Chevaughn Dixon, Tinker Island, August 24, 2020

NUTRITION FOR SEA KAYAKERS

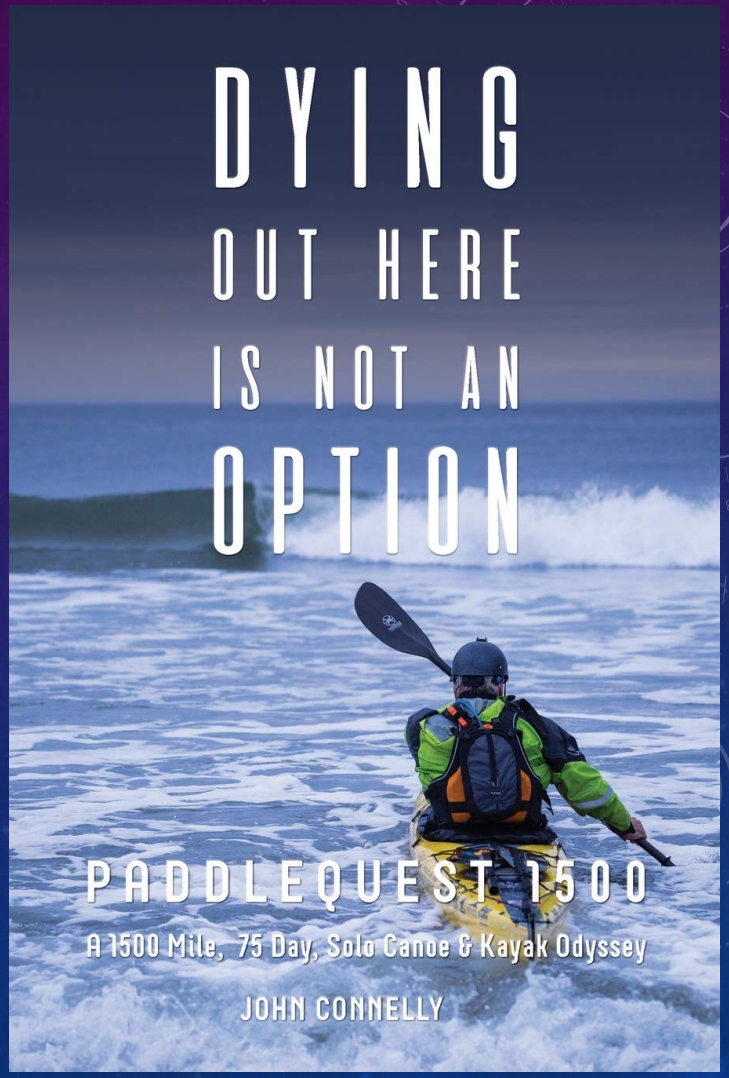
Thoughts and opinions of a free range largely organic fed omnivore amateur nutrition geek

NORTH SHORE PADDLERS NETWORK

FEBRUARY 15, 2024

WHY?

- Personal experience on high mileage days and multiple multiday trips of >100 to 250 miles in 10 to 14 days
  - At the worst hardship becomes suffering if we are not properly fueled
  - The point of this is to have fun
- Observation of Others (Paddle Buddies)
  - Cranky
  - Brain fog
  - Disequilibrium
- Wilderness First Responder Training
  - How long ago did you eat something?
  - How Long ago did you drink something

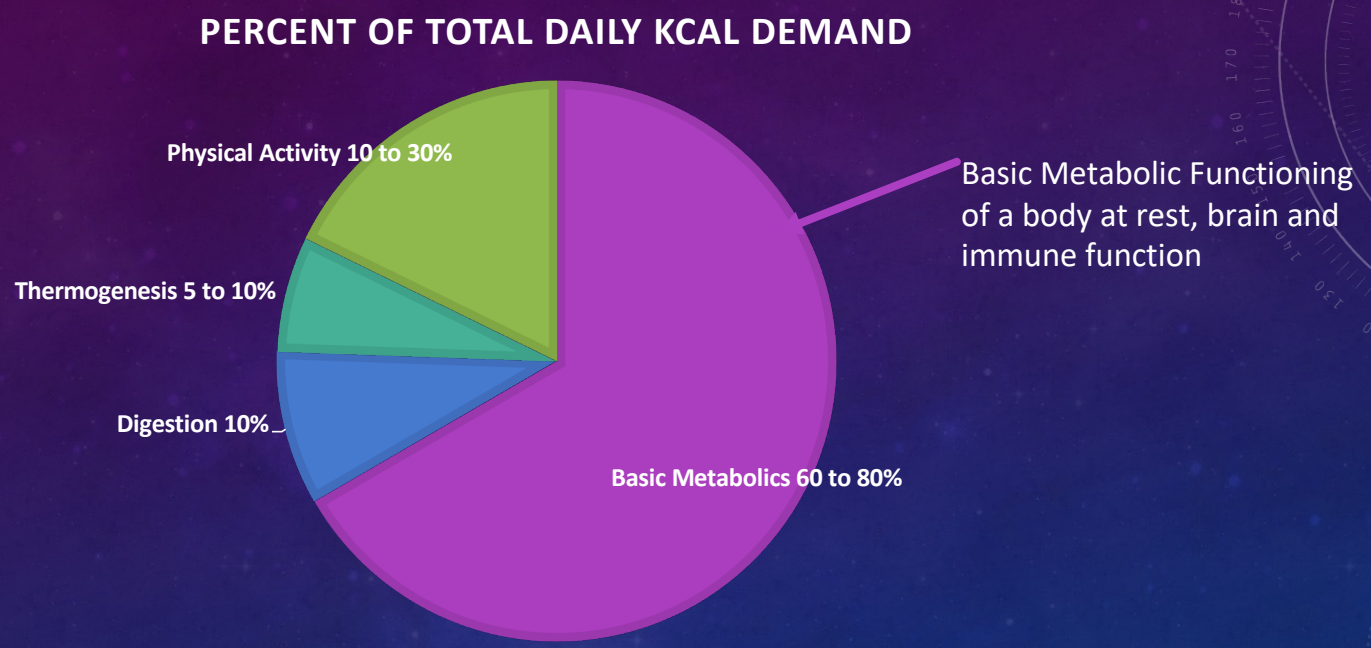


POTENTIAL CONSEQUENCES OF UNDER FUELING

June 5, 2016, Gooseberry Island off Western Head, west of Musquash Harbor,NB

- Poor athletic performance
- Mood changes - Hangry
- Exhaustion
- Insomnia
- Impaired Cognition
- Susceptibility to illness and injury
- Impaired Recovery
- Loss of Muscle Mass

COMPONENTS OF ENERGY DEMAND



Source https://www.vox.com/2017/12/23/16774320/exercise-in-cold-burn-more-calories.

Cold weather doesn't dramatically increase caloric expenditure if you are active and generating heat through muscle movement. When a person is shivering involuntary muscle contractions are attempting to maintain body temperature and may burn on the order of 400 Kcal/hr. https://www.acefitness.org/education-and-resources/lifestyle/blog/1061/do-i-burn-more-calories-when-it-is-hot-outside-or-cold/

SIMPLE PRACTICES

1. Become aware of your Kcal needs for paddling- See links to web sources and references

2.Match your nutrition and trip planning

3. Do what the Army Does -¼ Rule - shoot for ¼ of daily Kcal needs from each meal, ¼ from on the fly fueling

4. Consider supplementing your typical meals with high energy density foodstuffs.

- items that don't add much to volume consumed but increase nutrition and add to flavor

