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Co-designing a data platform to impact nature policy and management: experiences from the Dutch Caribbean

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ABSTRACT

To secure the sustainable use of nature, governments track nature's health and develop regulations and policies. Although there is a seeming abundance in observation-recordings, decision- and policy-makers are constrained by the lack of data and indicators, mostly as a result of barriers preventing existing data from being found, accessed, made suitable for (automated) processing and reused, but also due to missing visualisations targeted at answering questions asked by policy makers. This paper explores the process and principles for developing a biodiversity web-platform that informs policy and management on the state and trends of nature, based on experiences with the Dutch Caribbean Biodiversity Database (DCBD). The DCBD supports the assessment of the state of nature and guarantees long-term data availability in an environment that experiences a high turnover in project funds and personnel. Three principles made DCBD's uptake and growth possible: The platform is funded, promoted and used by national and regional policy makers, it simplifies tasks of local management and rapporteurs, and it is continuously being adapted to changing needs and insights. Stronger dissemination of DCBD's narratives in social arenas (e.g. newspapers, social media) may make Caribbean nature and biodiversity more politically and societally relevant.

1. INTRODUCTION

There is an increasing awareness that biological diversity is a global asset of great value for current and future generations. At the same time biodiversity is under pressure by expanding human activities. To secure the sustainable use of nature, governments develop regulations and policies, and monitor nature to track the state and trends of its health. The state and trends also provide the evidence base to evaluate the effectiveness of those policies (Miedziński, 2018), to discover environmental implications of the use of nature (Linton and Warner, 2003; Dahl, 1981), and to counter negative effects by developing effective strategies and action plans (Asongu et al., 2018, Addison et al., 2015; Mascia et al., 2014). Tracking the state and trends of nature is therefore also acknowledged in global monitoring and reporting policies, such as the Sustainable Development Goals (SDGs) and the Aichi Targets of the Convention on Biological Diversity (CBD)[2] .

The clearing-house mechanism of the CBD promotes the use of web-platforms[3] to inform and enable the transparent sharing of information with governments and all other stakeholders, including private and voluntary sectors, science and the public at large (UNEP, 1995; Blurton, 2002; Chemutai, 2009). A great number of biodiversity web-platforms exist, including community interfacing platforms aspiring to bring the science and policy-making communities closer together (e.g. Kovács and Pataki, 2016), syntheses of scientific knowledge (e.g. Pérez-Soba et al., 2018), research infrastructures for open-data (e.g. GBIF[4] ; OBIS[5] ; Beck et al., 2014), GIS-data repositories (e.g. Siles et al., 2018) and citizen-science data collections (e.g. Sullivan et al., 2014).

Biodiversity information is based on data that is gathered by a

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[1] Current position: Nature2, Kralendijk, Bonaire, Caribbean Netherlands.
[2] https://www.cbd.int/sp/targets/, retrieved at August 26, 2018
[3] https://www.cbd.int/chm/network/, retrieved at August 26, 2018
[4] https://www.gbif.org/, retrieved at September 13, 2018
[5] https://obis.org/, retrieved at January 21, 2019

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variety of people. Professionals and nature enthusiasts observe and record nature, either by the use of protocols in field studies, remote sensing and monitoring schemes, or via opportunistic sightings (Proença et al., 2017). Despite this seeming abundance in data availability, decision- and policy-makers are constrained by the lack of targeted data and indicators (Geijzendorffer et al., 2016), mostly as a result of barriers preventing existing data from being found, accessed, fit for (automated) processing and reusable (Wetzel et al., 2015, Wilkinson et al., 2016). Existing data cannot be found when it (or the data's meta-data) is not uploaded to a well-known public data-platform. Existing data are also often not accessible, e.g. because of legal restrictions, or sharing reluctance due to scientific publication possibilities. Finally, processing may be time-consuming or impossible if data descriptions (i.e. meta-data) necessary for data interpretation are missing, or if the data are captured in a handwritten scanned document. Stronger collaborations between policy makers and observers are needed to ensure that observation efforts generate data that can be found, accessed and made suitable for processing and presented in such a way that it answers questions asked by policy makers (Addison, 2015).

In order to develop a sustainable data platform it needs to be embraced by its users, both the data providers and data consumers. Many development methods exist (Curcio et al., 2019; Iden and Bygstad, 2018; Huijgens et al., 2017; Verweij et al., 2010) of which two stand out for their iterative, human-centred and action-oriented characteristics: User-Centred Design (Abras et al., 2004), and Participatory Design (Sanders, 2013) or Co-Design (Blomkamp, 2018). In User-Centred Design, end users influence how ICT experts and designers develop a system, whereas in co-design, users collaborate in exploring, developing and testing solutions to shared challenges. Co-design is a form of co-creation in which the initiative lies with a public organisation (Voorberg et al., 2015; Ramaswamy and Ozcan, 2018) and is considered to be useful for solving complex issues and realizing changes. How can the co-design process and principles be used to develop a sustainable data-platform that answers policy questions and impacts local nature policy and management? In this paper we describe our experiences with the development of the web-platform for Dutch Caribbean nature and biodiversity.

