MONTANA GIS NEWS, Summer 1995

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BLACK-FOOTED FERRET REINTRODUCTION IN MONTANA:
Application of advanced mapping technologies

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Introduction

Understanding and managing animal behavior and habitat conditions is critical to successfully reintroduce an endangered species such as the black-footed ferret. The total number of black-footed ferrets in existence is very low and care must be taken to insure the greatest chance for establishment and ultimately recovery of the species. To help increase success rates and understand techniques to reintroduce ferrets, the U.S. Fish and Wildlife Service along with several other federal and state agencies are using various types of advanced mapping techniques. Technologies used during this effort include Global Positioning Systems (GPS), Geographic Information Systems (GIS), and radio telemetry.

GPS Use

GPS provides a mechanism to accurately map geographical features, record paths and locations, and import data into GIS. Locational accuracy after differential correction with a Community GPS Base Station in Lewistown, Montana (see article on page 5) was thought to be ± five meters or less. Trimble Navigation Ltd., Pathfinder Professional GPS receivers with Corvalis MicroTechnology MC-V data loggers were used for a variety of applications during the 1994 Montana black-footed ferret reintroduction on the UL Bend National Wildlife Refuge in southern Phillips County.

Carnivore Disease Sampling

Carnivores, mostly coyotes, have been collected from the black-footed ferret reintroduction area during January 1993, February 1994, August 1994, February 1995, and August 1995. Samples have also been obtained from adjacent areas on the Fort Belknap Indian Reservation. Coyotes were shot from a helicopter by Animal Damage Control personnel and many of the collection locations were recorded with GPS. Mapping these locations is essential to begin understanding the dynamics of sylvatic plague and canine distemper. The reason for collecting coyotes was to assess the presence and distribution of plague and distemper, two diseases that can greatly affect black-footed ferrets. Although plague does not affect coyotes, coyote blood samples can indicate exposure levels. Plague can rapidly kill prairie dogs and thereby eliminate the habitat and prey source on which ferrets depend. Plague has eliminated many prairie dog colonies in recent years in southern Phillips County and understanding its distribution and dynamics is important to black-footed ferret recovery efforts. Additionally, black-footed ferrets are very susceptible to canine distemper and sampling coyotes may give insights to distemper presence.

Prairie Dog Burrow and Colony Boundary Mapping

Individual prairie dog burrows on colonies where black-footed ferrets were released were mapped with GPS. Data dictionaries were created for each of four GPS units to use the "QUICKMARK" feature of PATHLOG to record active and inactive prairie dog burrows. In addition to GPS recording these QUICKMARK features, a continuous "line" of positions was recorded, once per second, for the travel path of each burrow mapper, to map observer efficiency.

GPS antennas, receivers and data loggers were mounted on All-Terrain Vehicles (ATVs). An ATV was ridden to each burrow and positioned so the GPS antenna was above the burrow entrance. The burrow was recorded on the GPS data logger as active or inactive with a QUICKMARK. The burrow was then visually marked with a squirt of flour from a plastic beverage dispenser to prevent re- mapping or skipping burrows. With a little practice, only a few seconds were required per burrow to determine if it had been previously mapped, position the GPS antenna, ascertain prairie dog activity, record the location, and mark the burrow with flour.

Mapped burrows totaled 12,244 over 609 acres and 90% were active. Active burrows averaged 18.2 per acre and total burrow density was about 20 per acre. Great differences in burrow density (black- footed ferret habitat quality) and distribution were readily apparent in the final maps.

Black-footed ferret release cage placement was based on this burrow map with sites spread across the colony and clustered in areas of higher burrow density. Ferret locations will be plotted on this map in an effort to understand what role habitat (i.e. burrow location and distribution) may have on ferret success. Burrows on this area may be re-mapped in the future to assess changes in burrow location and distribution, and prairie dog colony dynamics.

The Bureau of Land Management and FWS have cooperated for several years in the GPS mapping of prairie dog colony perimeters in Phillips County. Maps and acreage estimations are important information for biologists and managers. GPS equipment is often mounted on ATVs, but foot and horseback travel have also been used. The edge of a prairie dog colony is traversed with the GPS and the resulting data is corrected and transferred to a polygon map in a GIS system. Current maps and displays of colony changes through time are then developed in a GIS and used as a basis for management decisions.

