EARTHLIGHT RESEARCH MANUAL:
OPTICAL OBSERVATION

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Welcome Earthlight investigators! If you would like to conduct your own research, the following manual describes in detail optical Earthlight observation procedures developed and used by IEA. The procedures listed below act as a checklist to provide you a means to document important, but often overlooked, details. By using these procedures you can add to the Earthlight knowledge base. You may wish to submit either data or reports to IEA to have them considered for publication elsewhere on this web site.

Safety and Security:
Earthlights often appear in remote locations, particularly desert locations. You will be out at night so we discourage making observations alone. Bring warm jackets, hats, gloves, and even blankets as temperatures, especially in the desert, can plummet from the 80's (F) during the day to freezing by midnight. A few additional desert tips: Be sure to carry enough water, 1 gallon per person per day. Carry a supply for at least one day more than you anticipate your expedition to last. Also be aware that during the late spring to early autumn, rattlesnakes are nocturnal. It is best to make your observations during late autumn through early spring if you wish to avoid encounters with them. Otherwise be careful, do not put your hands near, or climb, rocks, and always watch where you step. Use a light colored tarp so you can detect if you suddenly have "company." If you camp in the desert it is advisable to use a cot on a tarp to discourage snakes and other critters such as scorpions. Scorpions can be detected using an ultraviolet flashlight, which makes them glow. (link to e-store not yet available). Be aware of weather in the desert and areas that are subject to flash flooding. Floods can occur very suddenly and wash down channels from cumulous clouds over mountains many miles away.

If you are in a remote location be sure you have enough fuel for your vehicle(s). Many people focus on instruments and cameras and forget they need to eat! Remember to bring a picnic dinner or snacks. The best time to eat is after your cameras and instruments are set up, but well before sunset when sightings often occur. A cellular phone is a good safety feature in remote areas. Be sure to test it in the areas you will be traveling before you rely on it, as coverage is often spotty in many remote areas. Cell phone coverage varies with the service providers. Check your service provider's coverage maps. Always tell someone where you plan to go and make an agreement to check in when you return.

Useful tips:
The optimum number of people in a group is two to four. Lights are spotted most easily if two people making observations are facing in opposite directions, or four people sitting back-to-back facing in all four directions. It is optimal to have two teams in

communication by means of two-way radios so that Earthlight sightings can be triangulated and their distance and location determined. During the observation period, it is advisable to use no light other than red flashlights (Link to e-store). Any other color, including white, will interfere with the dark adaptation of your eyes, reducing your night vision and you will not be able to spot dim lights. Smoking tobacco also reduces night vision. It is a good idea to reduce talking to a minimum during observations. Many a light has "gotten away" while a listener politely waited rather than interrupt a talker to tell him about the light over his shoulder! If the area is subject to heavy dew, equipment can become wet before the observation night is over. Erecting a canopy or covering instruments with plastic will help. However, condensation can occur on instruments inside of plastic boxes that have been taken into the field from a warm room. Video cameras are particularly sensitive to condensation. Always carry a large supply of extra batteries of various types used in instruments and flashlights.

Observation site:
If you plan to make observations on private property, first contact the property owners for their permission. Remember to clean up your observation site. Leave it cleaner than you found it. You want to keep the good will of Rangers and Property owners! If you observe in a national park, be aware that there is a law against using a magnetometer within park boundaries.

Standardization of Metrics
Many of the measurements you will make can be made using various scales, or metrics. Converting these measurements to compare to another's data often adds confusion and creates errors. To assure accuracy, IEA suggests standardizing on the following measurement systems.

First, for time, use Universal Time (UT), formerly called Greenwich Mean Time (GMT). Use of UT allows observers to compare data more easily with each other, and with government geophysical data. Use a 24-hour clock instead of AM and PM. Convert to the 24 hour clock by adding 12 to the hour, for instance 4:00 PM = 16:00. This is more accurate because people often forget to note AM or PM. It also allows you to make time calculations more easily. In the field you can use an inexpensive digital alarm clock set to UT to take your readings.

When recording dates (contained in waypoint names on your GPS see below), or in computer data files, use the six character format YYMMDD, or if you have room in your GPS waypoint title use the eight character format, YYYYMMDD. In this format February 14, 2004 would be represented as 040214 or 20040214. Do not use dashes or slashes in your dates. Use of this date format will allow you to sort and manipulate dates more easily than other date formats.

IEA has also standardized on use of magnetic compass bearings (as opposed to true) because no conversion is necessary for location. In order to be able to perform mathematical calculations easily, use degrees and decimal degrees DDD.ddddd, not

minutes and seconds. Use a 0-360 degree compass, (some compasses use a different system--they range from 0-400 and should not be used). When reporting GPS location coordinates, generally five decimal places are used. In order to facilitate distance calculations, West Longitude and South Latitudes are preceded by a minus "-". 121.00000W degrees west would be -121.00000.

