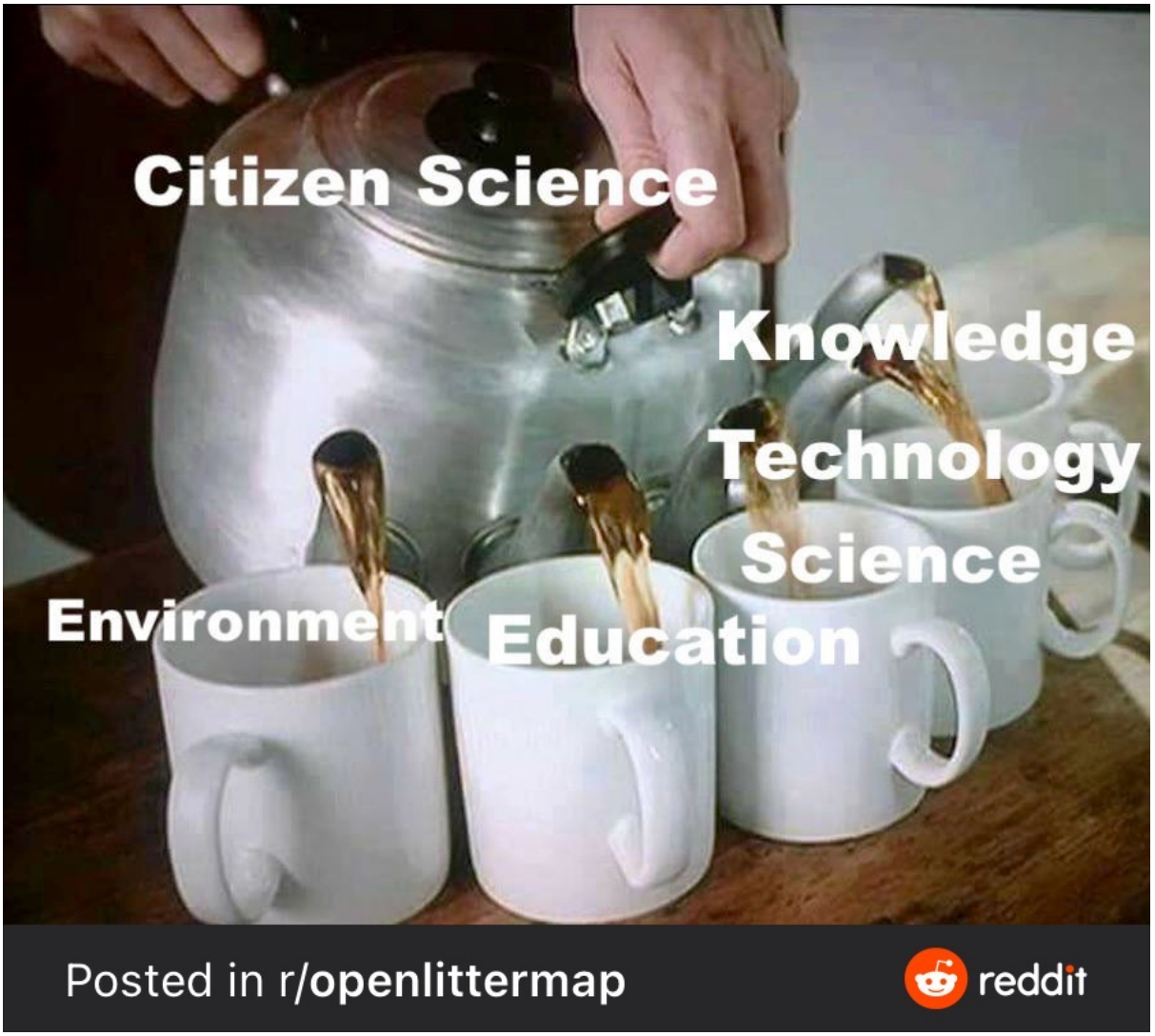
Citizen Science: A Scientific Renaissance

An open discussion about the challenges & opportunities of big data collection, citizen engagement, and environmental monitoring.



