

AD-779 409

SUMMARY OF THE HUMAN ENGINEERING
LABORATORY'S AIR-TO-GROUND TARGET
DETECTION STUDIES USING STATIONARY
TARGETS

Human Engineering Laboratory
Aberdeen Proving Ground, Maryland

March 1974

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

20050203010

Best Available Copy

ACCESSION for		
NTIS	Write Section	<input checked="" type="checkbox"/>
D C	Ref Section	<input type="checkbox"/>
UNCLASSIFIED		<input type="checkbox"/>
JUSTIFICATION		
BY		
DISTRIBUTION/AVAILABILITY CODES		
Dist.	AVAIL.	and/or SPECIAL
A		

Destroy this report when no longer needed.
Do not return it to the originator.

The findings in this report are not to be construed as an official Department of the Army position unless so designated by other authorized documents.

Use of trade names in this report does not constitute an official endorsement or approval of the use of such commercial products.

AD 779 409

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER Technical Note 5-74	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Summary of the Human Engineering Laboratory's Air-To-Ground Target Detection Studies Using Stationary Targets		5. TYPE OF REPORT & PERIOD COVERED Final
7. AUTHOR(s) Systems Performance and Concept Directorate		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Human Engineering Laboratory Bldg. 520 Aberdeen Proving Ground, MD 21005		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE March 1974
		13. NUMBER OF PAGES X 12
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Target detection/identification Stationary targets Air-to-ground target detection Human Factors Engineering Reproduced by NATIONAL TECHNICAL INFORMATION SERVICE U S Department of Commerce Springfield VA 22151		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The Human Engineering Laboratory (HEL) has conducted a number of air-to-ground target detection/identification studies since 1962. Each study was conducted using stationary, passive, noncamouflaged military ordnance type targets, but the type of helicopters ranged from the OH-13 for the 1962 study through the UH-1 to the OH-58 for the 1974 study. This report summarizes these findings.		

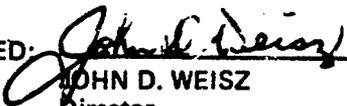
Technical Note 5-74

**SUMMARY OF THE HUMAN ENGINEERING LABORATORY'S AIR-TO-GROUND
TARGET DETECTION STUDIES USING STATIONARY TARGETS**

Systems Performance and Concept Directorate

March 1974

APPROVED:



JOHN D. WEISZ
Director

U. S. Army Human Engineering Laboratory

U. S. ARMY HUMAN ENGINEERING LABORATORY
Aberdeen Proving Ground, Maryland

ii.

Approved for public release;
distribution unlimited.

**SUMMARY OF THE HUMAN ENGINEERING LABORATORY'S AIR-TO-GROUND
TARGET DETECTION STUDIES USING STATIONARY TARGETS**

The Human Engineering Laboratory (HEL) has conducted a number of air-to-ground target detection/identification studies since 1962 (Table 1). Each study was conducted using stationary, passive, noncamouflaged military ordnance type targets, but the type of helicopters ranged from the OH-13 for the 1962 study through the UH-1 to the OH-58 for the 1974 study.

Recent events have increased interest in the ranges at which the helicopter crewman can be expected to detect and/or identify a target.

The Human Engineering Laboratory's studies of air-to-ground target detection identification have all concluded with essentially the same results; a stationary, passive, noncamouflaged military ordnance type of target can be detected by an observer in a slow speed, 60 knots, low flying, less than 300 feet, helicopter at maximum ranges up to 2000 meters but cannot be reliably identified at ranges greater than 1000 meters.

Terrain and terrain cover play a very important role in the detection/identification problem. Figure 1 indicates that at flight levels between 100 feet and 300 feet there is somewhere between 40 percent and 85 percent of smooth terrain visible. When the terrain becomes moderately rough, the availability drops to between 20 percent and 38 percent. The effect of terrain cover is shown in Figure 2 which indicates a 90 percent availability of targets at a 1000 meter range and a 300 foot altitude where there is no foliage, when there is foliage the availability drops to 30 percent.