GPS as a Navigating Tool

Coordinates can be entered into a GPS as waypoints and then used to navigate to that point. Errors in current position of ± 150 meter "float" can be expected with this GPS equipment operating in instantaneous, autonomous mode. Nonetheless, the unit proved useful in this mode for several applications using the following approach.

The GPS unit displays cardinal direction and distance from the estimated current position to a specified waypoint. As a geometric function, the inherent "float" in current GPS position has less influence on direction to a specified point the farther the GPS unit is from that specified point.

With this in mind, navigating toward a waypoint would begin "far" (usually ½ mile) away from that point. Coordinates of the desired location might be derived from a map, previously with GPS, or be coordinates or directions derived from radio telemetry.

With the aid of a compass, a person would begin moving in the direction indicated by the GPS and attempt to move so the travel direction indicated by GPS, remained constant. Upon approach to, arrival at, and pass by, the desired location, the GPS direction indicator would change radically and the distance to go would read in 1/100ths of a mile. When that happened, one was as close to the waypoint as this GPS equipment could guide. At that point, visual and/or telemetry guidance was used for further refinement.

With this approach, sites for black-footed ferret release boxes were selected. Coordinates of areas with dense prairie dog burrows and well spaced across the colony were derived from the prairie dog burrow map. GPS was used to "navigate" to these areas and then visual inspection of the area helped in selection of specific sites to bury release boxes.

I can't speak for other project members, but my orientation on a wide-open, "featureless" prairie dog town was not as good as I thought. We relied on GPS to help guide us to release sites we identified from the burrow map

and a few were not the exact spots I pictured in my mental
map. Nonetheless, we placed release boxes in areas as indicated by GPS navigation.

After the release boxes were buried, the exact location of each box was determined with GPS by averaging at least 500 differentially corrected positions at each site. I was surprised to find their location, in every case, exactly where we wanted it based on the burrow map appraisal. If I
had gone more by my "feel" of where I was on the prairie dog colony, the release cages would not have been placed at the locations picked based on study of the burrow map.

Two of the radio tracking trailers were situated in a wilderness area. Use of motorized equipment is generally prohibited in wilderness areas. The wilderness boundary was signed along the ATV access route to one of the trailers, but the boundary was not obvious along the route to the other. The coordinates of the wilderness boundary intersection with the access ridge were estimated from a 7.5 minute topographical adrangle and entered into the GPS. GPS was then used to navigate close to that boundary/ridge location which was then marked with a stake. Use of motorized equipment was limited from that point on.

As a check, 500 GPS positions were collected at the point on the ridge thought to be the wilderness boundary. These positions were differentially corrected, averaged, and then compared to the map- derived coordinates. The points re nearly the same and considered acceptable for the purposes of limiting use of motorized equipment within a wilderness area.

GPS and Radio Telemetry System
A total of 33 sites were selected as radio telemetry sites and marked with wooden stakes. Researchers occupied many of these sites to triangulate the position of black-footed ferrets using radio telemetry. Accurate coordinates for each tracking site are essential to estimating ferret positions.

A minimum of 1000 GPS positions were recorded for each site, differentially corrected, and then averaged to produce the UTM coordinate pair used in triangulation calculations. The remaining sites were established for use with mobile telemetry gear. coordinates were estimated for these sites in the same manner except 500 GPS positions was considered the minimum. A variety of other points re mapped with GPS by recording several hundred positions and averaging the differentially corrected positions, e.g. release sites, dead ferret retrieval sites and ferret trapping and observation sites.

Black-footed ferrets are almost exclusively nocturnal and they were radio-tracked throughout each night during October and November, 1994. When radio contact was lost, a ferret was dispersing, presumed dead, or other situations, searches with hand- or truck-mounted radio equipment were often initiated. The coordinates of all the radio tracking stations were stored as waypoints in the GPS. At any time, the GPS operator could estimate his current coordinates and distance and cardinal direction to each of those sites. Radio telemetry is based on azimuths from each tracking site and the navigation portion of GPS allowed positioning (with a back- azimuth) directly on line with the last known ferret radio signal bearing.

Typically, searches began at the last known fix. GPS was metimes used to aid in navigating to that fix. This was especially helpful when searching for a dispersing ferret at night, on a relatively featureless prairie, in unfamiliar areas. In other situations, the last radio contact with a ferret was from a single tracking station, resulting in a single azimuth line. In this situation, searchers used GPS to locate themselves along that azimuth line for searching at varying distances from the tracking station. Searchers could orient along that bearing from the tracking station with GPS, even when the tracking trailer was hidden by terrain features.