By Seán Lynch
Founder of OpenLitterMap, Littercoin & more
M.Sc. GIS & Remote Sensing UCC 2013-2014
M.Sc. Coastal & Marine Environments NUIG 2014-15
B.A. Geography & Economics UCC 2008-2011
linkedin.com/in/seanlynchgis
openlittermap.com
druglitter.info
info@openlittermap.com

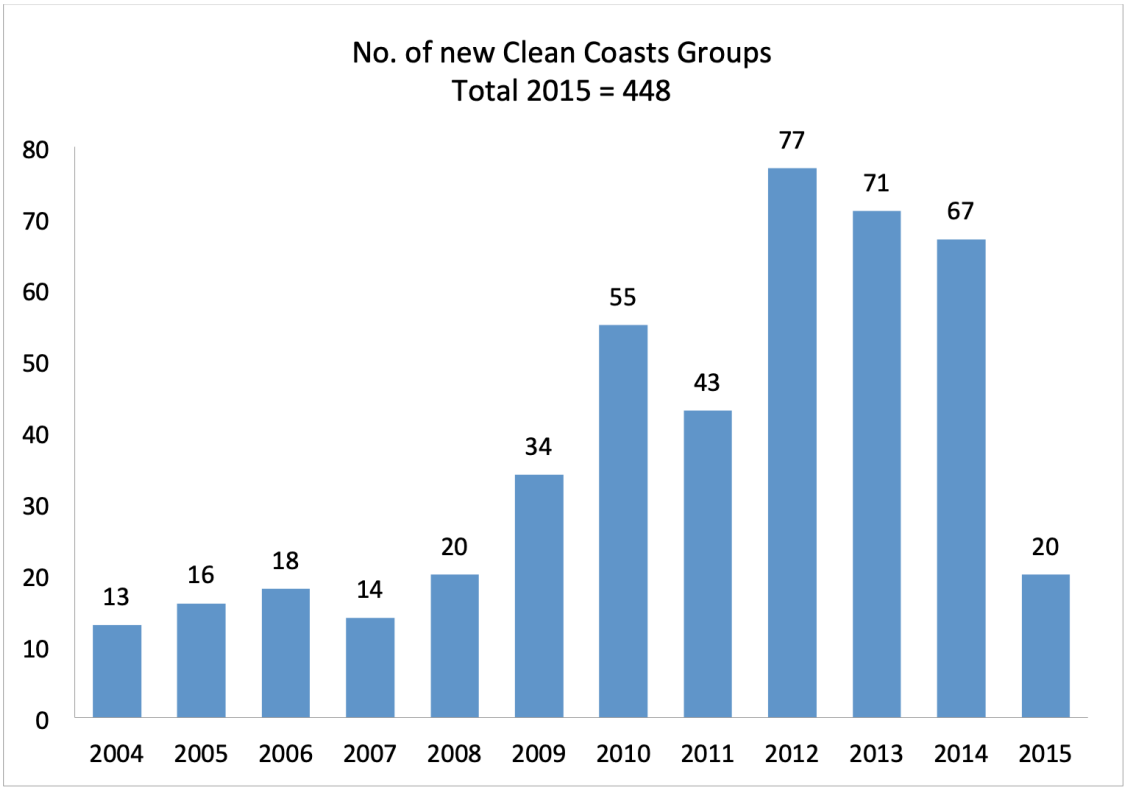
Dear Ms. Long,

As clerk to the Oireachtas Committee on Education, Research, Innovation and Science, I am writing to you to spark a discussion about the unprecedented and largely unexplored potential of citizen science.

Citizen science is the anti-covid, covid-friendly, environmentally engaging, fun, rewarding, progressive, disruptive, sustainable, largely outdoor, highly educational STEAM panacea that can bring society together to fix the environment, create economic opportunities, and save huge amounts of time and money. However, despite being the solution that society needs and deserves, science, innovation, and competitiveness is being stifled by a lack of understanding and opportunity. I would like to change this by inviting your committee members together, along with other stakeholders in citizen science, to present my work and open a discussion about the challenges and opportunities we face. There is a huge opportunity to pioneer a variety of citizen science initiatives in Ireland as, for example, we enjoy some of the most incredible coastal zones in the world. However, despite having huge potential for sustainable tourism and environmental capacity, Ireland is neglecting the development of citizen science tools and platforms which are essential to achieve innovation in public engagement and science. If we want to explore the benefits of citizen science and create new opportunities, we need to foster a more understanding and informed dialogue that can lead to sustainable economic development and a more progressive and applied educational paradigm.

