An intricate, black and white decorative border with a classic, ornate style. It features symmetrical scrollwork, acanthus leaves, and floral motifs, framing the central text. The design is reminiscent of 19th-century book ornamentation.

The Future of Trapping?

By: Janice Pulver
York County Mosquito Control

The Idea

- During Prince William County's presentation last VMCA Conference, saw that the BG Pro uses a power bank
 - The standard 6V and 12V lead batteries are bulky, heavy, and don't last more than 2 years typically
 - Could we modify our current traps to work off of power banks?
 - How well would they work compared to the standard lead batteries?
 - After thinking about trap redesign with power banks, we decided to excluded CDCs and BGs and work with Gravids



Battery Comparison

Lead

- Older technology
- Cheaper
- Shorter life span
- Heavy
- Exposed terminals

Lithium

- Newer technology
- More expensive
- Longer life span
- Light weight
- Internal Components

Power Banks

- Wanted to stay in the same price range as a 6V lead battery
- Decided to go with Anker brand because of their high rating and reviews
 - Chose the 10Ah at \$18.99
- Prince William County said they used a 20.8Ah Mophie brand power bank (N. Nagle personal communication, February 1, 2021)
- Biogents sells a 10Ah power bank for the BG Pro (H. Rose personal communication, November 22, 2021)
 - BG Pro runs off a 6V lead battery or power bank



Lead Battery

Type	mAh	Ah	Cost
6V	12,000	12	\$12.99

Lithium Battery

mAh	Ah	Cost
10,000	10	\$18.99
13,000	13	\$39.98
20,000	20	\$59.98
20,800	20.8	\$35.76
25,600	25.6	\$159.99

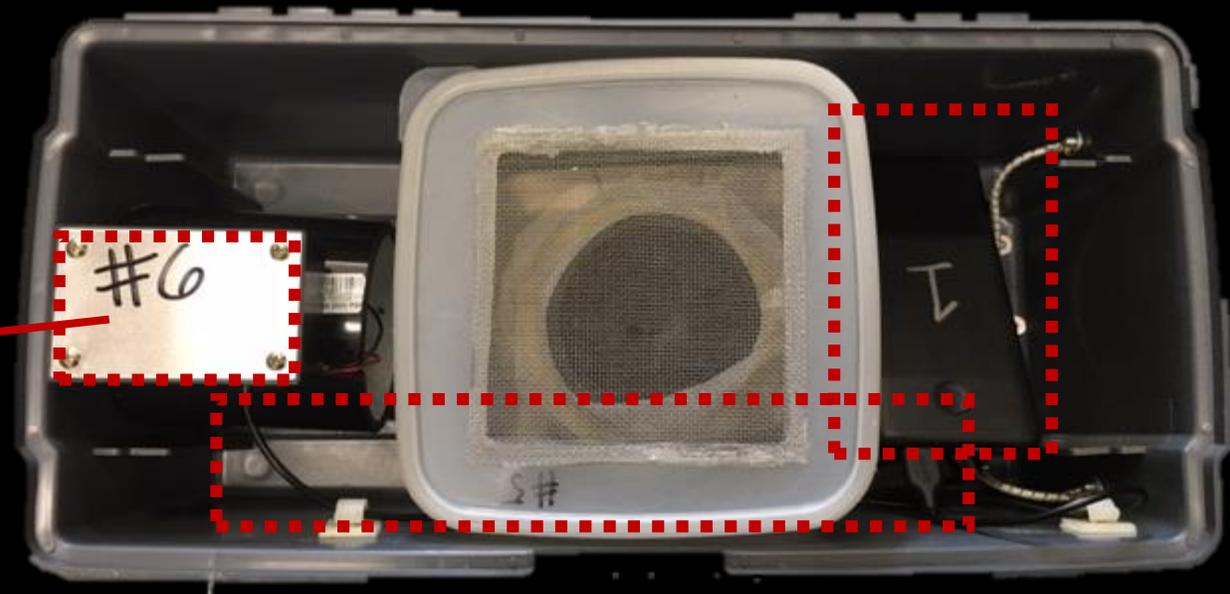
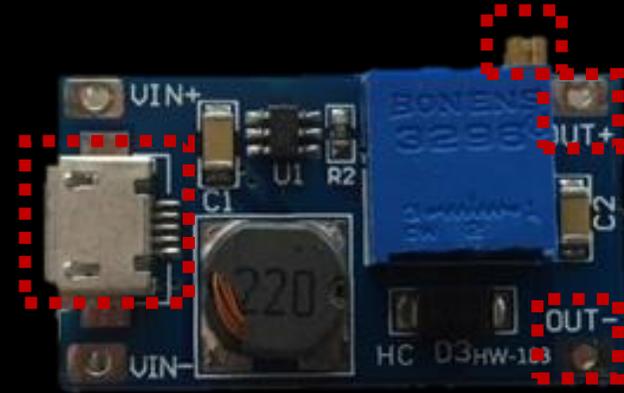