GPS was also used to estimate the accuracy of telemetric fixes. I carried a ferret transmitter while I rode an ATV to differing parts of the ferret release area. I stopped periodically while the tracking crew ascertained my position with telemetry. I recorded a GPS point location at each of these sites. Based on distance and angles to radio-tracking stations, locational accuracy varied. Overall, telemetric fixes were within about 100 meters of positions estimated with GPS.

"Real-time" Use of GIS
During ferret releases, especially the night of a release, there was great interest to SEE a map of ferret movements. Azimuths from tracking stations were sometimes hand-plotted with a protractor on a map to estimate ferret locations. This effort was time-consuming and maps quickly became cluttered and unreadable. For instant gratification, the following method was used to map and display ferret movements within a few minutes of the telemetry crew deriving azimuth readings. Select tracking station azimuth readings were recorded at base camp while monitoring tracking crew radio conversations. These readings were entered into the telemetry program TRITEL, which then produced ferret position parameters, including estimated UTM coordinates. Those coordinates were typed into a file in a format that would write appropriate text on a PC-Arc/Info ARCPLOT display. Part of the challenge was conducting this omputer work/hacking where portable generators were the only source of electricity!

A macro was written for ARCPLOT that displayed a base map showing the locations of all radio- tracking sites, release boxes, roads, fences, UTM grid, section lines, prairie dog colony boundaries, drainages, camp, etc. On this base map the "text file" was drawn and the result depicted ferret locations by ferret numbers and colors on the release site. Multiple "text files" were made to show individual animals, all animals, all males, all females, animals from specific release sites, etc.

This technique was hastily developed during ferret releases. Further development of this ability and linking directly with TRITEL is straightforward, but would require some time to develop.
Plotting ferret locations on an active base map (i.e. can zoom in and out and select a multitude of data layers to display) within a few seconds of deriving a telemetric fix was the goal. Evidently I succeeded, as the atmosphere during one release night with people crowding around computer screens, watching ferret movements as they happened, was not unlike football fans crowded around a bar room TV watching the SuperBowl.

Summary
Reintroduction and recovery of an endangered species is a challenging process. Understanding biological relationships and incorporating economic, societal, and political forces is often controversial. Mapping tools such as GPS and GIS have and continue to assist in practical applications associated with the reintroduction and recovery of black- footed ferrets in Montana.

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AN INVITATION TO GET INVOLVED WITH GIS IN YOUR SCHOOLS

In 1994, the Montana GIS Users' Group formed a school subcommittee to see how GIS might be supported in Montana schools. The Users' Group started the ball rolling to establish a scholarship at Montana State University and the University of Montana. But the GIS community wanted to get younger people involved as well.

At the Seventh Annual Montana GIS Conference in May 1995, the Montana GIS Users' Group had a special section of Public Night aimed specifically at school children. There were several activity booths set up for a wide variety of age groups, and there were prizes for the children that completed the activities.

The next GIS Users' Group Conference will be held in Missoula in April 1996. We would like to expand the GIS activities for the K-12 crowd at the conference. We also plan to develop a "GIS Traveling Box." The box will include lesson plans and equipment, and will travel to schools throughout the state during the school year. To accomplish these goals, we need HELP. Volunteers are needed to supervise K-12 GIS booths at the conference and we are seeking K-12 teachers to advise us on our ideas. The 1996 Conference would be a good time to test our ideas and to see if they would work in the classroom.

Please share your enthusiasm and let's spark some ideas about bringing GIS into the classroom. If you would like to serve on the GIS Users' Group school committee, or help develop K-12 activities for the 1996 GIS Users' Conference, please contact one of the members of the school committee:

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MONTANA LOCAL GOVERNMENT GIS COALITION FORMED

The Montana Local Government GIS Coalition (MLGGC) was formed by a group of interested local government GIS practitioners in July 1995. Membership is open to all city and county government entities in Montana. Members are charged an annual fee based on taxable value (counties) and population (cities). This new organization has six goals: (1) to promote a bottom up approach for data acquisition which begins at the local level, (2) to provide for an exchange of ideas among local government GIS users, (3) to provide information through workshops, seminars, and meetings, (4) to provide a forum to identify common problems and unified solutions to benefit both county and state entities, (5) to establish a vehicle to provide non-computer users with information and technical assistance, and (6) to provide representation and advisement on state and regional technology issues and encourage participation by other interested parties. The Montana State University
Geographic Information and Analysis Center provides technical as well as logistical support.

