

Rochester Institute of Technology

Let Wildlife Live
**A Computer Illustrated Calendar
of Endangered Species**

**A Thesis Submitted to the Faculty of
The College of Imaging Arts and Sciences
in Candidacy for the Degree of
Master of Fine Arts**

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To my parents Eugene and Cecelia, without whom my graduate studies would not have been possible

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Credits

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Imagery

A special thanks to all the wildlife photographers who made this thesis possible.

Thesis Proposal

In this thesis I intend to explore the possibility of creating wildlife illustrations utilizing the latest image processing techniques on the Macintosh computer. The imagery for the illustrations will be developed from my work in painting and illustration in an attempt to create a computer illustrated 6-month calendar on endangered species. This calendar will also be used as a self-promotional piece.

Thesis Statement

We are part of the earth and it is part of us. The perfumed flowers are our sisters; the deer, the horse, the great eagle: these are our brothers. All things are connected like the blood which unites one's family.

--Chief Seattle

It is estimated that by the year 2000, humankind will extinguish between half a million and 2 million species or 15-20 per cent of all species on earth. People, wilderness, and wildlife are all integral parts of one fragile biosphere, which is now teetering in a complex balancing act of interdependence. This balance is maintained by diversity--when one species disappears gradually, another may take its place over time, reweaving itself into the web of life. But when we threaten thousands of species simultaneously, the balance of nature becomes more and more precarious for us all. (The Living Planet Press 1990, 74,75)

The purpose of my graduate thesis was to address this critical issue from an illustrator's perspective utilizing the latest and most advanced digital image processing techniques on the Apple Macintosh computer to create, develop, and produce a 6-month calendar of endangered species that would be used as a self-promotional piece as well.

This required the use of the image processing software Adobe Photoshop that allowed for image manipulation and retouching that was necessary for this thesis. To achieve the integration of images, many of the capabilities of Photoshop were utilized. This method of creating illustration on the computer I believe allowed for more complete artistic expression, that could not have been obtained otherwise.

To achieve a more cohesive body of work, I decided to use the illustrations in a calendar format. The thesis title, "*Let Wildlife Live*" originated from a very inspirational chapter in The Animal Rights Handbook. This book became the foundation for this thesis, and the chapter "Let Wildlife Live", helped to ultimately guide the content of the illustrations for the calendar. Since the intent of the thesis was to create a wildlife calendar using image processing techniques for the illustrations, the calendar required its own identity and the title "Let Wildlife Live" seemed extremely appropriate.

In a way, the idea for my graduate thesis began during my undergraduate work at Syracuse University. It was at that time during 1989-1990 that I first became interested in wildlife illustration. One of the illustrations that I completed during this time was an airbrush painting entitled, *"The Penguins"*. This illustration would again find its way into my work several years later, this time having been created with the computer for my graduate thesis.

After having studied traditional illustration and painting in my undergraduate work, and now looking to expand my potential and knowledge as an illustrator, I looked to the possibilities that the computer seemed to offer. I was not at all familiar with computers, if anything, I was completely phobic about them. I was convinced that I would never have a use for them and counted myself lucky to have just missed their arrival into my high school back in 1983. But now I could no longer avoid them since at last they seemed to offer artists something of value. Having seen several books on computer graphics that contained countless computer illustrations, my interest was at long last ignited. Many of these computer illustrations seemed to look just like airbrush paintings with all of their smooth gradated blends. I figured that if it was possible to create airbrush-like illustrations on the computer, I should see if there was potential for my own work. What ultimately sold me on the usefulness of the computer was its ability to create and manipulate images.

As an illustrator who works predominantly from photographic reference, this seemed to be the perfect environment to work in. As a medium, the computer appeared to offer artists the most flexibility and potential for creating images. I was hooked, now all I had to do was find a college with a graduate-level program and the computers and software that I needed.

Since I lived in Rochester, the "Imaging Center" of the world, I figured RIT had to offer the type of graduate program that I was looking for. Not only did they have the graduate program, but all the latest Macintosh computers and software programs!

Because my original intention on going to graduate school was to learn about computers and how they could benefit an illustrator like myself, I felt

that my graduate thesis should somehow reflect this. As my choice of minor, I decided upon painting/illustration, so that I might balance the computer work with some traditional media.

One of the first elective illustration classes that I took during my first year provided me the opportunity to continue some of the airbrush wildlife illustration that I had begun during my undergraduate years. The class project was to illustrate a book of our own choice. I decided to illustrate the book, The Animal Rights Handbook by The Living Planet Press. I came up with five different illustrations, each dealing with a different wildlife topic.

Unfortunately though, I was not able to complete all of these airbrush illustrations to my satisfaction. I guess I was a little over ambitious in my attempt to try to complete such a major project. I was very disappointed with the final results of my effort and decided that I would finish the illustrations when I had enough time. I was very happy with the five compositions that I created and vowed to use them again when enough time presented itself.

Then came my second year of graduate school and the time to decide upon a thesis topic. Initially I was stuck for an idea that I felt was worthy of a thesis project. I played with the idea of three-dimensional computer illustration for a long time and even decided upon this as my thesis, but I still was not sold on 3D being the proper choice. I felt that I would not be able to render the kind of organic shapes that I desired. Also, I felt that I might run into many memory problems since the computers in our lab lacked the proper RAM memory required by most of the three-dimensional programs for proper rendering. After that, I thought of exploring all the possibilities of computer illustration programs and show the various techniques each could provide an illustrator with.

It wasn't until almost Christmas break that I finally came across the idea for creating a self-promotional calendar on endangered species. This seemed like the perfect opportunity to finish the wildlife illustrations that I had begun a year earlier in my elective illustration class. This time though, I would be creating the illustrations on the computer.

After discussing this thesis idea with my chief advisor, who also felt this had some real potential, I became extremely excited about the possibility of giving my wildlife illustrations the time and focus that they deserved.

The problem now was how to recreate the wildlife illustrations that I had begun into computer illustrations without losing the feel of the original artwork.

Also, I wondered how I might present these illustrations in a way that would complement each of them best.

The idea of creating a calendar that would showcase each illustration by month became the central focus of the thesis. Originally, my intention was to create a 12-month calendar complete with cover illustration. But after consulting my committee on this, the decision was made to design it as a 6-month calendar with a cover illustration. The calendar would also be designed for use as a self-promotional piece.

Now that the format for presenting the illustrations was resolved, the next problem was how to create a set of visually exciting illustrations that would reflect the critical issue of endangered species, and at the same time show a new approach to my own illustration utilizing the latest and most advanced image processing techniques on the Apple Macintosh computer. This problem was attempted to be resolved through this thesis.

Limitations

There were several limitations that I anticipated in the beginning stages of my thesis project. Some of these included, not having enough RAM memory on my Apple Macintosh IIfx computer to work with large color images effectively. Not having enough disk storage space to save large color image. Inadequate color print output, and not being able to work with large enough image sizes at high enough resolution for the final output. These were just a few of the possible limitations that I felt I might face along the way to the final project.

Other possible limitations included, lack of sufficient computer knowledge about the software application programs, and other technical hardware complications that would be out of my control, but nonetheless could cause delays and problems. And finally, the amount of time that was available to complete the thesis.

Assumptions

Early on there were many assumptions that I felt might cause me some trouble along the way to the completion of my final thesis project. These assumptions were, not being able to scan the photographic images at a high enough resolution for final output because of disk space. Not being able to work with the images at a large enough image size for final output, because of inadequate memory. Not being able to take the illustrations to the level of expertise that I had wanted to because of time. And possibly believing that I would be able to incorporate several different techniques and styles into each of the illustrations.

Some of the other assumptions that I had in the beginning stages of my thesis project were, inadequate photo-reference, not enough knowledge of the software, and color output accuracy.

Definition of Terms

At this point it would seem appropriate to define some of the most important terms that apply to this thesis. Since it would be too time consuming to cover every definition, a glossary of terms can be found in the back of the thesis. This glossary should help to define some terms not covered here.

Because Adobe Photoshop was used exclusively for the image processing for this thesis, a summary of its major tools and filters will be discussed.

Adobe Photoshop was originally created as an image processing tool that would allow users with varied backgrounds and levels of experience to achieve results on the Macintosh desktop that could only recently be obtained by professional prepress technicians using expensive high-end paintbox systems. (Biedny and Monroy 1991, 1) Photoshop has infact changed the world of computer graphics almost overnight. It has become one of the best and most successful software programs available for the Macintosh, and has set the standards for many other programs as well.

Photoshop is on a level previously associated with the high-end computer graphics world. The tools used in Photoshop have their counterparts in systems such as the Scitex, (a high-end color publishing and separation system, used to produce four-color magazines), TIPS and RIO (PC-based color paintbox systems that are written around the TrueVision NuVista 32-bit graphics card), and other professional paintbox environments, such as the Quantel Paintbox and Images II systems. Photoshop has the capabilities to communicate directly with the high-end prepress world, thus making it an indispensable tool for artists. Photoshop also has the ability to work in almost any resolution the user desires. (Biedny and Monroy 1991, 2,3)

Image processing is a term that has been loosely thrown around the computer graphics world and can mean many things. In the scientific world, image processing is used to analyze images in order to "see" things that aren't immediately apparent. In the prepress world, "color correcting" techniques are actually image processing in disguise.

A better definition of image processing might be the procedures that modify images, both to enhance their visibility and to creatively alter them. Images can be photographic in origin and represent a pixel array of intensity values. They can also be synthetically generated and approximate a photographic perspective. (Kerlow and Rosebush 1986, 126)

Image processing systems manipulate images rather than create them. An image to be processed is first digitized by sampling its levels of brightness, then storing them as pixels in a bitmap. This input of images is accomplished by video cameras, flat-bed scanners, and drum scanners. (Kerlow and Rosebush 1986, 126)

The image processing capabilities of Photoshop sets it apart from other graphics programs in the Macintosh world. The variety of filters, image-processing tools, and controls over almost every aspect of an image makes Photoshop the leader and indisputable best choice for image processing on the Macintosh.

Photoshop comes with many built-in filters, but accepts "*drop-in*" filters or "*plug-in*" filters as well. These are filters that are usually developed by a third-party company in conjunction with Adobe Systems that allows the user to use a function that is not available in the standard Photoshop application. Many Image controls such as, Color Correction, Brightness/Contrast, Posterization, and Hue/Saturation, work in "real time" on 8 and 24-bit displays. As the settings are changed, the screen display responds by showing the changes instantaneously.

According to Adobe Systems, Photoshop doesn't rely on alot of RAM (random access memory) in order to work with large images, but I found this not to be completely true. Virtual memory does not really substitute for real RAM memory, as is suppose to be the case. *Random access memory* is data storage in which records or individual bytes are accessible independent of their location in relation to the previous record or byte accessed. This is also the part of the computer's memory that stores information temporarily while a file is being used. There is no substitute for real RAM, the more you have the better, as this is directly influential on the speed and performance of the application program.

Photoshop requires alot of hard disk space, when working with large color image files at high resolution. This hard disk space is referred to as the "*Scratch-disk*", and is usually the start-up disk. It is possible to start-up off of a separate Syquest hard disk that has a system on it and use this as

the scratch-disk when more memory is needed. This was how I was able to work with the large image files in Photoshop on my Mac IIci without enough hard disk space.

To take full advantage of the 24-bit functions of Photoshop, a *24-bit graphics card* is needed for driving the monitor. This will allow the user to work in millions of colors, which I found to be absolutely essential for this thesis. Crucial color accuracy is important when photo retouching, a 24-bit graphics card is mandatory.

Another important piece of hardware that was necessary is a removable-hard disk system such as a *Syquest cartridge drive*. This is a must for archiving large color image files. Because the illustrations for the calendar were 6.43Mb at 6 inches by 9 inches with a resolution of 204 dpi, there was no other solution for storing these images other than on Syquest removable-hard disks. It became necessary to purchase several more of these hard disks to store the thesis files as well as back-up files of each.

A much more expensive solution for storing image files would be an *optical-disk drive*. Although extremely expensive at this point in time, these drives can store up to 120Mb of information on a single optical disc. The optical disks themselves are much cheaper than the removable-hard disks, but the optical drives are still extremely expensive. This would be the ideal solution for archiving large color image files.

Photoshop is a paint program that creates raster bit-mapped images. *Bitmaps* are simply a matrix of dots or pixels. The resolution of an image corresponds to the resolution of the computer screen. The artist moves a pointing device across the computer screen turning pixels on or off. In color programs, each pixel contains closely spaced red, green, and blue dots that can be varied in intensity to synthesize a spectrum of continuous tone and colors. (Olsen 1989, 53) *Raster graphics* is like working with colored pencils on a sheet of paper or paint on a canvas. Images are changed by erasing areas or by painting over the top of other things.

Paint programs contain on-screen tools that act like traditional drawing and painting tools: a pencil, brushes, pens, eraser and airbrush to name just a few. Paint effects like spatter or blending can be accomplished using a smudge tool. Artist can express themselves freely and spontaneously in a paint program. (Olsen 1989, 53) Photographic retouching and manipulation is also possible within certain paint programs.

The main image processing controls that effect an image are: posterization

effects, color correction controls, filters, and resizing and resampling. The *Image* menu in Photoshop is the place to find the commands for all of these image effects.

Posterizing an image allows for a reduced number of colors or grayshades in an image. This can be quite useful for special color effects.

The commands that are found in the *Adjust* submenu in Photoshop include: Levels, Brightness/Contrast, Color Balance, and Hue/Saturation. The *Levels* control is the most accurate tool for precisely adjusting the brightness and contrast levels in an image. The *Brightness/Contrast* controls adjust the overall brightness and contrast values of either an entire image or of a selected area.

Each pixel in an image is a color made up of a mixture of the three primary colors: red, green, and blue. The *Color Balance* control allows for the adjustment of these colors. With the *Hue/Saturation* control, the hue (color) or the saturation (purity of color) of an image or selected area can be changed. Basically, the Hue command is equivalent to sliding all of the values in an image or selected area along a color wheel. As the Hue slider is dragged, all of the colors change with respect to one another. (Biedny and Monroy 1991, 169)

The *Noise filter* adds random pixels to an image. This can be used for very useful effects that would otherwise require tedious work to produce. Unusual textures can be created instantly, as well as patterns and other interesting effects.

One of the most basic smoothing filters found in Photoshop is the *Blur* filter. The Blur filter works by lightening the pixels found next to the hard edges of well-defined lines and shaded regions. The Blur filter is the subtlest compared to Blur More and Gaussian Blur. The Blur filter can smooth out large regions of noise from a badly scanned image, but it is more useful for touching up small areas of noise in scans. (Biedny and Monroy 1991, 178)

Another useful blurring effect that doesn't effect distinct areas of contrast is the *Despeckle* command. Despeckle finds the distinct edges in an image and slightly blurs everything except the edges. This filter is excellent for removing unwanted noise from an image without effecting areas of detail. Images that are scanned from magazines that are made up of half-tone dots from the printing process are good candidates for this filter. This filter was used on every scanned image for this thesis, and provided excellent results in smoothing out unwanted noise.

The *Gaussian Blur* is a variable smoothing filter unlike the other blurring filters, specific degrees of blurriness can be entered. With this filter a very subtle or overwhelming blurred variation of an image can be obtained.

The *Sharpen* filter is used to sharpen blurry images. It does this by increasing the contrast of adjacent pixels. This filter was also used on every image for this thesis after the Despeckle filter was used and provided excellent results.

In Photoshop the relationship between the size and resolution of an image is essential. The size of an image is measured by the number of pixels or inches that make up the dimensions of an image. An image that is 6 inches by 9 inches takes up that much physical space when printed. The resolution of an image deals with the pixel density of that image. For example, a 6 x 9 inch image might vary in terms of the number of pixels in that area, even though the size is fixed. An image with a resolution of 72 dpi takes up much less disk space, and contains much less detail than the same size image with 300 dpi. (Biedny and Monroy 1991, 222) *Resolution* is usually determined by two factors: The resolution at which the image is scanned, and the resolution of the output device. For printing of an image, the output resolution should be twice the desired linescreen value. If the the image is going to be printed with a linescreen of 133, the image should be 266 dpi.