TABLE 1
Human Engineering Laboratory's
Target Detection/Identification Studies

January	1962	Helicopter Armament Program. Air-To-Ground Target Detection and Identification. C. G. Moler. TM 1-62
June	1965	Development of an Air-To-Ground Detection/Identification Model. M. E. Franklin and J. A. Whittenburg. HSR-RR-65/4-Dt.
January	1966	Acquiring and Relocating Targets from a Helicopter: A Preliminary Investigation. R. A. Monty, S. A. Hicks, C. G. Moler. TM 2-66
January	1973	Air-To-Ground Target Identification Using Stabilized Optics. H. L. Cheever and G. L. Horley. TM 2-73
January	1974	HELHAT II, Scout Crew/Observer Target Detection Flight Tests. TN 1-74

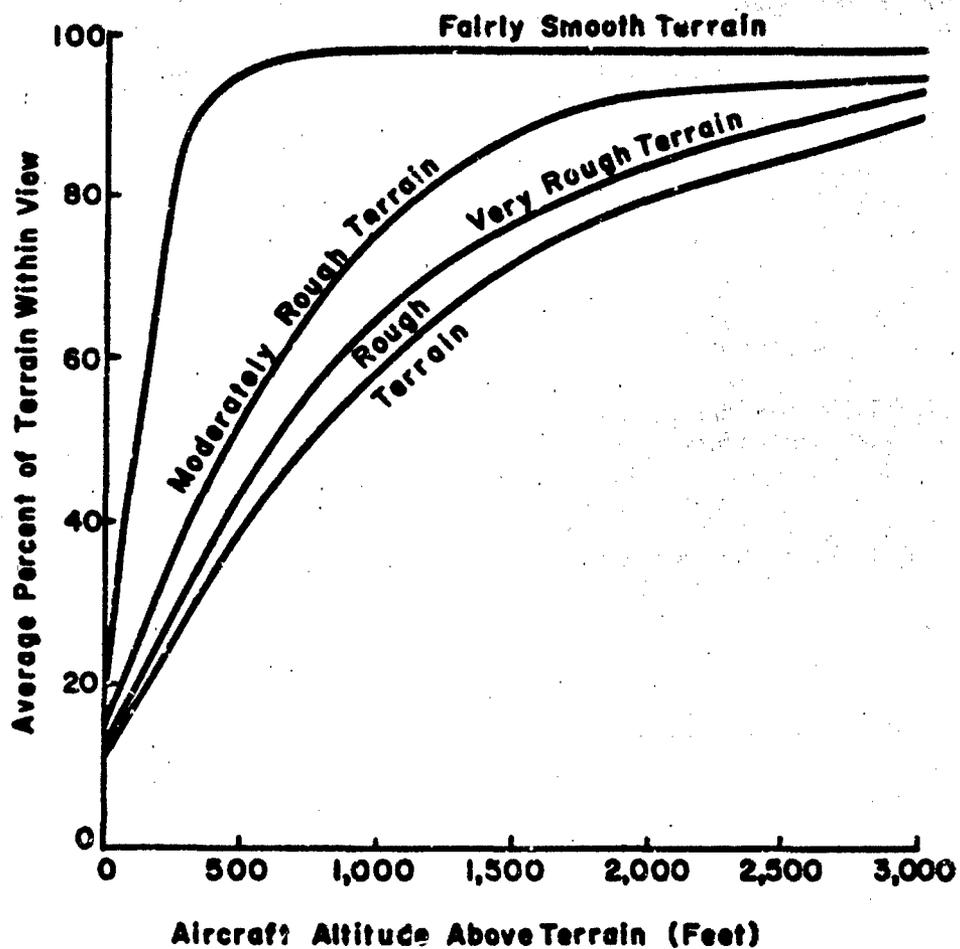


Fig. 1. Average percentage of terrain seen from aircraft as a function of type of terrain and altitude (redrawn from Erickson, 1961).