2. A PLATFORM FOR NATURE IN THE DUTCH CARIBBEAN

Caribbean terrestrial and marine ecosystems are facing major threats and are undergoing considerable change due to over-exploitation, fragmentation, pollution, invasive species and climate change (Linton and Warner, 2003; Jackson et al., 2012; Debrot et al., 2018). The Dutch Caribbean economy depends heavily on incoming tourists and tourism in turn depends mostly on the natural capital of the islands, which underpins the importance of a healthy natural environment (ministry of Economic Affairs, 2013). For example, for the island of Bonaire – one of the Dutch Caribbean islands - the direct tourism expenditure is estimated at around 160 million US dollars, while 415 million US dollars was the Gross Domestic Product in 2015 (Statistics Netherlands, 2017).

The Kingdom of the Netherlands has ratified international and regional biodiversity treaties and conventions and made national legislation for the protection of nature and biodiversity in the Dutch Caribbean. These bring about reporting obligations that ask for monitoring and assessment of nature and biodiversity and in case of decline, taking counteractive policy and management measures and tracking its effectiveness. International and regional conventions are: the Convention on Biological Diversity (CBD), the Cartagena Convention including the SPAW-protocol (Specially Protected Areas and Wildlife in the wider Caribbean region), Convention on the Conservation of Migratory Species of wild animals (CMS), Memorandum of Understanding on sharks, Inter-American Convention for the protection and conservation of sea-turtles (IAC), International Plant Protection Convention (FAO IPPC) and Convention on wetlands (RAMSAR). A European initiative is target 6 '*step-up action to tackle the global biodiversity crises*' of the European Biodiversity strategy (European Commission, 2011). National strategies and action plans include the Nature Policy Plan for the Caribbean Netherlands 2013-2017 (Ministry of Economic affairs, 2013). The CBD and the national Nature Policy Plan require the implementation of a national biodiversity web-platform ('clearinghouse mechanism' [6]) to provide effective information services to facilitate the implementation of the national biodiversity strategies and action.

The Dutch ministry of Agriculture, Nature and Food Quality has initiated and funded the development of the Dutch Caribbean Biodiversity Database (DCBD) as a nature and biodiversity web-platform for the Dutch Caribbean since 2010. The DCBD is publicly available at: www.dcbd.nl (see Fig. 1). It is a central knowledge store for policy making to assist nature management and spatial planning and for science to exchange research information. It guarantees long-term data availability in an environment that experiences a high turnover in project funds and personnel. The DCBD allows the user to assess the status of ecosystems, species and threats and pressures, to explore spatial data on biophysical, socio-economic, ecological and topographical properties, to navigate a listing of biodiversity and ecosystem-based information portals and to search in a library for reports, journal articles, documents and raw data.

3. CO-DESIGN OF THE DUTCH CARIBBEAN BIODIVERSITY DATABASE

3.1. Development process

In 2011, the development of the DCBD started with a one-day scoping workshop with representatives of about 20 local nature NGO's (park managers and conservationists) and island governments from six islands, scientists and representatives of the Dutch ministry of Economic Affairs, at Bonaire. The 25 invitees were selected by the ministry and the Dutch Caribbean Nature Alliance (DCNA), a regional network of protected areas and conservation organisations spanning the Dutch Caribbean islands of Aruba, Bonaire, Curaçao, Saba, St. Eustatius and St. Maarten. Prior to the workshop, we studied existing nature observation web-portals for inspiration, including seaturtle.org, Dutch Caribbean Biodiversity Explorer[7], eBird.org, Reef.org, SynBioSys[8], observado.org and FloraVanNederland.nl. We also collected in-house available GIS data (soil, geomorphology and vegetation), an excerpt of the sea turtle monitoring data and set up a draft species taxonomy. Based on this we developed a prototype for the DCBD to elicit targeted feedback. This prototype included the aspects that we presumed to be elementary: i) maps, ii) encyclopaedic functionality, iii) observation functionalities (data entry and summary charts) and iv) document sharing (uploading and downloading reports and scientific articles). During the workshop we presented the prototype and asked individual participants for feedback on these four specific aspects. Next, we inventoried additional desired functionalities of the participants and set priorities.

To ensure that the web-platform remains updated in content and connected to user demand, the development process is viewed as ongoing and is organized in iterations that allow the web-platform and the process to adjust to new scientific or managerial insights, reporting obligations, or changing user groups (Sébastien et al., 2014). To maintain the web-platform, the ministry grants a budget to the DCBD development on a yearly basis. To guarantee continuity an informal advisory board provides strategic advice. The advisory board is made up of the donor and the DCNA (Fig. 2). The Dutch national government

[6] https://www.cbd.int/chm/, retrieved at October 10, 2018
[7] http://biodivexplorer.dcbd.nl/explorer/home
[8] https://www.synbiosys.alterra.nl/

