DAUNTLESS AIR

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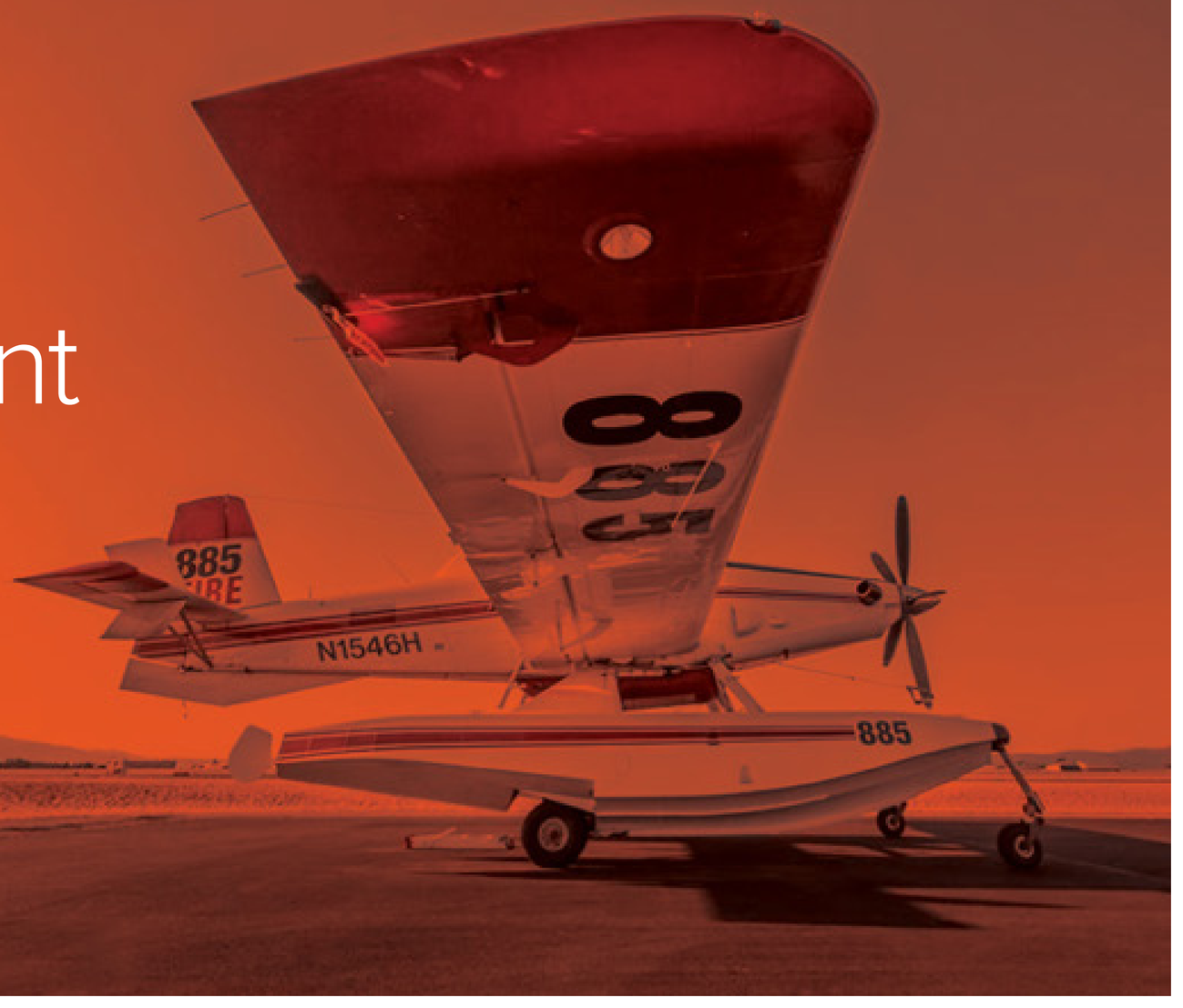
Transforming Aerial Firefighting for a Changing Environment

How to Strengthen Initial Response and Direct Attack Capabilities for Success in Today's World