-Principally, Durable sources of fat and protein

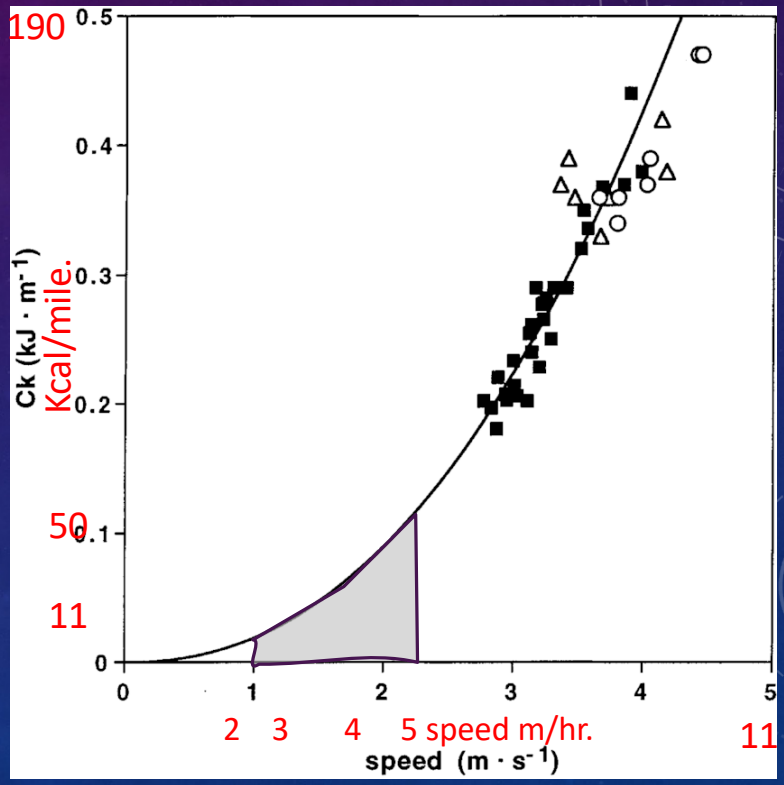
ENERGY DEMANDS?

For the Rest of Us:

125 lb. person may burn about 280 Kcal/hr. kayaking

200 lb. person may burn about 450 Kcal/hr. kayaking

These caloric demands may be on top of normal needs, which for an adult may be on the order of 1.500 to 3,000 Kcal or more a day



Zamparo, Paola & Capelli, Carlo & Guerrini, G. (1999). Energetics of kayaking at submaximal and maximal speeds. European journal of applied physiology and occupational physiology. 80. 542-8. 10.1007/s004210050632.

ESTIMATE YOUR KCAL NEED

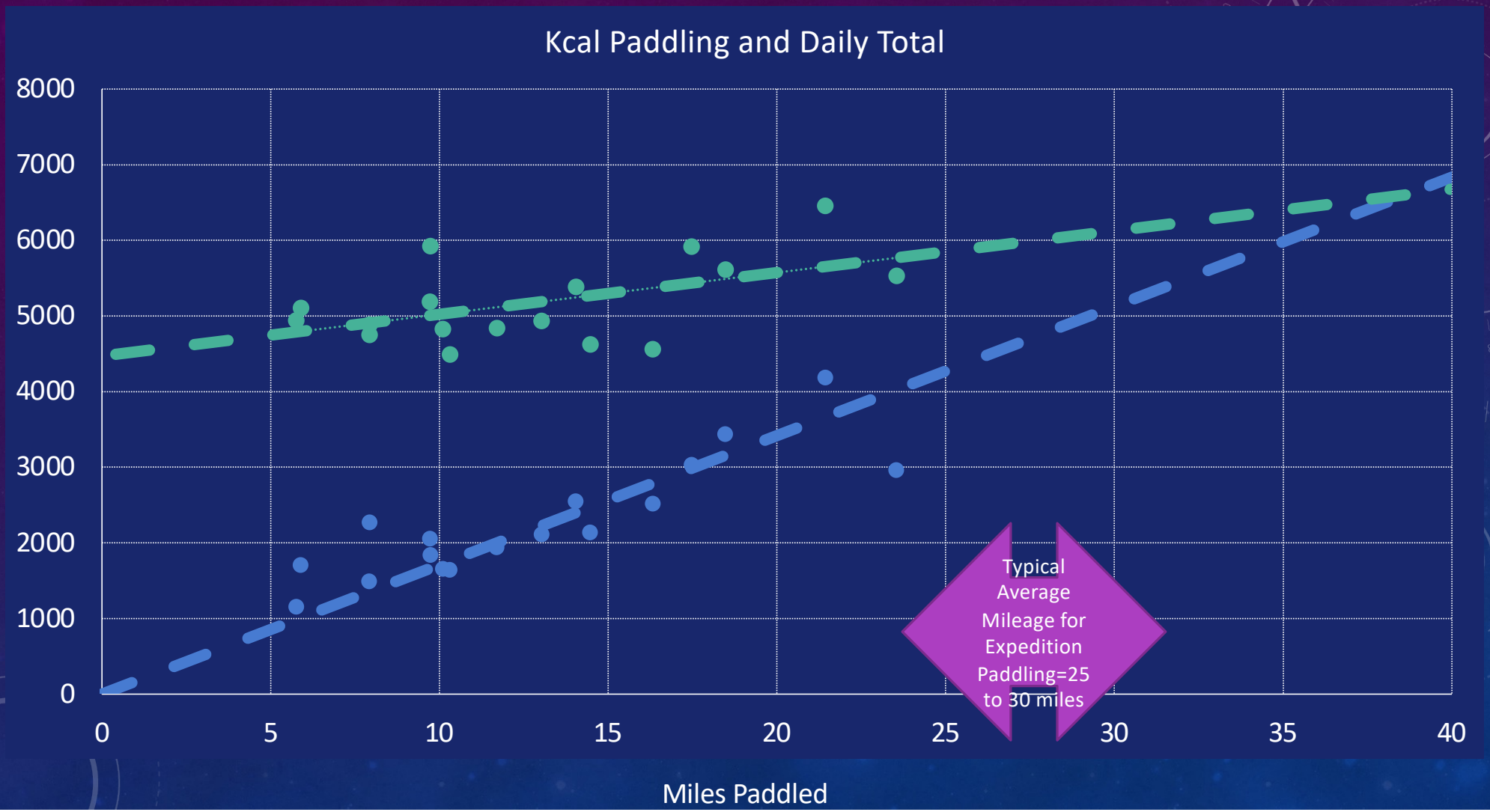
Calculators are available to estimate the normal Kcal needs for individuals of different ages, body mass, and activity level to inform your planning

GlobalRxPh Clinicians Reference

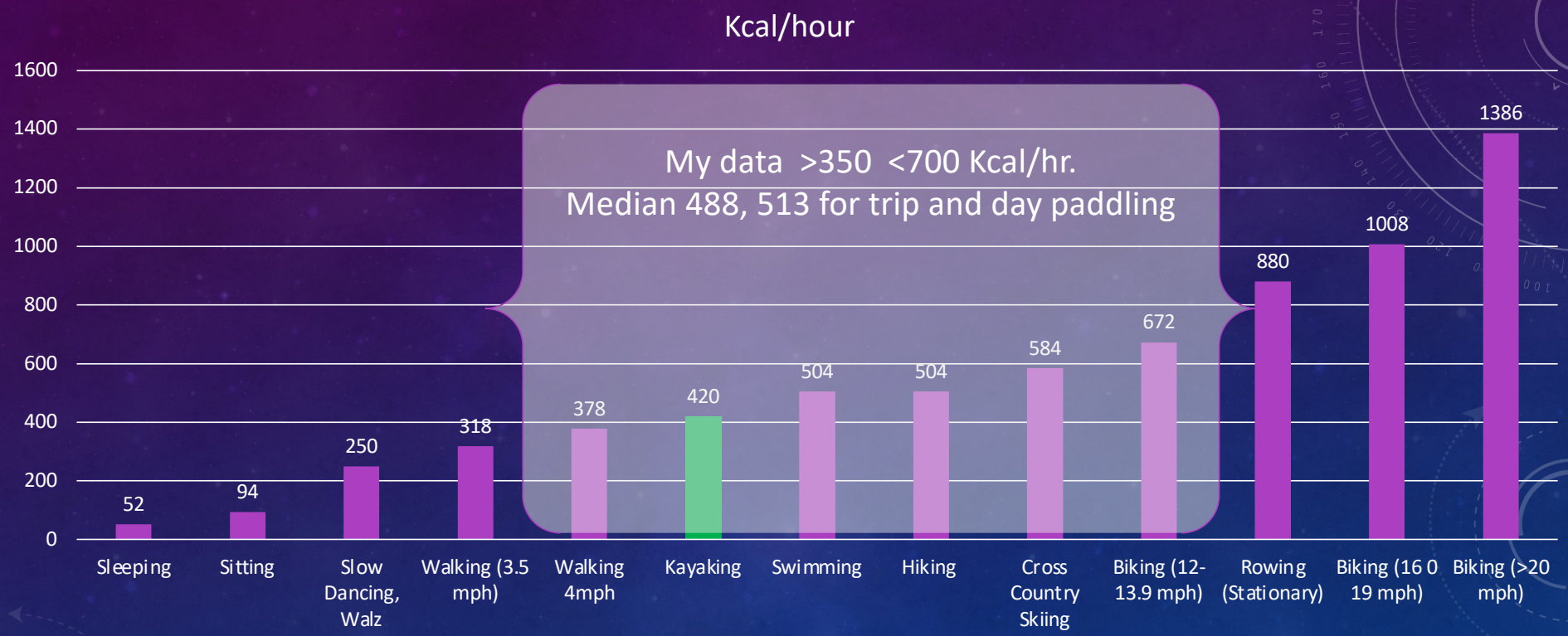
US Army Performance Triad- Nutrition During Deployment & Field Operations

