Biocoin.Life Foundation

White Paper V0.85

11 Feb 2018

A token to facilitate the development of the global biodiversity information community

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1. Summary

This White Paper is still in the process of development.

The Biocoin.life Network Project aims to create a global token economy that can improve the rate at which biodiversity is mapped around the globe.

At the moment most of the animal and plant species on earth have yet to be discovered or their location mapped. Much of the work in identifying new species and the location of known species falls upon a small army of volunteers (citizen scientists), working with professionals from non-profit science organisations.

Recent work by organizations such as iNaturalist and QuestaGame suggests that this effort can be made much more scalable using modern technology, such as the smart phone, machine learning and gamification. For instance, QuestaGame has demonstrated successful gamification of the data acquisition process involving school children.

Nevertheless, a missing element in the process is a means for those who need the data rewarding those who gather it. The Biocoin.life Network Project aims to put in place a means of closing this gap that can involve the community from around the world.

2. The problem - a lack of incentives to catalogue and map biodiversity

Life on Earth is facing it's greatest threats in 66 million years, when an asteroid wiped out the dinosaurs. Humanity's ability to thrive depends on the diversity of life, or biodiversity. To better manage this scenario, we need more data about what species exist and where

Apart from when there is a broader imperative, such as an environmental study related to land development, there is little incentive to map and maintain flora and fauna species in a local ecosystem.

This lack of an incentive leads to a dearth of information upon which communities, companies and governments can make rational decisions about preserving ecosystems, dealing with biosecurity issues, or even just understanding the tradeoffs that result in the context of economic development.

This is due, in part, to the underinvestment by individuals and institutions in activities for which there is no clear private gain. It's a classic externalities problem.

The collective activity of government organisations helps contribute to biodiversity data (e.g the activities of organisations such as national museums). The pro-bono activities of citizen scientists also help overcome, to some extent, the dearth of biodiversity data (e.g. citizen science apps). But these efforts are still somewhat limited compared with the magnitude of the task. In addition, the efforts of both governments and citizen scientists tend to be concentrated in easily accessible environments, such as designated wildlife habitats or parks near urban areas.

The result is that only around two million of an estimated eight million species have been identified, and their levels of abundance and movement in local ecosystems, over time, is not well known or updated.

> *"What will it take to describe a million species in 10 years? That is the rate of species discovery that's needed, and it will require **radical changes in thinking**…"*
>
> La Salle J, Williams KJ, Moritz C. (2016) Biodiversity analysis in the digital era.

3. The state of biodiversity information systems

As with any information system that is attempting to map a universe, a biodiversity information system will consist of six components, viz:

- **Means of acquiring data in the field** for sightings of flora and fauna that is geolocated (e.g traditional birdwatchers)
- **Means of accurately identifying the objects** spotted in the field (e.g the professionals employed at museums who "clean and identify" the data)
- **Creation of a repository of data** regarding each sighting which can power many applications (e.g biodiversity databases such as GBIF.org)
- **Applications that use the data** (e.g biosecurity, school education, land development, citizen education and general biodiversity policy-making)
- **Creation of an exchange mechanism or equitable marketplace** to trade value across the previous steps
- **A means of injecting capital** into the above economy

Historically, the mapping of the universe has proceeded slowly as the cost of the first three steps are high and increasing in real terms over time as the real costs of generalist and specialist labour increases, not only in developed, but also in developing economies.

For there to be a much more aggressive and successful effort to map global biodiversity, there needs to be breakthroughs in all six of these steps.

Here are some possibilities for dramatic reach and performance improvement, at each of these system components, include:

- **Expanding the citizen army to acquire data in the field** - Need to expand, at low cost, via various incentive programs, the number of citizen scientists, using modern technology such as smartphones, gamification and blockchain-based reward structures.
- **Accurately identifying objects** - Need to expand, at low cost, the ability to identify objects in a timely manner. A combination of visual intelligence and citizen experts can do the job but need to be rewarded via intrinsic or extrinsic incentives.
- **Creating decentralised (blockchain based) incorruptible repositories of quality graded data** - Decentralised databases that are highly secure and available to communities may be useful in maintaining the integrity and accessibility of data.
- **Open market API environment** - where diverse applications developers can thrive and pay for applications such as those related to biosecurity, land use planning and education.
- **Low cost efficient blockchain based exchange mechanism (or market place) to facilitate each of the four previous steps** - using smart contracts to reward people who do the work in creating events, verifying identity, maintaining ecosystem data and facilitating uses of the data.
- **Injecting capital into the above information economy** via means such as venture capital and/or an initial coin offering (ICO) related to financing an underlying blockchain infrastructure.

