

Hardcore Mode [ON] in numbers

Numbers given for version 1.5.

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Core module.

Primary needs.

Each need Hunger, Thirst and Fatigue fold from base limit value and limit per actor value.

$$need\ limit = base + (ActorValue1 + ActorValue2 + \dots) * LimitPerActorValue$$

- Hunger base limit: 700. Per actor limit: 15. Actor values that increase limit: Strength, Luck.
- Thirst base limit: 700. Per actor limit: 15. Actor values that increase limit: Endurance, Luck.
- Fatigue base limit: 700. Per actor limit: 15. Actor values that increase limit: Intelligence, Perception.

Hunger, thirst and fatigue growth-rate have base value, and then to in applied modifier.

- Hunger base growth value: 4.17 point/h
- Thirst base growth value: 4.17 point/h
- Fatigue base growth value: 5.56 point/h

Hours here is a game hours, so no matter what time scale is used.

Modifier is a multiplier that folds from weather, time of day, activity and combat state influence.

Weather:

- Sunny. Considered as warm/hot. Hunger multiplier 1.0. Thirst multiplier 1.2. Fatigue multiplier 1.0.
- Overcast. Considered as normal. Hunger multiplier 1.0. Thirst multiplier 1.0. Fatigue multiplier 1.0.
- Moist. Hunger multiplier 1.0. Thirst multiplier 0.8. Fatigue multiplier 1.0.
- Rainy. Hunger multiplier 1.0. Thirst multiplier 0.6. Fatigue multiplier 1.0.

Activity modifiers:

- Sprinting multiplier 1.2.
- Walking/Running multiplier 1.0.
- Sitting multiplier 0.8.
- Sneaking multiplier 0.8.

Combat modifiers:

- Hunger growth-rate multiplier 1.5.
- Thirst growth-rate multiplier 1.5.
- Fatigue growth-rate multiplier 1.5.

Modifier while sleeping:

- Hunger growth-rate multiplier 0.5.
- Thirst growth-rate multiplier 0.5.
- Fatigue growth-rate multiplier 0.0.

Time of day: It's a non-linear modifier and applies only to thirst growth-rate. Calculated as:

$$modifier = \sin(modifier)$$

The higher total modifier there more it drops down at night. Night time considered as interval from 10:00 PM to 7:00 AM.

All modifiers are cumulative. Means they all do their impact on resulting value.

$$Modifier_{hunger} = Weather_{hunger} * Activity * Combat$$
$$Modifier_{thirst} = \begin{cases} Weather_{thirst} * Activity * Combat, & 7\ AM < time < 10\ PM \\ \sin(Weather_{thirst} * Activity) * Combat, & 10\ PM \leq time \leq 7\ AM \end{cases}$$
$$Modifier_{fatigue} = Weather_{fatigue} * Activity * Combat$$

All calculations performed every Tick time. Tick time is 1 second.

Consumables.

Food/Drink/Chems/Sleep.

Food, drinks and chems can reduce current hunger/thirst/fatigue levels. It has minimum restore threshold and percent threshold. Whichever is greater will be applied.

Delayed returns.

Some ingestibles may increase current values of hunger, thirst or fatigue. These increases can be imminent, delayer or both and called as 'returns'. Time for delayed returns is 3 in-game hours. Returns also have maximum threshold equal to 100 points. If accumulated return value above this threshold then only 100 points will be returned to player, from accumulated return value will be subtracted threshold value and return time will be setted to 1 in-game hour.

Consumables table.

Name	Reduce Hunger				Reduce Thirst		Reduce Fatigue	Increase Hunger	Increase Thirst			Increase Fatigue	Spoilage time
	5/5%	20/20%	40/40%	80/80%	20/20%	40/40%	40/40%	0 im/30 del	30 im/0 del	0 im/20 del	0 im/60 del	0 im/40 del	in-game hour
Baked Bloatfly			+						+				48
Beer						+				+			
Berry Mentats							+					+	
Blamco Brand Mac and Cheese			+						+				
Blamco Brand Mac and Cheese (Pre-war)			+						+				
Bloatfly Meat		+											24
Bloodbug Meat		+											24
Bloodbug Steak			+						+				48
Bobrov's Best Moonshine					+						+		
Bourbon					+						+		
Brahmin Meat		+											24
Brain Fungus		+											72
Bubblegum	+												
Buffjet							+					+	
Buffout							+					+	
Bufftats							+					+	
Calmex							+					+	
Canned Dog Food		+							+				
Carrot		+			+								240

