Using the Principles of Probability and Statistics to Determine the Most Effective Starter Pokemon in Pokemon Sapphire

McKinley Glenn Wheeley

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Using the Principles of Probability and Statistics to Determine the Most Effective Starter Pokémon in Pokémon Sapphire

by

McKinley Glenn Wheeley

An Honors Capstone

submitted in partial fulfillment of the requirements

for the Honors Diploma

to

The Honors College

of

The University of Alabama in Huntsville

May 4, 2020

Honors Capstone Director: Mrs. Katie Popp

Part-Time Lecturer

Student Date

Director Date

Department Chair Date

Honors College Dean Date
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Abstract

This project was performed to determine which starter Pokémon was the most effective for gameplay in Pokémon Sapphire. Three separate runs were conducted, once with each starter. Every Pokémon encounter was logged and it was determined whether the starter was effective, ineffective or neutral. The information was separated into 3 main categories: Trainers, Wild, and Overall. For each run an Effective to Ineffective ratio was calculated and the Pokémon with the generally highest ratio was considered to be the most effective. Torchic was the most effective against Trainers, but Mudkip was most effective against Wild Pokémon. Overall, Mudkip had the highest Effective to Ineffective ratio in the first and second run, but Torchic had the highest ratio in the third run. A one sided proportion test proved that the ratios between each starter were significantly different. It was concluded that Mudkip was the most effective starter Pokémon in Pokémon Sapphire.
Introduction

At the beginning of every Pokémon game, the player must choose a starter Pokémon to accompany them on their journey. In Pokémon Sapphire the three starters are as follows: the grass type Treeko, the fire type Torchic, or the water type Mudkip. There has always been a debate over which starter is the best to choose in each game. Many try to answer this question and provide opinions, but there is hardly ever empirical evidence to back up any claims. This project aimed to collect and present data that would prove which starter was most effective throughout the game. This information could prove useful for competitive Pokémon players that compete in speed run competitions or even for the average player that wishes to obtain a deeper understanding about the statistics within the game.

Typing and Effectiveness

In every game a player will encounter a variety of Pokémon with many different types. In Pokémon Sapphire there are 17 possible types for each Pokémon: Normal, Grass, Fire, Water, Electric, Ground, Rock, Flying, Fighting, Psychic, Poison, Ice, Bug, Dark, Ghost, Steel, and Dragon. A Pokémon may have either one or two types (Dual Type). Each Pokémon can know up to four different moves. Each move has only one type. When battling it is important for a player to be conscious of the type of Pokémon both they and their opponent have. When attacking, a move can be either “super effective” (2×), “neutral” (1×), “not very effective “(0.5×), or “not effective” (0×). This effectiveness relies on the type of the move used and the specific type of the defending Pokémon. For example, water type moves are super effective against fire type opponents. Therefore water type moves will do 2x the damage of say a normal type move when attacking a fire type Pokémon.
Dual Type (DT) Pokémon are very important to the game as dual typing can change the effectiveness of a move. This is important to remember because many Pokémon have dual typings. The effectiveness of a move when battling a dual type opponent is found by multiplying the effectiveness values together. For example, water type moves are 2× effective on rock types and on ground types, so water is 4× effective when battling rock-ground DT’s. Fighting type moves are 2× effective on steel types, but only 0.5× effective on psychic types. Therefore fighting types are only 1× effective on steel-psychic DT’s.

A comprehensive type chart can be seen below in Figure 1. The left most column of the chart corresponds to the type of the attacking move. The top row indicates the type of the defending Pokémon. The effectiveness of an attacking type on a defending opponent is where the row and column cross. For example, consider the row for Fighting types. The green box at the intersection of the Fighting row and the Normal column indicates that a fighting type move is 2× effective against a normal type Pokémon. The red box at the intersection of the Fighting row and the Flying column indicates that a fighting type move is 0.5× effective against a flying type.

Lastly consider a fighting type move against a normal-flying DT Pokémon. Since fighting is 2× effective against normal types and only 0.5× effective against flying types, then a fighting type move would be 1× effective against a normal-flying DT Pokémon.