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Executive Summary

Aerial firefighting strategies and aircraft mobilization tactics must be revisited given the intensifying threat of US wildfires and mounting pressure to control costs. Existing models were built for a different time and the development and deployment of modern, technology-enabled methods is essential. History shows that to best protect people, land and property against wildland fire, initial response and direct air attack strategies that utilize rapid-attack aircraft on the front lines – in combination with, and often ahead of, ground fire suppression equipment and personnel – can better contain fires and keep them small. This allows ground crews to put out blazes more efficiently, helping to limit wildfire devastation and the ever-increasing associated costs for fire suppression, and freeing up valuable funds for the federal and state restoration and forest management work that helps prevent catastrophic fires in the first place.

The Increasing Wildfire Threat

The US wildfire landscape is changing.

US wildfires are burning more acres than ever. In 1989, the projected acreage burned per US wildfire was 32.2 acres. More than two decades later, that average had increased to 108.1 acres per wildfire – more than three times the pre-1990 level.[1] This new size and intensity of US wildfires has caused fire suppression and recovery costs to drastically increase. In 2017, the US Department of Agriculture spent $2.4 billion fighting fires from Florida to Washington – the largest wildfire suppression bill in US history. Just two decades earlier, the agency spent less than one-sixth that amount on suppression and recovery.[2] In the face of these mounting costs, the US wildfire threat is forecasted to only grow.

Fueling the Fire: Three factors are changing the US wildfire landscape.

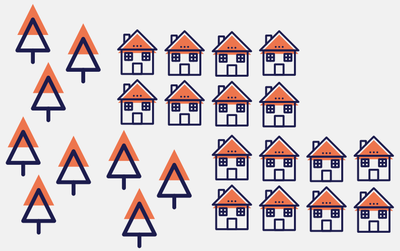
1.

The science is clear, climate change is bringing longer and more intense wildfire seasons. Increasing greenhouse gas emissions are warming the environment, creating fire-friendly weather conditions and escalating the potential for ‘very large fires’ (fires that span at least 5,000 hectares). These very large fires represent the top 10% of fires, which account for a majority of acres burned in many US regions. Climate scientists agree, the season during which these fires tend to spread is expected to lengthen, and by mid-century western parts of the US could see a six-fold increase in the number of weeks during which conditions are favorable for very large fires.[3] This new normal has been years in the making; already, wildfire seasons are 78 days longer today than they were four decades ago.

1.

CLIMATE CHANGE

2.



EXPANDING HUMAN DEVELOPMENT

3.

UNHEALTHY LANDSCAPES

The Increasing Wildfire Threat (cont.)

2. For federal, state and local agencies, the response to larger, more intense wildfires has become increasingly complex. This is due in large part to expanding human development in the wildland-urban interface (WUI), the zone of transition between unoccupied land and human development. These lands and communities adjacent to and surrounded by wildlands are at heightened risk for devastation from wildfires.[4] Between 2000 and 2010, the percent of homes in the WUI in the contiguous US increased by over 5%, totaling 44 million houses; that's equivalent to one in every three homes in the country, with the highest concentrations in California, Texas and Florida.[5] It's well known that increasing densities of people and infrastructure in the WUI requires more firefighting assets to ensure safe and effective suppression, which in turn drives up costs.[6]

3. Another key factor changing today's firefighting landscape is an all too common budgetary practice known as fire borrowing.

