



ARL-TR-10198 • SEP 2025



Advancing Military Working Dog Capabilities through Scientific Research and Technological Innovation to Support Irregular Warfare Operations Starting in 2025

by Tyrone Jones

DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.

NOTICES

Disclaimers

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.

Citation of manufacturer's or trade names does not constitute an official endorsement or approval of the use thereof.

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



Advancing Military Working Dog Capabilities through Scientific Research and Technological Innovation to Support Irregular Warfare Operations Starting in 2025

Tyrone Jones

DEVCOM Army Research Laboratory

REPORT DOCUMENTATION PAGE

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED	
September 2025	Technical Report	START DATE 08/01/2024	END DATE 08/01/2025
4. TITLE AND SUBTITLE Advancing Military Working Dog Capabilities through Scientific Research and Technological Innovation to Support Irregular Warfare Operations Starting in 2025			
5a. CONTRACT NUMBER		5b. GRANT NUMBER	5c. PROGRAM ELEMENT NUMBER
5d. PROJECT NUMBER		5e. TASK NUMBER	5f. WORK UNIT NUMBER
6. AUTHOR(S) Tyrone Jones			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) DEVCOM Army Research Laboratory ATTN: FCDD-RLA-MF Aberdeen Proving Ground, MD 21005			8. PERFORMING ORGANIZATION REPORT NUMBER ARL-TR-10198
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)	11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT DISTRIBUTION STATEMENT A. Approved for public release: distribution unlimited.			
13. SUPPLEMENTARY NOTES			
14. ABSTRACT This technical report details ARL's research and development initiatives aimed at advancing Military Working Dog (MWD) capabilities to support dismounted Soldiers in irregular warfare operations beginning in 2025. ARL's efforts integrate both fundamental and applied research, encompassing canine genetics, physiology, behavior, sensory systems, and stress response, alongside the development of deployable technologies such as canine head-mounted displays, advanced protective gear, automated hydration systems, and physiological monitoring tools. These initiatives are designed to enhance MWD performance, survivability, and operational integration with human teams. By leveraging interdisciplinary research, technological innovation, and strategic partnerships, ARL ensures that MWDs remain a critical force multiplier, providing actionable insights and operational advantages in complex mission environments.			
15. SUBJECT TERMS Sciences of Extreme Materials, Military Working Dog, MWD, irregular warfare operations, Soldier technologies, Soldier Lethality			
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT
a. REPORT UNCLASSIFIED	b. ABSTRACT UNCLASSIFIED	c. THIS PAGE UNCLASSIFIED	UU
19a. NAME OF RESPONSIBLE PERSON Tyrone Jones			19b. PHONE NUMBER (Include area code) (520) 717-3742

STANDARD FORM 298 (REV. 5/2020)

Prescribed by ANSI Std. Z39.18

Contents

Executive Summary	v
1. Introduction	1
2. ARL Overview	1
2.1 Research Competencies	1
2.2 Role of MWDs in Military Operations	2
3. S&T Development	2
3.1 Fundamental Basic Research	2
3.1.1 Working Dog Genetics and Behavior	2
3.1.2 Predicting Working Dog Performance	2
3.1.3 Vision and Sight Research	2
3.1.4 Auditory Research	2
3.1.5 Canine Thermal Burden and Stress	2
3.1.6 Olfaction	3
3.1.7 MWD Genomics Program	3
3.1.8 Canine Auditory Cognition and Hearing Acuity	3
3.2 Applied Research	3
3.2.1 Augmented Reality for MWDs	3
3.2.2 Chemical Exposure Effects	3
3.2.3 Working Dog Bite Strength	3
3.2.4 Automated Working Dog Hydration	3
3.2.5 Physiological and Cognitive Monitoring	3
3.2.6 Advanced Protection Systems	4
3.3 Canine Head-Mounted Display	4
4. Technology Development	4
4.1 Canine Eye Protection	4
4.2 Canine Mounted Displays	4
4.3 Hearing Protection Systems	4
4.4 Acoustic Architectural Testing	4

4.5	MWD Transportation and Protection	5
4.6	One-Handed/Remote Operation of E-Collars	5
4.7	Bite-Sleeve Training Systems	5
4.8	Tracking and Veterinary Technology	5
5.	Conclusion	5
	List of Symbols, Abbreviations, and Acronyms	6
	Distribution List	7

Executive Summary

This technical report presents a comprehensive overview of the U.S. Army Combat Capabilities Development Command (DEVCOM) Army Research Laboratory's (ARL's) current research and development (R&D) initiatives focused on enhancing the operational effectiveness of Military Working Dogs (MWDs). These efforts are aligned with the Army's broader mission to develop and deploy innovative technologies that strengthen the capabilities of dismounted Soldiers.