![Figure 1](type_chart.png)

Figure 1 shows a comprehensive type chart that includes each individual type available in Pokémon Sapphire and its effectiveness against a defending type.
Lastly, evolution is an integral aspect of the Pokémon games. Each Pokémon gains experience as it is used in battle. As it gains experience its level will increase. Each starter evolves at level 16 and again at level 36. Treeko evolves into Grovyle and then Sceptile. Torchic evolves into Combusken and then Blaziken. Mudkip evolves into Marshtomp and then Swampert. Two of the starters become DT’s upon their first evolution. Mudkip transitions from a water type to a water-ground DT. Torchic transitions from a fire type to a fire-fighting DT. Treeko maintains its grass typing throughout all evolutions. The DT characteristic can have both positive and negative side effects for both of the starters. The DT evolution relieves Mudkip of its weakness to electric type moves with the addition of the ground typing. Conversely Torchic gains two additional weaknesses with the addition of the fighting typing.
Methods

Three trials were performed and data collected for each trial. For each trial a different starter was chosen. Every possible trainer was battled one time. No rematch was logged. There is one trainer that has different Pokémon depending on which starter is chosen by the player. This was taken into account and the proper changes were made for each trial. Every wild Pokémon was also logged. No items such as repels were used to influence the frequency at which wild Pokémon appeared. No gameplay was logged following the completion of the main story mode (defeating the Elite Four and Champion). There is not an easy method to determine the moves of every opponent that was encountered, so this project focused solely on whether the starter Pokémon was effective against an opponent. The data does not indicate whether or not the opponent was effective against the starter. The collected data was based on three major criteria.

1. It was understood that the starter Pokémon knows at least one damaging move that is the same type as it is. This meant Mudkip was considered to know at least one water type move. Marshtomp and Swampert were considered to know at least one water type move and one ground type move. Torchic was considered to know at least one fire type move. Combusken and Blaziken were considered to know one fire type move and one fighting type move. Treeko, Grovyle, and Sceptile were considered to know at least one grass type move.

2. Each starter was evolved prior to entering the first gym in Rustboro City. The dual typing was only considered to be present once the first battle in the gym began. This is important because Torchic would be considered ineffective with its fire type moves against the rock type Pokémon in the gym, but Combusken’s additional fighting type makes it effective.
3. The data was separated into categories based on whether a move from the starter was 1× effective, 2× effective, 4× effective, 0.5× effective, or 0.25× effective. For DT’s the highest possible effectiveness was logged. For example, a fire type move from Combusken would be 0.5× effective against a rock type, but a fighting type move would be 2× effective. So 2× effective was logged when a rock type was encountered.

Once all the Pokémon were logged, the effectiveness of each starter against each opponent was determined. The collected data was compiled into pie charts. The charts were made to show how each starter performed against strictly Trainers’ Pokémon, strictly Wild Pokémon, and Overall (combined the trainer and wild Pokémon data for the trial). Anytime the starter was 2× or 4× effective, it was logged as “Effective”. Anytime the starter was 1× effective, it was logged as “Neutral”. Anytime the starter was 0.5× or 0.25× effective, it was logged as “Ineffective”. Table 1 below summarizes this information.

<table>
<thead>
<tr>
<th>Degree of Effectiveness</th>
<th>Effective</th>
<th>Neutral</th>
<th>Ineffective</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.25×</td>
<td>☒</td>
<td>☒</td>
<td>✔</td>
</tr>
<tr>
<td>0.5×</td>
<td>☒</td>
<td>☒</td>
<td>✔</td>
</tr>
<tr>
<td>1×</td>
<td>☒</td>
<td>✔</td>
<td>☒</td>
</tr>
<tr>
<td>2×</td>
<td>✔</td>
<td>✔</td>
<td>☒</td>
</tr>
<tr>
<td>4×</td>
<td>✔</td>
<td>☒</td>
<td>☒</td>
</tr>
</tbody>
</table>

Table 1 summarizes how the data was categorized. The leftmost column indicates the degree of effectiveness. The top row indicates how the data was categorized.

Finally, the instances where the starter was Effective and Ineffective were tallied and an Effective to Ineffective (E/I) ratio was calculated. The starter with the highest E/I ratio calculated from the Overall data was considered the most effective starter. This ratio was chosen because
the most effective starter should maximize effectiveness and minimize ineffectiveness. Using the Overall data, a two sample proportion test was performed between two starter Pokémon. First the number of effective encounters was tested, then the Ineffective encounters. The combinations included: Mudkip and Torchic, Torchic and Treeko, and Mudkip and Treeko.
Effectiveness Against Trainer Pokémon

Trainers are a huge aspect of every Pokémon game. Trainers generally have Pokémon that are at comparable levels to that of your starter. There were 724 trainer Pokémon. As you can see in the graphs below, Torchic had the highest Effective percentage at 37.2% and the lowest Ineffective percentage at 13.1%.
The table for the E/I ratios against Trainers can be seen below. Torchic had the highest E/I ratio against trainers at 2.83158. This nearly doubled Mudkip’s and more than doubled Treeko’s.