- For my age (65) and weight (186 lbs.) the calculators suggests 3,100 Kcal day on the average to maintain weight under normal activity, without the paddling demands

Assuming a paddling burn rate of 400 Kcal/hr., I may need 5,100 to 7,100 Kcal/day for 5 and 10 hrs. of paddling, respectively


Kcal Paddling and Daily Total
8000
7000
6000
5000
4000
3000
2000
1000
0
0
5
10
15
20
25
30
35
40
Miles Paddled
Typical Average Mileage for Expedition Paddling=25 to 30 miles

COMPARISON WITH OTHER ACTIVITIES



Harvard Health Publishing, "Calories Burned in 30 minutes for people of three different weights, March 2021, *values for 185 pound person doubled to reflect hourly rates*. https://www.health.harvard.edu/diet-and-weight-loss/calories-burned-in-30-minutes-of-leisure-and-routine-activities

PUBLISHED STUDIES AS A BENCHMARK

Daily energy intake vs. energy expenditure	Canoeists and kayakers		Rowers	
	Male (n = 7)	Female (n = 5)	Male (n = 21)	Female (n = 3)
	Mean ± SD			
EER, kcal	5473.2 ± 1005.6	3771.5 ± 422.0	5303.1 ± 638.6	4258.0 ± 338.9
EER, kcal BW	61.6 ± 9.1	58.0 ± 5.4	60.4 ± 6.5	59.8 ± 3.2
EI, kcal	3710.5 ± 680.2	2296.4 ± 132.9	3952.2 ± 945.7	2999.6 ± 605.6
EI, kcal/kg BW	42.0 ± 8.4	35.4 ± 3.1	45.2 ± 11.1	42.6 ± 10.9
% EER	68.7 ± 12.5	61.7 ± 10.4	75.5 ± 19.8	70.8 ± 14.9

Table 3. **Energy intake of Lithuanian Olympic team canoeists, kayakers and rowers**

Note. Values are expressed as mean ± SD; EI – Energy Intake; EER – Estimated Energy Requirement; BW – Body Weight; % EER – Ratio of EER and EEI.

2014, Marius Baranauskas et, al., "Nutrition Status of High Performance Rowers, Canoeists, and Kayakers, Biomedical Sciences, No1(92) 16-25.

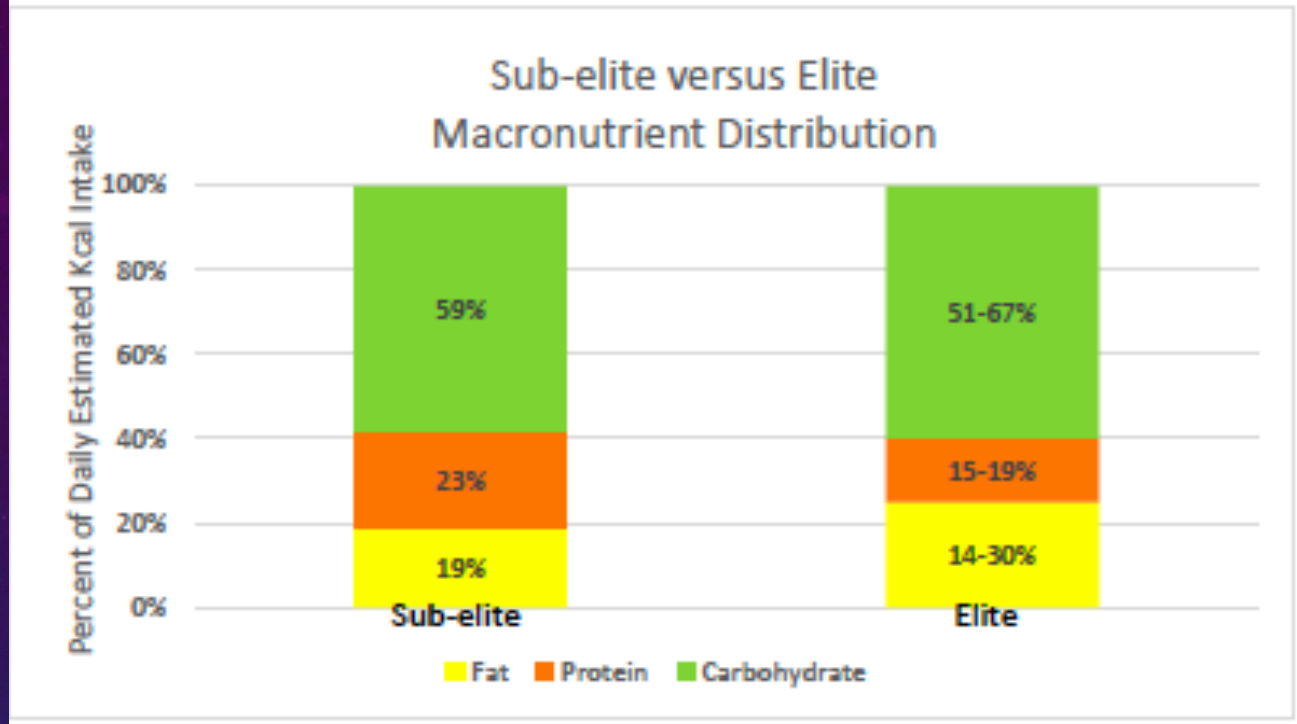


Figure 9: Subjects VioScreen estimated macronutrient distribution compared to elite rower's macronutrient distribution as percent of estimated daily intake. Elite macronutrient distribution is a combination of Xia, Morris, and Woods subjects[36,38,71]

COMPETITIVE COLLEGIATE ROWERS

- Burning 600 to 1,200 Kcal/hr. in training
- Under fueling Kcal negatively effects performance at burn rates of 600 to 1,200 Kcal/hour
- Energy rich fats appear to increase performance
- Fats with Omega 3 and 6 fatty acids assist with recovery
- Protein also key to recovery and building lean muscle mass.

S.P. Zorn, 2017, "Body Composition, Dietary Habits and Rowing Performance of Male Collegiate Club Rowers", MS. Thesis, Ohio State University

NUTRITIONAL GUIDELINES

Component	Percentage of Caloric Intake	Discussion
Carbohydrates	50 to 60%	Simple: Sugars, starches for quick energy Complex: Pasta, grains with slower energy release
Fats	25 to 35%	More complex molecules 2X the calories per unit mass and are slower metabolized. Research in sports nutrition for water sports associated a higher proportion of fat to elite performance. Fats with Omega 3 and 6 fatty acids assist with recovery Oil, margarine butter, meat fat, nuts, cheese
Protein	15 to 20%	Slowest metabolized building blocks for tissue that hold off hunger longer. Critical to rebuilding muscle mass.
Dietary Fiber	0%	Does not contribute to caloric load but important

Source: University of Montana Notes “Outdoor Skills 1204 “Winter Camping Nutrition, Food Planning, and Cooking

DOD RESEARCH

MRE designed for 1/4 of the daily demand of 5,000 Kcal an average of 1,250 Kcal with 51% carbs, 36% fat, 13% protein. The equivalent of another meal is made up by snacking.