Individual components of the above ecosystem are being addressed. For instance:

- GBIF.org has created a global repository of data, along with data standards and visualisation techniques.
- Citizen Science apps such as iNaturalist are expanding the repository and mobilising citizen science communities.
- QuestaGame has created incentives for participants above and beyond pro-bono contributions (e.g. entertainment, info-advantages, bio-currency).
- Organisations such as iNaturalist, iSpotNature, QuestaGame's BioExpertise Engine (BEE), and others have created Identification "engines" that integrate collective intelligence - and machine learning in some cases - to identify flora and fauna to research levels.

Nevertheless, it is clear that a blockchain-based solution may be able to contribute significantly in developing the above biodiversity information community, with regard to each component. In other words, a blockchain can provide a powerful **infrastructure component.**

See **Attachment B**. for a short discussion on problems with existing citizen science economics.

4. The Proposal - Creating an Infrastructure for a Biodiversity Information Token Economy (biocoin.life)

Accordingly, it is proposed to establish an element of community infrastructure, to be called the Biodiversity Information Token economy, or biocoin.life economy.

4.1 Structure of the biocoin.life economy

The major characteristics of the Biocoin.life economy would include:

- A token economy, advised by an independent Foundation Advisory Board, with open token votes and an open community.
- A base level of tokens (or 'bioCoins') will be issued upon the payment of fiat or fungible cryptocurrency via an ICO process.
- This capital will be used to finance the development of the Biocoin.life economy.
- This development work will be undertaken by a Biocoin.life Development Team (Biocoin.life DT) (managed by QuestaGame, who will, in turn, contract to parties such as iNaturalist, Visipedia, GBIF and others who are leading in developments of the system components mentioned above).
- Each time a significant valuable "work" event takes place in the biodiversity community, which meets an agreed specification (e.g a species is identified), a token (or part thereof) will be generated and issued to the party(ies) doing the work.
- A "smart contract" will be used to track and certify the sequence of work that needs to be undertaken to complete each event.
- The holders of these tokens can then trade them.
- Users who wish to unlock data that's contained in the blockchain will purchase tokens that can then be used to buy smart contracts which come with certain data access and use rights.
- The data accessed via completion of such smart contracts will then be used by applications that allow the data to be accessed.
- Some of these applications would be paid for using tokens.

The "work" events that will lead to the issuance of new tokens will be thoroughly reviewed by the Foundation Board and might include:

- The identification and verification by an expert, standardised description of and lodgement of a data event, involving in identifying a photo of a specimen.
- As above, but involving say the initial eco-mapping of a defined area.
- Rewarding students, members of the public, or intermediaries (e.g the management of say a park) to do the work.

4.2 Creation of an event in the biocoin.life economy

The smart contract associated with the creation of a "work" event, will include workflow components such as:

- Acquiring basic photo data from citizen scientists, including associated geolocation data Identifying the detailed species description using "guesses" from the citizen scientist, machine learning, and/or the crowd
- Verifying the accuracy of this identification and the "remarkability" of the find and/or identification, using a "double blinded" review panel.
    - Note: "Remarkability" can include, among other things, rarity for location and season, difficulty of identification; rarity of the knowledge associated with the find, and so forth.
- Lodging this event record in the blockchain repository.
- Creation and distribution of the token rewards to the parties who took the event through this sequence.

Attachment A sets out some more detail as to a proposed scoring algorithm.

4.3 Accessing the data in the biocoin.life economy

The smart contract associated with accessing the stored repository of events data shall have parameters such as:

- Speed of response
- Volume of event records sought
- Specific data fields sought in each record
- Certified quality of data
- Currency of data
- Tracking the use of the data
- Availability of data for a specified period

Users would purchase tokens and pay differing amounts of token for different combinations of these parameters. For instance, a verified not-for-profit school might pay less than a for-profit corporation.

