

# WHIMS User's Manual



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[http://www.fort.usgs.gov/resources/spotlight/horse/home\\_horse.asp](http://www.fort.usgs.gov/resources/spotlight/horse/home_horse.asp)

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## Introduction

WHIMS is a Microsoft Access 2000 application consisting of an application database, a wild horse identification database, and a collection of digital photographs. WHIMS was originally intended to be used with a collection of 35mm slides that were scanned to create Kodak PhotoCDs by a third party. The current WHIMS is enhanced to support a digital image collection acquired from digital cameras or scanned with a film scanner and recorded to CD or DVD. WHIMS can be integrated into the user's established digital image workflow providing that 1) original digital images are archived on uniquely labeled optical media in photoCD, TIF, or JPG format, 2) the collection of derived wild horse images are stored on the user's hard drive relative to the wild horse identification database, and 3) the subdirectories to the WHIMS wild horse identification database reflect the optical media's volume labels and directory structure.

Whether the collection originates from digital camera, film scanners, or legacy PhotoCD technology, special software is typically bundled with hardware to download, rename, and edit images. More advanced digital darkroom techniques require the power of special image editing software, e.g., Photoshop or PaintShop Pro. In addition, software and hardware is needed to produce CD or DVD archives of photographs from digital cameras or scanned film. The user is expected to already have some familiarity with these tools, which WHIMS does not replicate. Instead, WHIMS integrates with a wide range of software and workflows to facilitate the organization, access, attribution and display of the digital images. For the uninitiated, some examples are provided of how to develop a workflow that integrates WHIMS with a generic editor, e.g., PaintShop Pro.

The WHIMS application database (WHIMS2k.mdb) contains standard forms, queries, and Visual Basic for Applications program code. A separate wild horse identification database (e.g., HORSESDemo.mdb) contains the data tables, which the application database connects to when it is first opened. In this way, a single application database may work with several wild horse databases, and each wild horse database may represent a separate herd management area. WHIMS has been used to develop wild horse databases for the Pryor Mountain, WY and the Bookcliffs, CO horse management areas. Other wild horse databases are being developed for McCullough Peak, WY and Cape Lookout, NC wild horses. An empty template wild horse database, HorsesDBTemplate.mdb, may be used as is, or copied and renamed in a separate directory to reflect the herd management area it represents. This initial horse database may be further customized to include only colors and feature descriptions related to your herd management area. The exact structure of a wild horse identification database is outlined below.

## Film or Digital Photography?

Photographs in WHIMS may originate from conventional 35mm film or a Digital Still Camera. High quality photographs are possible with either technology, but each has its pros and cons. Conventional film for low light conditions is typically better than pushing the digital camera CCD signal. Film doesn't provide immediate feedback about the successful

capture of an image and, therefore, may require more competency as a photographer. Film must also be scanned to get a digital image, requiring additional time and expense. But perhaps the biggest benefit of digital camera usage is the automatic metadata tagging done by the camera. A properly set digital camera automatically preserves metadata in the image file, including the date the picture was taken, and camera settings (e.g., f-stop, exposure, shutter speed, flash fired, etc.). It is even possible to include geo-reference metadata from a GPS using third party software, e.g., GPS-Photo Link. Not all software treat the image metadata kindly, however, and it is critical that original digital still camera images be archived using a CD or DVD-Recorder to preserve these metadata prior to manipulation with image editing software. Horse identification images from the archive are stored on the hard drive and represent the WHIMS Catalog.

## Organization of Information

WHIMS is designed to catalog the CD or DVD archives and corresponding wild horse images derived from these originals. WHIMS can interact with a variety of image editing applications to build this catalog based on the software that Windows associates with image file extensions. Catalog images are stored externally to the database, however, and only maintained as lists of images within WHIMS. For this reason, it is critical that images be organized in the on-line wild horse database collection in a way that easily corresponds to the original archival media from which they are derived. WHIMS can accommodate a variety of organizational schemes, but it is best to keep it simple, if possible, and follow these tips. First, don't place originals on the CD or DVD in complicated subdirectory structures. Use only one level of subdirectories, or even better, but all archival images in the root directory. Second, use meaningful unique identifiers for the media's volume labels when the CD or DVDs is recorded. In its simplest form, this allows WHIMS application logic to use only the volume, archival filename, and on-line filename stored in the wild horse database to access both the derived and original images as appropriate.

In the past, PhotoCDs served as an inexpensive way to develop a digital collection from film. They were mastered commercially according to standards developed by Kodak with the following protocol. Each PhotoCD has a unique 12 digit serial number and bar code visible on the inside hub of the CD (see Figure 1). When photos are written to these PhotoCDs, the last four digits are included in the disk volume label, e.g., PCD2726. Each master disk contained up to 100 images in directory \Photo\_CD\Images. Filenames were incremented from IMG0001 and use .pcd as the file extension. Each file, e.g., IMG0002.pcd, termed an ImagePak, stores the digital scan of a single 35mm slide or negative in a multi-resolution proprietary format. The highest resolution is 3072x2048 pixels in 24-bit color. These digital images may then be edited with a graphics package, e.g., Photoshop. WHIMS application logic requires that edited images are stored on the hard disk as JPEG files in directories below the wild horse database, e.g. HORSESDemo.mdb. The directory names must correspond to the full 12-digit PhotoCD serial number volume prefixed with PCD, e.g., PCD719832842726. While the derived file may be named anything, it is probably best to have it prefixed with the original ImagePak filename and if more than one horse is cropped from the original a letter can be appended, e.g., IMG0002A.jpg. In this way, WHIMS knows

that this file originated from the second ImagePak on PhotoCD 719832842726 and can detect whether the correct CD is in the drive.

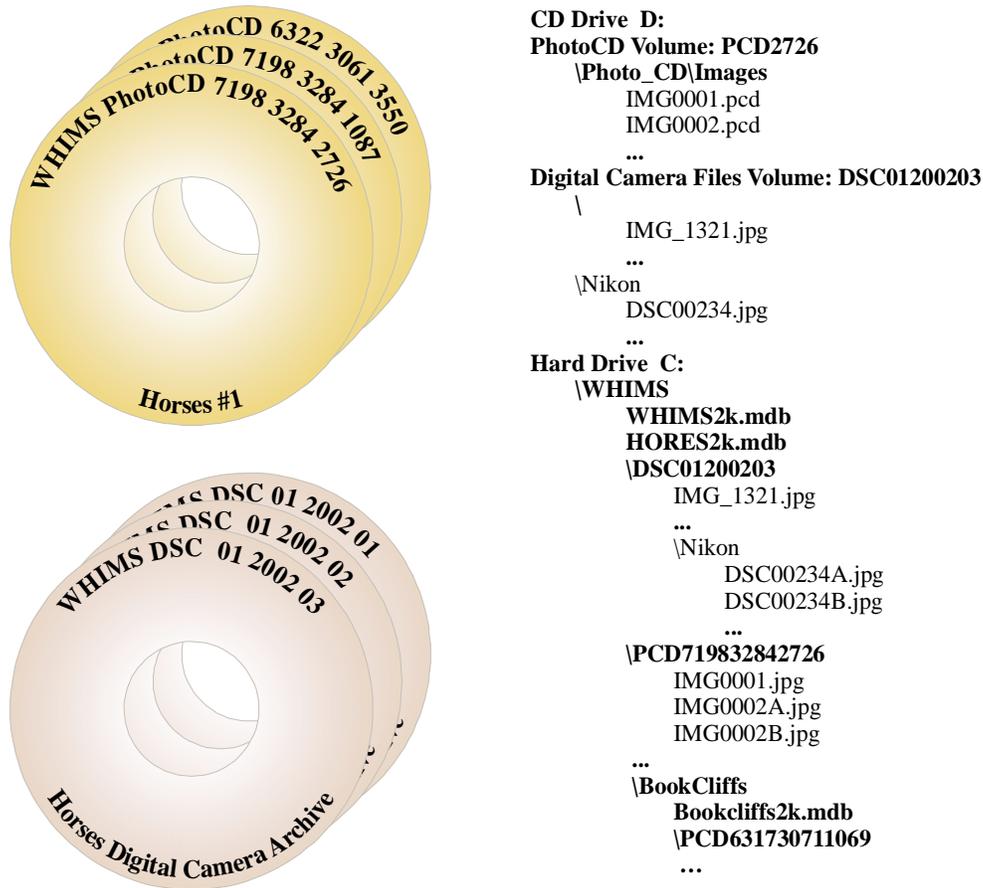


Figure 1. WHIMS CD image achieves and relationship to photo catalog directory structure.

WHIMS currently supports file import filters installed with Microsoft Office, but it is recommended to use JPG or TIF formats in archived media. WHIMS does not support proprietary RAW formats, which some digital still cameras create. If necessary, these files may be converted with camera supplied software before archiving. While CD or DVD archives may use multiple directories and arbitrary filenames, it is recommended to simply place all files in the root directory on the archive media. It is also recommended, but not required, that the online wild horse catalog match the archive media structure with derived images located in directories relative to the wild horse database using the archive volume and pathname from which it was derived, e.g., DSC01200203\Nikon\DSC00234B.jpg. Workflows that deviate from these recommendations may require some tinkering to retain the functionality of the Image Updater (see Image Updater Form below). It may also be difficult to relocate an image unintentionally moved or saved elsewhere by another application when using arbitrary names for derived images.

### **Wild Horse Identification Database**

A wild horse identification database (e.g. HORSESEDEMO.mdb) consists of lookup tables, which contain the domain of valid values for horse attributes, and related attribute tables,

which contain the attribute values of an individual horse (see Table 1). Lookup tables are mostly pre-defined. Names of herds used to subdivide the population or range into separate areas, between which horses infrequently move must be defined if used. Other values in lookup tables may be added or modified to accommodate different terminology or needs. For consistency, it is recommended to use Sponenberg and Beaver (1983) as the standard to describe horse color and markings.

Table 1. WHIMS pre-defined and editable lookup tables in a wild horse identification database.