The *Resizing* command in Photoshop is used when an image needs to be rescaled, or when the workspace canvas (window) needs to be larger without effecting the size of the image. The *Constrain Aspect Ratio* forces the image to maintain the proper aspect ratio, and to resize without any distortion.

Resampling an image in Photoshop involves increasing the resolution of an image using interpolation: Photoshop inserts a new pixel with an intermediate value in between two existing pixels. At the same time, the size of the pixel is reduced accordingly. After an image is resampled, its printed size does not change, the amount of information in the image increases. (Biedny and Monroy 1991, 224) If an image is resampled down in resolution, and then resampled back up again, there is a loss in data, resulting in decreased overall image quality.

The Filters that are available in Photoshop are virtually unequaled by any other Macintosh graphics program on the market. There are so many filters available, it would take weeks to test them all. Some of the effects are very subtle, while others are quite overwhelming. The filters can be of two separate types: built-in or plug-in. The *built-in* filters are the standard

filters that are programmed directly into Photoshop and cannot be removed from the program. The *plug-in* filters on the other hand are separate programs developed by a third-party company along with Adobe Systems that can be added to the Photoshop filter menu at anytime by adding them to the folder which contains the Photoshop preference file.

Another topic that needs to be discussed is the importing of images into the computer. All of the images that were used for this thesis were scanned in using a *Microtek Scanmaker 600ZS* color flatbed laser scanner. This is a scanner that is similar to a photocopier and scans in images that are positioned face down on a glass plate. Its design accommodates books and other slightly oversized images. The exact alignment of the original page produces more precise results than sheet-fed scanners that feed the image into the scanner with rollers. (Meyerowitz and Sanchez 1990, 136) Scanners are important input devices that allow for the conversion of printed matter into byte data that can be read, stored, and manipulated electronically by the computer.

The resolution that the image is scanned in at is another important factor when importing images into the computer. *Resolution* is the number of pixels per unit area, the sharpness of an image on a screen monitor or in printed form. It is measured in dots, spots, or lines per inch.

The *dots-per-inch*, (dpi) is a measure of printer resolution or density. The dpi determines the overall appearance or quality of the printed output. Laser printers are usually 300 dpi.

Grayscale refers to the representation of an image using different levels of gray tone. Halftone images employ grayscale by varying the density of the halftone dots. Shades of gray on the computer screen that are created by varying the intensity of the screen's pixels, rather than by using a combination of black and white pixels to produce shading is also considered grayscale. (Meyerowitz and Sanchez 1990, 136) Grayscale also refers to a single-channel image that consists of up to 256 levels of gray, with 8-bits of color information per pixel.

The *file formats* that were used for this thesis were *Pict* and *Tiff*. *Pict* file is the standard file format for the Macintosh. It is a format for storage and exchange of graphics documents on the Mac and the format used by its clipboard. Tag image file format or *Tiff*, is a graphic file format developed by Apple, Aldus, and Adobe for gray scale data. It is the best file format for

scanned images and other large bitmaps. The newer versions of Tiff support color and image compression. Tiff files are also used for importing images into the page layout program Quarkxpress, which was used for the final layout of the thesis calendar.

Review of the Related Literature

The Imagery

The photographic reference that was used to create the illustrations for my thesis calendar came from many different wildlife magazines and sources. Many of these photographs were collected and compiled into a large photo-reference file that I had begun during my undergraduate study at Syracuse University. Although some had been found in *National Geographic*, others came from magazines like *Natural History*, *Smithsonian*, and *Time*. Since I had begun collecting many of these images so long ago, and had cut them out of the original sources, I was not able to account for all of the photographers. Because of this I felt that a general acknowledgement was in order at the beginning of the thesis report that would give credit to all of them.

It would have been nearly impossible for me to complete a thesis of this kind without the help of all of the wildlife reference that I had obtained. To go out and shoot my own photo-reference would not have been realistic. The variety of animals that I had chose to include in the calendar illustrations would have been impossible to find at the local zoo. As it was, countless hours were spent hunting down the best possible photo-reference to use for the thesis illustrations.

Because it was determined from the very beginning that the illustrations were only going to be used for my thesis and self-promotion and not for reprint or resale, my thesis committee and myself felt this would be acceptable.

The Influences

I have always held a fascination for the surrealistic art world and have often tried to integrate some of its influences into my own work. Animals for me, have always seemed to be a part of this world. Since many animals appear almost surreal in themselves, they can be adapted quite well to fit into this kind of environment. Integrating these two together on the computer seemed to be the perfect thesis topic.

I studied books, photographs, films, as well as anything else that was related to these images. I also studied other artists that shared the same interests that I had. Three things that influenced this thesis most were: *The Animal Rights Handbook*, by The Living Planet Press, the work of artist Roger Dean, and the computer graphics program Adobe Photoshop.

I have always been intrigued by animals, even from my earliest memories. They seem to have a power and sense of perception that is unequaled by man. Even though some appear quite vulnerable, they give the feeling that they are in complete control of themselves. But this is not the case when it comes to their environments. They are completely at loss over their own habitats. Man needs to be aware of this and act responsibly for the sake of the whole environment. Animals are essential for mans survival as well as the planets.

This is perhaps one of the greatest concerns of the present day, and needs to be taken seriously. No longer can we expect things to take care of themselves, they will not. Every year thousands of species become extinct and little is being done to change this. Extinction is irreversible. Animals deserve the right to survive just like man, one cannot live without the other. This concern was the foundation for this thesis, and I hope that it raised some real concern about this devastating issue. Someday these animals might only be remembered through images like the ones created for this thesis.

The Animal Rights Handbook, by The Living Planet Press in Los Angeles was the original source of inspiration for the thesis. I came across this book during my first year in graduate school. I was looking for a wildlife book to illustrate for an elective illustration class that I was taking at that time. The book speaks out on the many injustices towards animals in our present day society. It made a strong impact on me and forced me think about how much man does not take care of the animals around him. Animals were not put on this planet to be exploited and treated inhumanly. They are

our friends, our companions and need to be treated with great care and respect. The American Indian knew this, and took great pride in sharing the earth with them. They respected them and believed that the animals were spirits that were related to them. They understood the importance of living together with the animals and sharing the planet with them.

This book helped to make me more aware of the present day problem of endangered species. This is such a major problem, yet nothing seems to be done about it. How can we just look the other way when every year more and more species of animals become extinct. If things keep going as they are presently, by the turn of the century many of the greatest animals that ever lived on this planet might be gone for good. These animals are essential to the survival of the planet and must be protected before they are lost forever. This book was a great source of information, and ultimately help me to decide upon which topics to illustrate for the calendar.

A second source was artist Roger Dean, who seemed to be quite aware of how to integrate animals into a surreal environment with his own work. He would build incredible surrealistic landscapes and then let animals roam about in them. Roger Dean is probably the greatest influence on my own artwork.

Growing up listening to YES music, his work for their album covers always fascinated me. He seemed to be able to create an almost perfect world that he would let his animals roam about free and protected. His first book Views, had quite a profound impact upon me as an artist years ago, and still continues today. This book helped to give me the inspiration that I so desperately needed in the beginning stages of this thesis. His art still intrigues me to this very day and continues to be a constant source of inspiration. The way that he creates his incredible surrealistic landscapes and inhabits them with exotic wildlife is just amazing. He is truly one of the master's of fantasy art.

The third and final influence on this thesis was the discovery of the computer program Adobe Photoshop. This program like no other was responsible for ultimately helping me to decided which direction the thesis should follow. From the very first time I experimented with Photoshop my first year of graduate school, I was convinced that it was the ultimate computer graphics program. Because of the power and capabilities that the program offered I was immediately fascinated. Photoshop offered all the photographic manipulation and retouching capabilities that I needed to

complete my thesis. It is truly the most advanced image processing program available for the Macintosh computer to date. Photoshop was unquestionably the right choice for my graduate thesis project.

The Process

The process by which all of the illustrations were created remained consistent for the sake of continuity throughout the calendar. All of the images were manipulated in Photoshop utilizing the same filters and effects to create the final illustrations. Since all of the illustrations were basically created the same way in Photoshop, only one final illustration, "*The Rainforest*" will be discussed in detail.

To begin, a low-resolution mock-up of the calendar layout and illustrations was constructed. (See Appendix: A) This was created to act as a guide for the final calendar as well as show my committee what the actual layout and design would look like. All of the images that I was planning to incorporate into the illustrations were scanned in gray scale at 75 dpi using a Microtek 600ZS color flatbed scanner. The reason for scanning these at such a low-resolution and in gray scale was two-fold. First, the images did not need to be in color because I was only going to use this as a rough sketch to determine the compositions and layouts. Second, there was no need for any resolution over 75 dpi because I wanted to keep the file sizes as small as possible at this stage. Storing all of these images and compositions at any higher resolution would have been an unnecessary waste of disk space.

After each of the images were scanned in at 75 dpi, I went ahead and assembled the seven rough compositions for the calendar. Each composition was created extremely fast, in less than an hour, since the I had already worked out most of these earlier. The quality of these was not important, only the compositions and the initial layout of the calendar.

When all six months were finished, I decided which illustration would be best for the cover. The one that seemed to work best as a cover design was the illustration that I titled, "*Let Wildlife Live*". This seemed like the best choice since it really spoke of the urgency and desperation of the endangered wildlife situation. It was one of the five illustrations that I had begun earlier, but was originally designed as a vertical composition. Now I had to redesign it as a horizontal composition and add the appropriate type

so that it could be used for the cover. The title, "*Let Wildlife Live*" was chosen at this point and added as a type arc to complement the rest of the composition.

Upon completing this calendar mock-up, I met with my committee advisors individually to discuss the overall calendar design and each individual illustration. They all seemed quite impressed and gave me the go ahead that I needed to begin the final calendar.

Before the final illustrations for the calendar were begun, I decided to research which color printer would be best for my final output. Since the graduate computer lab only had a *QMS ColorScript 100* color laser printer, which I felt was not at all acceptable as final output, I decided it was necessary to seek out a better color printer.

Having been involved with working on the next issue of *E.S.P.R.I.T.* magazine, (Electronic Still Photography Rochester Institute of Technology), put together by a group of students chosen for their individual talents, mine being illustration, I did not have far to search for the appropriate color printer.

The two color printers that were available in the ESP lab were, a *Cannon Color Laser Copier 500*, and a *Kodak 7700* continuous-tone color printer. Both of these had been donated to the school and provided incredible results.

The first step in the process towards the creation of the final illustrations was to rescan all of the images that I planned on using. Unfortunately, at this stage I made the mistake of not scanning these images at a high enough resolution for my final output. As I would find out several weeks later, the images needed to be scanned in at a minimum resolution of 204 dpi to be printed out using the Cannon or Kodak printers. This presented the problem of having to rescan all of the images over again to a higher resolution of 204 dpi. This took an incredible amount of time as well as disk space to save all of the images. I also determined at this point that I would not need to scan any higher than 204 dpi because I was only going to print the final calendar illustrations out on the E.S.P. lab's printers and not for actual color separation print outs. Had I decided to make color separations of each illustrations, they would have had to been scanned in at a higher resolution of about 266 dpi for a linescreen of 133. Also, they would have required much more disk space than I could afford at that time.

A second reason for not wanting to scan the images any higher than 204

dpi was because I wanted to make the final illustration size as large as possible. If I had used a higher resolution, the file sizes would have become too large to work with and store.

The final illustration size was determined by this resolution and ended up being 6 inches by 9 inches. This unfortunately was the largest size I could work with. Each image at 204 dpi at 6 inches by 9 inches was 6.43Mb in size. Because I had to store seven files this size, as well as all of the images that went into each of these and backups of all seven illustrations, I was required to invest in two more 44Mb Syquest removable-hard-disk cartridges. These were not cheap and they became full extremely fast, because I was saving such large color image files.

As I would find out later, 6 inches by 9 inches was too large a file for the computer to handle efficiently. This was because the computer needs lots of RAM memory as well as hard disk space when working with large color images in Photoshop, which requires a large amount of RAM and hard disk space to operate.

Because of the lack of RAM and harddisk space, I kept running into the problem of Photoshop's "scratch-disk" being too full, so I was required to start-up from a separate scratch-disk. This was accomplished by booting-off an empty Syquest disk with only a system start-up on it. If we had more harddrive space this would not have been a issue. But, because I had to work this way, too much time was spent waiting for the computer. This might have been resolved also by smaller image sizes, but I did not want to work any smaller, since 6 inches by 9 inches I felt was the minimum size for appropriate final thesis show output.

After all of the images were rescanned at the proper resolution, the next step was to begin cleaning them up. This was accomplished through several steps. The first step included running the image through the noise filter in Photoshop called *Despeckle* which is found under *Image* in the menu bar. This acts to smooth out the images by evening out the pixels so that the rough grainy texture is removed. This step was essential since most of the images that I was using originated from magazines. The printing process requires that the images be printed with half-tone dots, so the smoothing out of these is extremely important for a good final image. Each image was run through this filter once or twice, depending on how rough the image was to begin with. It is important not to *Despeckle* the image more than a couple of times or there will be a loss of detail.

Next, all of the images were run through the Photoshop *Sharpening* filter which is also located under *Image* in the menu bar. This step helped to make the images a little more clear after they were despeckled. Sharpening an image should only be done once or twice, since any more will cause the image to break up and distort causing loss of detail.

After this, the *Brightness/Contrast* levels were adjusted. These were not fully adjusted at this point because the images would have to be readjusted once they were assembled into the final composition. Also, at this point the *Color Balance* was also slightly adjusted, but would also be fully adjusted later. These filters were found under *Adjust levels*, also under *Image* in the menu bar.

When these steps were finished each image was scaled down to the approximant size and cropped to save memory. It is important to note at this stage, that it is possible to reduce an image in size without losing its resolution, but you can not enlarge an image since it is not possible to maintain the resolution scaling up. All images that needed to be larger than their original size needed to be scanned in at a larger size by enlarging it on the flatbed. This also presented some problems, since it was hard to determine what size was needed for the final compositions. That is why the mock-up calendar become quite helpful in determining image sizes in the very beginning. It is better to scan the images larger than needed, and then scale them down to the proper size later. The only problem with this is the file sizes will be large in the beginning, but after all the images are adjusted to their proper sizes, this will no longer be an issue.

The next step after all of the images were sized and adjusted was to make each image ready for cutting and pasting into the final composition background. Each image required that all of the surrounding color and unimportant backgrounds be deleted and removed. This proved to be one of the hardest and most time consuming steps in the project. Great care was given at this point to ensure proper and accurate removal of unwanted background information from each image. This was achieved through various tools provided by Photoshop. Some of these tools included, the *paintbrush*, *pencil*, *airbrush*, and *selection* tool. Each of these tools provided a different and necessary function for editing the unwanted information from the images. The *zoom* tool, or magnifying tool was extremely important for accuracy right down to the border pixels. The *paintbrush* tool with a foreground color of white helped to finish this step. It is important to note,

that it was essential that each image be surrounded by pure white after the unwanted information was deleted. This was so that each image could easily be selected using the *Magicwand* tool and then the Inverse selection, for copying and pasting of each image into the appropriate backgrounds. It might also be important to state that this is how I chose to work with the images in Photoshop and there is probably a more efficient way of working such as with the alpha-channels.

The next step included preparing the backgrounds for the illustrations. At this point, it became necessary to work on all of the illustrations simultaneously because the thesis show deadline was quickly approaching. It was a nice change to work on different illustrations at different times. This helped to kept me from losing interest in any one particular piece from working on it too long. It was also particularly helpful to view each illustration at different times because this helped me to make careful decisions.

Each illustration was composed of a set of background images that were combined to give the illusion of one separate image. This is where the intensive research of images paid off. It was important to combine similar images together to achieve the right effect. Each image had to have some of the same color values to be related to the surrounding images.

The backgrounds had to be created and then adjusted before the animal images could be pasted on top. The *Eye Dropper* tool was used to select the proper colors, while the *Paintbrush* and *Airbrush* tools helped to retouch the different images together. The other tools that were utilized at this point were, the *Rubber Stamp* tool for cloning different textures and colors, and the *Smudge* tool for blending the different elements together.

