Project title: *In Search of Sunken Warbirds: A remote sensing survey of Lake Michigan*

Principal Investigator and institution: Dr. Robert Neyland, Naval Historical Center

Expedition Title: *In Search of Sunken Warbirds: A remote sensing survey of Lake Michigan*

Expedition dates and itinerary: May 28-June 6, 2004

Friday 28 May: U.S. Navy Explosive Ordnance Disposal (EOD) MU10 depart Norfolk, VA
Saturday 29 May: EOD MU10 and NHC field supervisor arrive Chicago Ill., launch boats and secure equipment at Calumet Harbor Coast Guard Station.
Sunday 30 May: Interview with *Chicago Tribune*. Ops 0800-2000
Monday 31 May: Ops: 0800-2100
Tuesday 1 June: Ops: 0800-0300 Met with Illinois "Girls Take Off" at Calumet Harbor CG.
Wednesday 2 June: Ops: 1100-0230
Thursday 3 June: Ops: 1100-2400
Friday 4 June: Ops: 0730-0400
Saturday 5 June: NHC Field Supervisor departs for Washington DC. EOD MU10 depart for Norfolk, VA.
Sunday 6 June: EOD MU10 return to Norfolk, VA

Chief Scientist and institution: Wendy M. Coble, Naval Historical Center

Co-Sponsors/ partners/ participating organizations: EOD MU10

Vessel Identification: 7-meter RHIB , 27' Boston Whaler (BW)

Primary Equipment: Triton Elics Isis Sonar Acquisition System, Edgetech DF-1000 Towfish, Klein System 3000

Geographic area of operations: Southern Lake Michigan, within a 20-mile radius of Calumet Harbor Coast Guard Station.

Summary of Expedition Objectives: Five of the ten targeted areas were either fully or partially surveyed. Apparent zebra mussel colonies were noted. Three likely targets were identified.

Milestones Achieved: Five of the ten targeted areas, plus one area where a search was not planned, were systematically searched using side scan sonar technology. The survey was hampered by thunderstorms and equipment malfunctions, but despite these problems, much useful data was collected. Colonies of what appear to be zebra mussels growing on ridges of sand, unattached to any objects were noted, verifying information already gathered about the spread of this non-native nuisance species. The colonies were not

noted farther out into the lake, which is a good sign for the preservation of submerged cultural resources in deeper water. Of the five areas searched, preliminary analysis indicates that possibly three sites have been located. Target six, an area where a Hellcat might have been, was thoroughly searched, with no resulting likely targets, but this site will be more thoroughly discussed in the final report. This was important data as there was speculation as to whether this aircraft had been recovered prior to the survey. Subsequent to the removal of a Hellcat this year, we can now say with relative assurance that there are no remaining Hellcats in the Lake Michigan Assemblage. It appears that all three likely targets are very nearly where we calculated, which validates our theories and assists us in our management plan. We can now be somewhat more assured that the aircraft should be found within a one-mile radius of their last known position. This fact makes management easier, but does verify a higher threat level for the sites, as a large percentage of the historical information is publicly available.

Sample of log entries: "6-1-04 Repositioning targets again. Put them into HYPACK again. Decided to go for 2117 (which was really 06915) because it was decided that 12301 was too close to shore. The belief is that has been recovered since it is so close to shore. May go back to that target.

(Brown, Umpuch, Myers, Fecteau and me) underway by 1000, on target by 1130. Computer/fish/cable/generator/power problems, so returned to check/get spares, then went back out.

On station by 1400- breakers, 3-4' waves, multiple rollers.

On the way to the survey area we ran across what looks like a hit. We went back but didn't see it again. (In reality we have this target many times, but didn't recognize it again until processing the data.)

We were late to talk to GTO so only ran 3 lanes, 11, 12, and 10. No hits.

Came back and Fecteau talked to the girls- went well, very interested, some asked more questions than others.

A reporter from WGN came and thought there would be a press conference. When I told him he could be there while we talked to the girls he waited some, but …left. He didn't seem to want to ask any questions.

We ate and then went back out at 2000 for a night op. (Brown, Umpuch, Fecteau, Myers and me).

The weather was very cooperative and the later the better (the weather got). By the time we quit there were virtually <u>no</u> waves. We ran over the unexpected target again but got no hits.

We went to the 2117 (06915) area and ran lines 21-13 and 11 again. Very good data with too much overlap, but nothing that looks like a plane. Decided to widen the lanes to 150 meters rather than 100 m and will probably cut down the number of lanes.

Broke off ops at 0330 and returned to (Calumet Coast Guard) station.

After 5 hours of sleep we hit it again.

Cable length 10 meters, 485 minutes night run."

Summary of Digital Data Collected: Side-Scan Sonar images using the Triton Elics Isis System and the Edgetech/Klein system. 8.5 GB of data. Approximately 10 minutes of video images obtained on high-resolution mini-dv tape. 44 digital still images.

Summary of outreach and educational activities: The expedition included a shore visit from the *Girls Take Off* program. This after-school program encourages middle school girls' interest in math and science careers by introducing them to real life applications for the subjects, and to women with careers in fields using math and science. The project's chief scientist had prepared the girls on what to expect prior to the survey with in-class and web educational exercises. An example of one of the preparatory exercises is attached at the end of the Quick Look Report. The shore visit was very well received. The girls and their sponsors toured the boats and talked to the EOD survey crew and the chief scientist who explained the equipment and software to an eager audience.