The MLGGC met at the MACO offices in Helena on 6 July 1995 to adopt by-laws, set membership fees, and elect an interim slate of officers. Steve Helenthal (Yellowstone County) was elected chair, Stu Kirkpatrick (Butte-Silver Bow) was elected vice-chair, Monty Sealey (Musselshell County) was elected secretary/treasurer, and Doug Burreson (Missoula County) and Sue Haverfield (Flathead County) were elected as board members. A number of activities have already been initiated. Coalition members are working with Jackie Magnant at the MSU Geographic Information and Analysis Center to prepare an ArcView 2 demonstration for the September MACO Meeting in Billings. The coalition has also been asked to appoint two members to an ITAC GIS Task Force that is being formed at the request to the Montana Department of Revenue to
review and promote effective use and implementation of GIS at all levels of government. Finally, the MSU Geographic Information and Analysis Center has just learned that it was awarded a National Spatial Data Infrastructure grant by the Federal Geographic Data Committee (FGDC). This one-year grant will be used to: (1) provide additional technical and logistical support to the MLGGC, (2) work with local governments to develop a metadata plan in compliance with FGDC-endorsed Contents Standards for Digital Geospatial Metadata, (3) build a local government data repository in compliance with the FGDC metadata standards, (4) establish a World Wide Web (WWW) node for local governments on the National Geospatial Data Clearinghouse, and (5) implement a Montana Local Government GIS Users list server on the Internet For more

information about this grant and the coalition, call Jackie Magnant at 994-6921.

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GLOBAL POSITIONING SYSTEM COMMUNITY BASE STATION

by Randy Matchett
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The Bureau of Reclamation, Bureau of Land Management, Canadian Park Service, and U.S. Fish and Wildlife Service combined resources in 1993 to purchase, install and operate a Trimble Community Base Station for collection of Global Positioning System (GPS) base data at the Charles M. Russell National Wildlife Refuge office in Lewistown, Montana. The initial system was recently ungraded to a 12-channel receiver with Maxwell chip technology through combined funds from the Bureau of Land Management and Fish and Wildlife Service.

The initial intent was, and remains, to make GPS base station data available to anyone. The interagency agreement used to establish this base station stipulates priority service to the original contributors, but allows others to access the system until demand exceeds abilities to fulfill requests.

Over 40 users from 4 states and provinces in several federal, state, tribal, and private agencies have accessed data on the computer bulletin board maintained for the transfer of GPS base station files. Users login to this system and select the base files they need, minimizing staff time needed for assistance and allowing for continued open public access.

Base station parameters are usually as follows, but configuration and hours of operation sometimes vary as trials of new software and applications are tried. Please call ahead for critical projects of coordinate base station operation.

Pathfinder Community Base Station Software version = 2.32 Pathfinder Community Base Station Firmware version = 2.07 Datum = WGS84 Latitude = 47 03 05.264 North Longitude = 109 26 34.419 West Elevation = 1251.35 m Elevation mask = 10 degrees PDOP mask = 6 SNR mask = 6 Pdop sw = 6 Filter Constant = 0.005 Logging Rates: Position = 5 seconds Synched = 5 seconds Days of operation 7 Hours of operation = 24 (may vary to save disk space by omitting night hours)

Files are collected in hourly blocks and are named with Trimble's default file naming convention with "F" being the file prefix (e.g. F5040916.SSF is a base file from 1995, April 09, at 1600 hours GPS time). These files are available on the bulletin board as soon as data collection is complete for any given hour. At 2:00 am local time, the 24 files from the previous day are compressed into four hour blocks and labeled with the suffix A-F, resulting in six, self- extracting files for that day.

Files for the current month and previous month are maintained online and files two months previous may or may not be online depending on disk space. Files are maintained on tape backups for one year and can be restored. Such restoration requires staff time that is in short supply. Downloading base files while they are online is strongly encouraged.

Because synched measurements are being recorded, users must use Pfinder 2.50 or greater to differentially correct their rover files. Older versions of Pfinder can still utilize base data collected in synchronous mode, but first must run the base file through the program SYNC2RAW.EXE. This conversion program is also available on the bulletin board and converts synchronous base files to the older format compatible with Pfinder versions before 2.50.