7.3 oz, 4lbs



Voltage Regulator

- Took the average of our charged lead batteries
 - 6V batteries were 6.70V
- Bought voltage regulators to adjust voltage being supplied to power bank traps
 - We can test the voltage of the standard batteries, but not power banks
 - More uniformity between power sources
- Converted two gravid traps, one regulated to 6V and another to 6.70V average
 - Initial tests on both trap types used 25% battery power over night



Temperature and Longevity

- Know that cold weather decreases the voltage of lead batteries, but does temperature affect power banks the same?
 - After some research
 - The life of a lithium battery is shortened at temperatures above 77°F
 - Perform best at room temperature/68°F
- Decided to trap under “ideal” and “hot” humid temperatures of the season
- One thing we wouldn't be able to test is longevity of the power banks over multiple seasons



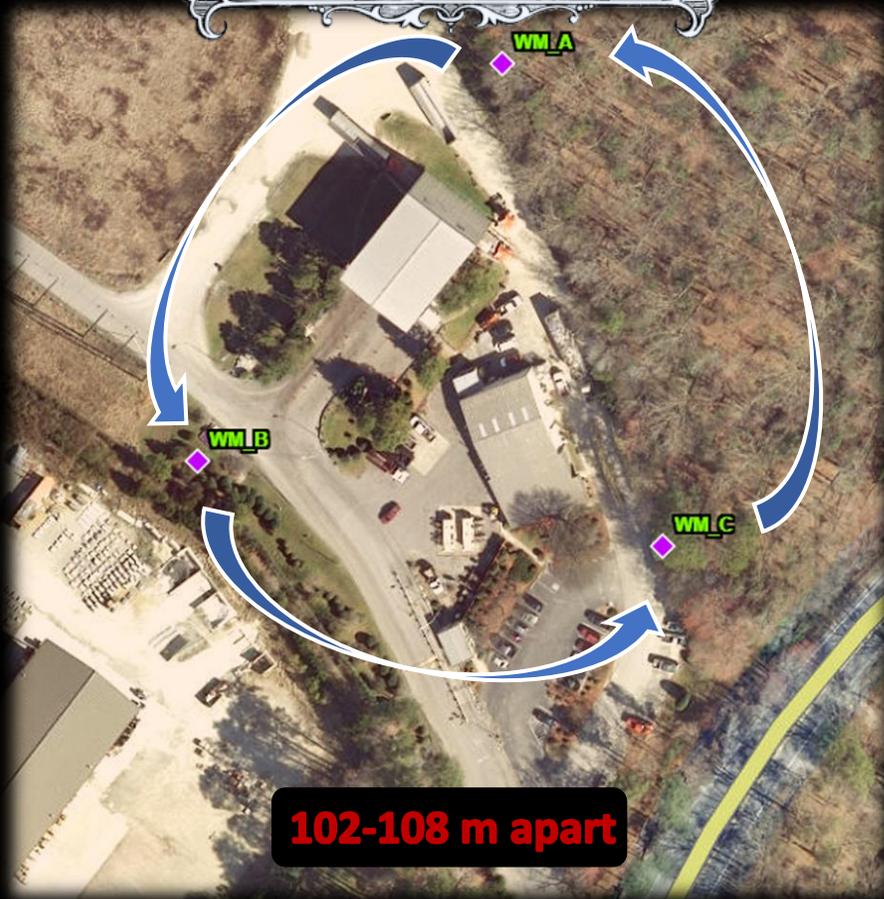
Experiment Design

- Latin Square 3 X 3 design
 - Three different trap sites with known high *Cx. pipiens* and *Cx. restuans* populations
 - Sites also within 10 minutes of our office
- Trapped
 - “Ideal” temperature May 18th – June 3rd
 - EPI weeks 20,21,22
 - “Hot” and humid July 27th – August 25th
 - EPI weeks 30,32,34
- Each temperature variant had 27 trap events
 - 3 nights of trapping per site