Distance measurements are best made in the system with which you are most familiar. For observers based in the US, use miles and feet. Observers, who live other countries where the metric system is used, use the metric system. Always set your instruments to the system with which you are most familiar regardless of where you are. It is important to use the distance measurement system you are most familiar with to reduce conversion errors when you are busy in the field. In order to exchange distance and size data internationally, these values can be converted later by computer when you analyze the data.

1) GENERAL SETUP

A) GPS SETUP
   1) Set GPS to Magnetic (not true)
   2) Set GPS to decimal degrees
   3) Set track on
   4) Set WAAS enabled if you have it
   5) Set time zone to Universal Time (GMT) use 24 hour clock
   6) Distance to your most familiar setting, miles and feet (US), or meters and km

B) DATASCOPE SETUP:
   1) Set to Magnetic
   2) Set to decimal degrees
   3) Set time to UT
   4) Set time to 24 hour clock

C) CHARGE/REPLACE BATTERIES

2) PREPARATION BEFORE GOING TO SITE:

A) Use atomic clock to set and synchronize UT (GMT) times on the following equipment...
   1) PST +8 hours
   2) MST +7 hours
   3) CST +6 hours
   4) EST +5 hours
   5) Subtract one hour from all above during daylight savings time. UT itself does not change with daylight savings time.

B) Video Cameras (take a picture of the clock).
C) Film camera
D) Laptop computer
E) Datascope
F) HP200LX or palmtop computer for radiation measurements

G) Check instruments
   1) Check lenses on equipment for dust. Clean if required.
   2) Check batteries in GPS
   3) Check/charge video camera batteries
   4) Check/charge FRS radio batteries
   5) Check batteries in night vision scope
   6) Compare magnetic compass to each of two data scopes. Recalibrate Datascopes if necessary.
   7) Check supply of videotape
   8) Check VLF system to confirm operational

3) PLAN TO ARRIVE AT SITE AT LEAST TWO HOURS BEFORE SUNSET (Bring a picnic dinner to eat after equipment is set up but before sunset)

A) Attach all cameras on their tripods. Take GPS Coordinates including elevation of each camera. Waypoint titles are often limited to 8 characters. Best to use two letters to signify the place and include date in Waypoint title YYMMDD as you may return to observe at the same site several times. An example waypoint title PT040213.

B) Videotape all 360 degrees of the landscape turning the camera slightly overlapping the landscape in the viewfinder. Note the bearing of the center of the viewfinder and also note the exact bearings of important features such as mountains, roads, vegetation obstacles to horizon etc.

C) Set out colored LED flashlights while looking through master video camera. Work with team member to place lights at exact degrees of cardinal points from one of the cameras. (0,090,180,270) Use measuring tape to place flashlights 75 feet from the master camera. (So that color and intensity can be "calibrated" and compared to earthlights)
   1) White =North = 0 degrees =(snow)
   2) Red= South= 180 degrees =(warm)
   3) Blue = West = 270 degrees =(ocean)
   4) Green= East = 090 degrees =(mountains)

D) Take the bearing of each colored LED light from each camera.

E) Photograph colored LED light positions at dusk so colored LED light colors as well as landscape can be seen, by all cameras. Also, take one picture showing the date, site, equipment setup, and camera number/name for each camera.

F) Take GPS coordinates including elevation of each flashlight.

G) If Earthlights are expected to appear in a particular direction, place purple and amber lights 30 degrees between the cardinal point lights. Take their GPS positions. They can be used as a backup to determine bearings, and to determine the zoom level of the camera (important to estimate size and brightness).

4) GENERAL PROCEDURES:

A) Use 24 hour clock settings

B) Set all clocks in all devices to nearest second UT (GMT)

C) Use manual camera settings.
   1) Set video
      (a) Camera lens focus to infinity and aperture to maximum.
   2) Set still camera
      (a) Lenses to infinity.
      (b) If you expect dim distant lights use maximum aperture (lowest *f* number)
      (c) If you expect bright closer lights using a high aperture, number and longer exposure may give better focus.
      (d) Use bulb setting if available, otherwise use night setting or longest possible exposure
         (i) Use exposure times from 30 seconds to 5 minutes depending on ambient light and earthlight intensity. It is a good idea to take several pictures at different exposure times.

