Telling the tale of rewilding – visual storytelling for communicating nature conservation

Rosanne van der Wijngaart

Student number: 5859123

Date: 31 October 2022

Supervisor & Examiner: Dr. M.J.W. (Mark) Bos

Second reviewer: Prof. dr. E.H.M. (Liesbeth) Sterck

1. Layman's summary

Rewilding (opnieuw verwilderen) is een manier om natuurgebieden te herstellen door de natuur zoveel mogelijk vrij te laten. Het is een complex proces en relateert aan meerdere wetenschappelijke disciplines zoals klimaatwetenschappen en ecologie. Natuurgebieden worden bijvoorbeeld hersteld door roofdieren en grote grazers te herintroduceren en rivieren meer ruimte te geven. Voor omwonende kan dit zorgen oproepen: ze weten niet hoe het natuurgebied gaat veranderen of vrezen voor conflicten met (roof)dieren.

In deze studie werd er gekeken hoe en of verhalende afbeeldingen gebruikt kunnen worden om omwonenden te informeren over rewilding. Er werd naar literatuur gekeken over wetenschapscommunicatie en verhaaltechnieken. Aan de hand van de indeling van een afbeelding, gebruik van symbolen, overtuigingskracht, verhaaltechnieken en eventuele discussiepunten werd er in de artikelen gezocht naar manieren hoe en of visuele verhalen een aanwinst zijn t.o.v. huidige visuele communicatie over complexe onderwerpen.

Uit de resultaten bleek dat de indeling moest zorgen voor betere leesbaarheid en dat symbolen moesten zorgen voor snelle herkenning van het onderwerp of het toekennen van emoties aan de personages. In wetenschapscommunicatie was het belangrijk dat de lezer overtuigd werd van de betrouwbaarheid van de bron, terwijl in visuele verhalen een emotionele verbinding werd gemaakt met de lezer. Daarnaast hadden verhalende afbeeldingen een protagonist, een probleem dat opgelost moest worden en een duidelijk begin en einde. De discussiepunten over het gebruik van verhalen gingen vooral over het overtuigende karakter en of verhalen niet te veel simplificeerden.

De resultaten werden toegepast door een verhaallijn voor te stellen om rewilding te communiceren. Door de verhaallijn rondom de bevolking te maken, sluit het verhaal aan op de belevingswereld van de lezers. De sterke overtuigingskracht van verhalende afbeeldingen waren een discussiepunt. Deze overtuigingskracht was een voordeel, maar ook een nadeel. Het kon manipulatief overkomen en daardoor weerstand oproepen bij de kijker. In de verhalende communicatie moet de focus dus liggen op informeren. Een verhaallijn over rewilding heeft een balans te vinden met het emotioneel verbinden met de lezer en informeren over rewilding.

2. Abstract

Rewilding is a way of nature restoration and focusses on reintroducing natural processes that once have been part of that area. This could be done by reintroducing predators and large herbivores and by providing more space for flooding rivers. It is important that local residents are informed about the impacts of rewilding; the area might change, and local residents may be afraid of conflicts with animals. On the other hand, rewilding provides many benefits, such as an expansion of (economic) prosperity and nature restoration.

Visual storytelling can be used to inform local communities. By using multiple images, a story can be told that engages people, which help them to empathize with the message that is being told. This study focused on how and if visual storytelling could be used to inform people about rewilding. Literature on science communication and storytelling related to biology, ecology and sustainability were reviewed. Literature was analyzed on gestalt (organization of visual elements), semiotics (use of signs), rhetorics (persuasiveness), storytelling techniques and discussion points in using visual storytelling for communication.

It was found that gestalt principles were used to improve readability by chunking information. Signs were used for quick topic recognition or identifying storyline aspects (passing of time or character's emotions). Visuals in science communication tried to persuade their audience by coming over as a trusty recourse while in storytelling to connect emotionally with the audience. Storytelling techniques included having a plot with a protagonist, a clear beginning, and an ending where a problem had to be solved. Discussion points were about the persuasive value of stories which could be identified as manipulative and thus create resistance to the message in the audience.

The results of this story were used to create a storyline for communicating rewilding. To create a story which connects with the audience, the locals were put at the center of rewilding communication as protagonists. The high persuasiveness of stories was the biggest discussion point in using storytelling for communication. Thus, for creating a rewilding storyline, the main goal was to inform and connect with the viewer, not manipulate the audience into the message of rewilding.