Traditionally, collecting data and producing knowledge about the world, particularly that of a geospatial nature, has been mostly an exclusive top-down process facilitated by a small number of institutions who held a near monopoly on science and the production of knowledge. As only a small number of people could participate, spatiotemporal constraints imposed considerably narrow limitations on the scientific paradigm which was carefully constructed around sampling. This institutionalisation of science has failed to protect the environment and is ripe for disruption. Recently, 100s of millions of people around the world have been equipped with incredibly powerful data collection devices which can collect precise location (GPS) and a variety of other types of data (e.g. photo, LIDAR, attribute, and more). This evolution in our data collection capacity is changing our conceptualisation of scientific limitation and where we can situate our knowledge. However, despite environmental collapse, our ability at harnessing and understanding the scale of this unprecedented human potential remains largely unexplored due to no other reason than a lack of interest.

Despite extremely limited resources, Ireland is a global citizen science hotspot. Coastwatch, started by Karin Dubsky in the 1970s, is an outstanding contemporary global pioneer developed in Trinity College who produce annual crowdsourced surveys of the Irish coastline. Starting with coastal biodiversity monitoring, Coastwatch volunteers have established one of the most impressive national coastal biodiversity monitoring initiatives in the world. Since at least 1991, well ahead of many global peers, a small but highly dedicated army of nationwide Coastwatch volunteers have been actively monitoring the location and distribution of plastic bottles and microplastics across Irish beaches and coastlines. This collaborative and coordinated data collection activity has been complemented by increased clean up efforts (Fig. 1) who are needed to go to great lengths to pick up a tiny fraction of our unlimited plastic waste. More recently, the National Biodiversity Data Center in Waterford has developed a comprehensive catalogue of Ireland's species which people are voluntarily contributing data to. The EPA and other groups like Birdwatch Ireland, Cork Nature Network, Kilkenny Nore Vision and many more have also facilitated citizen science events, initiatives and workshops but we have yet to achieve any significant capacity as the data collection tools and strategies remain remarkably underdeveloped. Internationally, citizen science has not achieved anywhere near its full potential either. This is largely because funding and direction has been overly focused on a narrow institutional dialogue who are not experts in developing interactive and immersive systems like snapchat and online games which have all come from the private sector. Unfortunately, despite potentially irreversible environmental destruction, zero creativity is being made with grants, PhDs, or research assistants to experiment and innovate with citizen science tools and business models. Many other countries have been actively investing in various citizen science initiatives for years because of the significant positive implications it has for society and the environment. But here in Ireland, we have fallen significantly behind, despite starting long ago.



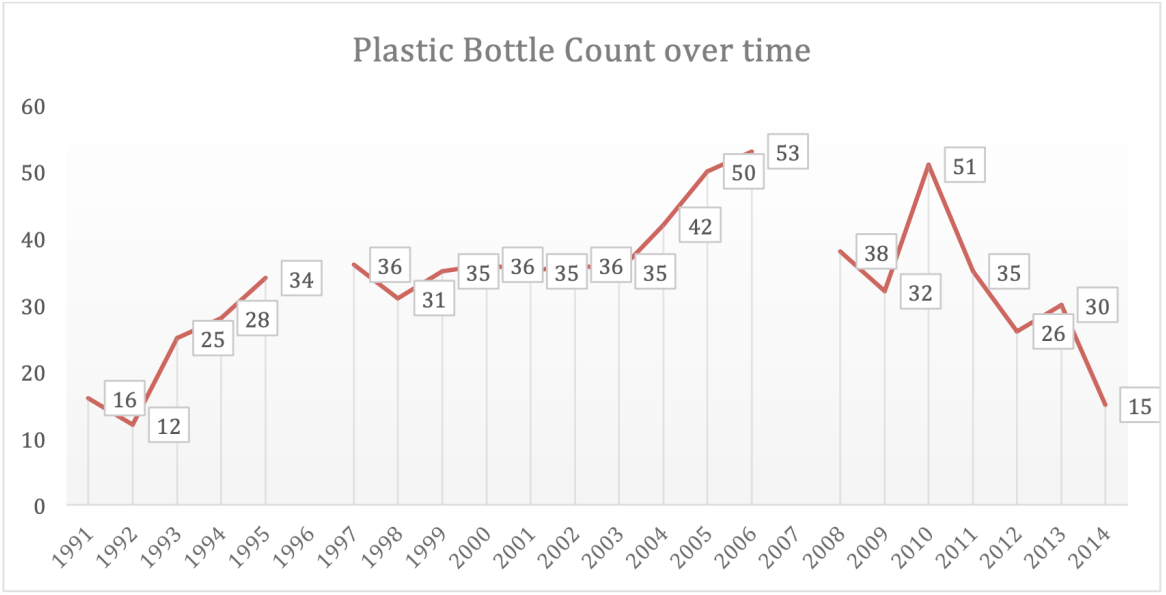


Figure 1: Time-series of Coastwatch plastic bottle counts and the formation of new Clean Coasts groups. By 2004, increasing plastic on coastlines saw a continued increase in the need for new cleanup groups which are helping but should not be needed. From OpenLitterMap Dissertation in NUIG 2014-2015.

