



Reducing Risk in Invasive Species Management

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Our Approach:

Two major areas of inquiry

1. Just how many seeds (and other propagules) can a vehicle carry?
Or, what is the magnitude of the risk?
2. How well can we clean vehicles with commercially available technology?
Or, can we reduce the risk with reasonable effort?

Focused on needs of U.S. Department of Defense and U.S. Forest Service

Military vehicles clearly have potential to transport seeds long distances during deployments, but the level of risk to transport seeds has never been quantified.

Off-road exercises in two environmental settings

Measuring seed acquisition, with focus on non-natives

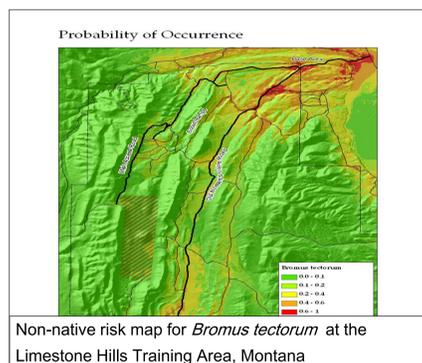
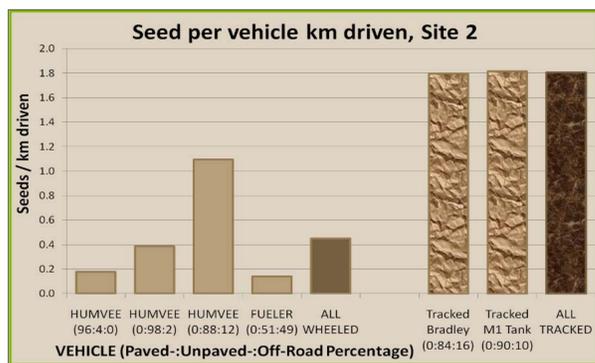


1. Armored vehicle training in Montana



2. Military vehicles training in Idaho

What did we find?

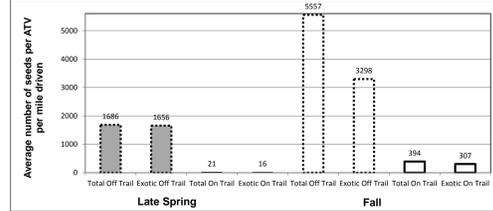
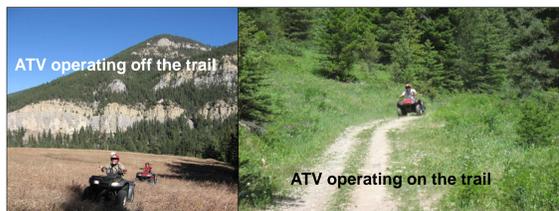


Conclusions:

- Tracked vehicles collect more seeds and wheeled vehicles much less...not a surprise
- At sites 1 and 2, 61 and 53 species recovered...20 and 45%, respectively, were non-native
- Without appropriate post deployment cleaning procedures, military vehicles could serve as significant vectors of non-native seed dispersal at a global scale
- At the local scale, vegetation surveys conducted within training areas can be used to create non-native plant occupancy or "risk" maps which will allow for an assessment of risk related to the transport of non-native plant propagules during training exercises or other activities

What about non-military off-road vehicles?

How do they relate to these findings?



- In a separate study, seed-load potential of all-terrain vehicles was measured
- They were tested on trail and off-trail and in late spring and fall
- If anything, seed load was greater than for military vehicles on a per mile basis

Abstract

Military regular and reserve components may often train at several locations in a year, and may also conduct exercises on various public lands as well. The vehicles and equipment must be driven or transported from place to place. Only a few locations require vehicles to be systematically cleaned before entering. Forest managers, ranchers, research scientists and the general public also operate vehicles off-road. Whoever performs it, this movement of vehicles, persons and equipment has the potential to transport seeds and other plant parts among locations where vehicles have been stored or operated. Just how great is this risk, and what steps may be taken to completely or partially alleviate the risk? Research efforts have allowed the risk associated with such activities to be quantified. One aspect determined how many seeds can be accrued and quantified the potential for civilian and military vehicles to pick up weed seeds when they are operated either on or off road, and also how much of the seed load is lost along the driving route between the field site and the destination. These studies have shown that considerable seed loads may be acquired, and that they remain largely intact over hundreds of kilometers on paved or unpaved roads in dry weather. The second focus was on the effectiveness of existing cleaning methodologies to remove soil, seeds and other propagules from the vehicles. It was found that cleaning using field-portable equipment typically removes up to 80+% of the soil on a vehicle. This clearly reduces risk of transport from place to place, but does not eliminate it. The data and risk assessments are applicable to all types of vehicles and all public and private operators of the vehicles, including the military, forest managers, private farmers and ranchers, and the recreational public.