GUIDELINES APPLIED TO A 15 MILE DAY

Component	Component %	Component Kcal	Kcal/gram	Targets (g)
Carbohydrates	50 to 60%	2,500 to 3,000	4	630 to 750
Fats	25 to 35%	1,250 to 1,750	9	140 to 190
Protein	15 to 20%	750 to 1,000	4	190 to 250
Fiber		0	0	30

Meal Planning Example:

- 5,000 Kcal for a 15 mile day
- Balanced among carbs, fat, protein
- ¼ per meal and ¼ fueling on the fly

Summary:
5,000 Kcal
700 g Carbs
170 g Fat
190 g Protein
30 g Fiber

TYPICAL DAY?

1 Cup dry=two servings 560 Kcal mostly quick burning carbs.

The equivalent of about 1 hour of paddling

1/10th of my needs for a 15 mile day

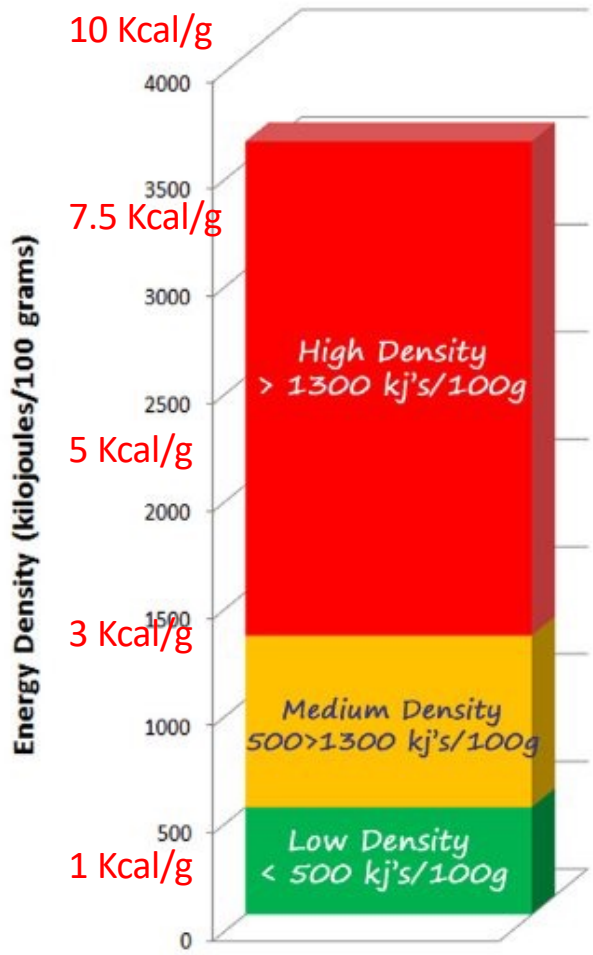
+

440 Kcal less than 1 hour and less than 1/10th

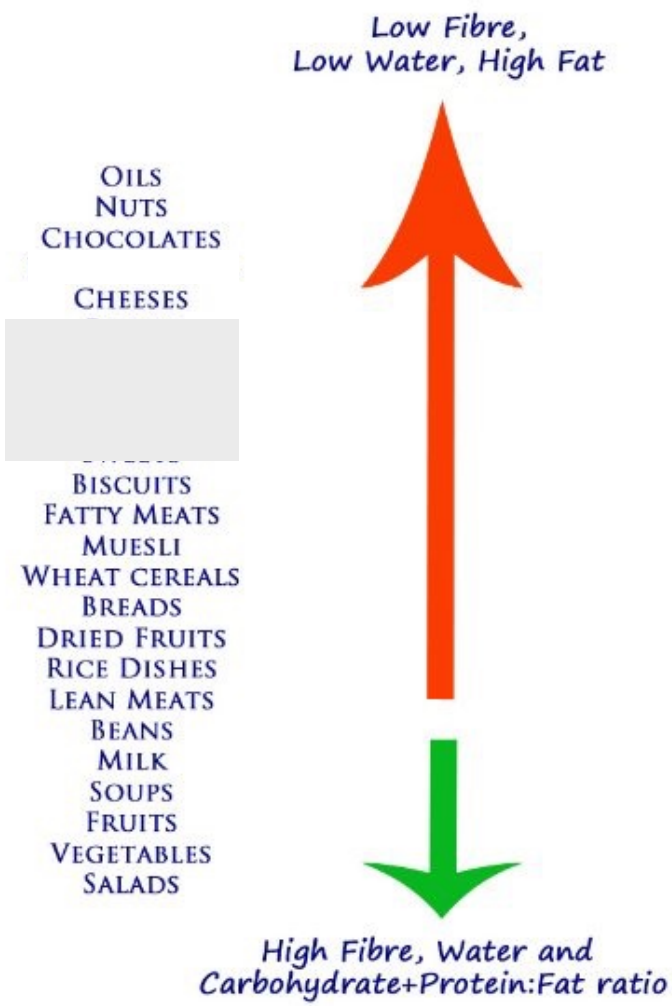
+

Two serving size 820 Kcal

ENERGY DENSITY CONTINUUM



1 Kilojoule/100 g = 2.39x10-3 Kcal/g



Macronutrient Rules of Thumb:

Carbohydrates	4 Kcal/g
Protein	4 Kcal/g
Fats	9 Kcal/g

SUPPLEMENTS

- Packaged food can be supplemented with:
  - Packaged broth, liquid or dehydrated
  - Ghee/Coconut Oil
  - Canned/Pouch chicken/fish
  - Dehydrated milk
  - Other?

SUPPLEMENTS

Possible additions to commercial or home-made foods to increase nutritional value and/or taste

Food Supplement	Meal	Calories	Carbs	Fat	Protein	Sodium	Sugar	Fiber
Nutritional Yeast (2 TBSP)	**u**	**40**	**3**	**0**	**5**	**20**	**0**	**2**
Walnuts 1/8 cup	b	96	4	0	2	0	0	1
Dried Dates (3)	b	165	47	0	1.5	0	41	5
Dried Cherries 1/4 Cup	b	120	26	0	0	0	17	3
Bone Broth (2 cups)	**d**	**90**	**0**	**0.5**	**18**	**90**	**0**	**0**
Vegetable Protein Powder (1 scoop 27g)	**u**	**90**	**4**	**1.5**	**15**	**0**	**0**	**1**
Pouched Salmon 3oz	d	100	0	5	17	210	0	0
Judees Whole Egg Powder (2 TBS)	**u**	**80**	**0**	**5**	**6**	**70**	**0**	**0**
Smoked Mussels (1 tin)	d	160	6	7	18	840	0	0
Judees Whole Milk Powder (1/4 cup)	**u**	**170**	**13**	**9**	**8**	**130**	**13**	**0**
Cheese Sticks (2)	l	160	0	12	14	190	0	0
Ghee (1TBSP)	**u**	**120**	**0**	**14**	**0**	**0**	**0**	**0**
Hard Salami (2oz)	l	200	1	16	11	840	0	0
Peanut Butter 2 tbsp	b,l	190	8	16	7	140	3	2

Meal
b- breakfast
L-Lunch
D-dinner
U-Universal

EXAMPLE APPLICATION OF SUPPLEMENTS:

Meal	Kcal before	Discussion	Supplements	Kcal After	Discussion
Breakfast- 1 cup Bobs Red Mill Muesli	560	Mostly quick burning carbs, gone in 1 hour	1/8 cup walnuts 3 dried dates ¼ cup dried cherries 1 scoop veg protein powder 1 tbs ghee	1,740	37%, 22%, 24% of carbs, fat, protein for a 15-mile day
Lunch- bagels, string cheese (2), apple	440	Ditto	2 cups Country Kitchen Homestyle Chicken Soup 2oz Hard Salami ½ cup Gorp trail mix	1,360	22%, 38%, 30% of needed carb, fat, protein
Dinner- Good to Go Herbed Mushroom Risotto	820	19%, 12%, 14% of needed carbs, fats, protein	Hydrate with bone broth 2 oz pouched chicken 2 tbs nutritional yeast 1 tsp ghee	1,060	19%, 16%, 33% of needed carb, fat, protein
Totals	1,820			4,160	
Deficit	3,180	Need carbs, fat, protein at 157, 39 and 25 grams each	On the fly fueling	834	22% carbs 24% fat, and 13% protein