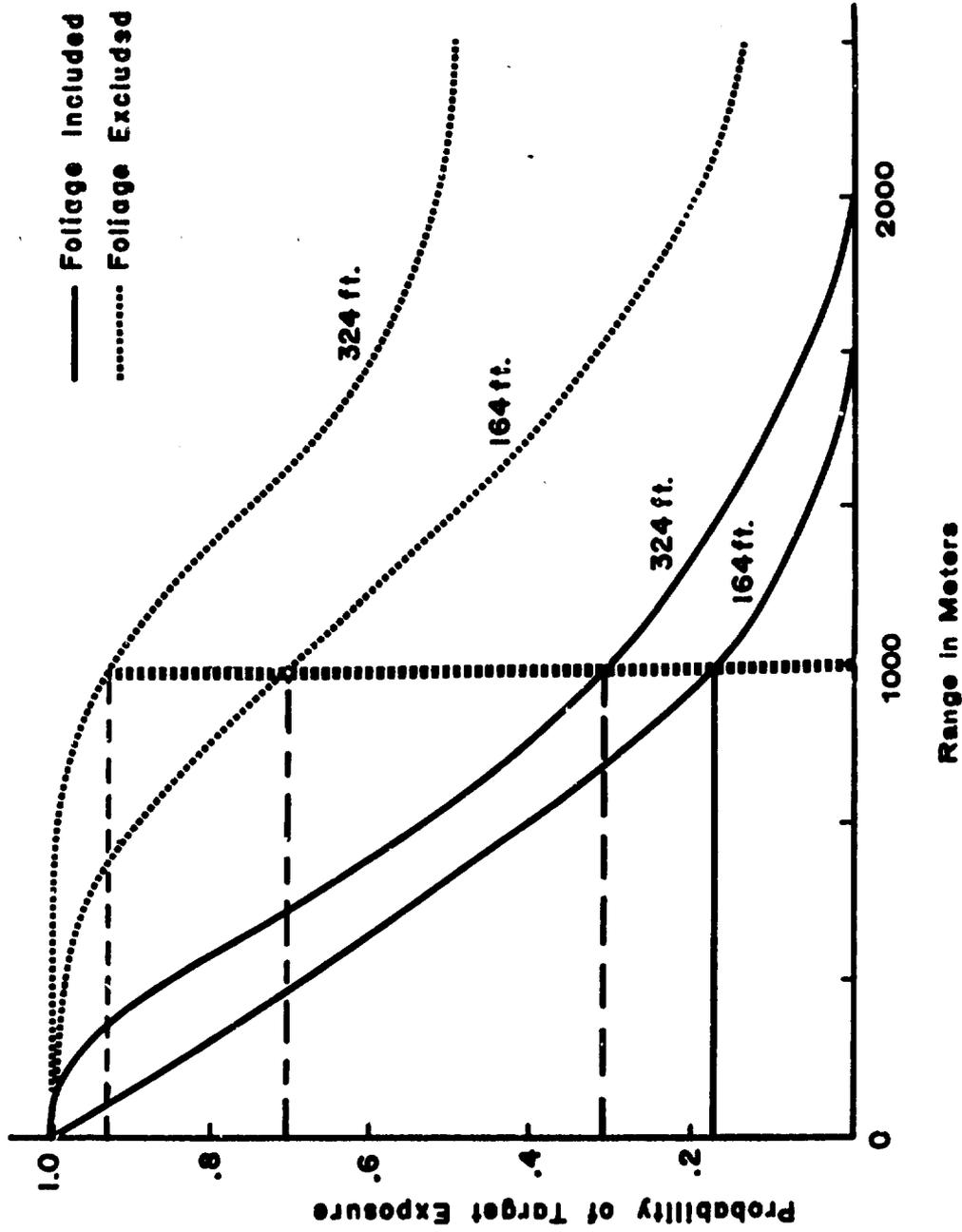


Fig. 2. Average probability that a 7-foot target is exposed as a function of range and altitude with foliage included and excluded (redrawn from Ballistics Analysis Laboratory, 1959). Altitude is shown on each curve.

Target Tank, Stationary
 Terrain Rolling
 Altitude 100 ft.
 Speed 100 m. p. h.

