Biosyn Quarterly Report for Investors

Amirali Omidfar

Sofia University

MSCS3019 Data Visualization

Dr. Sooudi

June 7, 2024

Abstract

In this quarterly review report for our investors we hope to demonstrate some of our latest advancements at Biosyn Genetics. From our analysis of the intelligence measurements in Dinosaurs, to projected investments, the public interests and our dinosaurs' genera development status, we aim to provide you a comprehensive summary of our achievements. Hence providing you with the right vision to invest accurately. We genuinely hope this report helps you with your decision making in supporting our institute and solidifying our partnership.

Biosyn Quarterly Report for Investors

Contents

Introduction

At Biosyn our focus is to work towards a future where Humans-Dinosaurs coexistence is not only a possibility but the safest, the most appropriate destination to head to. In this report created in APA style (referenced "APA Style," n.d.), we take you on a journey through our latest experiments and results and share with you the vision we have in mind for the future of Humans-Dinosaurs coexistence. We are going to stumble upon a fascinating path and show the potentials we can unlock with your help through this journey. We also like to offer you a detailed analysis of our studies. So we can guide you in directions we believe are best to invest toward financially and present to you our high return on investment ongoing projects.

"How we think about the future world in which both dinosaurs and humans coexist is critical to the choices we make today!"

- Owen Grady- Animal Behaviorist

"The Science behind these discoveries has been incredible to witness!"

- Dr. Alan Grant, Paleontologist

"Genetic Power has now been released!"

- Ellie Sattler, Paleontologist

"We have spared no expense in our investments"

- John Hammond, "Former CEO of Jurassic Park, Biosyn Investor"

Figure 1

Quotes from our team members on Biosyn latest advancements

We first highlight some quotes from our team members to emphasize on the importance of this work and ultimately the results we are about to share with you. As our former CEO, John Hammond once said we have started off with very little expenses in investment and have come a long way. To put it as Dr. Alan Grant and Ellie Sattler, two of our Paleontologist once did, we are now on the verge of witnessing bright discoveries in the field of Genetics. While we have reached exciting technology enhancements, the coexistence of Dinosaurs and us now requires our critical decision making. According to Owen Grady, one of our animal Behaviorists at Biosyn, this is where generous and thoughtful people like you step in to support us making the right decision in securing our future and the future of generations after us.

In this report we go over four main data sets and explore different aspects of our findings with each of them. The data sets to be discussed are as follows:

1. Data Set 1: Brain to Body Weight and Mass (Animals Today and Dinosaurs Species)
2. Data Set 2: Annual and Projected Investment on Dinosaurs
3. Data Set 3: Public Interest in Dinosaurs (Survey Results)
4. Data Set 4: Dinosaurs Development Status

To better visualize the journey we are about to embark on, one can refer to the journey map provided in Figure 2 (In preparation of the Journey plot "Slide Egg," n.d. and "Flat Icon Website," n.d. references were used).

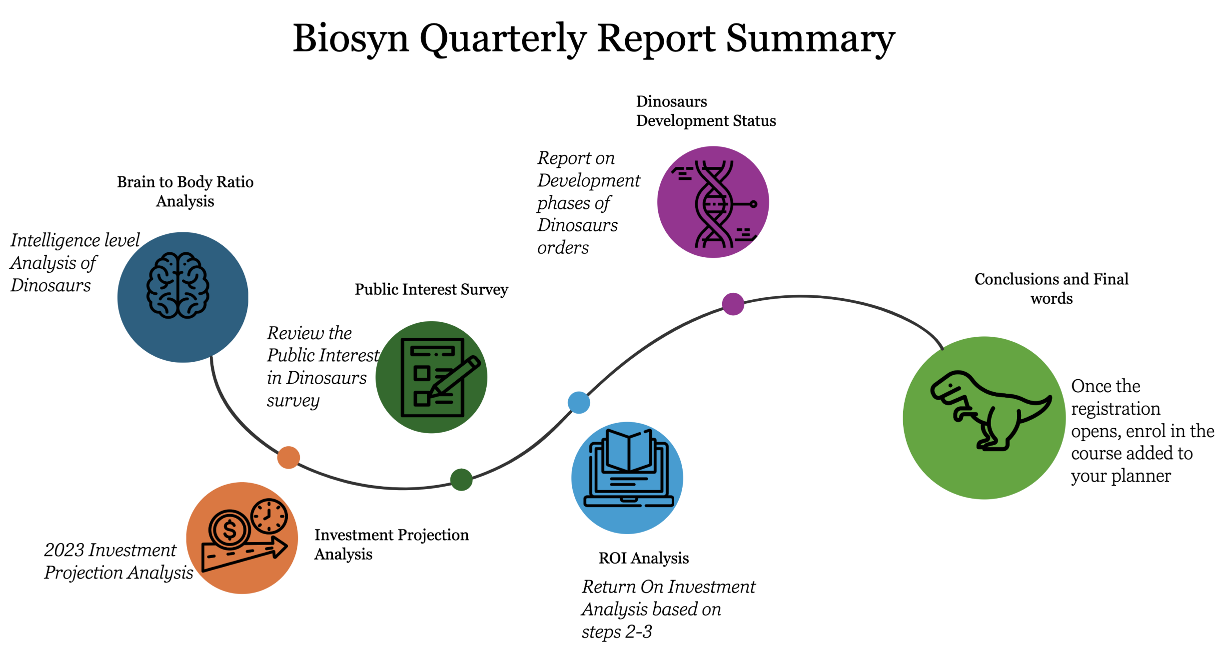

Figure 2

Journey Map - Biosyn Quarterly Report

Data Set 1: Brain To Body Mass Ratio

Animals Today				
Group	Species	Brain mass (g)	Body mass (g)	Body wt (kg)
Primates	Homo sapiens	1420	83,000	83
Cetacea	Porpoise (Phocaena phocaena)	1735	142,430	142.43
Primates	Chimpanzee (Troglodytes niger)	440	56,690	56.69
Marsupials	Baboon (Papio cynocephalus)	175	19,510	19.51
Aves	Crow (Corvus brachyrhynchos)	9.3	337	0.337
Proboscidea	Elephant (Loxodonta africana knochenhaueri)	5712	6,654,000	6654
Cetacea	Whale, Blue (Balaenoptera musculus)	6800	59,200,000	58059
Marsupials	Opossum (Didelphus marsupialis etensis)	4.8	1,147	1.147
Fish	Goldfish (Carassius auratus)	0.1	9.5	0.00952
Aves	Ostrich, Masai (Struthio camelus massaicus)	42.11	123,000	123
Fish	Tuna (Thunus secundodorsalis)	3.09	5,210	5.21
Reptiles	Alligator (Alligator mississippiensis)	14.08	205,000	205
Dinosaurs				
Carnosaur	Allosaurus	167.5	2,300,000	2300
Ornithopod	Anatosaurus	150	3,400,000	3400
Sauropod	Brachiosaurus	154.5	87,000,000	87000
Ornithopod	Camptosaurus	23	400,000	400
Sauropod	Diplodocus	50	11,700,000	11700