Sites

Waste Management



102-108 m apart

SR_A

SR_C

SR_B

51-63 m apart

Shooting Range



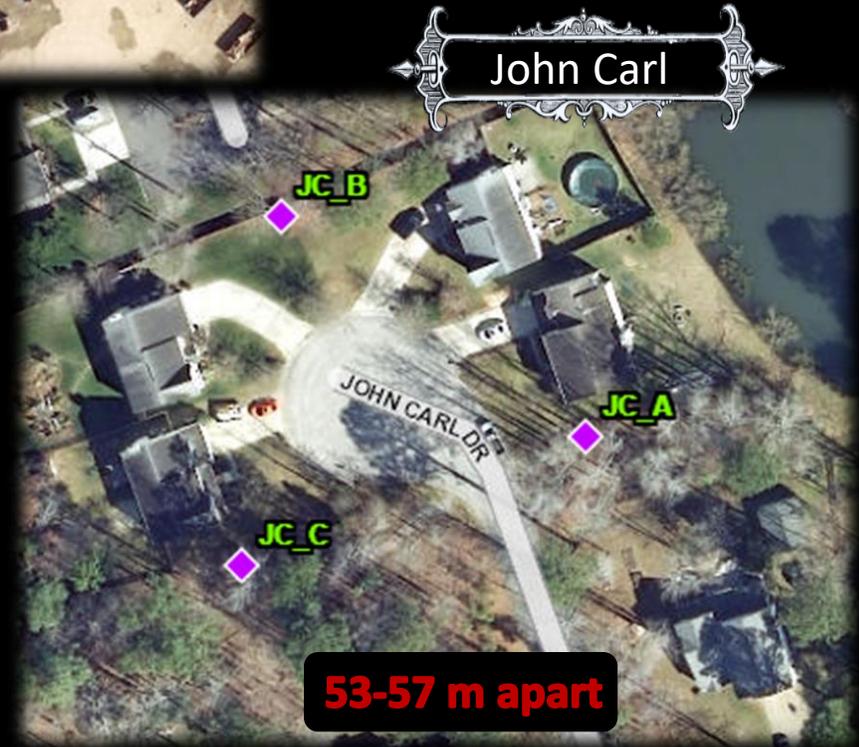
John Carl

JC_B

JC_A

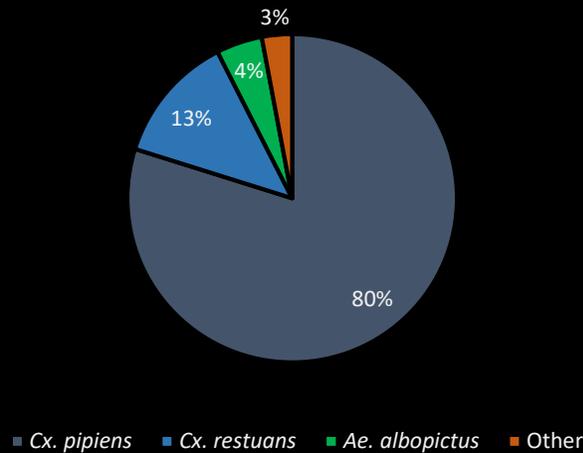
JC_C

53-57 m apart

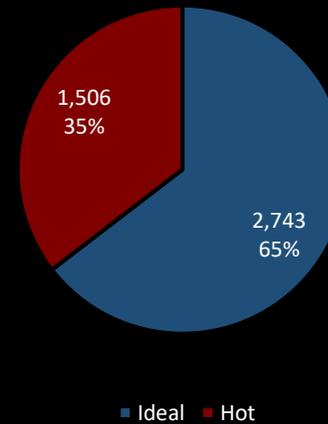


"Analysis"-Catches

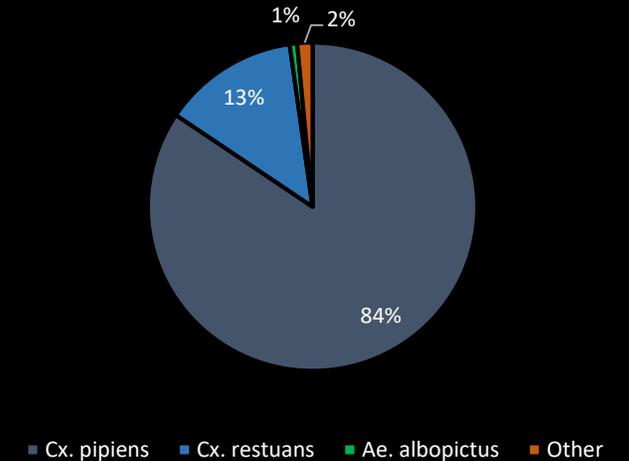
Female Mosquitoes Caught



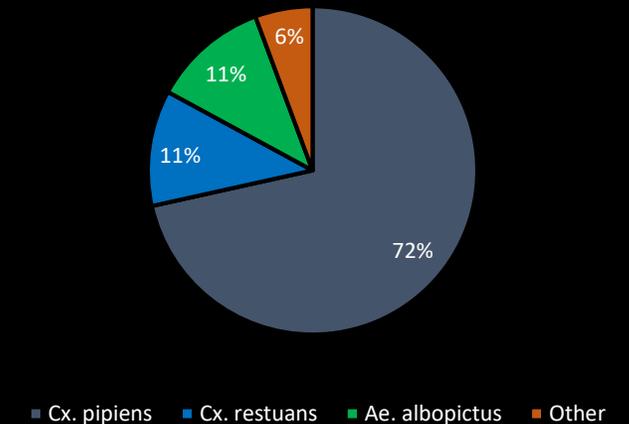
Temperature Caught



Ideal Temp Catch



