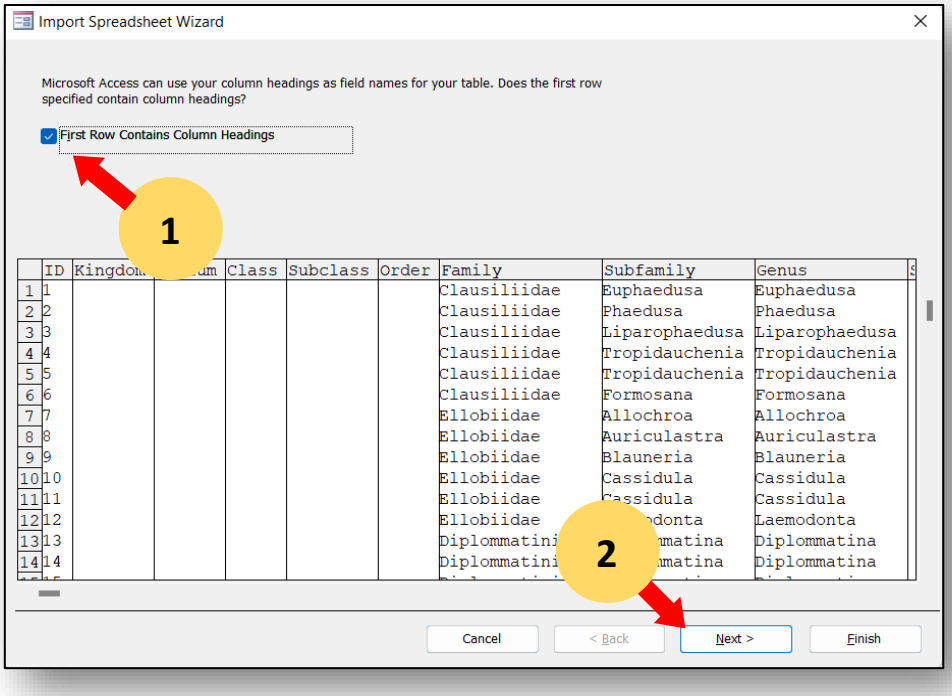
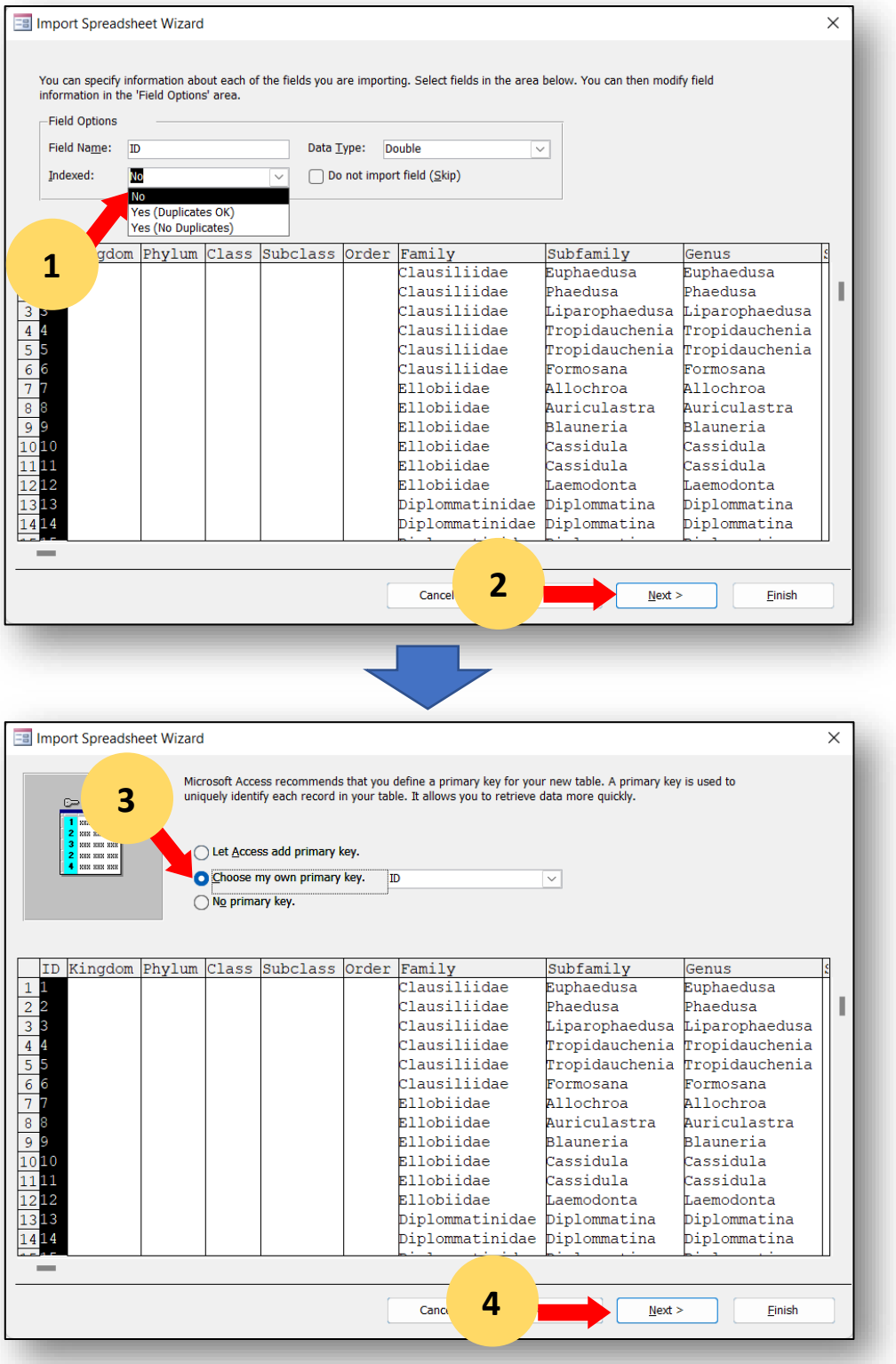


Figure 5. Import Spreadsheet Wizard popup window (Part 1).

9. In the popup window, select "No" for "ID" at the "Indexed" (**Step 1**) and click "Next >" to proceed (**Step 2**) (**Figure 6**).

10. Select "Choose my own primary key" option (**Step 3**) to set the primary key "ID" from the imported Excel spreadsheet. Click "Next >" to proceed (**Step 4**) (**Figure 6**).



	ID	Kingdom	Phylum	Class	Subclass	Order	Family	Subfamily	Genus
1	1						Clausiliidae	Euphaedusa	Euphaedusa
2	2						Clausiliidae	Phaedusa	Phaedusa
3	3						Clausiliidae	Liparophaedusa	Liparophaedusa
4	4						Clausiliidae	Tropidauchenia	Tropidauchenia
5	5						Clausiliidae	Tropidauchenia	Tropidauchenia
6	6						Clausiliidae	Formosana	Formosana
7	7						Ellobiidae	Allochroa	Allochroa
8	8						Ellobiidae	Auriculastra	Auriculastra
9	9						Ellobiidae	Blauneria	Blauneria
10	10						Ellobiidae	Cassidula	Cassidula
11	11						Ellobiidae	Cassidula	Cassidula
12	12						Ellobiidae	Laemodonta	Laemodonta
13	13						Diplommatinidae	Diplommatina	Diplommatina
14	14						Diplommatinidae	Diplommatina	Diplommatina

Figure 6. Import Spreadsheet Wizard popup window (Part 2).

11. Enter the original name of the table that to be replaced (see **No. 4** – **No. 5**) in the "Import to Table:" (**Step 1**). Click "Finish" to save the name of the new table into the database (**Step 2**) (**Figure 7**).

12. Click “Close” to complete the import of excel spreadsheet into the database (**Step 3**) (**Figure 7**).

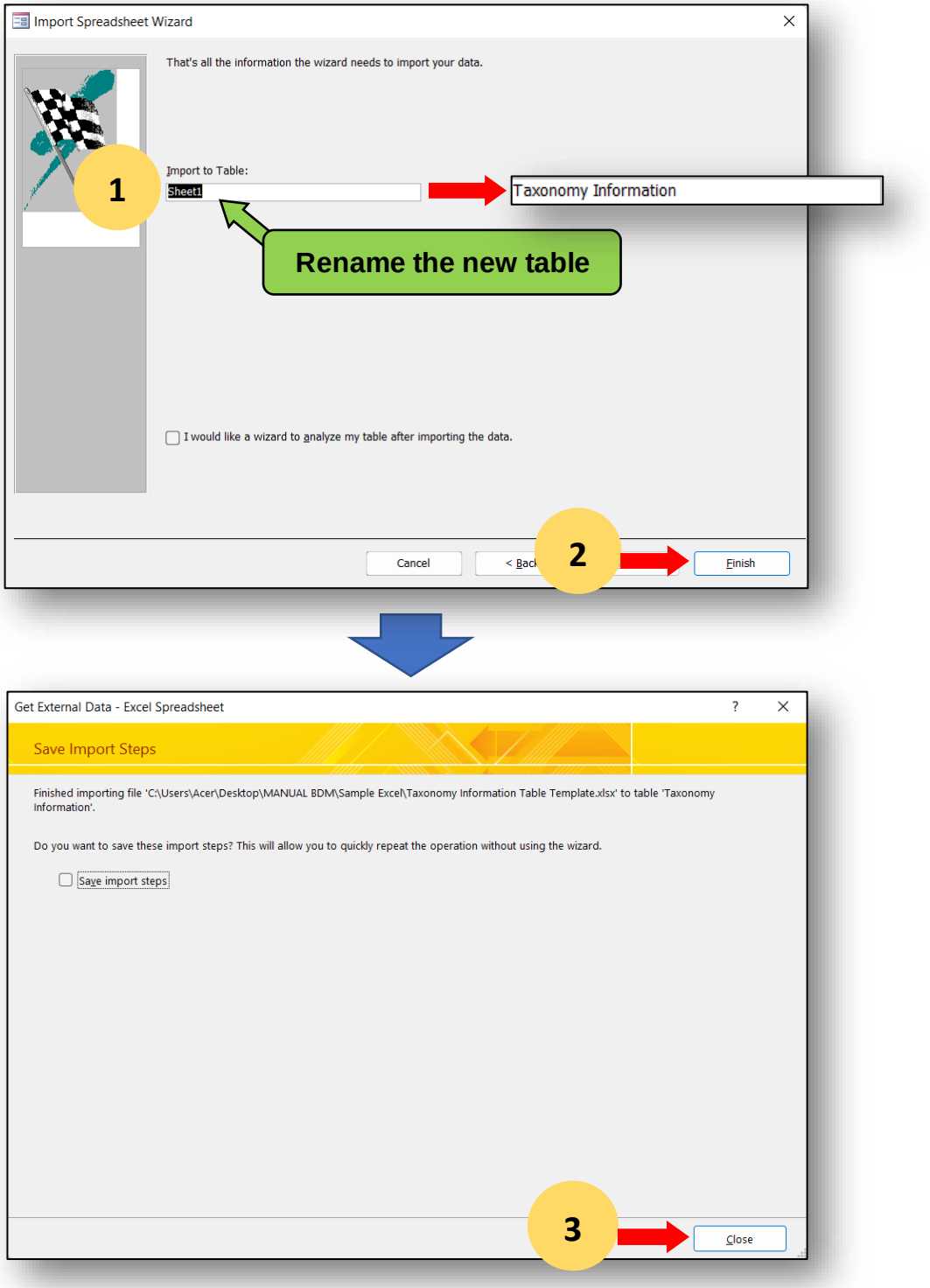


Figure 7. Import Spreadsheet Wizard popup window (Part 3).

13. Click on the imported "Taxonomy Information" (**Step 1**) (**Figure 8**).

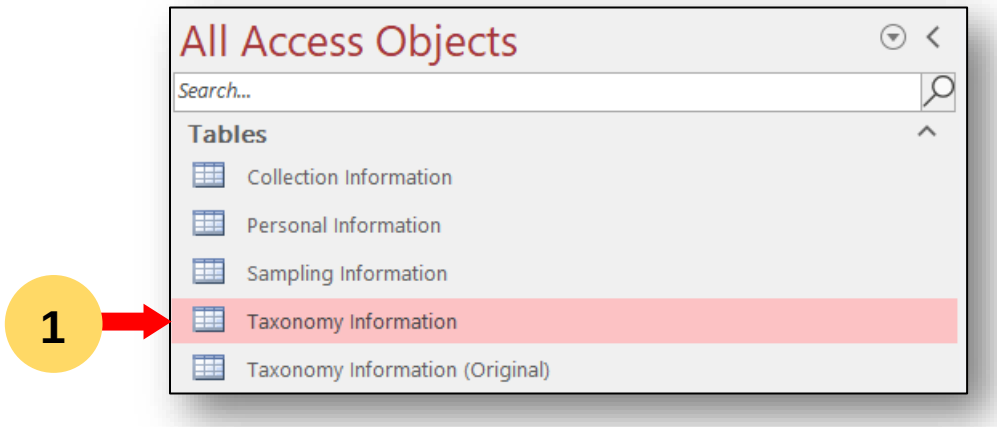


Figure 8. New "Taxonomy information" table added into one of the master lists.

14. Check the field and data of the newly imported table (**Figure 9**).

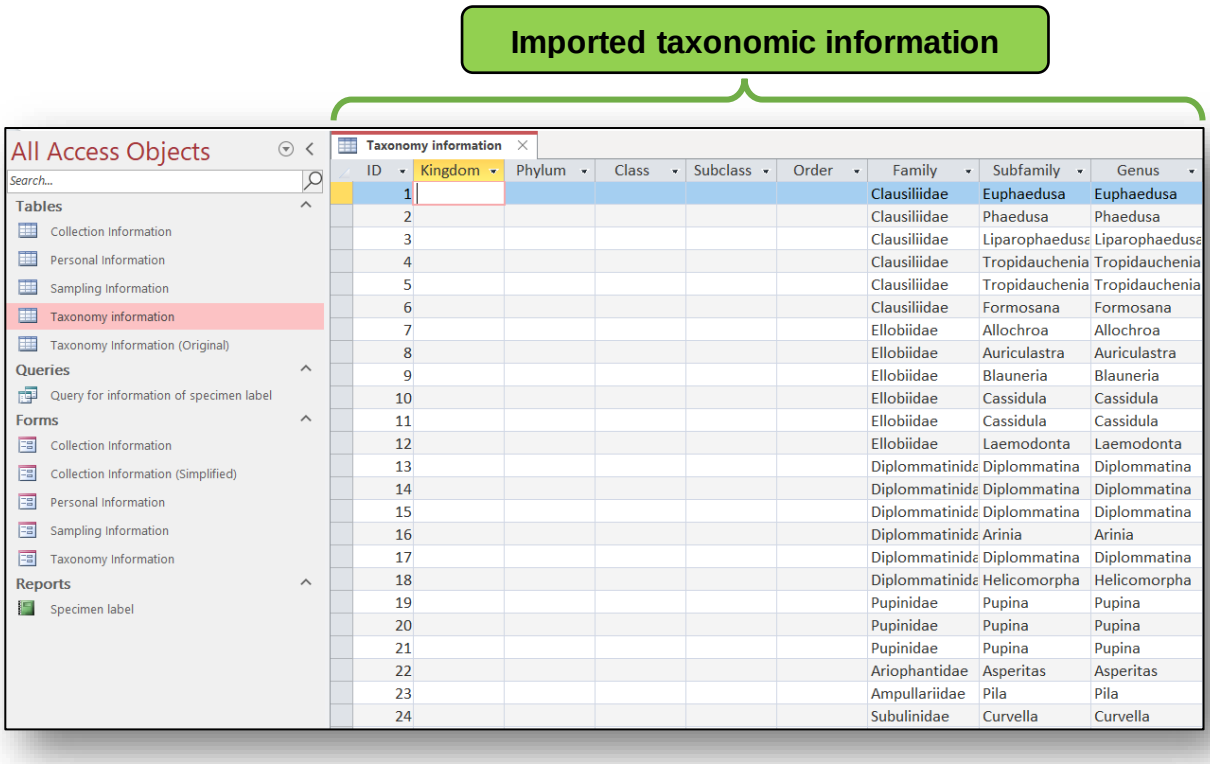


Figure 9. Imported taxonomic information table.

iv) Collection information

For the catalogue data element, "Institution Code", "Collection Code" and "Catalogue Number" are required. The concatenation of these three data into "Full Catalogue Information" must be a unique value. This is static data generated by the institution and serves as a unique identifier for the specimens and the other information associated with the specimens. The specimens cannot be catalogued until they have been given an accession number by the depository institutions. Reserving catalogue numbers should be avoided as it will mess up the running catalogue number sequence and create unnecessary confusion in future.

For the specimen with existing collection numbers (e.g., donated specimens from other depository institutions), the original voucher specimen number shall be entered in field "Other Catalogue Numbers". If the specimen is a type specimen, then record this data in field "Type Status". It is strongly recommended that to enter the details of the person who catalogued the specimen in "Catalogued By". If the specimen is used in a publication, the citation of the scientific publication shall be indicated under "Material Citation".

Procedure G. Set default values in the fields ((example – Collection Information Table)

1. Right click on the Collection Information table (**Step 1**), select "Design View" (**Step 2**) (**Figure 1**).

2. Click on "Institution Code" (**Step 3**) and select "General" Tab (**Step 4**) (**Figure 1**).

3. Enter default value or text in "Default Value" for institution code, for example "BOR" (**Step 5**) (**Figure 1**).

4. Repeat No. 2 – No. 3, but for "Collection Code" (**Step 6**) but enter Collection Code that represent the Taxa Code in the depository institution, for example, "MOL" (**Figure 1**).

5. Click on the (×) icon to close the Table and click "Yes" to save.

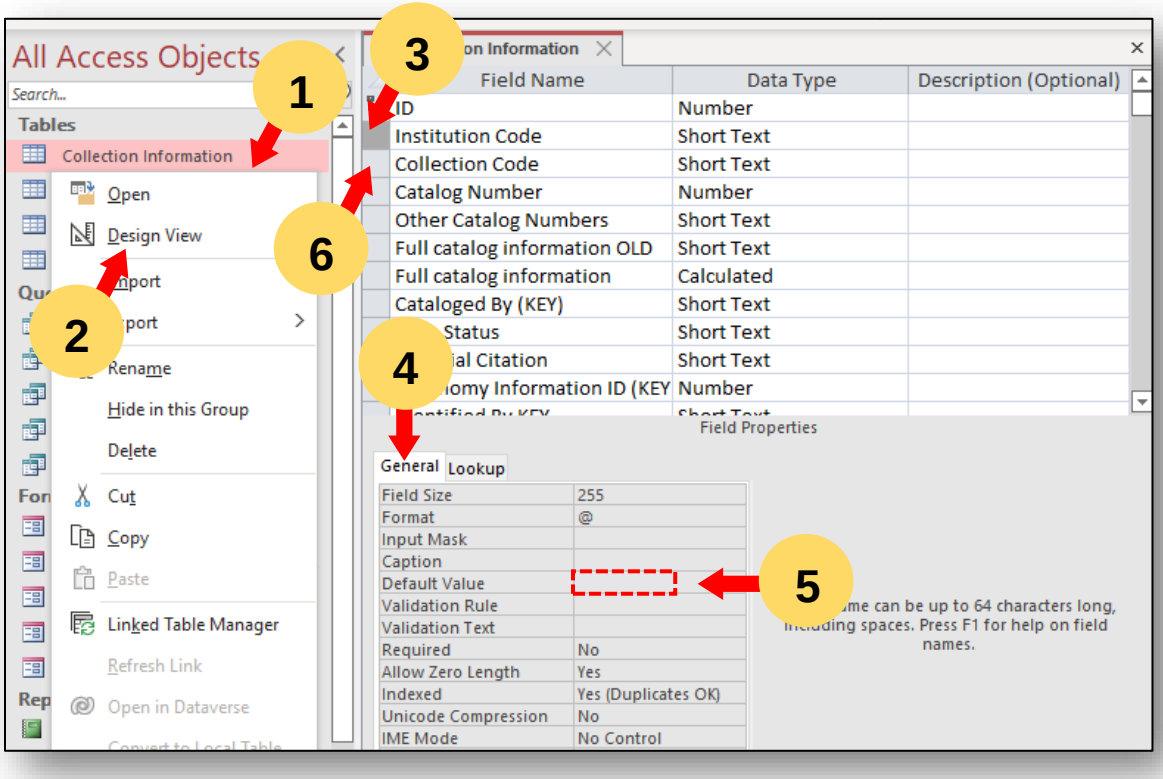


Figure 1. Set default values for Institution Code and Collection Code for Collection Information table.

Procedure H. Duplicate SDBMS for different collections under the same Depository Institution

1. Open Microsoft Access, create a new SDBMS for a collection, for example, Mammal collection in BORNEENSIS by clicking on "Blank database" (**Step 1**) (**Figure 1**).