Table 1

Animals and Dinosaurs Brain to Body Weight & Mass

In the first data set we compare the Brain-Body mass ratio across dinosaur species and today's animals. We start by separating animals from dinosaurs and then combining the groups that have more than one species listed in the table. This data refinement helps us gain an overall understanding of the brain mass to body weight ratio across animals and then dinosaurs. As for calculating the brain mass (in grams) to body weight (in kilograms) ratio, Grams and kilograms for brain masses and body weights are selected respectively. These selections are necessary to make the plots scale well and be easy to comprehend.

Animal Groups	Brain mass (g)	Body mass (g)	Body wt (kg)	Brain mass (g) to Body weigt (kg) ratio
Primates	930	69845	69.845	13.32
Cetacea	4267.5	29671215	29100.715	0.15
Marsupials	89.9	10328.5	10.3285	8.7
Aves	25.705	61668.5	61.6685	0.42
Proboscidea	5712	6,654,000	6654	0.86
Fish	1.595	2609.75	2.60976	0.61
Reptiles	14.08	205,000	205	0.07

Table 2

Animals groups Brain Mass (g) to Body Weight (kg) Ratio

Aside from Primates and Marsupials, the brain Mass(g) to body weight(kg) ratio is below 1 for all the animal groups. However, including these two categories that seem like outliers the ratio averages around 3.45 for all animals groups. Figure 3 show the ratio across different groups of animals with respect to the benchmark line (average ratio among all groups). To unify the dataset one step further in Figure 4 we repeated the same process while excluding Primates and Marsupials. This time the average ratio turned to be 0.422 and the results are depicted in the same Figure.