D) Set up at least one video camera (the master) to record continuously. This will be the master video and audio log that will record all sightings. It is helpful to have a headset and microphone attached to this camera. Describe all events loudly, so that the camera can "hear"/record them. When a team member makes a comment, the master camera person should repeat it so that the camera is sure to record it. Include the following data in your spoken observations:
   1) All observations,
      (a) Magnetic bearings of Earthlights
      (b) Weather changes
      (c) People arriving or leaving
      (d) Equipment failures
      (e) Battery changes
      (f) New data file creation
      (g) All changes to camera settings
      (h) Changes to other equipment
      (i) Observations that may be needed later during analysis.

E) Photography techniques
   1) When photographing or videotaping an earthlight always try to have the horizon or a reference light in the photograph. Yard and ranch lights can be used, but your colored LED lights are better.
   2) Always use tripods--handheld cameras produce artificial "motion."

F) You will use several videotapes during an observation. Announce date, time, and location at the beginning of each tape in case there was an error setting the video camera time. Announcing the location is very important….dark looks the same everywhere.

G) On the first master tape, record who is present in the research party on that date.

H) When light is observed, you need to tell others where to look. Yell "light," then the direction determined by the color of the LED flashlight, and distance from horizon by "ground," "horizon," or "high." That should be enough information to allow others to quickly find it.

I) Do not try to determine the nature of a light unless it is clearly a car on a known road.
J) Photograph and/or videotape all possible Earthlights--decide what they are later by reviewing video or photograph... Film and tape are cheap, opportunities are rare.
K) Determine bearing of all lights.
L) Note time that a possible Earthlight appeared. Keep a clock nearby set to UT to record the time. If you use your wristwatch, speak the time to the camera and write a note that you are using local time.
M) If a possible Earthlight is moving, take additional bearings and note times of each bearing
N) If a light disappears on video camera, continue photographing the area for at least a minute after light goes out
O) Use only red flashlights to take readings and walk around to keep your eyes acclimated to the dark.
P) If possible, look at the computer screen to see if any instruments have recorded any unknown readings. If so, make a voice note of it on the master video camera.

5) REMOTE TEAM:

A) Set GPS track ON
B) Walk or drive to remote location preferably in the daylight
C) Attempt to separate by at least a mile. Two miles or more are better. Radio contact is the limitation.
D) When outbound, continuously check for radio contact. Move to another location if contact is lost or retrace position to last radio contact.
E) Get in a location where radio transmission quality is good. It will be difficult to change after dark.
F) Take GPS waypoints that includes date in the form YYMMDD. Be sure to include elevation.
G) Take note pad to jot down bearings and times of lights.
H) If possible take camera gear
I) Recording/reporting a light
    1) Take a bearing
    2) Report light by radio to master camera of base team
    3) Report bearing of light after asking if master camera is ready to copy
    4) Report additional observations
    5) Take notes of observations
        (a) Time
        (b) Bearing
        (c) Distance if possible
        (d) Motion
        (e) Color
        (f) Character etc.
    6) For a longer duration Earthlight try to synchronize taking of bearings with the base team.

J) RADIO PROCEDURES:

1) Hold the radios close to the camera microphone or wear radio on clip that you can attach to yourself near your shoulder.
2) Repeat radio messages back to the sender and simultaneously into the master camera microphone to verify it was heard correctly
3) Communicate with other team(s) by radio to attempt to observe same light
4) Remote team should inquire if master camera person is "ready to copy" (sometimes camera person will be busy photographing a light or recording local bearing)
5) Check to see if bearings reported make sense
6) When reporting bearings always report leading zeros. Such as 20 degrees, you would say zero two zero degrees.
7) Say "zero" not the letter "O".

6) AFTER EXPEDITON:

A) Download GPS tracks and waypoints into computer

B) Plot bearings of lights on computer determine distance and GPS coordinates using GPS or Map software. The process of locating a light using bearings from two teams is called *triangulation*. The position of the light is calculated from knowing the coordinates of each team and the bearing of the light from each. If you draw a line on each bearing from the coordinates of each team, the light will be located at the intersection of the bearings.

C) Explore area where lights were triangulated, check for

1) Active roads
2) Ranch or house lights
3) Stadium lights
4) Farms with tractors or harvesting machines
5) Air strips
6) Reflective objects
7) Railroad tracks

D) Review video tape using a video log form:

1) Capture still video frames of interesting lights
   (a) Video frame picture data:
      (i) Tape #
      (ii) Date,
      (iii) Time,
      (iv) Video frame number
      (v) Put a descriptive caption in the name of the photo
2) Listen to sound track of video
   (a) Record bearings of lights
   (b) Other comments from observers
   (c) Make note of exact times from camera timestamp
3) Make AVI or MPEG video clips of interesting activity. Note date, time, and location.

4) Make notes of questions that need to be answered about the site in future expeditions
5) Make notes of improvements in observation techniques

E) Send interesting data to **info@earthlights.org** for further analysis

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