2. Name the new database (**Step 2**) and click "Create" (**Step 3**) (**Figure 1**).

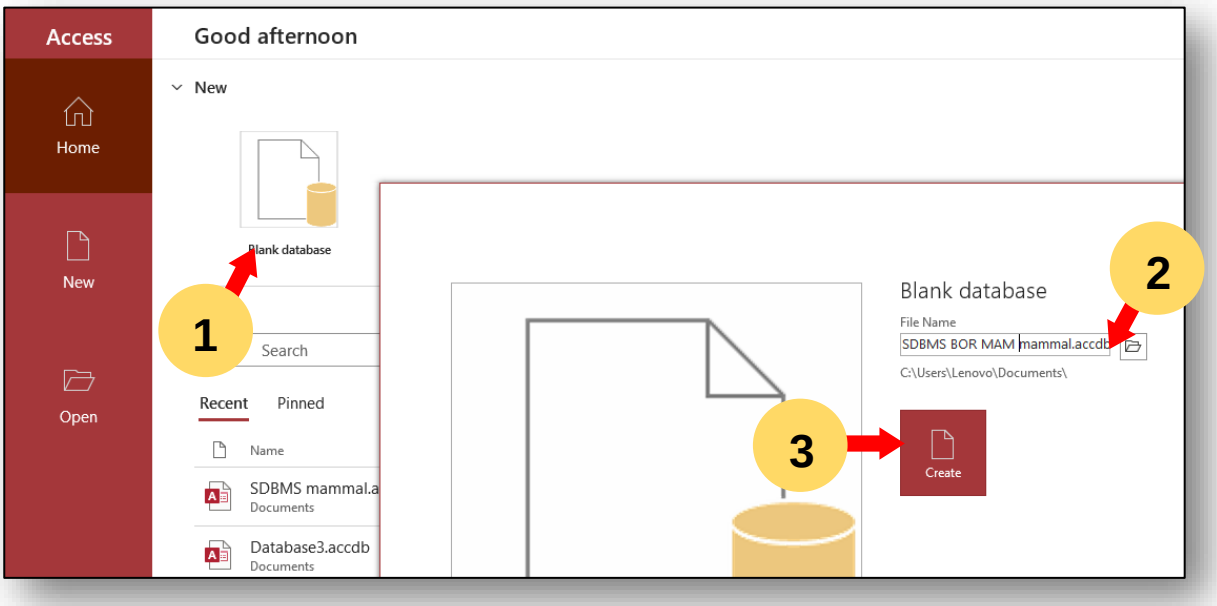


Figure 1. Create a new database for a collection under the same depository institute (i.e., same Institution Code, but different Collection Code).

3. Click on "External Data" form the Menu (**Step 1**), click "New Data Source" (**Step 2**), select "From Database" (**Step 3**), and then click "Access" (**Step 4**) (**Figure 2**).

4. Click on "Browse" to locate SDBMS (**Step 5**), select the SDBMS (**Step 6**), Click "Open" (**Step 7**), and then click "OK" (**Step 8**) (**Figure 2**).

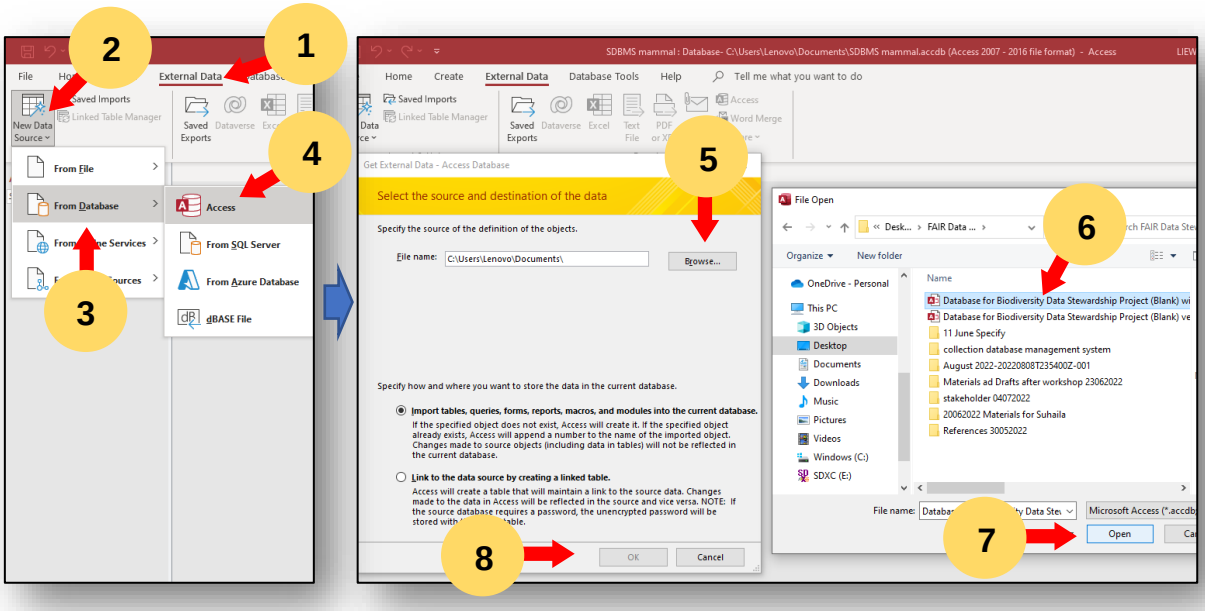


Figure 2. Import database structures and definition (Part 1).

5. Click on "Tables" Tab (**Step 1**) and click "Select All" (**Step 2**) (**Figure 3**).

6. Repeat **No. 5** - (**Step 1**) and (**Step 2**) for the remaining Tabs, namely, "Queries", "Forms" and "Reports" (**Figure 3**).

7. Click on "Option >>" (**Step 3**) and select "Definition Only" (**Step 4**) (**Figure 3**).

8. Click "OK" (**Step 5**) and then click "Close" (**Step 6**) (**Figure 3**).

9. A new SDBMS has been created with the same setting and modifications that were done in **Procedures A – G**.

10. Update the Collection Code by right click on the Collection Information table (**Step 1**) and click "Design View" (**Step 2**) (**Figure 4**).

11. Select "Collection Code" (**Step 3**) and update the "Default Value", for example, change "MOL" to "MAMM" (**Step 4**) (**Figure 4**).

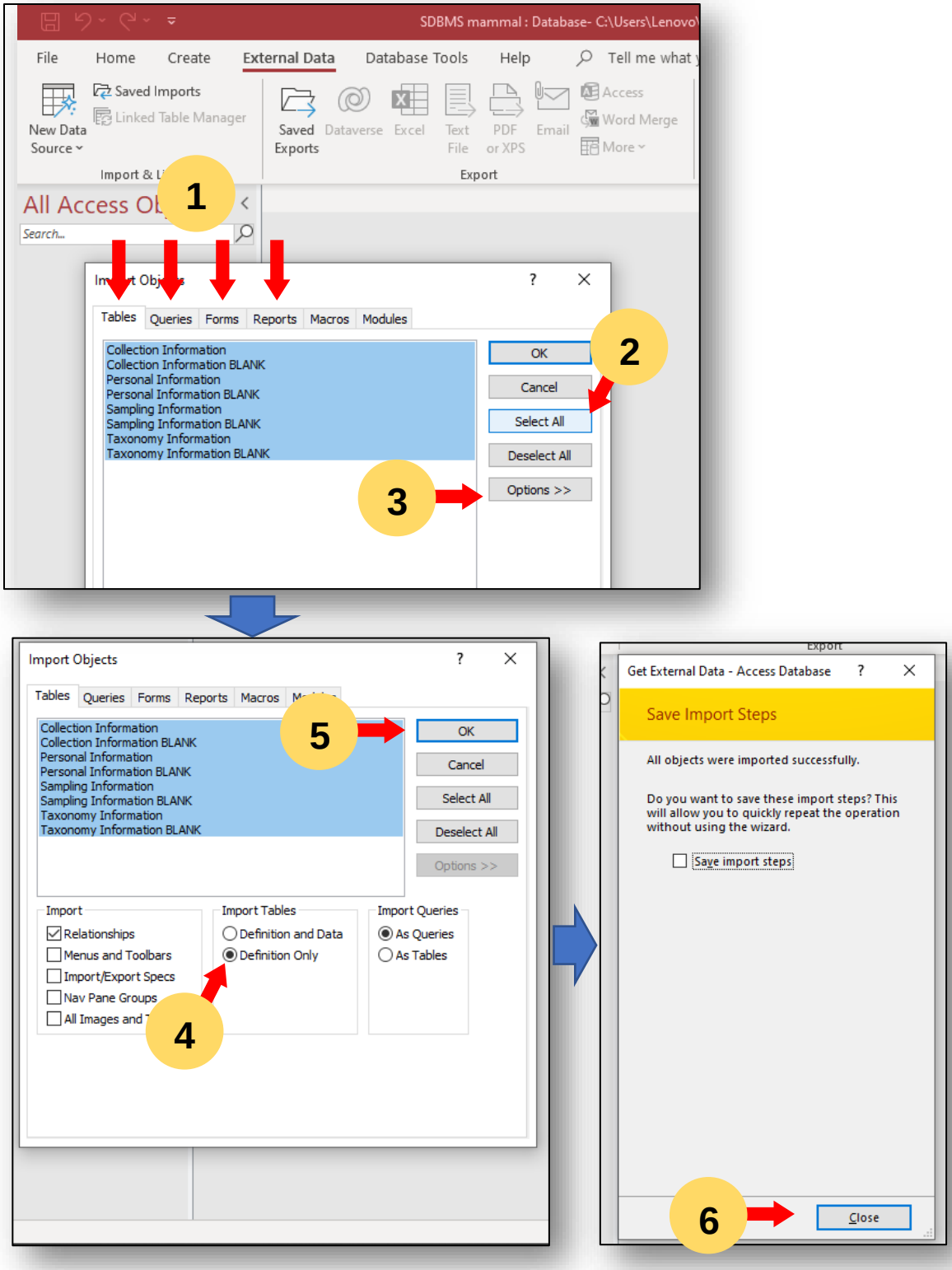


Figure 3. Import database structures and definition (Part 2).

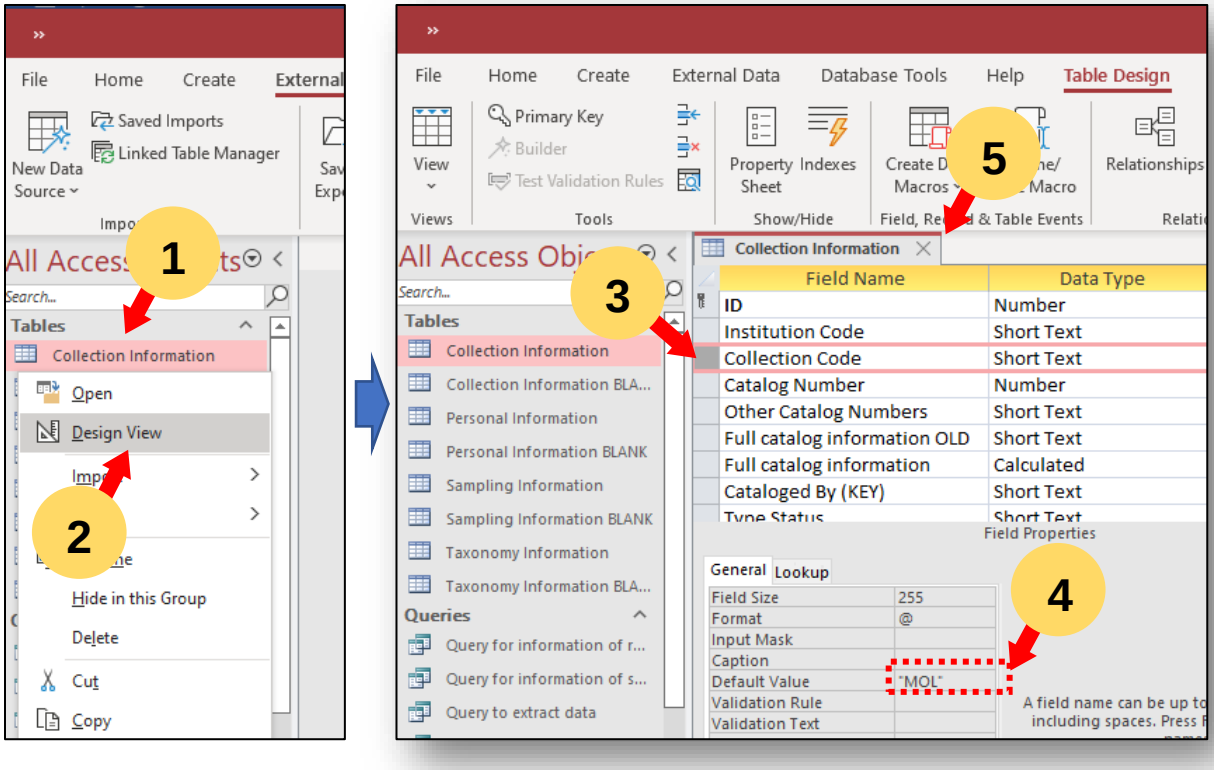


Figure 4. Update Collection Code for the new SDBMS.

Catalogue specimen data

The normal sequence of data entry as follow:

- Enter collector information of the sampling event in Personnel Profile Information Form if the collector is not in the list Personnel Profile Information of SDBMS.
- Enter sampling information.
- Enter taxonomy information in Taxonomy Information Table or Form if the taxa are not in the list Taxonomy Information of SDBMS.
- Enter collection information in Collection Information Form.

i) Personnel Profile Information

Throughout the workflow of managing biodiversity data, many personnel play different roles: as collectors of specimens from the field ("Recorded By" in the Sampling Information Table) and as curators who prepare and preserve the specimens (“Prepared By"), identify the specimens to species level ("Identified By") and then catalogue the specimen data in a database ("Catalogued By"), all of which should be recorded in the Collection Information Table. One person can play all these different roles and therefore it is important to have a master list that contains the information of all the people in the workflow. The Personnel Profile Information Table in the SDBMS is used to store and manage all the profiles of the personnel in terms of their personal information, namely, "First Name", "Last Name", and "Name Initial". It is important that there is only one entry in the table for each person. Other profile information such as "Affiliation" and "Other Personal Information" must also be filled in the Profile Information Table, which can provide additional unique identification of users.

Procedure I. Enter data in the Form (example – Personnel Profile Information Table)

1. Double-click on the "Personal Information" (**Step 1**) Form on the left panel (**Figure 1**).

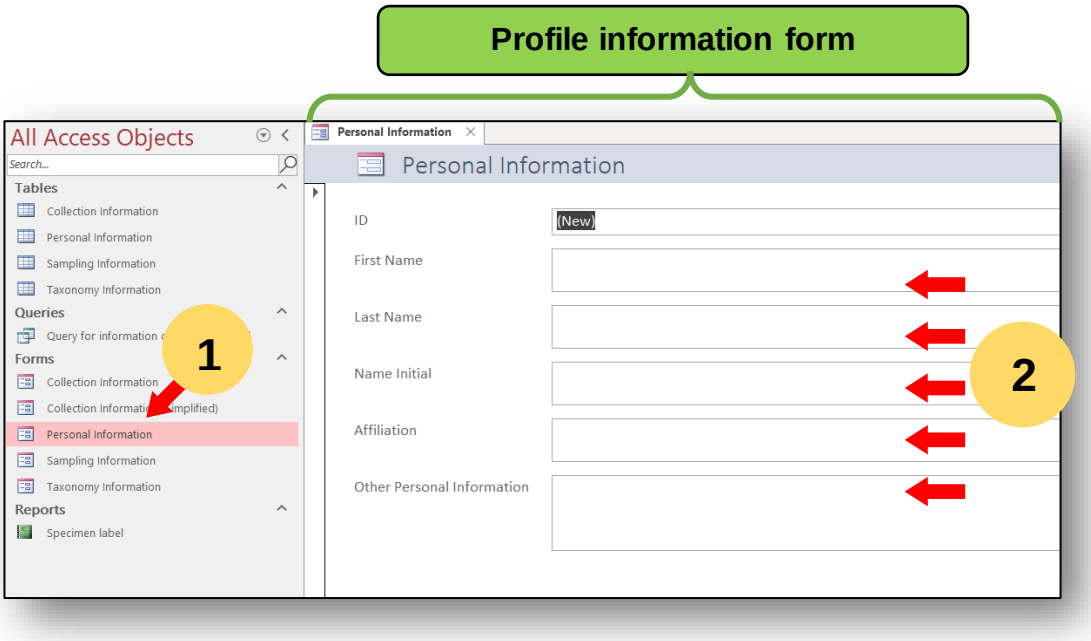


Figure 1. Profile Information form.

2. Double-click on the "Personal information" under the "Forms" panel (**Step 2**) to open the Profile information form (**Figure 1**). User can key in profile information into the form, and it will be updated simultaneously in the Personal information table. "ID" will be automatic generated by the Form.

3. After completed the data, user can click "New (blank) record" to enter the next record (**Step 1**). However, it is important to make sure there is not re-enter of the same record (same individual profile) in the SDBMS, and user can enter the name of the personnel in the "Search" box (**Step 2**) (**Figure 2**).

4. After completed data entry, click on the (×) icon to close and save the form with the keyed in information into the database (**Step 3**) (**Figure 2**).

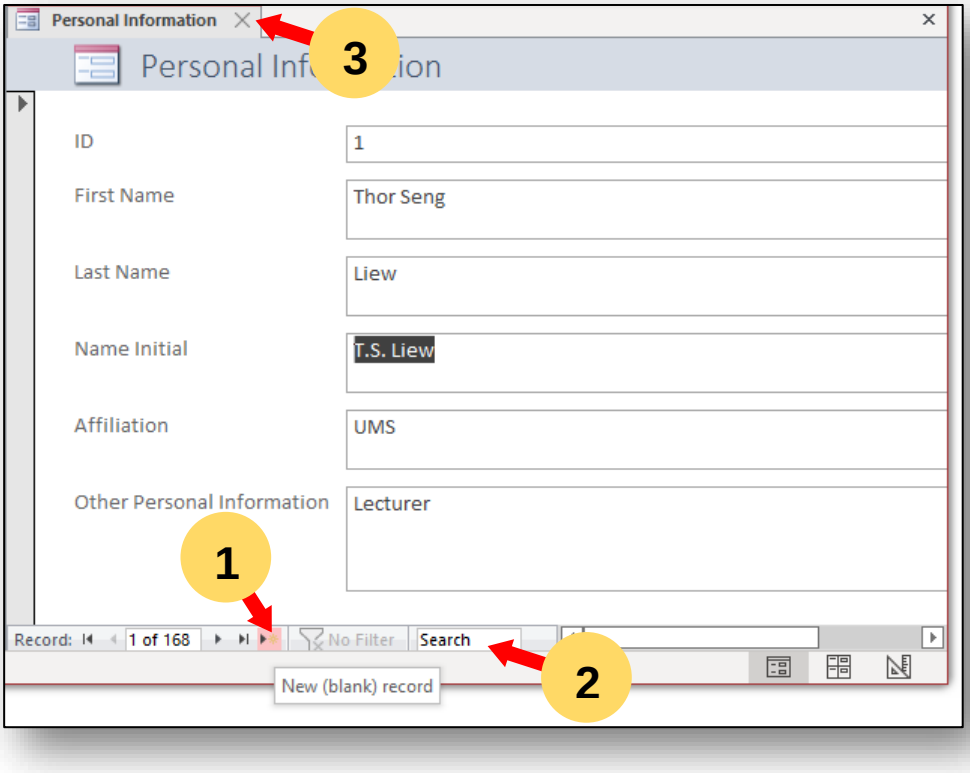


Figure 2. Profile Information form.

ii) Sampling Information

The sampling data must be entered into the database as soon as possible to avoid loss of information. In the SDBMS, there are 16 fields in the sampling information table, relating to GPS data, location data, elevation data, temporal data, sampling protocol data, of which 14 fields are required for newly collected specimens, one field is required when available, and one field is strongly recommended.

A. Newly collected specimens from the field

First, enter the "field number", which is a unique identifier for the sampling event. This information can be the reference of the sampling event recorded in the logbook of the data collector, e.g., '2022.Ali.01', which means the first sampling event made by Ali in 2022. The field number must be as short but as informative as possible so that entering the sampling information for the specimen can be done more effectively by simply selecting the field number rather than reading and searching for the location details.

Next, enter the verbatim description of the site: "Country", "State Province", "Municipality", "Location", "Locality", and "Habitat". The first four fields can be standardized by providing the standard value list to avoid confusion due to different spellings or different names for the same place. For the "Locality", the description must be as detailed as possible, if possible, not only the name of the place, but with additional information that helps to identify the place.

In addition to the textual description of the location, it is important to include the coordinates "Decimal Latitude" and "Decimal Longitude" of the location or area, as the name of the location may change over time. If samples have been taken from more than one location in an area, the coordinates of the centroid of the area may be used and a note of this need to be made in the "Location Remarks". It is also recommended that the "Verbatim Elevation" of the area be entered in the sampling information.

It is recommended that the data collector enters information such as "Location Remarks" and "Location According To", especially when the coordinates of GPS are not available, or the location description is based on the collector's own interpretation of the information on the specimen's label. Finally, the information of "Event Date", "Recorded By", "Sampling Protocol" and "Sampling Effort" are required. It is important that the sampling design, methods, and effort are specified to allow better inferences and to improve the re-use of data and the reproducibility of the analysis.

B. Existing specimens in collections with incomplete sampling data

Usually Sampling information can be completed for new data or existing collections with complete data. However, for existing collections with incomplete data or data lacking accuracy in the data sheet or on the specimen label, it is important to digitise all the sampling information that is available. Do not dispose of the specimen as it can still be very useful for taxonomy and larger scale inventory research for coarser resolution data, such as general location description. Georeferenced the textual locality can still be estimated based on gazetteer.

Procedure J. Enter data in the Form (example – Sampling Information Table)

1. Double-click on the "Sampling Information" from (**Step 1**) on the left pane (**Figure 1**).

2. User can start to key in the available data manually one-by-one by using the "Sampling information form" (**Step 2**) (**Figure 1**). "ID" will be automatic generated by the Form.