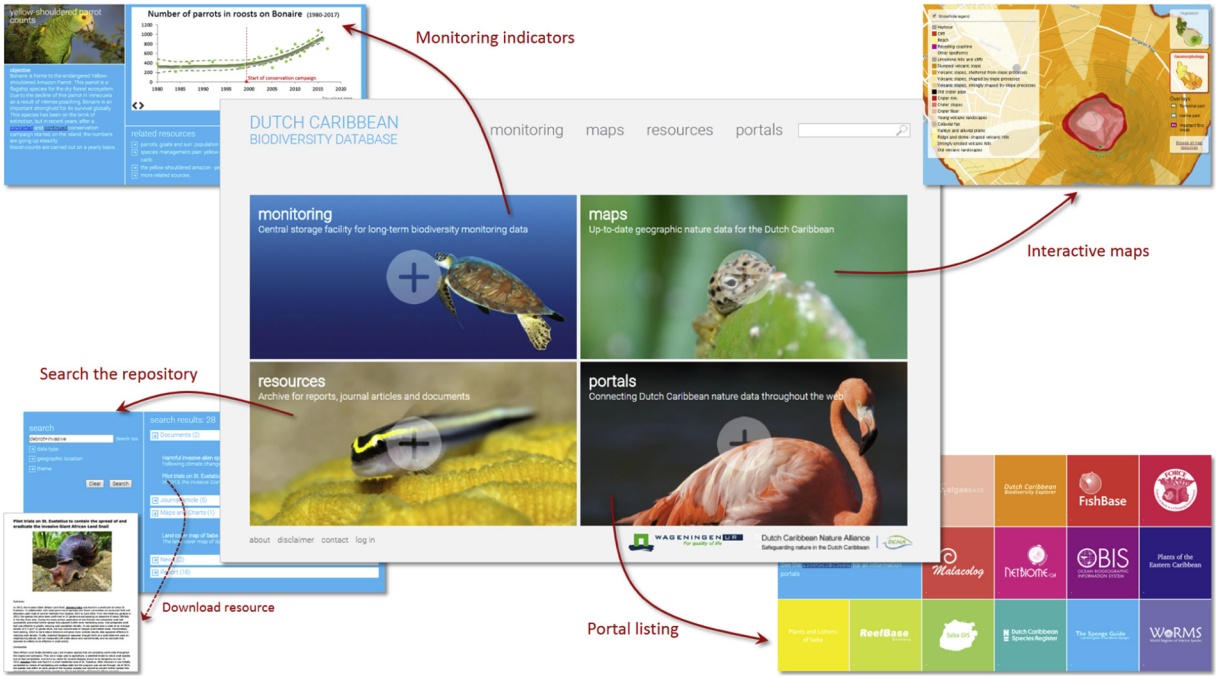

Fig. 1. screen compilation of the Dutch Caribbean Biodiversity Database (DCBD) homepage showing the four key services: monitoring, maps, resources and portals (www.dcbd.nl).

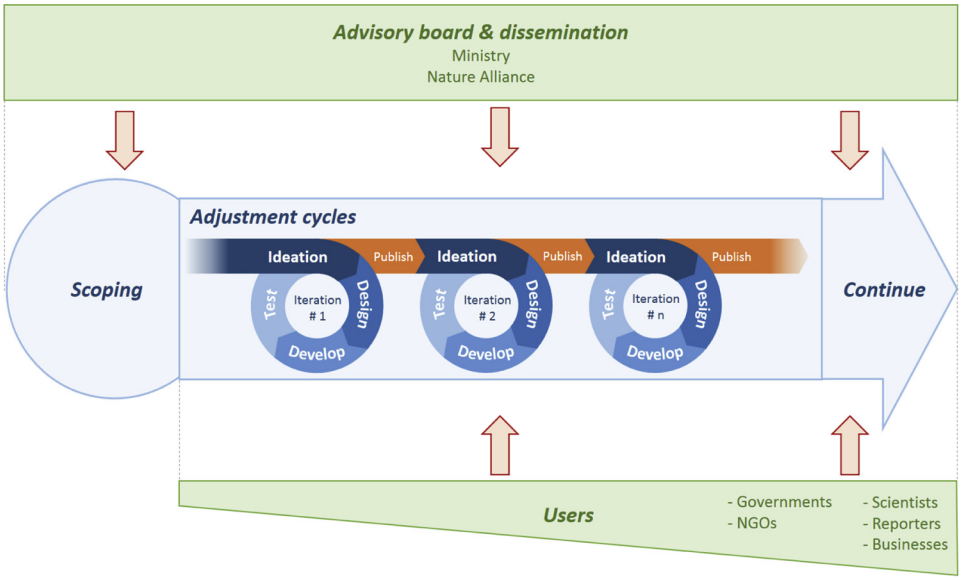

Fig. 2. Schematic overview of collaboration with users and advisory board in the development process. The adjustment cycles for the Dutch Caribbean Biodiversity Database occur annually through bilateral meetings with users and database maintainers.

and the DCNA are actively involved in the policy process and agenda setting and maintain the DCBD by funding staff and experts to maintain the DCDB. Maintenance activities include scanning research activities, uploading data and reports, maintaining professional and social networks and encouraging their network to share their data and reports on the DCBD.