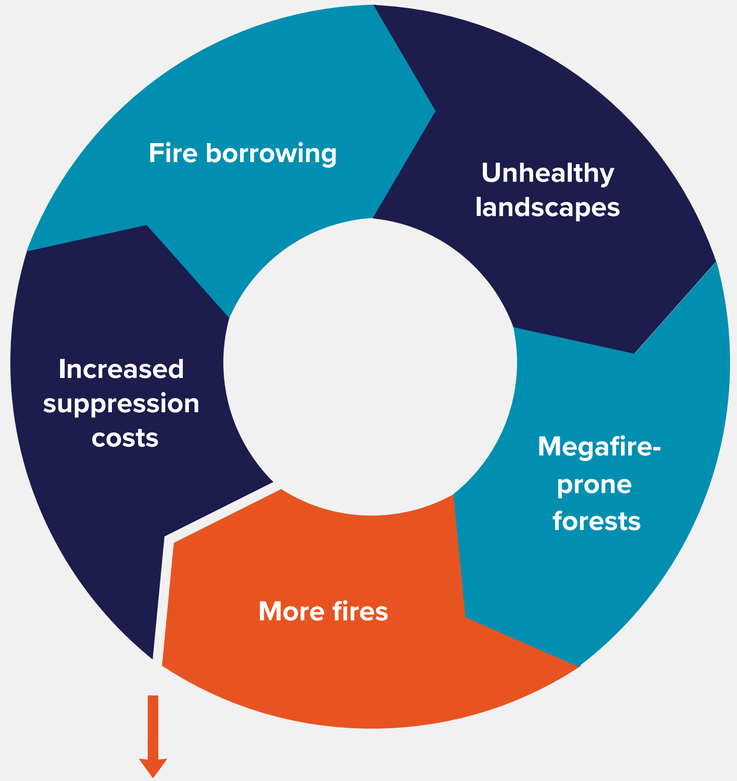
Nearly every year since 2000, wildfire suppression costs have greatly exceeded the US Forest Service's (USFS) annual appropriated budget, requiring the agency to take funding from forest management programs in order to pay for fire suppression efforts. Years of fire borrowing from forest health programs, which fund proven tactics like prescribed burns and forest thinning, has resulted in unhealthy landscapes flush with overgrown thickets prone to catastrophic fires.[7] Recently, the USFS determined that approximately 11 million acres of National Forest lands located in or near the WUI would benefit from fuel treatment tactics to reduce severe wildfire risk and increase ecosystem and community resilience. However, as fires worsen and suppression costs increase, we risk a parallel jump in the rate of fire borrowing, limiting the ability to fund fuel treatment tactics therefore perpetuating the decline of our national forests. Breaking this cycle will require more than a temporary emergency funding fix like the legislation passed in 2018. To truly reduce costs and limit fire borrowing, we must establish more cost-effective wildfire response. This will better ensure that suppression costs are controlled and funds are once again available to revitalize our landscapes and create healthier forests less prone to megafires.

A National Strategy to Improve Response

Tying initial attack together with effective fuel management to win the battle against wildfires.

Improving the safety and effectiveness of wildfire response is the highest priority set forth by the US Departments of Interior and Agriculture in the 2014 National Cohesive Wildland Fire Management Strategy[8] (National Strategy), commissioned by Congress as part of the 2009 FLAME act.[9] This strategic priority includes "enhancing wildfire response preparedness with an emphasis on both structural protection and wildfire prevention to maximize the effectiveness of initial response." The second priority aims to restore our nation's landscapes through vegetation and fuel management. General guidance in this area includes "designing and prioritizing fuel treatments; strategically placing fuel treatments; increasing use of wildland fire for meeting resource objectives; and continuing and expanding the use of all methods to improve the resiliency of our forests and rangelands." The final priority involves "engaging homeowners and communities in creating fire adapted communities where populations and infrastructure can withstand fire without loss of property." To move the needle toward achieving National Strategy goals, wildfire response tactics must be reevaluated to improve effectiveness and rein in costs. By doing so, we can reduce the use of fire borrowing and ensure that programs to restore and maintain US landscapes are positioned (and funded) to succeed.

A Perpetuating Problem



Aerial fire suppression alone addresses the wildfire threat for only one season. It is through effective fuel management plus a heightened focus on keeping fires small through effective initial attack that reduces the wildfire threat for years to come.

A Change in the Air

Federal and state agencies revisit aerial firefighting strategies as wildfires grow in size and budgets stretch thin.

The first pillar of the National Strategy—improving the safety and effectiveness of wildfire response—is more important than ever as blazes burn larger and dangerously hot over the course of a longer season. One area of wildfire response that is primed for increased effectiveness is the use of aerial firefighting.