In addition, two press releases were sent out notifying the public of the survey work. The NHC issued one release prior to the project's start. An article in the *Chicago Tribune* and *Naval Reserve News* was generated from that release. NOAA issued a second press release after the work was completed.

Thoughts for the Future: EOD Mobile Unit 10 would like to continue the surveys and found the work very useful for their training. Unfortunately, one week is not enough time to do more than a cursory search. Weather on Lake Michigan is unpredictable and violent storms can appear quickly. Nighttime operations seemed preferable to daytime - as the sea state became much more smooth. Electrical problems are a given in that area. If further work is done, expect equipment failures and plan extra down time to mitigate the problems.

EOD MU10 has the equipment, personnel and the desire to search for high priority targets. Once the management plan is complete and a priority of wreck sites established, it would be beneficial to search for the highest priority targets. Their work is less expensive and more reliable than purchasing unverified information at a premium price from outside sources.

Summary of Expedition Operations

Date	Boat	Target ID	Location	Lanes run
5-30	RHIB	00564B	41 44’ 15” 087 28’ 00”	3
6-1	BW	12301AT	42 03’ 00” 087 18’20”	0
6-1	RHIB	42583A/B	41.4780 087.1810	3
6-2	BW	06915A	41.5510 087.2140	12
6-3	RHIB	06354A	41 54’20” 087 16’50”	6
6-3	BW	06915A	41.5510 087.2140	5
		06660/5662	41 54’45” 087 27’20”	7
6-4	BW	06915A	41.5510 087.2140	14
		06660/5662	41 54’45” 087 27’20”	10
6-4	RHIB	42583	41 47’10” 087 18’00”	20
		06354	41 54’20” 087 16’50”	20

Selected Images:

The following images are included as promising information requiring further analysis. Each of these and many other images will be thoroughly discussed in the final report.

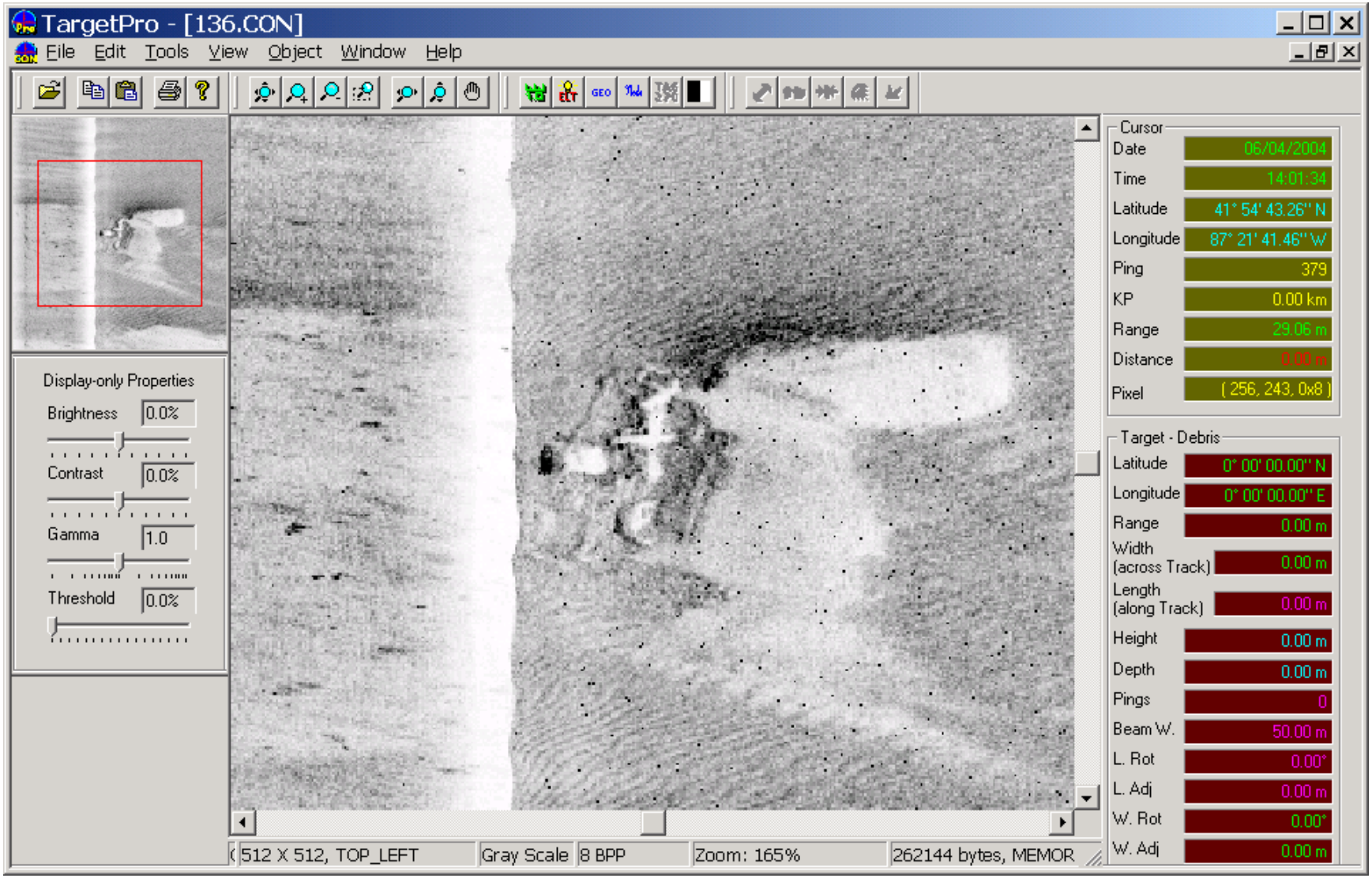


Image 1.