Table	Description
AuthorityLookup	Contains a list of valid methods for parental determination.
ColorLookup	Contains a list of valid horse colors.
FaceMarkLookup	Contains a list of valid horse face markings.
HerdLookup	Contains name of subpopulations, or regions on the range, otherwise known as herds.
LegMarkLookup	Contains a list of valid horse leg markings.
SexLookup	Contains a list of valid horse sex codes.
StatusLookup	Contains a list of valid values for the management status of horses.

Records in the attribute tables (see Table 2) are related by a Horse ID number. When a horse is first identified and documented with photographs, it is assigned a unique six digit number. The first four digits indicate the horse's real or estimated birth year, and the last two digits indicate when it was first identified relative to other horses of that birth year. Zero is reserved as a special ID number. Use ID 000000 to catalog photos and edited images until they are verified as a specific horse.

Table 2. WHIMS attribute tables in a wild horse identification database and their relationship to the master list of horse IDs.

Table	Relations	Description
IDs	Primary key	Contains all horse ID numbers.
Names	1:1	Contains friendly horse names for many horse IDs.
Sex	1:1	Identifies sex of horses when known.
Status	1:many	Identifies management status of horses.
Bands	1:1	Contains names of the horse bands or harems that are affiliated with horse IDs.
Herd	1:1	Identifies subpopulations or regions on the range where horses are located.
Parents	1:1	Contains information about parents of horses when known.
Color	1:1	Identifies color of horses.
Face	1:many	Identifies face markings of horses.
LFLeg	1:1	Identifies left front leg markings of horses.
LHLeg	1:1	Identifies left hind leg markings of horses.
RFLeg	1:1	Identifies right front leg markings of horses.
RHLeg	1:1	Identifies right hind leg markings of horses.
Photos	1:many	Catalogs original photos on archive media and derived images on the hard drive.

Attributes used for horse identification are shown in Figures 2-4 and include color, and patterns of white on the body, face, and legs (Sponenberg and Beaver, 1983). WHIMS tracks additional information about a horse that aids in its identification, including sex, harem or band affiliation, herd (or subpopulation or region), and parental lineage. Personal names given some horses and a horse's status (on the range, adopted, or dead) are also tracked by WHIMS to easily focus on groups of horses or individuals of interest. Each of these attributes and the catalog of photos are stored in separate tables within the wild horse identification database.

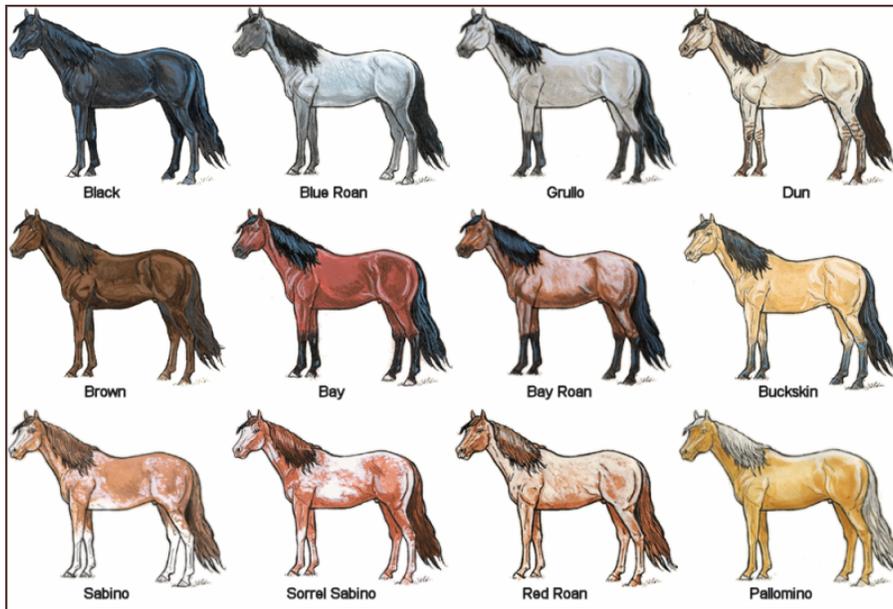


Figure 2. Common colors and body patterns used for horse identification.

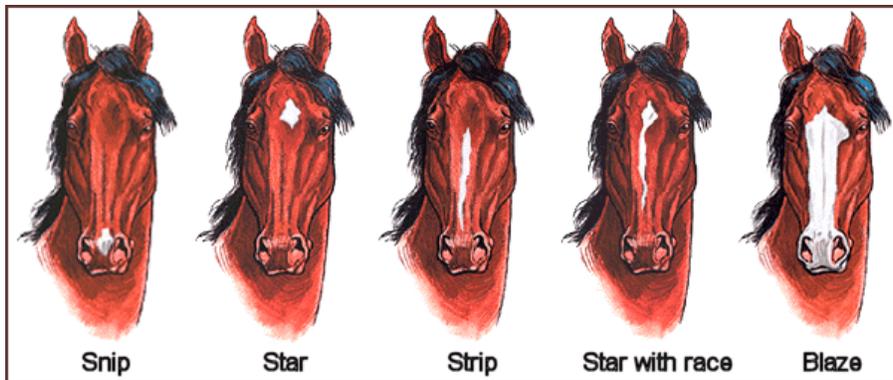


Figure 3. Common face markings used for horse identification.

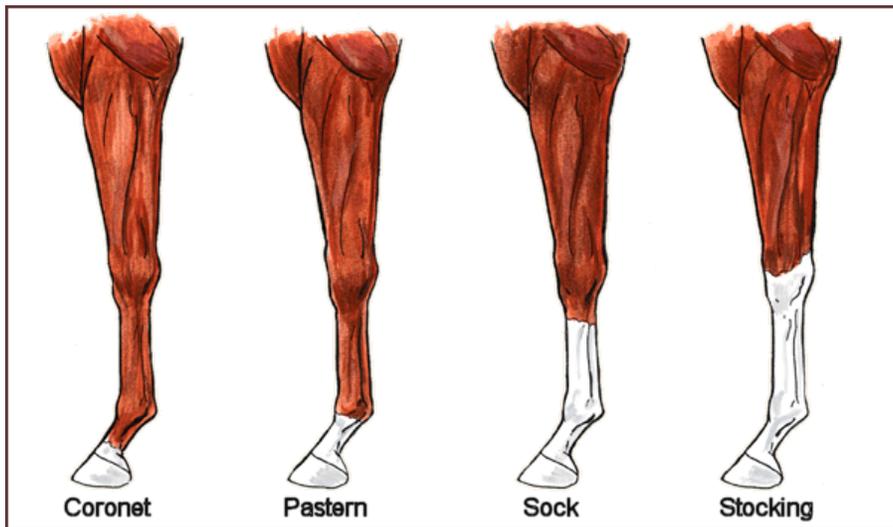


Figure 4. Common leg markings used for horse identification.

Contents of wild horse identification database tables and their relationships to one another are summarized graphically in Figure 5. An ID must be added to the IDs table before any associated information may be stored in a wild horse identification database. Horse attributes are stored in separate tables so that only information that applies to a horse needs to be stored. For example, if a horse's parents are not known, there is no record in the Parents table for that horse.

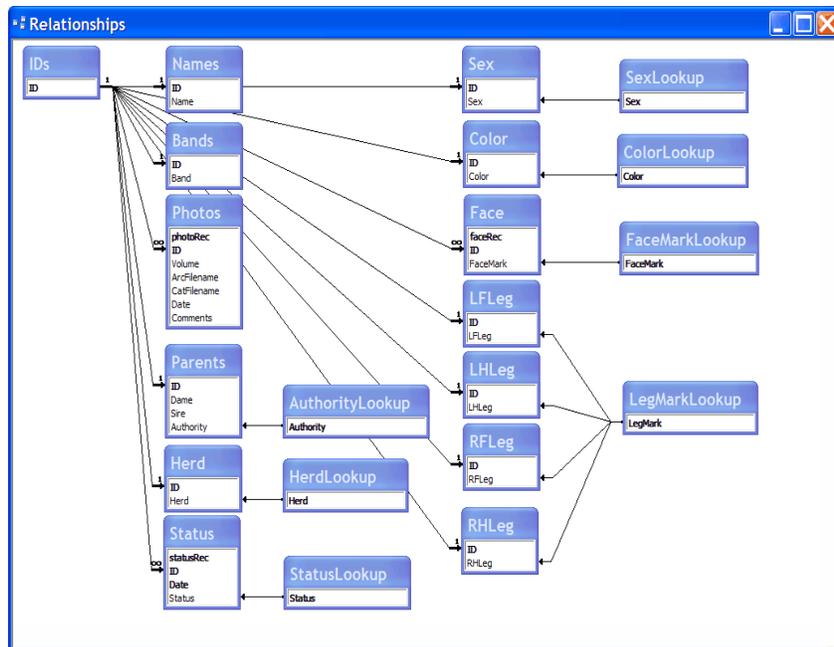


Figure 5. Wild horse identification database tables, fields and their relationships to one another.

Some tables contain additional fields besides the horse ID and table name attribute. For example, the Status table contains the date when a horse's management status changes (used to exclude horses on the range from those which have been adopted or have died). The photograph's catalog record consists of the date the photograph was taken, the archive volume or PhotoCD number, the name and location of the image on the archive volume, the filename and location where edited catalog image is stored, and any descriptive comment. Photo comments are useful when horse markings are observed and documented in field notes but not included in the photograph proper (e.g., a pastern on the right front leg hidden in the vegetation). Comments are also beneficial when more than one horse is included in the photograph (e.g., the dun with White Cloud is Laramie).

Table 3. WHIMS required fields and rules for valid entry when a record is stored in the associated table.

Table	Field	Rules
IDs	ID	0=unkown; otherwise yyyy## where yyyy is real or estimated birth year.
Bands	Band	Name of dominant harem stud or "bachelor" if not associated with a harem.
Color	Color <sup>1</sup>	Defined in ColorLookup table.
Parents	Authority <sup>2</sup>	Values in AuthorityLookup table ("copulation seen"; "harem known"; "unknown")
Status	Date	DD-MMM-YY (may actually be entered in any valid date format and delimited with #, e.g., #1/30/99#, when filtering by form)
Status	Status <sup>2</sup>	Values in StatusLookup table ("adopted"; "dead"; "range")

<sup>1</sup>Initial values come from Pryor Mountain, WY Herd Management Area. Values may be removed and new ones added to reflect colors in your Herd Management Area.