For decades now, the use of firefighting aircraft has been central to wildfire response programs. However, as the decades have passed by, traditional aerial firefighting strategies have remained mostly unchanged despite the shifting fire environment and the introduction of new aircraft, technologies and tactics. To increase response effectiveness, it is time for these strategies to be revisited.

Aerial firefighting through initial response to wildfires.

It is well known that aerial firefighting is most effective through initial response to small wildfires.[10] During initial response, small forward-attack aircraft and helicopters can arrive on a scene within minutes, carrying loads of water, gel, foam or retardant that can help contain a fire situation until ground crews arrive to put it out. Each time a small wildfire is suppressed during initial response, agencies prevent greater devastation and millions more in associated costs that come with large and very large fires.[11] In fact, a USDA Audit Report found that when success rate of USFS initial response dropped by 1.5% in 2007, it represented an estimated 150 more fires that escaped containment and cost the Forest Service an additional $300 million to $450 million to suppress.[12] By avoiding decreases like this and instead improving the success rate of initial response, the USFS could generate hundreds of millions of dollars in savings that could be used to fund critical fuel management tactics like forest thinning and prescribed burns.

The full benefits of reliable and successful initial response are realized when small wildfires are quickly suppressed and the resulting budget savings are funneled into programs that help restore ecological balance to our forests and better protect against megafires for years to come.

Additionally, there are public health benefits to extinguishing fires during initial response. Less smoke is released into the air, which in past wildfire situations has affected the health of thousands of people in communities across the US. Fewer harmful carbons are emitted, which research shows can have a lasting impact on climate change—a severe wildfire season such as 2015 has the potential to release a decade's worth of stored carbon into the atmosphere in just a single season.[13] The degradation of water quality is also reduced, as each large wildfire increases susceptibility of watersheds to flooding and erosion which can have short- and long-term impacts on water supplies, such as increased treatment costs, need for alternative supplies and diminished reservoir capacity.[14] These public health benefits underscore the importance of the National Strategy's first priority, "to maximize the effectiveness of initial response" so wildfires can be suppressed and extinguished while they're still small.

A Change in the Air (cont.)

However, the reality is that many aerial firefighting models are not optimized to execute the swift, reliable initial response needed to control fires that are burning and spreading more quickly today due to climate change and unhealthy landscapes. Rather, firefighting aircraft are more often deployed when a fire has already escaped containment and grown into a larger, more expensive disaster. When this happens, typically large and very large air tankers (LATs and VLATs) are used to initiate an indirect attack where aerial firefighters surround a fire with retardant, creating fire lines to box in the threat. Over the course of the indirect attack, LATs and VLATs complete numerous drops of retardant to contain the blaze. Turnaround time between drops often exceeds one to two hours for LATs and VLATs due to the time-intensive procedures required for loading high volumes of retardants. Turnaround time may also be impacted by basing requirements, as large aircraft must operate out of large airports as opposed to smaller, regional bases. As with all aircraft, turnaround time contributes to the overall length of a wildfire mission, which in turn increases aircraft operating costs. In some situations, incident managers have tried to ameliorate long turnaround times by "filling the gap" with an additional LAT or VLAT to help paint more lines around a fire. Doing so essentially doubles the cost of a suppression mission.

When a small fire does break initial containment efforts, LATs and VLATs play a critical role in suppression, but at a high cost. Significant acquisition and retrofitting costs, plus on-going maintenance requirements, naturally limits the number of LATs and VLATs that can be made available. For example, for the 2018 season, the USFS will have only 13 exclusive use LAT/VLAT contracts and 12 call-when-needed contracts for aircraft of the same size.[15] With at best a small number of large aircraft operating from limited bases, LATs and VLATs cannot be as widely distributed as smaller, less expensive aircraft across a fire-prone region. Given the broadening geographic areas requiring potential fire suppression, and the limited number of LATs and VLATs, there is simply too much ground to cover to ensure a swift, reliable initial response. This structural challenge for large aircraft, combined with higher operating costs, makes LATs and VLATs primarily, if not solely, suited for indirect attack on large fires. While this type of response will continue to have a highly effective and important role in fighting big blazes, public entities must bolster rapid and direct initial air attack capability in order to quickly respond to and contain fire starts in the WUI when they are still small. Otherwise, small wildfires will continue to become large public health disasters that require millions of dollars to suppress.