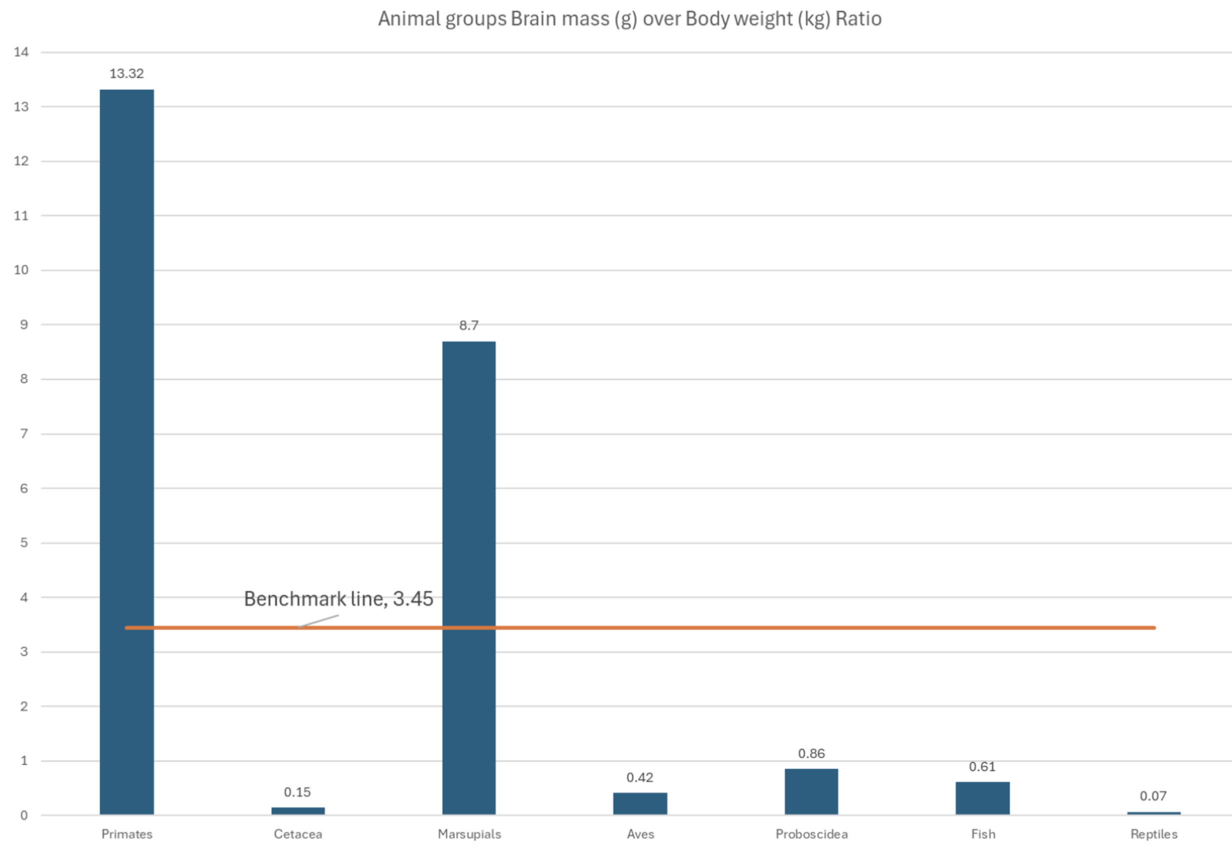

Figure 3

Bench-marked Animals Brain Mass(g) to Body Weight(kg) Ratio

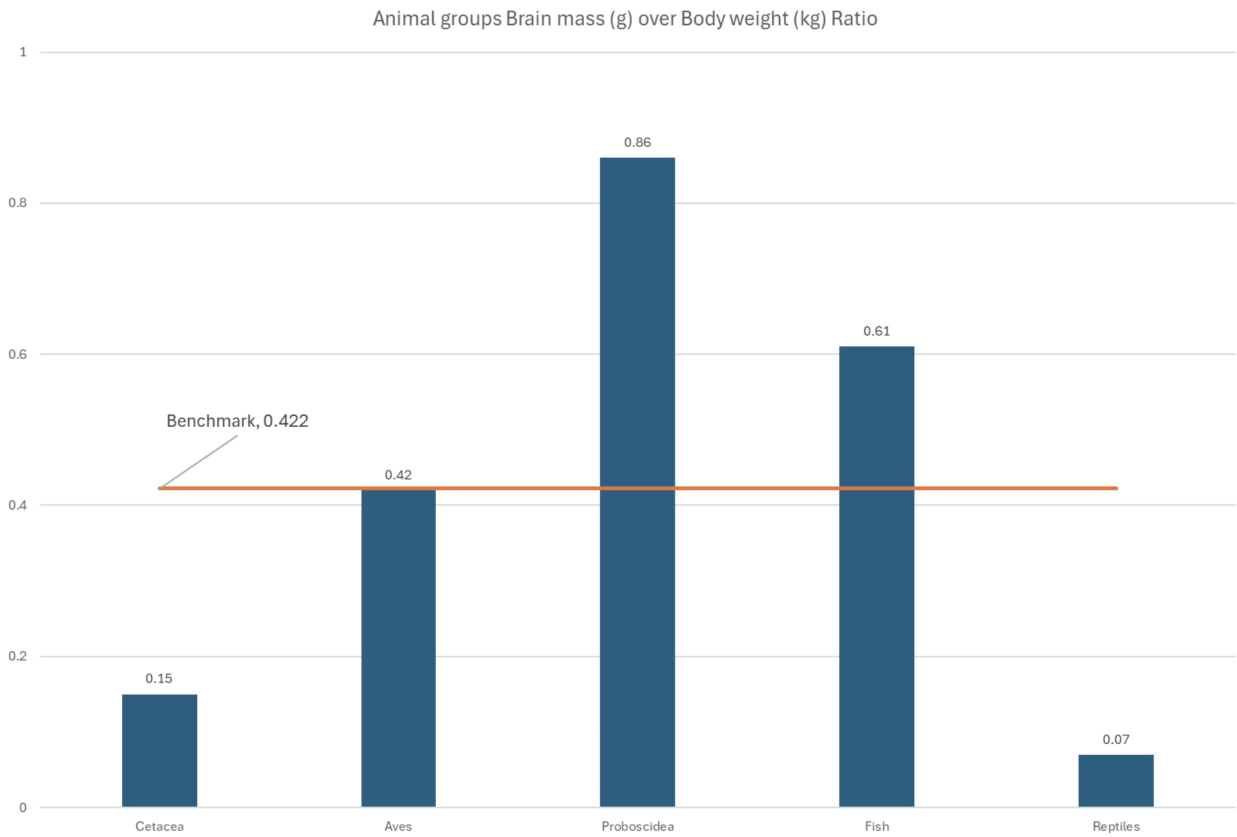

Figure 4

Bench-marked Animals Brain Mass(g) to Body Weight(kg) Ratio (without outliers)

Following the same procedure, we calculate the same ratio for the given groups of dinosaurs as shown in Table 3. One important point here is that the ratio has dropped significantly given the massive body weight of dinosaurs. Here the average ratio is 0.041 which is 10 times smaller than the reported benchmark value in Figure 4 and almost 100 times smaller than the value in Figure 3.

Dinosaurs groups	Brain mass (g)	Body mass (g)	Body wt (kg)	Brain mass (g) to Body weigt (kg) ratio
Carnosaur	167.5	2,300,000	2300	0.07
Ornithopod	86.5	1900000	1900	0.05
Sauropod	102.25	49350000	49350	0.003

Table 3

Dinosaurs groups Brain Mss (g) to Body Weight (kg) Ratio

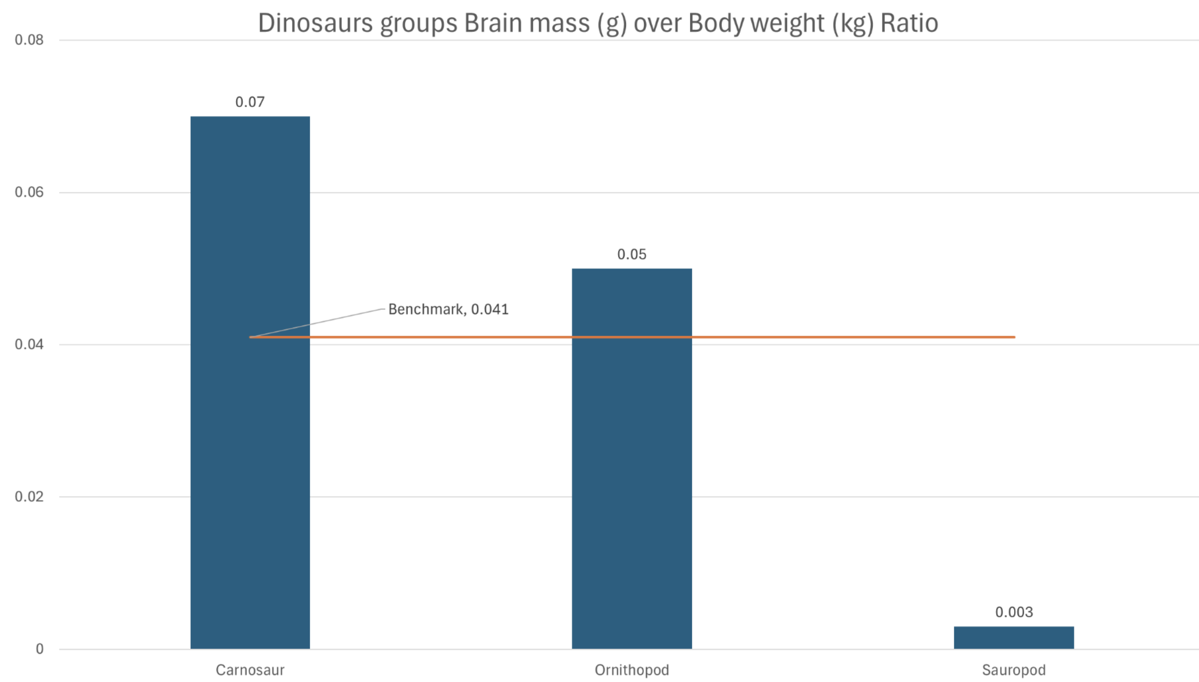

Figure 5

Bench-marked Dinosaurs Brain Mass(g) to Body Weight(kg) Ratio

Observing the trend in the brain to body weight ratio might seem misleading, especially if one assumes a direct relationship between the ratio and cognitive abilities in any species. According to *External Measures of Cognition* Cairó O, 2011, the ratio for some of the species is as follows:

1. Human male: Brain: 1.4kg. Weight: 75kg. Ratio: 1.86%
2. Bottle-nosed dolphin: Brain: 1.5kg. Weight: 120kg. Ratio: 1.25%
3. Chimpanzee. Brain: 0.4kg. Weight: 45kg. Ratio: 0.88%
4. African gray parrot: Brain: 0.0057kg. Weight: 0.33kg. Ratio: 1.72%

The author further explains even though the trend may seem logical, the ratio does not linearly correlates with the level of intelligence in different species. For example, the 10% ratio (brain weighs 3g, total weight 30g) in shrew, would suggests it should be five times smarter than a human being which is obviously not the case.