3. Introduction

Due to climate change and anthropogenic pressure, there is an ongoing degeneration of nature taking place worldwide (Egoh et al., 2021). Current conservation practices have not been enough to restore and maintain ecosystems. However, alternatives such as rewilding, a relatively new way of land management and nature conservation, seem promising (Perino et al., 2019). Rewilding focusses on bringing back ecological processes that have once been part of an ecosystem, for example by reintroducing predators and/or large herbivores and by providing space for flooding rivers (Lorimer et al., 2015). Rewilding includes science related topics such as: ecology, biology, and sustainability.

Nevertheless, rewilding can be a controversial topic. Locals living near rewilded areas fear natural disturbances such as floods, fires and human-wildlife conflicts (Perino et al., 2019). For example, the comeback of the wolf as predator in the Netherlands has resulted in fear for safety of children and attacks on livestock increases resistance to its comeback (de Joode, 2022). Besides the comeback of predators, people fear that the nature they are used to will change. Because rewilding lets nature take care of its own, it is impossible to say how landscapes will develop in the future (Perino et al., 2019). On the other hand, pro-rewilders state that rewilding has many benefits. The amount of nature will increase for coming generations, while current generations benefit by increased local economies and overall welfare (Jepson et al., 2018; Lorimer et al., 2015).

It is important that locals are well informed as nature conservation and rewilding will only succeed with local support (Perino et al., 2019). A successful rewilding project in Romania had an involved community of locals who were allowed in the decision making (Rewilding Europe, 2018). Also, in the community they placed a tourist trail map which increased understanding of rewilding and tourism. However, other communities can be more resistant to the idea of rewilding. They may be difficult to reach and get informed and involved into the process (Lorimer et al., 2015).

To help in informing about rewilding, visuals could be used as they provide a fast and clear method of conveying information and are more engaging than plain texts (Agrawala et al., 2011; Rodríguez Estrada & Davis, 2015). Still, solely providing images to explain rewilding might not be

engaging enough. To involve people with the concept of rewilding, visuals can be used to tell a story that connects with their audience.

(Visual) storytelling is found to be an excellent way to emotionally connect, increasing engagement, understanding and interest in complex scientific topics (Dahlstrom, 2014; Joubert et al., 2019; Martinez-Conde & Macknik, 2017). Storytelling is such an effective communication tool, as it reaches people by narrative transportation, which can be described as being lost in a story and having an empathic connection with the characters (Morris et al., 2019). Narrative transportation activates higher emotional arousal and reduces the chance of the viewer giving counter-arguments to the communicated message (Barraza et al., 2015; Morris et al., 2019), which makes storytelling effective in controversial topics. In a direct comparison with an expository text, narrative texts were read twice as fast and were remembered twice as well, regardless of topic familiarity or interest in the content itself (Graesser et al., 2002).

There is no data available on if and how visual storytelling could be used in communication about rewilding. A literature study will be used to collect available data on topics related to visual communication and visual storytelling in science, nature conservation, sustainability, and storytelling. Research questions are focused on what literature states about (1) what factors are important in visual science communication (2) what factors are important in storytelling, (3) and what factors are mutually exclusive or symbiotic for visual science communication and visual storytelling. By answering these sub questions, we will be able to say more about how visual storytelling can be used in communication of rewilding.

The remainder of this paper is arranged in the following way: first the terms rewilding, the framework for analyzing visuals, and visual storytelling are discussed in order to conceptualize terms for the literature review. Next the methodology of this study is described and is followed by the results of the systematic literature review. Lastly the results will be discussed and suggestions for future research are given.

3.1 What should be explained about rewilding.

Rewilding is about bringing back natural processes in an ecosystem to increase its resilience to disturbance (Lorimer et al., 2015). There are three critical components of rewilding (Perino et al., 2019).

The first one is trophic complexity, in which species at different trophic levels are highly connected. Especially species at higher trophic levels are important for a functioning ecosystem (Perino et al., 2019). Large herbivores are connected to other taxa, such as plants, birds, smaller mammals, and insects. They provision dung and carrion, facilitating dispersal and affect the environment by trampling or grazing. Predators ensure that the number of herbivores is contained and makes external management unnecessary.

The second component is stochastic disturbances where natural disturbances occur by chance on different locations and frequencies within an ecosystem. Examples are floods, storms, fires, or pest outbreaks. These disturbances reorganize ecosystems and can result in ecosystem complexity as they promote co-existence of different species with different niches. Species that have enough competitive ability to survive, promote the reorganization and recovery of an ecosystem.

The last one is dispersal between habitats. Individuals should be able to exchange habitats to avoid overcrowding and increasing gene flow leading to more viable populations. Dispersal barriers (e.g., fences, roads, or dams) should be removed or adapted to facilitate connectivity between ecosystems. Mammals and birds will also facilitate dispersal of plants and seeds.