<sup>2</sup>Other values may be added to associated lookup table.

WHIMS uses lookup tables and pick-lists to simplify and limit errors during data entry. For example, Sex can only be 'M' or 'F.' Some WHIMS fields are required to contain values (Table 3.) while others may contain no value (otherwise known as null). For example, a date

must be entered for records in the Status table, but comments for a record in the Photos table are optional. Nevertheless, a required value, e.g., color, only exists if a record for that horse ID is entered. Required fields, their validation rules, and explanation of coded values are listed in Table 3.

In some instances where a field is required, the associated lookup table may contain a “#delete” value. This allows an existing value to be replaced with “#delete” and triggers the record for deletion when moving to another record or re-querying the table or form. If the field is not required, an existing value may be replaced with a null value. The null may also trigger the record to be deleted if the record is left with only a horse ID value. For example, if a horse's sex is incorrectly entered, the value may be deleted (marked with “#delete”), and WHIMS automatically deletes the record when it is updated. Under such circumstances, special sanctioned values may continue to show a value as ‘#Deleted’ until the recordset is re-queried or the form re-opened. Tables with this behavior are detailed in Table 4.

Table 4. WHIMS fields with sanctioned null or “#delete” values and their validation rules (see Appendix A for a full description of metadata).

Table	Field	Rules
Herd	Herd	(null); any value entered in HerdLookup table
Names	Name	(null); any name up to 50 characters long
Sex	Sex	Values in SexLookup table (“#delete”;“F”;“M”)
Face	FaceMark	Values in FaceMarkLookup table (“#delete”;“blaze”;“race”;“snip”;“star”;“strip”;“stripe”)
LFLeg	LFLeg	Values in LegMarkLookup table (“#delete”;“coronet”;“pastern”;“sock”;“stocking”)
LHLeg	LHLeg	Values in LegMarkLookup table (“#delete”;“coronet”;“pastern”;“sock”;“stocking”)
RFLeg	RFLeg	Values in LegMarkLookup table (“#delete”;“coronet”;“pastern”;“sock”;“stocking”)
RHLeg	RHLeg	Values in LegMarkLookup table (“#delete”;“coronet”;“pastern”;“sock”;“stocking”)
Parents	Dame and Sire	(null); any value in ID Table except zero; record triggered for deletion if both values are null.

The HerdLookup table is only used if the herd management area is subdivided into regions of the range where subpopulations exist. These herds will be unique to each wild horse identification database (see Table 5) and, if used, should be entered into the HerdLookup table prior to data entry of horse information. To add these values, access the table directly through Advanced Features (see below).

Table 5. HerdLookup table values for Pryor Mtns and Bookcliffs.

PryorMtns Herds	Bookcliff Herds
DryHead,	Coal Canyon, Main Canyon & Miscellaneous Areas,
Sykes,	Indian Park, Low Gap, Monument Rocks,
Burnt Timber	North Soda and 'off range'

The remaining fields in a wild horse identification database, and tables they are stored in, are described in Table 6.

Table 6. Other Fields in required WHIMS tables and their validation rules.

Table	Field	Rules
Photos	Date	DD-MMM-YY (may actually be entered in any valid date format and delimited with #, e.g., #1/30/99#, when filtering by form)
Photos	Volume <sup>1</sup>	12 digit number for PhotoCDs; any character value up to 50 characters, although 11 characters or less without spaces are recommended
Photos	ArcFilename <sup>1</sup>	Up to 120 characters for path and filename relative to the root directory of archive media (e.g., Nikon\DSC00234.tif)
Photos	CatFilename <sup>1</sup>	Up to 120 characters for path and filename relative to the horse database subdirectory of the volume the image was derived from (e.g., C:\WHIMS\DSC01200203\Nikon\DSC00234A.jpg would be entered as Nikon\DSC00234A.jpg to represent the catalog file for a horse database in C:\WHIMS derived from an archive volume DSC01200203)
Photos	Comments	Any text up to 255 characters to describe horses and/or their markings in the original archive image and helpful to eliminate ambiguities.

<sup>1</sup> If all fields are null, record in Photos table is triggered for deletion

## WHIMS Application Database

The application database links to a wild horse identification database and defines the standard queries, forms, and code to perform the most frequently encountered tasks of horse identification and record management. The main features are described below.

### Task Manager

When WHIMS is run, the startup screen (see manual's title page) is briefly displayed while WHIMS checks links to a horse identification database and runs the WHIMS task manager (Figure 6). The task manager is the central control to initiate common WHIMS tasks including to Query or Edit horse identification information, View or Edit photo catalog information, access Advanced Features, and Exit WHIMS.

- Click the Horse Identification Query button to query WHIMS for horses having particular attributes and display their photos (This uses the Horse Identification form described below but prevents you from editing any data).
- Click the Horse Identification Edit button to enter or edit horse attribute information with the Horse Identification Form (see the Horse Identification Form details below).



Figure 6. WHIMS Task Manager.

- Click the Photo Catalog View button to view the WHIMS photo catalog of derived images used to identify horses using the Horse Catalog form (see Horse Catalog Form details below). Use this form to browse the catalog. You can not use it to edit data.
- Click the Photo Catalog Edit button to enter or edit photo catalog and archive information. From here you can also edit the image using what ever software you have installed, e.g., Photoshop, and associated the image's file extension, e.g., jpg, pcd, or tif (see Updating Image Information details below).
- Click Select Horse Database to open another wild horse database. You should do this after playing with the demo (HORSEDEMO.mdb) and renaming, copying, and relocating the empty template database (HorseDBTemplate.mdb) found in the WHIMS2K directory.
- Click Advanced Features to access the WHIMS database window. This provides full use of Microsoft Access. It allows you to enter herds and customize lookup tables, define your own queries, or design special reports. Inappropriate changes to existing WHIMS tables, queries, forms, or code, however, may cause WHIMS to malfunction, or even corrupt a database, so you should make regular backup copies of both WHIMS2k.mdb and your wild horse database to reduce the risk of losing work. If you don't make regular backups, shame on you.
- Click Exit to close the WHIMS database application

### **Horse Identification Form**

The horse identification form is the most frequently used feature within WHIMS and understanding its capabilities are central to mastering the use and maintenance of a wild horse identification database.

#### **View Horse Identification**

Click the Horse Identification Query button on the Task Manager to open the Horse Identification form (Figure 7) or change it to 'Query Only Mode.' No WHIMS data can be altered while in query mode. Use this mode unless you explicitly want to change WHIMS data.

The form displays information about a wild horse (called the current record) in a collection of



Figure 7. The Horse Identification form opened in query mode.

wild horse records (called the current recordset). In the lower left are the record navigation controls (Record: [Previous] [Next] | [Current] 4 [Next] [End] [Refresh] of 6), which are used to move among horse records in the current recordset. The current recordset contains the entire database of wild horses when the form is first opened.

Click on the Next ([Next]), Last ([Last]), First ([First]), or Previous ([Previous]) button in the record navigation control to move to that record in the current recordset. The number in the current record window ([Current]) between the previous and next buttons shows which record number in the recordset is currently displayed. This window may also be used to enter a record number and navigate to it directly, and is sometimes called the 'Go To' window. Simply click in the window and type a number less than or equal to the number of records in the current recordset. Then press the Tab or Enter key to move to that record. Which record actually displays depends on the contents of the recordset and any sorting criteria that apply.

Horse information on the form is organized into sections (e.g., Horse attributes, Parents, Markings, Slides, and Filter). The Tab key is used to move from field to field within each section on the form. Most of these fields have dropdown lists, or combo boxes, (see Figure 8) which show the field's values in the wild horse identification database. The values for attributes of each horse ID are displayed in the form's fields as records are navigated. In addition to record navigation controls, the form also contains record indicators, or selectors, e.g., vertical bars or buttons ([Selector]) to the left of information that indicates which section and record has the focus. Notice that the Face Marking and Slides sections may have more than one record per horse. These sections are themselves forms (e.g., subforms), which express the one-to-many relationship of records in the underlying wild horse identification database tables (see Table 2). They also have their own record selectors (for Face Markings and Slides sections) and navigation controls (Slides section only). The current record selector ([Current Selector]) shows which record on the form or subform is the current record. For example, if you click the second face mark value its record selector becomes the current selection. The horse record and slide record selectors are always displayed with the current record selector since the form only shows one record from each of their queries at a time. Record indicators and selectors will be stressed again when data editing is discussed below.

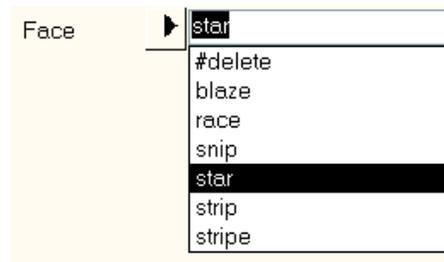


Figure 8. A combo box and its dropdown list.

Clicking on any field in the form will place the cursor there and the dropdown list of a field's combo box may be used to view values for that field. The Tab key may be used to move from field to field within the form and subforms (e.g., Face Markings or Slides). Use the Control-Tab key combination, or click the mouse cursor on a field in the main form or another subform, to move outside a subform. Keep in mind that some fields or subforms may be hidden if no information is available for the current horse. For example, if there are no photos of a horse, the Slides subform will be hidden and a message to that effect will be displayed instead. Right-click on the image to set the image window options (see Horse Catalog Form section below for details).

## Filter Horse Identification

The horse identification form contains several controls to rapidly query the wild horse database and filter records to focus on those horses that share common attributes, or are of special interest. There are combo boxes in the filter section to select an individual horse by its ID, name, or all the horses having a particular face mark. For example, to show horse information for White Cloud, simply select it from the dropdown list in the Name combo box in the Filter: section at the bottom of the form. For complex selections of horses based on combinations of their attributes, use the Filter-By-Form button on the right of the form (  ), or from the button command bar (  ) under the WHIMS menus. Clicking either one, or selecting a Filter option from the Records menu, displays the Filter-By-Form view (Figure 9).