Hot Temp Catch



- Species and their percentages caught expected
- Caught 65% of the total during ideal temperatures
- 45% decrease in catch amount during hot temperatures
- Caught more variety during hot temperatures

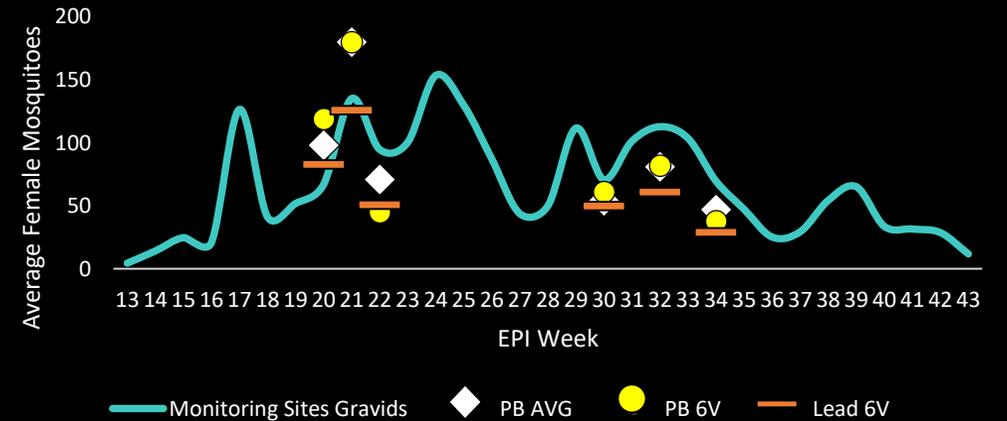
Temperature and Female Mosquitoes Caught					
Temp.	Cx. pipiens	Cx. restuans	Ae. albopictus	Other	Total
Ideal	2316	366	20	41	2743
Hot	1077	172	172	85	1506
Total	3393	538	192	126	4249

