

# WHIMS User's Manual



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## Organization of Information

WHIMS consists of a Microsoft Access application database, a wild horse identification database, and a collection of photoCDs and JPG images. The WHIMS.mdb file contains the application database, and connects to a wild horse identification database when it is first opened. The current prototype includes two wild horse identification databases---PRYORMTNS.mdb for the Pryor Mountain, WY horses and BOOKCLIFFS.mdb for the Little Bookcliffs, CO horses. Others databases may be built and used with WHIMS provided they follow the structure of the wild horse identification databases outlined below and fully documented in the Appendices.

PhotoCDs are used to store archival field photography for horse identification in a digital format. WHIMS assists in the cataloging of horse identification attributes, field photography and photoCDs. The organization of WHIMS and associated data are shown in Figure 1.

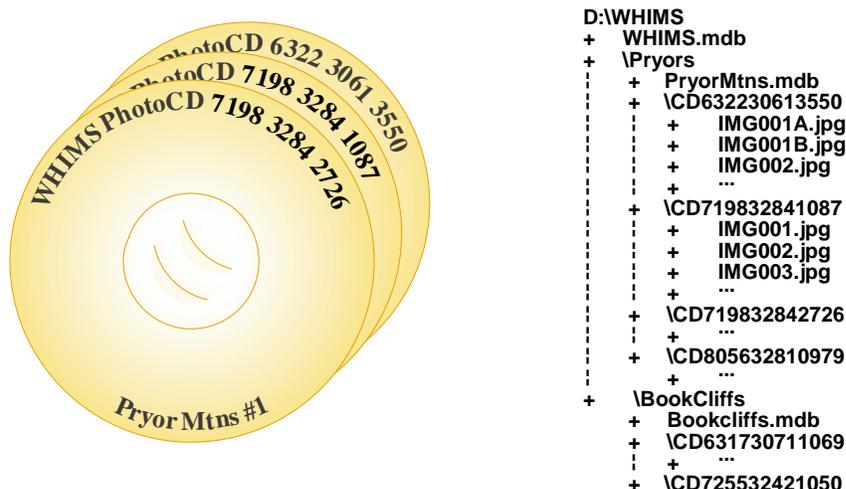


Figure 1. WHIMS directory structure and relationship to photoCD image archives.

There is a collection of slides stored digitally on photoCDs for each wild horse population. Digital images for each horse are created from the photoCD archives and stored on the users hard drive. Paint Shop Pro Version 4.14 has been used for the WHIMS prototype, but any desktop image processing software that is a standard Windows OLE server and supports JPEG and photoCD graphics formats could be used. Standard naming conventions for files and directories are used so that WHIMS can locate images for each record in a wild horse identification database and the image directories and filenames relate back to the photoCD archives. For example, each photoCD has a unique number that is reflected in the name of the directory where the image files are stored, and the image filename reflects the image number on the photoCD from which it was created. Say the first image on photoCD 6322 3061 3550 contained two horses---one we will name IMG001A.jpg and the other IMG001B.jpg. Both images are saved in directory CD632230613550, and that directory would be found where the wild horse identification database resides, i.e., D:\PRYORS. For convenience, the wild horse identification databases are located below the WHIMS

application database, but they could be located elsewhere. Since these files are images of the Pryor Mountains wild horse population, the pathnames relative to WHIMS are:

Pryors\CD632230613550\IMG001A.jpg  
 Pryors\CD632230613550\IMG001B.jpg.

**Wild Horse Identification Database**

A wild horse identification database (e.g. BOOKCLIFFS.mdb) consists of related tables containing horse attributes for identification and management of a single wild horse population. Wild horse identification databases have been developed for the Pryor Mountain, WY and the Little Bookcliffs, CO horse populations. A Horse ID number is the primary key which ties together table records in a wild horse identification database. Each horse is assigned a unique four-digit number. Typically, the first two digits indicate the horse's real or estimated birth year and the last two digits indicates when it was first identified relative to other horses of that birth year. Zero is reserved as a special ID number assigned to horses in images that have not yet been positively identified. Use ID 0 to catalog photos and edited images until they are verified as a specific horse.

Attributes used for horse identification include color, and patterns of white on the body, face, and legs (Sponenberg and Beaver, 1983). WHIMS tracks information about a horse that can also aid in its identification including sex, harem or band affiliation, subpopulation or region on the range the horse frequents, and parental lineage. Personal names given some horses and a horse's status are also tracked by WHIMS so their records may be easily separated or individuals are gathered for adoption or die. Each of these attributes and the catalog of photos are stored in separate tables within the wild horse identification database. Consequently, WHIMS requires that a wild horse identification database contain the tables described in Table 1.

Table 1. Required WHIMS tables in a wild horse identification database and their relationship to the master list of horse IDs (see Appendix for a full description of metadata).

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 photographs, photoCDs, and JPEG images on the hard drive of horses.

Contents of wild horse identification database tables and their relationships to one another are summarized graphically in Figure 2. 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 which 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.

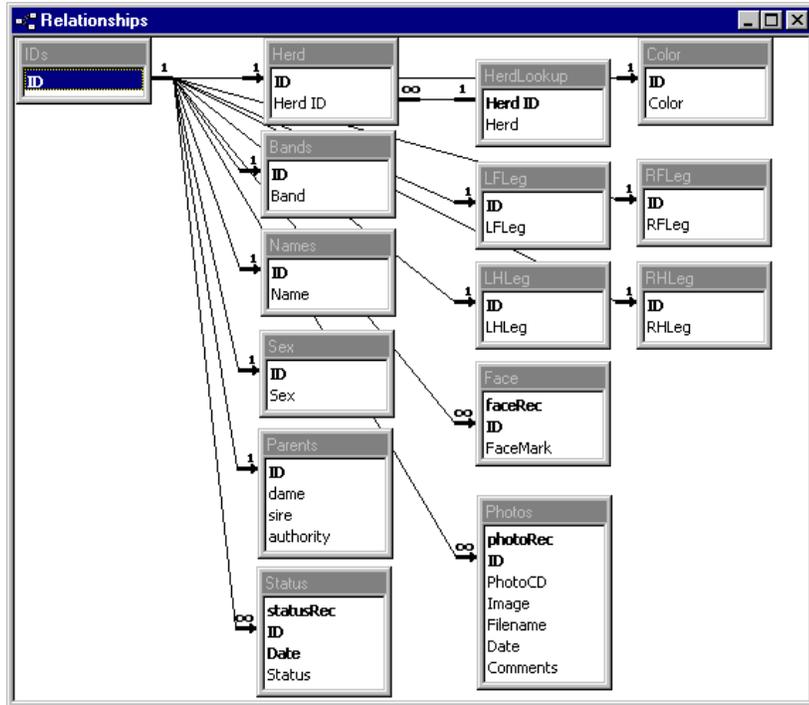


Figure 2. Wild horse identification database tables, fields and their relationships to one another.