This target is likely a plane and is within a half mile of the last known location for SBD-4 06915

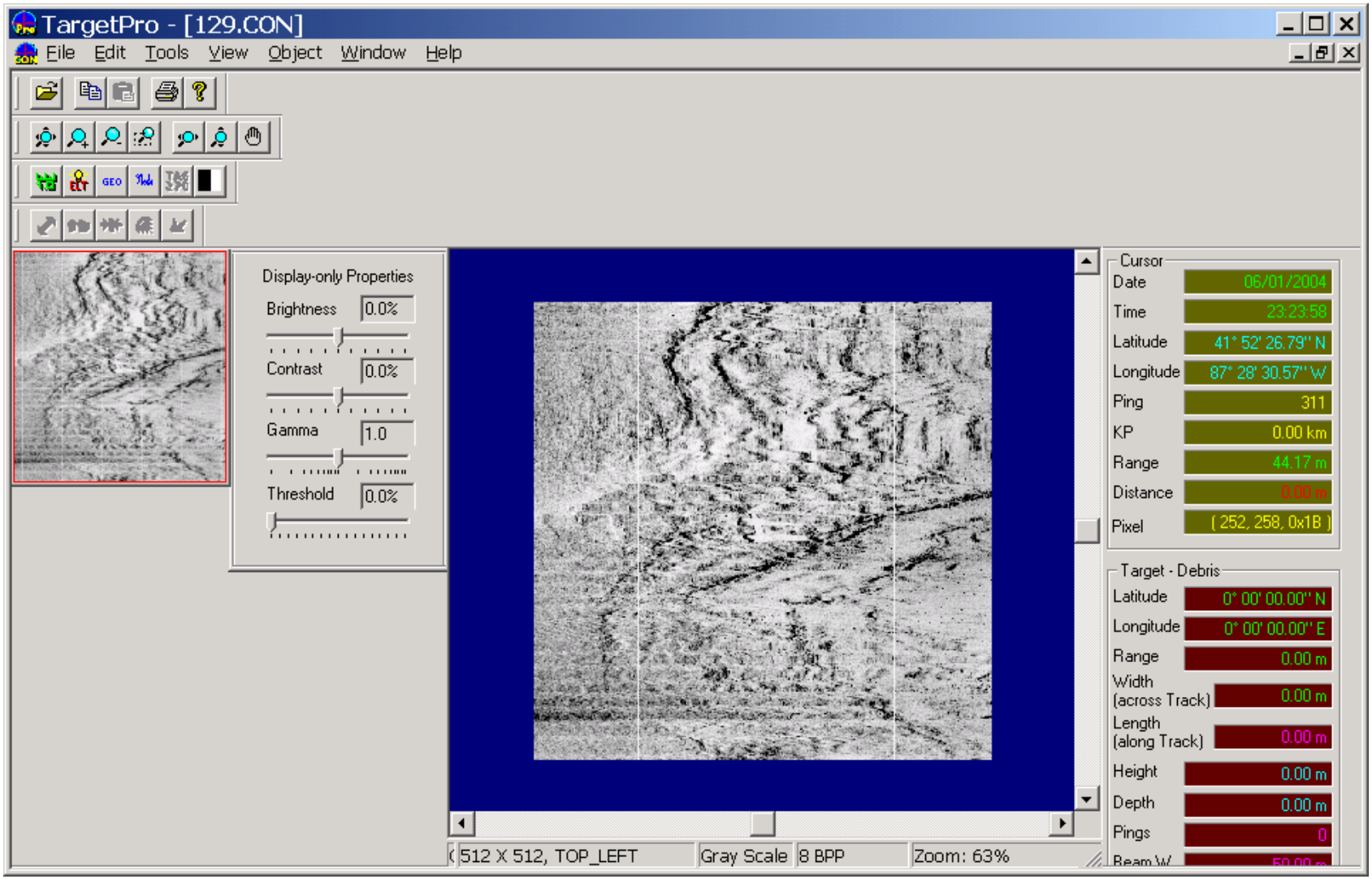
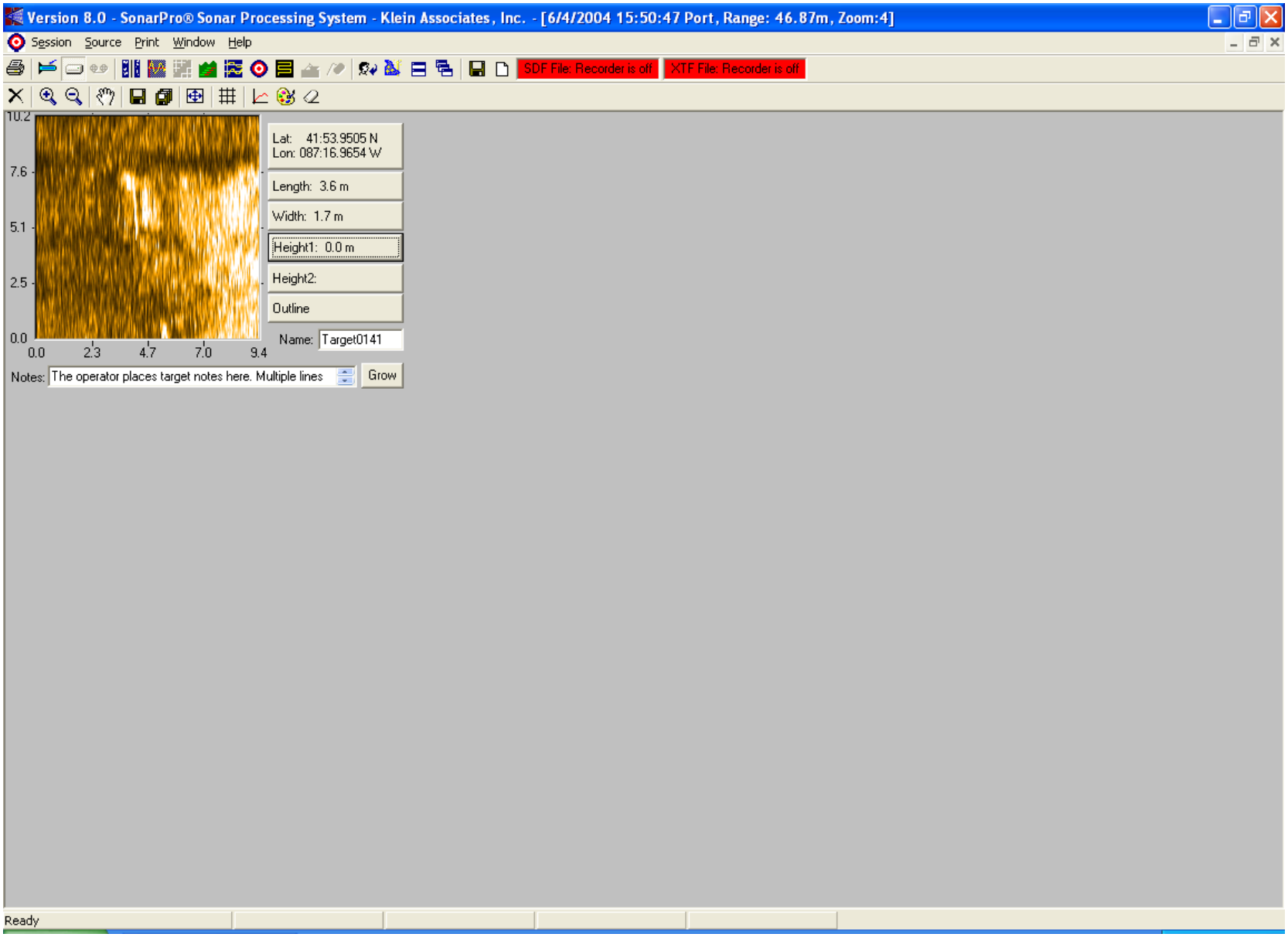