"Analysis"-Catches

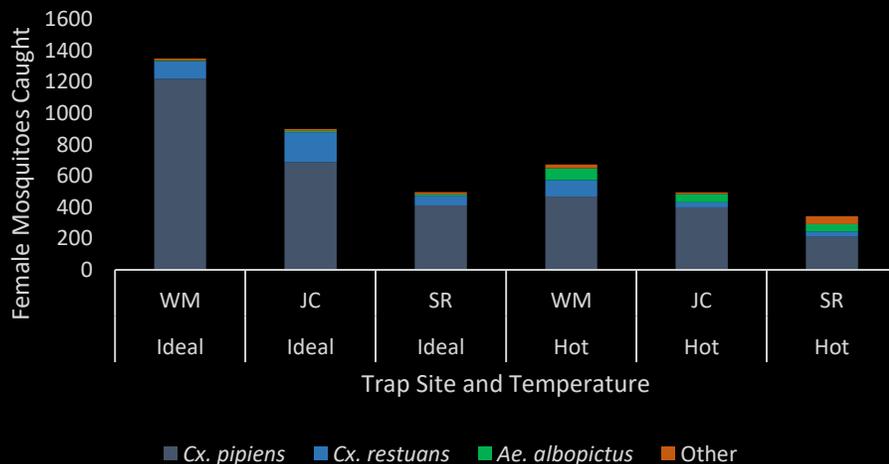
Female Mosquitoes Caught at Sites



Average Female Mosquitoes Caught in Gravid Traps 2021



Temperature, Sites, and Female Mosquito Catch



- Best site overall was Waste Management
- Follow the general trend of the regular gravid trap averages
 - Lead battery tends to have a lower trap average compared to power bank traps
 - Power bank traps seem to exceed or be closer to the monitoring site average than lead battery traps

"Analysis"-Batteries

Temperature Averages

	Ideal	Hot
Average High	79°F	89°F
Average Low	62°F	75°F
Average Overall	70.5°F	82°F

Total Female Mosquitoes Caught

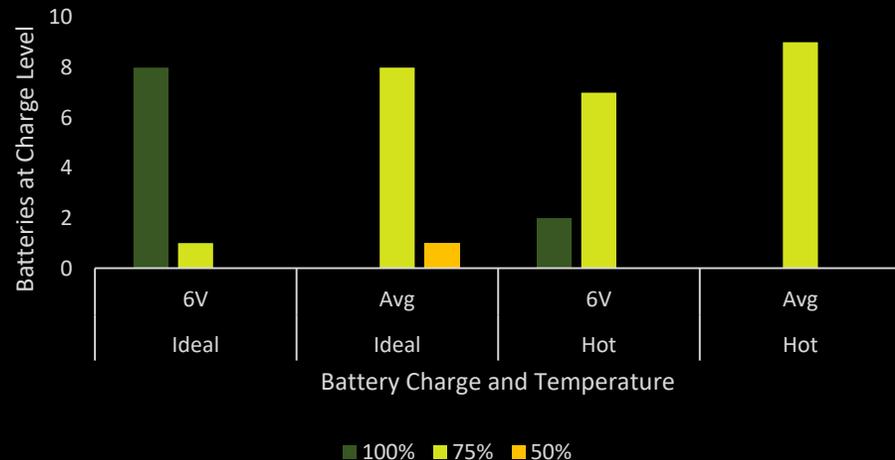
Battery Type	Ideal	Hot	Total
Avg	1,047	546	1,593
6V	920	541	1,461
Reg	778	419	1,197
Total	2,745	1,506	

Average Female Mosquitoes Caught

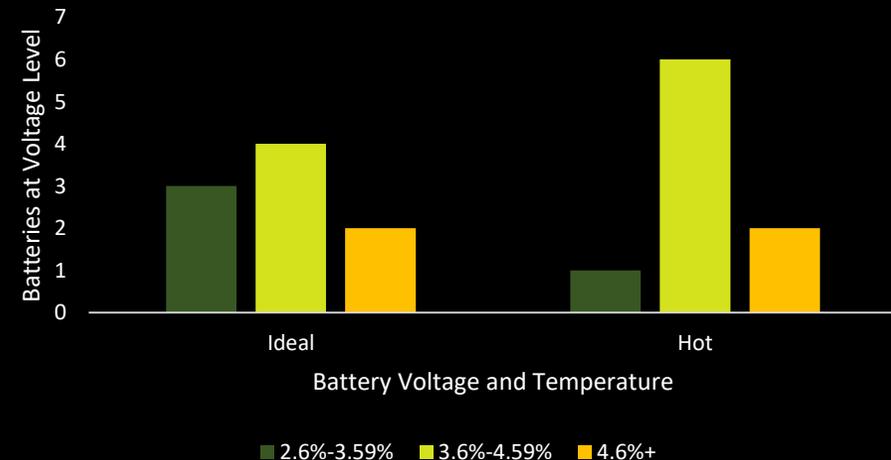
Battery Type	Ideal	Hot	Total
Avg	116.3	60.7	88.5
6V	102.2	60.1	81.2
Reg	86.4	46.6	66.5
Total	101.7	55.8	