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 died on the range). The photograph's catalog record consists of the date the photograph was taken, the image and photoCD number it is archived on, the filename created to store edited images, and any descriptive comment to help identify horses in the photograph. The Photos table includes comments, which are useful when horse markings are observed and documented in field notes but not included in the photograph (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 black horse on the right).

WHIMS validates most field entries before they are stored in a wild horse identification database. For example, colors are checked for correct spelling, and only IDs previously cataloged may be used in related tables. WHIMS also requires that many fields contain a value before the record can be save. Fields that are not always required may be left blank in which case it is known as a "Null" value. For example, a date must be entered for records in the Status table, but comments for a record in the Photos table are optional. Such requirement may have what seems unexpected consequences to the user new to databases and data management. For example, a horse will not have a record in the Band table if its harem is not known. You can correct the Band field for a horse ID placed in the wrong harem, provided you know its correct harem. If you do not know its harem, however, you must first delete its Band record. Deleting just the Band's field value will not work because this is a required field. Required fields, their validation rules, and explanation of coded values are listed in Table 2.

Table 2. WHIMS required fields and rules for valid entry when a record is stored in the associated table (see Appendix for a full description of metadata).

Table	Field	Descriptions
IDs	ID	0=unknown; otherwise yy## where yy is real or estimated birth year
Status	Status	Adopted, range, dead
Bands	Band	Name of dominant harem stud or "bachelor" if not a harem
Color	Color	bay, bay roan <sup>1</sup> , black, black bay <sup>1</sup> , black tobiano <sup>2</sup> , blue roan, brown, brown black <sup>1</sup> , brown tobiano <sup>2</sup> , buckskin, chestnut <sup>2</sup> , dun, grey <sup>2</sup> , grullo <sup>1</sup> , grullo roan <sup>1</sup> , medicine hat paint <sup>2</sup> , palomino, red dun <sup>1</sup> , red roan, sabino <sup>1</sup> , seal brown <sup>2</sup> , silver buckskin <sup>2</sup> , sorrel, sorrel sabino <sup>1</sup> , sorrel tobiano <sup>2</sup> , strawberry roan <sup>2</sup>

<sup>1</sup> only used in PryorMtn Wild Horse Identification Database

<sup>2</sup> only used in Bookcliffs Wild Horse Identification Database

Note that some differences exist between each wild horse identification database. For example, there are currently no greys or tobianos identified in the Pryor Mountains, and no grullos in the Bookcliffs. It is hard to say whether some of these differences are observer bias or not. Clearly WHIMS can help in the standardization of described colors and reduce observer bias through training if it does exist. Nevertheless, it is recommended to simplify attribute classifications by lumping categories. This will reduce the chance of misclassifying a horse in the field, simplify data entry, and reduce the chance of excluding a horse you hope to find when defining queries and filters. If new attribute values must be added to WHIMS for new wild horse identification databases where horse attributes described here do not cover the range of values found in the population of interest, validation rules may need to be modified.

In some instances, a field is not required, or a Null field value is sanctioned. This leaves records with only a horse ID value and marks the record for deletion (Table 3). For example, if a horse's sex is incorrectly entered, the value may be deleted (changed to Null), which automatically deletes the record when it is updated. Under such circumstances, these null sanctioned fields may show a value as "#deleted" until the recordset is re-queried or the form re-opened.

Table 3. WHIMS fields with sanctioned nulls and their validation rules (see Appendix A for a full description of metadata).

Table	Field	Description
Herd	Herd ID	(null); > 0 and < 4
Name	Name	(null); any name up to 50 characters long
Sex	Sex	(null); "F"; "M"
Face	Face	(null); "blaze"; "disconnected strip"; "snip"; "star"; "star with race"; "strip"; "thin strip" <sup>1</sup>
LFLeg	LFLeg	(null); "coronet"; "pastern"; "sock"; "stocking"
LHLeg	LHLeg	(null); "coronet"; "pastern"; "sock"; "stocking"
RFLeg	RFLeg	(null); "coronet"; "pastern"; "sock"; "stocking"
RHLeg	RHLeg	(null); "coronet"; "pastern"; "sock"; "stocking"

<sup>1</sup> only used in PryorMtn Wild Horse Identification Database

One additional table is used to lookup and interpret the Herd ID values. These values will be different for each wild horse identification database (see Table 4). Note that validation rules to the Herd Table WHIMS must require modification to WHIMS if the number of herds or locations on the range exceeds three.

Table 4. Herd ID lookup values the HerdLookup table (see Appendix for a full description of metadata).

Database	Herd Field Values
Bookcliffs	1) Coal Canyon, Main Canyon & Miscellaneous, 2) Indian Park, Low Gap, Monument Rocks, 3) North Soda and 'off range'
PryorMtns	1) DryHead, 2) Sykes, 3) Tillet

The remaining fields in a wild horse identification database, and tables they are stored in, are described in Table 5.

Table 5. Associated WHIMS Fields in selected tables and their validation rules (see Appendix for a full description of metadata).

Table	Required	Field	Description
Status	Yes	Date	DD-MMM-YY (may actually be entered in any valid date format delimited with #, e.g., #1/30/99#)
Photos		Date	DD-MMM-YY (may actually be entered in any valid date format delimited with #, e.g., #1/30/99#)
Photos	Yes	PhotoCD Number	632230613550, 719832841087, 719832842726, or 805632810979 (for Pryor Mountain Horses); 631730711069, 725532421050, 805632810979 (for Bookcliffs Horses)
Photos	Yes	Image Number	>0 and <99
Photos		Filename	Img###[a] (### are required digits 0-9 and the option letter suffix is used when more than one file is created from a photoCD image)
Photos		Comments	Any text helpful to describe horses and/or their markings.
Parents		Dame	ID of dame (may be null but must be a valid ID other than 0)
Parents		Sire	ID of sire (may be null but must be a valid ID other than 0)
Parents		Authority	"copulation seen";"harem known (BRD)";"harem known (Rev)";"unknown" (for Pryor Mountain Horses)

## 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 links to a horse identification database and runs the WHIMS task manager (Figure 3). 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.

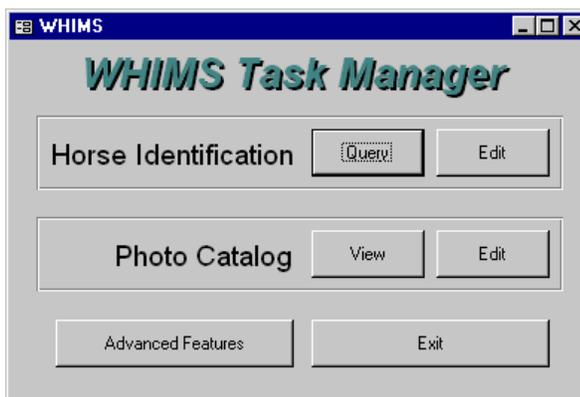


Figure 3. WHIMS Task Manager.