Most monitoring efforts take place on seasonal basis, e.g. turtle or bird nesting. Bilateral meetings between the DCBD maintainers and the various NGO data collectors provide updated information and data, help to clarify the data structure and share interpretation of the data. These also provide opportunity to learn about their new monitoring and management activities and noteworthy events, such as storms or seaweed invasion. The NGOs responsible for data collection are asked how they use the DCBD (e.g. archiving, communication, learn from others, support in statistical analysis tasks) and if there are refinements to better suit their evolving needs. These user wishes and the updated information and data provide input for the planning of each annual DCBD development iteration. Each iteration starts with the feedback and ideas from the users and advisory board ('*ideation*'), followed by the '*design*' and subsequent '*development*' of technical functionalities and graphics. Finally, the new developments are '*tested*' through reviews by users, before they are '*published*'.

During the bilateral meeting week, explicit attempts are made to expand the stakeholder network and community of practice, by engaging additional/new organisations recommended by the NGOs and local government partners, e.g. dive schools started to record their

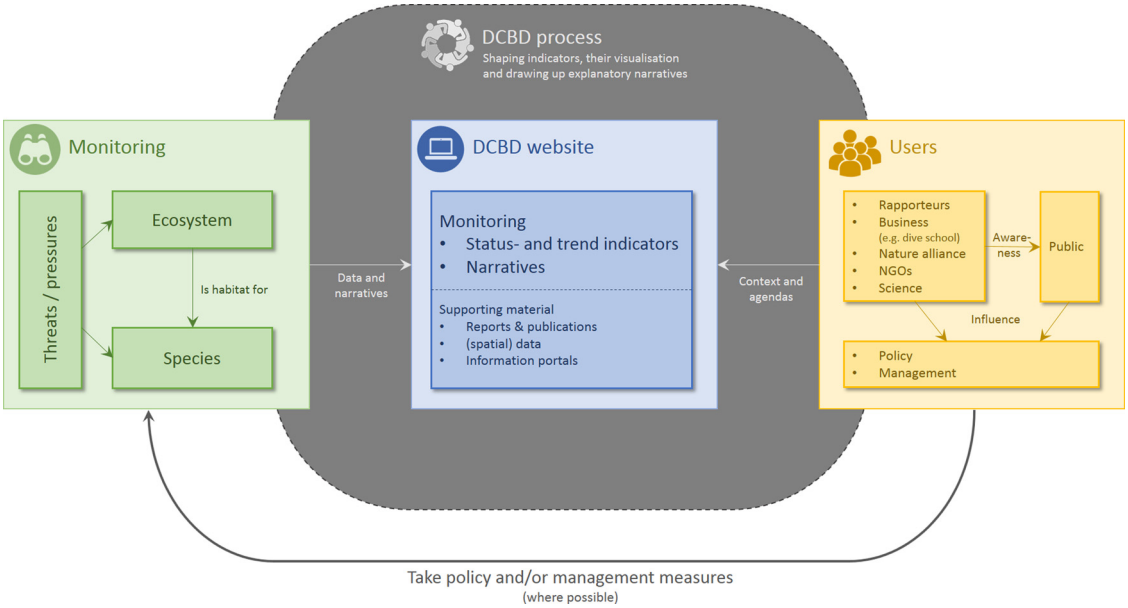

Fig. 3. Indicator development is based on managerial and policy requirements, context and agendas and by monitoring activities on ecosystems, species and threats.

sightings and National Statistics Netherlands recently added DCBD's biodiversity indicators to their annual reporting.

3.2. Sketching and storytelling during indicator development

Indicators signal changes in ecosystem health, biodiversity and pressures, and are elementary for taking evidence based policy and management measures (Laihonen et al., 2004). Indicator visualisations and graphics are a powerful means to communicate the status and trends (McInerny et al., 2014). Indicators, therefore, play a central role in the DCBD. Indicators are derived from field observations and remote sensing data. The indicators are defined based on managerial and policy requirements, context and agendas (Fig. 3). Indicators are jointly designed with data collectors (e.g. park managers, conservationists, local government) who provide their collected raw data (tabular, GIS, photographs, videos) and tacit knowledge on noteworthy events impacting the state of nature, e.g. severe storms, seaweed invasion, poaching, coastal development. Additionally, reporting staff clarify their need for indicators for specific species, species-groups, ecosystems and threats, or pressures that are relevant for reporting obligations.

The process to jointly design the indicators is initiated through iterative dialogue with the data-collectors. This serves to brainstorm and sketch several indicator graphs on paper based on the ideas generated by participant's narratives and data. Dialogues are organized per island per species, species group, ecosystem, pressure or threat. The indicator graphs are then debated in plenary to check whether the trends match expert and are management- and policy-relevant. This provides the basis for the final design stage, where the DCBD maintainers retreat for several hours to convert the paper sketches into real indicator graphs derived from collected raw data, which are then shared with the data collectors for feedback. If necessary, these are refined through one or several iterations of sketching and development, e.g. in case that the data does not support the narrative, or if the graph is not visually compelling. To ensure robustness in the quantitative analyses, Statistics Netherlands - an independent administration - provide input into this analysis and reviews the statistical methods used.