- Environmental temperatures ended up being close to what we wanted
- Avg power bank trap caught the most and had the highest trap averages
- Reg 6V lead trap caught the least out of the three
- 6V power banks last a little longer, especially in ideal temperatures
- Average power banks draw slightly more power and used about 25% battery power over a trap night
- 6V lead batteries had less of a decrease in voltage in ideal temperatures and more during hot temperatures

Power Bank Charge At Pick-Up

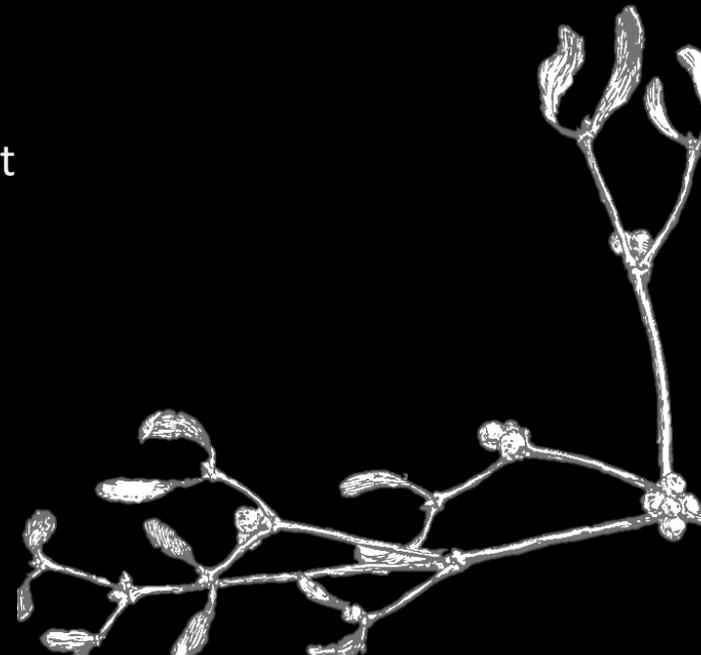


6V Lead Battery % Decrease in Voltage at Pick Up



Conclusion-Data

- Species caught by the power banks were similar to a regular gravid trap
- Higher temperatures drain power banks and lead batteries similarly
- At ideal and hot temperatures, power banks performed a little better than the traditional 6V lead batteries
 - Avg power bank catches 25% more than a 6V lead battery
 - 6V power bank catches 18% more than a 6V lead battery
- Avg power banks use more power than those set to 6V, but catch 8% more female mosquitoes



Conclusion-Practicality

Positives

- Power banks take up less office and truck space
- Much easier/lighter to carry trapping
- Feel fairly confident a power bank could last two trap nights
- Don't have to worry about spade foot connections breaking off
- Don't have to worry about metal contact with terminals
- Can use them to charge your phone out in the field

Negatives

- Easier to lose
- More likely to "walk away"
- Don't know the longevity of power banks
- Not weatherproof if you go with a reasonably priced power bank
- Unplug batteries when they are charged/have to watch them more
- Takes longer to recharge

20 Battery Set-up Cost Comparison

Power Banks

Item	Quantity	Cost	Total
Charging Station 20 Ports	1	\$36.99	\$417.76
Voltage Regulator 10 Pack	2	\$19.98 (\$9.99/pack, 0.99 cents each)	
Power Bank 2 Pack	10	\$309.90 (\$30.99/pack, \$15.50 each)	
USB Cables	20	\$37.00 (\$1.85 each)	
Hanging Shoe Rack 24 Pockets	1	\$13.89	