- 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 does not allow any editing to occur).
- 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).
- Click the Photo Catalog View button to view the WHIMS photo catalog with the Horse Slides form (see the Horse Slides Form details below).
- Click the Photo Catalog Edit button to enter or edit photo catalog information including when you need to display photoCD images or edit images with a Window OLE image server (see Updating Image Information details below).
- Click Advanced Features to access the WHIMS database window. This provides full use of Microsoft Access97. It allows you to define your own special tables, queries, and forms; link to supplemental wild horse management records in any database or spreadsheet formats that Access97 supports; or change WHIMS application code. Inappropriate changes, however, may cause WHIMS to malfunction or potentially even destroy data so these features should only be used by experienced Access97 users. In any case, backup WHIMS and your wild horse identification database first.
- 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 Horse Identification form (Figure 4) or change it to query mode. No WHIMS data can be altered while in query mode. Use this mode unless you explicitly want to change WHIMS data.

The screenshot shows the 'Horse Identification' application window. On the left, the 'Horse' section has dropdown menus for ID number (8605), Sex (F), Name (Pocatello), Harem (Pierre), Sub Population (Tillet), and Status. Below this is the 'Parents' section with fields for Dame, Sire (8502), and Authority (unknown). The 'Markings' section includes dropdowns for Color (black), LFLeg (coronet), RFLeg (sock), LHLeg, RHLeg (sock), and Face (snip, star, strip). The 'Slides' section on the right contains a table with columns: Date (7/1/96), PhotoCD Number (632230613550), Image (32), and Filename (Img032), and a Comments field. A large photo of a black horse with a white blaze is shown in the center. At the bottom, there are record navigation controls showing 'Record: 1 of 3' and a filter section with 'Filter: ID Number', 'Name', and 'Face Marking'.

Figure 4. The Horse Identification form in query mode.

The form displays information about a wild horse (called the current record) in a collection of wild horse records (called the current recordset). The record navigation control (Record: 49 of 295) in the lower left is 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 (), Last (), First (), or Previous () button in the record navigation control to move to that record in the current recordset. The number in the current record window ( 1) between the previous and next buttons shows which record number in the current 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. To use it, 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 comboboxes, (see Figure 5) 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



Figure 5. A combobox and its dropdown list.

navigation controls, the form also contains record indicators, or selectors, e.g., bars or buttons (▣) to the left of information that indicates which section and record has the focus. Notice that the Face and Slides sections may have more than one marking or image 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 1). They also have their own record selectors (for Face Markings and Slides sections) and navigation controls (Slides section only). The current record 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.

Clicking on any field in the form will place the cursor there and the dropdown list of a field's combobox 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 Slides 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 comboboxes 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 Conquistador, simply select it from the dropdown list in the Name combobox 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 buttons (▣) 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 6).

Use the comboboxes 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).

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 right front front leg, start with a blank "Look For" form and select "sock" from the RFLeg combobox. Click the "Or" tab and use the RFLeg combobox to select "stocking." This condition could also be entered on a single "Look For" form view with the phrase ("sock" or "stocking") in the RFLeg field.

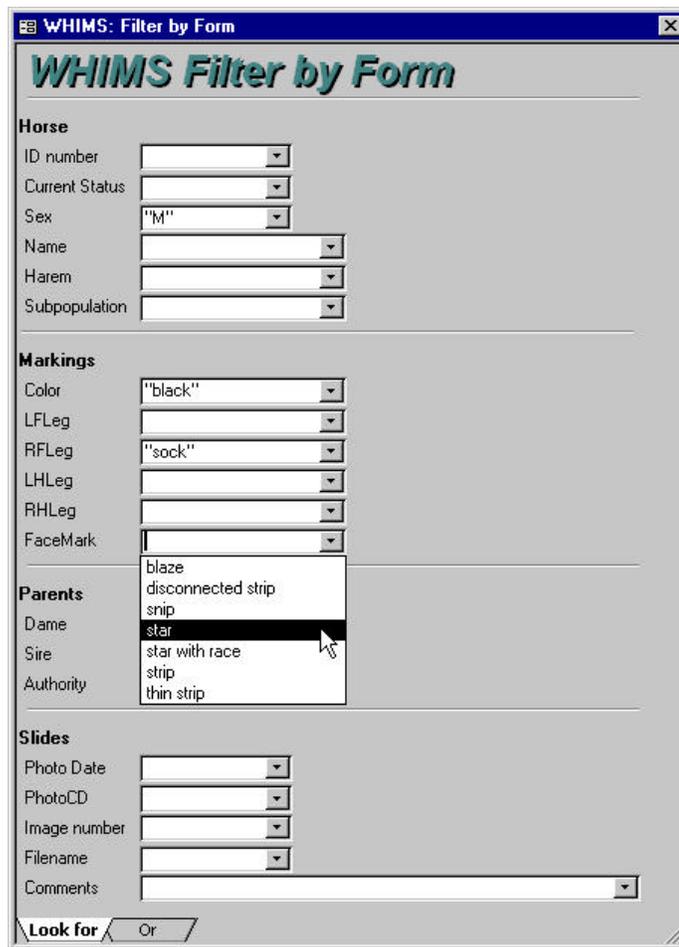


Figure 6. Filter-By-Form view to select all black stallions with a sock on the right front leg and a star on the face.

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 PhotoCD number, Image number, or 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 (Close) 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 (▽) 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 button's appearance is depressed (☑) and "(filtered)" appears after the record navigation control whenever a filter is applied. Clicking on the depressed button clears the filter and selects all horse records. Clicking on it when it is not depressed 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 (see Figure 7) so that data editing and entry capabilities are enabled. The caption on the form's title bar indicates when the form is in data editing mode. Data editing mode allows changes to existing records, including deleting them, as well as switching to data entering mode to add new records.

Figure 7. The Horse Identification form in editing mode.

To change a field's value in the current record selector (☑), move to that field and select a different value from the combobox's dropdown list. You may also type in a new value directly. Notice that the icon on the record selector changes to a pen (✎) when the field's value changes. The pen indicates that one or more of the form's field values have changed but underlying records in the wild horse identification database have not been updated. Also notice a blank Face markings field, indicated by the \* record selector if there are any face marks, or by the ☑ record selector otherwise, is always available in edit mode.

Changes to a field may be cancelled with the Esc key when the record selector indicator is a pen. 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 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 indicator 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 comboboxes list valid values. Lists for some fields contain a blank line, which is interpreted as a "Null" value. Select it to delete the record in the associated table, or, alternately, 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 the blank line from the list for the RFLeg field. Then select "sock" for the LFLeg field and navigate to another record to finalize that current record's 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 a table record rather than navigating to another record, the "Null" field shows "#Deleted." This indicates the record has been deleted from the underlying wild horse identification database table.