Use the combo boxes to select a value, or type a value directly into a field on the form. (Values for text fields should be surrounded with quotes while numeric fields do not need them; however, quotes are automatically supplied if forgotten).

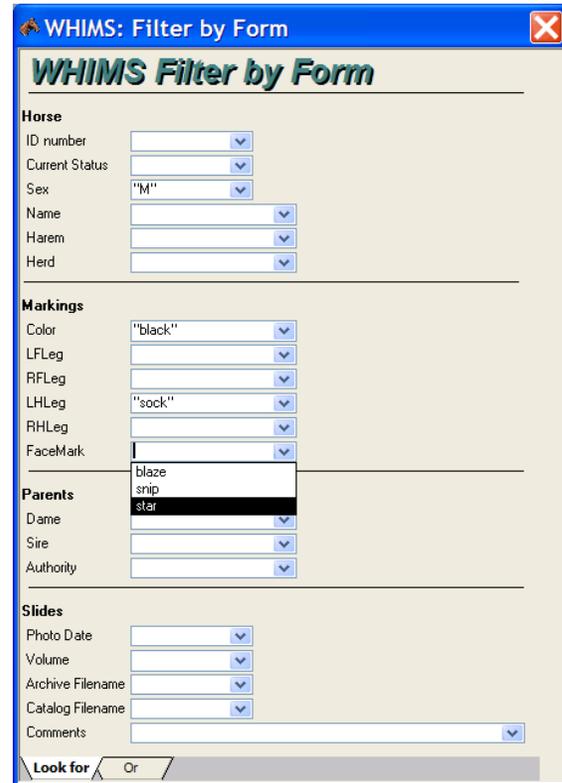


Figure 9. Filter-By-Form view to select all black stallions with a right front sock and star on the face.

Clicking the "Or" tab control at the bottom of the Filter-By-Form view allows additional criteria to be added to the filter. Use this feature to select horses with any of several attributes. For example, to get the horses that have either a "sock" or a "stocking" on the left hind leg, start with a blank "Look For" form and select "sock" from the LHLeg combo box. Click the "Or" tab and use the LHLeg combo box to select "stocking." This condition could also be entered on a single "Look For" form view with the phrase ("sock" or "stocking") in the LHLeg field. Also note that the list of values in the combo boxes are based on horse values, not lookup tables. For instance, if no gullos have been identified, gullo will not appear even though it is in the ColorLookup table. The special values "Is Null" and "Is Not Null" (without quotes) may be used in any field except ID number. Use "Is Null" to select horses without that feature. For example, entering Is Null for Current Status will select all horses that have no status information (which is likely those horses on the range). Entering "Is Not Null" for FaceMark will select all horses that have one or more markings on the face of any type. Using "Is Null" for Volume, Archive or Catalog Filename is a handy way to locate all horses that have not yet had a photo entered to document them.

Use the Clear Grid button (  ) from the buttons command bar under the WHIMS menus if you want to clear the Filter-By-Form view and start over. You cancel the Filter-By-Form action by closing the Filter-By-Form view with either the form's close window button (  ) or

the close button (**C**lose) on the WHIMS buttons command bar. Canceling the Filter-By-Form action will leave the old filter unchanged and in effect if selected.

After you are finished filling in the Filter-By-Form view, use the Apply Filter button (Apply Filter icon) in the command bar to switch back to the Horse Identification forms with horses having the specified characteristics selected. If you apply the filter after you have cleared the form, the recordset will revert to all horses in the database. You can tell if a filter has been applied when viewing the Horse Identification form by looking at the Apply Filter button in the command bar. The Apply Filter button's appearance is highlighted (Apply Filter icon) and "(Filtered)" appears after the record navigation controls whenever a filter is applied. Clicking on the highlighted button clears the filter and selects all horse records. Clicking on it when it is not highlighted applies the last filter specified. The form will be blank when the specified filter does not select any records (e.g., a null recordset).

## Edit and Entry of Horse Identification

Click the Edit Horse Identification button on the Task Manager to open or change the Horse Identification form to 'Edit Mode' (see Figure 10) so that data editing and entry capabilities are enabled. Changes may be made to existing records, including deleting them and adding new ones, when Edit Mode is shown in the upper right corner of the form.

With the exception of ID Number, change a field's value in the current record

selector (Record selector icon) by moving to that field and selecting a different value from the combo box's dropdown list. You may also type in a new value directly. Notice that the icon on the record selector changes to a pencil (Pencil icon) when the field's value changes. The pencil indicates that one or more of the form's field values have changed but underlying records in the wild horse identification database have not yet been updated.

Also notice that there may be several Face Marking records in Edit Mode, where the last one has an asterisk (Asterisk icon) selector with no value. If you click in this record, or there are no face marks, it changes to a current record selector (Record selector icon). Type in the field and it changes to a pencil and another blank Face Marking record appears. Changes to a field may be cancelled with the Esc key when the record selector indicator is a pencil. Use the Esc key again to cancel any other changes to the record that have not yet been updated. Changes to the fields in the main form of the current record are updated when you either navigate to another record or move the cursor to a field in a subform. Likewise, changes to fields in a subform are

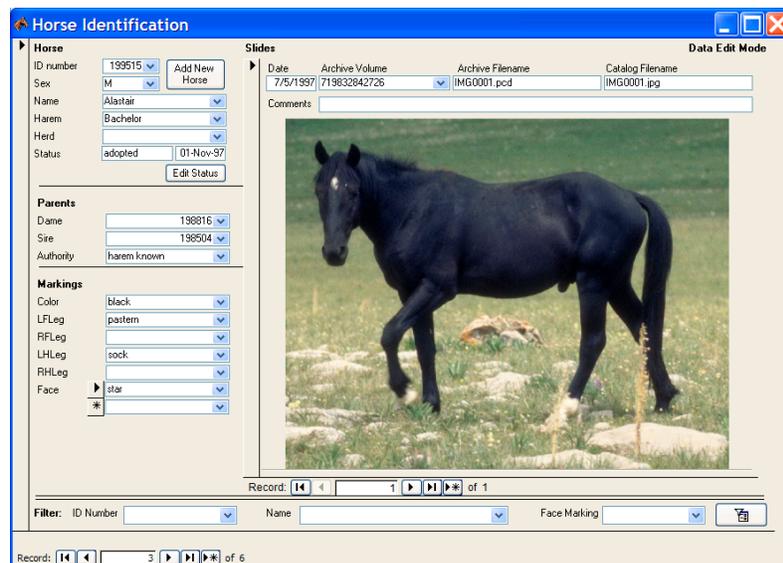


Figure 10. The Horse Identification form opened in editing mode.

updated when you move the cursor to a field in the main form, a field on another subform, or another subform record. Records on subforms (e.g., the face marking and slide fields) are updated when you move away from the subform with the control-Tab key combination, move to a different record in the subform with the record selector (for Face Markings), or move to another record with the record navigation controls (for Slides). Record selectors may be used to delete the record too. Simply click on it to highlight it (▾), and use the Delete key. You can also copy the information of a selected record to the Windows clipboard (with the Edit menu Copy command) and paste the information elsewhere. Record selectors provide visual feedback about the update process in all cases. Monitor the record selector icon and be aware of how it changes; otherwise, your data may not change as you expected.

Validation rules check for incorrectly entered or changed field values, and dialogs provide feedback about errors. Dropdown lists of combo boxes list valid values, but you may add new values that don't appear in the combo box for Name, Harem, Volume, Archive and Catalog Filename. Lists for some fields may contain a "#delete" or null (blank line) value, which when selected will trigger a deletion of the related record in the underlying table. Alternately, for fields that accept a null value, select the old value and delete it with the Delete key. For example, if you incorrectly enter "sock" for the right front leg instead of for the left front leg, correct it by selecting "#delete" from the list for the RFLeg field. Then select "sock" for the LFLeg field and navigate to another record to finalize the update. Perhaps a face mark needs to be deleted because the horse does not really have a snip and a strip, but just a strip. Just double-click the snip value and press the delete key; then move to another record. You may also use the record selector to delete face marks as described above. If you move to a field which updates the underlying table record before navigating to another record, the "#delete" value changes to "#Deleted." This indicates the record has been deleted from the underlying wild horse identification database table.

You can only add a Horse ID value on a blank form (Figure 11), using the Add New Horse (Add New Horse) button, the form's New Record buttons in the navigation controls (Add New Record), or the WHIMS button command bar (WHIMS). These buttons are only enabled while in edit mode. An existing ID Number can only be changed to a new ID Number, but this must be done directly in the ID table (see Advanced Features below).

Figure 11. Blank Horse Identification form used to enter information on a new horse.

The ID number must be entered before other information, and must not yet exist in the database. It is best to use the Add New Horse () button to specify the new ID. Otherwise when the record is updated, a warning explains that it is a duplicate ID and no changes are made. After clicking the button, the Add New Horse dialog appears (Figure 12), which simply allows a new ID to be added and checks that it doesn't already exist.



Figure 12. Add New Horse dialog.

Only the most recent status record is displayed in the form. To view or edit all the horses status records, click the Edit Status () button. This brings up the Edit Status form (Figure 13) showing the history of the horse ID's change in status (range, dead, adopted).

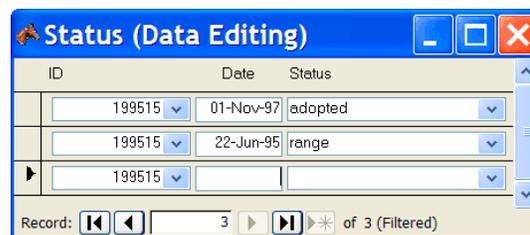


Figure 13. Edit Status form.

