

Vignettes from the Past: Airplane Surveys

Early Use of the Airplane for Surveying Insect Damage

Forest entomologists Miller & Keen take to the air - 1925 - 1927¹

The following accounts were extracted from the newsletters and they document the first use of the airplane by forest entomologists in the west, beginning with Miller on the Sierra N.F. in June 1925 and Keen on the Modoc N.F. in Sept. 1927. Both instances involved the western pine beetle and the airplane was the DeHaviland DH-4 open cockpit biplane that had been a bomber in WW I. The pilot and passenger compartments were some distance apart, being separated by the gas tank, making communication difficult.

Miller starts it, 1925

Here is Miller's initial account in the Newsletter of June, 1925, page 9-10, one month after the flight:

Spotting bug trees at 13,000 feet

During the period May 3 and 6, Lieutenant W.R. Taylor of the 15th Photo Section of the Air Service made a trip to North Fork and went over the ground to be covered in the air survey of the San Joaquin areas. Tests were made of the hyper-sensitized panchromatic films and the filters used by the Air Service in photographic mapping. These tests demonstrated that, under the right light conditions, the sorrel and red trees could be registered in contrast to the normal green trees of the forest.

Plans were made to carry out the survey early in May. Three different dates were set for the flight but each time storms and unfavorable weather conditions made postponement necessary. For a time it seemed as though the project would dissolve in rain and Pacific Coast fog. A final attempt was set for May 26th and this time the weather gods were favorable. At 10:00 A.M. two DeHaviland Army planes left Chrissey Field at San Francisco, heading straight as the crow flies for the San Joaquin areas. In one hour and twenty five minutes they were over the infested area at Bass Lake. This incidentally, is some time record as the best that has been done by any other means of transportation amounts to about nine hours.

One of these planes, piloted by Lieutenant Taylor carried the mapping camera and the operator from Chrissey Field. The other traveled as an observation plane and was piloted by Sergeant Fowler. The rear cockpit of this plane was occupied by the party whose initials appear at the

bottom of this news note and an effort was made to spot on a map the infestation as it could be seen, the object being to test out the observation as well as the photographic method.

The areas were at an elevation of 3500 to 4500 feet and the photographs were taken from an elevation of about 12,500 feet. The observation plane kept about 500 feet above this to allow for the maneuvering of the other ship for photographs. About one hour was spent over the areas and altogether nearly twenty square miles were photographed. The return trip to Crissey Field required over two hours due to a strong head wind. A landing was made at Modesto for lunch and the planes landed at the base field at 4:30 P.M.

A report on the results of the expedition will have to wait until the Air Service Laboratory finishes the pictures. These will be out in a few days. In viewing the areas from the air the red and sorrel trees stood out in strong contrast and an excellent idea of the general distribution of the infestation was formed. I do not maintain that I got anything like twenty five per cent of the bug trees on the map or that many of those I did get were near their correct location. I do not doubt but that someone familiar with this sort of work from the air would have been more effective as an observer.

-J.M.M.

In Miller's report², he says that \$150 was allotted for the test. Wratten A (red) and G (orange) filters were used on the camera lens on the ground beforehand and the G was chosen because "it permitted exposures of 1/50 sec or less and because of the general balance of contrasts and the colors desired were much better." The vertical aerial photos were taken with a 12 inch lens at an average height above ground of 9,000 ft (altitude: 12,000-13,000 ft). The map scale was 750 ft/inch. After examining the photos, he doubted that individual trees could be discerned at a lesser scale. The two photo prints in the report are 7 X 9 inches and are not a stereo pair. The faded trees on two plots shown in the photos were interpreted and compared to ground surveys. A total of 45 trees were detected on the photos; 4 were not. Because of the light colored soil, faded trees did not contrast with the background and were detected only by their shadow. Miller concluded that although the method cannot supplant ground "spotting" (locating & marking) infested trees, it showed promise for planning control projects and that it is of unquestioned value for various research purposes including showing the effects of infestations (or fire) upon the forest type and cover.

Next up: Keen, 1927

In the Dec. 1927 Western Forest Insect News, Keen describes his disconcerting moments as Capt. Boggs cut the engine to dampen vibration during opening the camera shutter for each photo. I don't know if any report was written but I have several 4X5 prints of his photos from this flight³. They are much larger scale than were Miller's. Also they are oblique views that are easy to interpret because the length of crowns is visible and the timing of photography was at low sun angle, resulting in sharp shadow silhouettes of the trees, which helps to detect faded crowns that blend with the ground color.