A horse's ID number on the form can only be changed to one that does not yet exist in the database. If you attempt to update it on the form to a new ID, you see the Write Conflict dialog (Figure 8). If you really want to change the ID, you must repeatedly click the save record button until the ID's records are updated in all the tables in which values are found before the dialog goes away. This action also removes the old ID number from the wild horse identification database.



Figure 8. Write Conflict dialog.

Information about a new horse can be entered in three ways---with the Add New Record button (▶\*) in the WHIMS button command bar, with the New Record (▶\*) button in the record navigation controls, or with the form's Add New Horse (Add New Horse) button. These buttons are only enabled while in edit mode. Use the Add New Record and New Record buttons to switch to data entry mode. Data entry mode displays a blank Horse

Identification form and allows you to enter information about a new horse ID. Remember that the ID number must be entered first, and can not yet exist in the database. Otherwise, when you attempt to update the record, a dialog explains that it is a duplicate ID and prevents you from making any changes. The form's add new horse button displays the Add New Horse dialog (Figure 9) which simply allows a new ID to be added and checks that it doesn't already exist without changing the forms current record. You may then navigate to new ID's record with Last Record (⏪) button and enter the horse's attributes.



Figure 9. Add New Horse dialog.

When status information exists, it is only displayed for the most current status. To view or edit all the horses status information, click the Edit Status (Edit Status) button. This bring up the Edit Status form (Figure 10) showing the history of the horse ID's change in status (on range, dead, adopted).

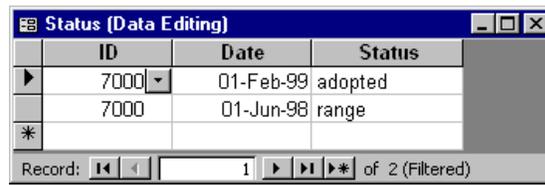


Figure 10. Edit Status form.

### Horse Slides Form

Click the Photo Catalog View button on the Task Manger form to View the WHIMS photo catalog with the Horse Slides form. Use this form (Figure 10) 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.

The form displays information about an image in the photo catalog, and the current recordset includes the entire photo catalog sorted by PhotoCD number and Image number when it is first opened. Tab or move the mouse cursor to a different field, and click the Sort Ascending (A↓) or Sort Descending (Z↓) 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 photoCDs, or all those of an individual horse.

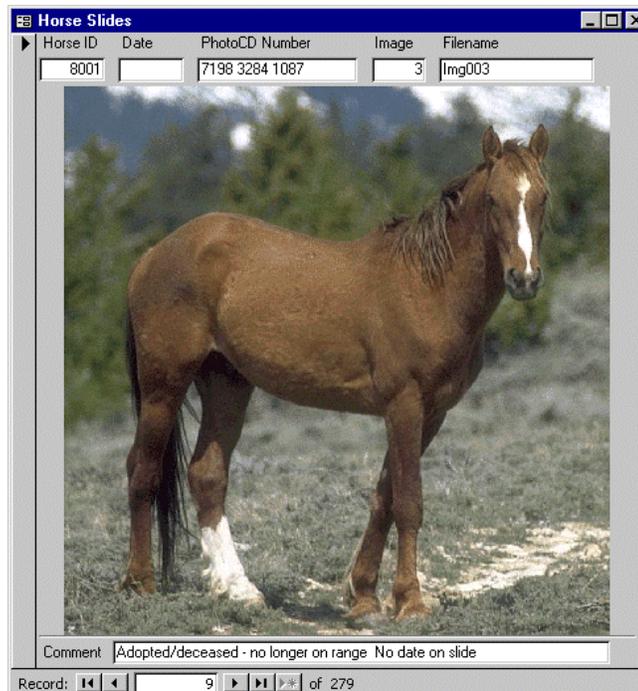


Figure 10. Horse Slides form for viewing the photo catalog.

Right-click anywhere on the image to view the image display options menu (Figure 11). Forms display images by default 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 are 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. Use this form to edit or enter data in the Photos table, access the photoCD archives, 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 displays the image indicated in the current record's filename field and the form's title bar displays the its full pathname (Figure 12). If the current record has no filename, or the filename can not be found, a message to that effect appears. Use the View PhotoCD

button (  ) to switch and view

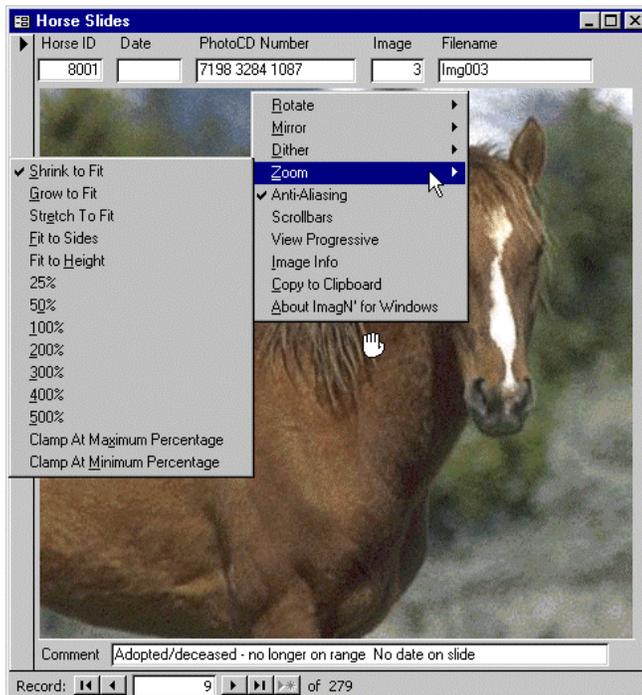


Figure 11. The image window and display option menu.

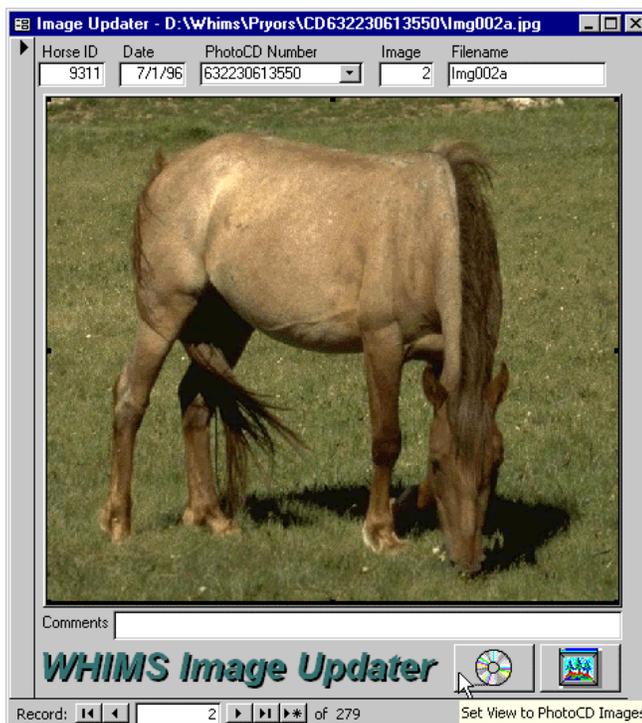


Figure 12. Image Updater for editing photo catalog.

the image in the photoCD archive. You will be asked to check the CD-ROM drive for the appropriate photoCD if it is either not already in the CD-ROM drive or has not yet loaded its image directory (see Figure 13.) You may have to click the Retry button several times since loading the image directory on a multisession photoCD may take a few seconds, especially on slower CD-ROM drives.