When all of the background images were in place and retouched, the *Brightness and Contrast* along with the *Color Balance* were again adjusted slightly. These again were not fully adjusted at this point as I felt it would be necessary to make these adjustment to the final illustration once all of the images were in place.

At this point, a step-by-step explanation of the procedures that led to the final illustration "*The Rainforest*" will be discussed. This illustration was the most involved of all of the calendar illustration and should provide a good explanation of how I created and manipulated all of the final illustrations. (See Appendix: B)

Working from the background out to the foreground of the illustration, all

of the separate elements were added in succession. Each of these images were added in specific order to allow for the overlapping of images that was needed to provide the proper compositional relationships.

The first step began with setting up the background for the illustration. This was accomplished by first specifying the proper Image size box to 6 inches by 9 inches with the proper resolution of 204 dpi in Photoshop. This Image box was 6.43Mb at this size and immediately caused hard drive problems when I tried to select the background *Sky* image which was about the same size from a second Image window in Photoshop.

This problem resulted from not having enough hard disk space available for Photoshop's scratch-disk to work with. This was immediately resolved by booting-off of a separate Syquest hard disk with only a system start-up on it, and using this as my start-up disk or scratch-disk. This became a real inefficient way to work since I only had several Syquest disks to work with and was forced to save all of the illustrations and back-ups on these. As a result, too much time was spent changing Syquest disks back and forth. This also slowed down the computer's processing time to an unbearable pace. More RAM memory would certainly have helped at this stage. But, because the image files were so large and the Mac IICI I was using only had 8Mb of RAM and 18Mb of hard disk space available way too much time was spent waiting for the computer. This thesis certainly pushed the envelope in working with Photoshop on a Mac IICI.

After successfully copying and pasting the *Sky* image (image 1), into the final illustration image box, the first step was complete. This step was accomplished using the *Select All* command to select the *Sky* image, then the *Copy* command, and finally the *Paste* command, to paste the *Sky* into the proper image box.

The next step included copying and pasting the *Trees* and *Water* (image 2) over part of the *Sky* image. This was done using the same process as the first step. Now the illustration consisted of the *Sky*, *Trees* and *Water* images. The *Ground* image (image 3) was added next. This also followed the same procedure as the previous steps, except this step included using the *Gaussian Blur* filter under *Image* in the menu bar. This filter was used to blur the ground more since it seemed too sharp and needed to be a little out of focus. The *Brightness/Contrast* along with the *Color Balance* were again slightly adjusted. This step concluded the formation and adjustment of the background.

Now that the background was in place and adjusted slightly, the next step included the pasting in of all of the separate images. Each of these were attempted to be pasted in specific order to allow for the proper overlapping. Unfortunately though, this stage was not planned out as well as it might have been, so a lot of time and thought was spent determining the proper placement of each element. This was the result of changing the composition of the illustration which ultimately proved to be the right choice. The original composition was far less complicating and exciting.

The *Moon* (image 4) was pasted onto the background next. This was resized in Photoshop using the *Image size* command with the *aspect ratio* locked to keep the proportions and resolution constrained. It was then pasted into the illustration just as the other elements were.

The following steps were very important steps since they would set up the proper balance of the illustration. These steps included the pasting in of the *Baby Mt. Gorilla* (image 5) and the *Lemur* (image 6). Both of these images were extremely important to the overall composition of the illustration. They help to set up the dynamic balance between the right and left side of the illustration. The placement of these two images was central to the compositional balance of the illustration.

After the Baby Mt. Gorilla and the Lemur were in place, the next step was to add another important compositional element to the illustration. This element was the *Large Palm Leaf* (image 7). This Palm Leaf was another crucial compositional element since it would ultimately lead the viewer's eye back into the central focus of the illustration, the Baby Mt. Gorilla. Following this step was the addition of several more smaller *Palm Branches* (images 8-10).

The next step in the construction of the illustration consisted of pasting in the *Red & Blue Macaw* (image 11). Following this step, another Small *Palm Branch* (image 12) was added. This image was a direct copy of image 9, except that it was Flipped horizontally using an Image option in Photoshop. This procedure was also done with several more of the smaller palm branches on the right side of the illustration, (images 14,16).

The *Toucan* (image 13) was pasted into the composition next, followed by another Small *Palm Branch* (image 14). Then the Leopard (image 15) was added to balance off the right side of the illustration by giving it some extra weight at the bottom. The *Palm Branch* (image 16) in front of the leopard was the next step.

This palm branch I felt helped to give the illustration a mysterious quality by partially obscuring the leopard.

With the addition of the *Chameleon* (image 17) at the top of the illustration, the final step in the completion of the right side is finished. This image as in all of the previous images was copied and pasted into the composition from separate Tiff files.

Now that the main composition of the illustration was complete, all that remained to be done was the addition of several more animals throughout the illustration. The first of these included the addition of the *Peacock Butterfly* (image 18). This was placed in a very key location to provide some extra tension to the illustration. Followed by the placement of the two *Sea Turtles* (images 19,20). The turtles helped to give the illustration a feel of movement and direction as well as direct the viewer's eye towards the right side. The *Dolphins* (image 21), were added next to give the illustration more depth and space. They are very important since they direct the viewer's eye into the illustration. Unfortunately though, the dolphins did not stand out enough on the final *Kodak 7700* prints, but were fine on the *Cannon CLC 500* prints. Color output was a problem that will be discussed later.

Only a few more elements remained for completion of the illustration. The finishing touches that remained to be added were added simply for fun and amusement. They included the *Seven-Colored Tanager* (image 22), a *Blue Poison-Dart Frog* (image 23), and a *Tarantula Spider* (image 24). The poison-dart frog and the tarantula spider were really added just to see if the viewer would actually look close enough to see them. They were also almost completely lost on the final *Kodak 7700* print out.

With the addition of the *tarantula spider*, the montage composition was almost complete. Now all that remained to be finished was the final retouching and color-balancing of the illustration. This would prove to be much quicker than the previous procedure of pasting together all of the separate images into the one final illustration.

Photoshop's tool palette again provided the necessary tools for the completion of the illustration. The *Eye Dropper* tool was utilized for selecting the proper color from the image to be used with the *Paintbrush* and *Airbrush* tools for retouching of the separate images together. The *Rubber Stamp* tool was used to clone leaves around the *seven-colored tanager* and *poison-dart frog*, while the *Smudge* tool and *Blur* tool were used throughout to blend the edges of the images together. The *Zoom* tool was used

throughout the various stages work to provide easier viewing of the images for selecting and retouching.

The illustration was almost complete after the *Brightness/Contrast* and *Color Balance* levels were finally adjusted. Because I did not have a good understanding of the printing process and color correcting, I was unaware of how to set the proper color balance levels for final output. I simply adjusted the levels to what I thought looked good on my color monitor. I was not aware that it was possible to adjust the color levels to levels that would be out of range for the printers I would be using. This became a big issue when the time came to print out the final illustrations.

Photoshop provides a *Densitometer* tool I was informed after all of the illustrations were completed, that measures the density levels of each of the four process colors, cyan, magenta, yellow and black. This tool allows the user to check each color to make sure that they are within the printers range and not over saturated.

After all of the color adjustment levels were finally set, all that remained was to apply a Photoshop *Gallery* plug-in watercolor filter. This Photoshop filter provided an incredible watercolor effect that gave each of the final thesis illustrations a wonderful painterly effect. This effect was applied to the entire image area of each illustration, and in a matter of about 15 minutes each, they were finished.

Calendar Layout

The layout of the calendar was accomplished using QuarkXpress 3.1. All of the illustrations were directly imported into Quark as Tiff files and placed into the proper picture boxes that were layed out inside Quark.

The calendar layout was designed as a simple straight ahead fine arts type that would emphasis the images rather than the dates of the month. Black was chosen to give the calendar a strong graphic feel as well as keep the attention focused on the illustrations.

Litbos Bold was chosen for its natural organic quality that seemed to compliment the images best. All of the picture boxes were surrounded using the framing option provided by Quark.

The calendar size was determined from the very beginning to measure 8.5 inches by 11 inches. This was chosen because it was the standard print out size for the ESP lab's printers. I decided that it would provide a big enough image size for each illustration.

The title type arc "*Let Wildlife Live*", was created in Adobe Illustrator 3.0 utilizing the type rotation tool, saved as a postscript file and then imported into Photoshop and saved as a Tiff file. I was then able to import it into Quark for the final calendar layout.

There were several significant results from the completion of my thesis. The first, and perhaps the best result was that I actually finished all of the calendar illustration in time for the graduate thesis show! Second, I was quite satisfied with most of the illustrations overall, and felt that this was truly a new and exciting way to create illustration on a Macintosh computer. Third, as a direct result of finishing the thesis illustrations, one was chosen by *Kodak* to be used on a photo-CD to promote *Montage '93* at a press conference in New York City in June.

Other positive results include, the favorable reaction to the illustrations at the thesis show, the image quality that was able to be achieved with Photoshop, and the fact that I learned an awful lot about image processing in such a short period of time.

Some of the less favorable results included the poor final color output accuracy, the trouble working with such large image files without proper memory, and only being able to create a six-month instead of a twelve-month calendar because of time.

Summary

The final thesis project began as a series of five traditional wildlife illustrations that were inspired by The Animal Rights Handbook. From there it grew into a set of seven image processed computer illustrations that were incorporated into a six-month computer illustrated calendar about endangered species. The research that was conducted for the thesis included finding the proper photographic reference, learning Adobe Photoshop, and understanding the fundamentals of image processing on the Apple Macintosh IIfx computer.

What began as a concern about endangered wildlife, ended in a complete thesis on computer manipulated illustration utilizing the latest and most advanced image processing techniques provided by Adobe Photoshop for the Macintosh computer.

Conclusions

The final thesis calendar culminated in a series of illustrations that not only reflect the issue of endangered species, but the influential work that ultimately led to its inception. The work that began as photographic reference developed, step by step, to integrate landscapes and the animals images. The Macintosh computer medium helped to develop and transfer new techniques that ultimately led to a more personal form of artistic expression. The computer provided further artistic possibilities for the illustrations that could not have been achieved through any other medium. The ability to develop and create an illustration and manipulate it into an even more personal work of art was quite exciting for me. All of the elements that were developed throughout my work; surreal landscapes, environmental themes and endangered wildlife, merged together with the use of the computer. It was the perfect tool for combining a variety of different elements and images together into a unified volume of work.

The careful combination and manipulation of images with the image processing capabilities of Photoshop and the Apple Macintosh computer proved to be a challenging and time consuming exploration into computer illustration, but nonetheless an extremely rewarding experience. This technique of manipulating images on the computer to create original illustration was carefully planned out and executed to ensure the success of the final calendar. Careful attention was given to the detail of each illustration for the sake of the overall continuity of the calendar. The combination of the many dissimilar images required careful planning in terms of composition, size, color balance, retouching and research, but proved to be an exciting and rewarding challenge that culminated in a visually rich collection of wildlife illustration.

My original intention to create a computer illustrated calendar on endangered species utilizing the latest image processing techniques on the Macintosh computer was fulfilled. The end result was a cohesive calendar that incorporated images, ideas and techniques that helped me to develop an original style of computer illustration. I produced a calendar that solved the technical problems and goal of the thesis: to create a computer illustrated calendar of endangered species.

Recommendations

There are several recommendations that I feel might be relevant to anyone interested in manipulating digital images on the Macintosh computer. First and most foremost, make sure that you are using a computer that has an adequate amount of RAM memory as well as hard disk space when working with large color images in Photoshop. The amount of RAM that I had available on my Mac IIci was 8Mb with 20Mb of free hard disk space. This proved to be barely enough since I was required to boot-off of a separate Syquest-harddisk that acted as my Photoshop "scratch disk". The more RAM that you have available the easier it will be for the application program and the computer to run. Unfortunately for me, the extra RAM that the school had ordered for the graduate lab to upgrade with did not show up until I was already finished working on the final illustrations.

A second recommendation would be to learn as much about the output of computer images as possible, as this will ultimately effect the color accuracy of your images. Learning as much as you can about the printing process and computer color calibration can only improve the printed quality of your images.

Additive primary colors: Red, green, and blue, which are the three colors used to create all other colors when direct, or transmitted, light is used (for example, on a computer monitor). They are called additive primaries because when pure red, green, and blue are superimposed on one another, they create white.

Active Window: The front most window displayed on the Macintosh screen. An active window's title bar is highlighted.

Anti-aliasing: The process by which the appearance of jagged lines that result from the limited resolution of a graphic display are smoothed. Software and programs correct the stepped appearance of diagonal and curved lines by averaging intensities between neighboring pixels to soften the staircase effect.

Application program: Software used to manipulate information, sometimes referred to simply as an "application".

Bitmap: A set of pixels, or picture elements, that represent a graphic image or a font.

Brightness: One of the three dimensions of color; the other two are hue and saturation. The term is used to describe differences in the intensity of light reflected from or transmitted through an image independent of its hue and saturation.

Clipboard: A feature on the Macintosh that temporarily holds the information last cut or copied; a buffer area in the memory.

Color correction: The changing of the colors of pixels in an image, including adjusting brightness, contrast, mid-level grays, hue, and saturation to achieve optimum printed results.

Color resolution: The number of different colors or grayscale values a system can produce or work with. A value is usually given in bits.

Continuous-tone image: An image containing gradient tones from black to white.

Contrast: The tonal gradation between the highlights, midtones, and shadows in an image.

Copy: To place something on the clipboard by selecting it and choosing copy from the edit menu.

Crop: To select part of an image and discard the unselected areas.

Cut and paste: The equivalent of using scissors to clip something and glue or paste it somewhere else. Moving data from one place in a document to another place or to another document.

Densitometer: An instrument used to measure the density of printed halftones. A densitometer is used to measure the density levels on the printed calibration bars.

Density: The ability of an object to stop or absorb light. The less the light is reflected or transmitted by an object, the higher its density.

Desktop: The Macintosh computer's on-screen working environment- the menu bar and the gray area on the screen.

Disk: The magnetic medium on which the Macintosh stores information. The Mac can use a 3 1/2" disk, or a hard disk.

Disk drive: The system or device that electromagnetically reads information from or writes information on a magnetic storage disk.

Document: Whatever you create with Macintosh applications; information you enter, modify, view, or save.

Dots per inch (dpi): A measure of printer resolution or density. The dpi determines the overall appearance or quality of the printed output. Laser text is often 300dpi.

Duplicate: To make a copy of selected objects by choosing Duplicate from the Edit menu or in some programs, depressing the Option key and dragging away the original.

Export: The output of text, graphics, or layouts from a program in a form suitable for use with other programs.

File: A collection of information stored on a disk-- a document, a system file like the System file or Finder, an application, etc.

Flatbed Scanner: A flatbed scanner is similar to a photocopier in that original art to be scanned is positioned face down on a glass plate. Its design accommodates books. Its exact alignment of the original page produces more precise results than sheet-fed scanners that feed the image into the scanner with rollers.

Folder: A holder of documents, applications, or other folders on the desktop. Folders allow you to organize information any way you desire.

Font: A complete assortment or set of all the characters of a particular typeface, all of one size and style.

Font style: A set of stylistic variations, such as bold, outline, underline, and italic.

Graphics program: A tool that produces drawings, designs, charts, and manipulates images on the computer.

Grayscale: Representation of images using different levels of gray tone. Halftone images employ gray scale by varying the density of the halftone dots. Shades of gray on the screen that are created by varying the intensity of the screen's pixels, rather than by using a combination of black and white pixels to produce shading. A single-channel image that consists of up to 256 levels of gray, with 8-bits of color information per pixel.

Halftone: The reproduction of a continuous-tone image, made by using a screen that breaks the image into various size dots.

Hard disk: A disk drive with a permanently encased storage disk. Hard disks usually boast high-volume storage capacities and can be housed inside a computer or in an external case.

Hardware: The actual equipment that makes up a computer system.

Histogram: A graphic representation of the number of pixels with given color values. A histogram shows the breakdown of colors in an image.

Hue: Color; the main attribute of a color that distinguishes it from other colors.

Input: The raw data, text, or commands inserted into the computer.

Marquee tool: A rectangular area surrounded by blinking dashes or dotted lines, used to select objects or regions in a drawing and paint programs.