The consequences of rewilding can be perceived as positive or negative and have effect on local communities, economies, politics, and current landscapes. Local communities benefit because rewilding increases the regulation of air quality and climate (Lorimer et al., 2015). There are also economic benefits as dispersal increases in rewilded and surrounding areas. Local economies benefit from an increase in natural recourses (Perino et al., 2019). Lastly, there are lower management costs as land management (e.g., removal of dead trees, hunting to decrease herbivore populations) is not necessary.

3.2 Gestalt, semiotics and rhetorics: a framework for analyzing visuals

When designing and analyzing visuals, three principles should be considered: 1) Gestalt (readability) 2) semiotics (symbols) and 3) rhetorics (persuasiveness) (van den Broek et al., 2010).

Gestalt is about bringing order to and reducing the amount of information in a visual. Bringing order is done by grouping visual elements, increasing the readability of a visual. For example, placing visual elements (e.g., a text with corresponding image) in proximity, it will be categorized as related by the viewer (van den Broek et al., 2010). Also leaving out excess information, such as details, will increase readability.

As described by the cognitive load theory the capacity of the working memory of humans is limited and can only hold limited amounts of information for a limited amount of time (Skulmowski & Rey, 2020; Sweller, 2011; Van Merriënboer & Sweller, 2010). To reduce cognitive load, leaving out unnecessary information and grouping the visual elements prevents overloading the working memory. There are several ways Gestalt could be applied in visual communication; six different examples of gestalt principles are visualized in **Fout! Verwijzingsbron niet gevonden.**.

Important gestalt principles

- **Readability**
- **Organization of the lay-out**
- **Low signal-to-noise ratio**

Similarity   *Proximity*   *Common fate*

Continuity   *Filling in the gaps*   *Figure ground*
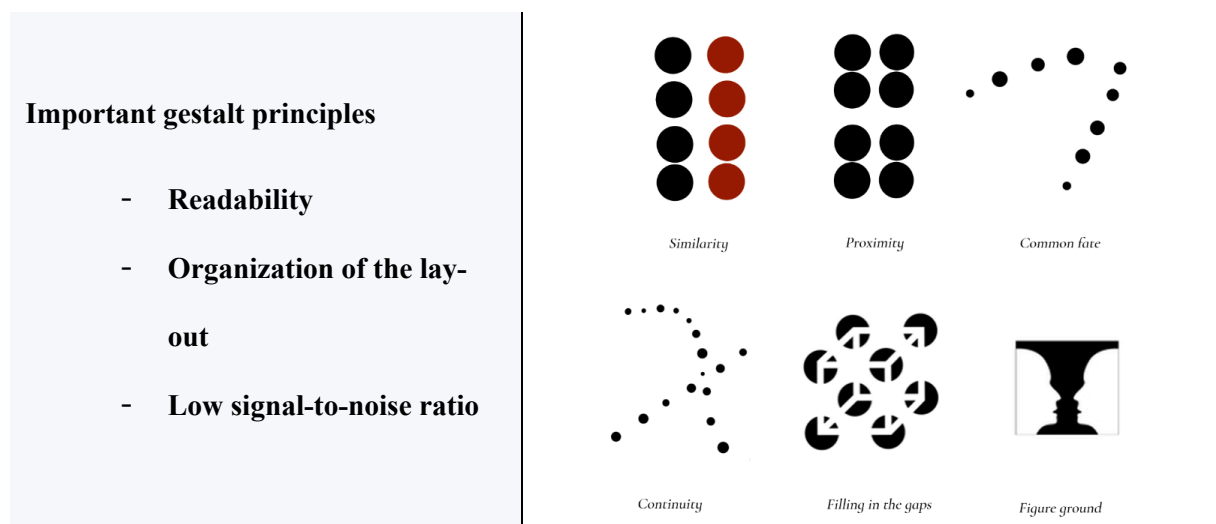
Figure 1: Gestalt: by grouping visual elements the cognitive load is not being overloaded. Six examples of gestalt principles are provided to group visual elements. Our brains group visual elements because they are similar, are in proximity or imply a common direction or form. E.g., the red dots top left will be considered as a group because they are similar. In the top middle example, the same dots are grouped, by fours horizontally, because they are most proximate.

The second principle is that of semiotics: the use of signs which carry a meaning. Signs aid in ordering visuals or address causation between different visual elements. Some signs are symbols and have to be learned to be understood (sign for danger, a question mark, or a commercial brand.) On the other hand, signs can have an iconic meaning, meaning that the sign resembles reality (e.g., using a magnification glass in an image to suggest magnification of an object). Lastly, signs can be indexical, meaning that the symbol implies another object. For example, smoke can be used as sign for fire (Figure 2).