Target Distinctiveness
 Low Contrast Target in
 Shadow, Cluttered Area
 Medium Contrast Target
 in Partial Shadow and
 Clutter
 High Contrast Target in
 Open
 O Predicted, Franklin & Whittenburg 1965
 + Actual, HELHAT II 1973

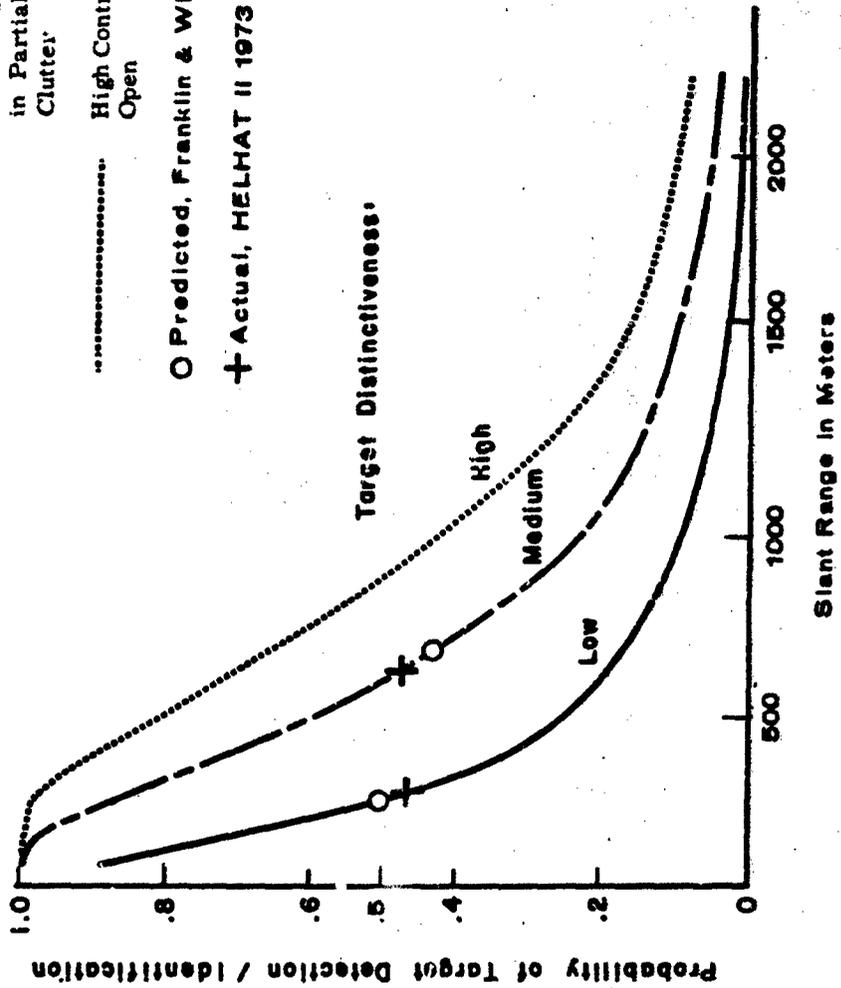


Fig. 3. Target distinctiveness.

It can also be determined from Figure 2 that at a 100-foot altitude the availability values become 70 percent and 15 percent respectively.

Considering these experimental findings the values shown in Figure 3 become more understandable. Given a tank on rolling terrain; about 40 percent of the terrain is visible from a 100-foot altitude and the medium contrast or part cover gives a 60 percent availability of the targets to be seen, therefore at 1000 meters these values should give a 24 percent probability of detection with about a 48 percent probability of detection at 500 meters. The actual overall detection value found in HELHAT II was 46 percent and the predicted value from a previous HEL study, HSR-RR-6514-Dt, was 45 percent.

As the cover increases the detection range will decrease if one is to maintain a 46 percent probability of detecting stationary ordnance type targets.

Figures 4 and 5, from a 1973 HEL study, TM 2-73, show the probability of identifying a stationary target after detection when flying at 1500 feet using variable, 1.5x to 20x, optics. Comparing this with similar work done by Blackwell and others in 1958, Figure 6, we see that optics were relatively ineffective as an aid to the identification of passive targets until the range was less than 1500 meters and achieved an acceptable value only at ranges less than 1000 meters.

The overall results of the studies conducted at HEL since 1962 indicate that when considering the detection and identification of stationary targets from low flying helicopters, at above the ground levels of 100 to 300 feet, and speeds of 50 to 100 knots, the detection/identification range for military ordnance emplaced on fairly smooth terrain with light to moderate ground cover will rarely exceed 1000 meters and more than likely will be closer to 500 meters.