Megabyte (Mb): A unit of measurement equal to 1024 kilobytes. It is commonly used in specifying the capacity of computer memory.

Memory: The area in a computer into which data can be entered and stored for later retrieval.

Menu: A list of choices presented by a particular program, by which a desired action may be selected. In the desktop interface, menus appear when you point to and click on menu titles on the menu bar. To select a certain command, drag through the menu and release the mouse button while a command is highlighted.

Menu bar: A horizontal strip at the top of the screen that contains menu titles.

Monitor: A video display terminal that serves as the user's window on the computer's doings.

Mouse: A small box-like device that is moved around on a flat surface next to the computer. Its position and motion controls the on-screen cursor to select operations, to move data, and to draw.

Noise: In an image, pixels with randomly distributed color values.

Palette: A column of symbols on the left side of a document window. You use the palette to draw, add text, and edit different objects in a document.

Paste: Placing a copy of saved material into a document or layout.

Peripheral equipment: The input/output units and secondary storage units of a computer system. The central processor and its associated storage and control units are the only parts of a computer system which are not considered peripheral equipment.

Pict: A format for storage and exchange of graphics documents on the Macintosh and the format used by the clipboard.

Pixel: The picture element is the smallest visual unit on the screen that can be stored, displayed, or modified. It is also a location in video memory that corresponds to a point on the graphics screen when the viewing window includes that location. Images that are created with pixels are referred to as bitmapped.

Plug-in module: Software developed by a third-party vendor in conjunction with Adobe Systems that lets you use a function that is not available in the standard Adobe Photoshop application.

Posterize: To transform an image to a more stark version by rounding tonal values.

PostScript: Adobe Systems's page description language. PostScript is built into a printer if it includes a processor that runs a program that translates statements in the PostScript language to the corresponding marks made by the printer. A software program is considered PostScript compatible if it translates statements in the PostScript page description language.

Print area: The area on which an output device can place an image, most often expressed within the bounds of a rectangle. On most electronic and image-processing devices, this is smaller than the full sheet of paper resulting in an area that is smaller than the page size.

Printer: A device that receives information and instructions from your computer and produces images of text and graphics on paper.

Printer font: A font that a printer uses to print a document.

Random access memory (RAM): Data storage in which records or individual bytes are accessible independent of their location in relation to the previous record or byte accessed. Also, the part of the computer's memory that stores information temporarily while you're working on it.

Raster graphics: Pixel or bitmap graphics. This type of graphics is like working with colored pencils on a sheet of paper or paint on a canvas. Images are changed by erasing areas or by painting over top of other things. Programs using raster graphics are often called "paint" programs.

Reduce: To see more of a document by making it appear smaller in the document window.

Resize: To change an image's size while maintaining its resolution.

Resolution: The number of pixels per unit of area. The sharpness of an image on a screen or in printed form, measured in dots, spots, or lines per inch.

RGB: A method of displaying a color video signal by transmitting primary colors as separate signals. In RGB, color is defined as percentages of red, green and blue.

Read Only Memory (ROM), the part of memory that contains information used throughout the system, including the information it needs to get itself started. Information in ROM is permanent; it doesn't vanish when you turn the power off. See RAM memory.

Saturation: A subjective term that refers to the difference of a hue from a gray of the same value. In a subtractive system, adding the complement makes the color darker. In an additive system, adding the complement will make the color lighter.

Save: To store information on a disk.

Scan: To convert an image from visible form to an electronic description.

Scanner: An input device that converts printed matter into bit data so it can be read, stored, and manipulated electronically by the computer.

Scanned image: The image that results when a photograph, slide, paper image, or other two- or three-dimensional image is converted into a digital image.

Scratch-disk: Hardisk space used by Photoshop when working with images.

Scroll: To move a document in its window so that a different part of it is visible. Sometimes this can be done with a hand tool and at other times, you must use the scroll bars at the bottom and right of a window.

Select: To designate where the next action will take place. To select, you click or drag across information.

Software: A program or collection of programs that control the computer.

Start-up disk: A disk that has all the necessary program and system files contained in the system folder for the Macintosh to set the computer in operation. Often called a boot disk.

Style: Variation in the appearance of a typeface, for example italic, underlined, outlined, or shadow.

System: An integrated assembly of hardware and software designed to run a given application or set of applications.

System software: Special files on the Macintosh that contain the operating system program and its supporting and auxiliary programs.

Tag image file format (Tiff): A graphic file format developed by Apple, Aldus, and Adobe for gray-scale data. It is suited for representing scanned images and other large bitmaps. Newer versions of Tiff support color and compression.

Tool: An object or icon used to perform operations in a computer program. Tools are often named either by what they do or by the type of object on which they work.

Value: Comparison of a chromatic color to an achromatic color along the grey scale from white to black. Synonyms are: intensity, brilliance, or brightness.

Vector Graphics: Object-oriented graphics. Imagine an environment where you create different shaped pieces of paper and shuffle them around. The image is changed by reassigning the object order rather than by rubbing things out objects have a border of varying or no thickness and an interior which can be filled with a pattern or not. Programs using vector graphics are often called "draw" programs. See also Raster graphics.

Virtual Memory: The memory space that is separate from the main memory (physical random access memory), such as hard disk space. Virtual memory allows you to work on large documents without requiring you to have large amounts of RAM.

Window: The area on the Macintosh desktop screen that displays information. Documents are viewed through a window. A window can be opened or closed, or moved around the desktop.

Zoom tool: Used to magnify or reduce your view of the current document or image.

* Glossary was compiled from the following sources:

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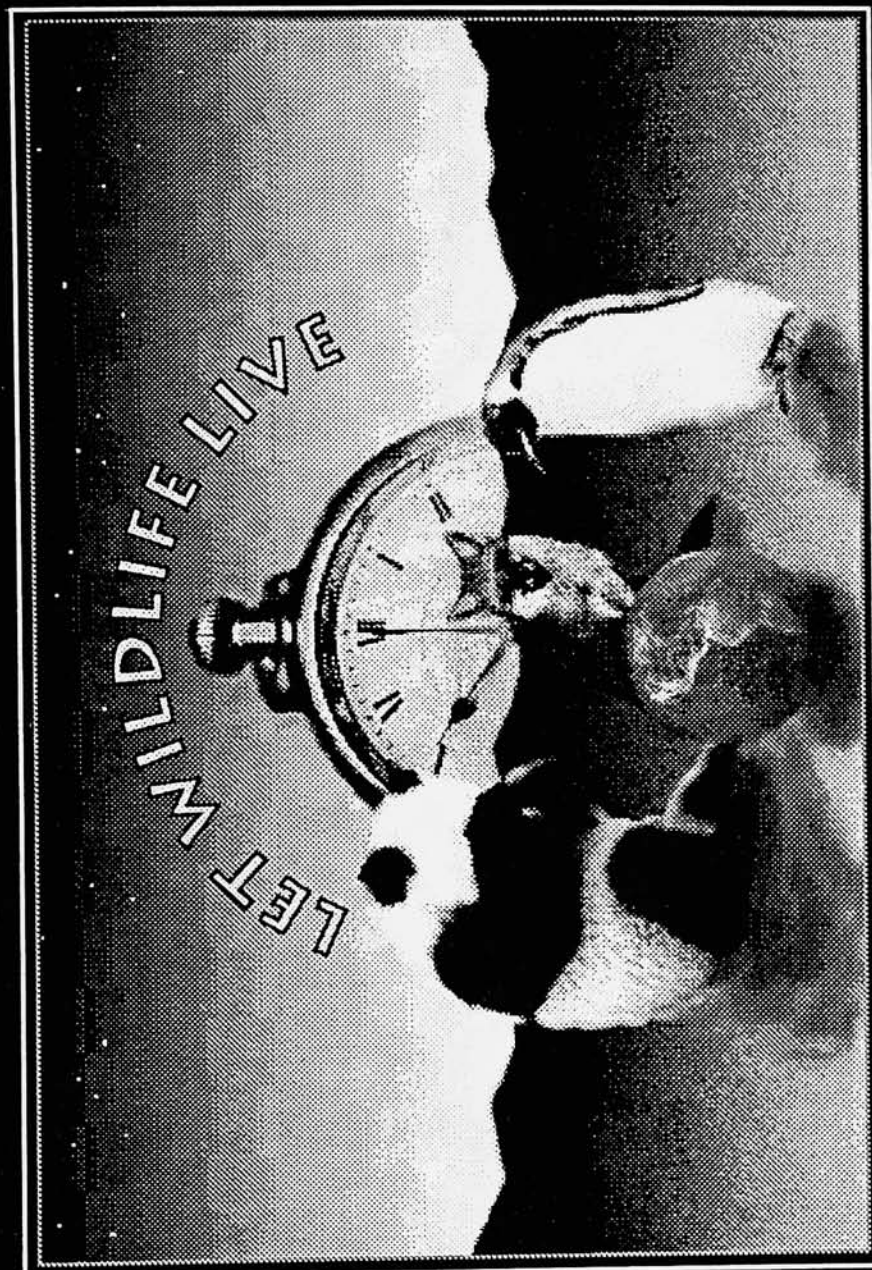
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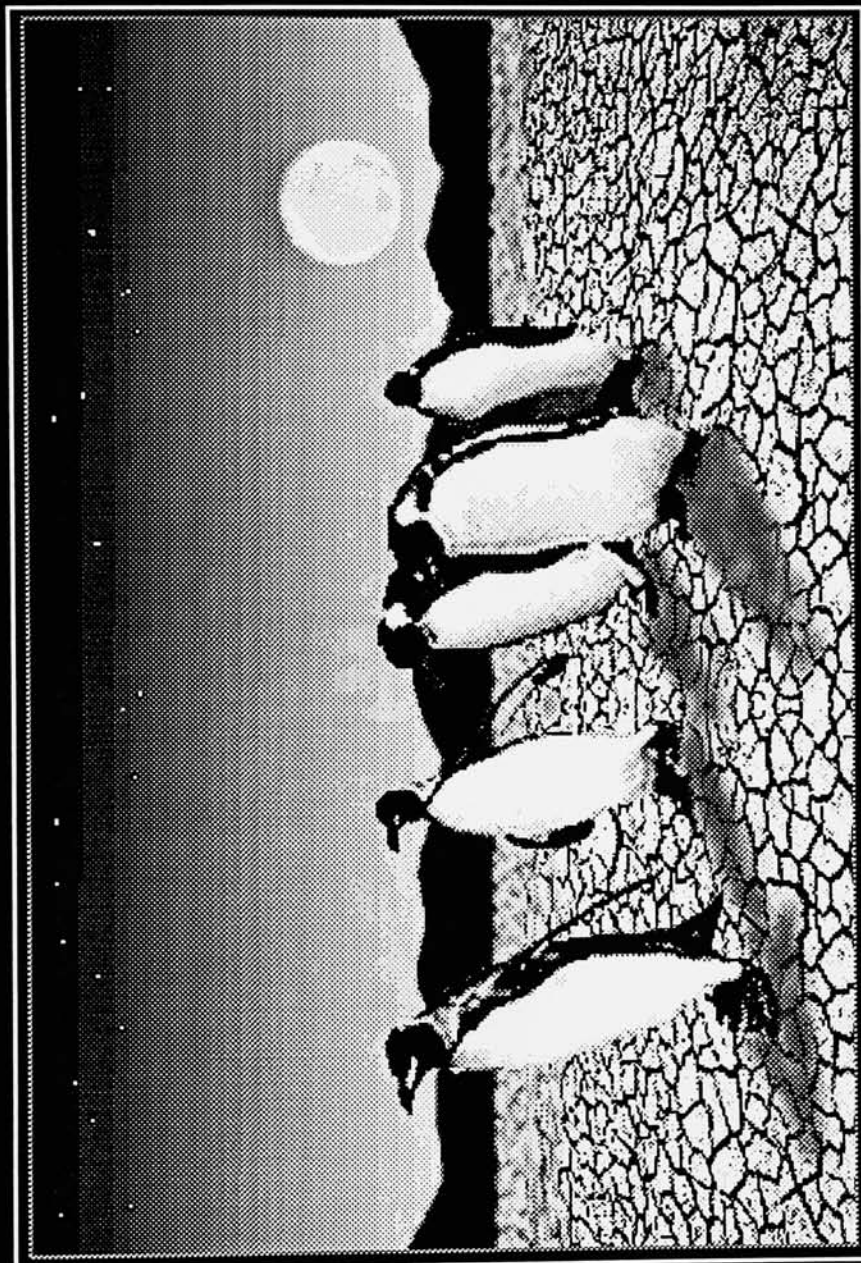
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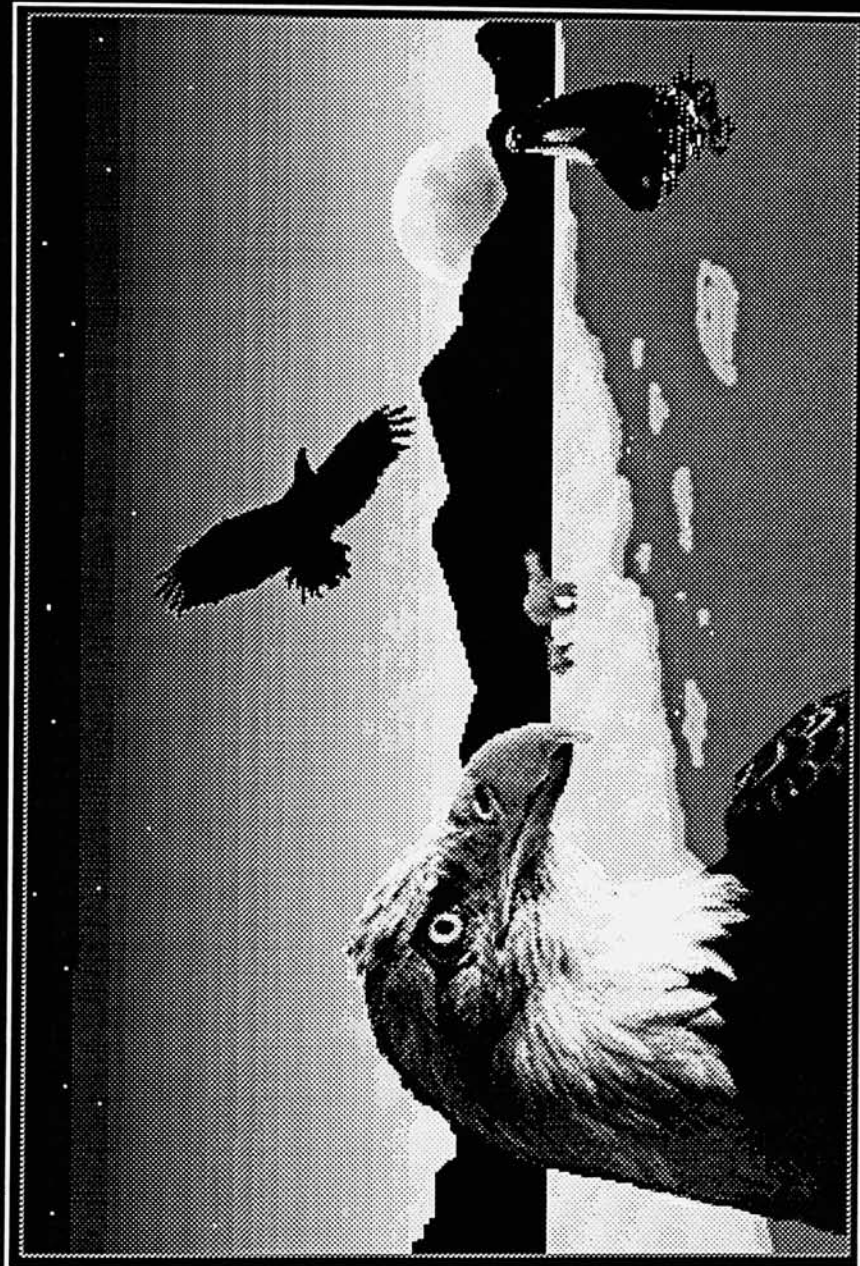
A COMPUTER ILLUSTRATED CALENDAR OF ENDANGERED SPECIES