Realizing the shortcomings of this ratio in reflecting the intelligence of species we looked into a more complicated approach called: "the **Encephalization Quotient** or **EQ**". Simply put as *Science journalist* ORTEGA, 2023 exaplains; EQ is an animal's brain size, related to its body size, using this equation:

$$EQ = \frac{brain - weight}{0.12xbody - weight^{\frac{2}{3}}}$$

Applying this formula shows some dinosaurs, T. rex, for instance, have an EQ of about 2.4. Comapring this results to the ones for humans (around 7.8), some dinosaurs are proven to be somewhat smart. Other works such as Herculano-Houzel, 2023's took other measures, for instance considering number of neurons and yet again proved some dinosaurs can actually be among smart animals. Hence with proper investments on the right species at Biosyn we believe we can pave the way of human-dinosaurs coexistence and use their intelligence capabilities properly. To sum up, we just want to reiterate the massive body weight of dinosaurs must not deceive us into underestimating their cognitive abilities while some of their genera are proven to be quite intelligent.

Data Set 2 and 3: Projected Investment and Public Interest in Dinosaurs

In this section we first cover the current and projected investments on Dinosaurs for the years of 2022 and 2023 respectively. We then review the public interest survey results about dinosaurs and reveal some ideal investment options that can lead to profitable returns for our investors.

Projected Investments

The first data set used in this section is shown in Table 4:

Dataset #2 - Annual And Projected Investment on Dinosaurs

Order/Suborder	Genus	Investment ’22 ($M)	Projected Investment ’23 ($M)
Carnosaur	Allosaurus	5	1
Ornithopod	Anatosaurus	3	2
Sauropod	Brachiosaurus	4	3
Ornithopod	Camptosaurus	6	4
Sauropod	Diplodocus	5	2
Ornithopod	Iguanodon	3	1
Ceratopsian	Protoceratops	4	2
Stegosaur	Stegosaurus	4	1
Ceratopsian	Triceratops	6	4
Theropod	Tyrannosaurus	9	5

Table 4

Current and Projected Investments on Dinosaurs

There is a significant drop in the total projected amount invested for the year 2023. As depicted in Figure 6, all genera across all orders are expected to have a lower invested amount toward their development.

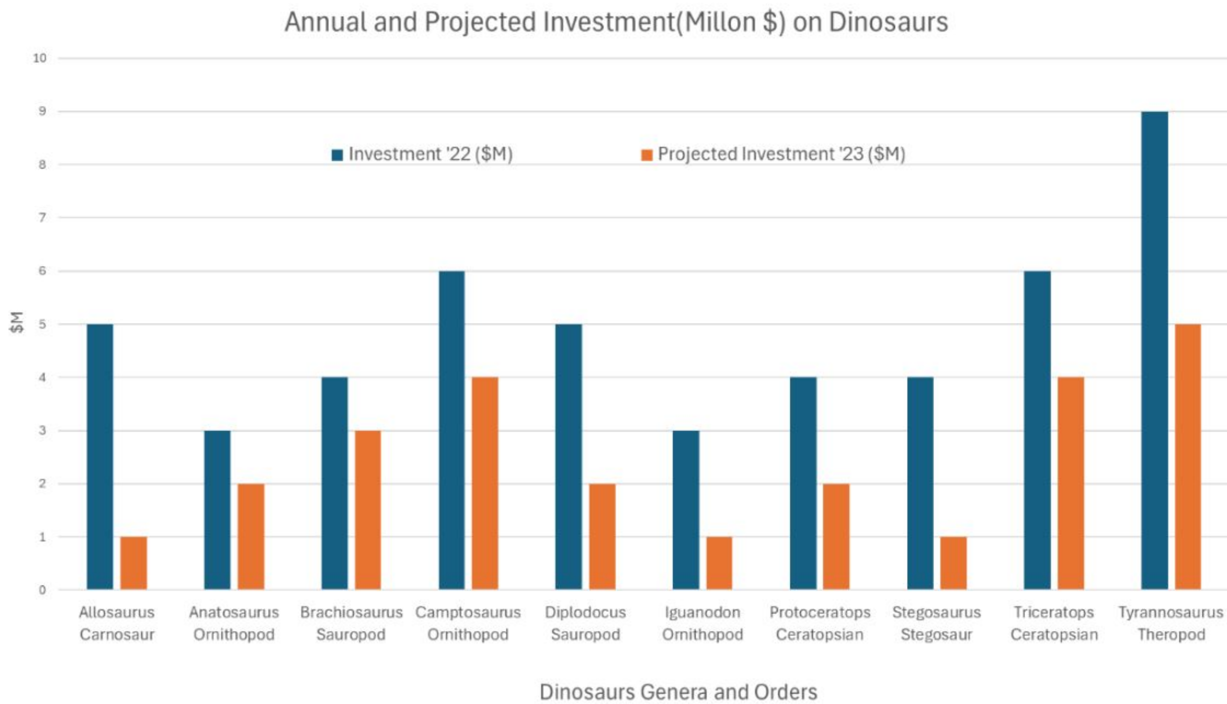

Figure 6

Clustered Columns - 2022 and Projected 2023 Investments on Dinosaurs

This concerning fact brings us to the next critical point of this report, which the required budget for maintaining the ongoing researches at our facility. For us to carry on with the current projects we require 2023 investment per genus to be at least 75% of the amount invested in 2022. In an effort to visually present our current state we first put together Table 5. This way we could derive the amount needed for each genus based on the average spending of its order/suborder in the year 2022. Observing the projected investment of each genus, we came up with the rubrics in Table 6, which are calculated based on the average amount utilized in "Order/Suborder" categories in 2022.

Following the guidelines from Table 5 and 6, we displayed the current status of projected investments in Figure 7. This figure presents a bullet chart that is referenced from Evergreen, 2020. As we discuss the patterns seen in this figure, it becomes clearer why this chart performs a better job at visualizing the data.