5. Technical environment - An Ethereum based decentralised application

The detailed technical plan is still under development and may change over time, given the rapid pace at which underlying blockchain infrastructure and tools are developing.

This project is an application of blockchain technology in a specific subject domain. Accordingly, the technical approach will be to try and stand on the shoulders of others who are developing the basic blockchain infrastructure and tools.

As of today, the major elements of the proposal are to:

- Build the system in the Ethereum environment, given the strong developer support, proven ability to withstand security assaults and large library of tools being built in that environment, by many other projects
- Provided there is a good prospect in 2018 that Ethereum can move from the current energy intensive “proof of work” approach to a “proof of stake” approach (that is, the so called “Casper” Project or alternative “sharding” approaches bear fruit)
- Also provided that the transaction processing speeds (and thus transaction expense) limitations of Ethereum can be overcome (e.g in the short term via sharding or in the longer term vie say the Plasma Project)
- Use another platform, such as NEO, if the problems associated with Ethereum cannot be surmounted)
- Issue an ERC20 compliant token
- Develop a side chain to enable the scalable execution at low cost of the various smart contracts involved in the project
- Use one of the high performing, low cost payments protocols such as OmiseGo
- Develop the smart contracts required by the project on this sidechain
- Use other blockchain protocols, such as “Keep”, to control the public availability of some of the information (e.g precise GPS coordinates of animal or plant sightings)
- Use a governance protocol such as “Aragon”, to govern the project

6. Token Economy - Deployment plan and management

It is proposed to create 1,000,000,000 tokens (bioCoin.life) on top of the Ethereum Network and issue them in the following manner:

- 30% to be issued prior to or at the ICO via fiat converted payment, or conversion from a fungible crypto-currency.
- 10% to be used to provide incentive to various key actors in the Biocoin.life economy
    - to be vested upon achievement of agreed milestones.
    - to be issued when and if required (e.g to Advisory Board members)
- 10% to be used to provide incentive to the Biocoin.life DT (i.e. Questagame and contracted parties) to develop the system, to be vested monthly over four years and upon achievement of agreed milestones
- The remaining 50% to be issued over time as “work is done”, which increases the GDP of the economy e.g a new species is discovered/identified and an event created, using predefined algorithms such:
    - As an “airdrop” to every child in a country, which can be activated if that child does a sighting that they then identify and have confirmed
    - As say a biosecurity agency specifies a threat and purchases cointo reward any sightings of the threat

7. Terms of token sales

The main terms of the proposed token sales are:

- Possible private “seed” round to finance the initial product development and ICO process - discount yet to be negotiated - is likely to be in the range of >20% , depending upon amount and time value of money
- 5% pre-ICO discount for others who buy tokens
- Minimum purchase value of 5 ETH for pre-ICO purchases
- Maximum purchase value of 50 ETH for pre-ICO purchases
- ICO issued tokens to be tradable and listed upon relevant exchanges
- ICO token pricing policy yet to be resolved- currently proposed to be

8. Token economy governance and project development group

8.1 Governance structure

It is proposed that the Biocoin.life community be governed via a combination of:

- The Biocoin.life DT assuming responsibility for managing the community
- The Biocoin.life DT adhering to a set of pre-agreed rules
- An Advisory Board reviewing all of the decisions of Biocoin.life development team with respect to the Biocoin.life economy in advance and issuing open, transparent guidance.
- Token holders, via 85% value of issued tokens voting, being able to overturn the decisions of the Advisory Board
- Use the Aragon smart contract framework to deliver governance smart contracts

8.2 Advisory Board

- The composition of the Advisory Board is constantly being updated. **The web site is the oracle. See: www.biocoin.life/about us**

8.3 Biocoin.life Development Team

- Mallika Robinson - Co-Founder, QuestaGame
- Andrew Robinson - Co-Founder, QuestaGame
- David Haynes - Co-Founder, QuestaGame
- TBA - Blockchain developer
- TBA - Machine learning specialist
- TBA - Full stack developer
- TBA - Token economy analyst

8.4 Main project development partner - Questagame

By way of background, QuestaGame developed and launched games that motivates players to find and identify flora and fauna. The use cases include:

- **Global point scoring bioquests** where the participants compete to find species
- **Team competitions** identifying flora and fauna in a local area, say a national park; or
- **School students** exploring their local ecosystem seeking to catalog its current state and any changes over time, as part of their science curriculum-based biology studies.