### Horse Catalog Form

Click the Photo Catalog View button on the Task Manger form to View the WHIMS photo catalog using the AllHorseSlides form. Use this form (Figure 14) to quickly view, filter, and sort horse images and associated information. You can not add, delete, or edit any photo catalog records or information with this form, and it only shows the Catalog image, not the archive image, is shown.

The form displays information about an image in the photo catalog, and the current recordset includes the entire photo catalog initially sorted by ID number. This will display images of unidentified horses, e.g.,

ID 000000, first. Tab or move the mouse cursor to a different field, and click the Sort Ascending () or Sort Descending () button in the WHIMS button command bar to order the catalog differently. You may also use the Filter-By-Form and Apply Filter buttons on the WHIMS button command bar to select only the photos of interest, e.g., all those from one of the archive Volumes, or all those of an individual horse.



Figure 14. Horse Catalog form for viewing the photo catalog (but not archive media).

Right-click anywhere on the image to view the image display options menu (Figure 15). By default, forms display images to fit within the forms viewing window regardless of the

image's actual resolution, e.g., the default zoom is "Shrink to Fit." You can enlarge the image, but not the window, and view horse marking details by changing the zoom factor to 100% since most WHIMS images will be saved at higher resolutions than the viewing window. A hand cursor appears when the image is displayed at a scale larger than the image window and the cursor moves over the image window. You can hold down the mouse button and use the hand to pan the image in the window. Alternately, you can display and use scrollbars for panning the image by checking Scrollbars on the options menu. These features may be helpful to check horse markings more carefully.

### Image Updater Form

Click the Photo Catalog Edit button on the Task Manager form to edit or enter photo catalog information using the Image Updater form (Figure 16). Use this form to edit or enter data in the Photos table, access images on archive media, or edit images in the photo catalog.

You can use the same features available in the Horse Identification form for editing data, including record navigation, filtering, changing field values, and adding new records. Remember that a horse's ID must have previously been added to the wild horse identification database before adding its photo catalog information.

The form initially opens in Catalog View showing a Folder (📁) button and displaying the Catalog File. Clicking on the folder switches to the Archive View (Figure 16) showing a Media (📀) button and displaying the Archive File. Clicking it again switches it back to Folder View. If the filename for the current record has not yet been entered, or the filename can not be found, a message to that effect appears.

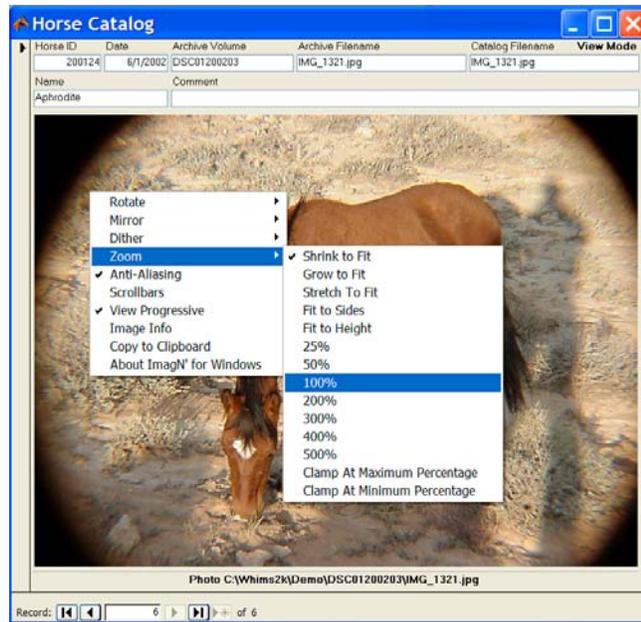


Figure 15. The image window and display option menu.



Figure 16. Image Updater for editing photo catalog.



Figure 17. Archive drive dialog.

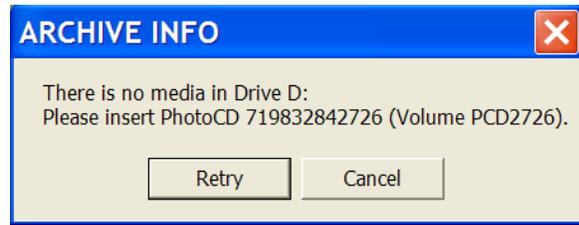


Figure 18. No media dialog.

WHIMS asks for the archive media drive if it hasn't been set (Figure 17). The default may also be set or changed in table DBLink. When displaying archive images, WHIMS informs you if there is no media, or the wrong media is in the drive (see Figure 18 and 19). Some hardware and media may also require several Retry attempts to successfully load an image.

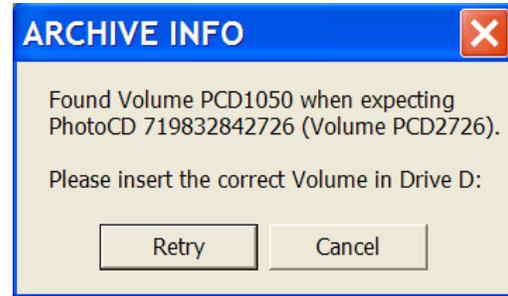


Figure 19. Wrong media dialog.

There are many possible workflow methods for handling images in WHIMS. One method is to work on all the images from a single archive Volume. Start by opening the Image Updater form. Then click on the new record button. Now add a horse ID, which will usually be 000000 for an as yet unidentified image. Enter Volume information and the first image on the archive media. Switch to Archive View if not already there, or use the Refresh (  ) button to load the archive file. Next, click on the image to open it in your associated image editor (Figure 20).



Figure 20. Click on the image to open it in the associated application for editing.

(If this is not the application you were expecting, you will need to associate your preferred application using Windows Explorer. To do this in Explorer, use the Tools menu and select Folder options. Go to the File Types tab and scroll to the file extension of interest, e.g., jpg, pcd, or tiff. Click change and select your preferred application from the list. If it is not in the list you may be able to browse to it and set it to be associated with that extension for editing.)

With the archived image open in an image editor, it may be cropped, enhanced, resampled, and saved (see “Guidelines for Using an Image Editor” below). Remember the image should be saved as a JPG file in a subdirectory below the horse database directory identical to the volume label (or prefixed with “PCD” if derived from a PhotoCD) and named using the original filename as a prefix. Return to WHIMS and add the catalog filename just saved. If everything is correct, switching to Catalog View will load the image you just saved in your image editor. You can now repeat these steps for the next image on your archive media.

## Building the Photo Catalog

The workflow process of building the photo catalog may be somewhat different if you are creating an archive from digital camera photos on a CD/DVD recorder or sending out slides to be mastered onto PhotoCDs. If doing the latter, it is necessary to check that the returned media has images in the same order as the metadata for the slides you sent out. Otherwise the basic steps consists of the following:

- 1) selecting the best field photographs to archive onto CD/DVD or master onto PhotoCDs,
- 2) building an associated table with volume, filename, date photo taken, and comments,
- 3) deriving catalog images from original photos using an image editing application, and
- 4) saving JPEG images in the correct directory on the hard drive of the photo catalog.

There are many alternatives to each of these steps, and individual users are encouraged to experiment and find out what works best for them. Highlights of the procedures used during the development of the prototype are outlined here as a starting point. PhotoCDs were used for a decade to provide high quality, inexpensive digital images from original slides. While it is now a legacy technology, it can be replaced with a film scanner or service bureau that can scan slides at high resolution (e.g., 2000 x 3000 pixels) at comparable costs. Expect costs to vary greatly depending on the number of slides scanned and their quality, but by shopping around it is possible to get a good quality product for \$1.40-\$2.00 per slide.

If using film, it is **very important** to label and document slides **before** mastering. We documented slide information in a spreadsheet during the development of the WHIMS prototype, but a database table or word processor might work just as well for you. The columns in our spreadsheet identify the slide and match the fields in the wild horse identification database Photos table, e.g., slide order number, horse ID number, Volume label (or PhotoCD number), Archive Image filename on the CD/DVD, Derived Catalog Image Filename, Date, and Comments. The slide order number should be marked on each slide and can be any unique identifier of your choice for that slide. We have found it useful on other photographic projects to code the Photographers initials, roll number (a sequential number that may include the year), and slide number on each slide. For example, RGO9923-06 is the sixth slide on the 23<sup>rd</sup> roll taken by Ron Osborn in 1999. While this slide order number is not actually entered into WHIMS, which automatically generates its own unique record number, it is necessary to relate a digital record to the original slide. The Date column should reflect the date the slide was taken, not when it was developed or mastered on PhotoCD.

Add horse IDs to the spreadsheet for each slide used to document a horse's markings. New horses, which have not been previously identified, will need to be given a new unique horse

ID number. It is best to assign horse IDs and add them to WHIMS using the Horse Identification form as soon as you know that the horse is not already in WHIMS.

Fill in the slide number, its date, and any comments about this horse. Put each horse ID in a separate row and duplicate the slide information when using a single slide to document several horses. In this case, it is **very important** to note which horse is which in the comments column. For example, second horse from right, or horse in foreground. Remember that only those horses that need to be added to the catalog must be in the spreadsheet, not every horse in the photograph. Also, photos of horses already in the catalog should be updated or additional ones added, if markings, e.g., color, change. (The remaining horse identification fields will be entered later once the photos have been cataloged in WHIMS so there is no need to add this additional information to the spreadsheet.)

Send slides out for mastering after assembling a reasonable number of slides and completing the spreadsheet. Master PhotoCDs store about 100 images. More images may be added later to partially full PhotoCDs, but extra service charges may increase the per slide cost. If you are burning your own CD/DVDs it might be easier to add images as available in a CD/DVD-RW or UDP format, but standard CD/DVD-R media is still less expensive and more reliable as a long term archive format.

Review CD/DVDs images with image editing software, e.g., Paint Shop Pro, after mastering, and complete the spreadsheet data entry. Fill in the Archive and Derived Image Filenames, and verify the slide order is correct. It may be necessary to compare the PhotoCD image, the original slide, and its slide order number in the spreadsheet to correct problems when slides are not mastered in the same sequence that spreadsheet information is entered.