Required Investment for 2023

Order/Suborder	Investment 2022 ($M)	Requried Investment 2023 ($M)
Carnosaur	5	3.75
Ornithopod	4	3
Sauropod	4.5	3.375
Ceratopsian	5	3.75
Stegosaur	4	3
Theropod	9	6.75

Table 5

Required Investment for 2023

Investment Projection Rubrics for 2023	Amount required in Million $
Bad (up to 33% of 2022 average)	
Acceptable (33-53% of 2022 average)	
Good (53% of 2022 average and above)	

Table 6

Investment for 2023 Analysis Rubrics

As shown in Figure 7, only two genera have reached their required investment goal throughout the preliminary projections. Firstly, the projected budget for Triceratops from Ceratopsian order ($4M$\$), is just slightly over the required budget which is $3.75M$\$. But in the second case which is Camptosaurus from Ceratopsian order Ornithopod, we have surprisingly surpassed the required target budget by a lot and performed much better than the expected good amount of required investment. In this case, our required target was $3M$\$ and we are already showing $4M$\$ in our projections. while this is good news for Camptosaurus's research budget, we might end up partially using the exceeding amount toward other genera if we can not address all the shortcomings in other Order groups. All the other genera are in need of your generous support to maintain their current level of functionality. As this opens up lots of investment opportunities,

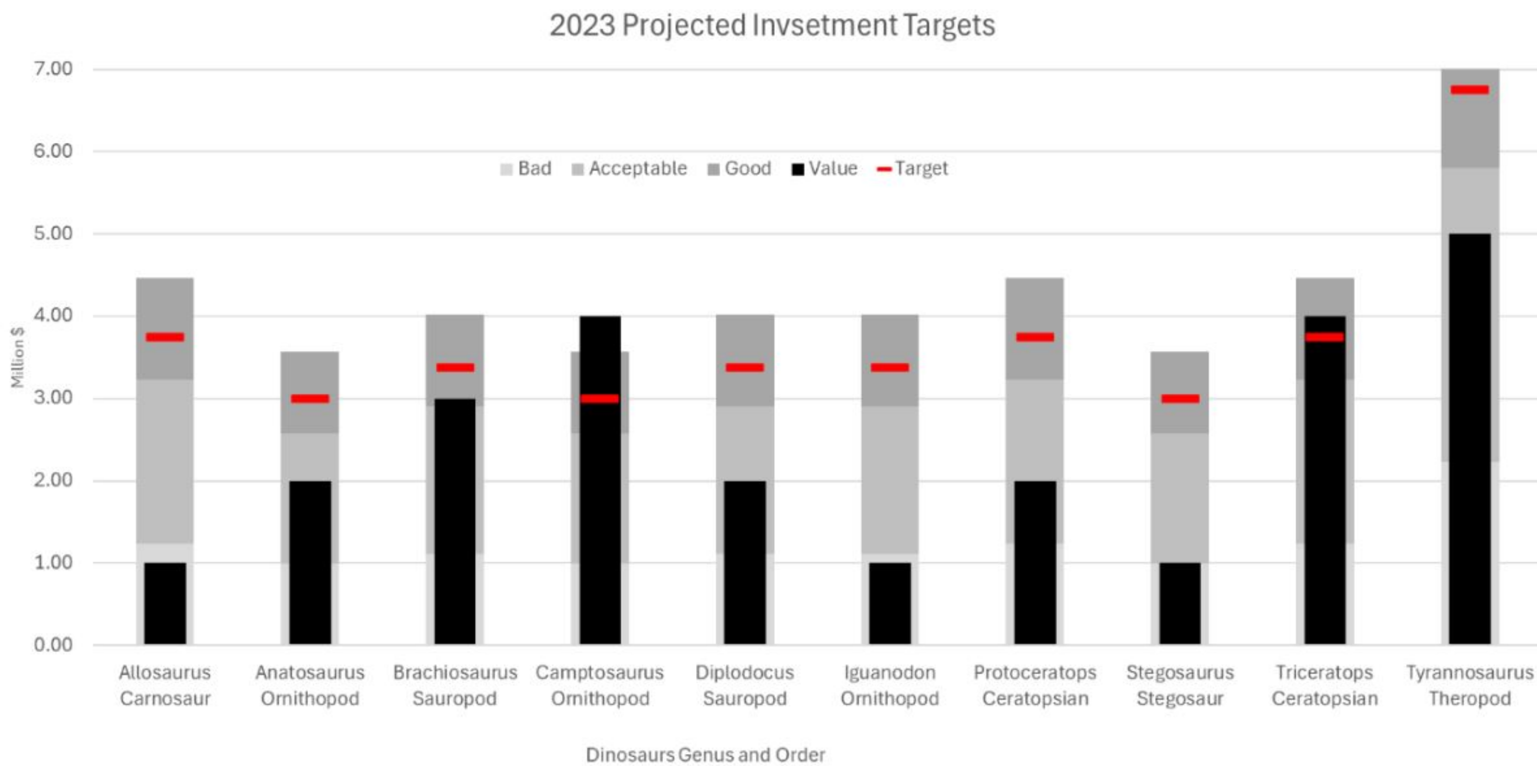

Figure 7

Bullet Graph - 2023 Projected Investment Targets

in the next subsection, we are going to showcase some survey results to guide you toward some of the more reliable investment opportunities from our dinosaurs' genera and order groups.

Public Interest in Dinosaurs (Survey Results)

In this subsection, we use the survey data reflecting people's interest in different genera and orders of dinosaurs. As shown in Table 7, the groups are sorted with "1" showing the highest interest and "5" representing the lowest amount of interest.

Dataset #3 - Public Interest on Dinosaurs (Survey Results)

Order/Suborder	Genus	Survey (Rankings from 1 to 5 - 1 being the highest interest)
Carnosaur	Allosaurus	3
Ornithopod	Anatosaurus	4
Sauropod	Brachiosaurus	2
Ornithopod	Camptosaurus	5
Sauropod	Diplodocus	5
Ornithopod	Iguanodon	3
Ceratopsian	Protoceratops	4
Stegosaur	Stegosaurus	4
Ceratopsian	Triceratops	2
Theropod	Tyrannosaurus	1

Table 7

Public Interest on Dinosaurs Survey

To visualize the rankings, we use a Treemap plot referenced from “Plotly Treemap charts in Python,” n.d. The value corresponding to each genus should indicate its popularity. Also as far as Treemaps go the larger the values get, the larger the area allocations become. Hence we implemented a color legend in the reverse order of the survey rankings to show the amount of public interest for different dinosaurs as well. For instance, Tyrannosaurus being the most popular genus with the rank of "1" obtains the largest area in Figure 8. Its color also, follows the "ColorRanks" legend and gets the highest Color Rank ("5"). In terms of popularity, following Tyrannosaurus from Theropod order, come Ceratopsian, Sauropod, Ornithopod, and then

Stegosaur orders.