ON THE FLY FUELING

Paddling		Est Total Energy Need	Deficit to Be Made Up On the Fly	Required Intake
Miles	Hours @ 3mph	Kcal	Kcal	Kcal/hr.
15	5	5,000	830	170
20	6.7	5,120	960	140
30	10	5,290	1,120	112
40	13	5,640	1,470	113

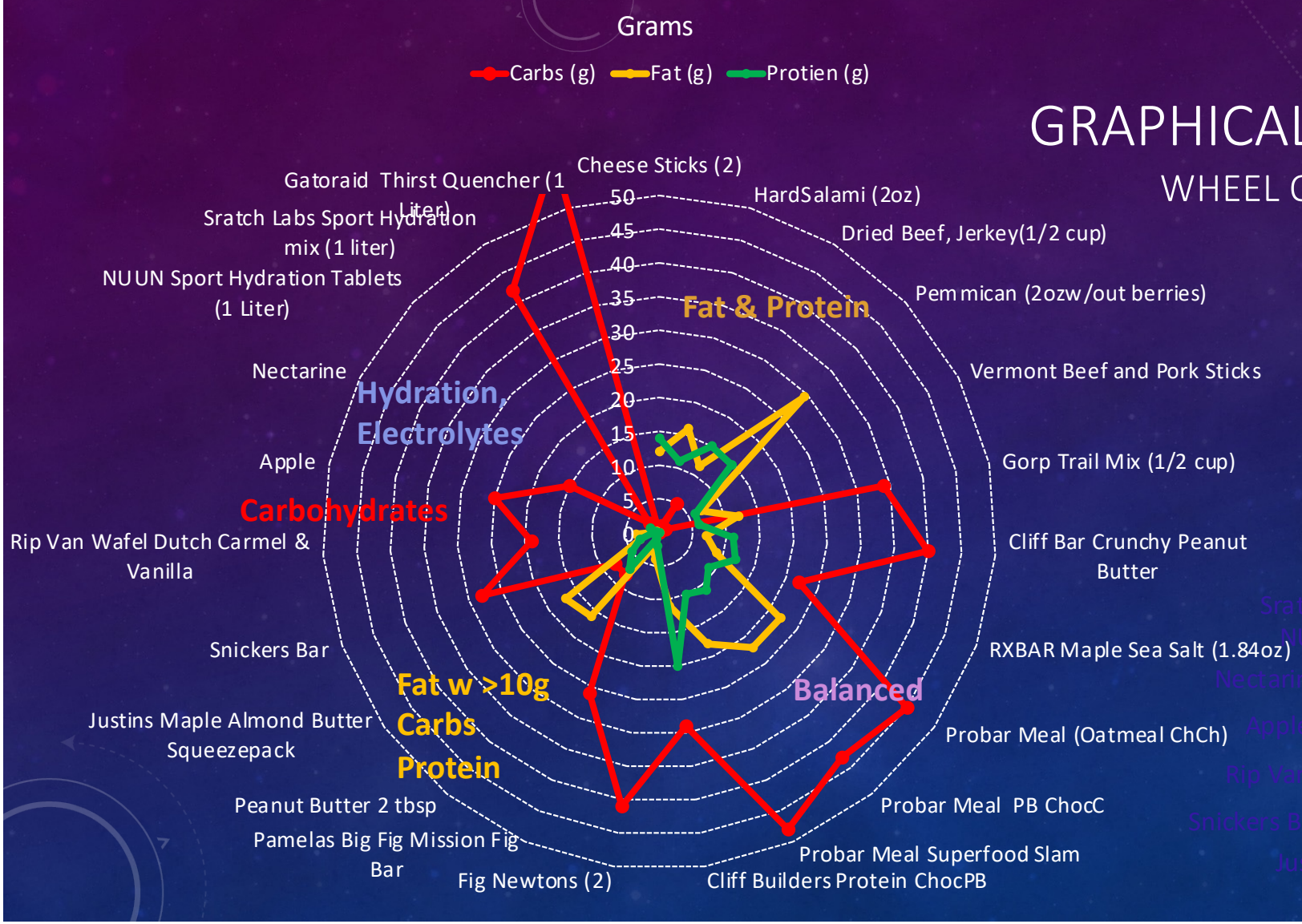
Fuel:

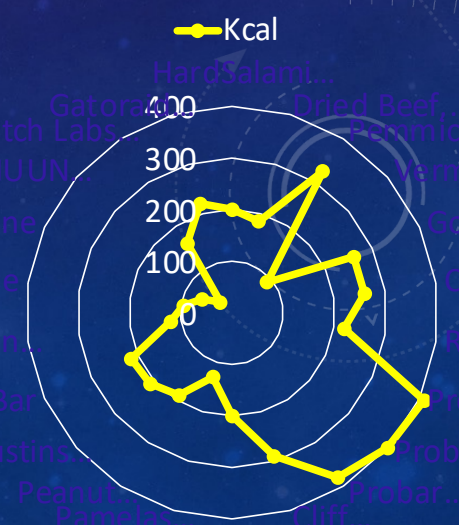
- Carbs
- Fat
- Protein
- Hydration

As a generalized rule of thumb perhaps 400 to 500 Kcal/10 miles

GRAPHICAL PICKLIST

WHEEL O FUEL





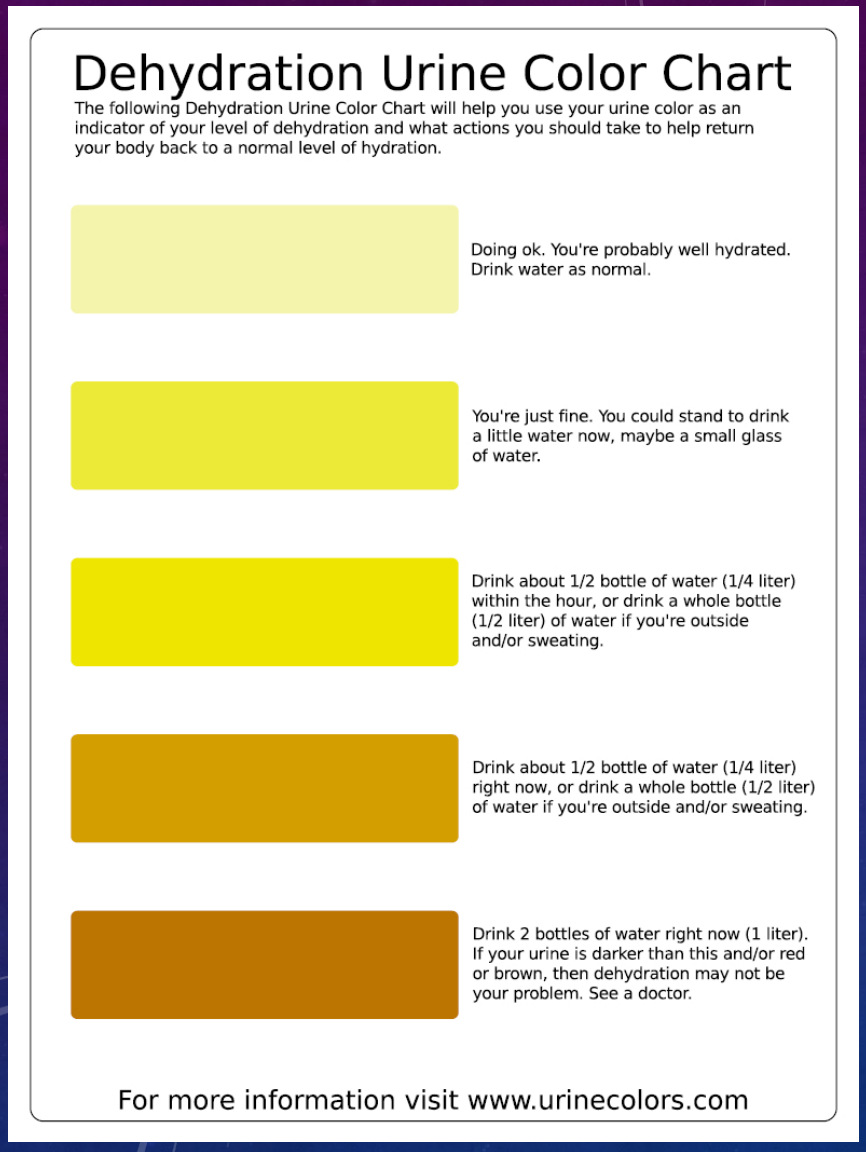
You are Here!