Shooting Bugs from the Air

By F.P. Keen

Forest Entomologists, keeping pace with the times, have already found many ways in which the airplane can be used in dealing with forest insect problems. Chief among these is in connection with extensive surveys of large areas of infested timber. Several flights of western forests have been made recently, and the technique of making insect surveys from the air has been fairly satisfactorily worked out. There are three general methods that can be employed:

1. Visual observation of the area as a whole; in which the observer makes a mental picture of the location, distribution and relative intensity of the infestation.
2. Sample strip counts; in which the observer tallies all conspicuous dead trees within his range of vision between certain markers on the plane as it flies over a course of known length.
3. Aerial photographs of sample plots; in which an aerial camera, equipped with a fast lens, "G" color filter and panchromatic plates, is used, and vertical "shots" are taken of sample plots at an elevation of about 5,500 feet. The color filter causes the yellow foliage of the dead trees to stand out white, in striking contrast to the rest of the trees, so that the number of such trees on the sample plot can be easily counted and the average run of infestation determined.

The three methods can usually be combined during one flight over an area, so that in a few hours' time an estimate can be secured of the insect damage over a large area - work which would normally take several weeks to do on the ground.



**F. P. Keen took aerial photos of western pine beetle-killed trees on the Modoc N.F. from this Forest Service fire patrol open-cockpit biplane in 1927.
Photo no. 6515 by J. M. Miller.**

In September I had the opportunity of making such a flight over the Happy Camp District of the Modoc National Forest. The District 5 air-patrol plane, piloted by Captain M.S. Boggs, was detailed to the project through the courtesy of the Forest Service, and to the Forest Supervisor, George W. Lyons, was allotted the task of serving as weather prophet and to advise Mather Field when air and light conditions would be satisfactory for the flight.

Monday, the twenty-sixth, dawned bright and clear, and Supervisor Lyons, trusting to his luck as an amateur Father Ricard, telephoned the field for the plane to come on. In the next two hours, while I negotiated forty miles of mountain road from camp to Alturas, the plane covered the two hundred miles from Sacramento to Alturas and landed on the field only a few minutes after me. Following a hasty lunch we donned helmets and goggles, strapped on the "chutes", wound up the DH-4, and in a moment Captain Boggs had it climbing skyward, like a *Chalcophora (angulicollis)* scared from a bug tree, and heading toward Happy Camp Mountain.

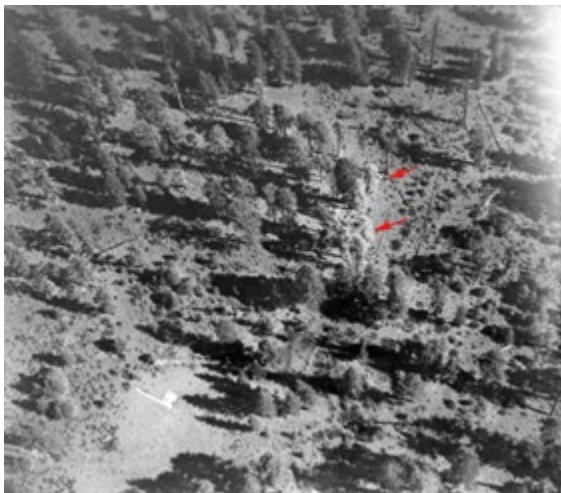
On reaching the area we circled Happy Camp lookout tower and headed toward Timber Mountain. When over the plots to be photographed I unbuckled the safety belt, knelt on the

seat and hung out over the side of the fuselage in preparation to shoot at the proper moment. Captain Boggs maneuvered the plane over the plot and at a given signal shut off the motor, turned the nose up, tilted the plane to the side (a most disconcerting procedure), and as the plane settled and the vibration of the propeller ceased I clicked the camera and climbed back to the safety to change plates and prepare for the next shot. After taking a dozen exposures, both verticals and obliques, we headed back to Alturas and landed safely at the field, after spending an hour and a half in the air and covering an area that would have taken a week to survey on the ground.

The first day we used a "G" filter with ordinary panchromatic plates, but upon developing them found that the negatives were too weak for the light conditions that prevailed on the area. You see, the Supervisor was almost as good a prophet as a Native Son, and so it started to cloud up by noon and was quite overcast by four o'clock.

And the next day it rained!