3.3. Approach to evaluate and increase the impact of the DCBD

The evaluation of the impact of the DCBD is based on four main sources of information. First, there is an explicit agenda item in every iterative work session in which feedback on DCBD's technical functionalities and the process of cooperation is elicited from individual users. Second, the diversity of returning user groups is monitored, which include those users brought in contact with the DCDB via existing users, those actively sought out through the DCDB process, or those that find the DCBD by themselves. Third, visit statistics of the DCDB website are monitored and fourth, the website statistics and visitor posts are assessed to understand the most common data and information requests and the most utilised parts of the DCBD and by whom.

The Dutch Caribbean Nature Alliance, as part of the advisory board, publishes '*BioNews*' a free monthly digital newsletter featuring recent nature related news about the Dutch Caribbean as well as overviews of recent publications, current research and monitoring programmes and upcoming events. News in *BioNews* contains hyperlink references that lead the reader to the specified resources on the DCBD, increasing the visibility of the DCBD. Articles on the DCBD are published in BioNews on irregular basis.

4. RESULTS

4.1. Platform evolution

During the scoping workshop the following priorities were set, based on feedback on the prototype (Fig. 4 A): 1) upload observation data in a well-structured and pre-defined data-entry-form, and download for a restricted set of users, 2) share and search documents, 3) display of GIS maps as a background for observation data (observations only visible for restricted set of users), 4) display encyclopaedic information that cannot be found on general purpose websites like wikipedia (with possible links to specific web-portals, e.g. reefbase.org, fishbase.org and CARMABI's[9] species register with taxonomic and trait information 'Dutch Caribbean Biodiversity Explorer'[10]) and 5) include a professional and high quality design.

Implementation of the first online operational system was based on these priorities and readily available information from the DCNA (Fig. 4 B). Digital reports and GIS maps were immediately available for publishing, but the sharing conditions for observation and monitoring data

[9] http://www.carmabi.org/
[10] http://biodivexplorer.dcbd.nl/explorer/

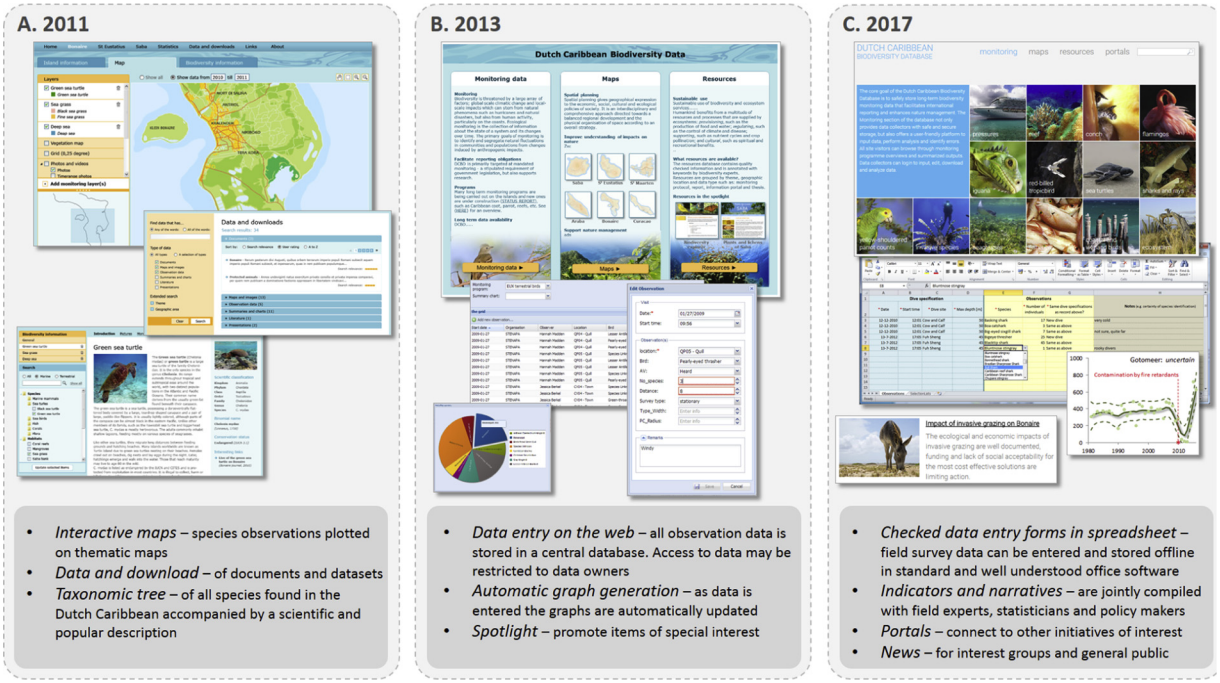

Fig. 4. Milestones in the evolution of DCBD through time.