A New Path Forward

The use of custom-built methods for today's fire environment, plus advances in aerial firefighting technology, help keep fires small and costs down.

Most wildfires start as small, containable situations. But when a spark occurs in today's shifting environment, a rapid, direct and reliable initial response is needed to avoid a multi-acre, multi-million-dollar disaster. By bolstering their initial response and direct attack capabilities with purpose-built firefighting aircraft, technology and flying tactics, fire agencies are able to knock down fires more quickly and better support crews on the ground that are putting out the flames. Doing so helps divert the large and very large wildfires that are predicted to increase in frequency over the coming years. Key to the success of this model is using money saved from reduced suppression costs to fund forest health programs like forest thinning and prescribed burns that reduce the enormous "inventory" of fuels on the ground.

To optimize strategies for rapid, direct initial response, there are three main categories to focus improvements: aircraft, technology and flying tactics.

Small, forward-attack aircraft are the most effective resource for rapid and direct initial air attack.

During initial response, every second counts. Small, forward-attack aircraft are needed for their ability to quickly get off the ground, arrive at a scene and nimbly maneuver a fire's frontline to drop continuous loads of water, foam, gel or retardant. These aircraft can quickly reload in between drops, returning to small, regional airports to reload, or scooping directly from a water source nearby the fire situation. These capabilities combine to support a rapid, reliable initial response to small wildfires. Only a handful of forward-attack aircraft provide these capabilities, and some are more cost effective than others.

A closer look: Land-based aircraft best suited for initial, direct response.

Single engine air tankers (SEATs). Like small, Type 3 helicopters, SEATs can take off and be en route to a fire situation faster than larger aircraft, a critical capability for successful initial response. Based on the situation at hand, SEATs can carry loads of water, gel, foam or retardant to drop on hot spots and help control the fire situation until ground crews can arrive. SEATs carry loads of about 800 gallons which allow for "surgical" drops on a fire, enabling the aircraft to work closer and more safely with ground crews. Land-based SEATs can operate out of smaller, regional air bases that are often closer to fires in the WUI, cutting down on turnaround time.

Helicopters. Smaller, typically Type 3 and Type 2 helicopters can take off and be en route to a fire in a matter of minutes, making them an effective complement to aerial firefighting arsenals. Helicopters have the advantage of dropping water, foam, gel or retardant based on the situation at hand, and are able to reload from small water sources or staged tanks that can be positioned very close to a fire. The disadvantage of helicopters is load size. Oftentimes a Type 3 helicopter can only carry a bucket that holds 150 to 300 gallons. Even so, these helicopters when deployed in larger numbers can be effective initial responders to a wildfire.

A closer look: Forward-attack scoopers provide rapid, continuous drops for direct initial attack.

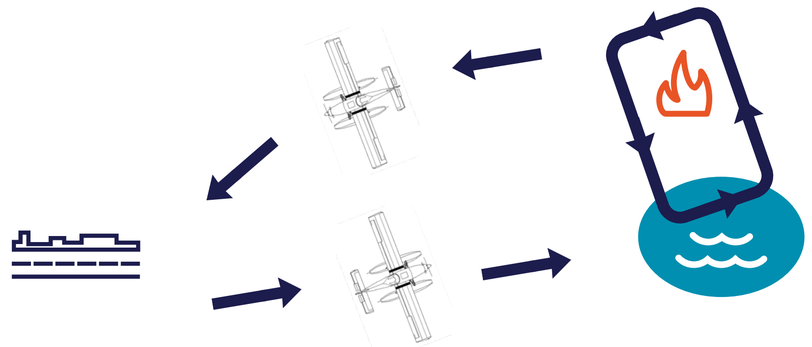
The Fire Boss. When equipped with amphibious floats, a SEAT becomes an 800-gallon scooper air tanker, like the Air Tractor AT-802F (Fire Boss). When nearby a water source, an aircraft like the Fire Boss can perform continuous scoops and drops on a fire for multiple hours – without needing to return to a base. Given that most human settlement is near water, and at least two-thirds of historical fires in the US have been within ten miles of a scooper-accessible water source (and about 80%[16] have been within five miles of a helicopter-accessible water source), there is undeniable value to adding scooper SEATs to firefighting arsenals. And at $3 million to acquire —or $4,500/day and $4,500/hour to operate—the Fire Boss is an obtainable resource for many fire agencies.