On the third day Captain Boggs had to return to Mather Field and so a second flight was attempted, even though storm clouds were drifting overhead and the chances of taking pictures looked none too good. However, we hopped off at eleven o'clock, sailed up through the clouds and bumped over the air holes, and soon were back over the area. By a great stroke of luck the clouds now cleared away, and the sun shone bright and clear and gave us a wonderful opportunity to get some clear pictures. This time we had equipped the camera lens with a "K-2" filter, and a dozen exposures were again made, with better coordination of signals that had prevailed the first day. We spent about two hours over the area, obtaining a wonderful view of the country as a whole, and I discovered two heavily-infested areas that I had not seen from the ground. On returning to Alturas the plates were developed and proved to be excellent pictures of the country, but the filter had not given us as much contrast to the "bug" trees as might be desired.



Faded trees (arrows) on Keen's Brown's Well plot taken with K2 filter (G was better) 1/120 sec at 200 ft above ground.

Location: T 44, R 8, Sec 30.

Each experience of this kind gives us a better understanding of the possibilities of the airplane in forest insect survey work and also the technique of the methods which will give the most satisfactory results. For instance, on this flight we learned that the "G" filter will have to be used to bring out the greatest contrast in the yellow trees, also that except under very favorable light conditions a hypersensitized panchromatic plate will be necessary. Exposures of 1/120 or 1/155 of a second are required on account of the vibration and speed of the plane. Oblique views are best secured at elevations of less than 2000 feet, for if one looks down at too sharp an angle too much of the ground between the trees comes into view, and the area doesn't look like a forest at all but more like a scattered brush flat. The vertical shots should be taken at an elevation of from 4000 to 6000 feet above the forest, so that the pictures will cover at least 40 acres of ground surface and yet not be so far away that the infested trees cannot be distinguished. There are also many little problems connected with the taking of the pictures, such as getting the light to the rear, proper coordination between cameraman and pilot, operation of the camera etc., which can be gained only through experience.

One of the finest things about the air method is the general picture one gets of the situation as a whole. The relative intensity and distribution of infestation on different parts of an area is very striking and impressive. When an area has been seen from the air, you have the satisfaction of feeling that nothing has been missed and that your estimate of the situation is a comprehensive one.

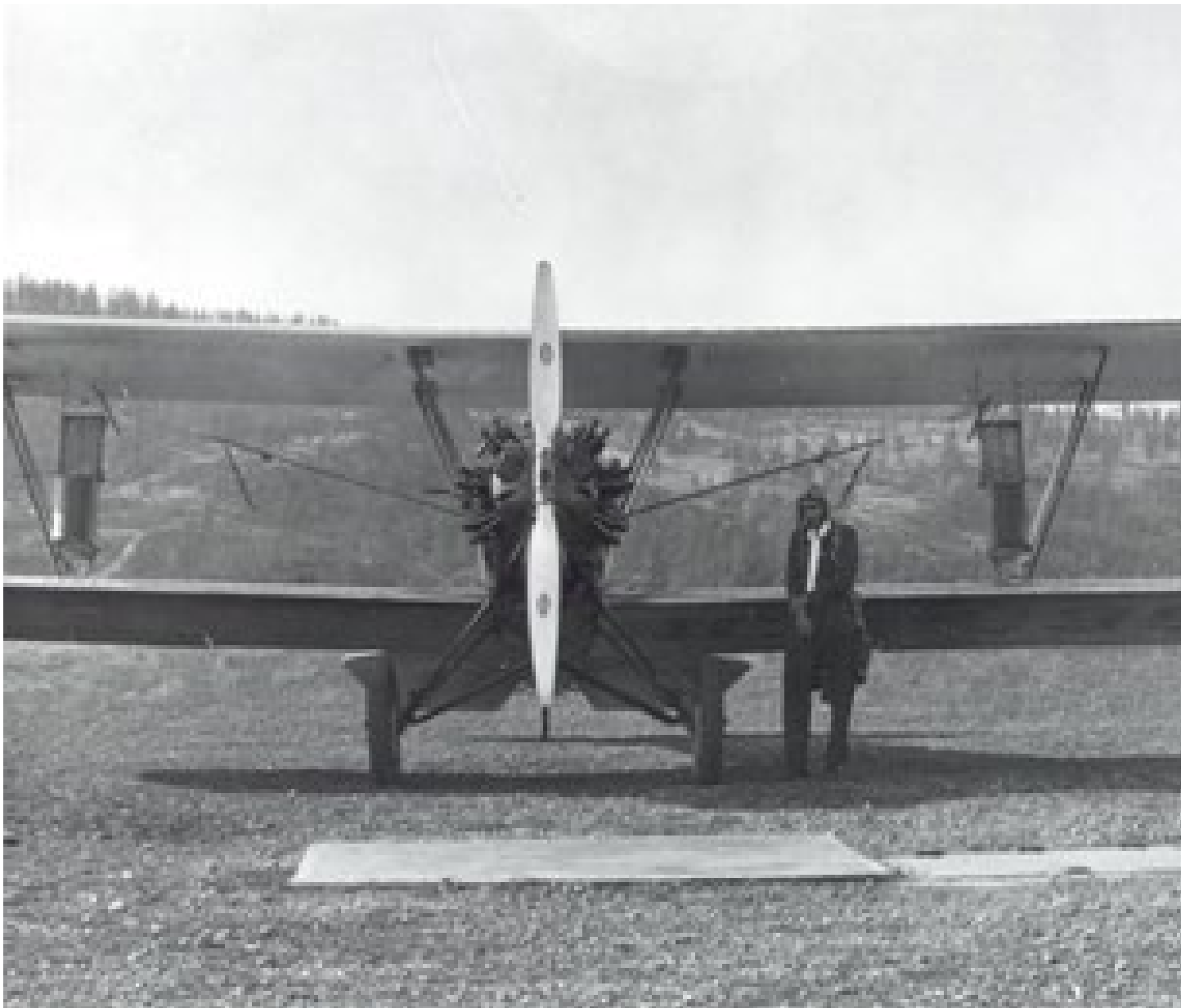
Airplanes as an aid to forest insect reconnaissance have already proved themselves of value. Who knows how soon it will be before every forest insect field station will include in its personnel a pilot and a trained air bug observer, and on its property list a late model "Spirit of Dendroctonus"?