<table>
<thead>
<tr>
<th></th>
<th>Effective</th>
<th>Ineffective</th>
<th>E/I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mudkip</td>
<td>165</td>
<td>107</td>
<td>1.54206</td>
</tr>
<tr>
<td>Torchic</td>
<td>269</td>
<td>95</td>
<td>2.83158</td>
</tr>
<tr>
<td>Treeko</td>
<td>230</td>
<td>186</td>
<td>1.23656</td>
</tr>
</tbody>
</table>
Effectiveness Against Wild Pokémon

The other form of battle comes from encountering wild Pokémon. Different Pokémon appear in different regions across the game. Some Pokémon appear more frequently than others. Across all three trials, Mudkip had the highest E/I ratio being as small as two times and as large as eleven times larger than both of the other starters.

First Trial

During the first trial 714 wild Pokémon were encountered. Mudkip had the highest Effective percentage at 32.2% and the lowest Ineffective percentage at 13.0%.
The E/I ratios against wild Pokémon for the first trial can be seen below. Mudkip had the highest E/I ratio at 2.47312. This more than doubled Torchic’s, and was nearly six times greater than Treeko’s.
Second Trial

During the second trial 471 wild Pokémon were encountered. Mudkip again had the highest Effective percentage at 36.9% and the lowest Ineffective percentage at 14.8%.
The E/I ratios against wild Pokémon for the second trial can be seen below. Mudkip had the highest E/I ratio at 2.48571. This nearly tripled Torchic’s, and was more than seven times greater than Treeko’s.
Third Trial

During the third trial 456 wild Pokémon were encountered. Mudkip yet again had the highest Effective percentage at 33.8% and the lowest Ineffective percentage at 8.1%.
The E/I ratios against wild Pokémon for the third trial can be seen below. Mudkip yet again had the highest E/I ratio at 4.16216. This nearly tripled Torchic’s E/I ratio and was more than eleven times greater than Treeko’s E/I ratio.
Overall Effectiveness

Since the game cannot be played without encountering both trainers and wild Pokémon, the trainer and wild data was combined into one data set per trial. Mudkip had the highest E/I ratio for the first and second trial, but Torchic had the highest for the third trial.

First Trial

During the first trial 1,438 Pokémon were encountered in total. Although Torchic had the highest Effective percentage at 33.1%, Mudkip had the lowest Ineffective percentage at 13.8%. 

![Mudkip Overall Effectiveness First Run](chart1)

![Torchic Overall Effectiveness First Run](chart2)
The overall E/I ratios for the first trial can be seen below. Mudkip’s E/I ratio was about 20% greater than Torchic’s and about 127% higher than Treeko’s.

<table>
<thead>
<tr>
<th></th>
<th>Effective</th>
<th>Ineffective</th>
<th>E/I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mudkip</td>
<td>395</td>
<td>200</td>
<td>1.97500</td>
</tr>
<tr>
<td>Torchic</td>
<td>476</td>
<td>289</td>
<td>1.64706</td>
</tr>
<tr>
<td>Treeko</td>
<td>300</td>
<td>346</td>
<td>0.86705</td>
</tr>
</tbody>
</table>

The two sample proportion test proved that all of the frequencies for both Effective and Ineffective encounters were significantly different for every combination of two starters with a p-value less than 0.05. The table of p-values for trial one can be seen below.

<table>
<thead>
<tr>
<th></th>
<th>Effective p-Value</th>
<th>Ineffective p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mudkip &amp; Torchic</td>
<td>0.001</td>
<td>0.000</td>
</tr>
<tr>
<td>Torchic &amp; Treeko</td>
<td>0.000</td>
<td>0.010</td>
</tr>
<tr>
<td>Mudkip &amp; Treeko</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Second Trial

During the second trial 1,195 Pokémon were encountered. Torchic had the highest Effective percentage at 32.9%, but Mudkip had the lowest Ineffective percentage at 14.8%.
The overall E/I ratios for the second trial can be seen below. Mudkip’s E/I ratio was about 15% greater than Torchic’s and about 120% higher than Treeko’s.