Cat Meat		+											24
Cave Fungus		+											72
Cooked Softshell Meat			+						+				48
Corn		+			+								240
Cram			+						+				
Crispy Squirrel Bits		+							+				
Daddy-O							+					+	
Dandy Boy Apples			+						+				
Day Tripper							+					+	
Deathclaw w Egg		+											168
Deathclaw w Egg Omelette		+							+				48
Deathclaw w Meat		+											24
Deathclaw w Steak				+					+				48
Deathclaw w Wellington		+											
Deezer's Lemonade								+					
Dirty Wastelander					+							+	
Dirty Water								+					
Drugged Water								+				+	
Fancy Lads Snack Cakes		+							+				
Fancy Lads Snack Cakes (Pre-war)		+							+				
Food Paste			+										
Fresh Carrot		+			+								240
Fresh Corn		+			+								240

Fresh Melon		+				+							240
Fresh Mutfruit		+				+							240
Fury							+					+	
Ghoul Meat		+											24
Glowing Fungus		+											72
Gourd				+	+								240
Gourd (Institute)				+	+								240
Grape Mentats							+					+	
Grilled Radroach			+						+				48
Grilled Radstag			+						+				48
Gum Drops	+												
Gwinnett Ale						+				+			
Gwinnett Brew						+				+			
Gwinnett Lager						+				+			
Gwinnett Pale						+				+			
Gwinnett Pilsner						+				+			
Gwinnett Stout						+				+			
Happy Birthday Sweet Roll		+											
Ice Cold Beer						+				+			
Ice Cold Gwinnett Ale						+				+			
Ice Cold Gwinnett Brew						+				+			
Ice Cold Gwinnett Lager						+				+			
Ice Cold Gwinnett Pale						+				+			
Ice Cold Gwinnett Pilsner						+				+			

Ice Cold Gwinnett Stout						+				+			
Ice Cold Nuka Cherry						+							
Ice Cold Nuka Cola						+							
Ice Cold Nuka Cola Quantum						+							
Iguana Bits		+							+				48
Iguana On A Stick		+							+				48
Iguana Soup				+	+								24
InstaMash			+						+				
Institute Bottled Water						+							
Institute Food Packet			+										
Jet							+					+	
Jet Fuel							+					+	
Med-X							+					+	
Melon		+				+							240
Mentats							+					+	
Mirelurk Cake		+											96
Mirelurk Egg				+									168
Mirelurk Egg Omelette		+							+				48
Mirelurk Meat		+											24
Mirelurk Queen Steak				+					+				48
Moldy Food			+						+				
Mole Rat Chunks			+						+				48
Mole Rat Meat		+											24
Mongrel Dog Meat		+											24

Mutant Hound Chops			+						+				48
Mutant Hound Meat		+											24
Mutfruit		+			+								240
Mutt Chops			+						+				48
Noodle Cup			+						+				
Nuka Cherry						+							
Nuka Cola						+							
Nuka Cola Quantum						+							
Orange Mentats							+					+	
Overdrive							+					+	
Perfectly Preserved Pie			+										
Poisoned Wine						+				+			
Pork n' Beans			+						+				
Potato Crisps	+								+				
Potted Meat				+					+				
Preserved InstaMash			+						+				
Pristine Deathclaw Egg		+											168
Psycho							+					+	
Psycho Jet							+					+	
Psychobuff							+					+	
Psychotats							+					+	
Purified Water						+							
Queen Mirelurk Meat		+											24
Radroach Meat		+											

Radscorpion Egg		+											168
Radscorpion Egg Omelette		+							+				48
Radscorpion Meat		+											24
Radscorpion Steak				+					+				48
Radstag Meat		+											24
Radstag Stew				+	+								24
Razorgrain	+												
Refreshing Beverage						+							
Ribeye Steak				+					+				48
Roasted Mirelurk Meat			+						+				48
Rum					+						+		
Salisbury Steak			+						+				
Salisbury Steak (Pre-war)			+						+				
Silt Bean		+											72
Slocum's BuzzBites			+						+				
Softshell Mirelurk Meat		+											24
Squirrel Bits		+							+				48
Squirrel On A Stick		+							+				48
Squirrel Stew				+	+								24
Stingwing Fillet			+						+				48
Stingwing Meat		+											24
Sugar Bombs			+						+				
Sugar Bombs (Pre-war)			+						+				

Sweet Roll		+							+				240
Synthetic Gorilla Meat		+											24
Tarberry		+											96
Tasty Deathclaw Omelette		+							+				48
Tato			+		+								168
Ultra Jet							+					+	
Vegetable Soup				+	+								24
Vodka					+						+		
Whiskey					+						+		
Wild Corn		+			+								240
Wild Mutfruit		+			+								240
Wild Razorgrain	+												
Wild Tarberry		+											96
Wine						+				+			
X-Cell							+					+	
Yao Guai Meat		+											24
Yao Guai Ribs				+					+				48
Yao Guai Roast				+					+				48
Yum Yum Deviled Eggs			+						+				

Penalty thresholds.