Over the road studies of seed loss during travel

Standardized seed load; paved and unpaved roads; wet and dry conditions



Mud accumulated under the fender well of a truck

Special plates (left) were built to measure loss of soil and seeds. Below, they are attached under the truck

- Standard mixture of mud and marked seeds was applied to fenders, bumpers and plates
- Higher seed retention rates for dry than wet conditions for all plate locations & road surfaces
- No clear difference in retention variability emerged between paved and unpaved roads
- On dry roads, either paved or unpaved, most plates retained 96% of their seeds at 256 km
- Under wet conditions more seeds were lost on both paved and unpaved roads
- On wet paved roads wheel wells retained 0%, but front bumpers kept 72% of seeds at 256 km

Can off road vehicles be cleaned effectively?

Using field-portable commercially available cleaning systems

Cleaning study conducted in two phases

- Three USFS vehicle types cleaned 95 times each; using 5 commercial systems
 - Vehicles driven on soil and mud test track and unpaved roads for 1742 m
 - Washed 19 times each by five commercial cleaning systems
 - Soil and debris removed by cleaning contractor collected and weighed
 - Soil and debris missed by system removed by hand cleaning
 - Proportion removed by cleaning system then calculated...see graphic below
- Five Army vehicle types cleaned following multi-day field exercises at two locations
 - Same locations 1 and 2 used for seed acquisition studies...as shown at left
 - Army training sites #1 in Montana and #2 in Idaho
 - Used one of the better cleaning systems as used in Test 1

Vehicles Used for Test 1

- The US Forest Service managed this part of study
- Focused on their concerns
- Wildland (Class 3) Fire Engines (two were used for test cycles)
- Light 4x4 vehicles (two pickup trucks and 1 sport utility vehicle [SUV])
- Bulldozer (one Cat D6R high track bulldozer).



Vehicles Used for Test 2

Cleaning armored vehicles in Idaho

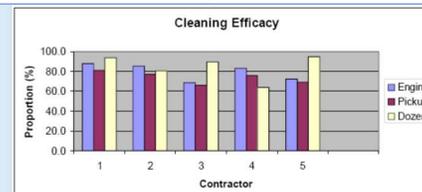


What about the Army's Tank Bath?



These facilities were not a part of this study. Invasive species were not one of the design criteria. Also, they are not typically located on travel routes to and from the training areas.

Efficacy Test 1



- The total (100%) was the amount contractors removed plus that which the research crew removed in the post wash.
- Even the most effective system could not remove more than 88% of debris from the wheeled vehicles, and the poorer ones only 65%.
- If more time had been allowed, the results would likely have been better; however it was decided to standardize vehicle washes at 5 minutes each to reflect fire-incident conditions in the field.
- This is also approximately the time allocated per vehicle by the Army in its washing facilities

General Conclusions

- All types of vehicles are likely transporting and spreading seeds
 - In dry conditions wheeled vehicles gained 5-40 seeds and tracked vehicles 120 seeds/100 km when driven mainly on unpaved roads
 - Under wet conditions these values increased to 105-840 and 5520 seeds/100 km respectively
 - Increasingly more seeds were gained when wheeled vehicles were driven on unpaved and off-road rather than paved roads
 - More seed was gained off-trail than on-trail, and in fall vs. spring when evaluated with ATVs
 - Seed adhered to vehicles can be transported several hundred kilometers without falling off under dry conditions, but is removed more rapidly when roads are wet
- Occupancy maps of target invasive species can be used to highlight areas where seed spread by vehicles are more likely to succeed and be more invasive
 - ~ 80% of soil and other matter may be removed from vehicles by mobile vehicle wash units
 - Such wash systems are a good prevention tool but need to be used in conjunction with a prioritization protocol of where and under what conditions different vehicle types are driven

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