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How Long Would It Actually Take To Catch Them All?

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Abstract
One of the most popular gaming franchises in the world, Pokémon, involves the player acting as a Pokémon trainer and taking an adventure through various regions, in an attempt to train and to "Catch 'em all!". But how long would this feat take? The Pokémon games red, yellow and blue have been used as a model for the original region of Kanto to calculate this. The results of this analysis show the time taken to do this is almost 5 years.

Introduction
Pokémon has become an iconic game series, TV series, movie franchise and trading card game beloved by millions. The original games (Pokémon red and blue) were based on a region of Japan called Kantō [1]. The TV series, which coined the phrase "Gotta catch 'em all!" follows the story of Ash Ketchum, a 10 year old who sets out from his home in Pallet town to capture every type of Pokémon. How long would it actually take him to achieve this feat? To help calculate this the original red and blue games have been used as a model of Pokémon-human interactions. Because of the evolution mechanic and trading, by catching 81 Pokémon and evolving or trading them the trainer would have them all.

Assumptions
Pokémon is a complex game, with many features and modifiers that affect many of aspects of the game. In order to calculate the time it would take to catch them all, some assumptions have been made. It is assumed that the trainer has access to *Ultra Balls*, the most powerful all-round commercially available Pokéball in the game, as well as enough funds to replenish them and buy required items such as evolution stones. This matches the reality in the games, as through repeated training with other trainers, the trainer is theoretically able to amass quite a considerable amount of winnings. It has been assumed that due to pre-planning each battle, at the point of attempting to capture the target Pokémon, that it has 50% chance of being asleep, isn't burned or poisoned, and is at $1/3^{rd}$ of its maximum health (these factors affect calculations in the "catch success" section). It is also assumed that no encounter modifiers such as Honey have been used. Additionally if the trainer has caught a Pokémon at the start of its evolutionary line they will, through training and Pokémon evolution, be able to obtain the rest of that Pokémon's evolutionary line. Just like in the game, some Pokémon (i.e. Jynx and Mr. Mime) can only be obtained through trade, and so multiples of the Pokémon required for the trade have been caught for this purpose. Some Pokémon are also given (such as Lapras), and this has remained the same in this calculation. However, where the trainer must choose between two unique Pokémon to receive, it is assumed that both have been given, as otherwise the one left behind can never be obtained. This is also because in reality it can be assumed that they can be obtained through evidence of successful training (which the trainer will eventually have) or monetary incentive (for Pokémon research funding). A *Master Ball* (a Pokéball with 100% success rate) is also given to the trainer in the course of his adventures, and it has been assumed that the trainer uses this on Mewtwo, the most powerful and difficult to catch Pokémon in the game. Mew has been omitted from this list due to it not appearing in the games under normal conditions.

Scaling and areas
The Kanto region is based on the actual Kantō region in Japan [1, 2]. By comparing the two, a scale was able to be created for the Pokémon map. The Kanto land region covers 32,423.9km^2 [3], but analysis of the image has shown that this only accounts for 55% of the map, the other 45% is water. Therefore the Pokémon map in its entirety is actually 61605.41km^2. The Pokémon map image used for

analysis is a 10x9 aspect ratio image, meaning that it could be split cleanly into 90 boxes of 50x50 pixels, each of these boxes being 684.503km^2. This means that each of the pixels is equal to 0.2738km^2, or is a box of sides 523.26m. Using ImageJ software, Route 1 has been measured on the Pokémon map (see Figure 1).

Figure 1) A map of the Kanto region [4].Originally taken from the Gameboy game Pokémon Yellow, by the Pokémon Company, Game Freak and Nintendo.

Route 1 is 50 pixels in length, making it (when scaled up) 26163m. This distance is comprised of 36 walking "spaces" [5] (the game mechanic ensures that when you are stood somewhere, you are stood in one of the set boxes). This makes each of the walking boxes 726.75m x 726.75m. The game mechanic for calculating the encounter chances is based upon the number of these boxes that have been walked through. In order to search through these boxes, which (in the environment to encounter Pokémon) is ~75cm tall grass, it is estimated that you can scan around 10m either side of you, looking for signs of Pokémon (grass rustling, animal movement noises etc.). This means that to search through one of the boxes, it would require 27115.03m of walking.

Pokémon encounters

Certain Pokémon can be encountered on each route. In order to encounter them, you need to walk through a number of "boxes" of grass (the only environment in the game aside from surfing on water, which is not required to catch them all). The formula for calculating the encounter chance is shown in equation 1 [6].

$$P_{enc} = x/187.5 \quad (1)$$

Where P_{enc} is the probability of encounter, and x is a value that varies depending on the encounter rarity (a statistic attributed to each Pokémon for each route), based on Table 1. From the encounter chances of each of the Pokémon on each route [8], it was possible to calculate using equation (1) how many "boxes" to search it would take for the probability to equal 1, using the x values from Table 1. From this, and from each box taking ~27.1km of walking to search, a distance could be found for an encounter for each of the Pokémon at the start of the different evolutionary chains. This was then added together, and resulted in a distance of 48,471.834km.