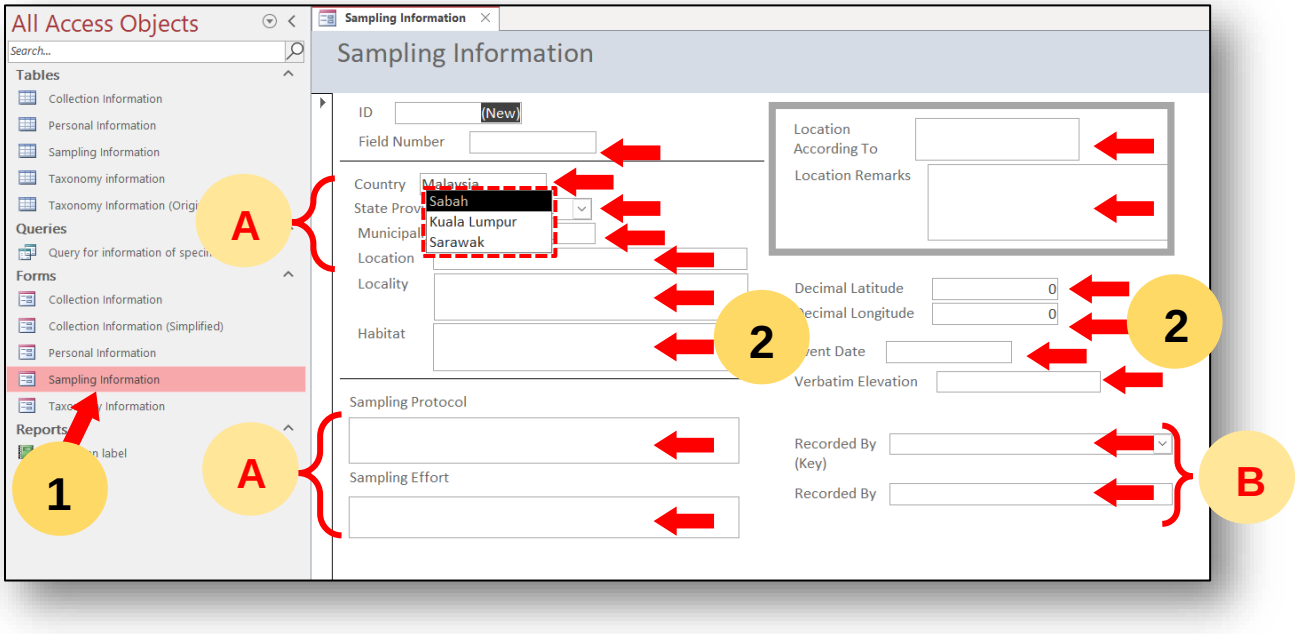


Figure 1. Sampling information form.

3. In the form, user can key in sampling related information by using the values in drop-down list of the Combo Box (**A**) (**Figure 1**). Please refer to the **Procedures C** for the steps to setup the value list in a Combo Box.

4. For collector information, it needs to be recorded in "Recorded By" (**B**) in two different ways (**Figure 1**).

5. First, click on the Combo Box "Recorded By (Key)" (**Step 1**), then select the collectors by check the box before the name, multiple selections are possible (**Step 2**), then click "OK" (**Step 3**) (**Figure 2**). If the names are not available in the list, user need to close the Sampling Information form, and then follow the **Procedures I** before reopen Sampling Information form to continue the data entry.

6. Second, retype the information as shown in "Recorded By (Key)" into "Recorded By" (**Step 4**) (**Figure 2**).

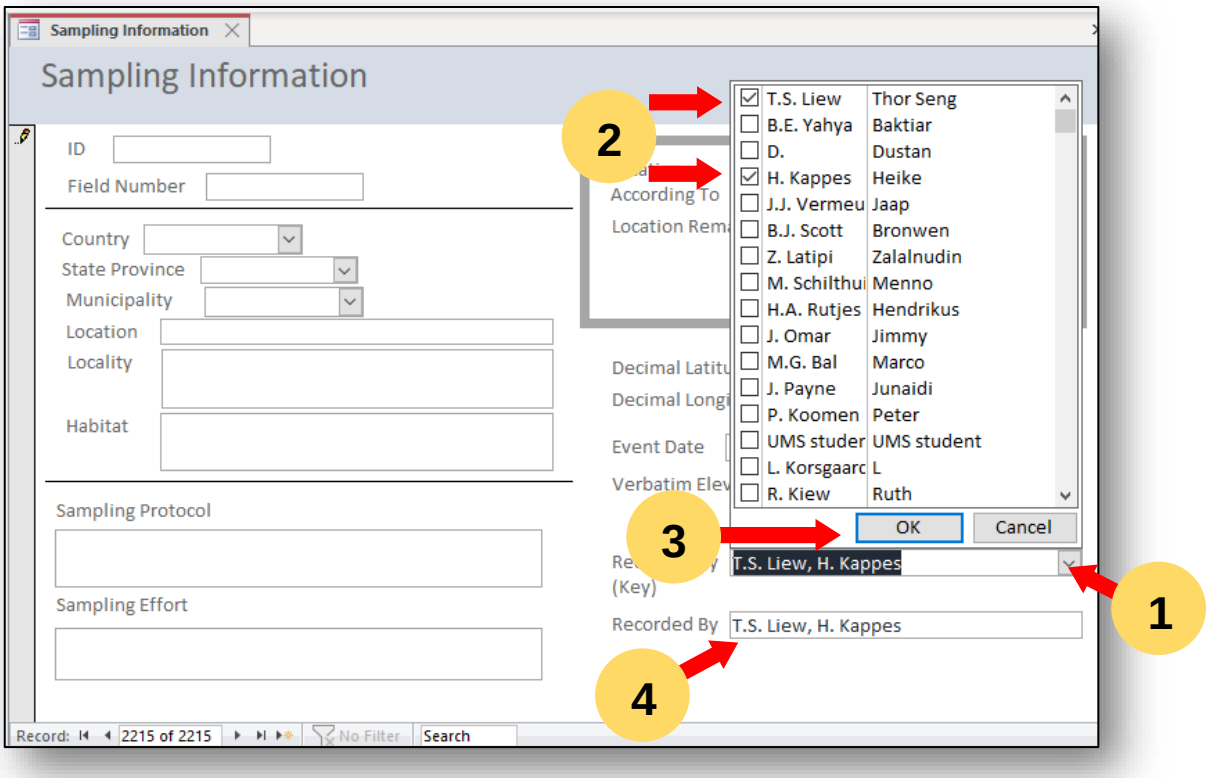


Figure 2. Enter collector information.

7. After completed the data entry for the sampling event, user can click "New (blank) record" to enter the next sampling event (i.e., next record) (**Step 1**) (**Figure 3**).

8. Click on the (×) icon to close and save the form with the keyed in information into the database (**Step 2**) (**Figure 3**).

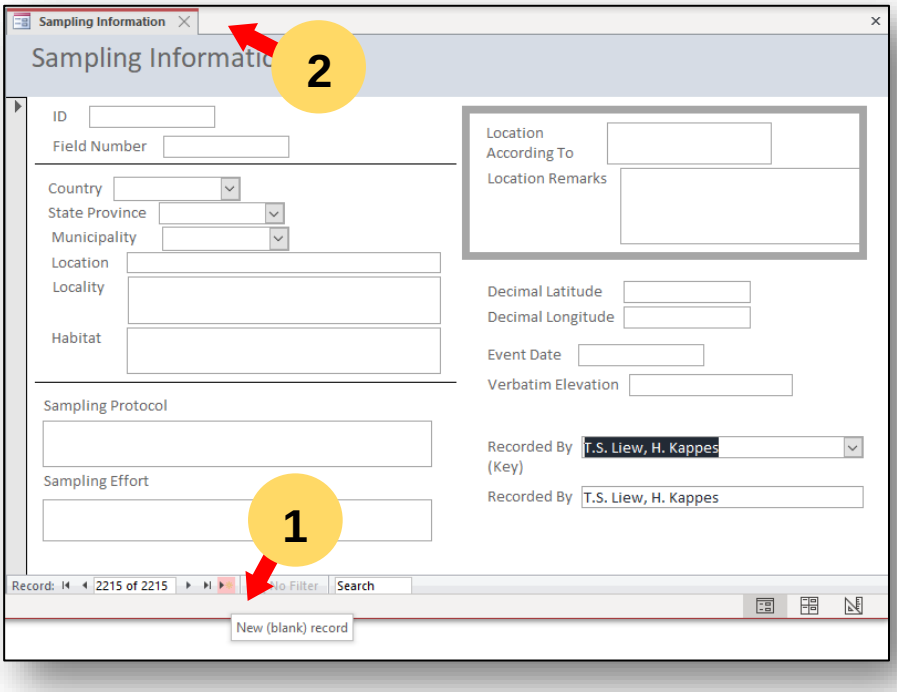


Figure 3. Save and enter the next record.

iii) Collection Information

After the specimens collected from the field have been processed and stored, the collection information is then created. In the SDBMS, there are 26 fields in the collection information table, of which nine fields are required for newly collected specimens, two are required when available, 10 are strongly recommended and five are recommended when available, that related to catalogue data, specimen collection data, specimen biological data, other specimen data, sampling data and taxonomic data. All of these are entered as new information by the data collector and data curator, except for the sampling and taxonomic data, which come from the Taxonomic Information Table and the Sampling Information Table.

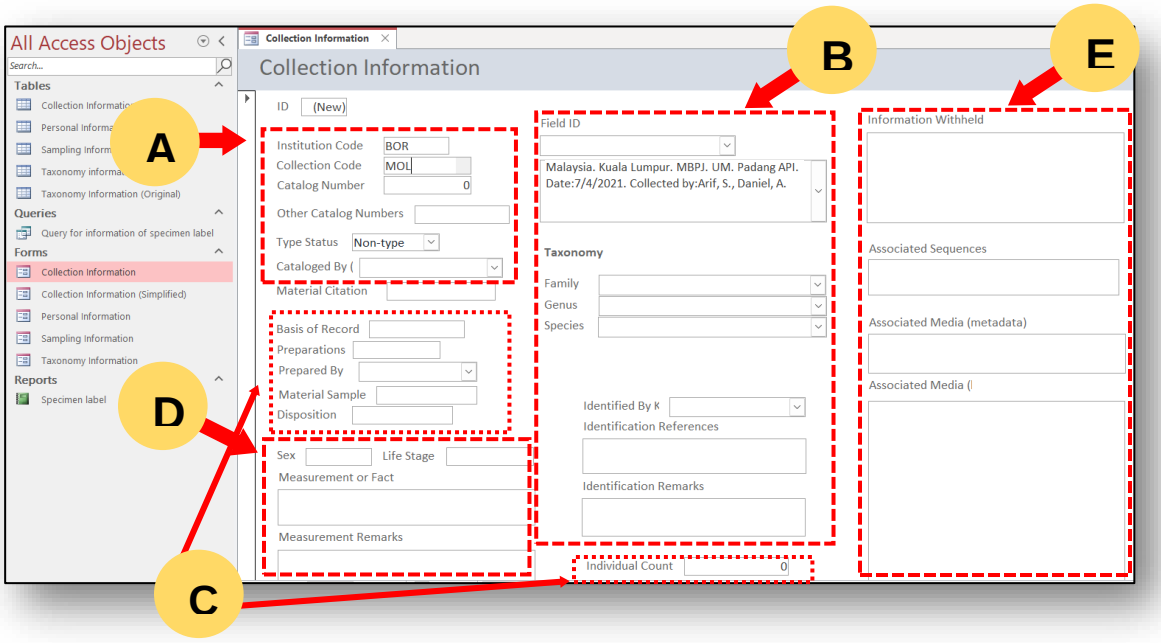


Figure 1. Collection information form.

A. Catalogue data

For the catalogue data element, "Institution Code", "Collection Code" and "Catalogue Number" are required. The concatenation of these three data into "Full Catalogue Information" must be a unique value. For the specimen with existing collection numbers (e.g., donated specimens from other depository institutions), the original voucher specimen number shall be entered in field "Other Catalogue Numbers". If the specimen is a type specimen, then record this data in field "Type Status". It is strongly recommended that to enter the details of the person who catalogued the specimen in "Catalogued By".

B. Taxonomy and Sampling data

We do not need to re-type country, state, locality, Kingdom, Phylum, Class, etc. again as the collection information is linked with taxonomy information and sampling information, and these data can be searched from a drop-down list at each field in the Collection Information Table. It is strongly recommended to enter the data on "Identified By", "Identification References", and "Identification Remarks". If the collection cannot be identified to species level, it is still important to label it at a higher taxonomic level for storage in depository institutions, as most institutions arrange and organise collections according to taxonomy.

C. Specimen collection data

Next, the descriptions of the specimen collection lots are required in terms of "Individual Count", "Preparations", and "Material Sample". At the same time, other information such as "Basis of Record", "Prepared By", and "Disposition" are strongly recommended to be entered into the database.

D. Specimen biological data

Some biological data of the specimens might have been collected in the field or during the processing of the specimens, for example, measurements, colours and other fields of the morphological features of the specimens. If these data are available, it shall be entered into the SDBMS. These data with the status "recommended when available", including "Sex", "Life Stage", "Measurement or Fact", and "Measurement Remarks". Much of this biological data obtained from specimens immediately after their collection or preservation is valuable, as some of the characteristics may be lost after the death of the organisms and the preservation process.

E. Other specimen data

It is important to enter the information into the database when the "Associated Media" and "Associated Sequences" are available. For "Associated Media", data users and curators can enter the data on the Digital Object Identifiers (DOI) of the images or videos in publications or online repositories.

For some specimens, some information may be available but not entered in the designated fields of the tables. This information and the explanation for this decision shall be entered in the field "Information Withheld". Special attention must be paid to sensitive data to prevent potential threats to biodiversity.

Procedure K. Enter data in the Form (example – Collection Information Table)

1. Double-click on the "Collection Information" form (**Step 1**) (**Figure 1**).

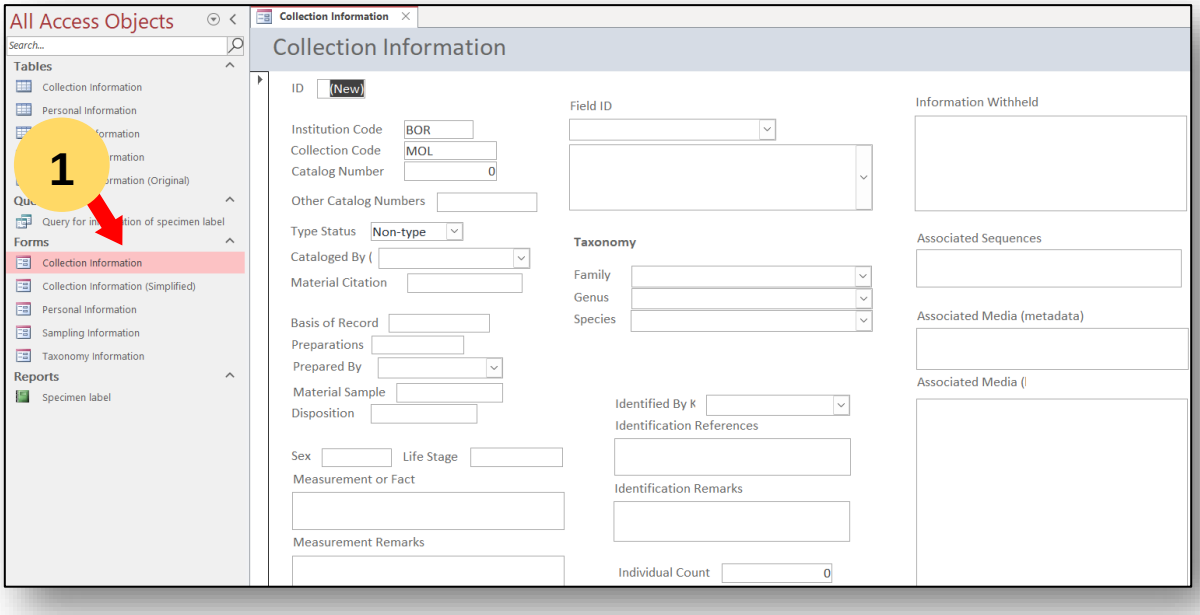


Figure 1. Collection information form.

2. Enter the core data for Collection Information (**Step 1**), if the default value for "Institution Code" and "Collection Code" do not appear as default value, user may close the Collection Information form and proceed to **Procedures G**, and then reopen the Collection Information form to continue data entry (**Figure 2**). "ID" will be generated automatically.

3. Enter the "Catalog Number" (**Step 1**) (**Figure 2**).

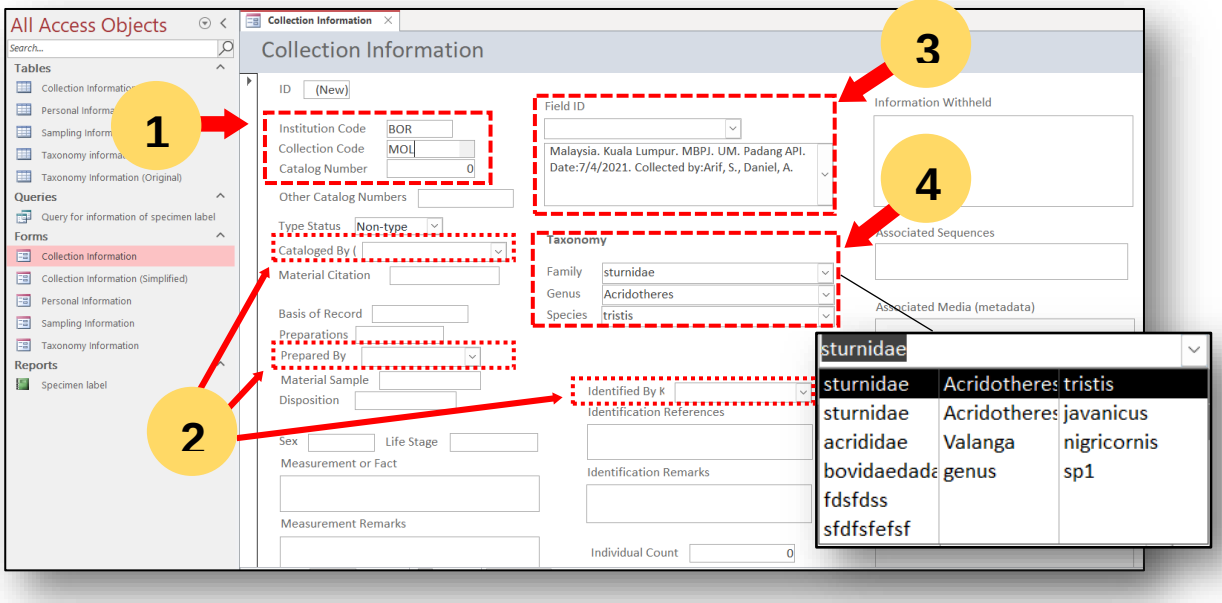


Figure 2. Enter the core data in "Collection information" form.

4. Enter the core data for Personnel Information (**Step 2**), if the personnel profile does not appear in the list of Combo Box, user may close the Collection Information form and proceed to **Procedures I**, and then reopen the Collection Information form to continue data entry (**Figure 2**).

5. Enter the core data for Sampling Information (**Step 3**), if the Sampling information does not appear in the list of Combo Box, user may close the Collection Information form and proceed to **Procedures J**, and then reopen the Collection Information form to continue data entry (**Figure 2**).

6. Enter the core data for Taxonomic Information (**Step 4**) (**Figure 2**), and then procced to **No. 11**. If the taxonomy information does not appear in the list of Combo Box, user may close the Collection Information form and proceed to **No. 8** (**Figure 3**).

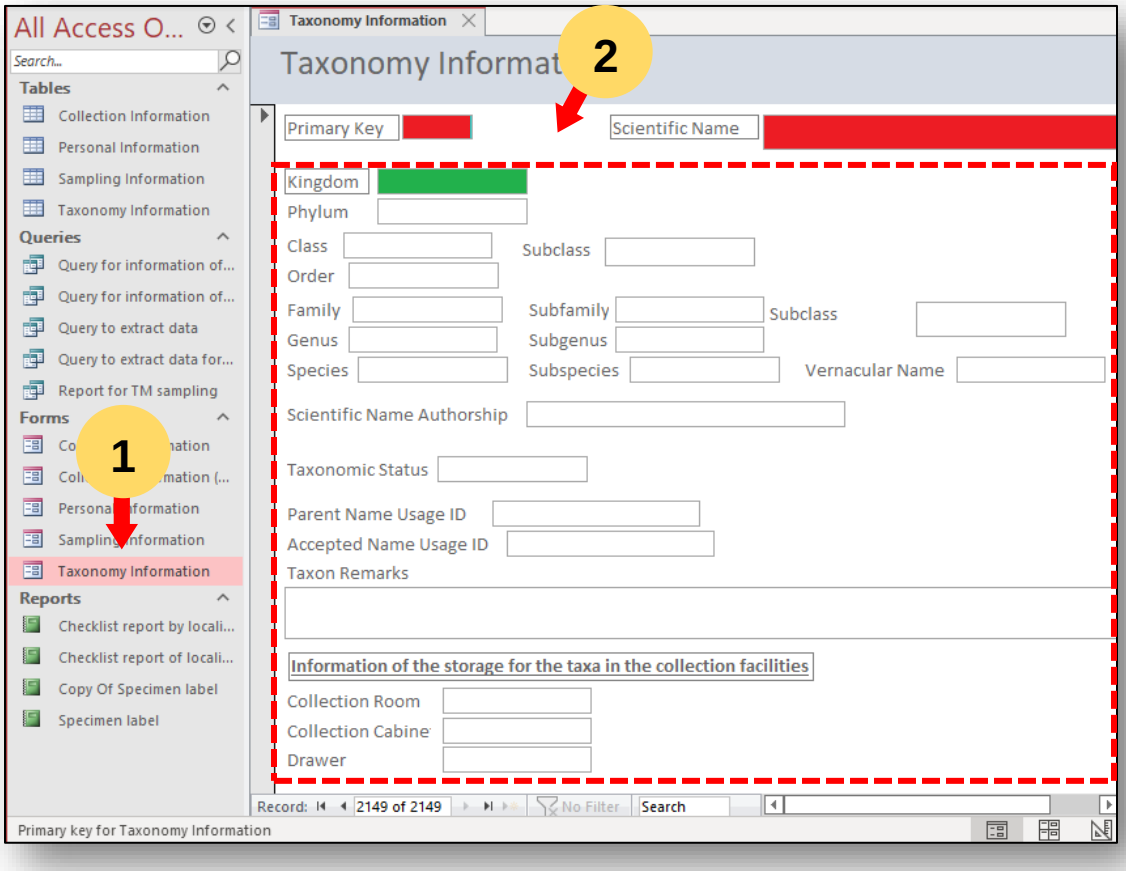


Figure 3. Enter the data in "Taxonomic information" form.