I have been independently researching and developing citizen science in Ireland since 2008. My journey began after being introduced to GIS while studying geography in UCC. Working independently is my only option, as Ireland does not have any opportunity for someone with interests, skills and ideas like mine to work on existing programmes or explore new business models. There are no PhDs in citizen science, no grants to apply for, and nothing being done with SBIR or any other government instrument including the climate action toolkit. Despite environmental collapse and the huge cost that environmental problems have on the taxpayer, public understanding of citizen science is low and few people see the value in using or supporting the development of critical environmental technology[1]. However, following my 12+ year effort, my apps are starting to meet societies' high technological expectations and we are beginning to grow a community and pilot with a range of institutional partners (HSE, Heritage Council, and UCD among others) and other stakeholders (schools, community groups and corporate partners). Although I am interested in a variety of citizen science domains, the most important and obvious to me is litter, which globally, is entering the oceans at a rate of about 900 tonnes every hour (Jambeck, 2015; Fig. 2). Anecdotally, here in Ireland, it's impossible for me to take a simple walk around Cork City & suburbs without some form of litter plaguing almost every step (Fig. 3). Due to its ubiquity, notoriety and abundance, collecting data on litter has a remarkably low barrier to entry. Therefore, this data collection exercise can bring many people into public engagement for the first time making litter mapping an important catalyst for the development of citizen science more generally. This can strengthen our data collection, innovation, and problem solving capacity across other domains too (eg. Earth Observation, biodiversity, and chemical monitoring) which collectively, will give us increased climate resilience. Inspired by various crowdsourcing initiatives such as Wikipedia and OpenStreetMap, I decided to apply the same global open source values to monitoring litter and plastic pollution which resulted in the development of OpenLitterMap.com. I am also developing several other tools, including DrugLitter.info, a closed system which in collaboration with the HSE and Cork Local Drug Task Force, has recorded 5+ years of continuous data on drug-related paraphernalia in Cork (one of the most comprehensive datasets on public injecting in the world) and a record 66 discarded syringes on the streets of Dublin in about 4 hours, and more. More recently I have begun developing EngageKilkenny.com for the Heritage Council to highlight and teach people about the features of historic buildings, and I have plans for many more platforms including dereliction mapping and more as there is a huge global opportunity for citizen science, data collection and citizen engagement.

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[1] https://gofundme.com/openlittermap stuck at 2% since launching in October 2020. Our kickstarter in 2017 achieved 0.00%. More than 70 of our funding proposals to build critically important environmental technology have been rejected in a row.

Figure 2: Plastic Waste Inputs From Land Into The Ocean. Source:

https://jambeck.engr.uga.edu/landplasticinput

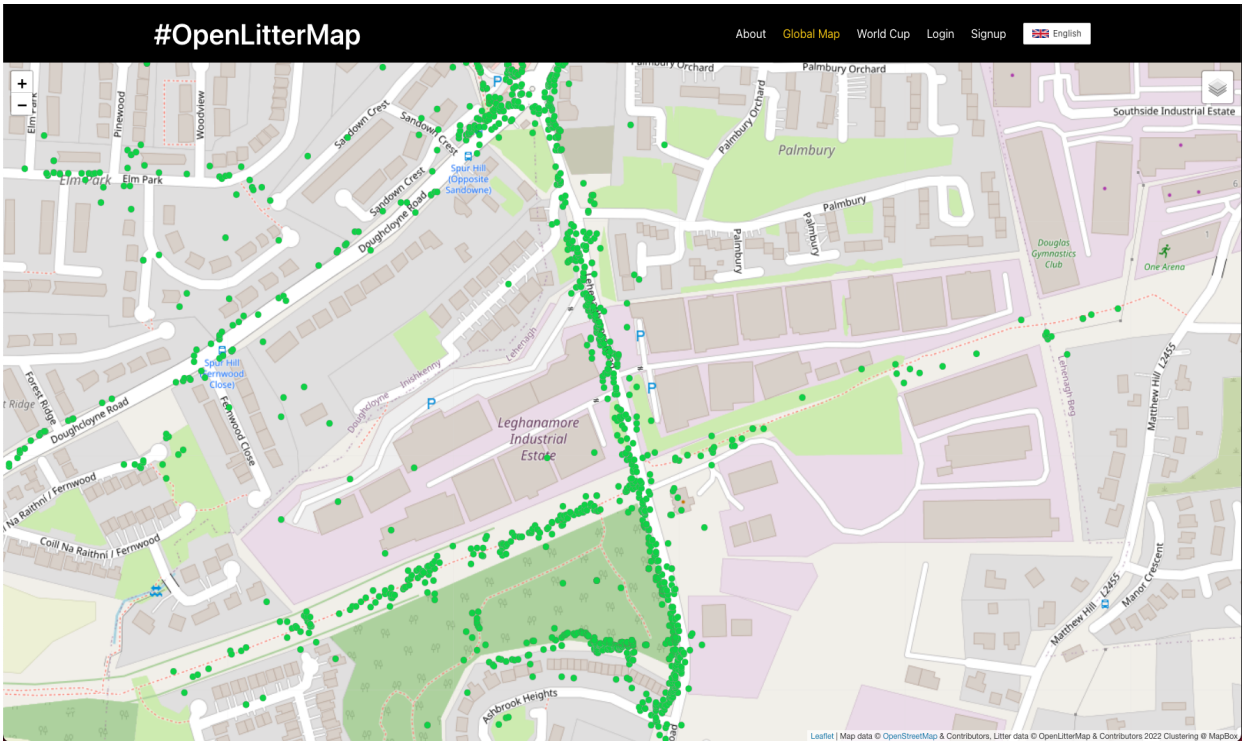

Figure 3: The daily observation that inspired the development of OpenLitterMap.

https://openlittermap.com/global?lat=51.87009424831793&lon=-8.495868153780522&zoom=17.34

I would like to use this opportunity to present my work to the committee. OpenLitterMap (Lynch, 2018) is a global, open source, litter and data collection monitoring platform being developed in Cork which covers 16/17 SDGs (Lynch, 2021). We are turning cleaning the planet into a game by making it fun and easy to collect data on litter. This data is used to create powerful visualisations that will educate society out of littering by communicating the problem through people's devices in a way that everyone can understand. It doesn't matter what language you speak or if you have reading difficulties. Our maps tell a powerful story that anyone can interact with. Several TidyTowns groups and thousands of others around the world have used the OpenLitterMap app to record their positive environmental impact, share data, and communicate their results. Last year, Engine Lease Finance, an aircraft engine leasing company with HQ in Shannon, became our first corporate sponsor by giving their global workforce a half day from work to pick up litter with their families and demonstrate their positive community and workplace commitment. We have also engaged schools, youth groups, universities, and community groups around the world and we have ambitious plans for the future. Recently, we have partnered with Plastic Raiders (UCD) who want to do research with our app in Ireland, and more recently we have partnered with Sky Ireland, who want to use our app for team building and CSR purposes and become number 1 in our competitive team leaderboards. However, as our platform and the practice more generally remains incredibly underdeveloped, we are at risk of losing this opportunity to overseas competitors unless something is done now.

I have spent the last 12+ years working on the R+D, attending conferences, and doing 2 masters to develop the methodologies in UCC and NUIG. After teaching myself how to code, I continued to develop the apps while working as a software developer for the last few years. More recently, after just 74 rejections, I received my first funding but not from any traditional source. Although central banks print an unlimited amount of fiat currency, they have not printed any money to support the development of citizen science startups in Ireland or Europe. In contrast, decentralised blockchain and cryptocurrency platforms have created trustless, open source, and programmable monetary networks that are disrupting traditional monetary, ownership, and voting systems. For example, Project Catalyst, the decentralised VC instrument of Cardano, accumulates their native ada token in a smart contract by putting a small tax on transactions. Every 10 weeks, the global community of ada holders vote on a range of proposals that can add value to the network. I received my first $50,000 worth of crypto-tokens this way to develop Littercoin, one of Ireland's first digital assets (2015). The next round of funding is about $12 million dollars worth of crypto that anyone can apply for and vote on how to distribute. Littercoin is not only the first token rewarded for producing geographic information (i.e. doing citizen science), but it is being engineered so that it can

only be spent in zero waste stores and the climate economy. This is purposefully done in contrast to traditional fiat currencies which have been disproportionately invested into destructive climate and environmental firms. For example, banks, the custodians of government money, have given more than $1.7 trillion dollars to firms who cause plastic pollution[2].