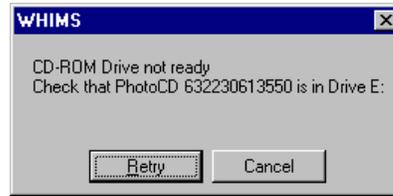


Figure 13. PhotoCD warning when it is not ready.

Images displayed in Image Updater form will open in an OLE server associated with its file extension (.PCD for photoCD images and .JPG or JPEG files) simply by clicking on them (Figure 14). The prototype works with Paint Shop Pro for image editing, but other standard desktop image editing software could be used including COREL PhotoPaint, Adobe Photoshop, or Microsoft PhotoEditor. Use the View Filename button

() to switch back and view the filename image.

The Image Updater form handles the workflow while adding images to the photo catalog. This work begins once a photoCD is mastered.



Figure 14. Click on the image to open it in an associated image editor.

First, click on the new record button and add the horse ID and related information about the first image on the new photoCD. Click the view photoCD button, then the image, to open that image with your photo editor. Edit the image for the horse ID indicated. Save the image on the hard drive as a JPEG image in the appropriate directory. Add the filename it was saved as to the record and repeat these step for the rest of the PhotoCD images and horse IDs you want to document.

## Building the Photo Catalog

The process of building the photo catalog consists of the following steps:

- 1) selecting the best field photographs to master onto photoCDs,
- 2) building an associated table for tracking slide information,
- 3) verifying that the photoCD image order matches the table's slide order (and adding the PhotoCD number and Image number to the table),
- 4) editing photoCD images from each horse being cataloged, and
- 5) 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. PhotoCD mastering is available at many retail photo-finishing outlets so it is not difficult to work with a local business. Discount photoCD vendors can be used via mail. Expect costs for mastering to range from \$1.40-\$2.00 per slide.

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, PhotoCD number, Image number on the photoCD, 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. 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, 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 photos 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. In addition, multisession photoCDs are typically slower, and can create problems with some CD-ROM drives.

Review photoCDs images with image editing software, e.g., Paint Shop Pro, after mastering and complete the spreadsheet data entry. Fill in the PhotoCD number and Image number 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 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 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 change.

### ***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. It is not the intent to tutor users in image editing or to specify which software to use. It is, however, useful to introduce a few concepts and terms that might be unfamiliar to some users and describe what generally worked for us 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 and individual pixels might be perceived. 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 a 425x400-pixel window 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 425-850 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 foal; 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 separate image of the face in addition to the entire horse.

PhotoCD images may be read at any of five different resolutions; however, we most commonly used the 512x768 and 1024x1536 resolutions (see Figure 15). The actual image size used 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.

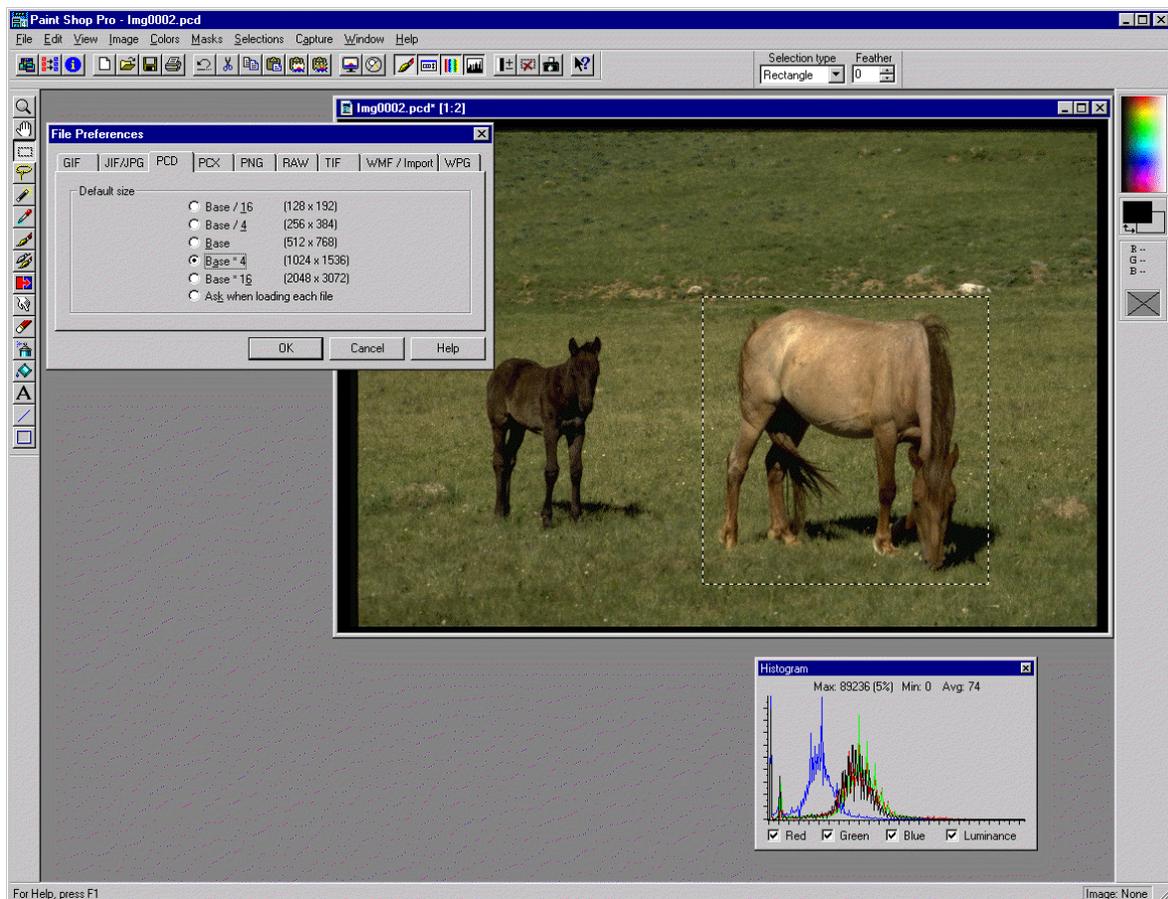


Figure 15. Paint Shop Pro's file preferences and photoCD resolutions, image cropping for the WHIMS photo catalog, and histogram of the image's color values.