had to first be clarified. All data collectors wanted a safe central database repository for their monitoring data as provided by the DCBD, to alleviate their challenges of severe staff turnover. These data collecting organisations viewed the DCBD as important to secure continuity in the structure and storage of their raw data. Some data collectors wanted to make their raw data publicly available, others only wanted to share derived indicators. Both options were made available through the DCBD, depending on the data collector's needs. Multiple devices were suggested for uploading field observations (mobile phone, smart phone, tablet, laptop, or desktop), but the data collectors preferred standard paper forms and water-proof notepads for underwater recordings. Field recordings were then manually entered via web-forms on the DCBD when back in the office, which were tailor-made for each monitoring program and organisation. During data-entry the format of the data was checked automatically to guarantee data consistency and enable automatic indicator graph generation. These indicator graphs were updated every time new data was entered. On specific request of the advisory board, items of special interest were put in the spotlight on the homepage. A graphical designer was added to the development team to secure a consistent, professional and attractive look-and-feel.

After a year however, it turned out that, although willing, data collectors hardly used the data entry facilities from the DCBD. The main challenges identified for inhibiting their use of the DCBD were: i) an unstable internet connection, ii) a deviation from their current data-entry practices, iii) the feeling of loss of control over their own data made them reluctant to use the web facility and iv) the limited possibilities of interactive analysis methods.

These challenges were addressed through reverting to custom-made data entry spreadsheets instead of online web-entry forms (Fig. 4 C). The spreadsheets were given automated consistency checks for data quality. For instance, a field that should express '*distance*' only accepts numerical values within a pre-defined range based on the monitoring protocol and the data collectors' expert knowledge. So '*far away*' could not be entered. A field that should contain a species name is to be filled via a pre-defined drop-down list to prevent typing errors which would hamper automatic analysis. Each tailor-made spreadsheet is maintained at the data-collectors' premises which ensures that familiar analysis tools and methods can be applied independently. At regular intervals the completed spreadsheets are sent over for storage at the DCBD.

4.2. Indicators and narratives

Indicators are created based on data availability and demand. Currently the indicators are grouped into 20 categories, comprising three on ecosystems (coral reefs, seagrasses, ecosystem size), five on pressures (invasive lion fish, corallita and goats, fisheries and tourism) and 12 on species (Queen conch, Caribbean flamingo, Antillean iguana, Red-billed tropicbird, sea turtles, sharks, rays, Yellow-shouldered parrot, coastal and wetland birds, invertebrates, terrestrial birds and terns). Where available, each category contains indicator graphs per island (e.g. sea turtles for Bonaire, St.Eustatius, Saba and St.Maarten). Multiple indicator graphs may be available per island. For example, for sea turtles on Bonaire there are indicator graphs available for nesting and for in-water sightings. The nesting graphs indicate the status of the reproduction, while the in-water sightings are indicative for the health of the foraging grounds.

Where many years of recordings exist, indicator graphs show general trends (Fig. 5 A). These trends are accompanied by a statistical interpretation conducted in cooperation with experts from Statistics Netherlands. When few repeated recordings are available, bar charts per observation period may visually indicate a trend (Fig. 5 B). Where a standard analysis and visualisation method exists (e.g. Atlantic and Gulf Rapid Reef Assessment[11]) that method is preferentially used (Fig. 5 C). Finally, an indicator graph may be accompanied by a detailed indicator to facilitate localized management (see respectively Fig. 5 A and Fig. 5D).

The aim is that each indicator is accompanied by a short narrative with particular attention given to indicators showing sudden changes in trends. In addition, explanations for these trends are shown on the indicator graph. For instance, in the salt lake Gotomeer a contamination by fire retardants as a result of a fire at the nearby oil depot, decimated the number of flamingos and this event is recorded on the indicator graph for flamingos (Fig. 5 D).