Although plastic has remarkable properties, it is simply devastating and toxic for people and the environment. About 300 million tonnes of new plastic is produced every year, which has been quipped “The new coal” as the generation of new plastic consumes about 4% of the world's oil supply, making it one of the most profound drivers of climate change[3]. Plastic is now found in the human system, tapwater, the sea breeze, rainfall, and even in unborn babies[4]. It has been estimated there is now about 150 million tonnes of plastic rotting in the oceans[5], which will continue to break up into smaller and smaller micro and nanoplastics indefinitely. Not only is the amount of plastic entering the oceans expected to continue to increase exponentially, but these fragmenting particles are only starting to break up, and are already cascading throughout ecosystems and trophic levels, poisoning the food chain and depleting ocean resilience such as carbon sequestration and oxygen generation which are contributing to the collapse of ocean circulation and runaway climate breakdown. The seriousness, urgency and scale of this cannot be put into words and many scientists like me believe that plastic pollution is more urgent and more unappreciated than climate change. As much of the ocean plastic has yet to even begin to break up into trillions upon trillions of more particles, we have yet to witness the full scale of what our generation is continuing to gift our children and many generations of the future. Although plastic has done considerable and irreparable damage to the oceans, the conversation about plastic pollution has been overly focused on the sinks where plastic ends up. Much less is known about how the pre-marine terrestrial origins of plastic are finding its way from land to sea which is where our direction needs to shift.

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2 https://www.bloomberg.com/news/articles/2021-01-07/banks-directed-1-7-trillion-to-firms-causing-plastic-pollution

3 https://static1.squarespace.com/static/5eda91260bbb7e7a4bf528d8/t/616ef29221985319611a64e0/1634661022294/REPORT_The_New-Coal_Plastics_and_Climate-Change_10-21-2021.pdf

4 https://www.theguardian.com/environment/2020/dec/22/microplastics-revealed-in-placentas-unborn-babies

5 https://www.nationalgeographic.com/science/article/plastic-trash-in-seas-will-nearly-triple-by-2040-if-nothing-done

Citizen science is a positively disruptive technological paradigm shift that will empower society with the ability to create new forms of data at scales previously unimaginable. Having a more informed understanding of this can help foster the development of a cluster that can create positive social and economic value for society. However, just as the public sector did not create social media or any contemporary application, clearly, the public sector is not going to develop citizen science either. Therefore, before citizen science can be adopted by the public sector, it needs private sector innovation and creativity. Following the development of the tools that are needed to facilitate citizen science, additional funding is needed for collaboration and improved networking opportunities to bring community facilitators, local stakeholders and national organisations together to experiment. I have made several attempts at raising money in Ireland to build the basic tools that are necessary to facilitate citizen science. After doing the research, building and then launching OpenLitterMap in 2017 I applied to Science Foundation Ireland for help, who told me they wouldn't even review my proposal. More recently in 2021 I applied to the EPA Green Enterprise call who failed to see the value in my LITTERCOIN proposal (Location Intelligence To Transform Environmental Reporting by Creating an Economic Incentive) which will help unlock societies data collection capacity by creating an incentive that will bring our knowledgeable users into zero waste stores to increase activity in the climate economy. As the urgency for and understanding of citizen science potential is low, we need to spark a conversation about the potential of citizen science and find a way to create funding opportunities that will support the development, training, and implementation of these emerging technologies across the public and private sectors. This data has important implications for society, including how we draft, measure and evaluate policy, enforce producer responsibility, inform public decision-making and guide an objective public dialogue. There is important synergy and cross-pollination between other departments too, including Housing, Local Government and Heritage; Environment and Climate Action; Finance, Public Expenditure and Reform; Health; EU Affairs; Enterprise, Trade and Development; Agriculture, Food and the Marine; and others, who we invite to participate in the discussion.

