R/C Soaring

By Mike Stump

Flying weight and wing loading: With the variety of designs available to the soaring pilot these days, that occupy either the extreme or the middle of the weight/loading spectrum, this is a factor I look at as Soaring's ying and yang. Flying weight and loading are often hot topics of discussion at any gathering of pilots. Different pilots, of course, have varying tastes in regard to speed, handling, and thermal performance.

For new or less technically oriented soaring enthusiasts the many choices make choosing a "next model" a difficult choice. This month we'll compare a couple of two-meter span sailplanes that I have. Both are "full house" 6-channel planes but represent the extremes of weight and wing loading.

On the heavyweight side I'll use the 2-meter *Duck*. Designed and kitted by Troy Lawicki I've flown the standard double-taper wing version with the S-3021 airfoil over the years, as well as a version with my own triple taper wing with the S-3021, SD-7080, and Quabeck 2.5/9 which I called the *Merganzer*. Early versions of the *Ducks* sometimes weighed as much as 65 ounces but continued to do very well on the contest circuits of the Midwest where we see a variety of conditions with regularity.

For the purpose of this comparison the *Duck* will be the standard wing planform variety. It has an S-3021 airfoil with obechi sheeting over white foam wings, stabs, and rudder. The flying surfaces are finished with a thinned epoxy instead of water-based "Varathane" as is the norm for obechi wings. This method is that preferred by Troy for finishing obechi wings. The fuselage is epoxy/glass. It is quite light for 2-meter *Ducks* with a flying weight of approximately 54 ounces. This plane was built for friend Cal Posthuma by Troy, and is the first *Duck* of many I've owned for contest use that I did not build myself. Radio equipment is all JR: aileron servos (341s), flap servos (3321), elevator (9021), and rudder servo (901). The receiver is a 649s PCM and it uses a 1200 mAh battery pack constructed from Sanyo 1200 AAE cells.

On the lightweight end of the spectrum is a plane I just recently completed building. It is the *Dove II* from Northeast Sailplane Products. I don't know what I did exceptionally right in building this plane as I followed the plans and instructions to the letter but I came out under NSP's advertised weight by three ounces at 23 ounces. The *Dove II* uses balsa (1/25-inch) over white foam wings with built-up stabs and rudder. The fuselage is epoxy/glass. Radio equipment is: ailerons (Hi-Tec HS-60s), flaps (JR 341), elevator (JR 3021), rudder (JR 3025). The receiver is a JR 649s, exactly as in the *Duck*, but lack of room (smaller, thinner nose section) and balance have made use of a 150–200 mAh battery pack necessary. This plane, as is, balances at the forward end of the workable c.g. range. I may switch to JR 341 servos for both elevator and rudder, to save weight, allowing for a more rearward c.g. and possibly more battery capacity. Let's look at the plane's statistics "side by side" to compare the numbers.

In a way there are many things in these comparisons that are strictly "apples to apples". But, for the sake of our comparisons, the data above concerning weight and wing loading is really what we want to look at. At this point we're just looking at flying qualities as well. Building and equipment requirements are a different story as the *Duck* with its larger fuselage and wing allow for almost any gear the builder may choose while the *Dove II* requires micro equipment.

Notice the weight of the *Duck* is more than double that of the *Dove II*. The differing design/handling requirements result in huge differences (more than 2.25 times) in weight, but this along with other differences give each plane uniquely different assets that may appeal to different pilot's styles or needs.

One of the things about the 2-meter class that attracts me is the variety of kits available on the market that offer the consumer choices in aesthetics and design and performance features when compared to most of the unlimited class Thermal Duration planes available as kits or ARF. The two kits we're comparing here are both planes that can be constructed by most anyone with general foam core, sheeted wing sailplane construction experience.

Flying the *Duck*

Ounce for ounce, or in this case pound for pound, the *Duck* brings a lot of durability and stability for the soaring pilot. The structure, both wings and fuselage, is extremely robust. The wings have a horizontal grain balsa spar with carbon fiber spar caps and either glass or ply shear webs. The wing is strong enough to handle repeated full-pedal launches from the most powerful winches. The weight/mass of these planes and the clean lines and good airfoil choice allow a practiced pilot to consistently make his *Duck* the highest launching plane at most any field.