Subsequent developments

The next known (to me) western application of the airplane for detecting bark beetle-killed trees was evidently by Tom T. Terrell of the Coeur d'Alene, Idaho, Forest Insect Lab. In 1930, he made the first aerial survey of forest insect damage in the northern Rocky Mountains, flying from Livingston, Montana, to Yellowstone N.P. where the mountain pine beetle was killing lodgepole pine (Furniss and Renkin 2003):⁴

"The first flight of the survey could not be called auspicious; it was to be over Yellowstone National Park from a field at Livingston, Montana. I had maps of the Park but nothing for the 65 miles between Livingston and the Park. The pilot had a railroad folder that showed a line going straight south to the Park. Away we went and got lost in the Absaroka Mountains where we were caught in a violent rainstorm. The plane was a small open-cockpit biplane, the pilot in the rear and me up front. The engine went quiet! Then loud pounding behind me! I was about to dive over the side and pull the ripcord when I discovered that the pilot was pounding on the

plane to get my attention. He got it. He wanted to know if I didn't think we ought to go back? He had cut the engine so he could talk to me. I most certainly agreed with him. I was scared stiff. We made it back to the field where Jim Evenden was waiting. By that time the storm was real bad. The pilot taxied the plane up to the fence where we jumped out and with the help of Jim hung onto the plane and the fence to keep the plane on the ground until the storm let up. The pilot was Nick Mammer who later became a famous aviator in the region and one of the first mail and airline pilots in our area."



Tom Terrell beside a biplane like that in which he attempted the first aerial insect survey in the northern Rocky Mountains, 1930. Bad weather aborted the flight.

Forester-pilot Wear and observer Buckhorn ignite the modern era, 1947

For an extended period beginning in the late 1940s, the spruce budworm defoliated millions of acres in Oregon and Washington. Coinciding with this, ending of WW II led ex-Navy pilot, John Wear to study forestry at the University of Michigan. Bob Furniss, In Charge of the Portland Forest Insect Lab hired Wear to develop methods of surveying and measuring insect caused tree damage. Walter Buckhorn was his observer (Furniss 2000).⁵



War surplus N3N biplane flown by pilot-forester John Wear and observer Walter Buckhorn of the Portland Forest Insect Lab to survey areas of spruce budworm defoliation in Oregon and Washington beginning in 1947. The airplane was replaced by a Cessna 195 and then a Cessna 170-B. M. Furniss flew and got sick in both. Once on the downwind leg while approaching Red Bluff airport, John chose to demonstrate how the plane would not spin when stalled. We spun. Digger pines went around and around for breathless moments!