On the other hand, if the horse is not in the foreground 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 425x800 to 850x400 pixels. If in doubt, select the next larger size to crop and resample (see below) it later, after all other enhancements have been made.

### 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, which is what your Windows display setting should be at for best visual results. Nevertheless, the actual number of discrete colors in photographs, even high quality ones, is far less than indicated by the color depth used. Most image editing software, including Paint Shop Pro, use histograms (Figure 15) to show pixel color value distributions (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 16).

### Image Sharpness

Use a sharpening filter 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 the full photoCD resolution or trying to salvage a poor photograph. In any event, different levels of sharpening may be applied to reduce image blurring. Sharpening is often done and, if no visual improvement is seen, immediately undone.

### Image Resampling

Resampling is the process of changing the image's size, or resolution, by alter the number of pixels it contains. Downsampling reduces the resolution and number of pixels in an image either by interpolating and averaging pixel values (sometimes termed antialiasing) or discarding pixel rows and columns (called resizing in Paint Shop Pro).

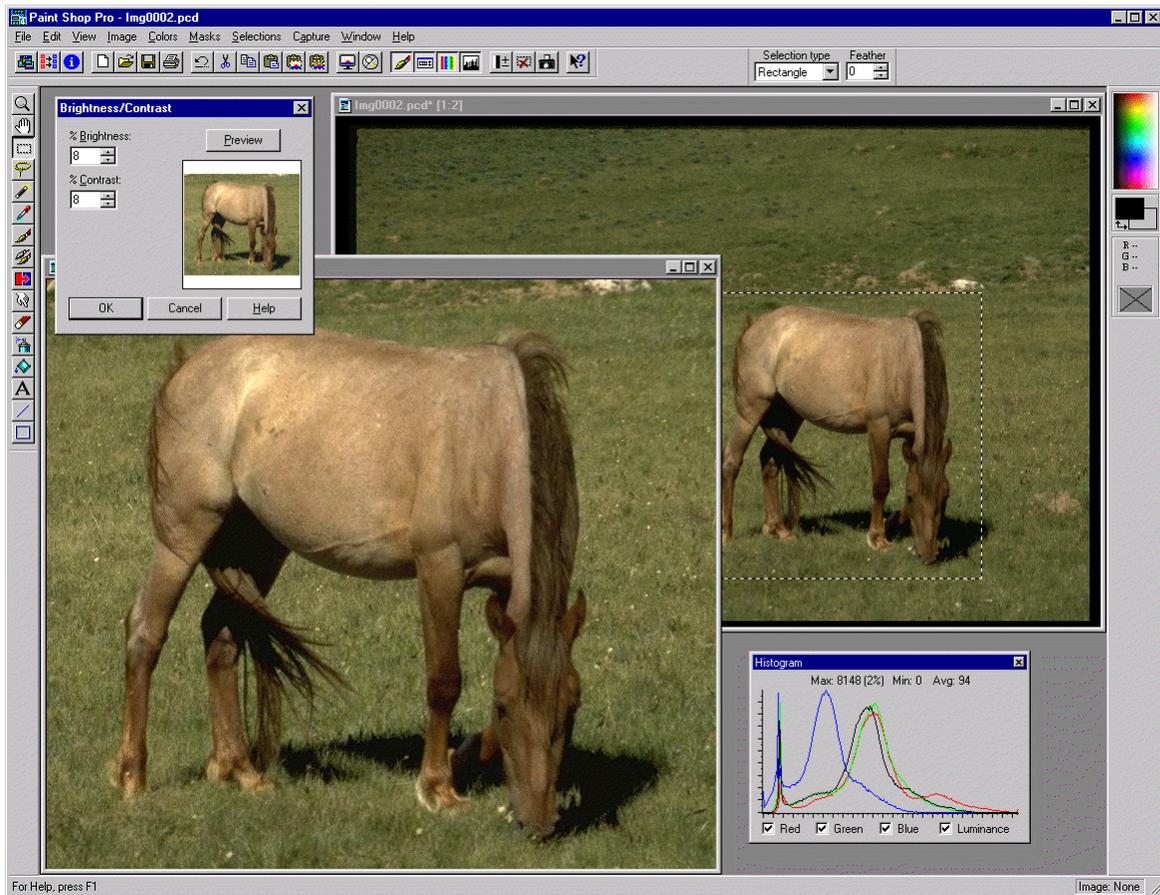


Figure 16. Example of typical brightness setting used in Paint Shop Pro and the smoothing effect on the histogram after sharpening and resampling the image.

Resampling is preferred to resizing, but requires much more computation, which is noticeably, especially for large images. Avoid upsampling, which increases the number of pixels and file size with little visual benefit. We normally downsample so the final image size doesn't exceed the 800x850 pixel size recommended above. Note that both sharpening and resampling also smooths the images histogram (see Figure 16.)

### Image Compression

Many methods exist for compressing an image's file size. Some techniques preserve all the image's original information (also know as lossless compression) while others discard or alter the image's original information without significantly changing its appearance (also know as lossy compression). Suffice it to say that WHIMS uses JPEG compression (a lossy method) to get high levels of compression (10-25 fold) and high visual quality. The quality level is specified before compression, and the image is compressed when it is saved (see Figure 17). 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 visual quality and file compression for horse images in WHIMS.