HUMAN FUEL - HYDRATION

The American Dietetic Association uses this scale for the progressive effects of dehydration:

Loss of body water	Progressive effects
0–1%	Thirst
2–5%	Dry mouth, flushed skin, fatigue, headache, impaired physical performance
6%	Increased body temperature, rate of breathing and pulse rate, dizziness, weakness

https://www.nrs.com/safety_tips/boaters_dehydration.asp



SIGNS AND SYMPTOMS OF DEHYDRATION

- Thirst
- Fatigue – can be profound
- Brightly colored urine
- Sleeplessness
- Mood Changes – anxiety, agitation, confusion
- Increased heart rate/respiration
- Reduction in coordination/balance
- Muscle Cramps
- Nausea

Hubbell, F.R. DO, 2014, Wildcare, Working in Less than Desirable Conditions and Remote Environments, Soloschools.com

HYDRATION STRATEGIES

- While you're on the water, try to drink 5 to 8 ounces 3 to 4x/hr. (0.5 to ~1 L/hr.)
- Equipment needed for big days– multiple water bladders/thermos
- If you are perspiring it may be necessary to add some powdered sports drink electrolyte. Have salt tabs in emergency kit
- Tank up- sipping water & electrolytes upon landing for the night.
- Alcohol does not help

- Pre-hydrate- 16-32 ounces (~0.5 to 1 L) before you get on the water.
- Coffee or tea are diuretics that causes you to lose fluids.
- Ibuprofen can cause water retention

https://www.nrs.com/safety_tips/boaters_dehydration.asp

REFLECTION

With just a bit more attention we can have a better time…performing better physically and mentally/emotionally

Each meal focused on ¼ of estimated energy needs with ¼ provided by snacking

- Steady intake of food and hydration – don't get behind
- Balance mix of Carbs, Fat, Protein @ 55, 30, 15%

- Human powered water travel is energy intensive
- Many of us are under fueled on the water and unaware of the consequences
  - Our eating habits at home and work do not serve us well in human powered travel
- With available Kcal calculators & rules of thumb you may be able to estimate your paddling needs reasonably well

Estimate Your Energy Demands:

1. Estimate your “normal” daily Kcal demand using on-line calculators and/or the equations on the graphic on a later slide.

2. Add 500 to 1,000 Kcal to account for greater activity when you take your boat out of the garage

3. Add paddling burn at rates of 250 to 500 Kcal/hour depending on body mass and applied to different paddling durations

4. Compare these estimates against those generated assuming 60Kcal/kg body mass

5. How does that feel to you? How does the energy demand estimates compare with your typical fueling?

DIY HOME MADE FOOD REFERENCES

1. Verywellfit -Calorie and Nutrition Recipe Analyzer
2. Clever Hiker 20 Backpacking Meal Recipes and Food Dehydration Tips
3. Urban Homesteader – Dried to Fresh Equivalents and rehydration tables
4. NRS How to Boat and Camp with Perishable Foods
5. Carnivore Aurelis -All things Pemmican

verywell fit

Recipe Analyzer Results

A single serving of breakfast skillet has 1022 calories.

Read through the nutrition label for a snapshot of this recipe's nutritional profile. If the label lists less than 5 percent daily value for a nutrient it is considered low, while 20 percent or more is high. In general, you want to limit saturated fat, cholesterol, and sodium, and get enough fiber, vitamins, and minerals.

Nutrition Facts

Serving size: 150g

Servings: 1

Amount per serving

Calories	**1022**
	% Daily Value*
Total Fat 48.8g	**63%**
Saturated Fat 14.2g	**71%**
Cholesterol 542mg	**181%**
Sodium 587mg	**26%**
Total Carbohydrate 109.9g	**40%**
Dietary Fiber 16.8g	**60%**
Total Sugars 12.9g	
Protein 35.8g	
Vitamin D 132mcg	659%
Calcium 86mg	7%
Iron 6mg	35%
Potassium 2945mg	63%

**The % Daily Value (DV) tells you how much a nutrient in a food serving contributes to a daily diet. 2,000 calorie a*

Ingredients:

- 3 two large eggs
- 3 medium potatoes
- 1 sausage patty
- 1 tablespoon olive oil
- 1 small onion diced

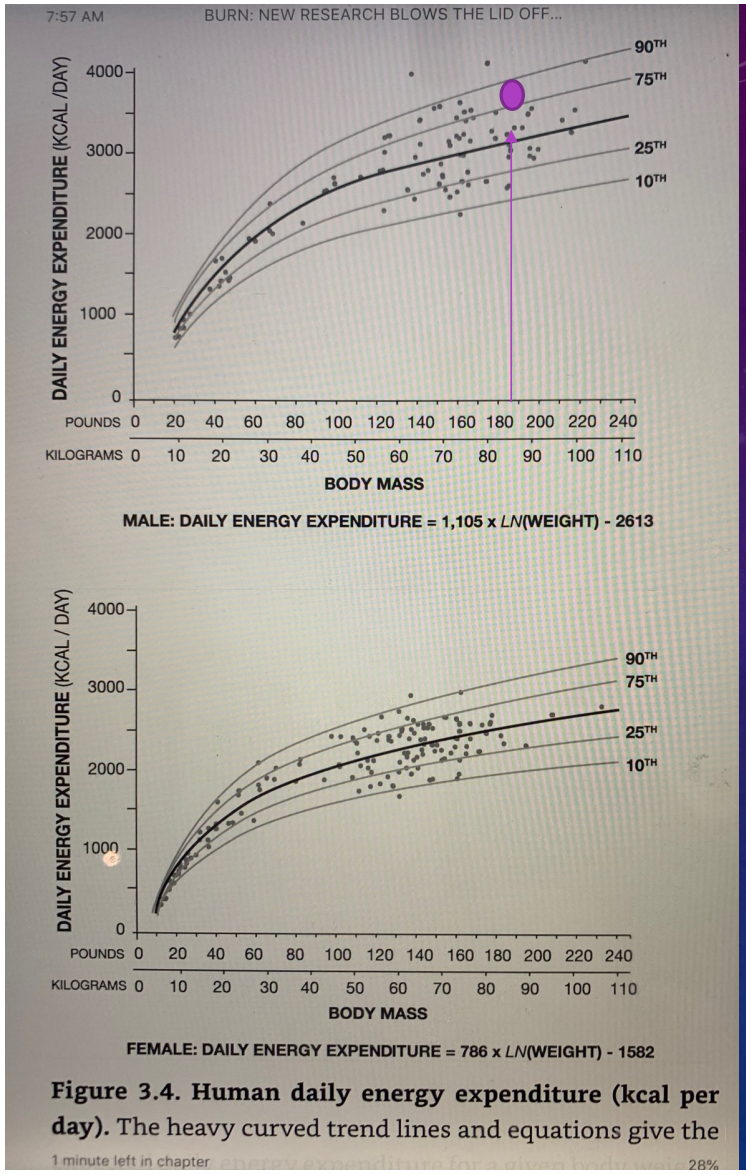
20g 8g
PROTEIN FIBER
Banza
GEMELLI MADE FROM CHICKPEAS
BRAGG
GOOD SOURCE OF PROTEIN
NUTRITIONAL YEAST
"Cheesy" Savory Seasoning without the Dairy
NET WT. 4.5 OZ (127G)
4th & HEART
GHEE
CLARIFIED BUTTER
HIMALAYAN PINK SALT
GRASS-FED
Plant-Based
Vega
protein made simple
TRUVANI
Protein+Greens
ORGANIC PROTEIN POWDER WITH GREENS
PROTEIN 10g PER SERVING
USDA ORGANIC
SUGAR 1g PER SERVING
✓ Premium Plant Based Protein Sweetened with Monk Fruit
✓ With Spinach, Kale, Broccoli and more
✓ Dairy Free, Vegan, Gluten Free, Non-GMO
NET WT 12.59 OZ (357 GRAMS)
PRO MEAL ON-THE-GO BAR
SUPERFOOD SLAM
WHOLE SUPERFOODS
BONE BROTH
INSTANT BEVERAGE MIX
1 RIP
2 MIX
3 SIP
BEEF
NET WT. 15G (.53OZ)
CHICKEN
NET WT. 15G (.53OZ)