Image two. This image looks very much like a plane, it is very interesting, but may not be a plane.


Version 8.0 - SonarPro® Sonar Processing System - Klein Associates, Inc. - [6/4/2004 15:50:47 Port, Range: 46.87m, Zoom:4]
Session Source Print Window Help
SDF File: Recorder is off
XTF File: Recorder is off
10.2
7.6
5.1
2.5
0.0
0.0 2.3 4.7 7.0 9.4
Lat: 41:53.9505 N
Lon: 087:16.9654 W
Length: 3.6 m
Width: 1.7 m
Height1: 0.0 m
Height2:
Outline
Name: Target0141
Notes: The operator places target notes here. Multiple lines
Grow
Ready
Image three.

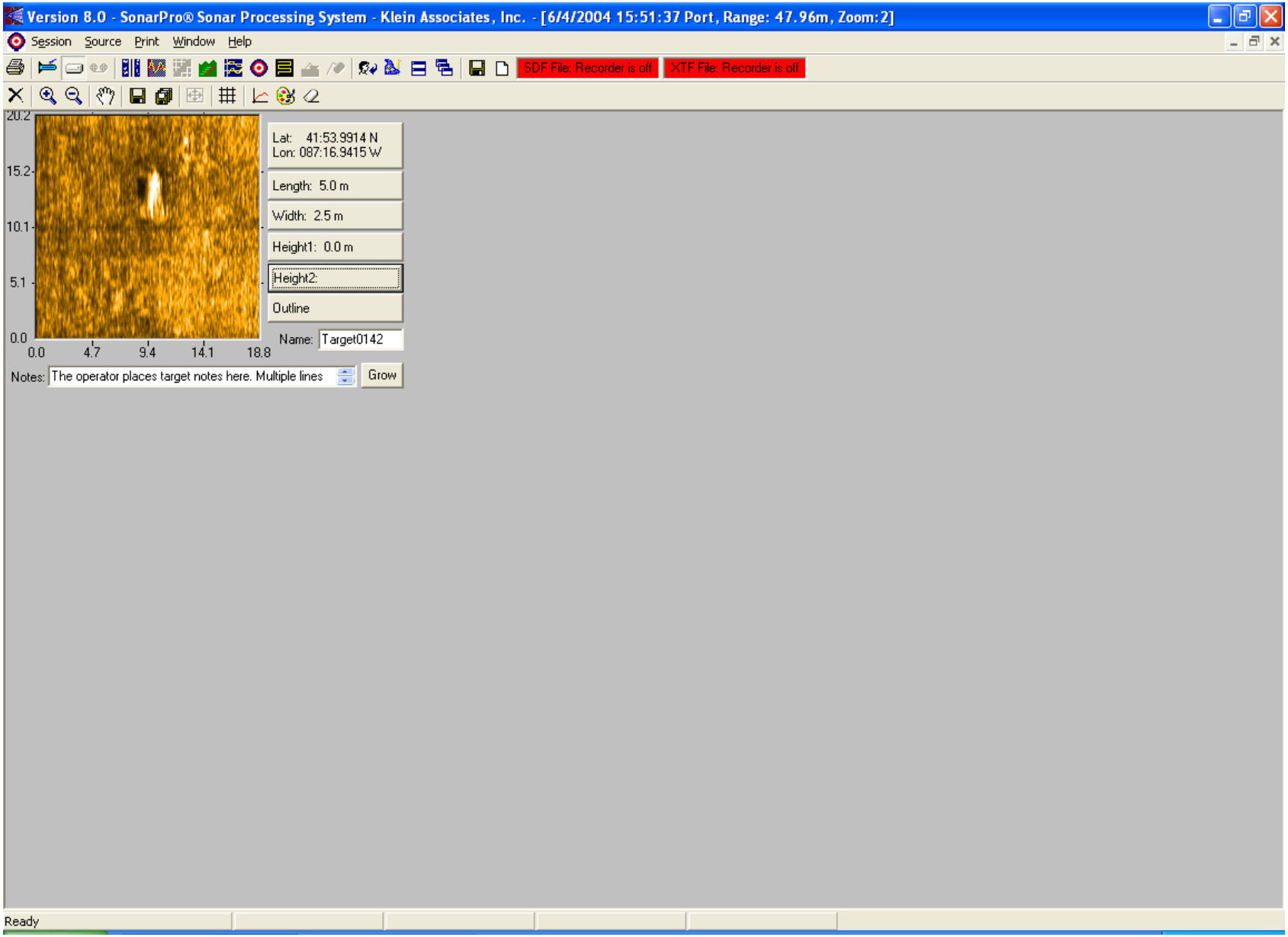


Image 4. Images 3 and 4 could be Avenger BuNo 06354 broken in two pieces.

Image 5 Image 6

These images of an Avenger in Lake Michigan were found at the following Internet site: http://www.sonarsearch.com/avenger.htm. Image number 5 is very similar to image number 3. Image number 6 appears to indicate that this plane is broken in two pieces. The location of images 5 and 6 is not recorded on this Internet site.

Mapping Exercise
(Teachers)

Goals: to learn the mathematics behind plotting a position on a map so that students can find a likely position for an aircraft wreck in Lake Michigan.

Task: The theory behind the procedure will be explained using latitude longitude and bearing coordinates, and practice plots will be given. The ultimate assignment is to plot the location of a specific wrecksite.

With this segment you will learn how to plot a specific location on a map using historical information provided for you. This will involve plotting points on *x*,*y* rectangular coordinates, and using a compass to find a position using a compass bearing. For all of the wreck sites I will be looking for the first week of June, I used either latitude longitude coordinates or bearings. This information was found in the deck logs of the ships these aircraft were training from. Every day one person kept a log- sort of like a diary- of events as they happened for that day. If an aircraft crashed they often recorded the position in case someone needed to come back to find the aircraft. Using that information, I plotted the location on a paper map, and later in a computer program, which will be used in our survey.

One thing to keep in mind is that not all maps use the same information even if they look the same. If you are looking at historic data, you need a map from that time period to be sure that your plots are accurate. Remember that the magnetic fields of the earth can shift, and the Magnetic North Pole does move, so a map drawn in 1932 isn't going to have Magnetic North at the exact same place as it is today. It doesn't move that much, say maybe a few miles one way or the other, but when you are looking for something very specific, a few miles makes a big difference.

I will explain the process to you, and give you some practice plots, and then you'll get the chance to plot a real wreck based on decklog information. We will be talking more about that specific site later.

Latitude/Longitude

Please go to this website and read about Latitude and Longitude:

http://www.punaridge.org/doc/factoids/Navigation/Default.htm

Although I know that the above explanation says *x*,*y* coordinates aren't sufficient to explain Latitude and Longitude, and that is true, when plotting a position on a map using Latitude and Longitude, you must use that type of coordinate to find the position on a paper map.

If you are not sure how to plot *x*,*y* coordinates using a grid, please see the attached explanation/worksheet.