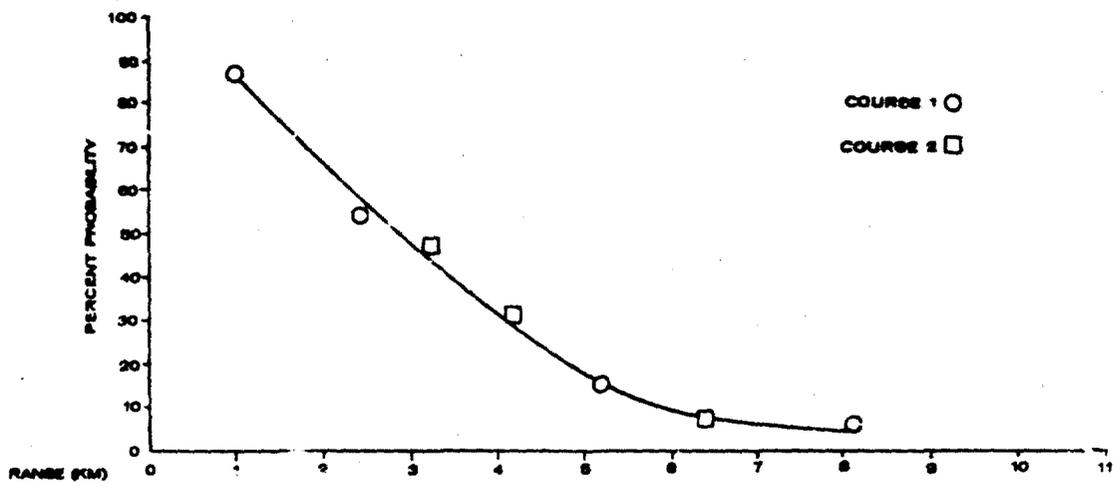


Fig. 5. Cumulative probability of a correct-by-name troop¹ identification versus slant range.

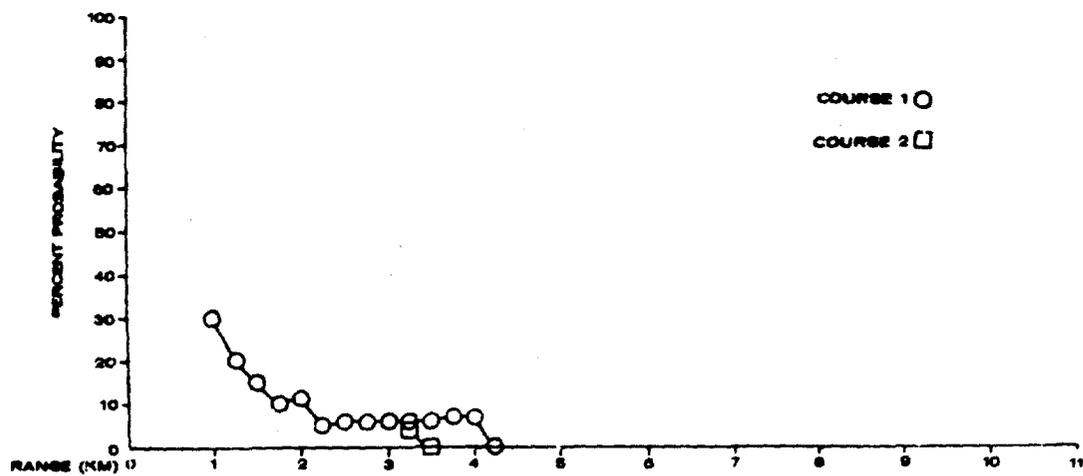


Fig. 4. Approximate cumulative probability of a correct-by-nation¹ vehicle identification versus slant range.

¹US and USSR.