Encounter rarity	Encounter chance	x value
Very common	>40%	10
Common	16% - 40%	8.5
Semi-rare	6%-5%	6.75
Rare	3%-5%	3.33
Very rare	1%-2%	1.25

Table 1) A table of encounter rarity to x value [6, 7].

This is only for the Pokémon encountered in wild grass; set encounters (e.g. legendary Pokémon) and fishing for Pokémon are accounted for in the time conversion section instead.

Pokémon catch success

The equation for determining the success of catching a Pokémon is described in the equations below. They include Pokémon max HP values at encountered levels [9], status ailments and Ball mods (sleeping gives a status ailment of 25, an *Ultra Ball* gives a *BallMod* of 150) [10].

$$P_{capture} = P_0 + P_1 \quad (2)$$

$$P_0 = \frac{statusAilment}{ballMod + 1} \quad (3)$$

$$P_1 = \left(\left(\frac{CatchRate + 1}{BallMod + 1}\right) \times \left(\frac{f + 1}{256}\right)\right) \quad (4)$$

$$f = \frac{(HP_{Max} \times 255 \times 4)}{(HP_{Current} \times Ball)} \quad (5)$$

Using these equations, and the aforementioned assumptions, the success rate of pokéballs was calculated for each of the target Pokémon. The majority of these could be caught with a single *Ultra Ball*, with the legendary birds succumbing after five, and Snorlax possibly requiring two. The results of these calculations can be found in the Appendix.

Time conversion

As previously mentioned, to catch the Pokémon you can encounter by walking it would require walking 48,471.834km. Pokémon with set encounters are not included in this, as it is assumed the trainer would run into them in the course of his adventure at their set locations, and not need to look for them. For Pokémon caught by fishing, the time taken for each of them is calculated from the percentage

encounter chance [8] and the time it takes to hook a fish on average [11]. At 4km hr^{-1} walking speed (slightly slower than normal walking pace to account for being on the lookout for Pokémon). This works out as a walking and fishing time of 12143.96 hours (see Appendix), or 1822 days of travelling, if the trainer walked for 8 hours a day, and took two days in every 10 off.

Conclusion

In order for a trainer to catch the 81 required Pokémon to "catch 'em all" in Kanto, It would take them 1822 days or ~5 years to do this.

References

[1] Bulbapedia.bulbagarden.net, "Pokémon world in relation to the real world - Bulbapedia, the community-driven Pokémon encyclopedia", 2016. [Online]. Available at: http://bulbapedia.bulbagarden.net/wiki/Pok%C3%A9mon_world_in_relation_to_the_real_world#Kanto, [Accessed 16/02/2016].

[2] Bulbapedia.bulbagarden.net, "Kanto - Bulbapedia, the community-driven Pokémon encyclopedia", 2016. [Online]. Available at: http://bulbapedia.bulbagarden.net/wiki/Kanto, [Accessed 28/01/2016].

[3] Wikipedia, "Greater Tokyo Area", 2016. [Online]. Available at: https://en.wikipedia.org/wiki/Greater_Tokyo_Area#cite_note-statb1-7 ,[Accessed: 28/01/ 2016].

[4] Etsy, "Items similar to Original Pokémon Yellow: Kanto Map Cross-Stitch Pattern on Etsy", 2016. [Online]. Available: https://www.etsy.com/listing/224502107/original-pokemon-yellow-kanto-map-cross, [Accessed: 29/01/ 2016].

[5] Strategywiki.org, "Pokémon Red and Blue/Route 1 — StrategyWiki, the video game walkthrough and strategy guide wiki", 2016. [Online]. Available at: http://strategywiki.org/wiki/Pok%C3%A9mon_Red_and_Blue/Route_1, [Accessed: 28/01/2016].

[6] Bulbapedia.bulbagarden.net, "Tall grass - Bulbapedia, the community-driven Pokémon encyclopedia", 2016. [Online]. Availableat : http://bulbapedia.bulbagarden.net/wiki/Tall_grass, [Accessed: 28/01/2016].

[7] Gamefaqs.com, "Pokemon Emerald Version Pokemon Locations FAQ for Game Boy Advance by seanolan - GameFAQs", 2016. [Online]. Availableat : http://www.gamefaqs.com/gba/921905-pokemon-emerald-version/faqs/34808, [Accessed: 28/01/2016].