ARL's work spans both fundamental and applied research. On the basic science side, ARL is advancing the understanding of canine genetics, physiology, behavior, sensory systems, and stress response to inform future training, selection, and health management strategies. Applied research efforts are focused on delivering the following field-ready technologies: augmented reality systems for canine communications, advanced protective gear, chemical and environmental threat mitigation tools, and integrated physiological monitoring systems.

Key technological developments include the following:

- **Canine Head-Mounted Displays** for real-time video and command feedback
- **High-impact protective eyewear and hearing protection systems**
- **Automated hydration solutions and sensor-equipped bite sleeves**
- **Veterinary innovations**, including field-deployable medical treatments and tracking systems

Together, these initiatives aim to improve MWD performance, survivability, and integration with human teams in complex operational environments. Through interdisciplinary research, strategic partnerships, and cutting-edge technology development, ARL is ensuring that MWDs remain a vital force multiplier for current and future Army missions.

1. Introduction

This technical report outlines the current research and development (R&D) initiatives led by the U.S. Army Combat Capabilities Development Command (DEVCOM) Army Research Laboratory (ARL) to enhance the operational capabilities of Military Working Dogs (MWDs) in support of dismounted Soldiers. These initiatives span both basic and applied research, focusing on optimizing canine performance, health, and safety in operational environments.

The report provides a comprehensive overview of ARL's scientific approach, technical challenges, and the anticipated operational impact of these initiatives on future military capabilities.

2. ARL Overview

As a core component of the U.S. Army Futures Command, ARL's mission is to operationalize science and deliver innovative capabilities to the Warfighter. ARL achieves this by conducting cross-disciplinary research and fostering strategic partnerships with academic institutions to accelerate the transition from discovery to deployment.

ARL's vision to **"Win the Competition to Operationalize Science"** is realized through robust translational research, technology transfer initiatives, and close collaboration across the Army enterprise.

2.1 Research Competencies

ARL maintains a diverse research portfolio encompassing the following core competencies:

- Sciences of Extreme Materials
- Humans in Complex Systems
- Biological and Biotechnology Sciences
- Electromagnetic Spectrum Sciences
- Energy Sciences
- Mechanical Sciences
- Military Information Sciences
- Network, Cyber, and Computational Sciences
- Photonics, Electronics, and Quantum Sciences
- Terminal Effects
- Weapons Sciences

ARL also operates world-class experimental infrastructure, including the DoD High-Performance Computing Modernization Program and the Data Analysis and Assessment Center.

2.2 Role of MWDs in Military Operations

MWDs have provided critical support to dismounted Soldiers for decades, evolving from basic sentry roles to complex missions such as explosive detection and search and rescue. ARL's current efforts aim to expand and modernize these capabilities through a comprehensive science and technology (S&T) strategy.

3. S&T Development

ARL's R&D is divided into two primary categories: **Fundamental Basic Research** and **Applied Research**.

3.1 Fundamental Basic Research

Basic research initiatives aim to deepen scientific understanding of canine biology and behavior to inform future technologies.

3.1.1 Working Dog Genetics and Behavior

Utilizes genomic analysis to identify genetic markers associated with desirable traits—such as, trainability, endurance, stress resilience, and cognitive function.

3.1.2 Predicting Working Dog Performance

Develops key performance indicators and predictive models using statistical and machine learning methods to assess early-stage performance potential.

3.1.3 Vision and Sight Research

Explores visual acuity, motion detection, peripheral vision, and low-light performance to support canine operations in visually complex environments.

3.1.4 Auditory Research

Focuses on mitigating noise-induced hearing loss through earplug design, active noise cancellation technologies, and kennel noise mitigation.

3.1.5 Canine Thermal Burden and Stress

Investigates physiological responses to heat stress and evaluates cooling strategies and predictive models for safe working conditions.