7. Double click (**Step 1**) to open Taxonomic Information form (**Figure 3**).

8. Enter (**Step 2**) the data into open Taxonomic Information form (**Figure 3**).

9. Reopen Collection Information form and enter the Taxonomic Information for the collection (**Step 4**) (**Figure 2**).

10. Enter the remaining data into Collection Information form (**Step 1**) (**Figure 4**).

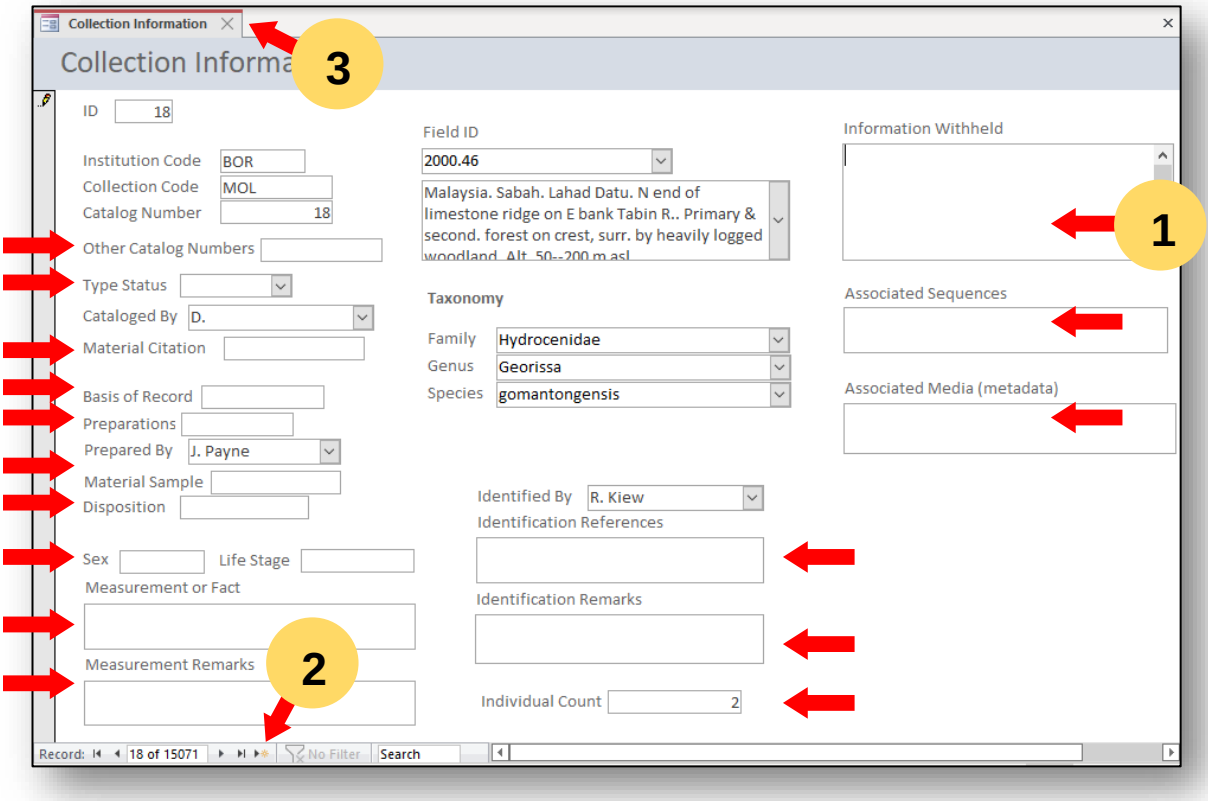


Figure 4. Enter the other data in "Collection information" form.

11. Click "New (blank) record" to enter the next data for the next collection lot/specimen the (**Step 2**) (**Figure 4**).

12. Click on the (×) icon to close the form (**Step 3**) (**Figure 4**).

iv) Link the images of the specimens to the SDBMS and display them in the Collection Information form

It is possible to link and display the images of the specimens with SDBMS. Instead of embedding and storing the images in SDBMS, which will exponentially increase the size of the database and compromises SDBMS functionality, it is better to store all the images in a folder on external or internal storage of the computer.

The images of each specimen/collection can be viewed by specifying the path to the image folder in the Collection Information table under "Associated Media" and then adding image objects in the Collection Information form by specifying the source of the image as specified in "Associated Media". The default path for the image folder is "C:\images\" and the images shall have the format ".jpg". Each image shall be named with the catalogue number of the specimen, e.g., "**15011**.jpg". If there are more than images for each specimen/collection, the image files shall be named with the same catalogue number followed by the second level of the numbering, e.g., "15011**.1**.jpg", "15011**.2**.jpg", "15011**.3**.jpg", etc.

In the default template of the Collection Information table and form, two images can be displayed for each collection, but more image objects can be added in the table and form. It is advisable to standardise the second level of numbering in the image file name with the type of specimen images, e.g., "#####**.1.jpg**" stand for an image in ventral view, "#####**.2.jpg**" for an image in dorsal view, etc.

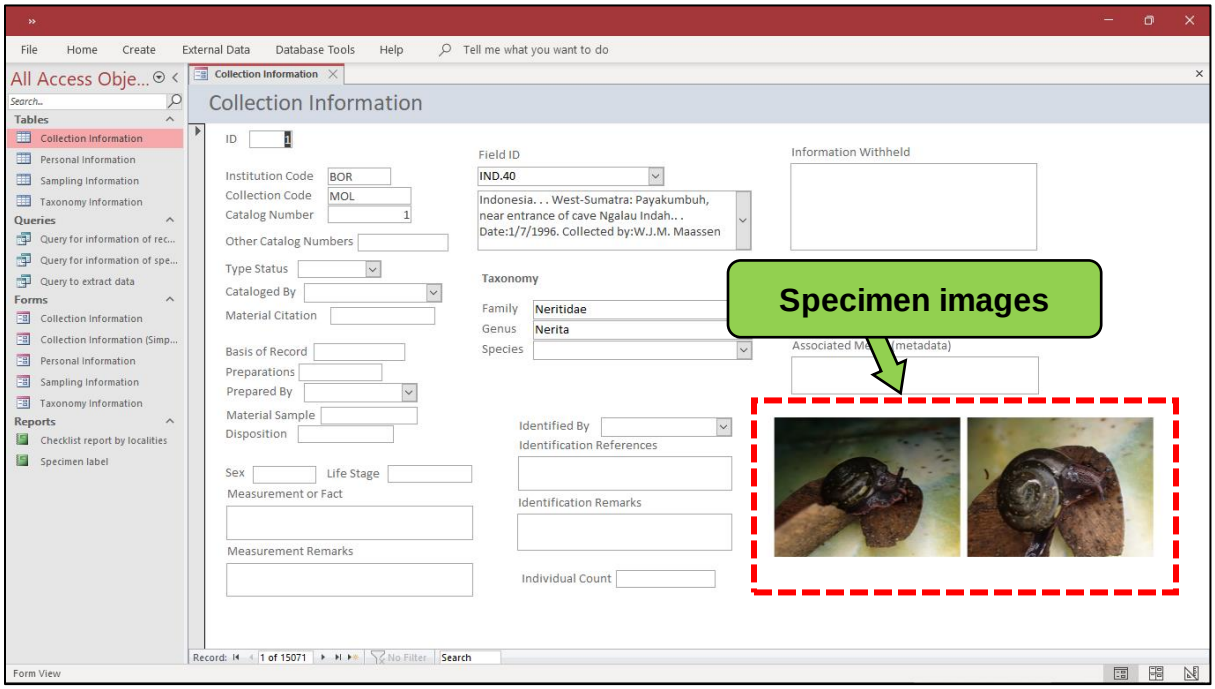


Figure 1. Display the images of the specimens in the default Collection Information

Procedure L. Link the images of the specimens to the SDBMS and display them in the Collection Information form

1. Open drive "C" in the computer (**Step 1**). Create a new folder and name it as "images" (**Step 2**) (**Figure 1**).

2. Store all the images with "jpg" file format in "images" folder (**Step 3**) (**Figure 1**).

3. Each image shall be named with the catalogue number of the specimen, e.g., "15011.jpg". If there are more than images for each specimen/collection, the image files shall be named with the same catalogue number followed by the second level of the numbering, e.g., "15011.1.jpg", "15011.2.jpg", "15011.3.jpg", etc (**Step 3**) (**Figure 1**).

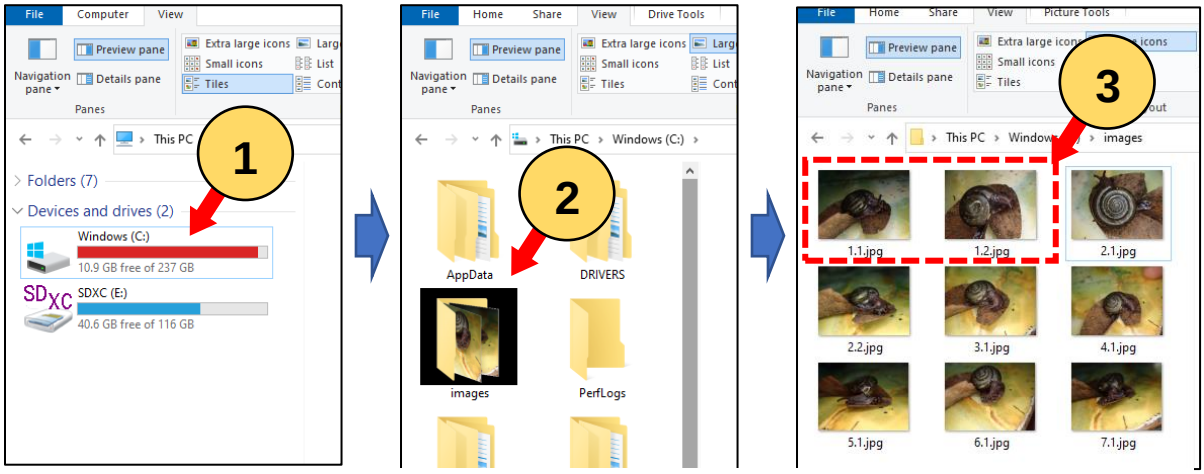


Figure 1. Display the images of the specimens in the Collection Information form.

4. Open SDBMS and right click on "Collection Information table (**Step 1**) and then select "Design View" (**Step 2**) (**Figure 2**).

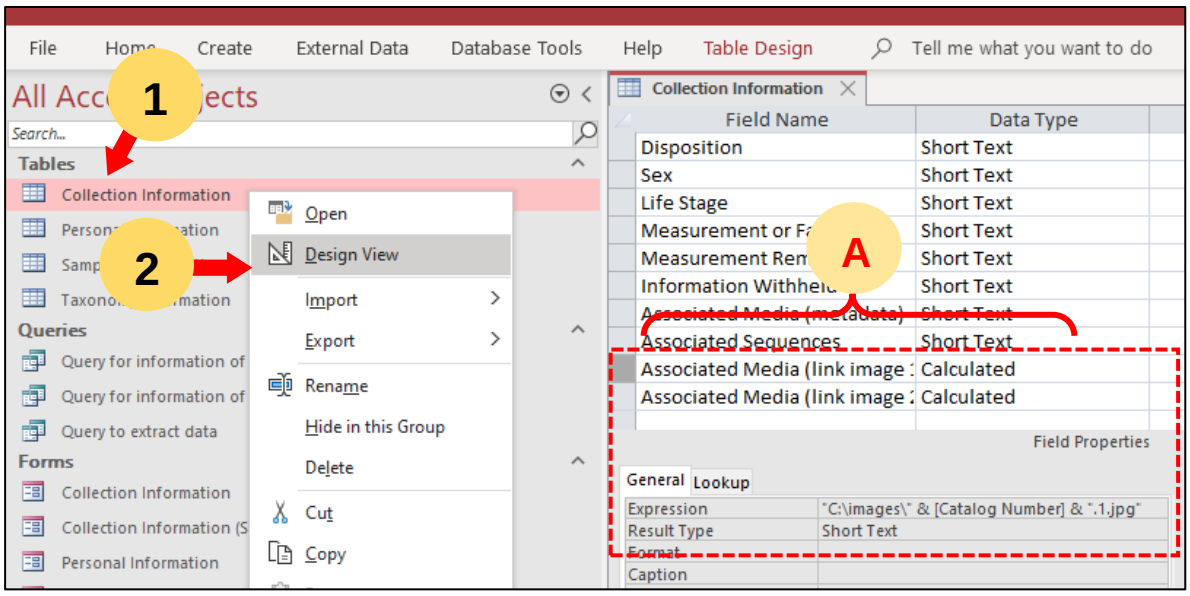


Figure 2. Design view of Collection Information table.

5. Select one of "Associated Media" (**Step 1**), right click at the selected row (**Step 2**), and then click "Copy" (**Step 3**) (**Figure 3**).

6. Right click at the new row (**Step 4**), then click "Paste" (**Step 5**) to create a new field (**A**) (**Figure 3**).

7. Update the "Associated Media" field name, for example change "… (link image **1**)" to "… (link image **3**)" (**Step 6**) (**Figure 3**).

8. Update the "Expression", for example change '…& ". **1**.jpg"' to '…& ". **3**.jpg"' (**Step 7**) (**Figure 3**).

9. Click on the (×) icon to close the form (**Step 8**) and click "Yes" (**Figure 3**).

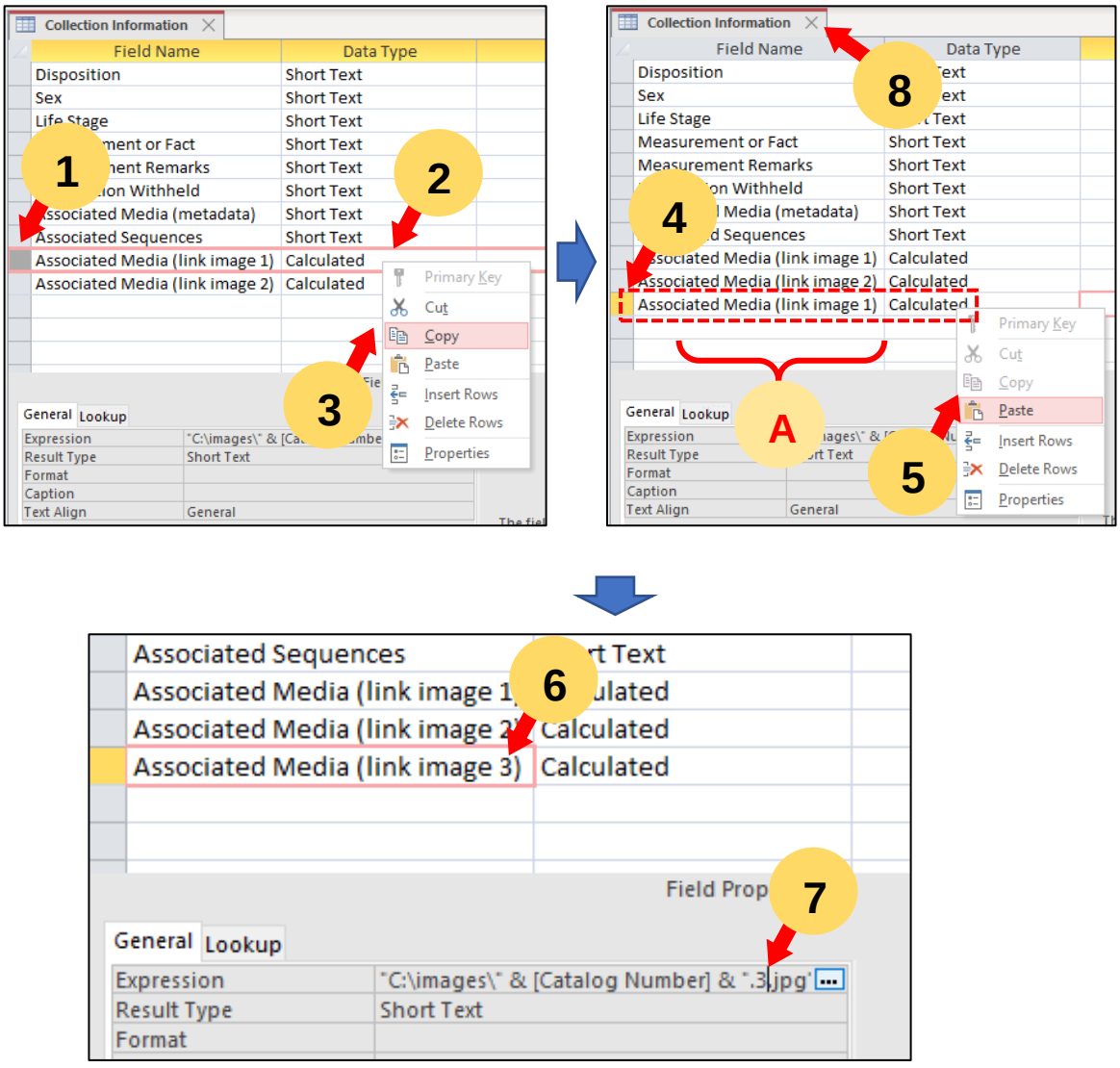


Figure 3. Add a new image field in the Collection Information table.

10. Right click on Collection Information form (**Step 1**) and select "Design View" (**Step 2**) to modify the image objects in the form **(A)** (**Figure 4**).

11. Right click on one of the image objects in Collection Information form (**Step 3**), select "Copy" (**Step 4**) and then right click on the same selected image object then select "Paste" (**Step 5**) (**Figure 4**).

12. Double click on the new image object (**Step 6**), select "Data" tab in "Property Sheet" (**Step 7**) (**Figure 4**).

13. Click "Control Source" (**Step 8**) to select the newly create "Associated Media" of the table (**Step 9**) (**Figure 4**). Click on the (×) icon to close the form and click Yes.

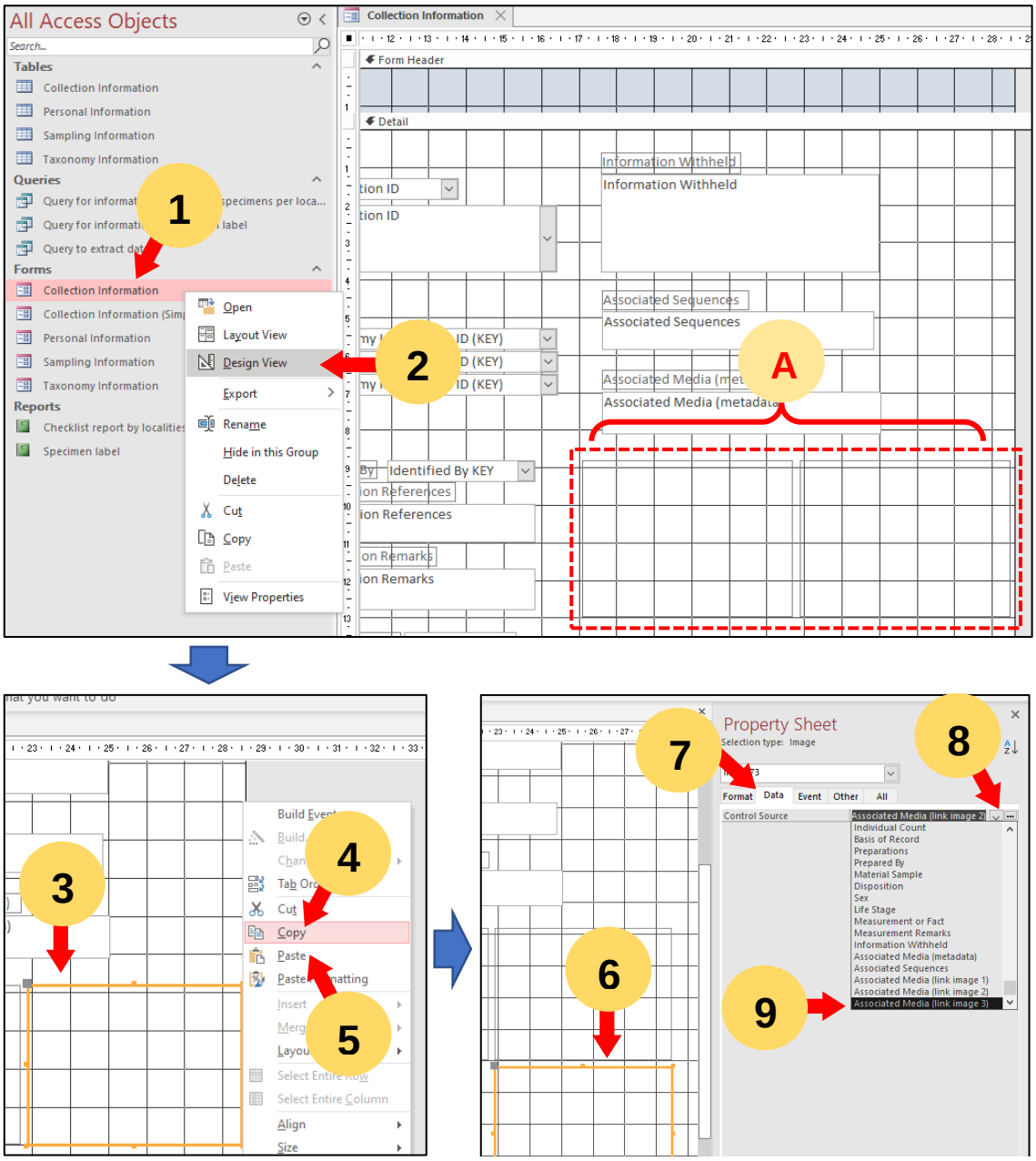


Figure 4. Add a new image object in the Collection Information form.