For each of hunger, thirst, and fatigue there are four penalty stages. These stages don't have fixed threshold value, instead, they use percent from the limit threshold.

- Stage 1 - Minor Starvation/Dehydration/Sleep Deprivation. Percent threshold: 11.5.
- Stage 2 - Advanced Starvation/Dehydration/Sleep Deprivation. Percent threshold: 23.5.
- Stage 3 - Critical Starvation/Dehydration/Sleep Deprivation. Percent threshold: 47.0.
- Stage 4 - Lethal Starvation/Dehydration/Sleep Deprivation. Percent threshold: 70.0.

Exceeding limit will result player death.

Penalty effects table.

	Minor	Advanced	Critical	Lethal	Exceed
Hunger	Carry Weight -50 Endurance -1	Carry Weight -60 Endurance -2 Strength -1	Carry Weight -70 Endurance -3 Strength -2 Charisma -1	Carry Weight -80 Endurance -4 Strength -3 Charisma -2 Intelligence -1	Death
Thirst	Action Points -20 Movement Speed -10% Strength -1	Action Points -30 Movement Speed -15% Strength -2 Endurance -1	Action Points -40 Movement Speed -20% Strength -3 Endurance -2 Charisma -1	Action Points -50 Movement Speed -25% Strength -4 Endurance -3 Charisma -2 Intelligence -1	Death
Fatigue	Aim Stability -10% Intelligence -1 VATS accuracy -10%	Aim Stability -15% Intelligence -2 Perception -1 VATS accuracy -15%	Aim Stability -20% Intelligence -3 Perception -2 Charisma -1 VATS accuracy -20%	Aim Stability -25% Intelligence -4 Perception -3 Charisma -2 Agility -1 VATS accuracy -25%	Death

Spoilage module.

Script tracks added to player inventory consumables and time it was added to inventory. Once estimate time expired consumable considered as spoiled and automatically removed. Instead of this item to player inventory added 'Stale ...' version of it. All consumables are distributed in groups by its appearance or provenance.

Currently there are such groups:

1. Bean
2. Carrot
3. Cooked meat
4. Corn
5. Eggs
6. Funguses
7. Groud
8. Melon
9. Mirelurk Cake
10. Nutfruit
11. Omelettes
12. Raw meat
13. Soups
14. Sweet Roll
15. Tarberry
16. Tato

For each of these groups, there is one stale version of consumable representing the whole group. Item name reads as 'Stale <group name>'. Each group has its own time to spoil which applies to every item in this group. Some groups may have same time by value, but they still independent.

When a player discards consumable from his inventory, like dropping it into the world or placing it to the container (NPCs also considered as containers), particularly this consumable removed from item tracking list and its time to spoil doesn't save anywhere. If this consumable re-added to player inventory it's considered as new and for it created a new entry in item tracking list.

The script can track maximum 128 stacks of consumable items and maximum 128 consumables per stack.

Diseases module.

Depending on different conditions and events player may get a disease, which will act as stats penalties. Most of the diseases have own mechanic of acquiring but still share some rules. One of such rules is a disease base chance. Further, this chance multiplied by player immunity failure chance, forming result chance to acquire particularly this disease. This result chance then compared with game generated random value from 0.0 to 1.0, and if result chance strictly less than random value disease is applied to player.

$$result\ chance = disease\ chance * (1 - Immunity\ resistance)$$

All diseases, except Cell Decay, could be healed by unique medicine, mysterious serum, or by visiting doctor. In case of using doctor's service choose the same line used to heal wounds (same as in vanilla survival).

Immunity resistance.

Immunity resistance folds from the base value, S.P.E.C.I.A.L. attribute Endurance, and cap value. Also, immunity depends on current needs deprivations and health level. The more such deprivations player has, and the heavier they are, the lower immunity resistance. Needs deprivations in calculations taken as magnitudes which decrease immunity resistance.

$$Immunity = (base + Endurance * ImmunityPerActorValue) * \left(1 - \sqrt{\frac{Mag_{hunger}^2 + Mag_{thirst}^2 + Mag_{fatigue}^2}{3}}\right) * \left(0.5 + \frac{Health}{2}\right)$$

Immunity constant values table

	Value	
Immunity base resistance	0.7	
Immunity resistance per actor	0.03	
Needs deprivation magnitude	Minor	0.25
	Advanced	0.5
	Critical	0.75
	Lethal	1.0
Immunity resistance cap	0.95	

Disease: Cell Decay

Cause	Stimpak
Apply method	Effect worn off
Cure	None. Disease will wear off by itself.
Cure obtain	N/A
Base chance	5.0
Effects	-% Health. Effect scales with Medic perk, and as the higher amount of health restores one stimpak the higher health loss from disease. Also, the speed of health loss and effect duration is same as stimpak restoration. However, the end effect of health loss is weaker then health restoration with stimpak.
Details	When player inject stimpak and its effect wore off there is a high possibility that fast grown cell will start to decay due to unstable mitosis process. The more stimpaks player inject before first wore off the higher possibility.
	$disease\ chance = base * (1 + Increment * Count)$
	Increment: 1.0 Count: counter of injections.