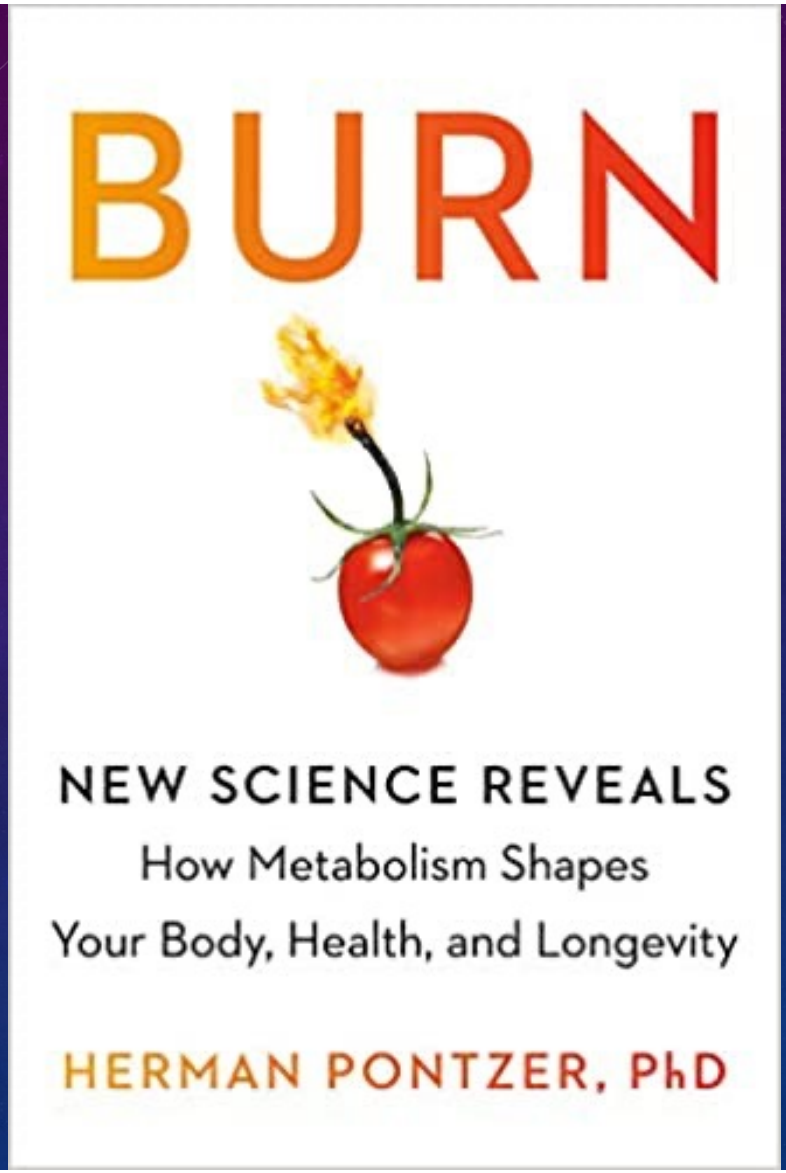
THE END

PICKLIST

ON THE FLY FUEL

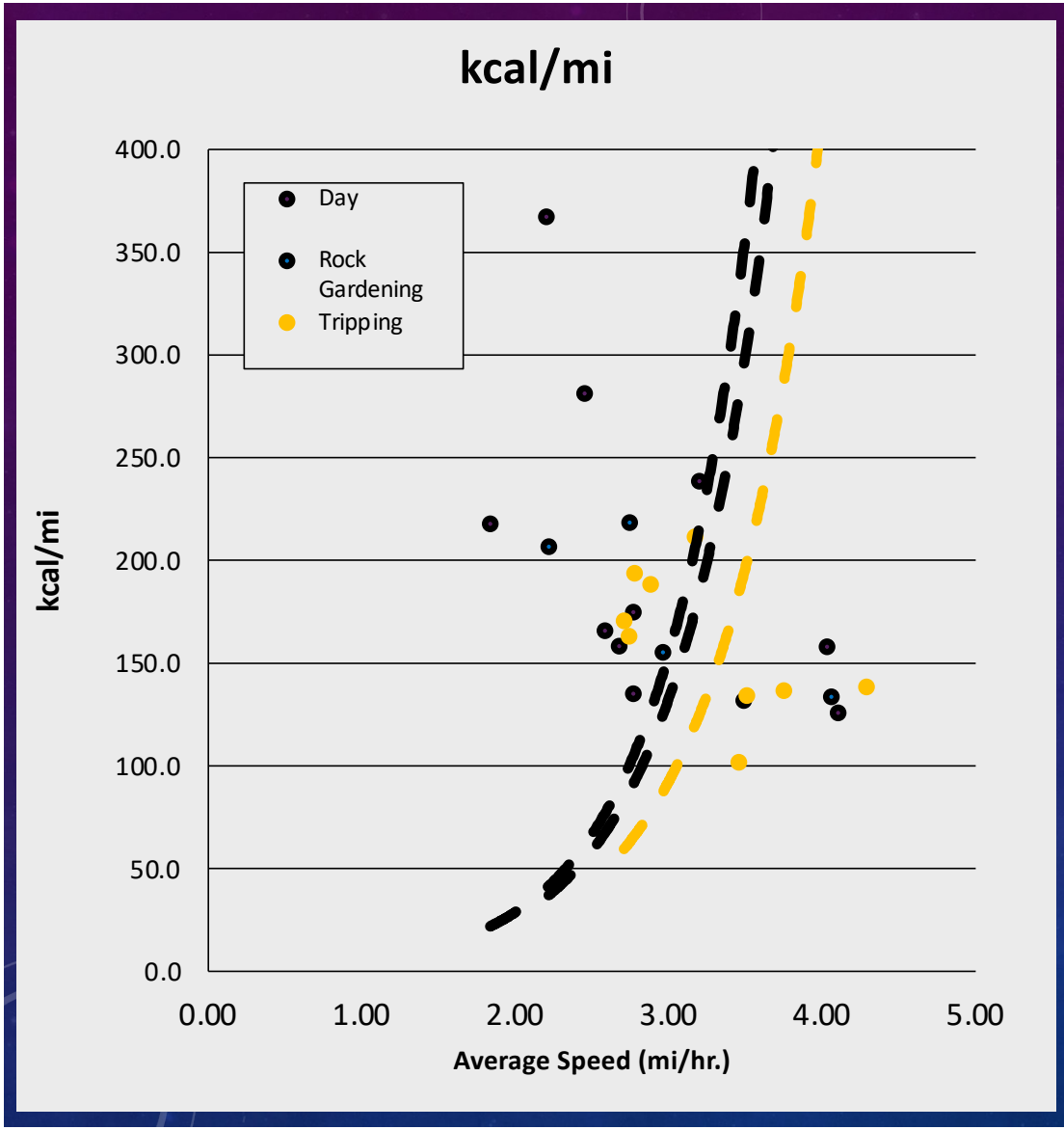
PICKLIST Sorted by Carbs	Kcal	Carbs (g)	Fat (g)	Protein (g)	Sodium (mg)	Sugars (g)	Dietary Fiber (g)
Goal	834	157	39	24.5	-1260	26	-21.4
Gatorade Thirst Quencher (1 Liter)	220	58	0	0	389	54	0
Probar Meal Bar (Oat ChCh) 3oz	410	45	22	9	115	19	6
Fig Newtons (2)	200	41	4	2	180	8	2
Cliff Bar Crunchy Peanut Butter	260	40	7	11	230	19	4
Gorp Trail Mix (1/2 cup)	260	34	12	6	20	26	4
Cliff Builders Protein ChocPB	290	29	11	20	330	17	2
Apple	95	25	0.3	0.5	2	19	4.4
RXBAR Maple Sea Salt (1.84oz)	220	22	9	12	310	14	4
RV Wafel Dutch Carmel & Vanilla	120	19	6	1	90	3	6
Nectarine	63	15	0.5	1.5	0	11	2.4
Peanut Butter 2 tbsp	190	8	16	7	140	3	2
Justin's Maple Almond Butter Squeezepk	210	8	17	5	90	5	2
Dried Beef, Jerky(1/2 cup)	184.5	5	12	15	20	0	2
NUUN Sport Hydration Tablets (1 Liter)	30	2	0	0	600	2	0
NUUN Rest Hydration (1 liter)	20	2	0	0	100	2	0
Hard Salami (2oz)	200	1	16	11	840	0	0
Cheese Sticks (2)	160	0	12	14	190	0	0
Pemmican (2ozw/out berries)	326	0	29	14.7	0	0	0