[8] Bulbapedia.bulbagarden.net, "List of Pokémon by National Pokédex number - Bulbapedia, the community-driven Pokémon encyclopedia", 2016. [Online]. Availableat : http://bulbapedia.bulbagarden.net/wiki/List_of_Pok%C3%A9mon_by_National_Pok%C3%A9dex_number, [Accessed: 29/01/2016].

[9] Azurilland.com, "Pokémon Stat Calculator — Calculate Pokémon's Stats", 2016. [Online]. Available at: http://www.azurilland.com/tools/stat-calculator, [Accessed: 29/01/2016].

[10] Bulbapedia.bulbagarden.net, "Catch rate - Bulbapedia, the community-driven Pokémon encyclopedia", 2016. [Online]. Available at: http://bulbapedia.bulbagarden.net/wiki/Catch_rate, [Accessed: 29/01/2016].

[11] Field & Stream, "From casting to catch... how long does it take YOU to catch your first fish of the day?", 2011. [Online]. Available at: http://www.fieldandstream.com/answers/fishing/bass-fishing/where-fish-bass/casting-catch-how-long-does-it-take-you-catch-your-firs, [Accessed: 29/01/2016].

Appendix:

Pokémon	Encounter chance	Encounter rarity (x)	Areas needed to be searched to ensure an encounter	Walking distance (km)	Time (hrs)	Catch rate	Max HP	1/3 HP	P_0	f	P_1	$P_{capture}$
Ratata	63%	10	18.8	508	127.1	255	15	3	0.083	1275	8.450	8.533
Pidgey	38%	8.5	22.1	598	149.5	255	16	3	0.083	1360	9.013	9.096
Diglett	95%	10	18.8	508	127.1	255	43	8	0.083	1371	9.084	9.166
Caterpie	15%	6.75	27.8	753	188.3	255	18	3	0.083	1530	10.139	10.222
Weedle	15%	6.75	27.8	753	188.3	255	18	3	0.083	1530	10.139	10.222
Nidoran f	15%	6.75	27.8	753	188.3	235	21	4	0.083	1339	8.179	8.262
Nidoran m	15%	6.75	27.8	753	188.3	235	21	4	0.083	1339	8.179	8.262
Clefairy	7%	6.75	27.8	753	188.3	150	31	6	0.083	1318	5.150	5.233
Zubat	78%	10	18.8	508	127.1	255	31	6	0.083	1318	8.732	8.815
Paras	15%	6.75	27.8	753	188.3	190	30	6	0.083	1275	6.305	6.388
Geodude	22%	8.5	22.1	598	149.5	255	31	6	0.083	1318	8.732	8.815
Spearow	45%	10	18.8	508	127.1	255	26	5	0.083	1326	8.788	8.871
Sandshrew	15%	6.75	27.8	753	188.3	255	33	6	0.083	1403	9.295	9.377
Jigglypuff	10%	6.75	27.8	753	188.3	170	28	5	0.083	1428	6.321	6.404
Mankey	15%	6.75	27.8	753	188.3	190	28	5	0.083	1428	7.061	7.143
Ekans	25%	8.5	22.1	598	149.5	255	34	6	0.083	1445	9.576	9.659
Magikarp	100%	fishing	-	-	1	255	18	3	0.083	1530	10.139	10.222
Poliwag	50%	fishing	-	-	2	255	31	6	0.083	1318	8.732	8.815
Goldeen	50%	fishing	-	-	2	255	43	8	0.083	1371	9.084	9.166
Psyduck	33%	fishing	-	-	3	190	44	8	0.083	1403	6.935	7.018
Krabby	33%	fishing	-	-	3	225	38	7	0.083	1384	8.099	8.182
Lapras	-	-	-	-	-				given	given	given	given
Hitmonchan	-	-	-	-	-				given	given	given	given
Hitmonlee	-	-	-	-	-				given	given	given	given
Oddish	40%	8.5	22.1	598	149.5	255	45	9	0.083	1275	8.450	8.533
Meowth	25%	8.5	22.1	598	149.5	255	43	8	0.083	1371	9.084	9.166
Abra x2	15%	6.75	27.8	753	188.3	200	22	4	0.083	1403	7.298	7.381
Bellsprout	40%	8.5	22.1	598	149.5	255	46	9	0.083	1303	8.638	8.721
Shelder	50%	fishing	-	-	2	190	38	7	0.083	1384	6.845	6.928
Vulpix	10%	6.75	27.8	753	188.3	190	51	10	0.083	1301	6.431	6.514
Growlithe	10%	6.75	27.8	753	188.3	190	58	11	0.083	1345	6.648	6.731
Eevee	-	-	-	-	-				given	given	given	given
Cubone	8%	6.75	27.8	753	188.3	190	65	13	0.083	1275	6.305	6.388
Ghastly	87%	10	18.8	508	127.1	190	65	13	0.083	1275	6.305	6.388
Machop	5%	3.33	56.3	1526	381.7	180	58	11	0.083	1345	6.300	6.383
Magnemite	55%	10	18.8	508	127.1	190	49	9	0.083	1388	6.865	6.948
Polywhirl	50%	fishing	-	-	2	120	70	14	0.083	1275	3.994	4.077
Voltorb	45%	10	18.8	508	127.1	190	45	9	0.083	1275	6.305	6.388
Horsea	20%	fishing	-	-	5	225	29	5	0.083	1479	8.653	8.736
Pikachu	25%	8.5	22.1	598	149.5	190	58	11	0.083	1345	6.648	6.731
Grimer	15%	6.75	27.8	753	188.3	190	117	23	0.083	1297	6.414	6.497
Electrabuzz	5%	3.33	56.3	1527	381.7	45	103	20	0.083	1313	1.564	1.647
Zapdos	-	-	-	-	-	3	165	33	0.083	1275	0.132	0.215
Onix	10%	6.75	27.8	753	188.3	45	40	8	0.083	1275	1.518	1.601
Drowsee	25%	8.5	22.1	598	149.5	190	47	9	0.083	1332	6.585	6.668
Tentacool	90%	fishing	-	-	2	190	52	10	0.083	1326	6.5571	6.640
Gloom	5%	3.33	56.3	1527	381.7	120	85	17	0.083	1275	3.994	4.077
Venonat	20%	8.5	22.1	598.	149.5	190	75	15	0.083	1275	6.305	6.388
Farfetch'd	5%	3.33	56.3	1527	381.7	45	82	16	0.083	1307	1.556	1.639
Slowpoke	95%	10	18.8	508	127.1	190	56	11	0.083	1298	6.419	6.502
Snorlax	-	-	-	-	-	25	145	29	0.083	1275	0.858	0.941
Ditto	5%	3.33	56.3	1527	381.7	35	66	13	0.083	1295	1.207	1.289
Doduo	30%	8.5	22.1	598	149.5	190	62	12	0.083	1318	6.515	6.598