The company is gaining traction with:

- Individual participants in >100 countries around the world;
- Week-long competitions generating over 20,000 sightings
- Classroom-based use case being progressively rolled out (on a paid basis) in all Government schools in NSW and Victoria;
- A price point of A$10-40 per user identified in advanced economies; and
- Already, the games, competitions and school-based applications, have generated millions of ecosystem data points.

The bottom line is that Questagame is gradually proving that the citizen science movement can be dramatically expanded and incentivised to mobilize millions of people - particularly young people - to explore and catalog the ecosystems of local areas.

The technology underlying the system is:

- A **gaming front and back end** that uses smartphones to capture images of plants and animals and a cloud backend to administer competitions and quests, whether these be identity groups, not-for-profit organizations, or school-based groups.
- A **bio-expertize engine** that uses a combination of visual intelligence in the cloud, and backup human experts, to identify the objects, store the data and assign values such as rarity, to be used in the gaming and blockchain rewards mechanisms
- A (proposed) **blockchain based "biodata" token economy** that can provide the basis of rewarding "the work" done by the legion of citizen scientists and the associated, generally non-profit, institutions, while mobilizing investment in the ongoing development of the global biodiversity database.

8.5 Proposed major Biocoin.life token economy Partners

- iNaturalist - a California based major repository of species data, with over 7M location based observations, that is currently scaling exponentially
- Global Biodiversity Information Facility - www.gbif.org - the UN biodiversity repository
- Australian National University (ANU) - One of the top ranked research universities in the world
- CSIRO Data 61 - Australia's national government owned research organisation

9. Timeline for development of Biocoin.life token economy

- Issuing the White Paper Feb 2018
- Create communication channels Feb 2018
- Pre-ICO sales Q1, Q2, 2018
- ICO, Q2 2018
- Alpha - Assuming the DT has assessed the degree of risk accurately, Q3, 2018
- Beta - Q4, 2018

- Production Q1, 2019, in time for the Southern Hemisphere school year

10. Continuing the discussion

The Biocoin.life system aims to become the global standard in biodiversity information systems, but this won't be possible without a community. Please join our groups and have your say on the future of the Biocoin.life

Website: www.biocoin.life
Telegram - Official Announcement Channel:
Telegram - Official Discussion Group:
Reddit: TBA
Github: TBA
Wechat:TBA

Attachment A - “Work” for Coin - Event identification and verification

Definitions:

Score - a rated number that is used to gauge a sighting of an organism. The higher the score, the more the player is rewarded.

Category - a classification of a greater taxonomic group, for instance “Butterflies and Moths”, “Birds”, and “Flowering Plants”.

Currently, there are two main ways to “score” a sighting. The first is rewarding effort (time in the field, variety of species, number of areas visited). The second is rewarding significance (rarity of the species, finding new species, new locations for previously known species). Currently, QuestaGame uses the second.

The first form provides a more consistent input/output model for users, by effectively guaranteeing that they are rewarded in a regular manner for their effort outside. On the other hand, without correct regulation, it can lead to redundant data (i.e. 20 magpies from the same park in the same week). This model does not reward players for rarer finds, and instead treats rare species at an equal level as common species, which is not particularly satisfying for users. The backyard crow may be worth the same as a princess parrot from Alice Springs! On the other hand, this form does not rely on quantity data to judge currency, which prevents a wholly imbalanced system.

The second form provides a less consistent, somewhat randomized input/output model for users. Users are not guaranteed to earn much, or they may earn quite a lot, depending on what they found and how easily it can be identified. In QuestaGame, 5 submitted species can earn anywhere from around 120 gold to 5000 or more, depending on equipment and quality of identification. In some cases rare species earn very little, and in other cases common species earn a lot, as a result of collection bias. For instance, a rare lizard that has been widely surveyed may have several records in the database, despite being quite rare. A common moth may have 5 or less records, despite being common, which causes an imbalance in the currency received. This system provides a lot to those who find insects regularly (where common species can score very high), but far less to those who find mammals, birds, or reptiles (where even rare species can score very low).

These two forms both have their pros and their cons. In the first case, players may, as an example earn 100% of a typical gold value (in this example, 100 gold). In the second case, players may earn anywhere from 50% to 5000%, with little control on the resulting quantity.