Labelling

In the labelling stage, specimens must be labelled based on the information created in the cataloguing stage, while initial preservation and at least preliminary sorting of specimens are completed, and specimens may be temporarily held in the processing laboratory for further examination and identification.

Label should be attached to specimen at any time. There is a function in the SDBMS that enables the user to print label once the specimens are catalogued. The data collector and curator can select the information in SDBMS, customise the format including text font format and label size, and then create a label that is saved in PDF format for printing. In any circumstances, three important pieces of information must be included on the label, namely (1) "Full Catalogue Information" consisting of "Institution Code", "Collection Code" and "Catalogue Number", (2) "Field Number" and as much detail of the sampling information as can be accommodated on the label, and (3) taxonomic information. A label indicating the specimens are donated shall be attached to the specimens. Data curators, data users and data custodians shall bear in mind that any original labels with the specimens shall not be removed.

Procedure M. Selection of collection data and creation of a label for the specimen.

1. Double-click on the "Query for information of specimen label" (**Step 1**) (**Figure 1**).

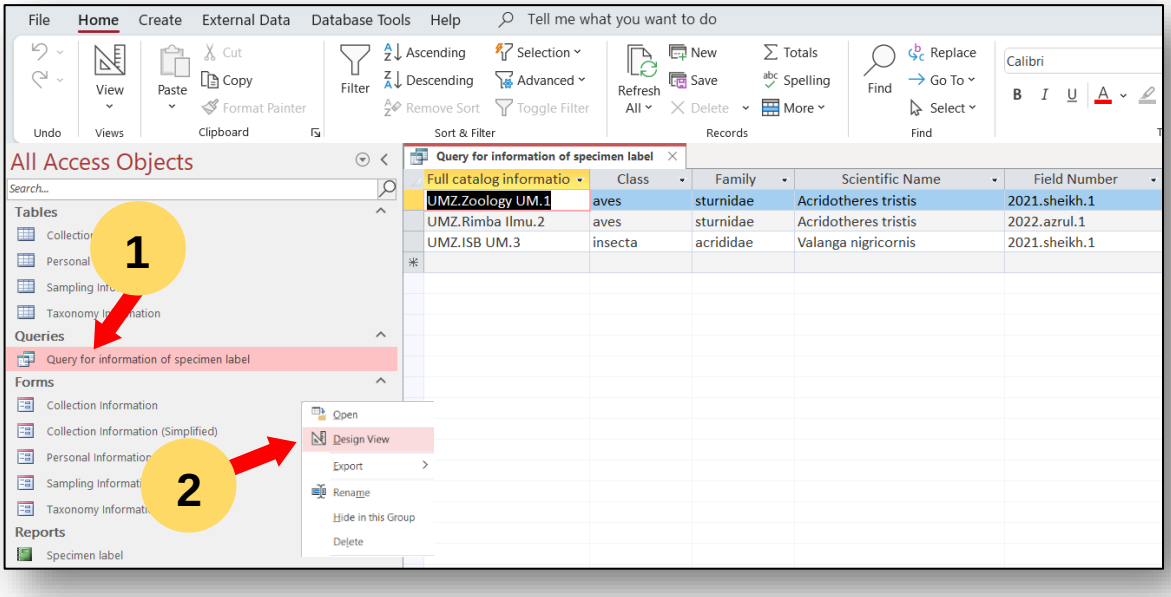


Figure 1. Query for information of specimen label.

2. Right click on the "Query for information of specimen label" and choose "Design View" (**Step 2**) (**Figure 1**).

3. Select the records from the SDBMS by specifying the query "Criteria" of the "Catalog number" (**Step 1**) (**Figure 2**). "**Criteria**" for "catalog number":

    a. For one record – enter exactly a value, such as catalog number, example: 100. User to enter **100** in the **"Criteria"**.
    b. For more than one record that with continuous catalog number, example: 100 – 110. User to enter **>=100 And <=110** in the **"Criteria"**.
    c. For more than one record that with discontinuous catalog number, example: 100, 102, 109. User to enter **100 OR 120 OR 109** in the **"Criteria"**.
    d. For catalog number larger than a catalog number, example: records after 100. User to enter **>= 100** in the **"Criteria"**.

4. Click on the "Run" (**Step 2**) to create the query for the list of record to be included in the "Specimen label" report (**Figure 2**).

5. Close the table by clicking (×) (**Step 3**) icon and click "Yes" to save the Query (**Figure 2**).

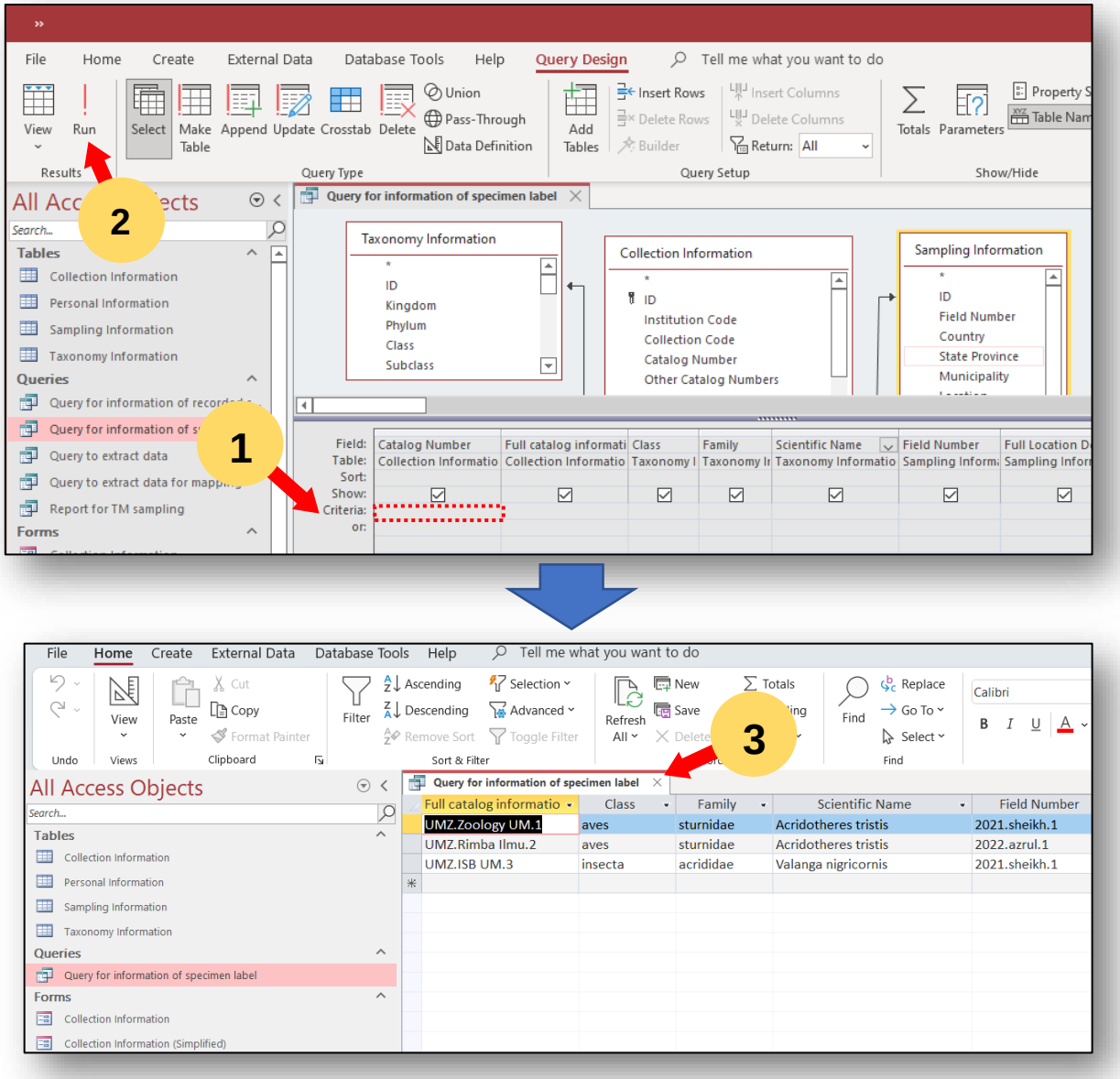


Figure 2. Design view of Query for information of specimen label.

6. Double-click on the "Specimen label" report (**Step 1**), click "View" (**Step 2**) and select "Print Preview" (**Step 3**) (**Figure 3**).

7. User can print the label by clicking on the "Print" (**Step 4**) (**Figure 3**).

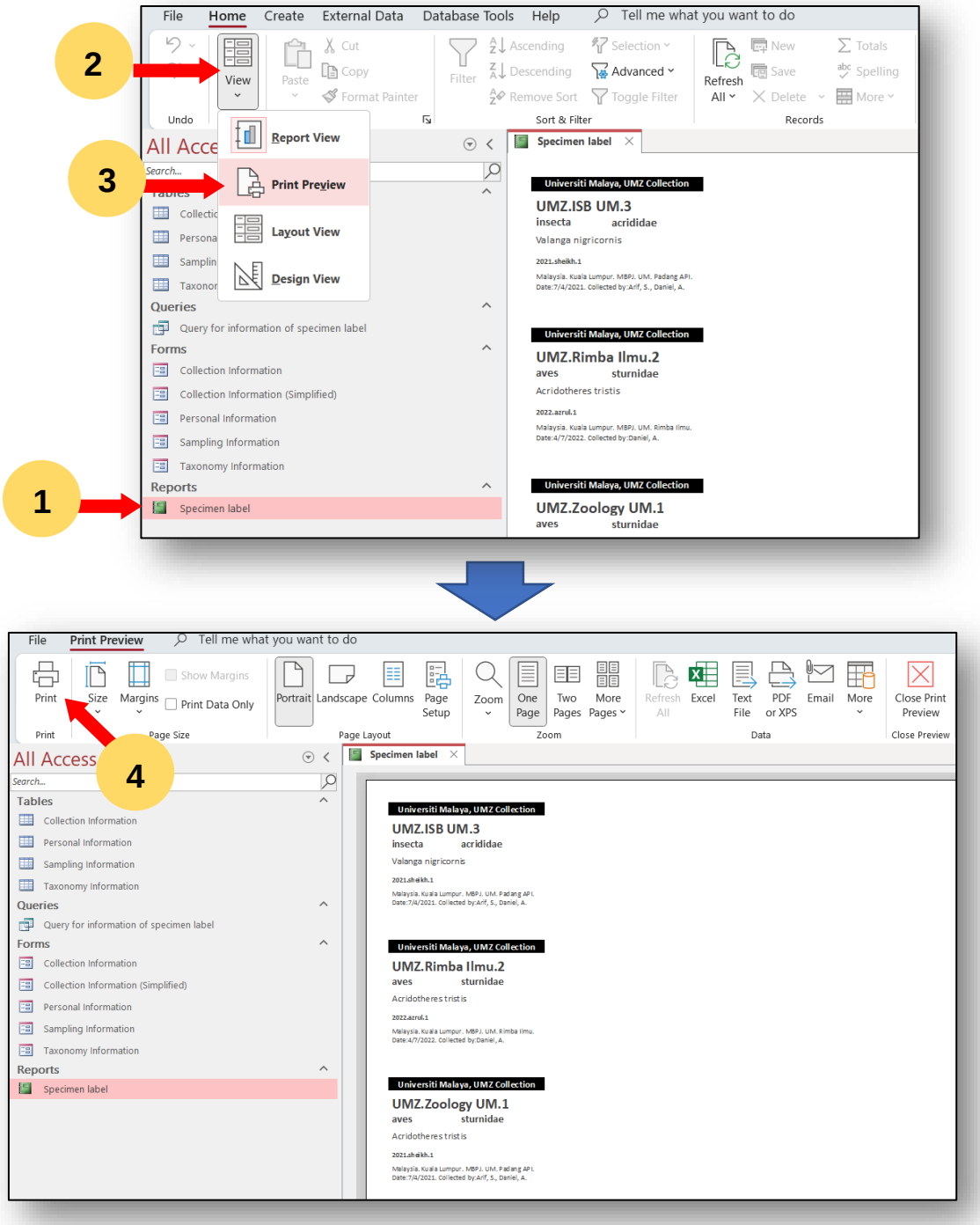


Figure 3. Specimen label of SDBMS.

Curating and Storing

The collections shall be deposited in the collection facilities as soon as the processing and analysis of the specimen collection is completed. The collections must be stored in the designated collection facilities as soon as possible. Normally, the collections are stored in drawers and cabinets according to the taxonomic classification. Therefore, the information on storage in the collection facilities, which consists of the information "Collection Room", "Collection Cabinet" and "Collection Drawer", is included in the Taxonomic Information Table of the SDBMS. All collections of the same taxonomic unit, e.g., the same species, shall be stored in the same storage room adjacent to the other species of the same genus.

Procedure N. Search and update the storage information

1. Right-click on Taxonomy Information Table (**Step 1**), click "Layout View" (**Step 2**) (**Figure 1**).

2. Select and right-click a field in the form (**Step 3**), select "Text Filters" (**Step 4**) and click "Contains…" (**Step 5**) (**Figure 1**).

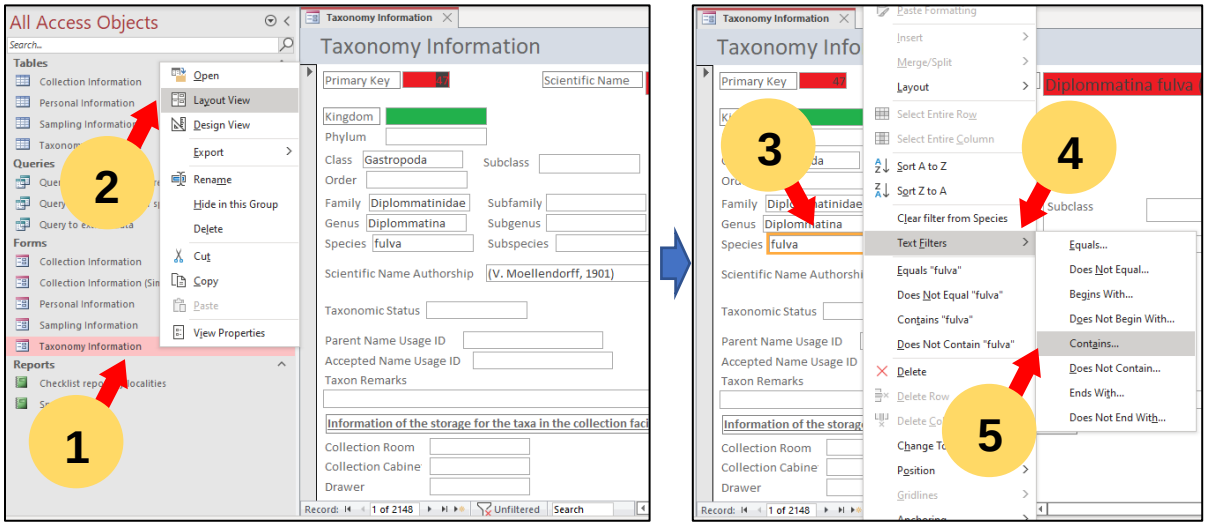


Figure 1. Layout View of Taxonomy Information form and filtering a specific field in the form.

3. Enter the keyword in "Custom Filter" (**Step 1**) and click "OK" (**Step 2**) (**Figure 2**).

4. A total of 3 records **(B)** of 2184 records **(A)** in Taxonomy Information form (i.e. table) with species "metcalfei" (**Figure 2**).

5. Click "Next record" (**Step 3**) to select the specific record and enter the storage information (**Step 4**) (**Figure 2**).

6. Click "Next record" (**Step 3**) to select the specific record and enter the storage information (**Step 4**) (**Figure 2**).

7. Before update storage information of the other records, click "Filtered" (**Step 5**) to remove the filter from the records.

8. Then repeat the **No. 3** – **No. 7** until completed the updating of storage information.

9. Click on the (×) icon to close the form and click Yes.

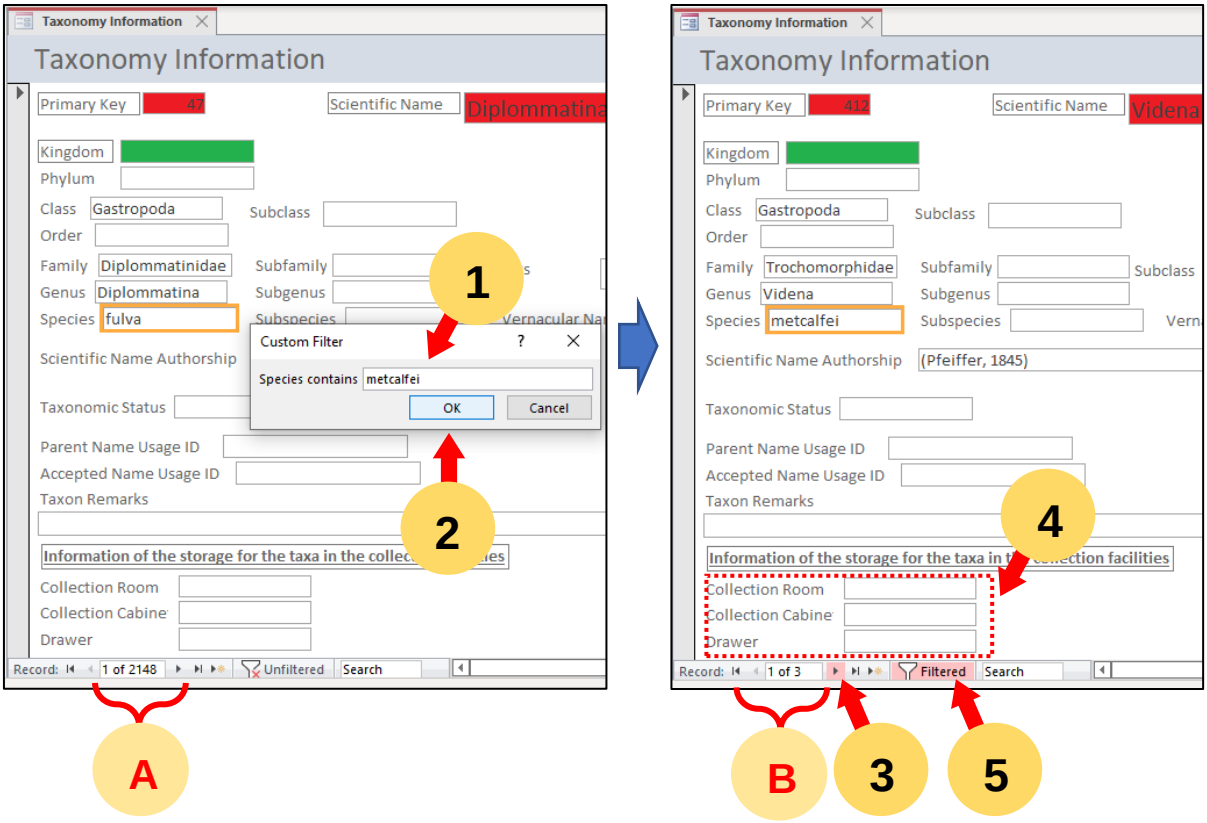


Figure 2. Search specific record according to the "Species" and update the storage information.

Retrieving and analysing

In the retrieving and analysing stages, the data is ready for use. The data collector, data curator, data user and data custodian can retrieve not only the data of the specimens that have just been entered into the database, but also the data of other specimens that were already in the database in order to perform data analysis. In this analysis phase of the data lifecycle, the data can be used to produce reports on the state of the collections for depository institutions administrative purposes and for analysis in scientific research projects as part of the manuscript submitted to scholarly publication.

a) Reporting

While managing biodiversity data according to the lifecycle of the data is an ongoing process, it is important for depository institutions to produce regular reports to document the status of their collections. This is the first step in enabling a paradigm shift from specimen and data ownership to specimen and data stewardship through explicit integration of specimens into existing data management plan guidelines and annual reporting. This regular reporting needs to be made public and include the basic statistics on the collection in terms of new specimen collections added and the frequency of data sharing on the data aggregator platform.

There is a query function in the SDBMS to facilitate the documentation process in preparing the reports based on localities, i.e., "Query for information of recorded specimens per localities" and "Checklist report by localities". This function provides templates to retrieve the required data and generate a report summarising the records (collections) by localities. Both the query and report templates in the SDBMS are editable and the status of the collections can be displayed by grouping the data by taxonomy, location, and year.

Procedure O. Create Checklist report by localities

1. Right-click on the "Query for information of recorded specimen per localities" (**Step 1**) and select "Design View" (**Step 2**) (**Figure 1**).

2. Select the records by localities from the SDBMS by specifying the query "Criteria" of the "Field Number" (**Step 3**) (**Figure 1**). "**Criteria**" for "Field Number":

    a. For one locality/sampling event – enter exactly a string, such as Field Number, example: "2016.KH323". User to enter **2016.KH323** in the **"Criteria"**.
    b. For more than one locality/sampling event that Contain the specified string, example: "2016.**KH**323", "2016.**KH**324", etc. User to enter **Like "*KH*"** in the **"Criteria"**.
    c. For more than one locality/sampling event that Contain the more than one specific string, example: all "Field Number" with contain number 23 or word Kanthan: "2016.KH3**23**", "**Kanthan**.1", etc. User to enter **Like "*23*" OR Like "*Kanthan*"** in the **"Criteria"**.