<table>
<thead>
<tr>
<th></th>
<th>Effective</th>
<th>Ineffective</th>
<th>E/I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mudkip</td>
<td>339</td>
<td>177</td>
<td>1.91525</td>
</tr>
<tr>
<td>Torchic</td>
<td>393</td>
<td>234</td>
<td>1.67949</td>
</tr>
<tr>
<td>Treeko</td>
<td>272</td>
<td>312</td>
<td>0.87179</td>
</tr>
</tbody>
</table>

The two sample proportion test proved that all of the frequencies for both Effective and Ineffective encounters were significantly different for every combination of two starters with a p-value less than 0.05. The table of p-values for trial two can be seen below.

<table>
<thead>
<tr>
<th></th>
<th>Effective p-Value</th>
<th>Ineffective p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mudkip &amp; Torchic</td>
<td>0.016</td>
<td>0.002</td>
</tr>
<tr>
<td>Torchic &amp; Treeko</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Mudkip &amp; Treeko</td>
<td>0.002</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Third Trial

During the third trial 1,180 Pokémon were encountered. Torchic had the highest Effective percentage at 33.9%. Mudkip retained the lowest Ineffective percentage at 12.2%.
The overall E/I ratios for the third trial can be seen below. In this trial Torchic had the highest E/I ratio, but it was only about 0.5% greater than Mudkip’s and about 160% higher than Treeko’s.

<table>
<thead>
<tr>
<th></th>
<th>Effective</th>
<th>Ineffective</th>
<th>E/I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mudkip</td>
<td>319</td>
<td>144</td>
<td>2.21528</td>
</tr>
<tr>
<td>Torchic</td>
<td>401</td>
<td>180</td>
<td>2.22778</td>
</tr>
<tr>
<td>Treeko</td>
<td>286</td>
<td>335</td>
<td>0.85373</td>
</tr>
</tbody>
</table>

The two sample proportion test for Effective encounters were significantly different for the combinations of Mudkip & Torchic as well as Torchic & Treeko. However, the Mudkip and Treeko combination was not significantly different with a p-value of 0.120. All of the frequencies for Ineffective encounters were significantly different for every combination of two starters with a p-value less than 0.05. The table of p-values for trial three can be seen below.

<table>
<thead>
<tr>
<th></th>
<th>Effective p-Value</th>
<th>Ineffective p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mudkip &amp; Torchic</td>
<td>0.000</td>
<td>0.031</td>
</tr>
<tr>
<td>Torchic &amp; Treeko</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>Mudkip &amp; Treeko</td>
<td>0.120</td>
<td>0.000</td>
</tr>
</tbody>
</table>
Conclusion

It was concluded that Mudkip was the most effective starter Pokémon in Pokémon Sapphire. Although Blaziken had the highest E/I ratio against trainers, Mudkip had the greatest E/I ratio against wild Pokémon in all three trials. Perhaps most importantly, Mudkip had an overall E/I ratio that was 15-20% higher than Torchic’s for the first and second run. Although Torchic had an E/I ratio that was 0.5% higher than Mudkip’s, the difference between the ratios in the first two trials supports that Mudkip generally has a higher E/I ratio than Torchic. Treeko had a very noticeably low E/I ratio when compared to either Mudkip or Torchic. The fact that Torchic had a slightly higher E/I ratio in trial three is most likely due to less time being spent in certain regions where Torchic or its evolutions were more likely to be ineffective. This would minimize the frequency of ineffective encounters thus increasing the E/I ratio. A comprehensive table of the overall E/I ratios for each trial can be seen below.

<table>
<thead>
<tr>
<th></th>
<th>First Run</th>
<th>Second Run</th>
<th>Third Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mudkip</td>
<td>1.97500</td>
<td>1.91525</td>
<td>2.21528</td>
</tr>
<tr>
<td>Torchic</td>
<td>1.64706</td>
<td>1.67949</td>
<td>2.22778</td>
</tr>
<tr>
<td>Treeko</td>
<td>0.86705</td>
<td>0.87179</td>
<td>0.85373</td>
</tr>
</tbody>
</table>

Discussion of Defense

This project provided large amounts of data and helped make clear conclusions based on empirical evidence. However, the defensive aspect of battle was not taken into consideration throughout the process. In order to properly include defensive data, the moves of every Pokémon must be known. This is very difficult to do, as the player has no control over which move the game’s computer chooses to use. This could result in an encounter being improperly categorized.
This could possibly be included in later studies that employed a different method of categorizing the effectiveness of a starter.