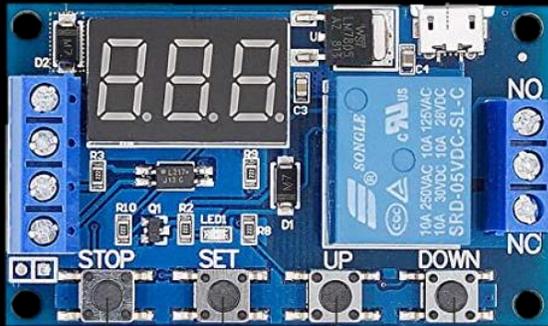
Lead 6V

Item	Quantity	Cost	Total
Battery Tender 10 Bank	1	\$999.95	\$1,291.91
6V 12Ah Lead Batteries 10 Pack	2	\$259.98 (\$129.99/pack, \$12.99)	
Heat Shrink Female Spade Connectors 200 Pieces	1	\$18.99 (0.09 cents each)	
18 Gauge Wire Spool 40ft	1	\$12.99	

\$874.15 price difference!

Going Forward

- Might convert a few more traps to power banks
 - Would set the voltage regulator to average
- Possibly switch to a cheaper, but highly rated power bank
- Figure out a way to easily switch trap wiring between power banks and lead batteries
- Make the batteries a bright color to minimize losing them
- Potential to integrate a programmable DC timer control module



Acknowledgements and Sources

- Betsy Hodson
- TJ Carner
- Curran Atkinson
- Dylan Raney
- Addie Weddle
- Olivia Henkle

References

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- Battery University. "BU-501A: Discharge Characteristics of Li-Ion." *Battery University*, Cadex, 27 Oct. 2021, <https://batteryuniversity.com/article/bu-501a-discharge-characteristics-of-li-ion>.
- Battery University. (2021, October 27). *BU-502: Discharging at high and low temperatures*. Battery University. Retrieved December 7, 2021, from <https://batteryuniversity.com/article/bu-502-discharging-at-high-and-low-temperatures>.

Product links:

Voltage Regulators: https://www.amazon.com/gp/product/B07RNBK5F/ref=ppx_yo_dt_b_asin_title_o09_s00?ie=UTF8&psc=1

Thermometers: https://www.amazon.com/gp/product/B06XGPSJMW/ref=ppx_yo_dt_b_asin_title_o01_s00?ie=UTF8&psc=1

Anker Power Banks: https://www.amazon.com/gp/product/B07QXV6N1B/ref=ppx_yo_dt_b_asin_title_o02_s00?ie=UTF8&psc=1

Charging Station: https://www.amazon.com/USB-100W-Multiple-Charging-Smartphones%EF%BC%8CTablets%EF%BC%8C/dp/B08CNCNDW9/ref=asc_df_B08CNCNDW9/?tag=hyprod-20&linkCode=df0&hvadid=459773112140&hvpos=&hvnetw=g&hvrand=3904117567016147998&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmld=&hvlocint=&hvlocphy=9008584&hvtargid=pla-952966526395&th=1

Shoe Rack: https://www.amazon.com/SLEEPING-LAMB-Hanging-Organizer-Rotating/dp/B08P599J8W/ref=sr_1_44?keywords=mesh+shoe+organizer+on+wall&qid=1638816177&sr=8-44

Cable: <https://www.grainger.com/product/MONOPRICE-1-1-2-ft-USB-Cable-5XFX9>

INIU Power Banks: https://www.amazon.com/INIU-Portable-Slimmest-High-Speed-Compatible/dp/B08MBQS368/ref=cm_cr_arp_d_product_top?ie=UTF8

Battery Tender: <https://www.batterytender.com/10-Bank-Charger-12V-6V-4A>

Spade Feet: https://www.amazon.com/gp/product/B07Q2RHX7G/ref=ppx_yo_dt_b_asin_title_o05_s01?ie=UTF8&psc=1

Electrical Wire: https://www.amazon.com/MARSWIRE-Gauge-Electrical-Hookup-Copper/dp/B08ZHCRY3T/ref=sr_1_11?crd=2ULU7TUJB4UPOQ&keywords=18+gauge+wire&qid=1638815063&s=hi&sprefix=18+g%2Ctools%2C160&sr=1-11

6V Lead Batteries: https://www.amazon.com/gp/product/B06WVCG5FN/ref=ppx_yo_dt_b_asin_title_o00_s00?ie=UTF8&psc=1

An intricate, black and white decorative border with a classic, ornate style. It features symmetrical scrollwork, acanthus leaves, and floral motifs, framing the central text. The design is reminiscent of 19th-century book ornamentation or Art Nouveau influences.

**Thank
You**