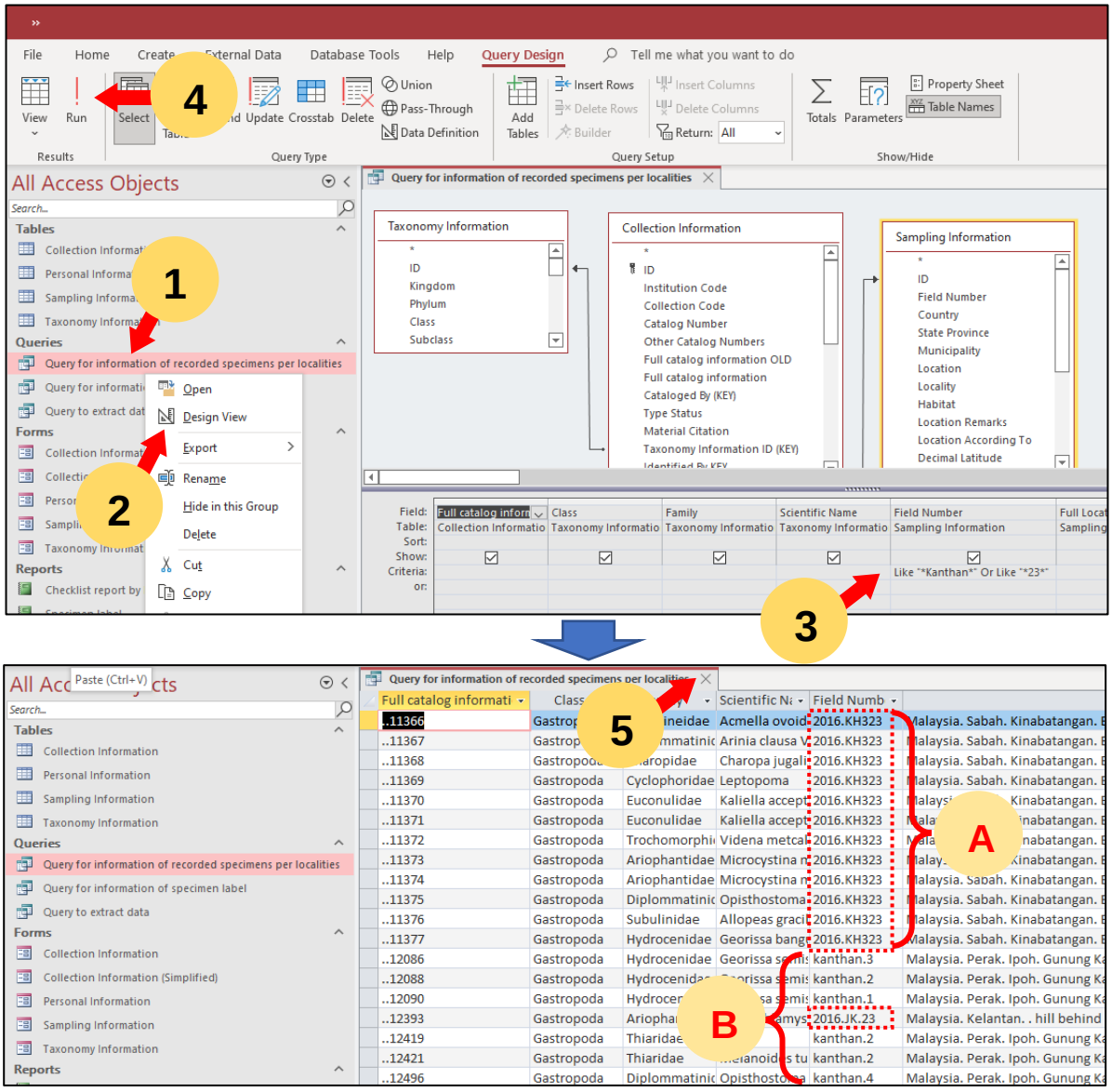


Figure 1. Design View of Query for information of recorded specimens per localities.

3. Click "Run" (**Step 4**) and the list of records from the localities contain string "KH" **(A)** and "Kanthan" will be generated **(B)** (**Figure 1**).

4. Click on the (×) icon (**Step 5**) to close the query table and click Yes (**Figure 1**).

5. Open "Checklist report by localities (**Step 1**) (**Figure 2**).

6. Right-click on "Checklist report by localities (**Step 2**), select "Export" (**Step 3**) and Click "Word RTF File" (**Step 4**) (**Figure 2**).

7. Click "Browse…" to save the file (**Step 5**) and Click "OK" (**Step 6**) (**Figure 2**).

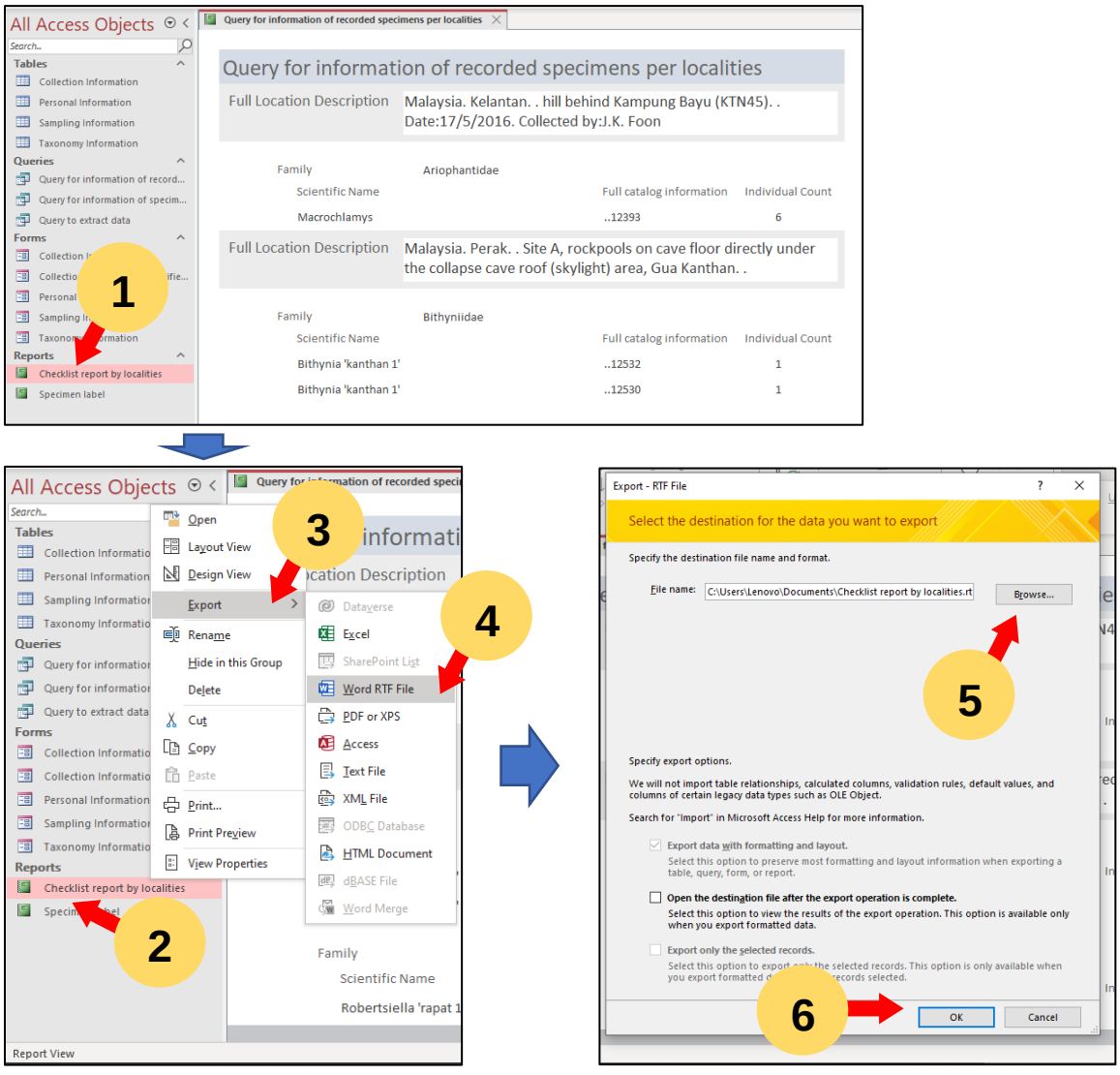


Figure 2. Export Checklist report by localities from SDBMS to Microsoft Word file.

8. Open the export Checklist report by localities RTF file in Microsoft Word (**Figure 3**).

9. Click "Layout" tab (**Step 1**), select "Margins" (**Step 2**) and click "Narrow" (**Step 3**) (**Figure 3**).

10. Click "Orientation" (**Step 4**) and select "Portrait" (**Step 5**) (**Figure 3**).

11. Click "Size" (**Step 6**) and select "A4" (**Step 7**) (**Figure 3**).

12. Click "View" (**Step 8**) and select "Print Layout" (**Step 9**) (**Figure 3**).

13. Continue editing the report in Microsoft Word.

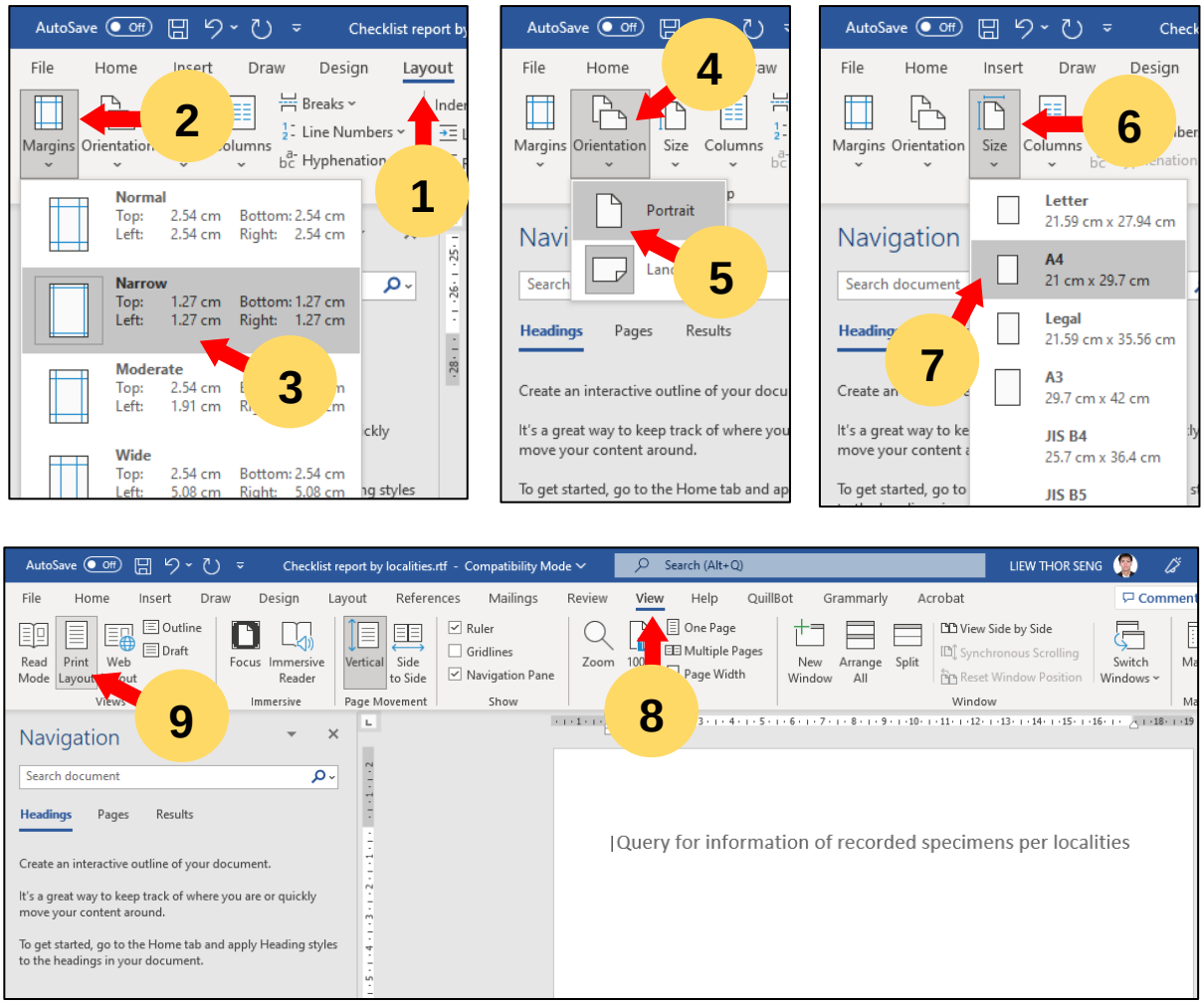


Figure 3. Customise exported Checklist report by localities in Microsoft word for further editing.

b) Analysing

In addition to institutional reporting purposes, researchers who collected the data can use the SDBMS to retrieve the data in the format they need for data analysis in their research. The most common format used in various biodiversity analyses is a matrix of biodiversity community data with samples as rows and species as columns.

Data users and data collectors can use a query template in the SDBMS (Query to extract data) to retrieve data such as "Scientific name" from the Taxonomy Information Table, "Field number" from the Sampling Information Table, "Full Catalogue Information" and "Individual Count" from the Collection Information Table of selected records from SDBMS. The query result can be exported to Microsoft Excel spreadsheet format as a list of records that can be converted into a biodiversity community data matrix using the Pivot Table function in Microsoft Excel – a data summary tool that automatically sorts, counts, and sum up data and display the summarised data.

Another common request from researchers is to create a species distribution map. Similar to the creation of the biodiversity community data matrix, researchers can add additional fields from the Sampling Information Table such as "Decimal Latitude", and "Decimal Longitude", to create a map.

Researchers do not need to keep separate data sheets for different needs in the research process for the information they have collected and curated from the sample collections. As suggested in this Guideline, they only need to enter the data into the SDBMS once and then retrieve it for analysis. This workflow makes it easier for researchers or data collectors to manage the same dataset in different ways for different purposes and minimises the errors in data consistency (e.g., entering same information in different ways) that could arise from many different versions of datasets.

Procedure P. Biodiversity community data matrix in Microsoft Excel spreadsheet format

1. Right-click on "Query to extract data" (**Step 1**) and select "Design View" (**Step 2**) (**Figure 1**).

2. Select the records by localities from the SDBMS by specifying the query "Criteria" of the "Field Number" (**Step 3**) (**Figure 1**). "**Criteria**" for "Field Number":

    a. For one locality/sampling event – enter exactly a string, such as Field Number, example: "2016.KH323". User to enter **2016.KH323** in the **"Criteria"**.
    b. For more than one locality/sampling event that Contain the specified string, example: "2016.**KH**323", "2016.**KH**324", etc. User to enter **Like "*KH*"** in the **"Criteria"**.
    c. For more than one locality/sampling event that Contain the more than one specific string, example: all "Field Number" with contain number 23 or word Kanthan: "2016.KH3**23**", "**Kanthan**.1", etc. User to enter **Like "*23*" OR Like "*Kanthan*"** in the **"Criteria"**.

3. Click "Run" (**Step 4**), then click on the (×) icon (**Step 5**) to close the query table and click Yes (**Step 6**) (**Figure 1**).

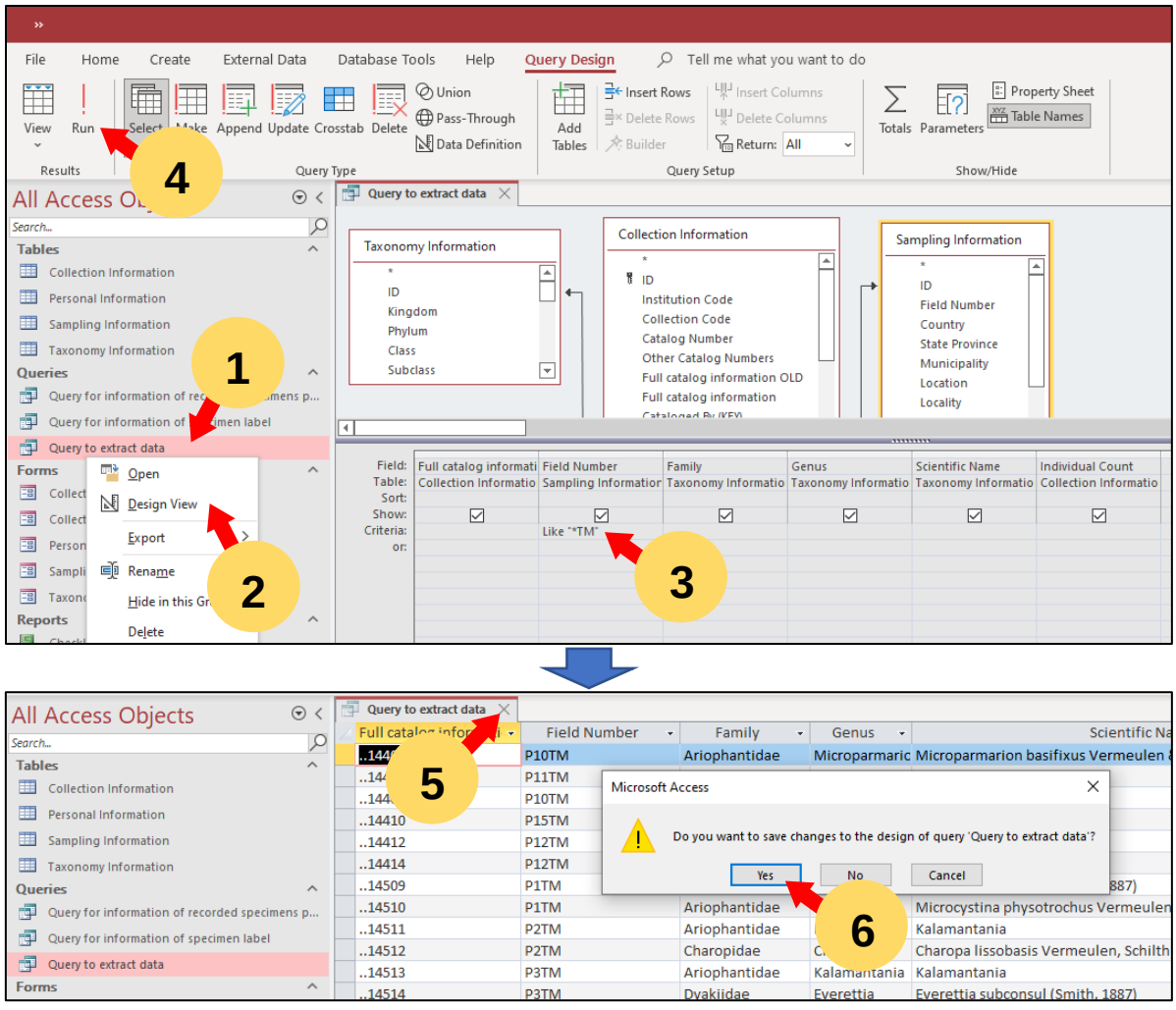


Figure 1. Query to extract data to create biodiversity community data matrix.

4. Right-click on “Query to extract data” (**Step 1**), select “Export” (**Step 2**), and click on “Excel” (**Step 3**) (**Figure 2**).

5. Click “Browse…” (**Step 4**) to save the file, click “OK” (**Step 5**) and click “Close” (**Step 6**) (**Figure 2**).

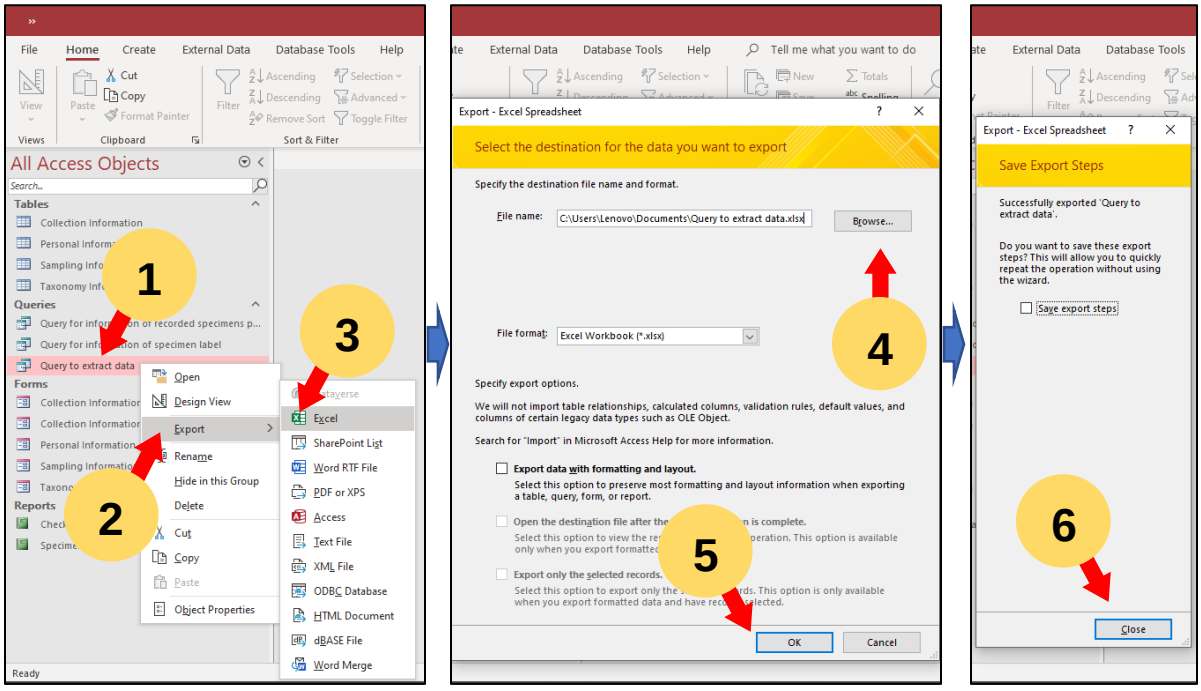


Figure 2. Export “Query to extract data” and save as Microsoft Excel spreadsheet.

6. Open the exported Excel file (**Figure 3**).

7. Select all the column with data (**Step 1**) (**Figure 3**).

8. Click on “Insert” tab (**Step 2**) and click “PivotTable” (**Step 3**) (**Figure 3**).

9. Select “New Worksheet” (**Step 4**) and click “OK” (**Step 5**) (**Figure 3**).

10. In the New Worksheet, drag the fields to respective “Columns”, “Rows” and “Values”: “Scientific Name” to “Rows” (**Step 6**); “Field Number” to “Columns” (**Step 7**); “Full catalog information” to “Values” (**Step 8**) (**Figure 3**).