Disease: Food Poisoning

Cause	Raw meat. Any stale food.
Apply method	Consumption.
Cure	Activated Carbon. Wear off after 12 real hours.
Cure obtain	Craftable at chem lab and cooking station. Required to take several portions of activated carbon to make it take effect. Since the efficiency of this medicine depends on dose per 10 kg of body mass, for male characters chance that one consumption of activated carbon will cure disease is 12.5%, for female is 16.5%. Cost: 1 Wood. Outcome: 10 portions.
Base chance	0.9 for raw meat. 9999.0 for stale food.
Effects	-1 Edurance, -10 Action Points.
Details	Consuming raw meat or stale food may cause acute poisoning with putrefying toxins.
	$disease\ chance = base$

Disease: Parasites

Cause	Raw meat. Any stale food.
Apply method	Consumption.
Cure	Antiparasitic Remedy. High radiation dose.
Cure obtain	Craftable at chem lab and cooking station. Cost: 1 Purified Water, 1 Vodka, 5 Hubflower, 5 Gourd Blossom. Outcome: 2 portions.
Base chance	0.9 for raw meat. 0.9 for stale food.
Effects	-1 Endurance, Food has only 50% of its satiation.
Details	The cysts and eggs of endoparasites may be found in raw meat and stale food.

$disease\ chance = base$

Disease: Insomnia

Cause	Sleep.
Apply method	On wake up.
Cure	Sleeping Potion. Should be consumed before taking sleep and before cure effect wore off.
Cure obtain	Craftable at chem lab and cooking station. Cost: 1 Purified Water, 5 Tarberry, 5 Bloodleaf, 5 Hubflower. Outcome: 1 portions.
Base chance	0.7
Effects	-1 Edurance, -1 Perception, Fatigue restores on 50% slower while sleeping.
Details	Neglecting of full fatigue restoration via sleep, or sleeping over needed values may cause different sleep disorders in sum called Insomnia.

$$disease\ chance = base * \left(\frac{||Fatigue_{Sleep\ start} - Fatigue_{Sleep\ stop}|| - RecoverPotential}{15 * 6} \right)^2$$

RecoverPotential: amount of fatigue that could be restored by sleeping given amount of time.

Disease: Leukemia

Cause	Radiation.
Apply method	Continuous check every 10 seconds.
Cure	Blood transfusion.
Cure obtain	In any settlement player should construct 'Blood transfusion station'. Then put in it 5 blood packs. Then use it to cure self. Process will take several in-game hours. After this 5 blood pack in station inventory will be replaced with 5 empty blood pack. Player health will be restored to available maximum. Cost: 2 Aluminium, 1 Plastic, 4 Rubber, 10 Steel, 10 Screw, 5 Cloth. Outcome: N/A
Base chance	0.1
Effects	-2 Edurance, -2 Strength, Slowly lose health if it above 25%.
Details	When player take more than half of lethal dose of radiation (500 RAD) then he has chance to get acute leukemia. Every 10 seconds this chance recalculated, also the closer radiation dose to lethal limit (1000 RAD) the higher disease chance.

$$disease\ chance = base + (EndChance - base) * \left(\frac{RADs - RADsLevel}{1000 - RADsLevel} \right)$$

RADs: amount of radiation player currently has.
RADsLevel: 0.5
EndChance: 2.0

Disease: Wound Infection

Cause	Animals. Cutting weapons.
Apply method	On hit. Not blocked.
Cure	Antibiotics.
Cure obtain	Craftable at chem lab. Cost: 1 Acid, 1 Purified Water, 5 Activated Carbon, 3 Penicillium Sample*. Outcome: 1 portions.
Base chance	0.3
Effects	-1 Agility, -50 Max Health.

Details

Being bitten by wild animals or stabbed with unclean cutting weapon may cause infection. Blunt weapons don't cause infections.

disease chance = base

* Penicillium Sample – acquired from stale fruits and vegetables which should be processed at chem lab. Stale Corn provide 3 Penicillium Sample, Groud provide 2 Penicillium Sample, rest provide 1 Penicillium Sample.