Table continued…												
Pokémon	**Encounter chance**	**Encounter rarity (x)**	**Areas needed to be searched to ensure an encounter**	**Walking distance (km)**	**Time (hrs)**	**Catch rate**	**Max HP**	**1/3 HP**	P_0	f	P_1	$P_{capture}$
Ponyta	24%	8.5	22.1	598	149.5	190	83	16	0.083	1323	6.541	6.624
Staryu	27%	8.5	22.1	598	149.5	225	38	7	0.083	1384	8.099	8.182
Seel	25%	8.5	22.1	598	149.5	190	88	17	0.083	1320	6.527	6.610
Articuno	-	-	-	-	-	3	165	33	0.083	1275	0.132	0.215
Omanyte	-	-	-	-	-				given	given	given	given
Kabuto	-	-	-	-	-				given	given	given	given
Aerodactyl	-	-	-	-	-				given	given	given	given
Koffing	35%	8.5	22.1	598	149.5	190	77	15	0.083	1309	6.473	6.556
Magmar	10%	6.75	27.8	753	188.3	45	98	19	0.083	1315	1.566	1.649
Tangela	10%	6.75	27.8	753	188.3	45	93	18	0.083	1318	1.569	1.652
Moltres	-	-	-	-	-	3	165	33	0.083	1275	0.132	0.215
Mewtwo	-	-	-	-	-	3	250	50	0.083	1275	0.132	(MB)
Rhyhorn	10%	6.75	27.8	753	188.3	120	161	32	0.083	1283	4.019	4.102
Chansey	5%	3.33	56.3	1527	381.7	30	413	82	0.083	1284	1.031	1.114
Lickitongue	5%	3.33	56.3	1527	381.7	45	181	36	0.083	1282	1.527	1.610
Porygon	-	200,000 credits		-	-				bought	bought	bought	bought
Tauros	4%	3.33	56.3	1527	381.7	45	69	13	0.083	1353	1.612	1.695
Pinsir	3%	1.25	150	4067	1016.8	45	70	14	0.083	1275	1.518	1.601
Dratini	25%	fishing	-	-	4	45	41	8	0.083	1307	1.556	1.639
Exeggcute	20%	8.5	22.1	598	149.5	90	72	14	0.083	1311	3.090	3.172
Kangaskhan	5%	3.33	56.3	1527	381.7	45	95	19	0.083	1275	1.518	1.601
Scyther	2%	1.25	150	4067	1016.8	45	72	14	0.083	1311	1.562	1.645

Table A) Calculating the encounter chance of Pokémon that can be encountered and the catch probabilities for each Pokémon, using equations 2,3,4,5. $P_{capture}$ values confirm that, on average, that only one pokéball is require to capture each Pokémon with the notable exception being the legendary birds.