Next, copy the spreadsheet slide information, except for the slide order number, and append it to the Photos table in the wild horse identification database. Select the cells containing slide information in the spreadsheet. Use the edit menu to copy the information to the Windows clipboard. Select Advanced Features in WHIMS (see below) to view the database window. Click on the Tables tab in the database window, if necessary; then open the Photos table. Finally, use the paste append command in the edit menu to add the clipboard data to the Photos table. A dialog appears indicating how many records will be pasted and asking you if that is what you want to do.

Building and maintaining the photo catalog is a critical part of WHIMS. Its utility and value is questionable if horse photographs and data are unreliable, incomplete, or outdated. Likewise, it is crucial that procedures are documented when protocols and standard operating procedures described here differ.

## ***Guidelines for Using an Image Editor***

Images for each new or updated horse ID must be edited with image processing software once slides are mastered on PhotoCDs. WHIMS will work with many image editing applications, including Adobe Photoshop, Corel Paint, Paint Shop Pro, and Microsoft PhotoEditor. While it is not the intent to tutor users in image editing or to specify which software to use, it is useful to introduce a few concepts and terms that might be unfamiliar and to describe what general workflow was followed during the development of the WHIMS prototype using Paint Shop Pro version 4.14.

### **Resolution**

Computer images are typically created as an array of dots, or pixels, each having a specific color. Image resolution expresses the amount of detail its file contains, i.e., the more pixels the more detail. (Color resolution or depth is discussed below.) Image resolution should not be confused with device resolution, which is measured in dots per inch (dpi). For example, a common monitor resolution is 96 dpi; common scanner and printer resolutions are 300 dpi. An unscaled 300x300-pixel image has no less resolution on a monitor than a printer. Both views contain the same number of pixels although the monitor's view appears about three times larger, making individual pixels more likely to be noticed. Overall resolution, therefore, is influenced by image resolution, device resolution, and the scale at which an image is displayed. For example, you can magnify, or zoom in, an image beyond 100% to make it larger, but this only shows the individual image's pixels larger as visible blocks with jagged corners. Zooming out makes the image smaller but reduces the number of image pixels that are displayed. Given that master PhotoCD images are scanned at near the film's resolution (2048 dpi) and images are displayed inside windows about 600x400 pixels in WHIMS, what is the best resolution to edit PhotoCD images and save results in the photo catalog?

Clearly we want at least the resolution of a forms image window, and typically want the individual horse to fill the window. In some situations, we want to magnify markings, e.g., on the face, but we generally found it better to include separate images of details rather than save one high-resolution image that had to be panned and zoomed repeatedly. Consequently, we focused on a target width between 600-900 pixels and target height between 400-800 pixels. The actual crop shape, or aspect ratio of width to height, depended on such things as the horse's profile, e.g., side or front view; whether there is more than one horse in the photo, e.g., mare and its fold; etc. In some cases, it took more than one image to document clearly all the markings on a horse, e.g., right and left sides, or a separate image of the face in addition to the entire horse.

Our question is further complicated since PhotoCD images, unlike digital camera images, can be read at five different resolutions. The most common PhotoCD resolutions used were 512x768 and 1024x1536; however, the actual size depends on the scale of the horse in the image. For example, the 512x768 resolution is sufficient if the horse fills the original slide or PhotoCD image. On the other hand, if the horse is not in the fore-ground or the picture is of several horses, you need to use a higher resolution, perhaps even the full PhotoCD resolution.

Over time, we realized a 400x400-pixel image cropped from the PhotoCD's highest quality image (3072x2048) sufficiently identifies individual horses. So first, select a suitable resolution on the PhotoCD so the cropped horse or detail from the original produces an image size somewhere between 400x800 to 900x400 pixels (see Figure 21). If in doubt or you are using a high resolution image from a digital camera, crop the full resolution and resample (see below) it later, after all other enhancements have been made.

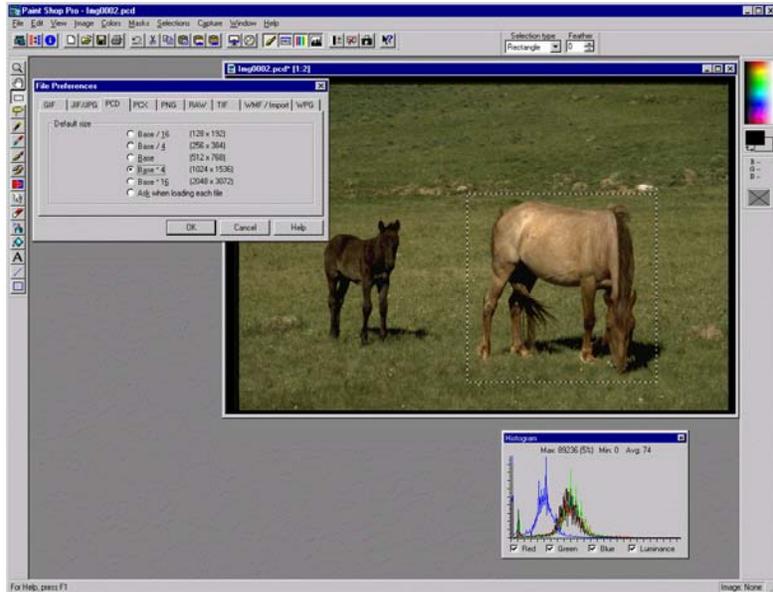


Figure 21. Paint Shop Pro's file preferences and PhotoCD resolutions, image cropping for the WHIMS photo catalog, and histogram of the image's color values.

### Color and Brightness

Color depth, or color space, indicates the number of possible colors a pixel can represent. The human eye can detect approximately 16 million colors, and to display all those colors requires that pixels have a 24-bit value (8 each for red, green, and blue color channels). (To check your monitors color depth, right click on the Windows desktop, and select properties. In the Display Properties, click the settings tab, and check color quality.)

The actually number of discrete colors in even high quality photographs at 24-bit color depth is far less than 16 million. Most image editing software, including Paint Shop Pro, use histograms (Figure 21) to show pixel frequency distributions of discrete color values (typically the red, green, and blue components, and overall luminance). These histograms can help you decide what changes might enhance an image's quality since specific enhancements are designed to alter the histogram in particular ways. Changing the shape of the histogram alters the image's balance, and in some cases that's exactly what you want to do. In other cases, when the image composition is good, you want to retain the histogram's shape, but shift it in one direction to subtly enhance the image. For example, an overcast sky creates photographs with low contrasts where histograms are compressed with few dark and light pixels. Underexposed photos have skewed distributions with colors bunched tightly toward the bottom, or dark end, of the luminance spectrum. Overexposed ones bunch colors tightly toward the top, or light end, of the spectrum. Increasing brightness shifts the histogram up the spectrum, increasing contrast stretches the histogram out.

We routinely apply the Stretch Histogram Function in Paint Shop Pro after cropping the PhotoCD image. This function almost always improves image quality, and dramatically so when the histogram does not cover the entire luminance spectrum, by adjusting the image's luminance so its histogram is more dispersed and balanced over the entire spectrum.

Then overall brightness and contrast is moderately adjusted if the image is still too dark or light (see Figure 22). Repeated manipulation of the image to adjust the histogram should be avoided since each adjustment will tend to reduce the number of unique colors. This is sometimes referred to as banding if the discrete colors are seen as contours or patches. Therefore, it is best to use as few steps as possible when adjusting color and brightness.

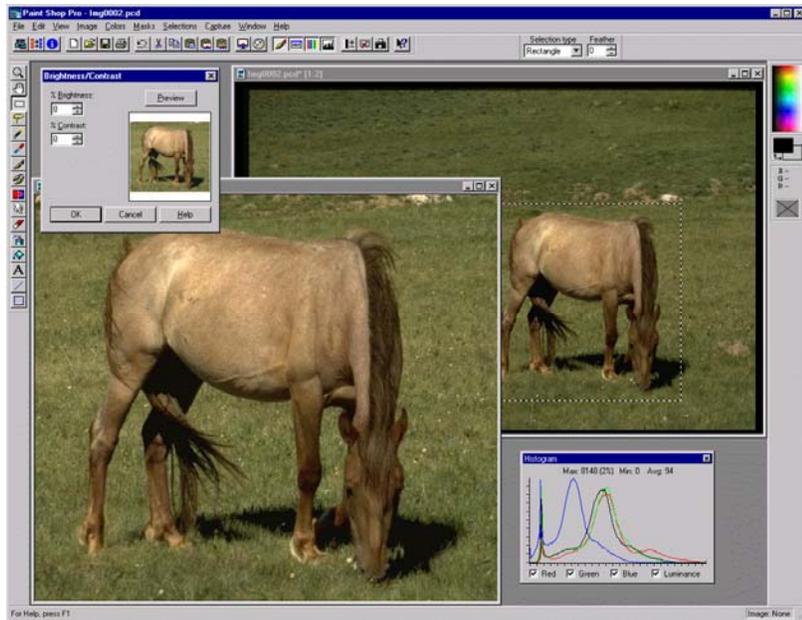


Figure 22. Example of typical brightness setting used in Paint Shop Pro and the smoothing effect on the histogram after sharpening and resampling the image.

### Image Sharpness

Use a sharpening filter, or alternately an unsharpen mask, when the photo is not sharply focused. Blurred images originate from poor quality lens, camera or subject movement, and slow shutter speeds. You will encounter them when either cropping a small portion of an image at full resolution or trying to salvage a poor photograph. In any event, different levels of sharpening may be applied to reduce image blurring. Sharpening may actually increase the noise, or graininess, of the image, and can be undesirable. If sharpening produces little visual improvement, it is probably best to avoid it altogether and undo what was just applied.

### Image Re-sampling

Re-sampling is the process of changing the image's size, or resolution, by altering the number of pixels it contains. Down-sampling reduces the resolution and number of pixels in an image either by interpolating and averaging pixel values (sometimes termed anti-aliasing) or discarding pixel rows and columns (called resizing in Paint Shop Pro).

Re-sampling is preferred to resizing, but requires much more computation, and will be noticeably slower for large images. Avoid up-sampling, which increases the number of pixels and file size with little visual benefit. We normally use down-sampling so the final image size doesn't exceed the 900x800 pixel size recommended above. Both sharpening and re-sampling smoothes the images histogram (see Figure 21 & 22.)