Once Mudkip is fully evolved into Swampert, it has the highest bases stat total among the three starters. It also has the highest base Defense stat across all three evolutions.

Prior to evolution, Mudkip only has a weakness to electric type moves and grass type moves. When Mudkip evolves, it is unable to be harmed by electric type moves and is left with the sole weakness to grass type moves. When considering defense, only having one weakness is very effective. Additionally, it is very easy to evolve Mudkip before ever encountering an electric type Pokémon, so its weakness to electric type moves is essentially a nonissue.

Conversely, Torchic has three weaknesses: water, ground, and rock type moves. Upon Torchic’s evolution it loses its weakness to rock type moves, but gains a weakness to both psychic and flying type moves. The latter portion of the game provides Torchic with many of its Ineffective encounters as numerous water, flying, and psychic type opponents appear. Treeko has five weaknesses: fire, flying, poison, bug, and ice type moves. This is the highest number of weaknesses of any starter. This explained why there were such a high number of Ineffective encounters for Treeko.

For the two DT starter Pokémon, the type that provided the highest effectiveness against an opponent was considered when categorizing the encounters. This failed to show the defensive side of battle as well. When Torchic evolved and gained the fighting typing, it became neutrally effective against some opponents that it was once Ineffective against. For example, fire type moves from Torchic would cause Torchic to be labeled ineffective, but a fighting type move from Combusken or Blaziken would mean that the encounter would be labeled as Neutral.
Although fighting type moves would inflict neutral damage, it is defensively unfavorable to put
Combusken or Blaziken into battle against a water type opponent.

Below is a list of some Pokémon that Torchic, Combusken, and Blaziken are Effective or
Neutral against offensively, but that are potentially dangerous defensively (bullets with multiple
Pokémon indicate an evolutionary family):

- Numel
- Spoink
- Doduo and Dodrio
- Taillow and Swellow
- Lunatone
- Solrock
- Metagross
- Meditite and Medicham
- Swablu and Altaria
- Zubat, Golbat, and Crobat
- Carvanha and Sharpedo
- Barboach and Whiscash
- Luvdisc
- Milotic
- Spheal, Sealeo, and Walrein
- Wailmer
- Clamperl
- Relicanth
- Gyarados
- Geodude and Graveler
- Salamence
- Skarmory
- Abra and Kadabra
- Ralts, Kirlia, and Gardevoir
- Beautifly
- Dustox
- Staryu
- Azurill, Marill, Azumarill

There are also Pokémon that pose defensive issues for Mudkip, Marshtomp, and Swampert, but the list is significantly shorter. These Pokémon include:

- Roselia
- Seedot, Nuzleaf, and Shiftry
- Lotad, Lombre, and Ludicolo
- Oddish and Gloom
- Cacnea and Cacturne
- Tropius
Teaching a Starter Pokemon Moves of a Different Type

This study did not consider the fact that some Pokémon can be taught moves that do not match their type. For example, the water-ground type Swampert can be taught the ice type move Ice Beam by using an item. When a player encounters a grass type opponent, he or she should consider using a Pokémon that is not weak to grass type moves. However if the player is in a pinch, a Swampert that has been taught Ice Beam could potentially defeat the grass opponent in one hit with the super effective ice type move. This is a quick remedy to Marshtomp and Swampert’s only weakness. Torchic unfortunately cannot learn dark or ghost type moves that would be super effective against psychic type opponents, or electric or ice type moves that could help against flying type opponents. It can however learn the rock type move called Rock Tomb. This still only provides a counter to flying type opponents. Although Treeko, Grovyle, and Sceptile have the most weaknesses, it is also able to learn more moves to help counter opponents it may be weak against. For example, Grovyle can learn Rock Tomb which is very effective against flying, bug, and ice type opponents. Sceptile can learn two different ground type moves, Dig and Earthquake, that would be super effective against fire or poison type opponents. Sceptile can also learn the flying type move Aerial Ace. This would be super effective against any grass-poison type opponents. So although Treeko and its evolutions have the most weakness, there are multiple options to help counter each of them.
Works Cited


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Part-Time Lecturer

5-4-20

Student

Date

Director

Date

Department Chair

Date

Honors College Dean

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[Signature]

Student Signature

5-4-20

Date
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Katie Popp

Sent from my iPhone