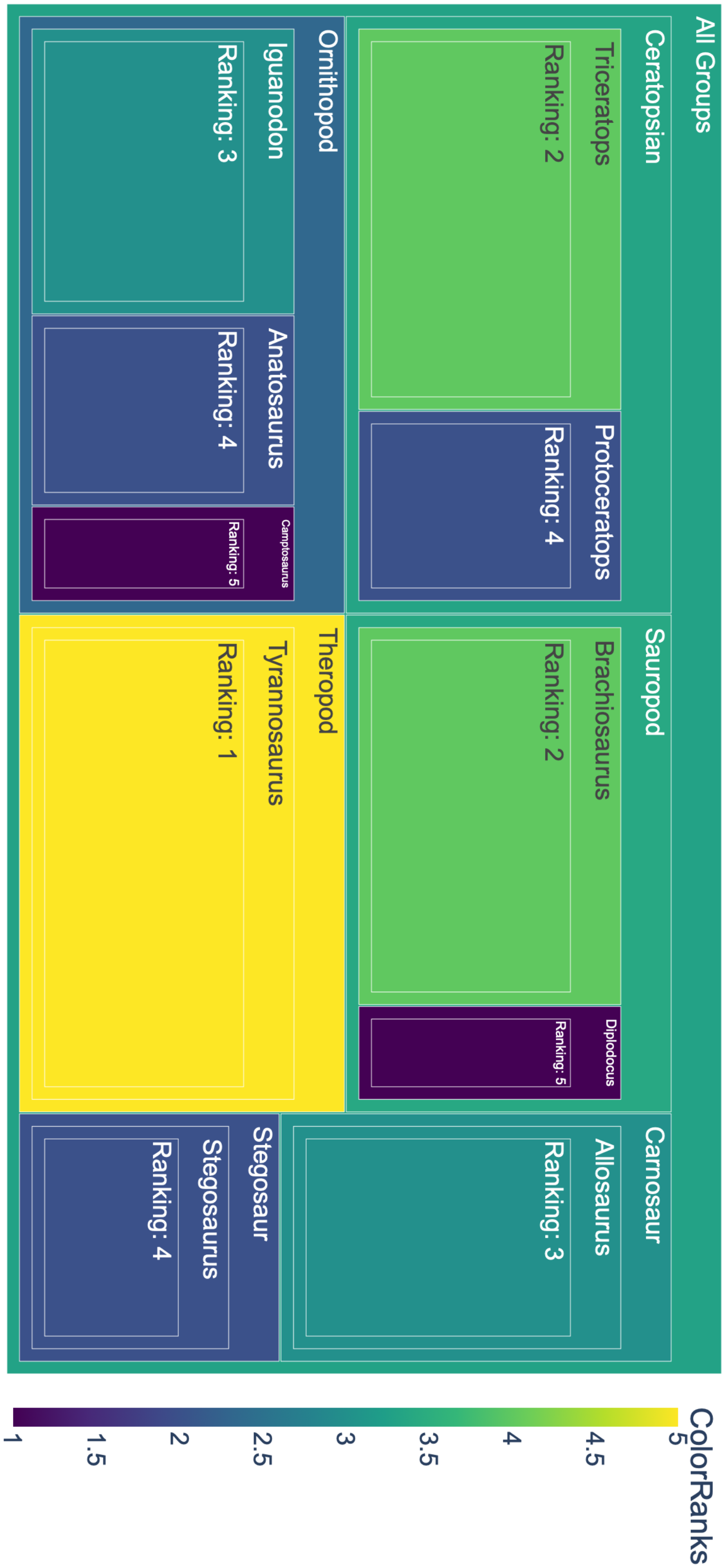

Figure 8

Treemap - Public Interest on Dinosaurs (Survey Results)

So far we have analyzed the projected investment shortcomings and the public interest survey rankings. Applying the information gained from these two tables, we take our analysis to the next level. We now want to answer one of the main questions we started the report off with: "What Dinosaurs orders can provide us with the highest Return On Investment (ROI) ?". The table used for this analysis, Table 8, has three critical columns we need to briefly go over. It is also import to note we combine genera from the same order family to simplify the representation:

1. **Survey Score**: This column is derived from Table 7 and its rankings. To properly project the value of each rankings, the values were reversed, meaning an order with the ranking 1 now gets the score of 5 and vice versa.

2. **Projected Investment Shortcoming**: If recall, in Table 5, we generated a required investment column for each dinosaur order. Now here, the Projected Investment Shortcoming is defined as the difference between the Projected Investment and the required one.

3. **Investment Potential**: Finally the Investment Potential Score gets calculated as the 2 : 1 weighted average between the Survey Score and the Projected Investment Shortcoming in this column.

Order/Suborder	Survey Score	Projected Investment Shortcoming	Investment Potential
Carnosaur	3.00	2.94	2.98
Ornithopod	1.00	1.61	1.20
Sauropod	2.50	1.44	2.15
Ceratopsian	3.00	0.94	2.31
Stegosaur	4.00	2.94	3.65
Theropod	5.00	-1.06	2.98

Table 8

Return On Investment Analysis

As the main focus here is the return on investment (ROI,) we weighed the Survey results twice as more. This is because we like to make sure our investors have the high chance to gain profits in their collaboration with us which ultimately requires investments in projects that have more public interest. The results are shown in the Heatmap format in Figure 9. In making this chart we used “Plotly Heatmap charts in Python,” n.d. resources. The plot is quite self-explanatory and clearly explains the region with warmer colors and higher final score are more likely to have higher ROI’s. Therefore those orders are the safer and better options for our investors. As far as the Heatmap goes, one can see and compare how each order group perfoms relatively in terms of survey results, inverstments shortcomings and potentials.