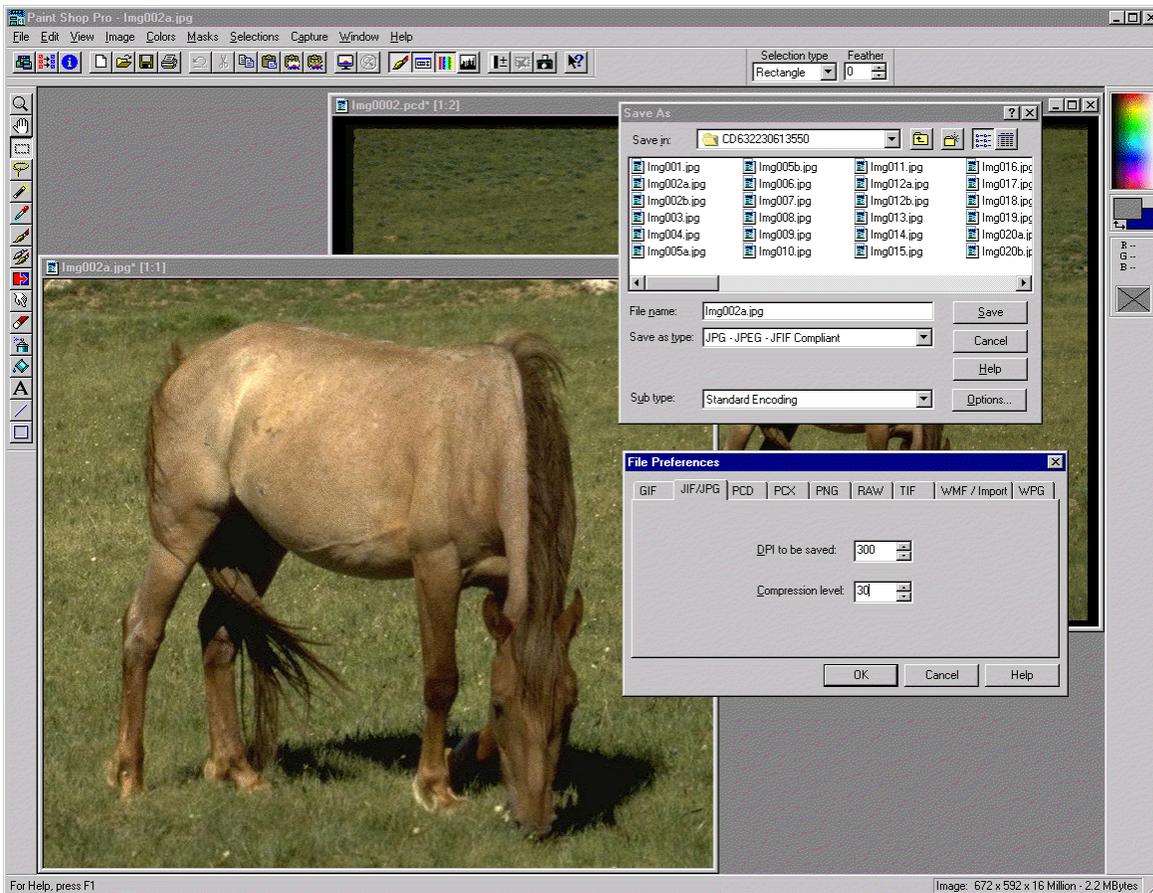


Figure 17. Paint Shop Pro example of JPEG file preferences and saving an image to the photo catalog.

Other software may use different quality ranges (e.g., 0-255) 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. If necessary, return to the original photoCD image and re-edit it.

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 photoCD, 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 18) providing access to all the queries, forms, and VBA code behind forms in WHIMS. Use the tab controls at the top of the window to view the components of interest.

First, a word of warning about these "Advanced Features." Altering any WHIMS components without knowing what you are doing may compromise its functionality and/or data integrity of a wild horse identification database.

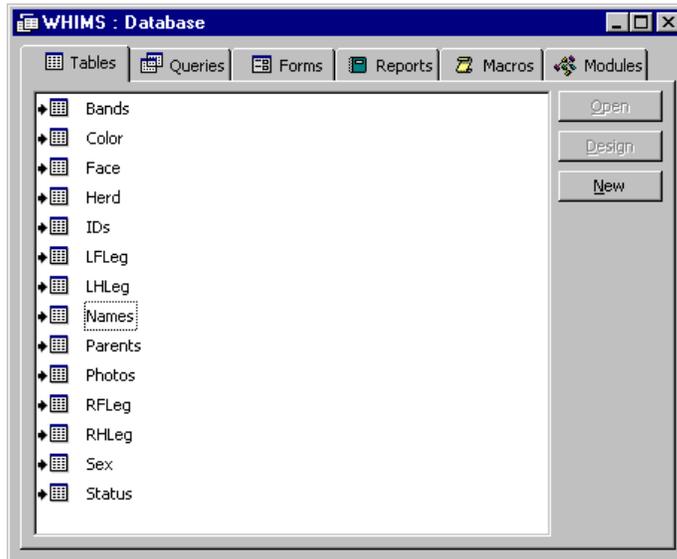


Figure 18. WHIMS components in the database window.

Regularly backup WHIMS and your wild horse identification database to insure that you can recover from problems. 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 Access97 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, and create special queries or reports for management needs. For example, use the Tables tab, click on the Photos table and open it so that you can append records from the clipboard as described in the "Building the Photo Catalog" section above. Another example is the Horse ID query, explained below.

WHIMS applications components not mentioned elsewhere are briefly explained here. Metadata and program listings are included in the appendix to complete the prototype's system documentation.

### Queries

#### 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 19) 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
9627	Sykes	Froggie	Cricket	M	bay	sock	coronet			9306	8406	harem known (BRD)
9628	Sykes	Littlefoot	Beacon	M	black			sock	sock	8707	8819	harem known (BRD)
9629	Tillet	Sandman	Baja	M	dun					8604	9003	unknown
9630	Sykes	Cocomo	Denali	F	blue roan							
9701	DryHead	Sam	Illiad	M	bay					8901	9004	unknown
9702	DryHead	Sir Lancelot	Strawberry	F	grullo roan					8903	8811	harem known (BRD)
9703	DryHead	Sir Lancelot	Merlin	M	dun			pastern		9318	8811	harem known (BRD)
9704	Sykes	Shaman	Katlian	F	grullo					8912	7015	harem known (BRD)
9705	DryHead	Sam	Bristol	M	grullo					9110	9004	harem known (BRD)
9706	Tillet	Opposite	Diablo	M	black					9005	8704	copulation seen
9707	Tillet	Two Boots	Regina	F	bay					9210	8814	harem known (BRD)
9708	DryHead	Cortez	Waif	F	dun					8806	8507	unknown
9709	Sykes	King	Gallatin	M	grullo					8506	8302	harem known (BRD)
9710	Sykes	Shaman	Fallon	F	grullo					8818	7015	harem known (BRD)
9711	Tillet	Two Boots	Avalon	F	grullo					9315	8814	harem known (BRD)
9712	DryHead	Crow	Popo Agie	F	bay					9102	8507	harem known (BRD)
9713	DryHead	Lone Wolf	Cascade	M	grullo					8803	8802	copulation seen
9714	Tillet	Boomer	Eclipse	F	black					8910	8504	unknown
9715	DryHead	Tony		M	dun							
9716	Tillet	Sandman	Sliver	F	bay					8705	8814	harem known (BRD)
9717	Tillet	Looking Glass	Mocha	M	sorrel			sock	sock			
9718	Sykes	Challenger	Misty	F	black			coronet	pastern	8817	8914	unknown
9719	DryHead	Black Beauty	Bonny	F	grullo					8801	8501	unknown
9720	Tillet	Raven	Ireland	F	sorrel					8905	8812	unknown
9721	Tillet	Raven	Gros Ventre	M	grullo					8813	8812	unknown
9722	Tillet	Raven	Cisco	F	buckskin					9104	8812	unknown
9723	Tillet	Opposite	Absaroka	M	black	pastern	sock	coronet		9100	9416	harem known (BRD)
9724	Sykes	Plenty Coups	Alamo	M	bay					8706	8915	copulation seen
9725	DryHead	Sam	Corona	M	bay					8902	9004	harem known (BRD)
9726			Auburn	M	sorrel sabino			stocking		8702	8704	harem known (BRD)
9727	Sykes	Tucson	Fallen Leaf	F	grullo					8707	8819	harem known (BRD)
9728	Tillet	Pierre	Inverness	F	black	pastern	coronet	stocking	stocking	8605	8908	unknown
9729	DryHead	Loner (Kiger M)	Illusion	M	bay							
9730	Tillet	Lakota	Ebony	F	black			sock	sock	8816	8504	harem known (BRD)
9731	DryHead	Three Bars	Seattle	M	black					9430	9106	harem known (BRD)
9732	Sykes	Froggie	Polaris	F	bay					9306	8406	harem known (BRD)
9733	Sykes	Plenty Coups	Zorro	M	blue roan					9425	9107	harem known (BRD)
9734	Tillet	Crazy Horse	Trigger	M	bay			Stocking		9105	8814	unknown
9735	Tillet	Littlefoot	Enigma	M	bay			pastern		9524	9207	copulation seen
9736				M								

Figure 19. 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.