One of the handling qualities I like with a slightly heavier plane is what I call the ability to groove. By my experience this is a condition of the wing-loading in combination with the longer tail-moment. The compromise often given in setting up a sailplane is by trimming and balancing a plane in this manner; you don't want to hinder the sailplane's ability to visually convey to the pilot what kind of air it's in. The best thermalling designs in the world are useless if you can't read the air you're in via visual flight traits.

A lot of this skill is developed by stick time for the pilot. Being able to react to, and trust your models actions and reactions to the air as it encounters changes in its domain can make the difference for staying aloft successfully in spotty and marginal lift conditions. Properly tuned and set-up the *Duck* will show definite signs of change in the air and the wing, though large, is sensitive enough to indicate air off the wing tips and periphery.

A wing with area like the *Duck's* is a lot to turn, but generous aileron and flap area allow for crisp positive roll control and adequate braking for de-thermalizing and landing. If you look at the data the stab volume is generous at just under 13% of the wing area. This gives lots of authority in pitch at launch, and in landing speeds which are critical phases of flight. The entire structural system of the *Duck* is stout enough that when needed, the pilot can put the plane home in spot landings without fear of needing major repair.

The fuselage nose under the slide-off nose cone offers generous room, making installation with most any gear no problem. And room exists for batteries with larger capacity. Most all of my *Ducks* have 1200–1400 mAh AAE packs. These batteries are the same length as AA cells and 2mm larger in diameter. They weigh generally .2 ounces per cell more. These packs are great for longer flight sessions and contest weekends. Where your fuselage has the room you have a pack with at least double the capacity of the 600 mAh AA cells supplied with most radio systems in a package that is only 4mm wider and .8 ounce heavier than the 600 mAh pack (square pack dimensions).

Flying the *Dove II*

The *Dove II* represents the lightest weight of any 2-meter span sailplane I have built. NSP shows a projected weight of 26 ounces for this plane in their catalog, but coming in at 23 ounces was a surprise. The entire airframe before covering and radio installation weighed a little over 11 ounces. In fact, at its present flying weight, it has no extra weight in the nose and a smaller capacity battery pack (200 mAh) and still is balanced at the forward c.g. range. I may replace one of the servos in the fuselage with something lighter, or remove the Tx case to try to remove enough weight from the nose to change the c.g.

The epoxy/glass fuselage uses a canopy which I choose to tape in. The bolt-on wing is sheeted with 1/25-inch balsa. The tiplets are taped on for flying. It's a lightweight attachment method that gives me a more portable 3-piece wing.

Servos used are: elevator (JR-3021), rudder (JR-341), flaps (JR-34), and ailerons (Hi-tec HS 60s). Receiver is a JR-649s micro 9-channel that weighs just an ounce with the case, and an SR 150 mAh pack has ended up in the nose.

I experimented with many different battery packs as that was my method in ad-

PHOTOGRAPHY: MIKE STUMP

So what does wing loading and weight do for a model sailplane's performance—not to mention a whole host of other topics? Mike gives comparisons between the heavy (56 ounces) 2-meter *Duck* **(above left)** and the much lighter (23 ounces) 2-meter *Dove II* **(above right)**. That's his lovely wife Sue holding both planes.

justing nose weight since that was where I had to make the plane lighter to balance. With the 150 mAh pack I can fly safely for approximately 45 minutes, so long duration flights are out of the question with this arrangement. A battery/ballast system could be installed beneath the wing if desired though.

I don't have near the stick time flying the *Dove II* as I do the *Duck* we looked at earlier. With its higher aspect ratio wing and light weight/low wing-loading its handling is quite different as you might figure. The *Dove II,* with the controls properly set, can circle quite tightly with confidence at very low altitude.

It's also light enough that it can be hand launched successfully. Before it had ever been up a winch or Hi-start line it had already thermalled out twice during hand toss trim flights. These early flights showed me several neat attributes of this lightweight performer.