DESIGNED AND ILLUSTRATED BY MARK SOMMERS



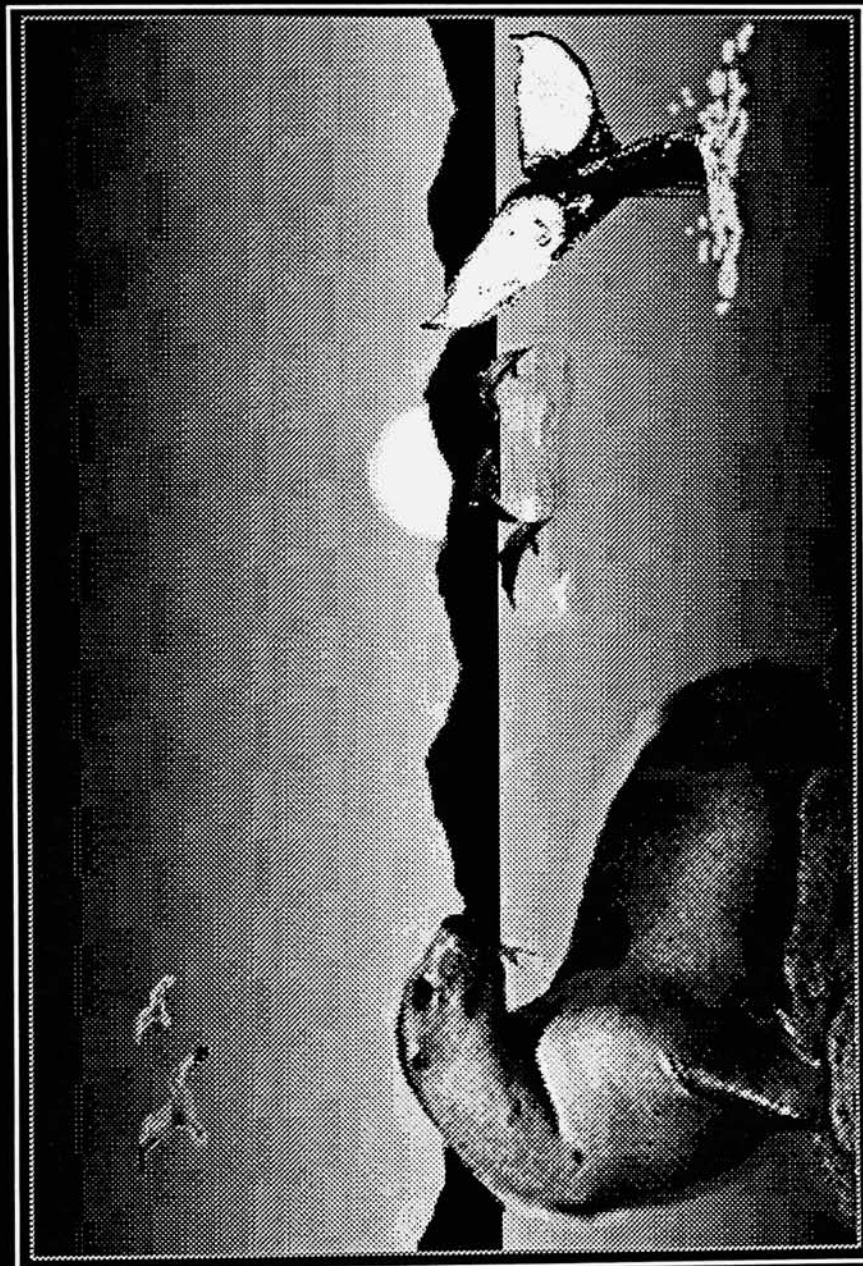
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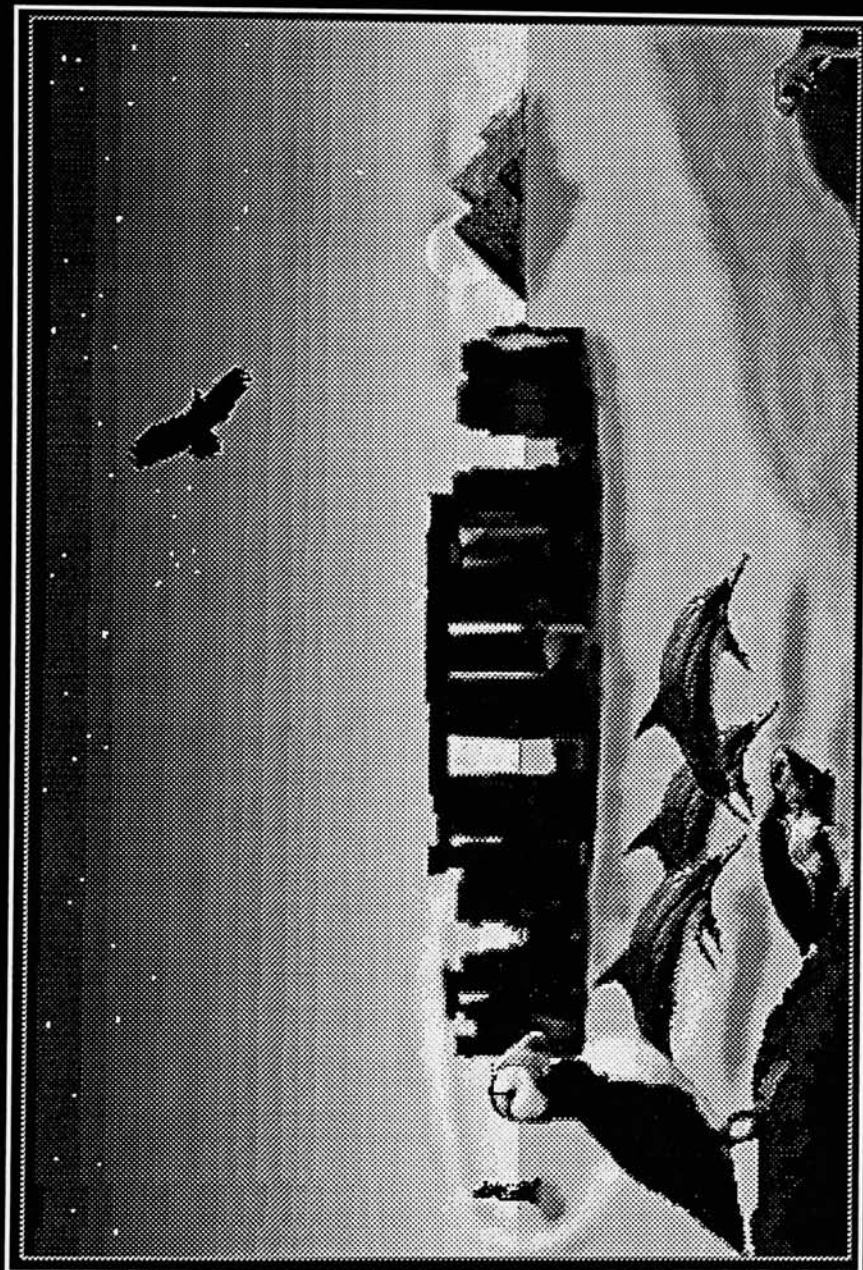
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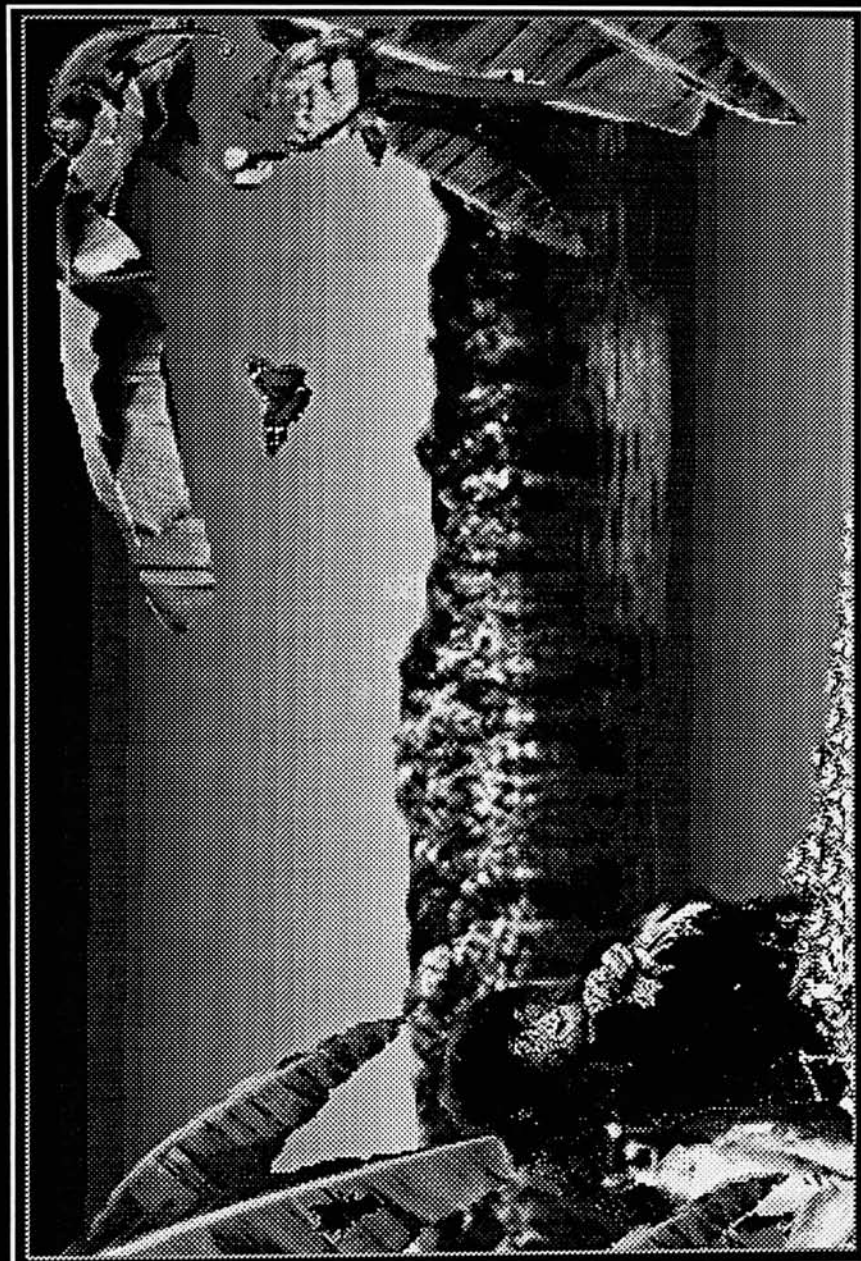
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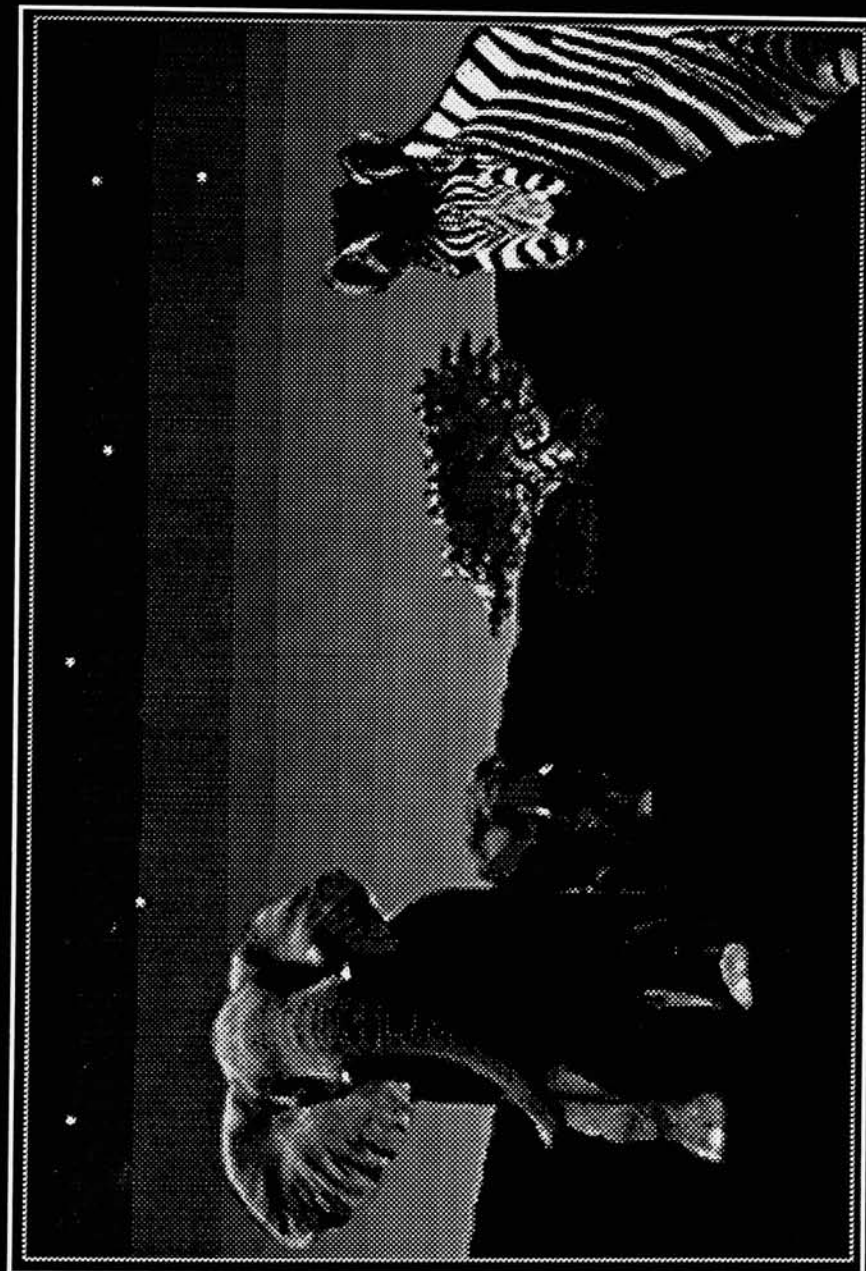
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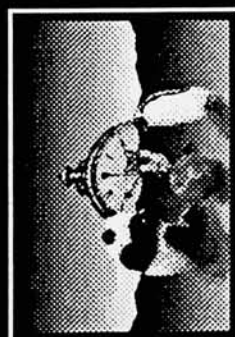
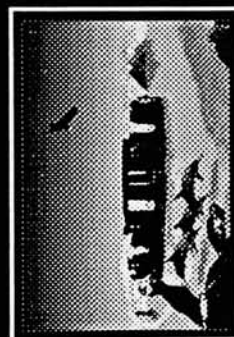
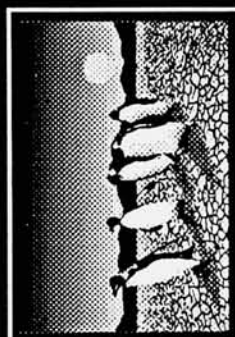
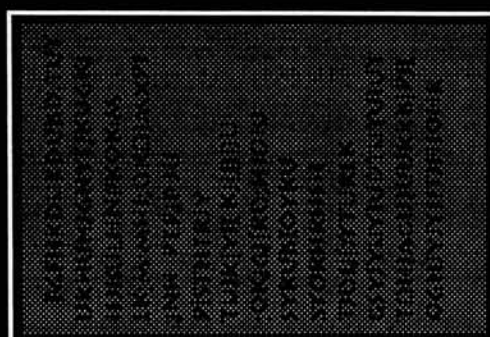
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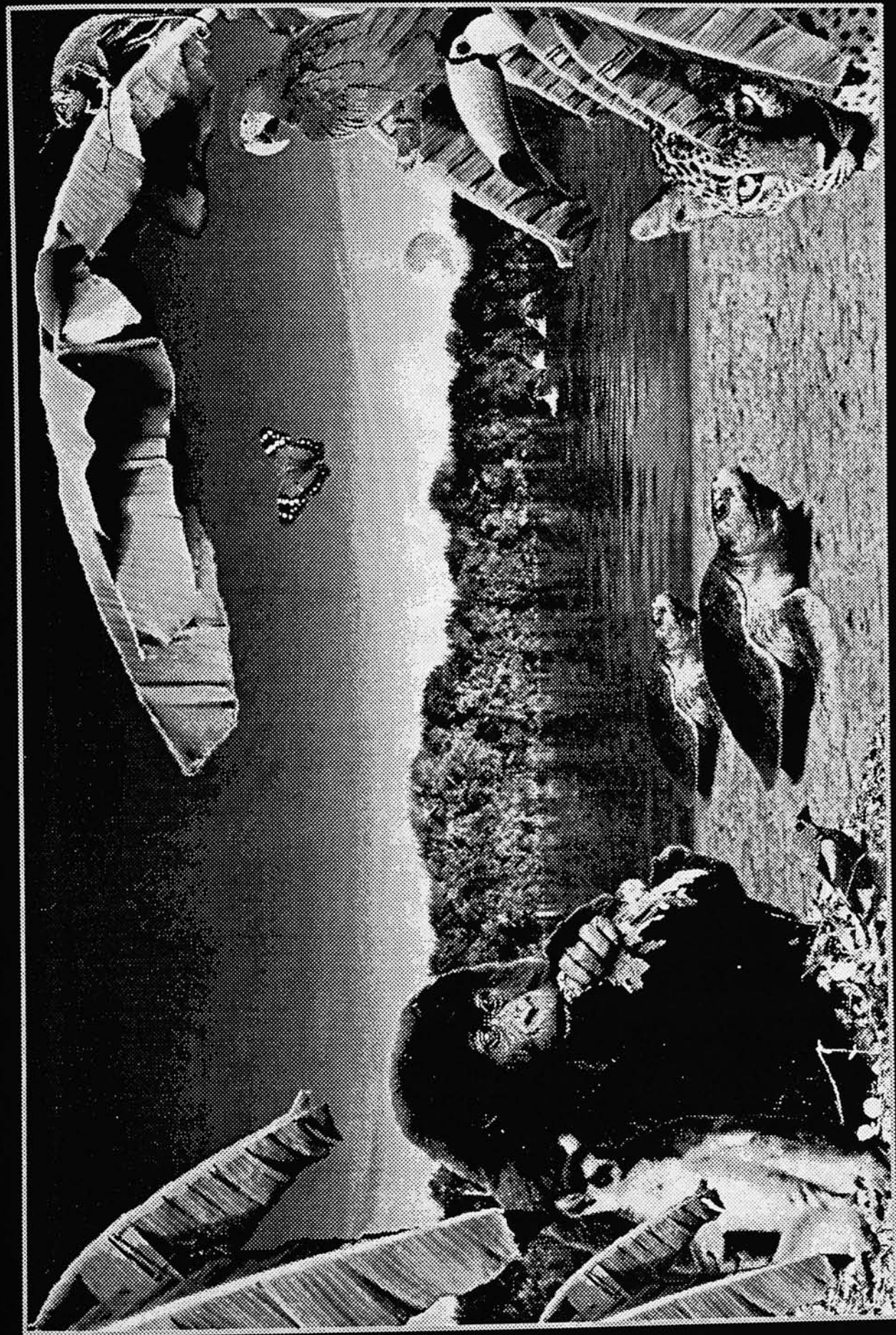