CL-415/215. In addition to the Fire Boss, the CL-415 is a multi-engine, 1,600-gallon scooper air tanker that has been used to fight US wildfires. However, at $35 to $40 million per aircraft – or $42,000 to $54,000 per day and $14,000 to $17,000 per hour to contract – the CL-415 is prohibitively expensive for many agencies in the country. When comparing the capabilities and cost of each scooper aircraft, it can be determined that replacing two CL-415s with five Fire Bosses would exceed total tank capacity and increase tactical flexibility while saving ~$13.6 million per year.

SEATs enable a widely distributed basing strategy in anticipation of dispersed fire starts. SEATs, whether wheeled or on floats like on a Fire Boss, are much less expensive to contract and operate, allowing departments to deploy more aircraft and create “nodes” of resources in fire prone areas. With more nodes of aircraft in more flexible locations, SEATs can dramatically improve the speed, effectiveness and reliability of initial response and extended operations throughout a fire-prone region. Scooper SEATS like the Fire Boss can be even more cost effective when positioned within 15 miles of a fire because of the rapid turnaround time possible when scooping directly from a water source.

Scooper aircraft tactics explained

- Scooper dispatched from airport loaded with water, foam, gel or retardant
- Remains at fire for 3.5 hours, scooping water from nearby source
- Can deliver up to 20 loads (i.e., 13,000 gallons) per hour
- Similar to helitack strategy



A closer look at scoopers: The Fire Boss and CL-415/215.

The Fire Boss

Key Capabilities

- 800-gallon capacity
- Onboard foam and gel mixing systems; ability to ground-load retardant, gel and water, if required
- 4-hour mission fuel
- Computer-controlled constant flow fire gate (Level 1-5 coverage)
- Operates from short/off-airport runways

Size and Build

- 16,000-lb. scooping weight
- 16,000-lb. take-off weight (from land)
- 8,800-lb. typical empty weight (Dauntless Air configuration)
- 1,600-hp turbine engine
- 36 feet long, 60-foot wing span, 16-foot tail height

Cost

- ~$3.0 million acquisition cost
- Contract cost: $4,500/day-$4,500/hour (including fuel)*

*based on short-term 60-day contract

CL-415/215

Currently not in production. Production expected to resume in 2020.

Key Capabilities

- 1600-gallon capacity
- Onboard foam mixing system, not permitted under USFS contract (water only); ground loading not SOP for USFS
- 4-hour mission fuel
- 4-door drop system, two settings (4-door salvo or single door drop)
- Requires 5,000 foot paved runway

Size and Build

- 47,000-lb. scooping weight
- 43,850-lb. take-off weight (from land)
- 28,400-lb. typical empty weight
- Two 2,380-hp turboprop engines
- 65 feet long, 94-foot wing span, 32-ft tail height

Cost

- New manufacturer estimated acquisition cost of $29 million
- Previous manufacturer acquisition cost over $35 million
- Estimated contract cost: $55,000/day plus $15,000/hour (including fuel)*

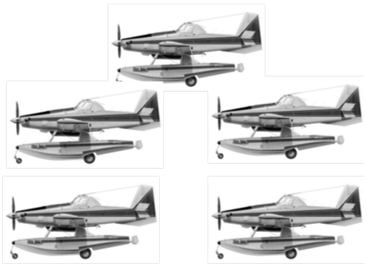
*based on 200-day USFS exclusive use contract that was terminated in 2017 due to excessive cost. Above rate estimates are Call-When-Needed only

Imagining the opportunity

Accessing multiple Fire Bosses instead of a small number of large air tankers can enable fire agencies to increase tank capacity and tactical flexibility while saving money.