### Image Compression

Many methods exist for compressing an image's file size. Some techniques preserve all the image's original information (known as lossless compression) while others discard or alter the image's original information without significantly changing its appearance (known as lossy compression).

Suffice it to say that JPEG compression (a lossy method) is recommended for WHIMS (Figure 23) since it provides a high degree of compression (10-25 fold) and visual quality. The quality level is specified before compression, and the image is compressed when it is saved. Paint Shop Pro uses a quality range of 0-99, where lower values produce higher quality but less compression. We discovered that a quality level of 30 provides good balance



Figure 23. Paint Shop Pro example of JPEG file preferences and saving an image to the photo catalog.

between visual quality and file compression for horse images in WHIMS. Other software may use different quality ranges (e.g., 0-255 or 0-10) so you may need to experiment and make your own assessment. It is also **very important** to avoid resaving a JPEG image since lossy compression continues to degrade quality with each resave operation. One exception, however, is when you down-sample a high resolution digital camera image, which may be in JPEG format, to the resolution recommended for the catalog image, e.g., 900x600. In any event, you should always start with the original and re-edit it, which is why an archive of the original is preserved and maintained in WHIMS.

Finally, image file and directory naming conventions are used in WHIMS (see Figure 1 and the "Organization of Information" section above for details). If images are saved in the wrong directory, the links between the photo catalog, the CD/DVD, and records in the Photos table will be broken or incorrect. Even worse, overwriting an image in the wrong directory deletes a correct one in the photo catalog. Your quality assurance procedures should include checks to verify that images are in the correct directories and properly linked in the Image Updater form.

## Advanced Features

This button brings up the Application database window (Figure 24) providing access to all the tables, queries, forms, and VBA code (in modules and behind forms) in WHIMS. Use the Objects list on the left to view the components of interest. WHIMS applications components not mentioned elsewhere are briefly explained here.

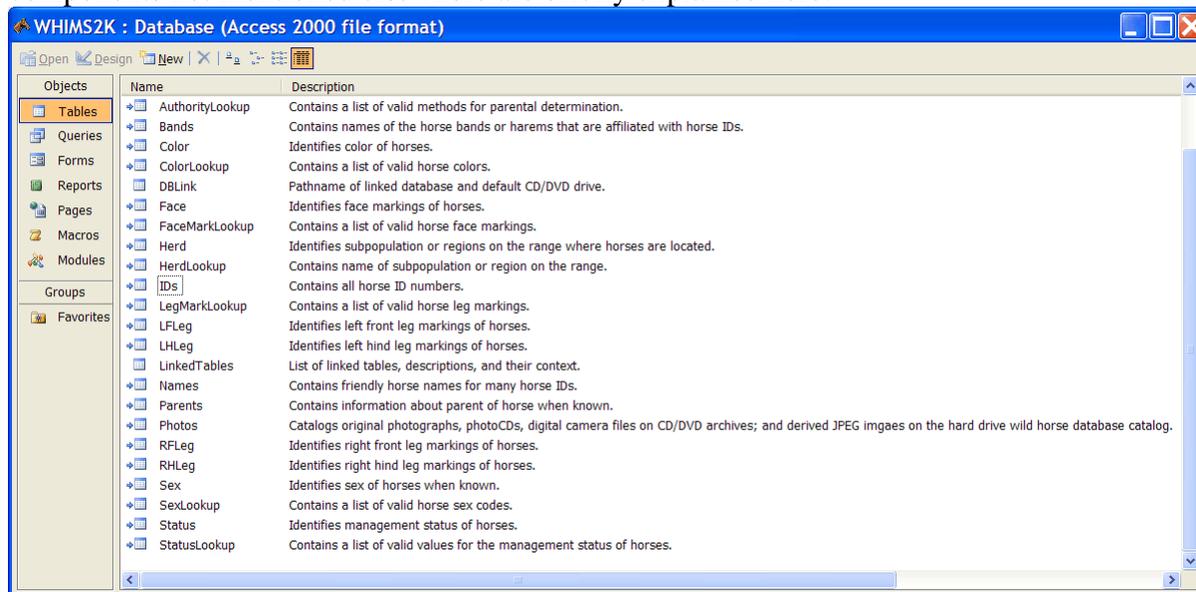


Figure 24. WHIMS tables are shown in the database window.

**Warning!** Advanced Features provides full access to all WHIMS components. Make regular backups of WHIMS and your wild horse identification database to insure that you can recover from problems. The photo catalog of the wild horse database should get backups too. It is assumed that users have standard procedures they follow in this regard. If you don't have backup procedures, ask someone knowledgeable to show you **before** you need to recover from a mishap. Changes to WHIMS components should only be undertaken by knowledgeable users, developers, or system support professionals. Nevertheless, these features provide a convenient way to access individual wild horse identification database tables, link to additional wild horse management data you may have in spreadsheets, or create special queries and reports for management needs. For example, use the Tables tab, click on the Herd table to open it and define horse management area herds, open the Photos table and append records from the clipboard as described in the "Building the Photo Catalog" section above.

### Tables

#### DBLink

This table contains the pathname of the wild horse database and default CD/DVD drive.

#### LinkedTables

This table lists all required tables in a wild horse database that are linked to the WHIMS application database.

## Queries

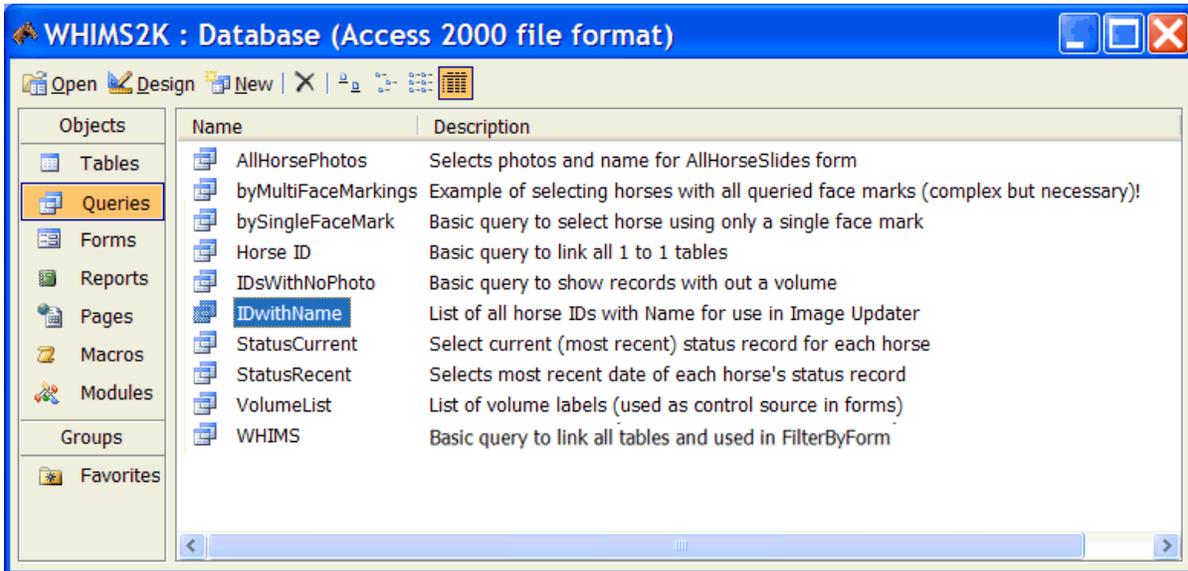


Figure 25. Standard queries supplied with WHIMS.

### AllHorsePhotos

This query relates names with IDs in the Photos table for used in the view Horse Catalog task; otherwise known as the Horse Catalog form.

### byMultiFaceMark

This query creates a list of ID's based on frequency of face marks, e.g., those with two or more face marks of any type.

### bySingleFaceMark

This query creates a list of ID's based on a single face mark.

### Horse ID

This query relates all one-to-one relationship tables in a wild horse identification database for use on the main Horse Identification form. Use this query (Figure 26) to produce a flat file of horse attributes suitable for spreadsheet analysis or for updating information that doesn't require viewing photos of the horse.

ID	Herd	Band	Name	Sex	Color	LFleg	RFleg	LHleg	RHleg	Dame	Sire	Authority
0												
199513	South	White Cloud	White Cloud	M	palomino							
199515	North	Bachelor	Alastair	M	black	pastern		sock		198816	198504	harem known
199523	South	White Cloud	Laramie	F	dun			pastern		198913	198708	harem known
200001												
200124			Aphrodite	F	bay				sock			

Figure 26. Datasheet view of the Horse ID query.

### IdsWithNoPhotos

This query creates a list of horse ID's and their names that have no photos in the photo catalog.

### IdWithName

This query lists all horse ID's and their names for use in the Image Updater form.

### StatusCurrent

This query uses the StatusRecent query to select each horse ID's most recent Status record.

### StatusRecent

This query allows the horse ID's most recent status to be determined by the StatusCurrent query by creating a list of the most recent date among Status records of each horse ID.

### VolumeList

This query creates a list of unique Archive Volume labels and PhotoCD numbers in the photo catalog.

## WHIMS

This query relates all wild horse identification database tables and fields into a large datasheet view. It is used by the Horse Identification form's Filter-By-Form form to get a unique list of IDs based on horse attributes.