If you were looking at the earth as if North and South were straight up and down, and East and West were perpendicular to North and South, then North and South would be the *y* coordinate and East to West would be the *x* coordinate. North to South is Longitude, and East to West is Latitude. Each degree of Longitude and Latitude can be broken up into minutes and seconds. There are 60 seconds in a minute and 60 minutes in a degree. So a Latitude of 86°30' 30" (the ° sign denotes degrees, the ' sign denotes minutes and the " sign denotes seconds) is 86 degrees plus another half degree, plus another half minute.

Look at the map of Lake Michigan that I sent. The outer edge is marked in segments of black and white. Every so often is a number. Those numbers on the left and right hand margins are Latitude and those numbers along the top and bottom edges are Longitude. Using a straight edge yardstick or some other straight edge that reaches all the way across the map, line up the top and bottom edges where the 86° point is. Now draw a pencil line along that yardstick so that you've marked the map from top to bottom at 86°. Now, using the same yardstick, turn it perpendicular to that line and find 42° on both sides of the map. Draw a line across the map at 42°. Now, where the lines cross or intersect, is 86° 00' 00" N Longitude by 42° 00' 00" E Latitude. It is 00 minutes and 00 seconds because you are right on the line of 86° and 42°

Now, to find 86° 30' 00" you would move the yardstick to halfway between 86° and 87°, because 30' is half of a degree (30' is half of 60'). On the map I sent you, it will be difficult to find seconds because the scale of the map is too big, but you can estimate it. For instance 15" is ¼ of one minute because 15 is ¼ of 60. 30" is half a minute, because 30 is half of 60.

So, let's give it a try. Please find these coordinates on the map provided:

41° 45' 15" N, 86° 30' 45" E

42° 00' 15" N, 87° 00' 00" E

41° 40' 10" N, 86° 45' 10" E

42° 45' 15" N, 87° 40' 20" E

41° 20' 15" N, 86° 35' 15" E

42° 50' 25" N, 87° 41' 09" E

41° 18' 16" N, 86° 33' 18" E

42° 57’ 18” N, 87° 26’ 37” E

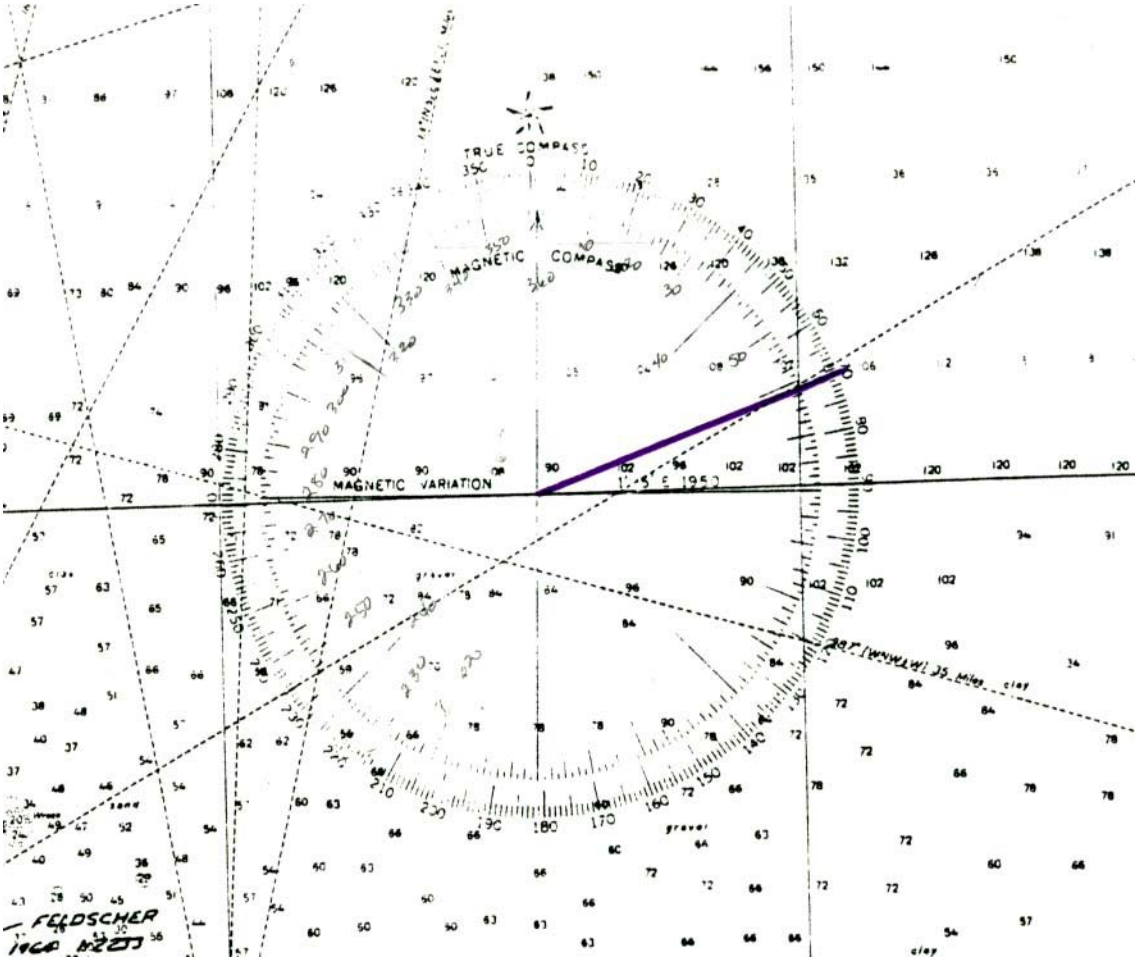
Bearings

Okay, so sometimes you don’t get Latitude and Longitude coordinates. Sometimes it is a bearing coordinate. Bearings refer to degrees on a compass. You will notice there are three compass “roses” on the map. Unfortunately they didn’t copy too well, so you will notice that I wrote some of the degrees with pencil. A compass rose has 360° on it. Let’s say you face North; if you turn all the way around so that you face South, then you have turned 180° or halfway around the compass bearing. From facing North, if you turned to your right one quarter turn, you have gone 90°. If you start at North and turn past South to West you have turned 270°.