FOR ADDITIONAL READING:

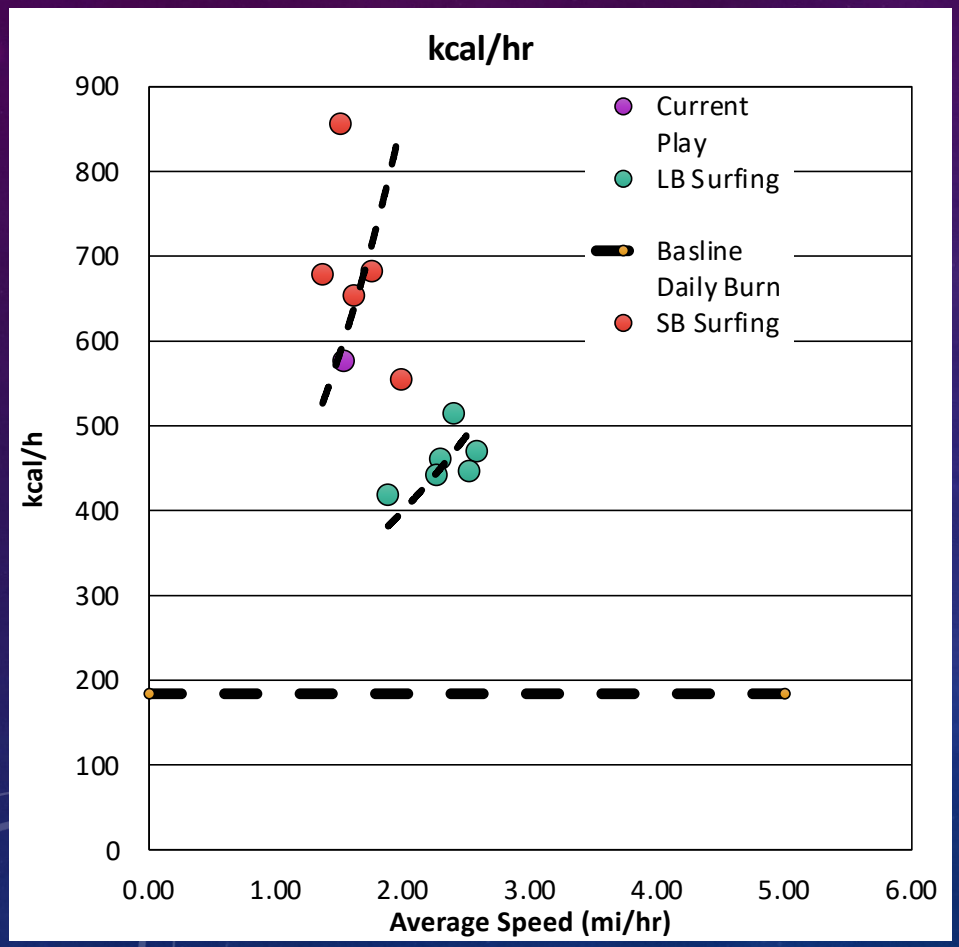
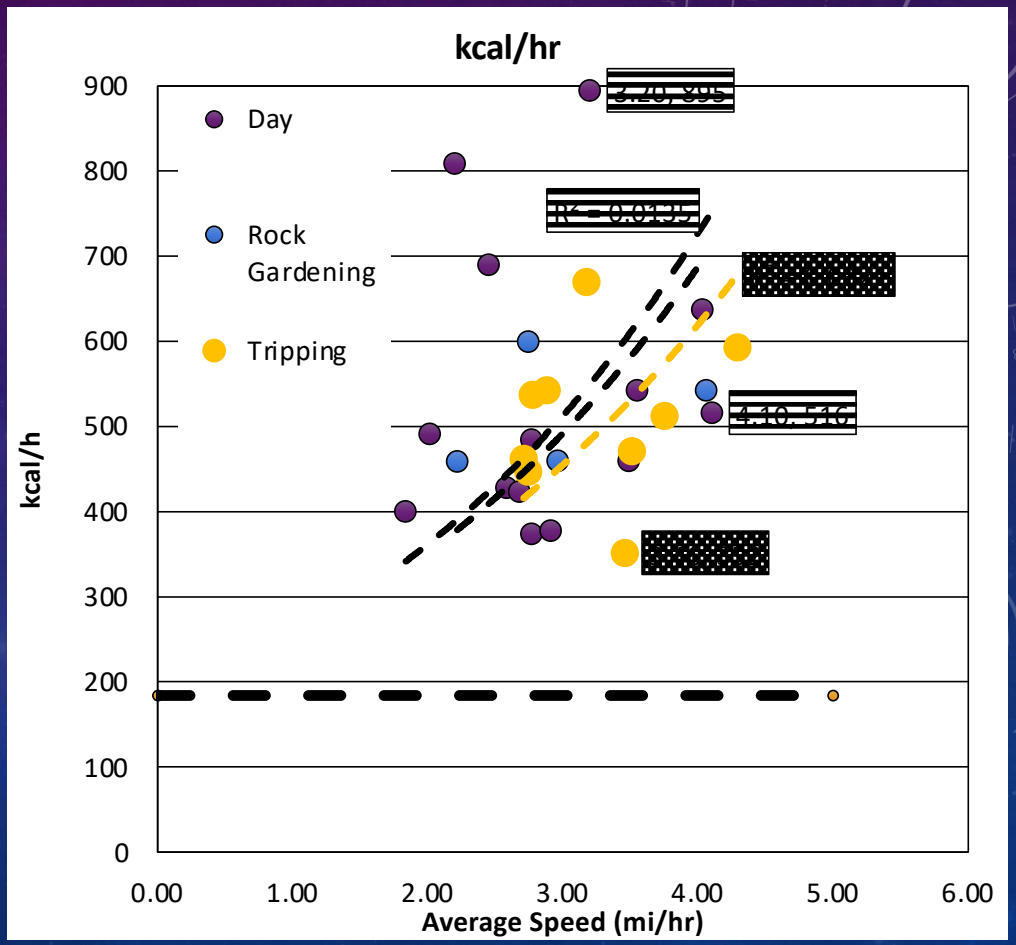
- Adult Humans burn 3,000 Kcal/day +/- 1,000
- Long term, the body adjusts the consumption of Kcal to differing levels of activity
- Finite limit to how much you can take in and burn/day about 5,000 Kcal



2020 DATA COLLECTION

- Polar Vantage M sports watch
  - Heart rate monitor
  - Accelerometer
  - GPS Tracking
  - Estimated Kcal burn based on heart rate and accelerometer data

Data from:

- 14 Day paddles of 3 to 24 miles w unloaded boat
- 9 Days of loaded boat travel 5 to 11 miles (Tripping)
- 4 Rock garden events of 5.5 to 16 miles w unloaded boat
- 11 kayak surfing events with long and short boats (next slide)

OBSERVED BURN RATES