With its low wing loading the *Dove II* does not need a large area of lift, or strong lift to gain altitude. The other side of this coin is that the plane is affected by everything going on around it in the air. It's not unstable but so light that it's easily bounced around by anything that goes on around it. I also discovered on the first climb out from hand launch—which was only the third throw—that at this light flying weight of 23 ounces, the *Dove II* needed the reflex of the 7037 airfoil to come home from the thermal it had followed downwind.

Once at altitude the *Dove II* was very smooth, even when getting bounced about in turbulent air. It has relatively large ailerons that work effectively. A couple clicks of down trim allowed the *Dove II* to add speed beyond what I thought 23 ounces would cruise at, but it really is too light to fly at sustained penetrating speeds without pointing the nose down.

This indicated that additional weight as ballast would be a good thing in any wind that was above 7–10 miles per hour. I have since made ballast slugs that bolt into the fuselage under the wing. These are 6 ounces and 12 ounces each and raise the wing loading from 6.2 ounces/square foot to 8.2 and 10.2 ounces/square foot respectively.

With the wing area of the *Dove II* this weight should bring the plane into the wing loading range of other popular designs. I haven't flown in true "dead air" with it yet to really try to see the effectiveness of the ultra-light 23-ounce flying weight.

Notice when you look at the *Dove II* data that the fuselage length and tail moments between the *Dove II* and *Duck* differ by a good bit for planes that have the same wing span. These differences help account for the lighter weight, but also complement other design goals for each plane.

Notice too that the stab volume for the *Dove II* is quite large. This again should be a great assist for stab authority at the critically slow speeds this plane can travel because of its light weight. The size of the stabs is a pleasant surprise for me as I tend to favor this in a design and expected something different in a design where weight was a critical design factor. That said, the construction of the *Dove II* stabs is all built-up and extremely light weight.

I winch launched the *Dove II* the first few times with a little fear and trepidation. After having flown 2-meter planes at the other end of the weight durability spectrum, I fear the real possibility that the light weight wing structure could fail during winch launch. The *Dove II* wing has a wood spar which extends out past the aileron servo cavity, and is capped, top and bottom, with carbon fiber. As I have discovered subsequently, the *Dove II* can be launched without fear as long as one uses some discretion with the winch pedal. The *Dove* will launch steeply and is certainly strong enough to maintain line tension throughout the launch. It will carry a mild zoom off the end of the line but without the mass of heavier planes, the long climbing zoom is not part of the *Dove II's* repertoire. I still remind myself of the structure and how to treat it when I step to the winch with the *Dove II.*

What do you choose?

Truth is, for most people neither. I mentioned earlier, "other popular designs". Somewhere between the extremes is where many people make their investment. The two examples shown are extremes of the spectrum and in the 2-meter size class, with six servos, there are countless choices between the ultra-light *Dove II* and the *Duck.* You have to decide whether your quest with your next plane is high energy launches with maximum search capability or hang time, or one of those options out there that do both tasks well, and they can be winners too. By the way, after 17 years of flying, my definition of winner is a sailplane that comes home with me—especially in its early flights.

Which plane is likely to be my regular 2-meter this season? Still the *Duck.* After six years of satisfaction and comfort with the basic system it's still the best overall set of compromises for my style. I am excited about having the *Dove II* for some particular light air sessions and look forward to gaining more experience with a different style of plane. We'll be adding experiences with hardware we'll see this season at the Nats and F3J Team selections.

2-Meter Comparison

	Dove II	**Duck**
Wingspan	2 meter	2 meter
Wing Area	535 square inches	740 square inches
Root Chord	8″(tapered main panel)	10.325″ (constant chord main panel)
Fuselage Length	40.5 inches	49.125 inches
Wing LE - Rud. TE	30.125 inches	36.7 inches
Stab area/volume	71.25 square inches/13.3%	93.85 square inches/12.7%
Weight	23 ounces	54 ounces
Wing Loading	6.2 oz./sq. ft.	10.4 oz./sq. ft.
Airfoil	SD-7037-modified	S-3021

Northeast Sailplane Products (Dove II) **Troy Lawicki** (Duck)