The proposed scoring system uses a base category score, with an added rarity score. It is proposed that the majority of the score is biased by the base category (rewarding players for effort), with the rarity score providing an extra bonus (rewarding players for significance).

The proposed formula for scoring is (C+S)/R, where C stands for the base category score (*Table 1*), while S stands for the significance bonus, and R stands for recurrence. The significance bonus (S) is calculated by S = [V*20]*C, where V indicates the rarity score. Rarity score is determined by a prior formula, taking the number of known occurrences of that species in an area, producing a range from 0 to 10. The recurrence number (R) starts at 1, and increases every time the user submits the same species again (*Table 2*). This value is individual, and is not influenced by other player’s submissions. This value is reset to 1 at the start of every month, and serves to avoid redundant data.

A modified formula, [(C+S)/R]*L, uses location data (L) to reward players for exploring less-travelled areas of the country. L is calculated by the number of records within a 50km radius, and multiplies the total score (Table 3).

Table 1: Suggested base score value (S) for each category. Categories with lower scores are easier to observe, better studied, and with the greatest number of occurrence records. Conversely, categories with higher scores are harder to observe, poorly studied, and often have less occurrence records overall.

Category name:	Base score value (C):	Significance bonus range (S = [V*20]*C)
Birds	100	0-200
Insects	120	0-240
Arachnids	120	0-240
Crustaceans	150	0-300
Other Arthropods	150	0-300.
Other Invertebrates	200	0-400.
Fish	200	0-400.
Amphibians	150	0-300.
Reptiles	150	0-300.
Mammals	150	0-300.
Fungi	120	0-240.
Plants	100	0-200.
Other life	200	0-400.

Table 2: Demonstration of the use of R (recurrence), to discourage continuous submission of the same species within a same-month period. The value R is individual to one user.

# of Same-Species Sightings Within 1 Month	Score:	Final total (rounded):
1	(100+10)/1	110
2	(100+10)/2	55
3	(100+10)/3	37
4	(100+10)/4	28
5	(100+10)/5	22

Table 3: Calculation of location data (L), based on number of records within a 50km radius.

# of Sightings within 50km radius	Value of L
0-499	1.4
500-1,999	1.3
2,000-14,999	1.2
15,000-59,999	1.1

60,000+	1

Attachment B - Note: Forms of Citizen Science

As per the “externality” problem associated with gathering biodiversity data, the question is how might it be overcome?

Solution - Mobilising the broader community to do the work

Means of overcoming this lack of “mapping” might include:

- **Additional direct government, institutional or private company**-based expenditure upon such mapping work - i.e use of skilled hourly paid labour
- **Improvements in the efficiency of existing such wor**k, such as AI-aided automation of cataloguing processes
- **Mobilisation of labour from within the “citizen science” community** to do the work

The most realistic - Mobilise low cost citizen science labour

Of these, the most realistic is the last, albeit sometimes aided by those pursuing the former pathways.

The existing citizen science movement consists of:

1. **Traditional hobbyists**, who are mainly adult community members, who specifically attempt to find animals, mainly birds, in their native habitat and often have extensive equipment. Their rewards appear mainly to be an intrinsic contribution to their well being.
2. **Members of the public, going about other activities** such as bushwalking, who deploy the now ubiquitous smartphone cameras to take photos of interesting plants or animals. They are probably intrinsic, mainly curiosity-driven.
3. **K-12 students engaged in discovery as part of curriculum** based activities in the education system, usually as part of a short term project. They are mainly extrinsically driven as part of their education, but intrinsic rewards might also be useful.
4. **Children and adults engaging in competitions**, using their smartphones, to identify flora and fauna, for rewards.

There is likely to be a real constraint upon the level of activity that can be engendered via 1. above. The best that can be hoped is to integrate such activity into a system with a broader base and reward, at a higher level, any outsized contribution this community can make.

The real breakthroughs are going to come from Groups 2. - 4., around the globe.

Companies such as Questagame have been testing ways of industrialising and gamifying 2.- 4., to allow each to work at scale and around the globe. The early results are very encouraging.

Nevertheless, the basic economics of generating local ecosystems data need improving. There needs to be more rewards for those who produce the data to encourage more to do it and to encourage those currently involved to remain involved.