Capacity of 3,200 gallons

Contracting fees for two CL-415s: $23,000,000*



Capacity of 4,000 gallons

Contracting fees for five Fire Bosses: $8,000,000*

*Based on 200-day contract

Imagining the opportunity

The Fire Boss is becoming a multi-resource tool for land management efforts.

Aerial Seeding and Hydro Mulching

- Reforestation and land reclamation in remote areas
- Aerial seeding of steep slopes, rugged terrain and pipeline/power line corridors to mitigate erosion and mud slides after construction activity, timber operations and wildfires

Fish Stocking

- Ability to rapidly plant young fish stock in remote lakes
- Release load at slow speed while coming “off the step”
- Very low mortality rate vs. air drops or ground delivery

Aerial Liming of Lakes with High Ph Levels

- Aerial delivery of lime powder to remote lakes to reduce Ph balance to levels that are suitable for fish and other aquatic life

Environmental Spill Containment and Dispersal in Coastal Waters

- Rapid and highly accurate aerial delivery of petroleum dispersal products to mitigate the environmental impact of oil and gas spills in coastal areas

Bolstering technology-enabled aircraft for improved initial and extended response.

There are myriad benefits that have been realized through new and emerging aerial firefighting technology. When evaluating aircraft, there are a handful of innovations to look for that make a fleet an even more efficient and effective early strike tool.

- Thermal imagining units (infrared) to accurately target hot spots
- Onboard gel blending systems to improve drop effectiveness
- Lighter fire gate to allow an operator to carry more water and match drop pattern to fire type
- Onboard collection of geo-referenced data to show location, quantity and types of drops made

The most advanced aerial firefighting partners innovate for the mission, geography and fire environment at hand. In the future, aerial firefighting technology will include night vision capability (like that used in military operations), pilot-monitored automatic flight missions for safety and accuracy, and (eventually) autonomous/non-piloted operations.

Effective tactics: Increasing safety and efficiency of firefighting missions.

Many of today's aerial firefighting aircraft and tactics were first developed and proven effective by the US military. One such strategy is group tactics, where communication-wise pilots operate as one aircraft/team thereby drastically reducing the amount of radio "chatter" and enhancing overall situational awareness. Each pilot also takes on a "wingman" role where they look out for other pilots in the group to ensure that safety checks are done and pilots are working from the same page. The use of group tactics improves teamwork and communication, which are at the heart of aviation safety.

"The best training events build crew cohesiveness and camaraderie. I recently attended an event put together by Dauntless Air where every person involved in the company from the CEO down participated. The flight and aircraft maintenance leadership made it clear that operational safety was the number one priority for everyone in the company."

Stanley Kubota, Retired
Former Federal Fixed Wing Operations Specialist

"Safety culture in combination with aggressive, coordinated direct attack strategies using the latest in on-board technology are key to successfully transitioning from larger aircraft to smaller, forward-attack aircraft."

Bill Shuster, Retired
Former State Wildfire Aviation Supervisor

A Vision to Win the War Against Wildfires

Climate change, expansion of the WUI and today's unhealthy landscapes are combining to create costlier fires that are burning and spreading much more quickly than they did 20 years ago. In the face of this new world order, public entities must bolster rapid and direct initial air attack capability by incorporating a network of smaller, lower cost, forward-attack aircraft into aerial firefighting arsenals. Doing so will prepare agencies and the country as a whole to rapidly respond to and contain fire situations in the WUI before small blazes escape and become multi-acre, multi-million-dollar devastations. Only then can we reduce the need for fire borrowing and return critical funds to forest management programs that reduce the fuels accumulating in our wildlands and restore the vitality of our nation's forests.

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ABOUT THE PUBLISHER

Dauntless Air

Dauntless Air is an aerial firefighting company deeply dedicated to protecting people, land and property from the devastation of wildfires.

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