## Forms

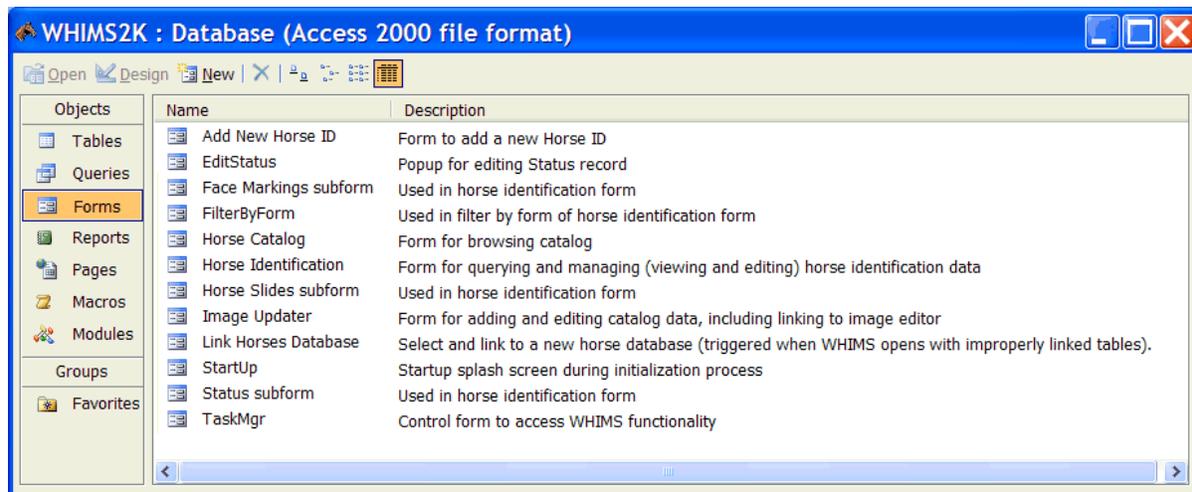


Figure 27. List of Forms and subforms used in WHIMS.

### Add New Horse ID

This form is used as a popup to creates a new horse ID. It is triggered from the Horse Identification form when in edit mode.

### **EditStatus**

This form is used as popup to enter and edit multiple status records for an individual horse. It is triggered from the Horse Identification form when in edit mode.

### **Face Markings subform**

This form used in the Horse Identification form to show multiple face marking attributes.

### **FilterByForm**

This form allows all fields in a wild horse identification database to be included in the specification of Horse ID's in a recordset. This form is normally seen only when filtering records on the Horse Identification form using the Filter-By-Form feature.

### **Horse Catalog**

This form is used to view the photo catalog (but not the archive images).

### **Horse Identification**

This form is used to view and edit WHIMS wild horse data.

### **Horse Slides subform**

This form is used in the Horse Identification form to show catalog information and image.

### **Image Updater**

This form provides data entry and editing for all information related to the Photo Catalog, including linking to an associated image editor for creating derived images from archive originals.

### **Link Horses Database**

This form is triggered when the wild horse identification database is not properly linked or cannot be found. Its action is similar to the Select Horse Database button in the Task Manager.

### **Startup**

This form is the splash screen shown at startup and initializes WHIMS program objects and references.

### **Status subform**

This form is used in the Horse Identification form to show most recent status information.

### **TaskMgr**

This form is used as the main navigation switchboard in WHIMS.

## Modules

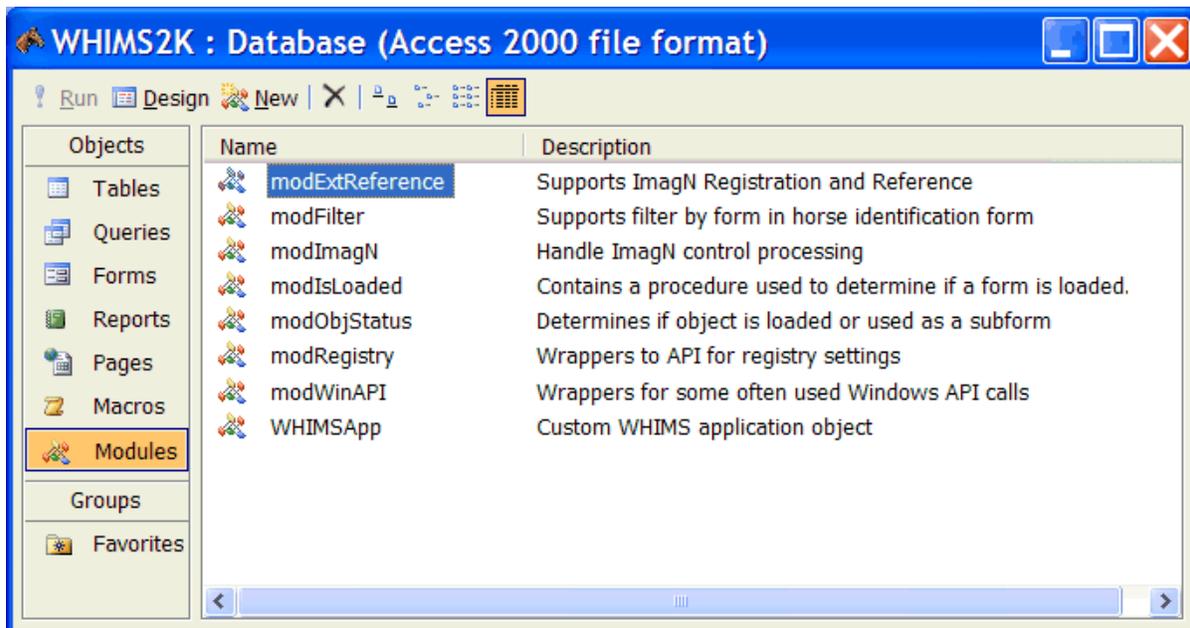


Figure 28. List of modules containing Visual Basic for Application code used in WHIMS.

### modExtReference

This module handles the registration, reference, and initialization of the ImagN ActiveX control at startup.

### modFilter

This module handles the Horse Identification form's Filter-By-Form exit condition (i.e., apply filter or cancel).

### modImagN

This module initializes the ImagN ActiveX control on forms and links record filenames to display the image.

### modIsLoaded

This module determines if a form is loaded.

### modObjStatus

This module determines if a form object is loaded or used in the context of a subform.

### modRegistry

This module interacts with the Windows Registry database to determine if the ImagN ActiveX control is properly registered and to open an image in an associated Windows application.

## modWinAPI

This module contains various file system support routines and uses the Windows API to check for or get a list of CD/DVD drives, CD/DVD media Volume labels, directories, and image filenames in the photo catalog and on archive media.

## WHIMSApp

This module handles initialization of WHIMS at startup and access to its global application properties.

## List of Citations

Sponenberg, D. P. and B.V. Beaver. 1983. Horse Color. Breakthrough Publications, Inc.  
124 pp.

## Appendix A. Wild Horse Identification Database Metadata.

### Summary of WHIMS Linked Table Definitions

A wild horse identification database contains the tables and fields described in Table A-1.

Table A-1. Wild horse identification database tables and required fields.

Table	Field Name	Type	Size
AuthorityLookup	Authority	Text	20
Band	ID	Number (Long Integer)	4
	Band	Text	50
Color	ID	Number (Long Integer)	4
	Color	Text	50
ColorLookup	Color	Text	50
Face	faceRec	Number (Long Integer)	4
	ID	Number (Long Integer)	4
	FaceMark	Text	20
FaceMarkLookup	FaceMark	Text	20
Herd	ID	Number (Long Integer)	4
	Herd	Text	50
HerdLookup	Herd	Text	50
IDs	ID	Number (Long Integer)	4
LegMarkLookup	LegMark	Text	10
LFLeg	ID	Number (Long Integer)	4
	LFLeg	Text	10
LHLeg	ID	Number (Long Integer)	4
	LHLeg	Text	10
Names	ID	Number (Long Integer)	4
	Name	Text	50
Parents	ID	Number (Long Integer)	4
	Dame	Number (Long Integer)	4
	Sire	Number (Long Integer)	4
	Authority	Text	20
Photos	photoRec	Number (Long Integer)	4
	ID	Number (Long Integer)	4
	Volume	Text	50
	ArcFilename	Text	120
	CatFilename	Text	120
	Date	Date/Time	8
	Comments	Text	255
RFLeg	ID	Number (Long Integer)	4
	RFLeg	Text	10
RHLeg	ID	Number (Long Integer)	4
	RHLeg	Text	10
Sex	ID	Number (Long Integer)	4
	Sex	Text	7
SexLookup	Sex	Text	7
Status	statusRec	Number (Long Integer)	4
	ID	Number (Long Integer)	4
	Date	Date/Time	8
	Status	Text	20
StatusLookup	Status	Text	20

### **Table Relationships**

Relationships of required tables are described in Table A-2 and previously depicted in Figure 2.

Table A-2. Relationships among required tables and their referential integrity defined in a wild horse identification database. Lookup table relationships are Indeterminate.

<b>Table.Field Relationships</b>	<b>Type of Relationship</b>	<b>Relationship attributes</b>
IDs.ID - Sex.ID	One-To-One	Unique, Enforced, Cascade Updates, Cascade Deletes, Left Join
IDs.ID - Names.ID	One-To-One	Unique, Enforced, Cascade Updates, Cascade Deletes, Left Join
IDs.ID - Bands.ID	One-To-One	Unique, Enforced, Cascade Updates, Cascade Deletes, Left Join
IDs.ID - Herd.ID	One-To-One	Unique, Enforced, Cascade Updates, Cascade Deletes, Left Join
IDs.ID - Parents.ID	One-To-One	Unique, Enforced, Cascade Updates, Cascade Deletes, Left Join
IDs.ID - Color.ID	One-To-One	Unique, Enforced, Cascade Updates, Cascade Deletes, Left Join
IDs.ID - LFLeg.ID	One-To-One	Unique, Enforced, Cascade Updates, Cascade Deletes, Left Join
IDs.ID - LHLeg.ID	One-To-One	Unique, Enforced, Cascade Updates, Cascade Deletes, Left Join
IDs.ID - RFLeg.ID	One-To-One	Unique, Enforced, Cascade Updates, Cascade Deletes, Left Join
IDs.ID - RHLeg.ID	One-To-One	Unique, Enforced, Cascade Updates, Cascade Deletes, Left Join
IDs.ID - Face.ID	One-To-Many	Enforced, Cascade Updates, Cascade Deletes, Left Join
IDs.ID - Status.ID	One-To-Many	Enforced, Cascade Updates, Cascade Deletes, Left Join
IDs.ID - Photos.ID	One-To-Many	Enforced, Cascade Updates, Cascade Deletes, Left Join