[11] www.agrra.org

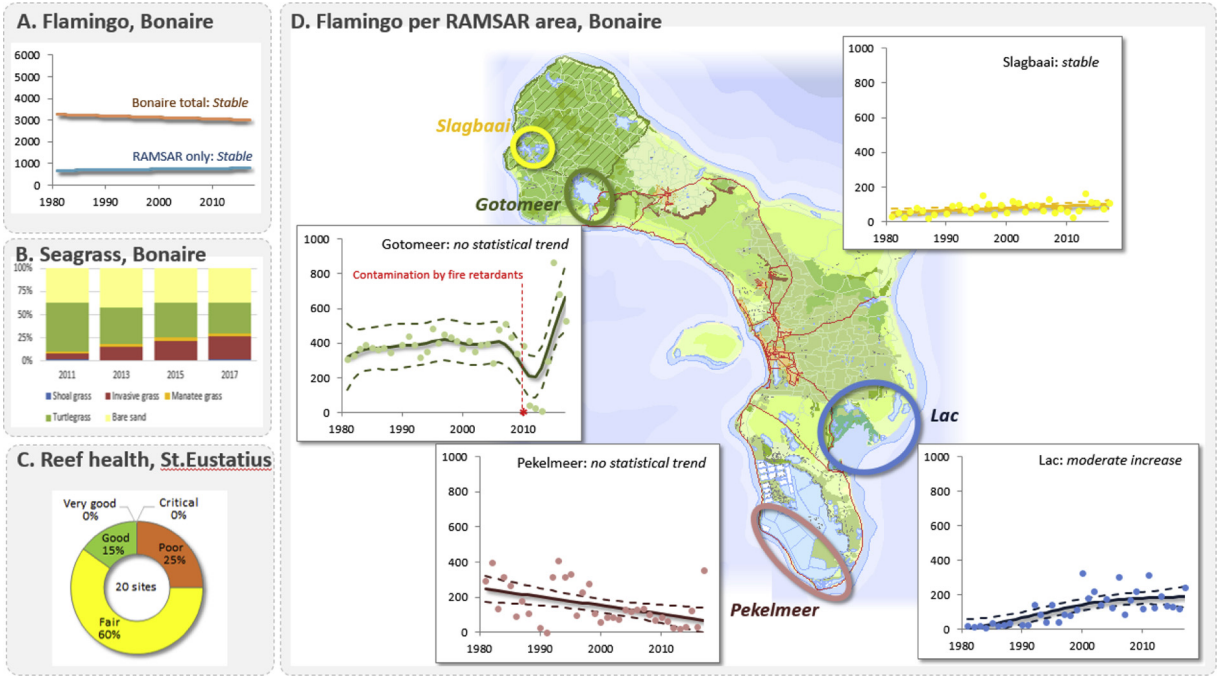

Fig. 5. Sample of DCBD indicator graphs.

4.3. Impact of the DCBD and its indicators

Interactive maps and resources are the most visited elements of the DCBD. Commonly search requests for reports and maps on the Dutch Caribbean via web-engines result in top-listed hits for the DCBD.

National government (Dutch ministries of Agriculture, Nature and Food Quality and Infrastructure and Water Management, Statistics Netherlands) use the DCBD for their reporting obligations based on the (inter)national treaties. These ministries regularly use the status and trend indicators as published on the DCBD to facilitate these reporting obligations (ministry of Economic Affairs, 2014; Verweij et al., 2015). For example, Statistics Netherlands publishes trends in turtle nests and flamingo abundance (Statistics Netherlands, 2016; Statistics Netherlands, 2017). Debrot et al. (2018) showed living coral cover trends, parrot abundance and the expansion of invasive plants for the national report on the state of nature.

Local authorities and management bodies in the Dutch Caribbean use the DCBD to inform responsibilities for spatial planning and carry out interventions for managing nature and the living environment. The DCBD provides evidence in the form of data and knowledge that underpins decisions on granting of permits, e.g. the annual reports of Sea Turtle Conservation Bonaire (STCB) use the DCBD's indicators on sea turtle nests and in-water sea turtle abundance to inform their decisions on (Willis et al., 2016; Schut et al., 2017). The indicators are developed in cooperation with STCB and are based on their data. Piontek (2015, 2016) as presented to the Island Government of St. Eustatius, includes several of the DCBD's indicator graphs. For the St. Eustatius' annual sea turtle conservation program report STENAPA uses the DCBD's indicators on sea turtle nests and in-water sea turtle abundance (Berkel, 2014). St. Maarten Nature Foundation uses the DCBD's indicator graphs on shark and ray sightings, sea turtle nests and brown pelican abundance for outreach and educational purposes[12] .

Businesses such as dive schools, provide their observation data that they record during daily dives as advertisement material to attract future customers. That data is handed over to the DCBD to generate indicator graphs. The graphs form outreach and marketing material for these businesses. For *researchers*, the DCBD offers data and information that is easily found and accessed. The raw data underlying the indicators and maps serve as an inspiration and basis for further research.

5. DISCUSSION

5.1. Principles for designing a policy relevant data platform

As demonstrated above DCBD has broadened its initial scope from data rescue (Diviacco et al., 2015; Hawkins et al., 2013; Costello, 2009) to a platform with indicators and narratives relevant for decision making. Reflecting on our experiences in co-designing this platform with data collectors, and a range of end users in government, business and research, we have distilled three principles that were critical in DCBD's uptake, growth and use.

First, the DCBD is actively supported by national and regional policy makers and embedded in a mandated local institution. The Dutch ministry organised initial meetings with park managers and non-governmental conservation organisations and continuous to give political credibility, legitimacy and visibility to DCBD, and continued to organise periodic meetings while using their network to expand DCBD's scope. The ministry also supports the maintenance of the DCBD by locally subcontracting staff that scan for and upload relevant resources. Research projects funded by the Dutch ministry are contractually obliged to provide their data and results to DCBD. Since the policy makers use DCBD themselves, they provide specific feedback on the DCBD system, the collaboration process and the network which it services. Their ongoing active role clearly shows they have taken ownership of the platform.

Second, DCBD simplifies mandated tasks of local management and rapporteurs. It simplifies or carries out tasks that would otherwise remain pending or would take much effort. This is facilitated by the co-designed workflow and data-entry practices of data-collectors and the tailor-made digital data-entry forms in software familiar to them. Data-collectors are forced to structurally input their observation data, which reduces input errors, enhances automated analysis, and meets the needs for central data repositories that cater for high staff turnover. From this workflow, reporting needs, including indicator visualisations, are made explicit. Similarly, needs of reporting staff are defined based on

[12] http://www.naturefoundationsxm.org/activities/, retrieved 9 August 2018

reporting obligations. Specific indicator graphs are created and custom-developed for each target group to meet their specific reporting mandates and needs.