Those wishing to use these GPS files may call the bulletin board at (406) 538-2514, up to 19,200 baud, 8 data bits, 1 stop bit, no parity, 24-hours a day. Most people have had the best success using PROCOMM+ with Ymodem (Batch) protocol, but other software packages and protocols also work.

Staff time is limited to provide assistance, nonetheless use of the system is encouraged. If you run into problems, call Randy Matchett at (406) 538-8706 and something will be worked out. Reference to tradenames in no way endorses the products for any purpose by the U.S. Government and are mentioned only as observations of user applications.

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ITAC's GIS TASK FORCE:

Helping Define GIS Statewide

Recognizing the impact of GIS in the state, the Department of Administration's Information Technology Advisory Council, ITAC, recently established a GIS Task Force to help them develop strategic direction for the state. ITAC has recently established a GIS Task Force. ITAC, consists of agency directors; deputy directors; representatives from the executive, legislative, judicial branches; representatives from city/county governments, and representatives from universities. ITAC serves in an advisory capacity for: reviewing statewide information and
data processing policies, making recomendatons regarding the application of new information processing technology in state government, and a division the Department of Administration on long-term strategic planning for use of information processing technology in state government.

The following nine representatives are slated to participate: four ITAC members, one individual from the Montana Natural Resource Information System (NRIS), another person from the Montana GIS Interagency Technical Working Group (TWG), a member from the Federal Geographic ta Committee (FGDC), and two representatives from the Montana Local Government GIS Coalition (MLGGC).

These representatives will gather regularly during the next six months to meet some hefty objectives, including:

Assessing and documenting Montana's current GIS environment (systems, standards, requirements, policies, etc.) and agencies/entities' future plans for utilizing GIS. This process will be enhanced by involving stakeholders (agencies, libraries, universities, schools, federal government, local government, etc.) who have already invested a tremendous amount of time into GIS research, database implementation, and reporting systems.

Reviewing existing GIS standards adopted by the Montana GIS Interagency Management Steering Committee and the TWG and recommending, to ITAC, the approval of those GIS standards that: are in line with federal guidelines for GIS; are widely accepted throughout the GIS industry; and support and/or enhance the enterprise's current IT standards as related to data sharing, database linkage, data integrity, and system interconnection and interoperability.

Identifying and prioritizing GIS issues and concerns that need in-depth study and resolution (possibly by an ITAC- appointed GIS Technical Group).

Recommending the future direction ITAC should take in setting statewide GIS direction and standards; coordinating the development of agency GIS; working with existing state, federal, and local GIS committees and coalitions; and preparing GIS funding proposals for the '97 legislature.

The result of this important work will be a Task Force report presented to ITAC during the spring of 1996. If your questions precede the finished product, please contact Kerry Spickelmier at (406) 444-2469. She is serving as Department of Administration, Information Services Division's facilitator of the Task Force.

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MONTANA GIS USERS' GROUP NEWS

New Board Members Elected
Montana GIS Users' Group members elected two new board members during the recent conference in Helena. The new board members are Loretta Reichert, the GIS Manager for the Reclamation Division Hardrock Mining Bureau with the Department of Environmental Quality and Hans Zuuring, Professor of Biometry, Program Director, Geographic Information Systems Laboratory, at the University of Montana.

They will join Stewart Kirkpatrick, GIS Manager, Butte Silver Bow; Ken Wall, Research Specialist, University of Montana and Principal of GeoData Services, Inc.; Kris Larson, GIS Programmer Analyst, Motnana Natural Resource Information System; Don Krogstad, GIS/Remote Sensing Coordinator, Flathead National Forest; and Fred Gifford, GIS Coordinator, Montana Natural Resource Information System.

Montana GIS Users Group to Award Endowments to Support GIS Education
At the 7th Annual Montana GIS Users' Group Conference in Helena, the group voted to support an initiative from the Board of Directors to establish endowed scholarships to support students pursuing GIS education opportunities at the University of Motnana and Montana State University. The plan is to establish the endowment completely at one university first and then work on establishing it at the other. The endowments will be established at $10,000 each and will provide $500 a year to a selected student. There are several options that the board, in consultation with the education sub-committee, still needs to investigate for setting up the criteria for who the recipients will be. These will be addressed at furture board meetings and presented to the Group during business meetings at the conferences.

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