11. A data matrix has been created (**Figure 4**).

12. To remove empty row, click “Manual Filters” next to “Row Labels” (**Step 1**), uncheck “(blank)” (**Step 2**) and click “OK” (**Step 3**) (**Figure 4**).

13. To remove empty row, click “Manual Filters” next to “Column Labels” (**Step 4**), uncheck “(blank)” (**Step 5**) and click “OK” (**Step 6**) (**Figure 4**).

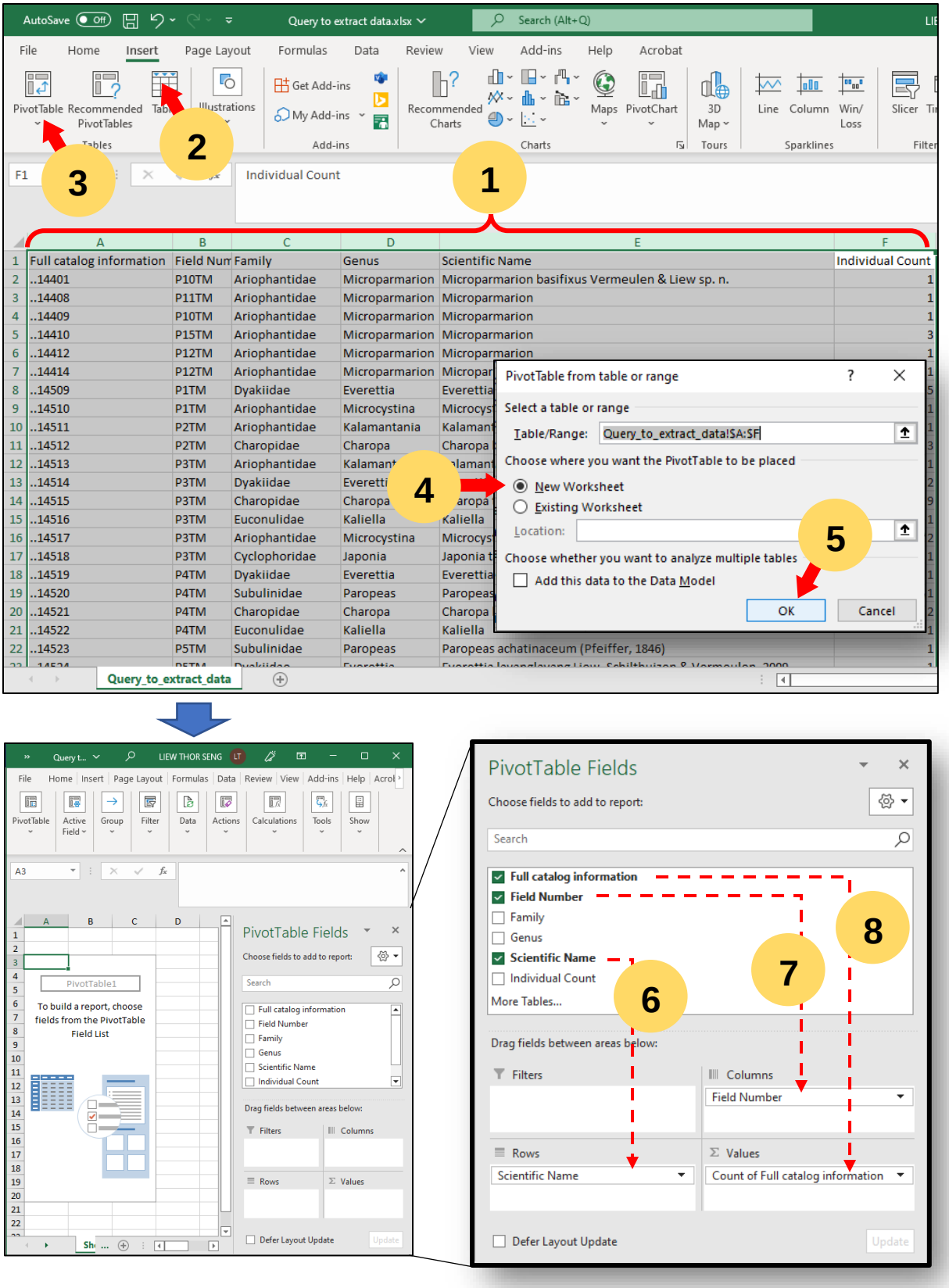
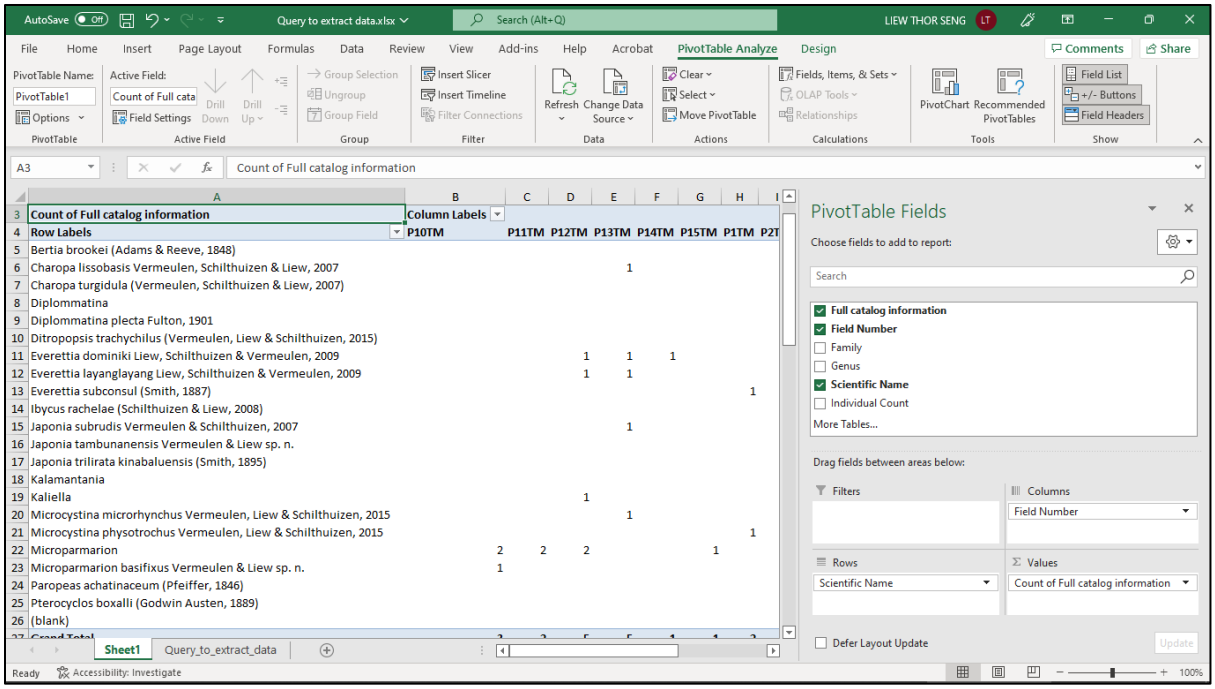


Figure 3. Using Pivot Table in Microsoft Excel to create biodiversity community data matrix.



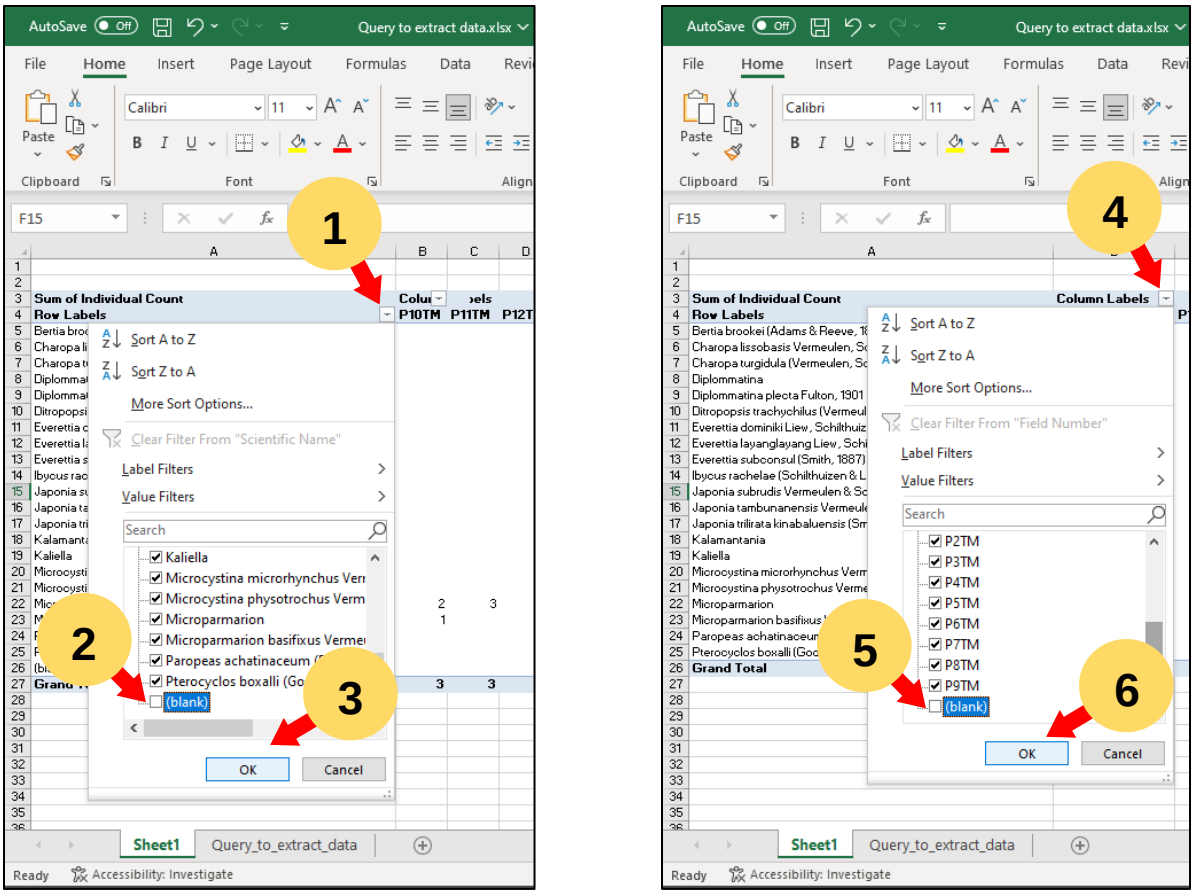


Figure 4. Remove empty column and row in biodiversity community data matrix.

14. When it is needed, users can group the rows according to different taxonomy level (Figure 5).

15. To group the taxa according to "Family" (A), drag "Family" to "Rows" and place it above "Scientific Name" (Step 1) (Figure 5).

16. To group the taxa according to "Family" (B), drag "Family" to "Rows" and place it in between "Family" and "Scientific Name" (Step 2) (Figure 5).

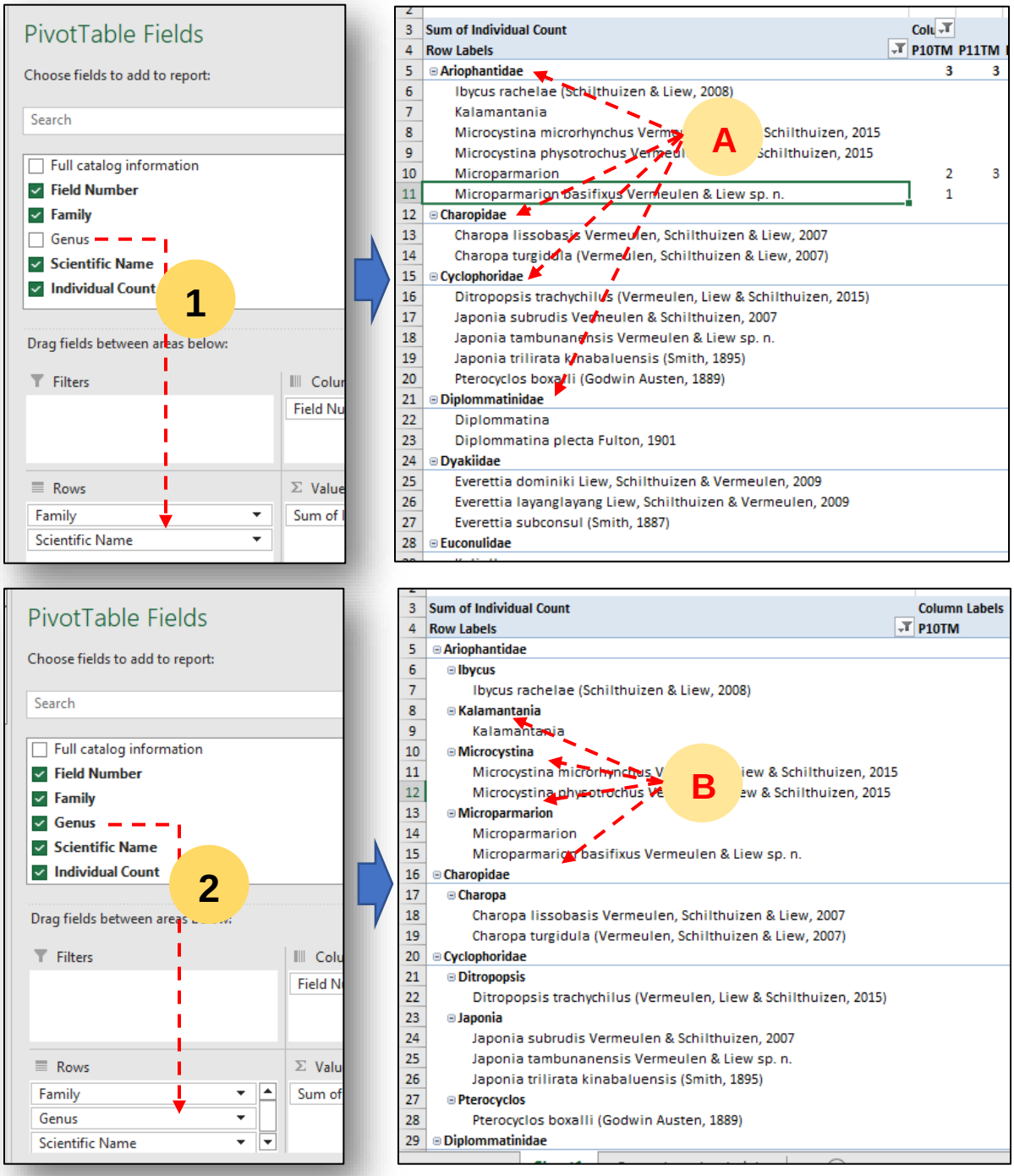


Figure 5. Add grouping of the species according to different taxonomy levels in biodiversity community data matrix.

Procedure Q. Create a species distribution map with Google Drive My Maps

1. Right-click on "Query to extract data" (**Step 1**) and select "Design View" (**Step 2**) (**Figure 1**).

2. Select the records by taxa from the SDBMS by specifying the query "Criteria" of the "Genus" (**Step 3**) and "Scientific Name" (**Step 4**) (**Figure 1**).
   a. "**Criteria**" for "Genus" – enter exactly a string, example: "Japonia.
   b. "**Criteria**" for "Scientific Name" – enter a string that contain the species name, example: *borneensis*

3. Double click on "Decimal Latitude" and "Decimal Longitude" of "Sampling information" to add these two fields in the query (**Step 5**) (**Figure 1**).

4. Click "Run" (**Step 6**), then click on the (×) icon (**Step 7**) to close the query table and click Yes (**Step 8**) (**Figure 1**).

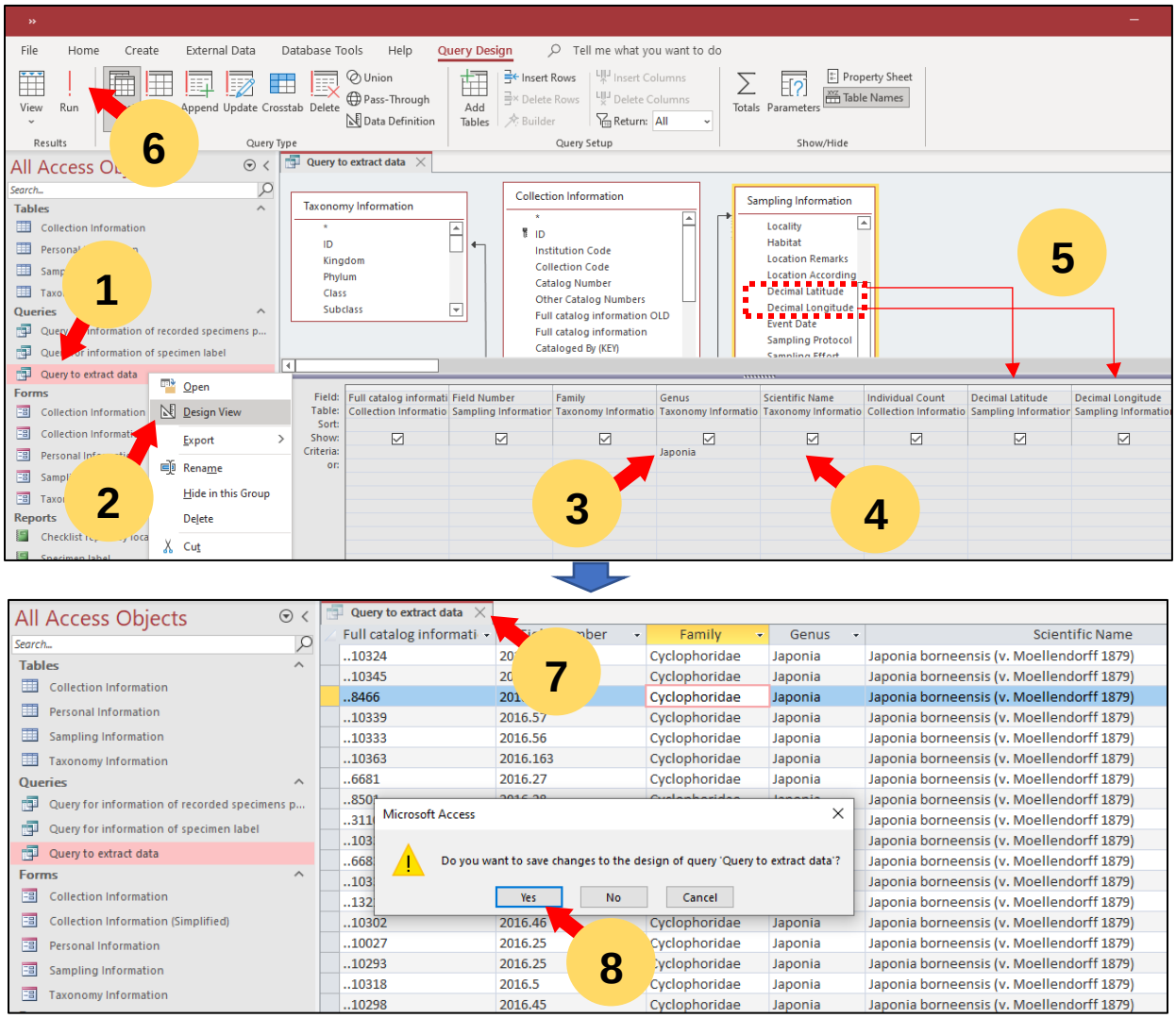


Figure 1. Query to extract records according to species.

5. Right-click on “Query to extract data” (**Step 1**), select “Export” (**Step 2**), and click on “Excel” (**Step 3**) (Figure 2).

6. Click “Browse…” (**Step 4**) to save the file, click “OK” (**Step 5**) and click “Close” (**Step 6**) (Figure 2).

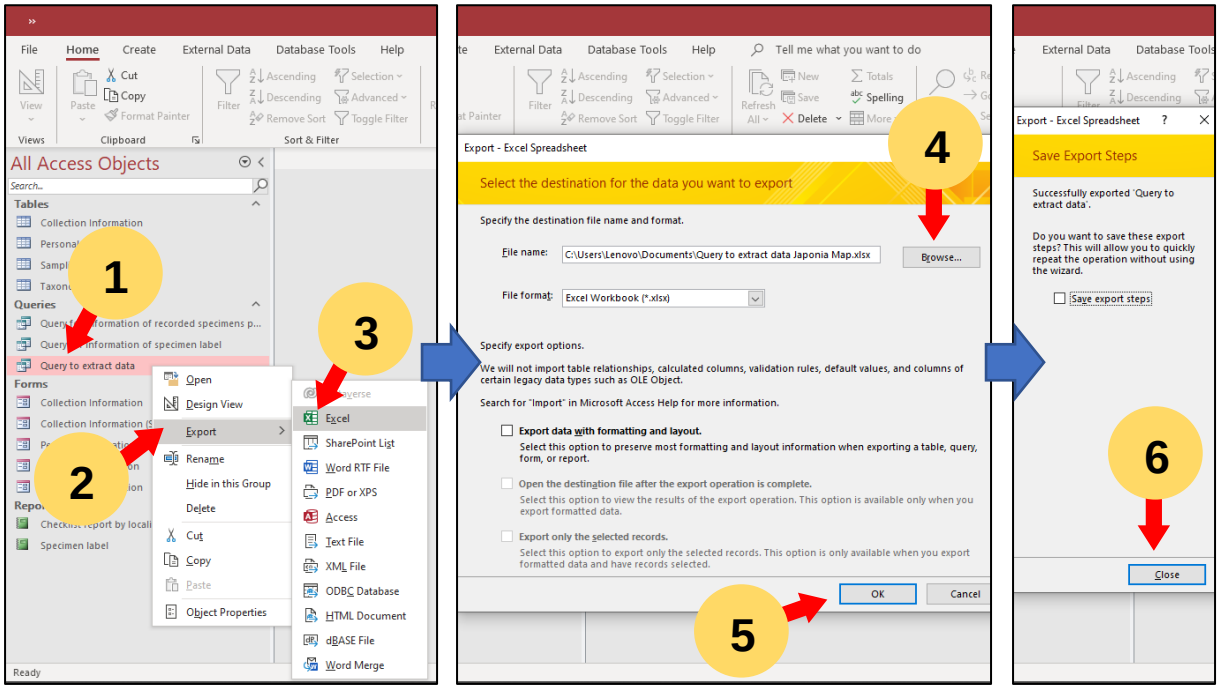


Figure 2. Export data to Microsoft Excel spreadsheet.