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MAY

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Image- 1

Our cruise lines may not
they'll take you to some h

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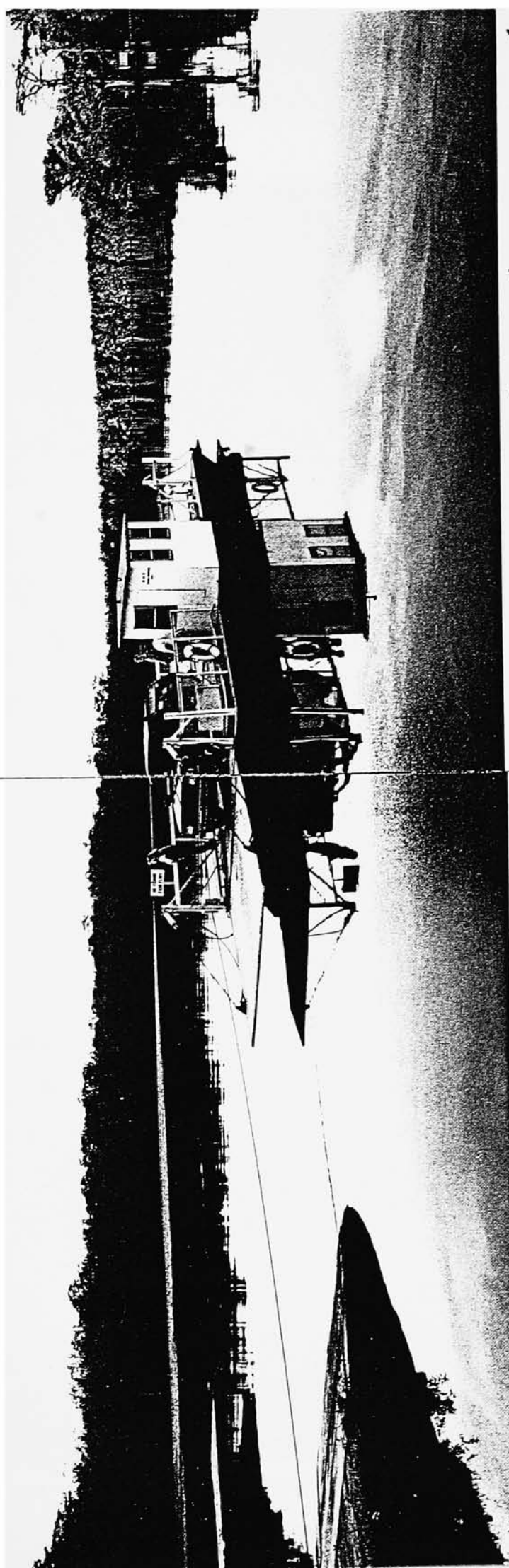


Image- 1



Our cruise lines may not be known for elegant dining, but they'll take you to some of the most beautiful islands in the world. Visit our colorful villages, you'll find beauty that you won't find anywhere else.



Image-4



**Whichever comes first. Limited warranty on powertrain and outer body rust-through. Excludes leases. Deductible applies. Ask for details.
BUCKLE UP FOR SAFETY.*



Image-2

Every second another acre of rain forest is destroyed forever. The World Wildlife Fund needs your help. 1-800-CALL-WWF.



Image-3

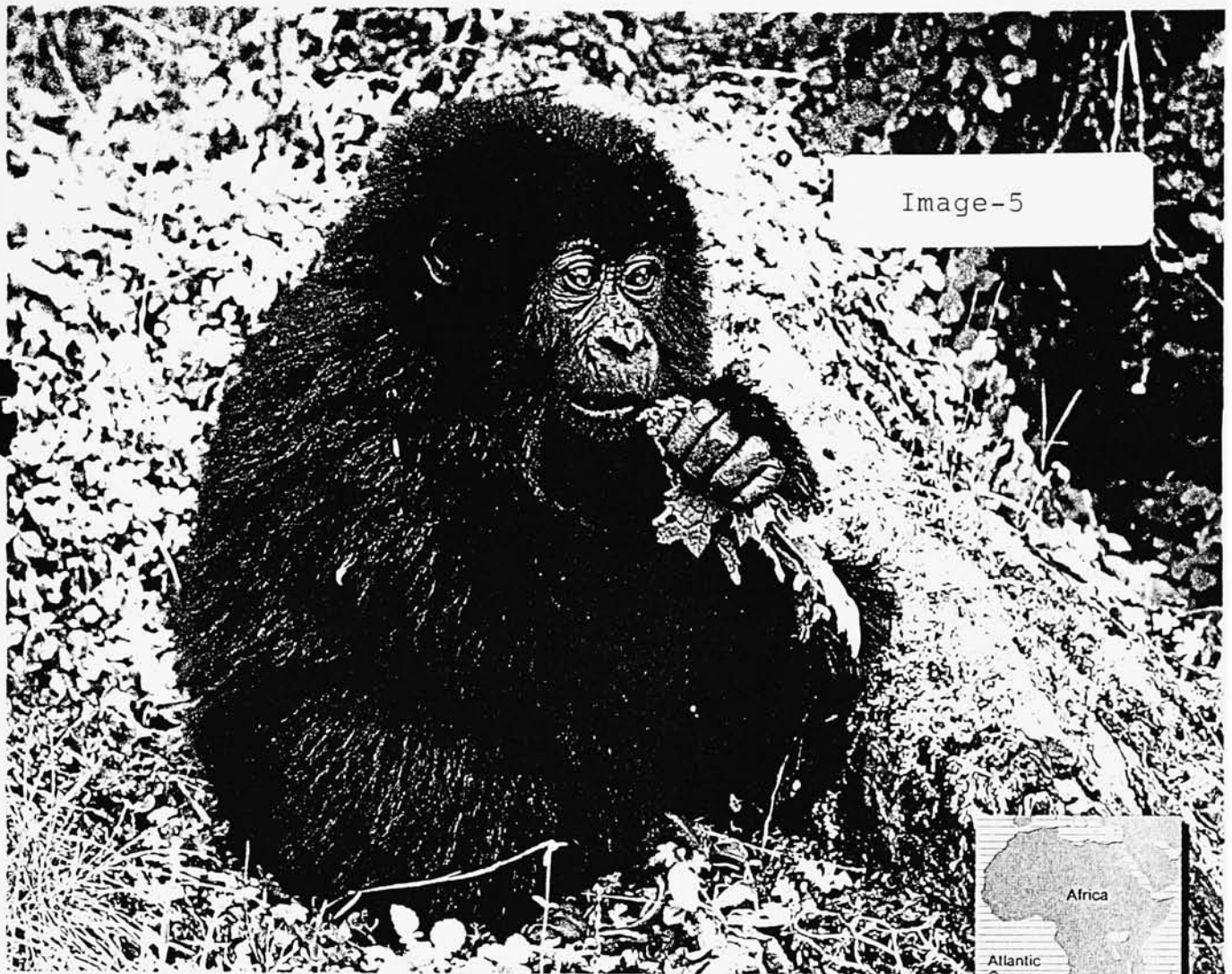


Image-5

Photographed by Peter G. Veit. *Mountain Gorilla: Genus: Gorilla Species: gorilla*
Subspecies: beringei Adult size: 152-182cm Adult weight: Approximately 182kg, male, and
114kg, female Habitat: Mountain rain forests in central Africa Surviving number: Less than 750



Wildlife as Canon sees it:

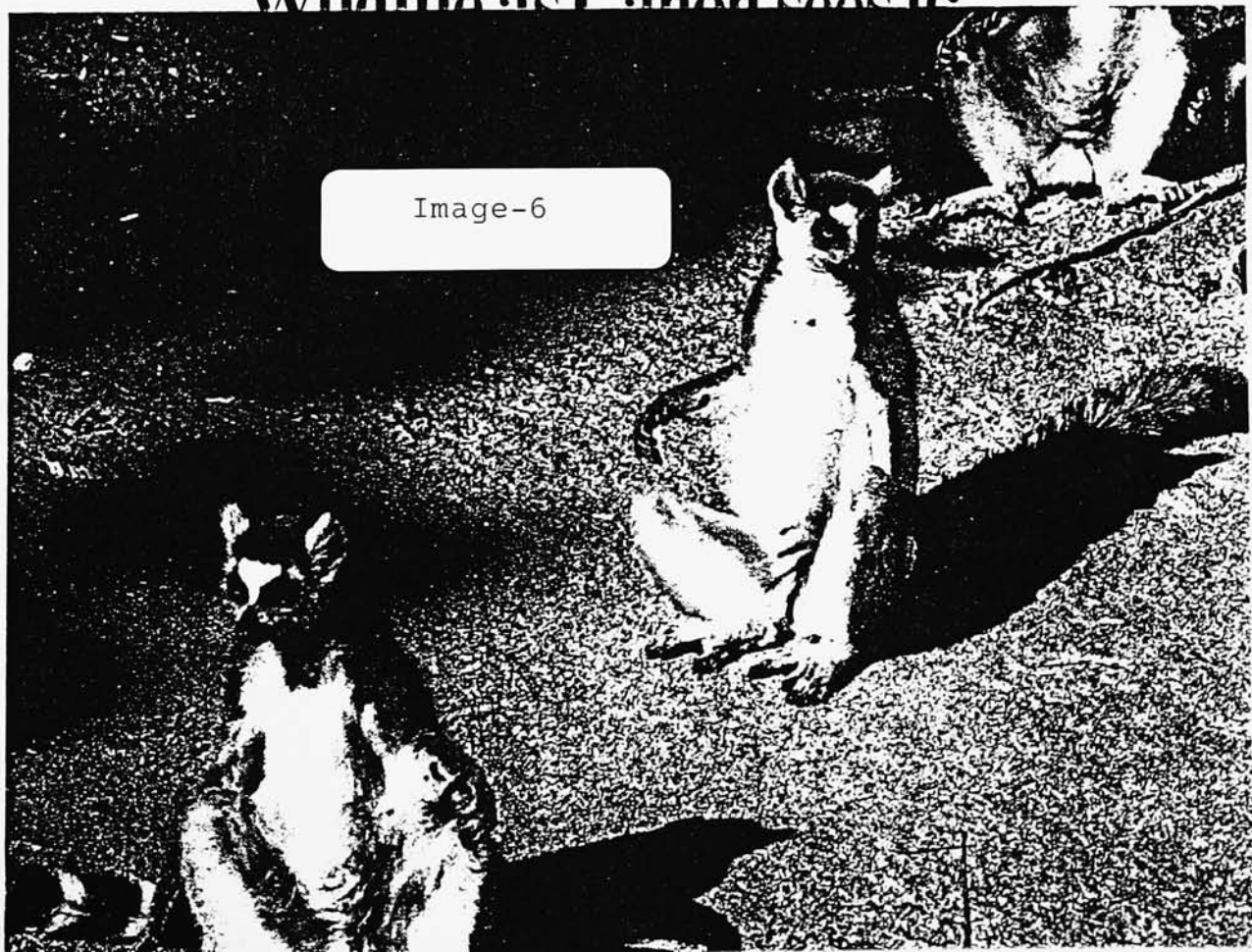


Image-6

No SQUAWK TALK

ON AN OKI CELLULAR PHONE

With an OKI cellular phone,

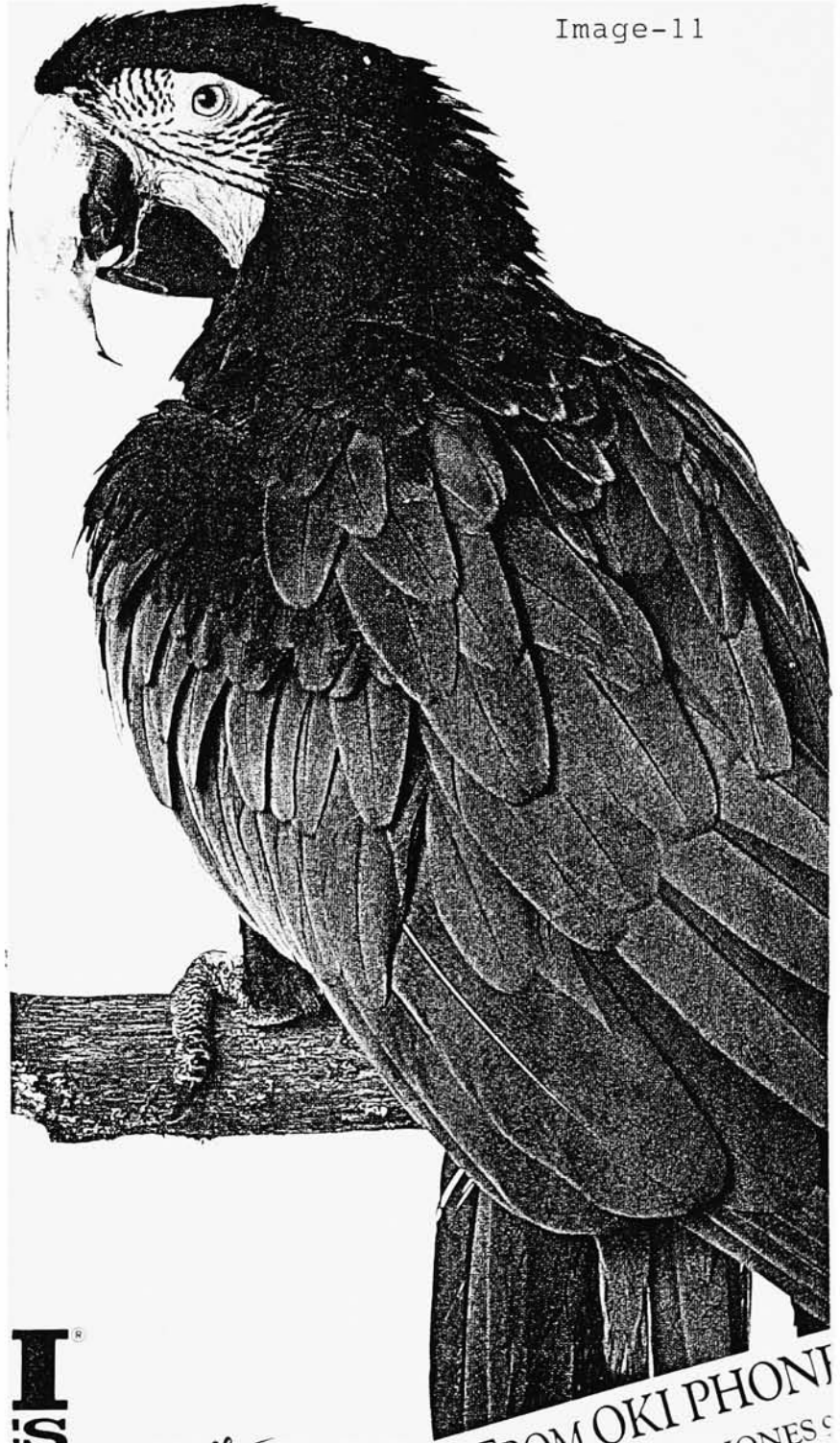
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GARDENS**  TM
Take A New Look.