Third, the DCBD must continuously evolve in response to changing external and internal factors, functional requirements, procedures, priorities and institutional environments. Sustaining and adaptation of the platform is made possible through 1) constant dialogue between users, maintainers, developers and donors Fig. 2, and 2) programmatic government funding, which is crucial for longterm storage and content curation (Arzberger et al., 2004; Bach et al., 2012; Bendix et al., 2012).

There are also principles that had to be revisited:

First, the initial idea to give data-collectors a login-account and to enter and store their data in the system via web-interface was unsuccessful. Contrary to what literature suggests on the necessity for online massive data storage and sophisticated automated analysis and query tools (Balmford et al., 2005; Bendix et al., 2012), data-collectors mostly dismissed the offered technical facilities and stuck to their daily routines. Even after various iterations of functional adaptations, the system was rejected due to limited internet connection availability, time constraints to become familiar with the online functionalities and the initial lack of trust to share data. Letting go of the concept of a large standardised database and focusing on simplifying daily routines resulted in increased participation and trust. Thus, the best technical solution is the one that best fits user practices and preferences.

Second, it was found that researchers are reluctant to share their data due to scientific publication possibilities or presumed insufficient quality. Even if researchers collect data with public money and are contractually obligated to share their data publicly it hardly ever happens. Possibly the contractual obligations are not enforced, because there are no penalties. Scientists and other data providers must be motivated to make their data available to the global community. Sayogo and Pardo (2013) suggest that scientists publish their dataset. As such it can be cited, crediting the ones that share their data, without the necessity or lead time required to publish a research article (e.g. Nature's scientific data[13]).

Third, the impact of the platform on nature policy making and management is difficult to quantify. Although Saarela et al. (2015) identified collaboration and informing as important means for generating impact – both characteristics of DCBD – and there are clear examples of policy making influenced through DCBD's information (e.g. Debrot et al., 2017), there is no straightforward relation between DCBD and policy making. Many factors, like public opinion, political will and timing, influence this relation. Stronger dissemination of DCBD's narratives in social arenas (e.g. newspapers, social media) may make Caribbean nature and biodiversity more politically and societally relevant.

5.2. Position compared to data platforms and indicator catalogues

Costello & Wieczorek (2014) advise to publish biodiversity data through a data platform, a system that enables integration of harmonised data in other similar datasets and to use a quality checked open-access data repository, to which, preferably, peer-reviewed articles are attached for proof of data quality (e.g. GBIF[14], GenBank[15]). Data platforms are typically used by data scientists. Although the DCBD stores data, it cannot be classified as a data platform in this sense. The DCBD stores all offered observation data in raw, non-harmonised format as practiced in data lakes (Russom, 2017). Data is provided by trained professionals and scientists which is an indication for its quality.

While data platforms target data scientists, indicator catalogues aim to provide condensed information in the form of indicators with accompanying narratives and references (e.g. EEA indicators[16] and Environmental Data Compendium[17]). These catalogues are designed to answer key policy questions and support all phases of environmental policy making, from designing policy frameworks to setting targets, and from policy monitoring and evaluation to communicating to policy makers and the public (EEA, 2018). Likewise, a selection of the DCBD's data and accompanying references is used to derive indicators and narratives for direct use by management and policy making. Where 'EEA indicators' and 'Environmental Data Compendium' can draw on a rich, long-term data collection built by spatially well-distributed monitoring networks, Dutch Caribbean monitoring activities have, almost without exception, a shorter history in monitoring. In general, when funds are limited, monitoring heavily depends on contribution of (skilled) volunteers (Van Swaay et al., 2008). Some monitoring programs in the Dutch Caribbean can draw on a limited number of volunteers willing to participate. The possibilities for long-term systematic sampling are constrained due to high turnover of volunteers which is typical for the islands.

6. CONCLUSION

What started out as a data rescue process, evolved into a platform with indicators and narratives relevant for decision making, while still offering all underlying data. This development could take place because of the process that was followed which actively sought to engage meaningfully with those who both supply and use data, and to customise the platform to meet both their needs. The process was supported by an Advisory group comprised of government institutions viewed as credible organisations in supporting such a multi-use platform, and was furthermore embedded in an institution responsible for its maintenance. Three principles made DCBD's uptake and growth possible: the platform is funded, promoted and used by national and regional policy makers, it simplifies tasks of local management and rapporteurs, and it is continuously being adapted to changing needs and insights. The development of a data-platform like DCBD is not necessarily about using state-of-the-art technology, but about meeting the needs and priorities of both data supplies and users, which are diverse and require diverse approaches, and growing an active stakeholder network. In this growing stakeholder network, a process that actively seeks to reflect on ways of working, improving and continuously evolving at both the individual level and collective cross-institutional level is key.

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