6. Repeat **No. 1 – No. 5** to export the data for other species.

7. Open Google Drive (**Step 1**) and click “+ New” (Figure 3).

8. Select “More” (**Step 2**) and click on “Google My Maps” (**Step 3**) (Figure 3).

9. Click “Import” (**Step 4**) to select a file (**Step 5**) and click one of the exported Excel file (**Step 6**) (Figure 3).

10. Click “Open” (**Step 7**) (Figure 3).

11. Check “Decimal Latitude” (**Step 1**) and select “Latitude” (**Step 2**); check “Decimal Longitude” (**Step 3**) and select “Longitude” (**Step 4**) (Figure 4).

12. Check “Full catalog information” (**Step 5**) and click “Finish” (**Step 6**) (Figure 4).

13. A map layer with the taxa distribution has been created (**A**) (Figure 4).

14. Click “Add layer” (**Step 7**) and Click “Import” (**Step 8**), then repeat **No. 10 – No. 12** to import data of other taxa to create more map layers for other species (Figure 4).

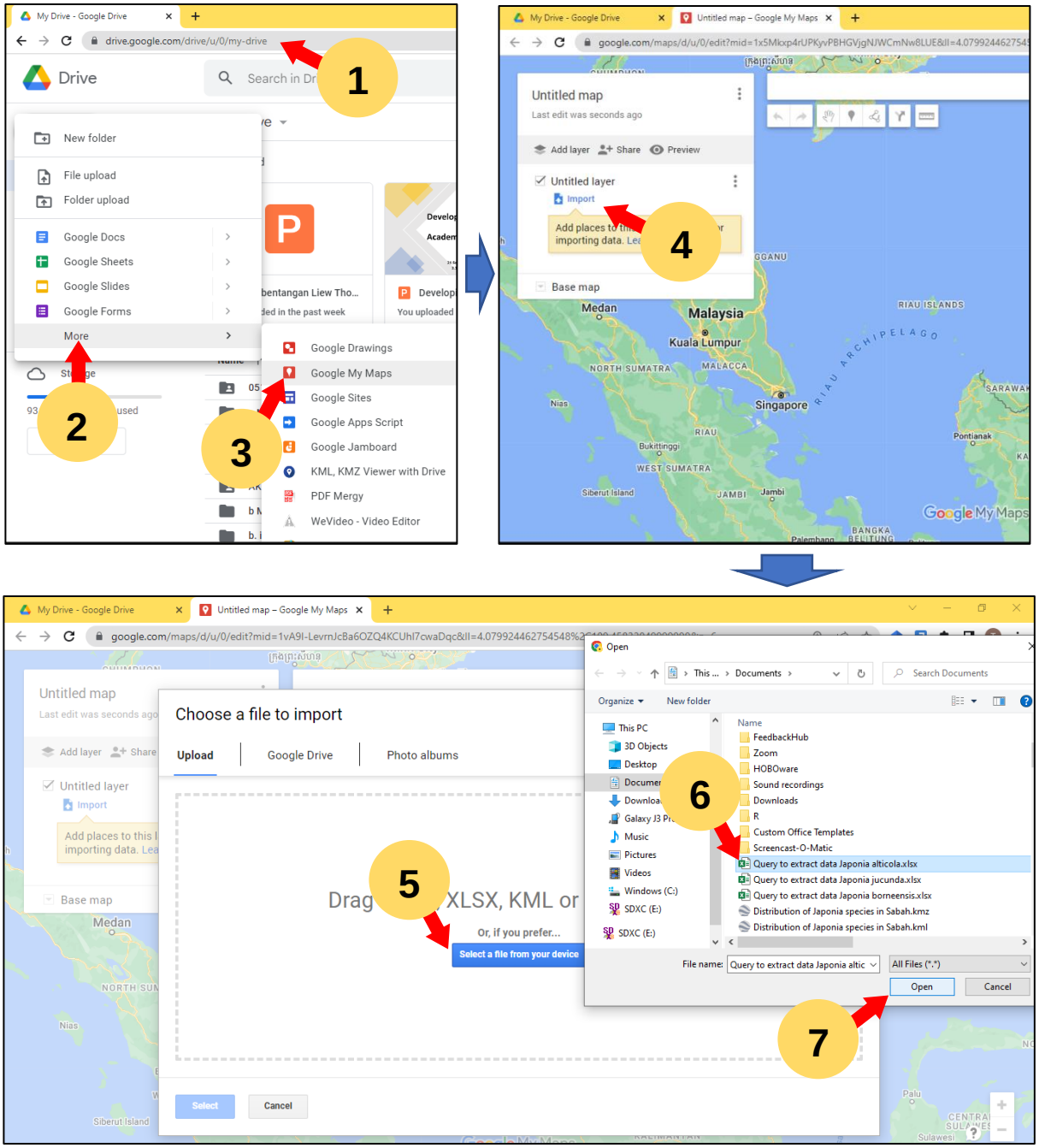


Figure 3. Import data to Google My Maps.

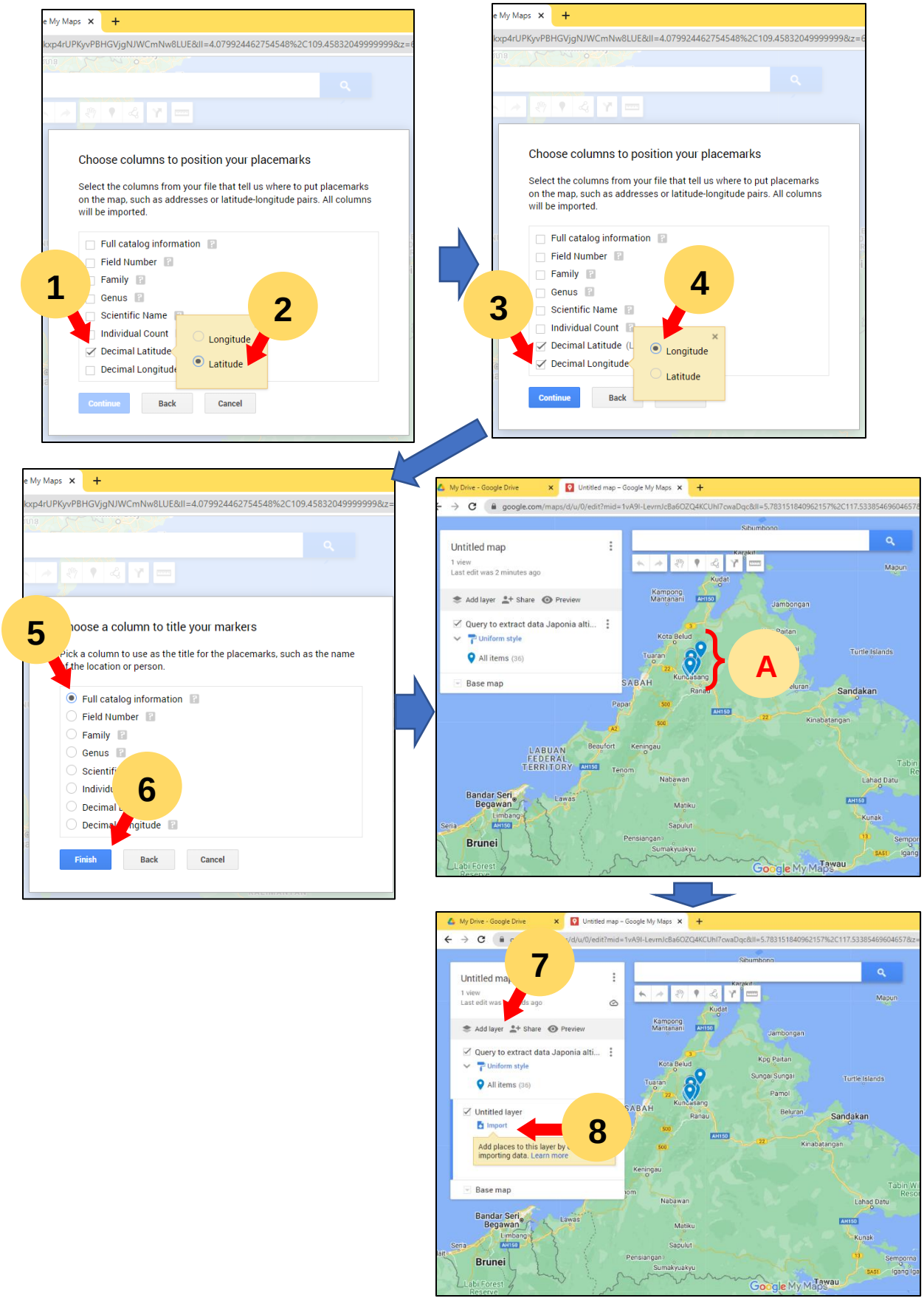


Figure 4. Select coordinates and title for the records (i.e., markers in the map).

15. Click on “colour” of one of the layers (**Step 1**) and select a “colour” (**Step 2**) (**Figure 5**).

16. Repeat **No. 15** for the remaining layers by setting different colour for different layers (**Figure 5**).

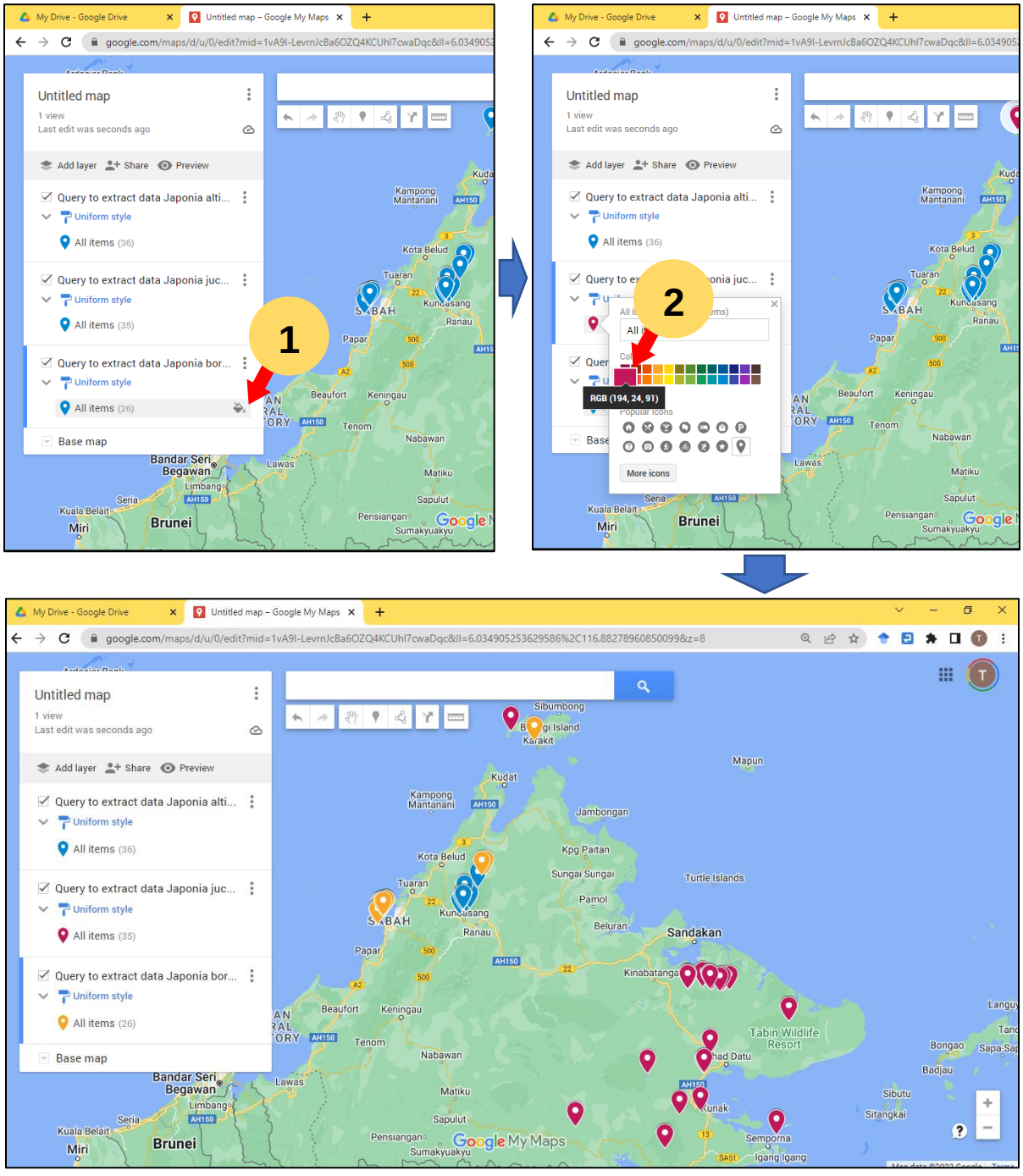


Figure 6. Update the colour of the marker according to taxa.

17. Click on "Layer options" of one of the layers (**Step 1**) and select a "Rename this layer" (**Step 2**) (**Figure 6**).

18. Enter the scientific name of the taxa for the layer name (**Step 3**) and Click "Save" (**Step 4**) (**Figure 6**).

19. Repeat **No. 17 – No. 18** for the remaining layers.

20. Click on "Untitled map" (**Step 5**), update "Map title" (**Step 6**) and "Description" (**Step 7**). Click "Save (**Step 8**) (**Figure 6**).

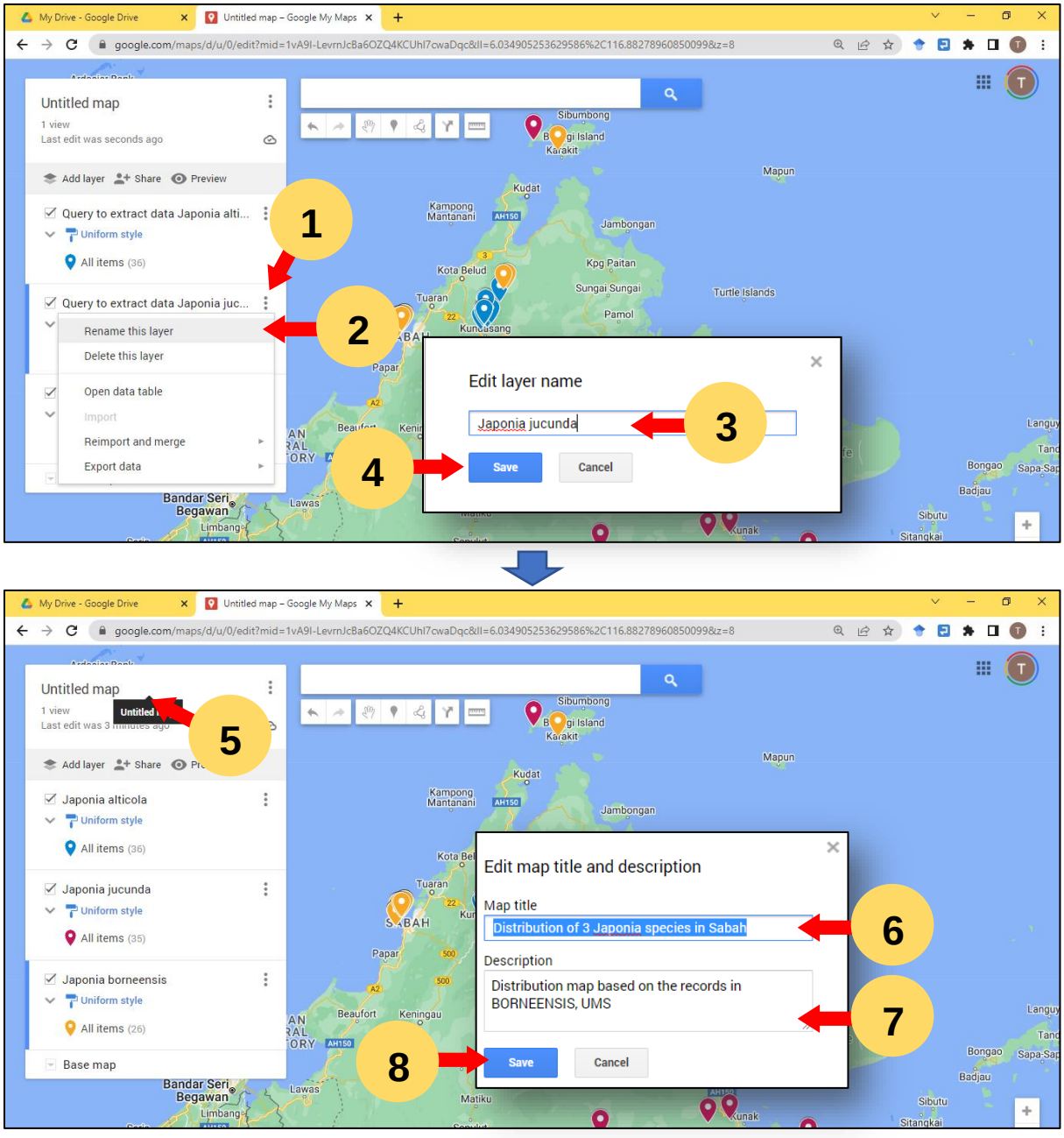


Figure 6. Update the taxa layer name and edit the title and description of the map.

21. Click on “Menu” (**Step 1**) and select a “Export to KML/KMZ” (**Step 2**) (**Figure 7**).

22. Click “Download” (**Step 3**), name the file (**Step 4**) and click “Save” as “KMZ” (**Step 5**) (**Figure 7**).

23. Open the newly created KMZ file with Google Earth (**Step 6**), users can explore the distribution of different species **(A)** and click on the “Placemark” to check the details of the specimen/collection (**Step 7**).

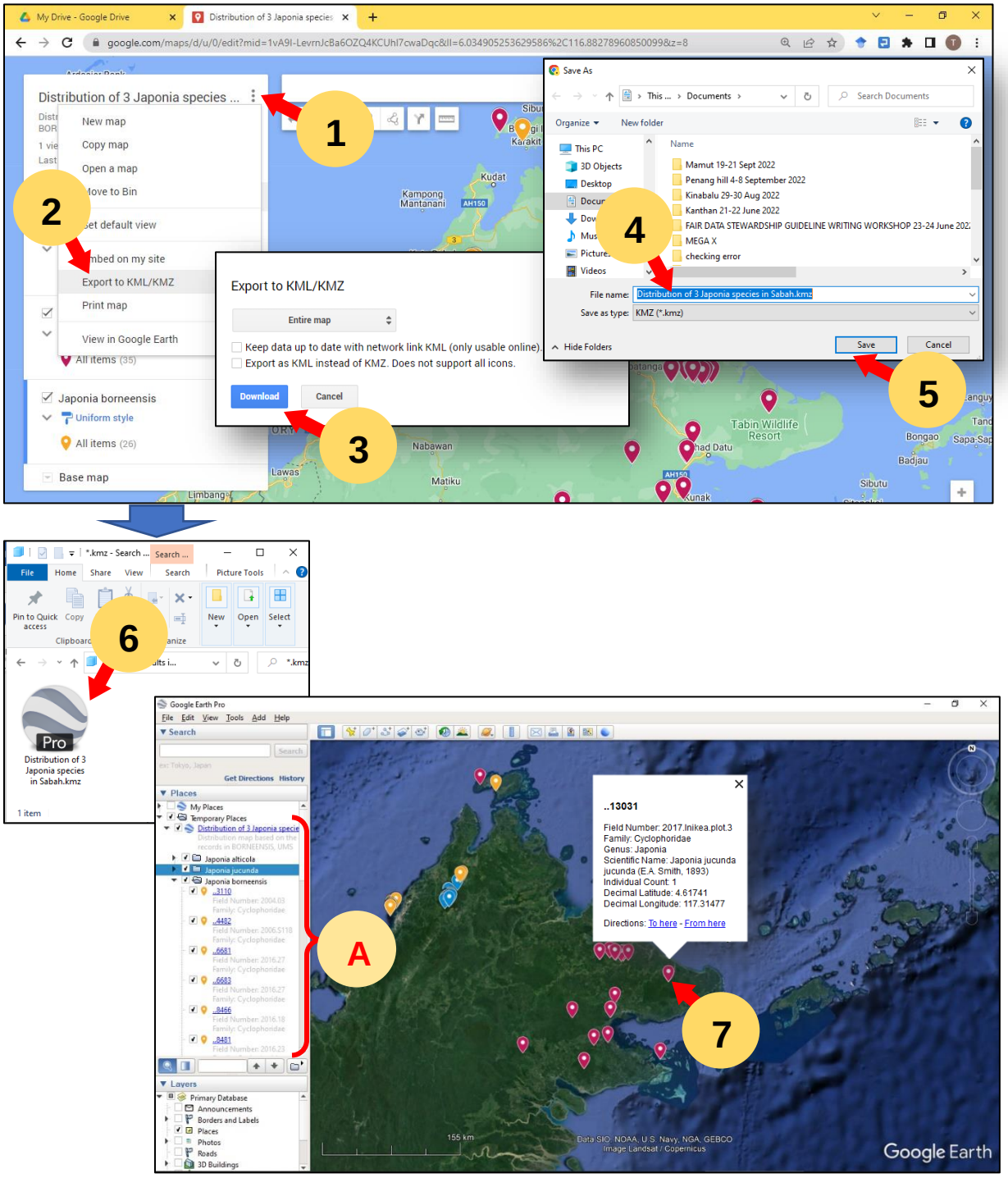


Figure 7. Export the Google My Maps as Google Earth KMZ file.