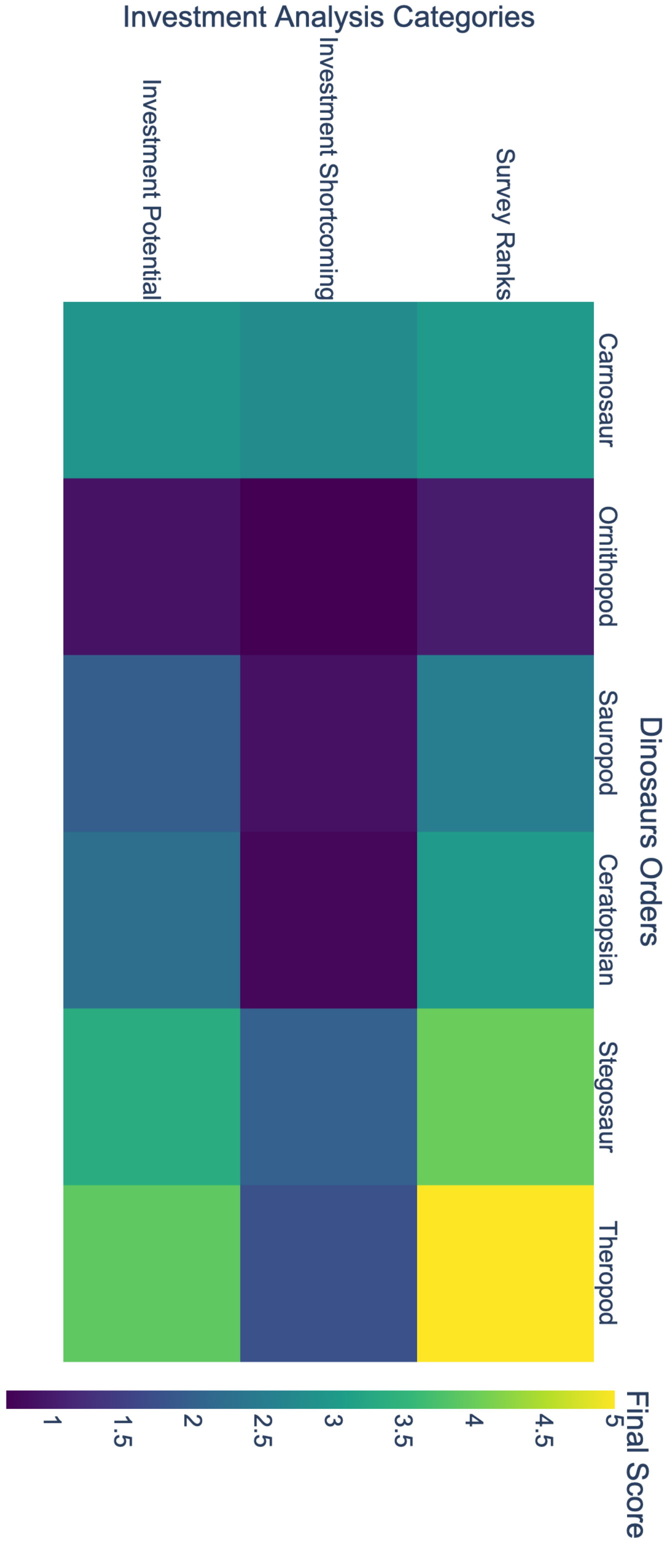

Figure 9

Heatmap - Return On Investment Analysis for Dinosaurs orders

In another way to visualize Figure 9, we can present this data in a stacked bar plot with some minor adjustments. Instead of calculating the weighted average we can add twice the Survey ranking to the score calculated earlier for investment shortcomings per each order group. This way the summation becomes a whole number that can be considered as the "ROI Success Coefficient". It is also obvious the higher this value the better chance of success an investment can have, that is where the naming convention comes from. The work explained is depicted in Figure 10 and representing the same concept of the Heatmap 9, the safest investment options again are: Theropod, Stegosaur and Caenosaur respectively.

Figure 10

Stacked Bar - Return On Investment Analysis

Data Set 4: Dinosaurs Development Status

In this section we present the latest development results for different dinosaurs orders and genera. According to Holden, 1997 and Homer and Gorman, 2009 there might be some possibilities in reaching the embryo development from the remnant of dinosaurs that are in the forms of bones or fossils. The data set used for this section is shown in Table 9. The incubation process can take up to several months and to reach that phase the following phases needs to occur in series:

1. Genetic Extraction
2. Fertilisation
3. Embryo Development

Dinosaurs Development Status

Status	Order/Suborder	Genus	Incubation Length	Estimated Hatchlings
Not Started	Carnosaur	Allosaurus	3 months	2
Genetic Extraction	Ornithopod	Anatosaurus	2 months	1
Fertilisation	Sauropod	Brachiosaurus	4 months	2
Embryo Development	Ornithopod	Camptosaurus	6 months	2
Genetic Extraction	Sauropod	Diplodocus	3 months	3
Genetic Extraction	Ornithopod	Iguanodon	8 months	1
Fertilisation	Ceratopsian	Protoceratops	7 months	2
Genetic Extraction	Stegosaur	Stegosaurus	4 months	1
Embryo Development	Ceratopsian	Triceratops	10 months	1
Embryo Development	Theropod	Tyrannosaurus	4 months	1

Table 9

Dinosaurs Development Status Table

To visualize this dataset we followed the “Sankey Diagram in Python,” n.d. guideline to represent the data in a Sankey diagram. This way the flow of data is well structured and presented and insightful visualizations can be easily shown. In the first segment of Figure 9, the development status of different orders is highlighted. Next it moves from orders to genera, to incubation periods and finally the hatchlings.

As shown in Figure 9 the majority genera have 1 estimated hatchlings or 2 and there is only one case with 3. On average the major incubation length, across different genera, takes 3-4 months which can be used in long-term plannings for deliverables’ timeline and their expected results. In terms of the development status, the good news is only one genus has not yet started. We have two in "Fertilisation" state, three in "Embryo Development" phase and four in "Genetic Extraction" stage. Our goal at Biosyn Genetics is to get all our genera to "Embryo Development" state, and as you can see there is already progress made across all genera except for "Allosaurus" genus. Therefore it is among our priorities to first get this genus to the next state of "Genetic Extraction".