- A Field Tests - Blackwell, et al
- O Field Tests - Cheever and Morley

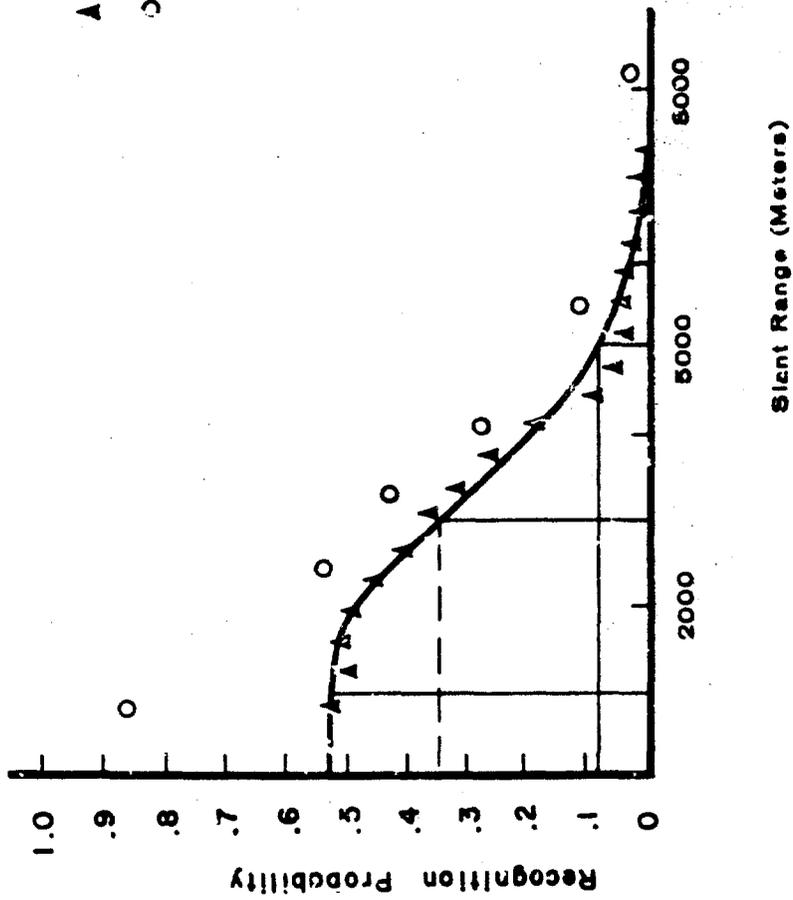


Fig. 6. Recognition probability as a function of slant range-field and simulator data (from Blackwell, et al., 1958).

REFERENCES

1. Aviation Team, Systems Performance and Concept Directorate. HELHAT II, Scout crew/observer target detection flight tests. Technical Note 1-74, U. S. Army Human Engineering Laboratory, Aberdeen Proving Ground, MD, 1974.
2. Ballistic Analysis Laboratory. An analysis of results of a ground roughness survey, III. Baltimore, Maryland: Johns Hopkins University, Institute for Cooperative Research, May 1959. (Project THOR Report No. 42; AD 217 514)
3. Blackwell, H. R., Ohmart, J. G., & Harcum, E. R. Field simulation studies of air-to-ground visibility distance. Final Report. Ann Arbor, Michigan: University of Michigan, Vision Research Laboratories, December 1958. (PROJECT MICHIGAN Rep. 2643-3-F; AD 211 151L)
4. Cheever, H. L., & Horley, G. L. Air-to-ground target identification using stabilized optics. (U) Technical Memorandum 2-73, U. S. Army Human Engineering Laboratory, Aberdeen Proving Ground, MD, 1973, Confidential report.
5. Erickson, R. A. Empirically determined effects of gross terrain features upon ground visibility from low-flying aircraft. China Lake, California: Naval Ordnance Test Station, September 1961. (NOTS Tech. Pub 1760; NAVWEPS Rep. 7779)
6. Franklin, M. E., & Whittenburg, J. A. Research on visual target detection, Part 1, development of an air-to-ground detection/identification model. Human Sciences Research, Inc., McLean, VA, 1965.
7. Moler, G. C. Helicopter armament program. Air-to-ground target detection and identification. Technical Memorandum 1-62, U. S. Army Human Engineering Laboratory, Aberdeen Proving Ground, MD, 1962.
8. Monty, R. A., Hicks, S. A., & Moler, G. C. Acquiring and relocating targets from a helicopter: A preliminary investigation. Technical Memorandum 2-66, U. S. Army Human Engineering Laboratory, Aberdeen Proving Ground, MD, 1966.