## PhotoCDList

This query creates a list of unique PhotoCD numbers in the photo catalog.

## 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.

## 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**

#### 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.

#### Link Horses Database

This form allows the linked wild horse identification database to be changed.

### **Modules**

#### 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.

#### ModRefreshTableLinks

This module refreshes the links to tables in a wild horse identification database, and asks the user to locate the database when tables are not found.

#### ModVerifyChange

This module is not used. Initially, it was developed to handle "#deleted" conditions and verify when records are removed in certain tables, i.e., those having required fields with sanctioned "Nulls."

#### ModWinAPI

This module contains various file system routines and uses the Windows API to check for and get a list of CD-ROM drives, photoCDs and their images, image filenames, and directories.

## **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
Bands	ID	Number (Long)	4
	Band	Text	50
Color	ID	Number (Long)	4
	Color	Text	50
Face	faceRec	Number (Long)	4
	ID	Number (Long)	4
	FaceMark	Text	20
Herd	ID	Number (Long)	4
	Herd ID	Number (Integer)	2
HerdLookup	Herd ID	Number (Integer)	2
	Herd	Text	50
IDs	ID	Number (Long)	4
LFLeg	ID	Number (Long)	4
	LFLeg	Text	10
LHLeg	ID	Number (Long)	4
	LHLeg	Text	10
Names	ID	Number (Long)	4
	Name	Text	50
Parents	ID	Number (Long)	4
	dame	Number (Long)	4
	sire	Number (Long)	4
	authority	Text	20
Photos	photoRec	Number (Long)	4
	ID	Number (Long)	4
	PhotoCD	Text	15
	Image	Number (Integer)	2
	Filename	Text	32
	Date	Date/Time	8
	Comments	Text	255
RFLeg	ID	Number (Long)	4
	RFLeg	Text	10
RHLeg	ID	Number (Long)	4
	RHLeg	Text	10
Sex	ID	Number (Long)	4
	Sex	Text	2
Status	statusRec	Number (Long)	4
	ID	Number (Long)	4
	Date	Date/Time	8
	Status	Text	20

## **Table Relationships**

Relationships of required tables are described in Table A-2 and depicted in Figure A-1.

Table A-2. Description of the relationships among required tables in a wild horse identification database.

<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

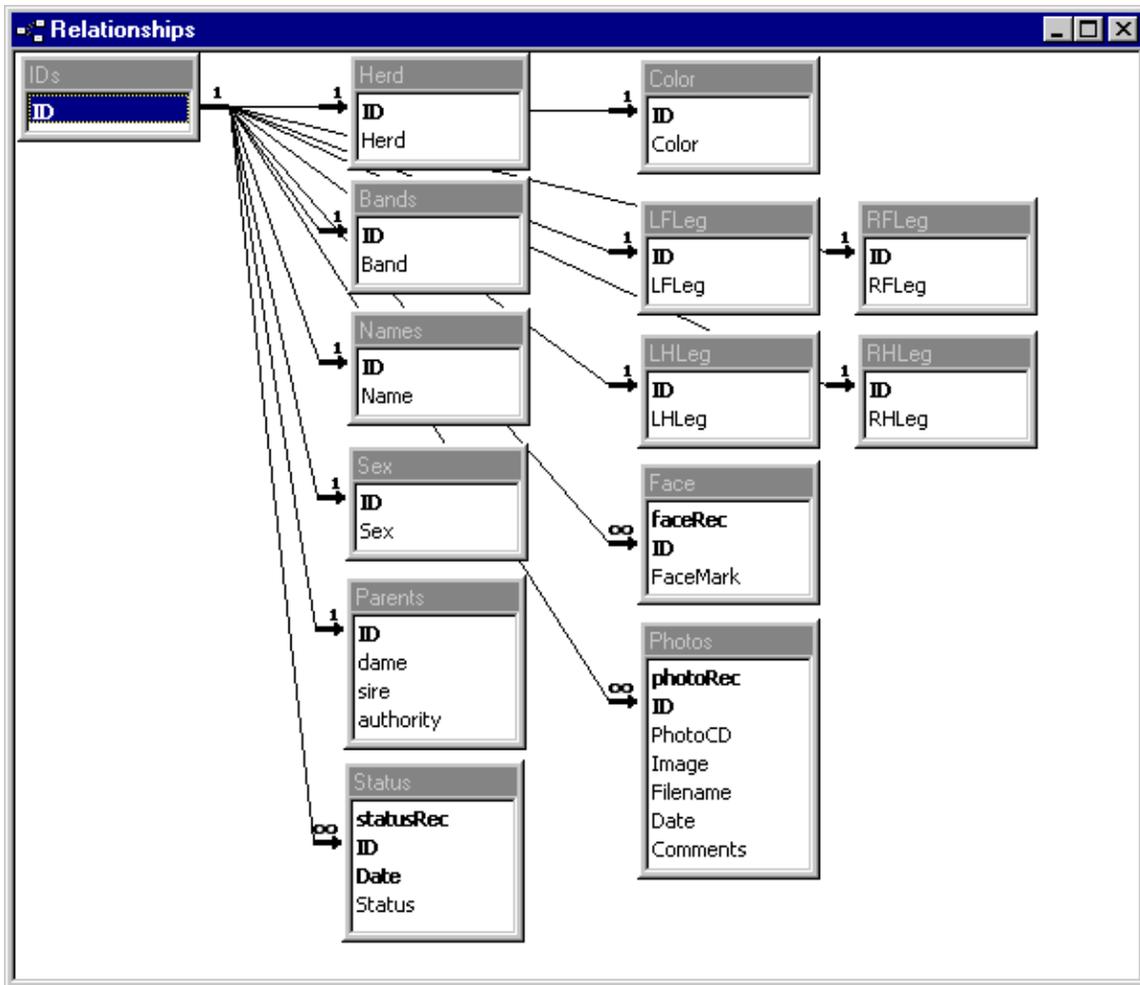


Figure A-1. Relationship of required tables in a wild horse identification database.