Images 7-10

Images 12, 14, 16

Image-11



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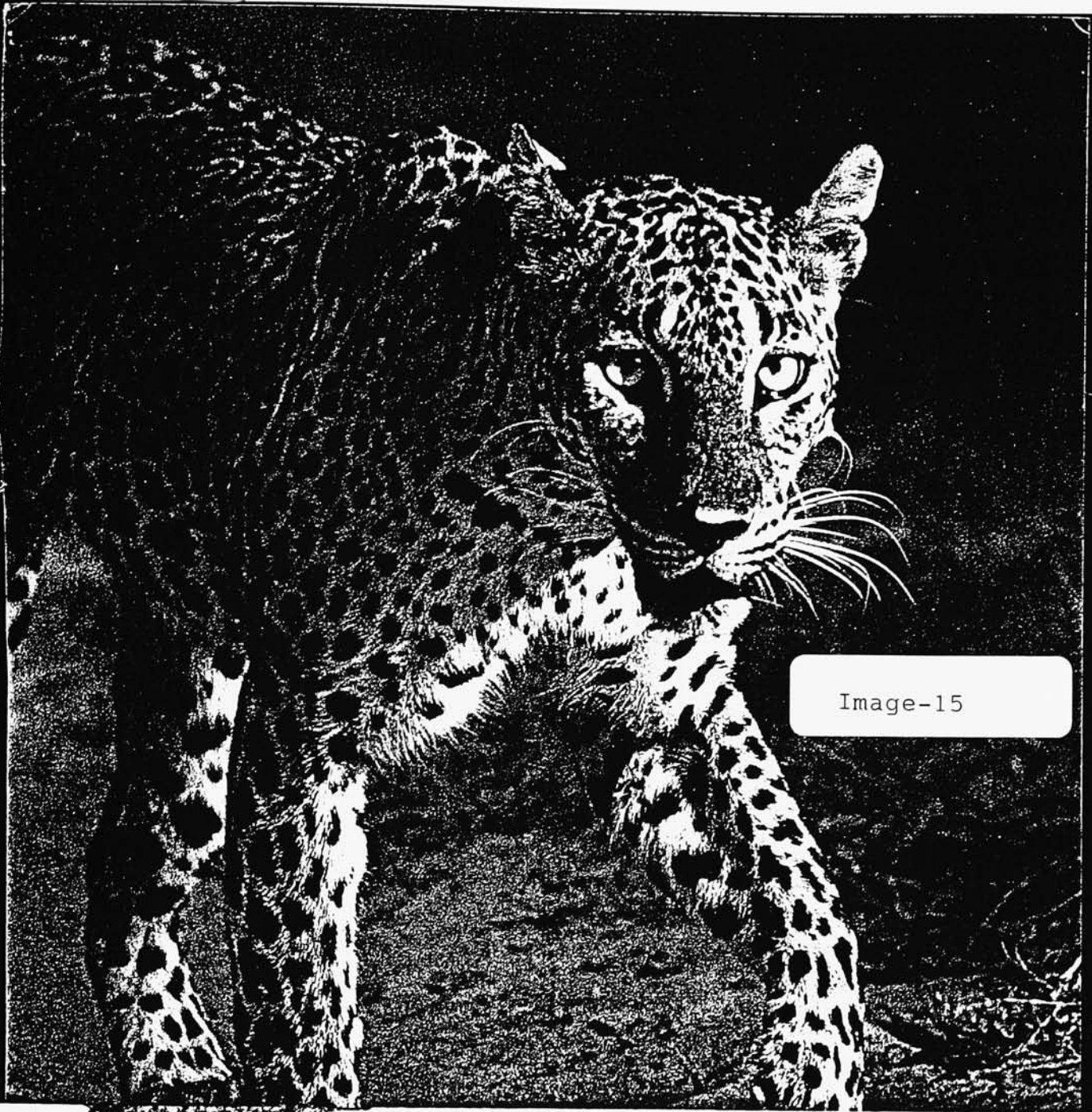


Image-15

into the structure of your company. You're never overstaffed or understaffed. Instead, you maintain a core of full-time workers. Then, when production increases and needs change, Olsten supplies you with appropriately skilled temporary workers. You get the job done more efficiently and economically. Morale is maintained. As well as productivity.

So make Olsten your partner in flexibility. And prepare your company for the future, whatever changes it brings. You won't have to let people go.

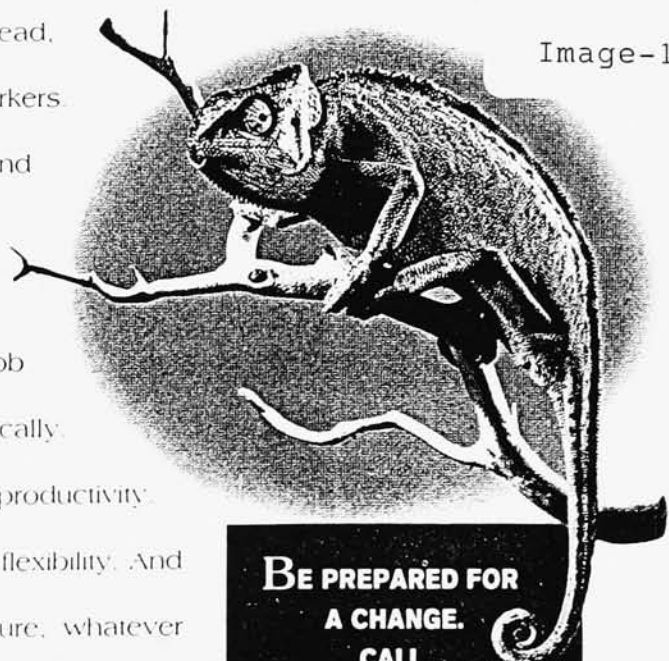
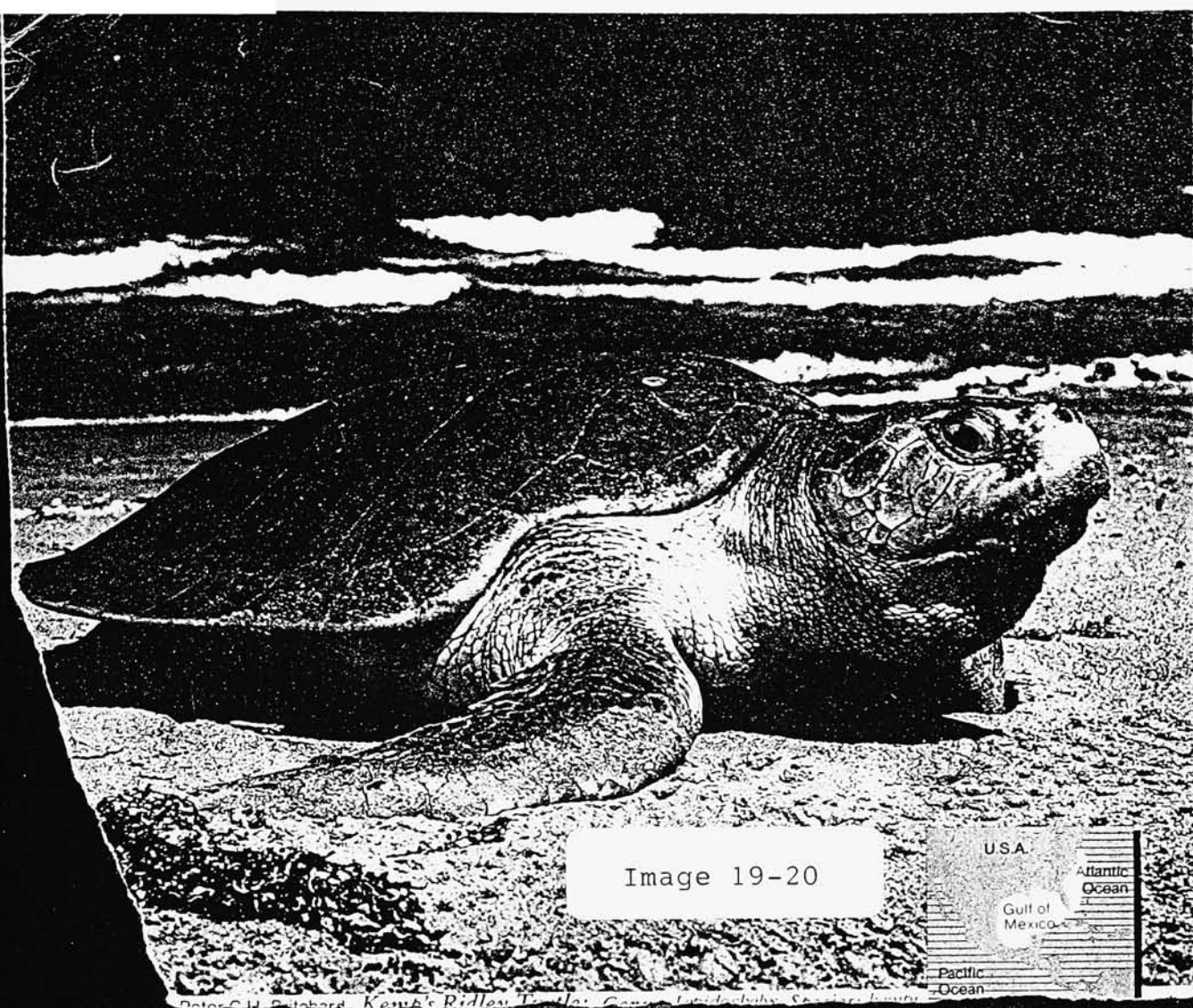


Image-17

**BE PREPARED FOR
A CHANGE.
CALL
1-800-225-TEMP**



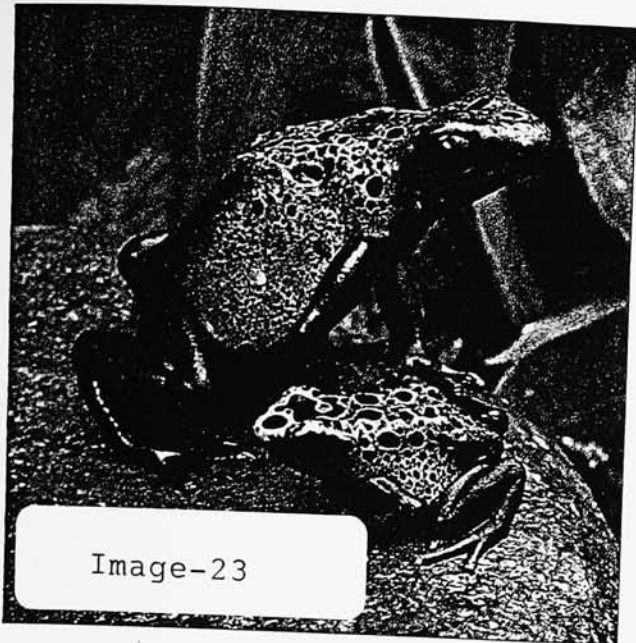
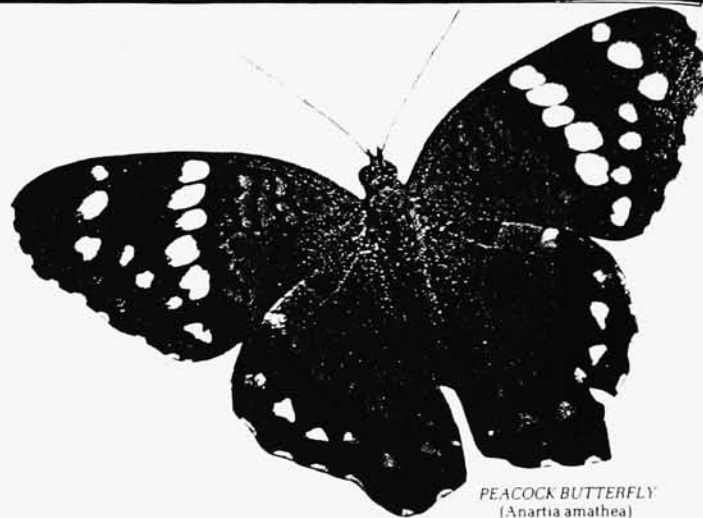


Image-23

GEORGE GRALL

The toxic sweat of dart-poison frogs native to Central and South American rain forests has long been used on poison arrows. Researchers now hope to use the sweat to create pain-controlling drugs.

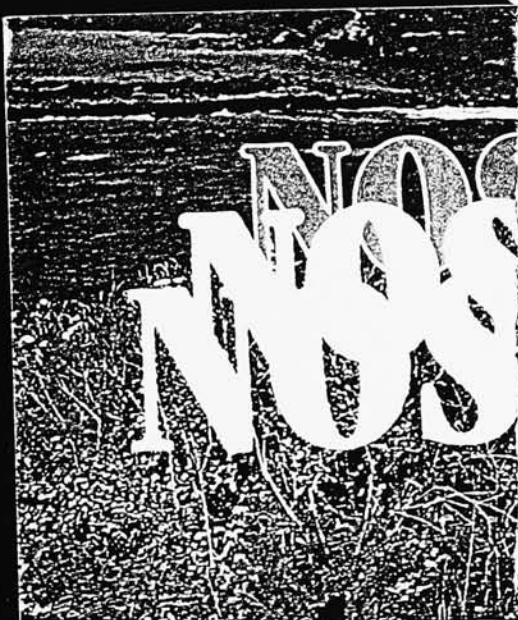


PEACOCK BUTTERFLY
(Anartia amathea)

Image-18

NYC, NY. Another reason Epson computers are the only way to go. For more information, call 800-BUY-EPSON.