3.1.6 Olfaction

Studies how environmental conditions affect olfactory performance, including detection of explosives and disease-related volatile organic compounds.

3.1.7 MWD Genomics Program

Aims to improve breeding, selection, and training programs by identifying genes influencing performance, health, and behavior.

3.1.8 Canine Auditory Cognition and Hearing Acuity

Examines auditory processing, sound localization, and hearing degradation, especially in aging or noise-exposed dogs.

3.2 Applied Research

Applied research projects focus on developing deployable technologies and practical solutions to enhance MWD field performance.

3.2.1 Augmented Reality for MWDs

Develops head-mounted displays for canines to provide situational awareness via visual cues and commands, integrating sensors such as GPS and cameras.

3.2.2 Chemical Exposure Effects

Studies canine response to chemical agents and develops canine-specific countermeasures, including opioid reversal agents and protective interventions.

3.2.3 Working Dog Bite Strength

Quantifies bite force and dynamics to inform training standards, injury prevention, and role-specific canine selection.

3.2.4 Automated Working Dog Hydration

Designs self-contained hydration systems for austere environments, improving logistics and canine health.

3.2.5 Physiological and Cognitive Monitoring

Develops noninvasive techniques to monitor stress, fatigue, and workload in MWDs and handlers to optimize team performance.

3.2.6 Advanced Protection Systems

Researches new materials and designs for protective goggles, noise-abatement kennel materials, and integrated sensory systems.

3.3 Canine Head-Mounted Display

This project integrates video transmission and command reception into a canine goggle platform. Phase I achieved the following:

- Less than 50-ms video latency
- Less than 30-ms command latency
- Transmission through three walls at 100 m

Phase II aims to reach **Technology Readiness Level 6/7**, enhance performance, and support near-term deployment of **Non-Line of Sight** directional control systems.

4. Technology Development

ARL is actively developing technologies to enhance MWD operational readiness and survivability.

4.1 Canine Eye Protection

Designs high-impact, UV-protective eyewear (e.g., Rex Specs goggles) for debris, radiation, and trauma protection, while maintaining visibility and comfort.

4.2 Canine Mounted Displays

Integrates AR displays into protective goggles to deliver real-time situational information to MWDs.

4.3 Hearing Protection Systems

Develops both passive and active hearing protection (e.g., CAPS, CIHPM), with successful deployments to U.S. Special Operations Command and the FBI's Hostage Rescue Team.

4.4 Acoustic Architectural Testing

Evaluates kennel materials and designs to reduce noise levels, supporting auditory health and recovery in resting environments.

4.5 MWD Transportation and Protection

Improves vehicle safety for MWDs through climate-controlled crates, restraint systems, and operational protocols.

4.6 One-Handed/Remote Operation of E-Collars

Enhances handler ergonomics by enabling intuitive, remote control of electronic collars.

4.7 Bite-Sleeve Training Systems

Develops realistic and sensor-equipped bite sleeves to improve training fidelity and bite force quantification.

4.8 Tracking and Veterinary Technology

Implement solutions as follows:

- **Android Tactical Observation and Surveillance tracking systems** for location monitoring
- **Lyophilized plasma** and enhanced field medical treatment
- **Smart feeding regimens** and wound care innovations
- **Integrated canine camera systems** for real-time visual feedback

5. Conclusion

ARL's ongoing S&T initiatives are critical to enhancing the capability, survivability, and effectiveness of MWDs. By leveraging interdisciplinary research, advanced technologies, and operational field insights, ARL is enabling the development of next-generation MWD systems to support the Warfighter.

Through its sustained investment in both fundamental discoveries and applied innovation, ARL ensures that MWDs continue to serve as a vital force multiplier in modern and future operational environments.

List of Symbols, Abbreviations, and Acronyms

ARL	Army Research Laboratory
DEVCOM	U.S. Army Combat Capabilities Development Command
DoD	Department of Defense
FBI	Federal Bureau of Investigation
GPS	global positioning system
MWD	Military Working Dog
R&D	research and development
S&T	science and technology
UV	ultraviolet

1 DEFENSE TECHNICAL
(PDF) INFORMATION CTR
DTIC OCA

1 DEVCOM ARL
(PDF) FCDD RLB CI
TECH LIB