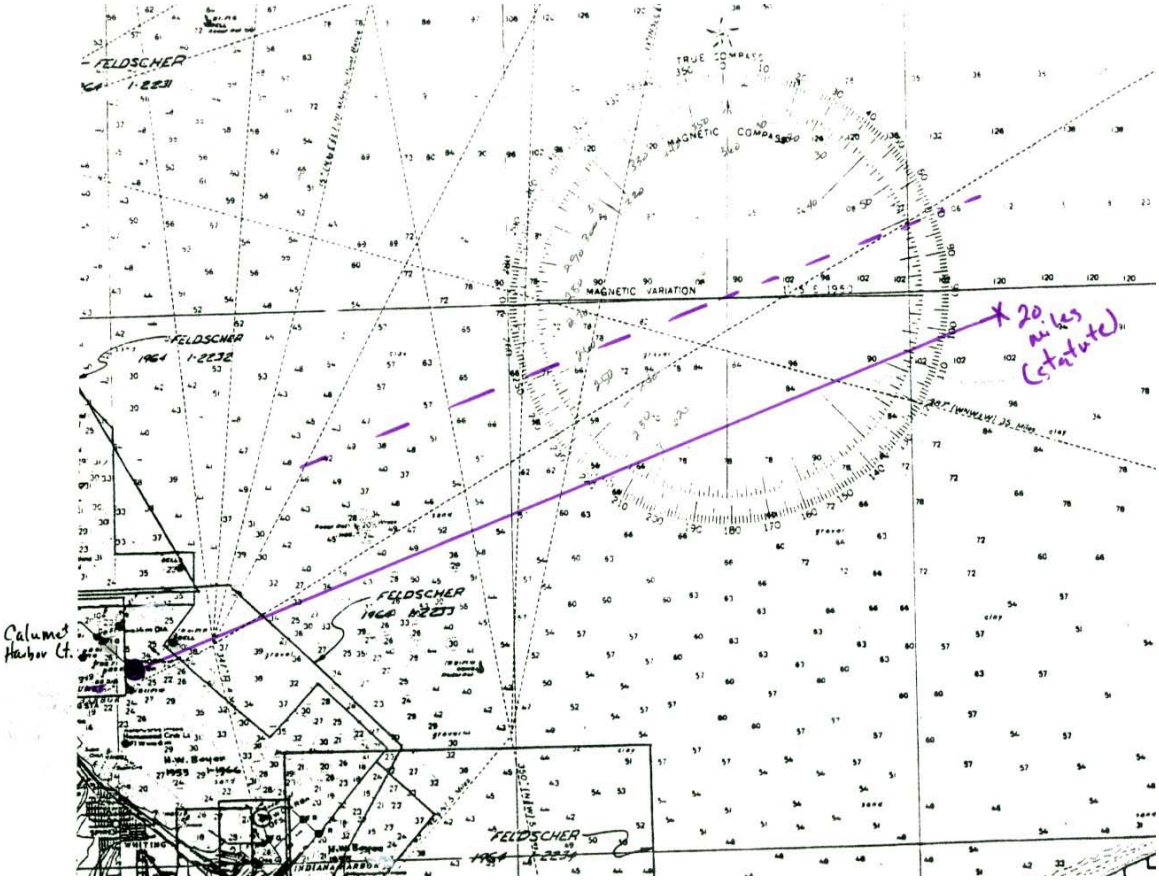
If you want to find a point using bearings you will need to know the compass reading and the distance from the point of reference or if you don’t know the distance, you need to have more than one bearing line to find that point. Even with a distance, it is better to have more than one bearing line as that makes your position more accurate. It’s kind of like having more than one witness to corroborate a story. The more reference points you have, the more accurate your plotting will be.

Take the parallel rulers I sent, and position them over the closest compass rose, to the area you will be measuring from. In your work please use the True compass not the Magnetic Compass. True is the outer ring, and Magnetic is the inner ring on the compass rose.