In July 1947, Wear and Buckhorn conducted the first systematic aerial forest insect survey over the Blue Mountains of Oregon and Washington where the spruce budworm was causing defoliation. According to Wear, their military surplus, open cockpit, N3N biplane (Fig.) gulped oil at a rate of one gallon per hour, and "Downdrafts were just too much for Betsy and only the presence of a convenient canyon off the Imnaha (River) . . . kept us from harvesting some ponderosa pine along the ridge." (Personal communication).

Once, at a makeshift airstrip, the tie-down ropes broke while the engine was warming, and the plane chewed into their vehicle, bending the propeller. They drove to Seattle to have it straightened; then, Buck, who was trained earlier as an aircraft mechanic, installed it and they resumed the survey.

In succeeding years, the survey was expanded to cover much of the forested areas of Oregon and Washington, involving participation of other agencies. Buck flew with Wear for 14 years as his observer. In 1955, they combined their experiences to write a manual to guide others in the conduct of forest insect aerial surveys.

Buck and Wear often slept in sleeping bags under the wings. Buck drove a panel truck between airstrips so that, on bad flying days, they could ground-check the accuracy of their aerial observations. They flew out of meadows or roadways and occasionally had to chase off cows. Their "per diem" was \$4.00 per day, affording a motel and hot showers once or twice a week and a restaurant meal every few days.

Surprisingly, Buck, who had been a barn-storming pilot in the late 1920s, was very susceptible to air sickness and never got over it. With a paper bag handy, he would sketch-map insect-caused tree damage until noon, eat lunch, rest, then fly for another hour, during which he got sick again. At day's end, he drank grapefruit juice and went immediately to bed. After a good breakfast next morning, he was in the air again.

By 1949, all of the 49 million acres of coniferous forests in Oregon and Washington were being surveyed aerially for infestations of defoliators and bark beetles. In 1953, Buckhorn and Wear, alone, covered 47½ million acres. That year they mapped 1,860 centers of infestation involving 8½ million acres of forest.

Large-scale salvage logging operations and aerial spraying were based, in large part, on Buckhorn's observations and maps. For example, 3¼ million acres of forest infested with western spruce budworm were sprayed from 1949-1953 at a cost of approximately \$3,900,000. The location of the infested areas to be sprayed was provided by Buck's maps.

Conclusion

Two other events occurred in those earlier days that merit inclusion here. One concerns an outbreak of the hemlock looper in Clatsop Co., Oregon, late in WW II. Bob Furniss of the Portland Lab managed to get authorization to scout the area aboard a Navy airplane! Bob never said much about it. However, he was involved in another survey "first" in 1946 when he flew on a forest insect aerial survey in southeast Alaska. This time he flew in a Bellanca pontoon monoplane flying at 90 mph. The occasion was a spruce beetle outbreak on Kosciusko Island. That led to Bill McCambridge being the first forest entomologist assigned to Alaska. He began annual surveys in 1952 that have continued since. See page 10-

11: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5340278.pdf (*Malcolm Furniss*)

Footnotes:

¹Western Division News Letter, Forest Insect Investigations, Bureau of Entomology, USDA. Palo Alto, California. Mimeo. Published monthly from March 1923 -June 1928. Copy of all issues is in possession of M.M. Furniss, destined for deposit in the Special Collections and Archives Library, University of Idaho, Moscow.

²Miller, J.M. Aerial photography as a means of mapping yellow pine areas to show losses caused by bark beetles. Results of tests carried out on the Sierra N.F. May 1925, by the 15th Photo Section, (Army) Air Service, in cooperation with the Bureau of Entomology, U.S. Department of Agriculture. USDA Bur. Entomol. Forest Insect

Investigations. Stanford University. June 18, 1926. Typed 6 pp + 2 vertical aerial photos with overlays showing plots.

³Photo numbers 6531-6544 in the California Station file subsequently located at the Pacific Southwest Forest Experiment Station, Berkeley, CA. and last known to be at Redding, CA. This file is described by Furniss, M. M., and B. E. Wickman. 1998. Photographic images and history of forest insect investigations on the Pacific slope, ca. 1910-1953. Part 1. *Amer. Entomol.* 44:206-216.

⁴Furniss, M. M., and R. Renkin. 2003. Forest entomology in Yellowstone National Park - 1922-1957. A time of discovery and learning to let live. *Amer. Entomol.* 49: 198-209.

⁵Furniss, M. M. 2000. Walter J. Buckhorn (1899-1968)-Legendary forest entomologist, not of the classroom kind. *Amer. Entomol.* 46:133-140.