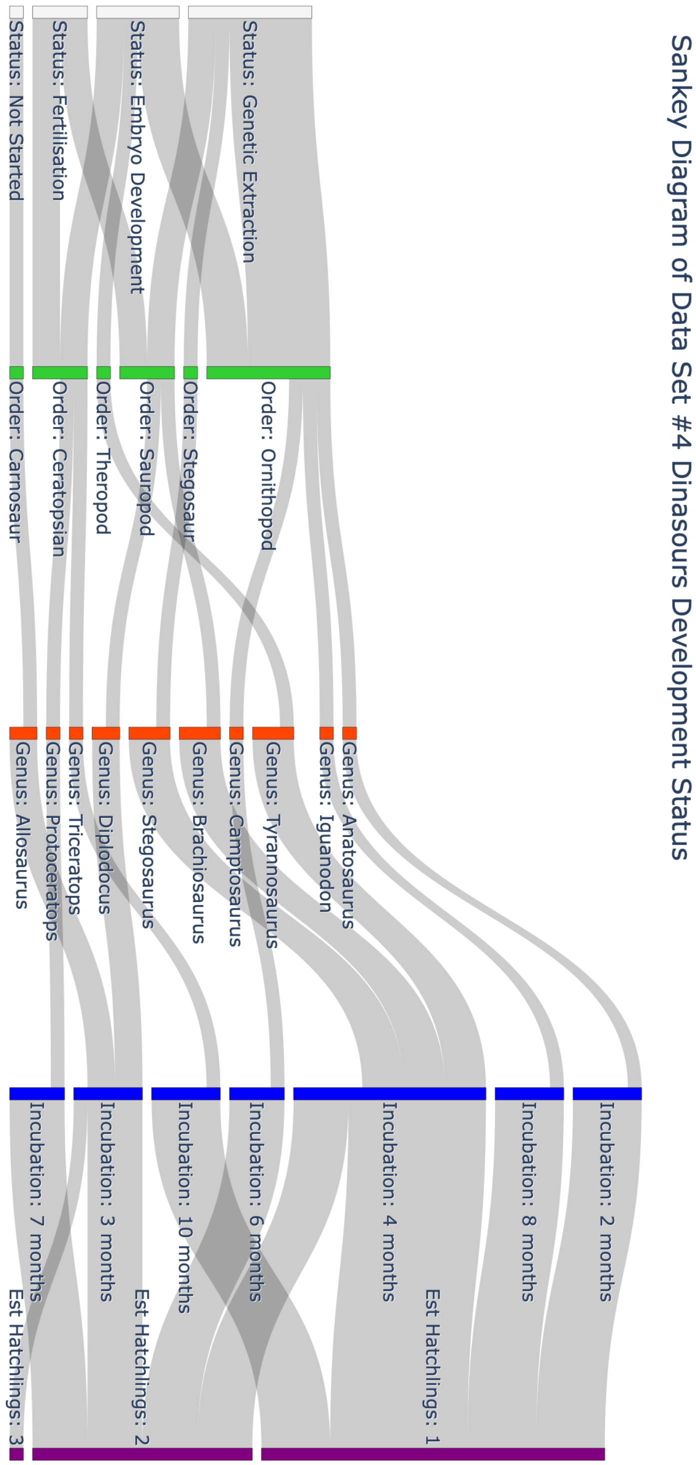

Figure 11

Sankey Diagram - Dinosaurs Development Status

As another approach to inform you of the current development status phases across all of our genera and orders, we created the pie chart below following the cited reference “Pie Charts in Python,” n.d.

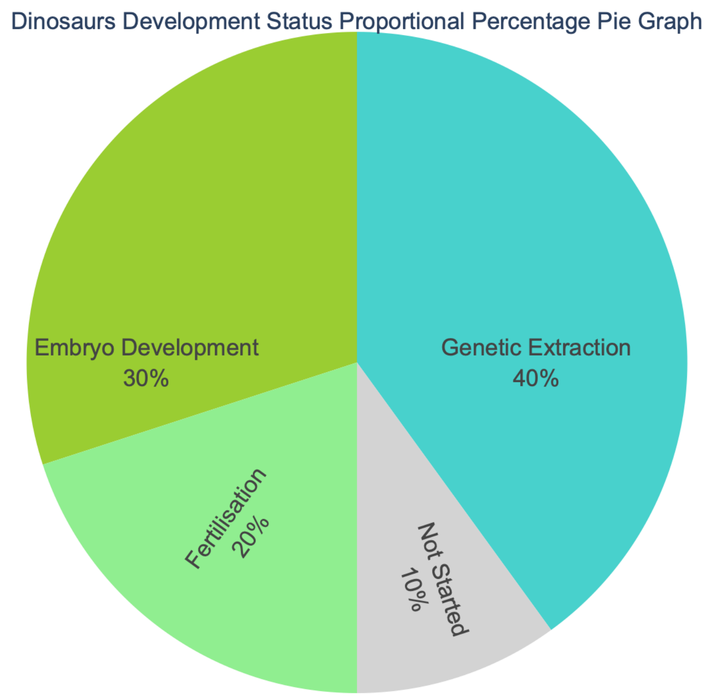

Figure 12

Pie Graph - Dinosaurs Development Status Proportional Percentage

Once again, the goal here to reach "Embryo Development" across all genera and so far we have reached the 30% of our goals. The targeted milestone for 2023 is to reach 40% or higher in "Embryo Development" and 30% or higher in "Fertilisation". We hope to have no genera showing "Not Started" status and keep everything, at minimum at, "Genetic Extraction" level.

Conclusion

As mentioned at the beginning in this report, we intended to demonstrate some of our latest enhancements at Biosyn Genetics. We began with analyzing some intelligence assessments (Brain to Body ratio) used for Dinosaurs and discussed how the human-dinosaurs coexistence with some of the smarter species may occur and be beneficial. We then dived into the important topic of investment in different orders and genera of dinosaurs. Using the projected investment shortcomings and considering the public interest, we derived the ROI and showed various investment options where our investors can enjoy the high return on their investment while our scientists can proceed with their brilliant works on different dinosaurs orders. Finally we visited our development status for different orders and highlighted how far we are to reach incubation phase for different dinosaurs genera. We analyzed the distribution of our dinosaurs in terms of their development status using pie charts and indicated the areas we need help and support with. In conclusion, we would like to thank you for our consistent support since the beginning of our establishment and we hope to continue exploring this fascinating journey with your support and presence along side of Biosyn Genetics.

List of Figures

List of Tables

References

Apa style. (n.d.). Retrieved 2020, from https://apastyle.apa.org

Cairó O. (2011). External measures of cognition. *Frontiers in human neuroscience*.

Evergreen, S. D. (2020). *Effective Data Visualization*. Sage.

Flat icon website. (n.d.). Retrieved 2010, from https://www.flaticon.com/

Herculano-Houzel, S. (2023). Theropod dinosaurs had primate-like numbers of telencephalic neurons. *The Journal of Complimentary Neurology*.

Holden, S. (1997). The lost world: Jurassic park. *New York Times*.

Homer, J., & Gorman, J. (2009). *How to build a dinosaur: The new science of reverse evolution*. Penguin.

ORTEGA, R. P. (2023). Some dinos may have been as brainy as modern primates, controversial study argues. *Science*.

Pie charts in python. (n.d.). Retrieved May 1, 2024, from https://plotly.com/python/pie-charts/

Plotly heatmap charts in python. (n.d.). Retrieved May 1, 2024, from https://plotly.com/python/heatmaps/

Plotly treemap charts in python. (n.d.). Retrieved May 1, 2024, from https://plotly.com/python/treemaps/

Sankey diagram in python. (n.d.). Retrieved May 1, 2024, from https://plotly.com/python/sankey-diagram/

Slide egg. (n.d.). Retrieved 2013, from https://www.slideegg.com/