Let’s do a bearing from Calumet Harbor. Find Calumet Harbor on the map. Then find the nearest compass rose. Now, if the bearing is 70°, distance 20 statute miles (when working in the water you usually use nautical miles instead of statute miles, but since your map scale is in statute miles please use that form of distance measurement), you place the parallel rulers so that they are parallel to the mark for 70° and also through the middle of the compass rose, like this, (note the purple line):



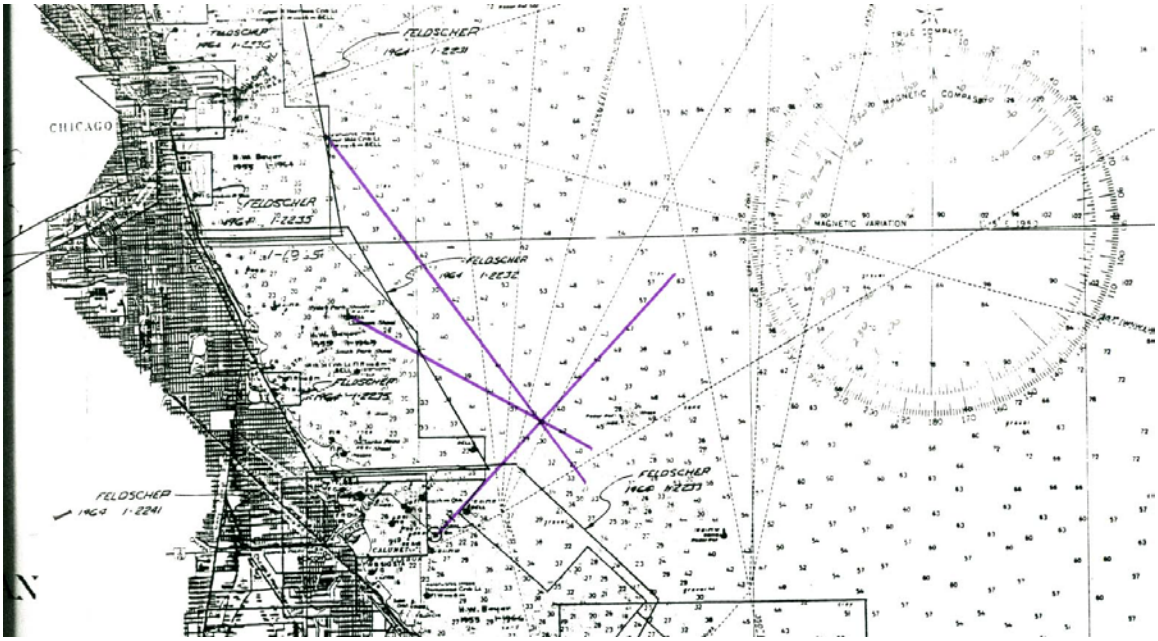
Now, walk the parallel rulers by sliding first one, and then the other, but maintaining the angle, over to Calumet Harbor (this is why you should use the closest compass rose, because you have a shorter distance to "walk" the rulers). Now, draw a line from Calumet Harbor Light, out as far as the ruler extends. The line should now look like this. See how the line is parallel to the line you drew in the compass rose (now a dashed purple line):



Now take a different ruler, one with marks on it to show inches or centimeters, and go to the map scale at the bottom left hand corner. Place the ruler parallel to the scale and measure how far 20 miles would be. Go back to the line you drew from Calumet Harbor Light, and measure the 20 miles based on the measurement you obtained from the map scale. Put an X at that spot. That is the location you are looking for.

So, now that you know how to find Latitude Longitude, go back to the X you made on the map and write down the Latitude Longitude for that X.
Answer: 41° 50’ 00”, 87° 09’ 00”

Sometimes you don’t have a distance, just a bearing angle. In that case you plot probably three bearings for that location, and where the bearing lines cross, that is the spot you are looking for. It would look like this:



This is 225° from Calumet Harbor Light, 300° from Hyde Park Light and 324° from Four Mile Crib Light. What would that Latitude Longitude coordinates be?
Answer: 41° 46' 25", 87° 27' 15"

Here are some practice bearings and distances for you to work on. Please plot the bearings and then find the Latitude/Longitude coordinates and write them down.

Point Locations:
Carter Harrison Crib Light: 41° 55' 00 ', 87° 32' 40"
Chicago Harbor Light: 41° 53' 15", 87° 35' 15"
Four Mile Crib Light: 41° 52' 20. 87° 32' 30"
Hyde Park Shoals Light: 41° 48' 30", 87° 32' 00"
Calumet Harbor Light: 41° 44' 10, 87° 30' 15"

Bearing: 53° from Carter Harrison Crib Light, distance 8 ¼ miles.

Answer: 41° 59' 00, 87° 25' 30"

Bearing: 80° from Hyde Park Shoals Light, distance 6 ¼ miles.

Answer: 41° 49' 15", 87° 25' 10"

Bearing: 60° from Calumet Harbor Light, 84° from Four Mile Crib Light, 73° from Hyde Park Shoals Light.

Answer: 41° 54' 30", 87° 05' 30"

Bearing: 36° from Calumet Harbor Light, 57° from Chicago Harbor Light, 44° from Hyde Park Crib Light.

Answer: 41° 65’ 45”, 87° 09’ 30”

So, attached is a copy of a deck log entry for an aircraft lost in Lake Michigan. What are the Latitude/Longitude coordinates for this accident? (note: ignore the Wreck Buoy coordinate because we don’t know where that is either.)

Answer: 41° 48’ 20”, 87° 23’ 30