Image-24



five years,
consultant
has put in over
\$1.1 million

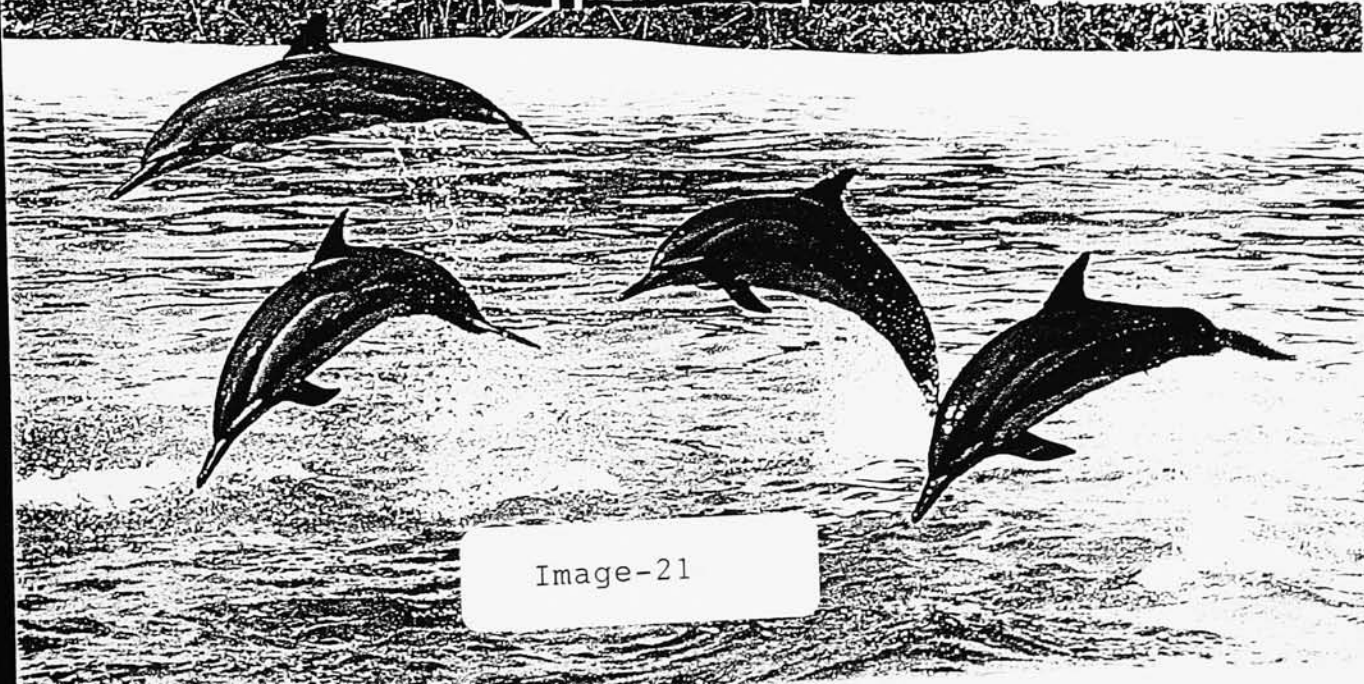


Image-21

LEFT WILDLIFE LIVE

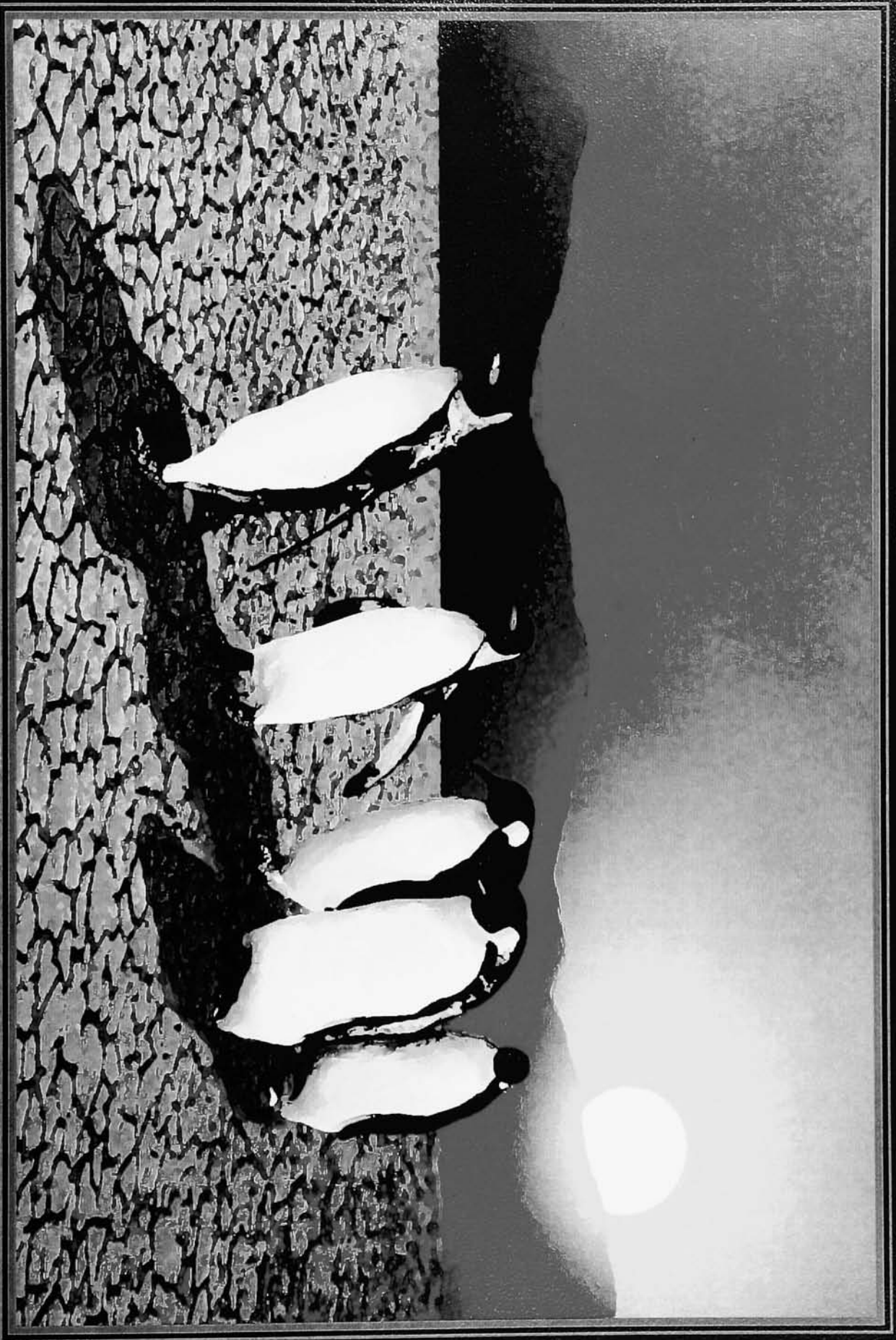
94

19



A COMPUTER ILLUSTRATED 6 MONTH CALENDAR OF ENDANGERED SPECIES

DESIGNED AND ILLUSTRATED BY MARK S. SOMMERS



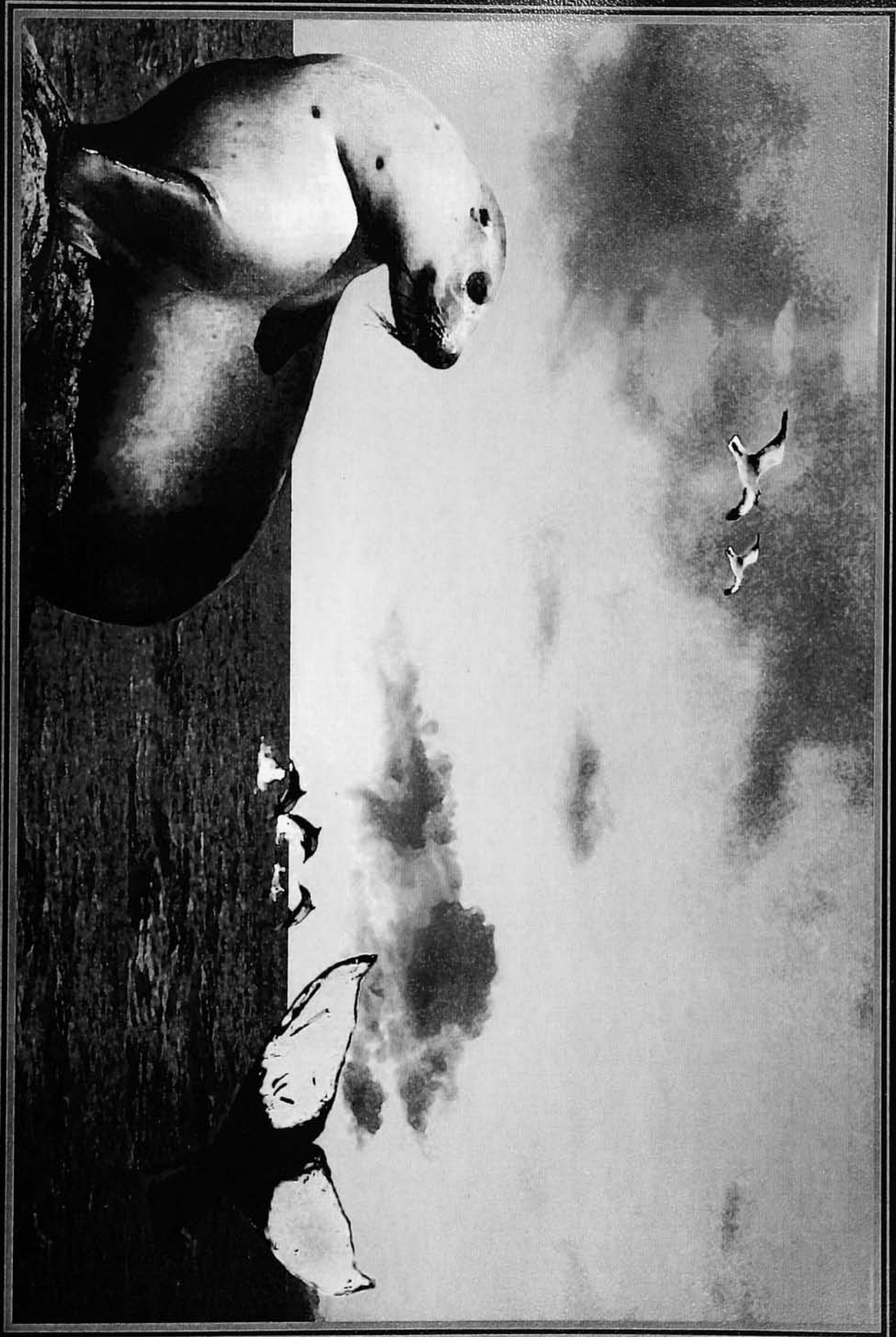
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FEBRUARY

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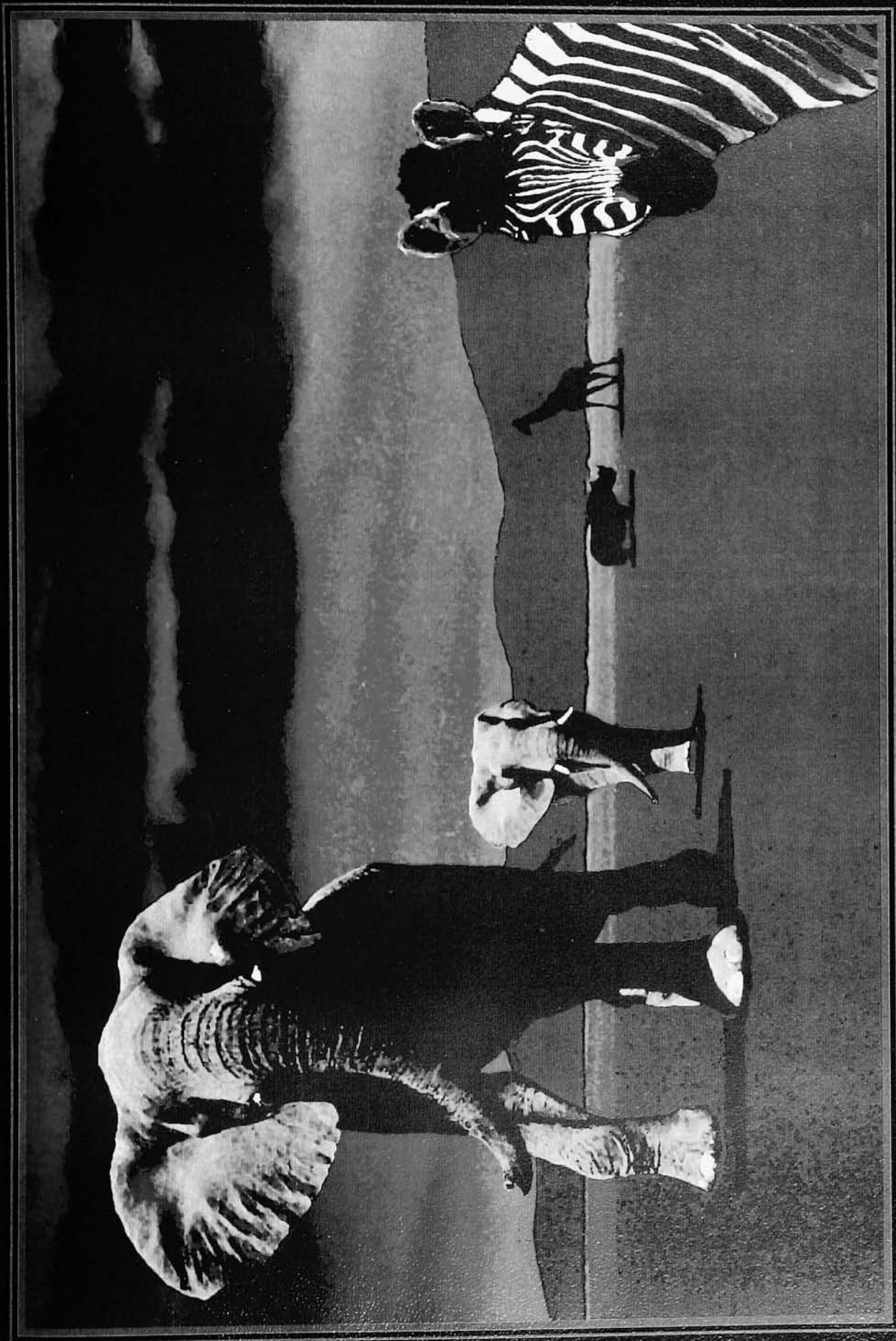
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APRIL

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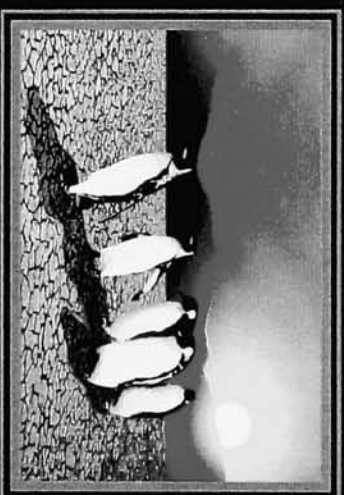


JUNE

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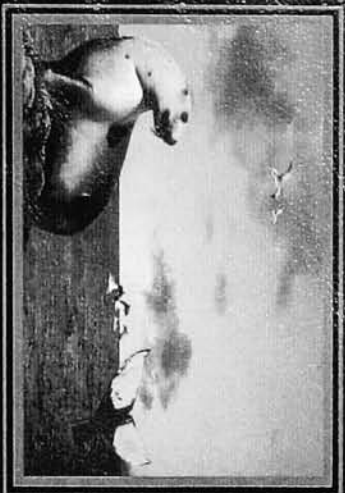
LEFT WILDLIFE LIVE



JANUARY



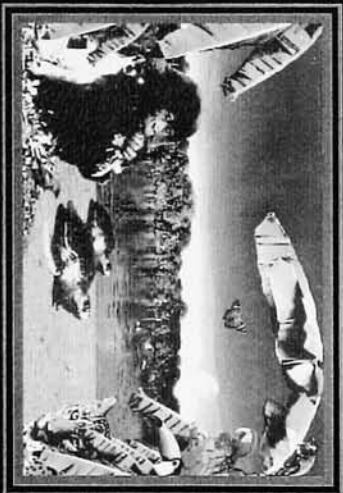
FEBRUARY



MARCH



APRIL



MAY



JUNE

THE ILLUSTRATIONS IN THIS
CALENDAR WERE CREATED
WITH THE IMAGE PROCESSING
TECHNIQUES THAT ARE
AVAILABLE WITH
ADOBE PHOTOSHOP 2.0
THE LAYOUT WAS COMPLETED
WITH QUARKXPRESS 3.1