To develop increased citizen science capacity and environmental resilience, we are developing a range of public engagement tools and initiatives that will grow and test our data collection potential. In 2022, in partnership with Plastic Raiders from UCD, we are launching The LitterWeek™ Challenge to involve schools and wider society in a data collection competition. The data collection will be complemented by a week-long series of lesson plans that different classes can adopt to teach students about the scale of plastic pollution, open science values, advances in geographic information science, optional coding lessons, and how citizen science can help mitigate the epidemic that we have gifted them. Instead of one

single week in the year where everyone must participate, groups will take the LitterWeek™ challenge any week that suits them. At the end of the school year, the challenge will finish with an awards ceremony with prizes live on Instagram. We are in conversation with several corporate partners who can provide prizes, such as in person and virtual school tours and technological equipment to the most active schools. We believe this mix of our data collection experience combined with the incentives we are working on will result in the biggest national citizen science campaign the world has ever seen, and will generate the most comprehensive baseline dataset of litter in any country. Unfortunately, due to the lack of interest, citizen science is unlikely to achieve its full potential anytime soon but by sparking a conversation about this now, we can begin to improve our understanding of it to develop a productive and valuable ecosystem that we can be proud of.

A range of public sector institutions can benefit from citizen science as they will gain new tools to collaborate with the public and gain new data to explore. Schools can benefit from engaging and interactive educational material. Internship opportunities could give graduates an opportunity to use their knowledge of these emerging datasets to create valuable new positions for themselves in the public sector- for example, Smart Sandyford are currently hiring a candidate with knowledge and interest in citizen science. Citizen science can be made available as Gaeilge, or in any language, to make learning a language even more fun and accessible. We can use this as a marketing tool to bring ecotourists here to study and work with Coastwatch and other emerging startups who can facilitate tours, training and conservation courses in our rich native kelp forests. Citizen science can even become the most important tool that The Shared Island initiative can use to bring conflicting communities together in Northern Ireland as the problems we are solving are global and shared by all people. One of the main advantages of citizen science is that it's incredibly accessible to everyone. You need to be good at a lot of things to join your school sports team but anyone with the interest can join their schools data collection team and be a part of a community.

Clearly, there is a lot of work to do and the best place to start is with a conversation. Therefore, I would like to invite your committee members and other stakeholders together to briefly introduce my work and open a conversation around the following 10 recommendations:

Recommendations:

1. Funding is urgently needed to support the development of citizen science tools. SBIR looks like a good candidate but other options should be explored by the committee.

2. The development of a national citizen science working group is needed to facilitate a continuous dialogue across the public sector that can continue to understand and support the development of citizen science.

3. Citizen science needs to be included in the climate action toolkit as a core activity that every business and citizen can be a part of.

4. Citizen science in Ireland needs political leadership[6].

5. We need private and public sector support of the LitterWeek campaign to help integrate into schools, universities and wider society to achieve collective national climate action.

6. Citizen science should become a cornerstone of the North-South Shared Island strategy[7] to actively increase peace building and a shared sense of global community. This could provide the funding that citizen science needs and become a significant output of the initiative and become a global example of building peace through science.

7. Litter monitoring should be integrated as another step within the CTCHC (Collaborative Town Centre Health Check).

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[6] We would like to pay a special thanks to Máire Devine, Sinn Féin, who is the only politician in Ireland that has supported our crowdfunding efforts. Máire has been sending a monthly donation to OpenLitterMap every month for over 3 years to support our work building citizen science. We would also like to thank Cllr. Mick Nugent and T.D. Thomas Gould, also Sinn Féin, for contacting us and encouraging us to submit a proposal to the Oireachtas. Another thanks is owed to Grace o Sullivan and Ciarán Cuffe, Green Party MEPs for Ireland, who shared our GoFundMe on social media and helped us with an introduction to Dublin City Council. Grma!

[7] https://www.gov.ie/en/campaigns/c3417-shared-island/?referrer=http://www.gov.ie/en/publication/de9fc-shared-island/

8. Expand on our litter app and our data collection process to map dereliction and a range of historical features about buildings, or anything else. Our open source code encourages experimentation and innovation.

9. One or more PhD positions need to be created to produce experts and more knowledge about citizen science and the state of global / national pollution.

10. Several pilots are needed with local authorities to test the capacity and evaluate the implications of citizen science data and community engagement. Each local authority has existing budgets for litter, which could be partly redirected to citizen science to reduce the overall burden of the expense that litter and pollution has on annual budgets.

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