Semiotic principles

- **Use of signs**
  - **Iconic**
  - **Indexical**
  - **Symbolic**
- **Colour symbolization (red for danger)**

Three Types of Signs

- **Icon** - a sign that physically resembles what it stands for - a literal sign
- **Index** - a sign which implies some other object or event - an implied sign
- **Symbol** - a sign with a conventional or arbitrary relation to the signified - a learned sign

CAT

Figure 2: Semiotic principles. In the example three different signs of a cat are visualized and described (Image source: Alexander Storey)

Lastly, rhetorics are about how a convincing core message is framed: what and how something is shown determines how convincing the message. Visual rhetorics are based on ethos, pathos, and logos (Figure 3). Ethos is the believability of the sender who is trying to convince the viewer. A campaign promoting the health benefits of milk might be less trustworthy when it comes from the bio-industry opposed to an independent research facility. Pathos is the use of emotion evoking visual to reach the audience emotionally. In communication about animal abuse, the use of pathos would be to provide visuals with sad-looking puppies. Logos is the application of rational arguments in the visual and supports the pathos and logos. For example, an NGO could provide a before photo of a logged forest and an after photo where nature has been restored as proof for their efforts in restoring nature.

Rhetoric principles:

- **Framing and argumentation of the message**
- **Credibility of the sender**
- **Evoking an emotional response.**

Figure 3: Rhetoric principles. Ethos: the sender is WWF, one of the biggest NGO's active in nature conservation, so this could be considered a serious message. The indexical sign of the trees forming the lungs is a rational argument that we are burning the "lungs of the earth". On the bottom right is some pathos as the text reads: "before it's too late", aiming to evoke an emotional response in the viewer. Source: WWF

3.3 (Visual) Storytelling

People are storytellers. Stories provide humans a framework to absorb, interpret and process complex information (Bietti et al., 2019; Sugiyama, 1996), such as everyday experiences and understanding reality (Gottschall, 2012). Visual storytelling is when a story is told through visuals, such as movies and comics (Hu et al., 2020; Huang et al., 2016). Also photographs or illustrations can tell a story; often multiple images are used to drive a storyline.

The main difference between information told in storytelling and without is how the material is presented. Without storytelling information is presented more factual, while storytelling provides an interpretation (Huang et al., 2016) (Figure 4). The definition of storytelling varies in literature but the most important is factors are similar across different sources. Storytelling is about causally linked events (with a beginning, midsection and ending), where a conflict has to be resolved by the main characters (Braddock & Dillard, 2016; Drew et al., 2010; Hu et al., 2020).

Figure 4: Example of explaining this picture with storytelling: it is the end of day; the sun is setting into the ocean. And without storytelling: A picture of the ocean, the sky is illuminated with orange tints.

4. Methodology

Papers were found through keywords in electronic databases. In this study Google Scholar, Scopus and Web of Science were used. The program "Publish or Perish", a software program that retrieves academic citations from different search engines, was used to search for and manage papers (Harzing, 2007).

Papers were retrieved in September 2022 with different keywords related to visuals in science communication or storytelling. The keywords "visual storytelling" or "storytelling" were used in combination with keywords for method of visual communication were: "visual" "Graphic" "Infographic" "Illustration", "comic". For the communication goal the keywords: "science communication", "communicat*" and "educat*", "gestalt", "Semiotics and "rhetorics" were used. Lastly, for the subject matter of the visuals the keywords "science", "Ecology", "Enviroment*", "Sustainab*", "biology" or "rewilding" were used in all search engines. Also, for visual science communication a query was run. "Visual storytelling" and "storytelling" were replaced with "visual science communication" and "science communication". The Boolean operator "AND" in combination with the operator "OR" were used to combine the keywords. There were no constrictions on publication date. In Appendix 1A the combination of keywords and the queries are described. Only papers with full access were retrieved. Peer reviewed journal articles, literature reviews and book (chapters) were included. Dissertations, book reviews and reports and theses were excluded.

Based on these keywords 104 papers could be identified in the electronic databases, 6 papers were removed because they were duplicates. Articles were screened on the title, to check if the topic was related to (visual) storytelling or visual science communication in combination with ecology, rewilding, or sustainability. 56 records were excluded because they did not meet that criterium as the title referred to topics relating to artificial intelligence or product design (Appendix 1b)

29 papers were assessed for eligibility. Abstracts and discussion sections were read to assess if they met the following inclusion criteria:

- The articles should be related to the objective of this study: (visual) storytelling or visual communication applied to topics related to biology, ecology, or sustainability.
- Studies should be directed at communicating science or communication practices to non-expert audience.

After Assessment, 17 papers could be included in this literature review and 12 papers were excluded because they did not meet the criteria above. A Prisma flow chart (Page et al., 2021) about the process is provided in figure 5.
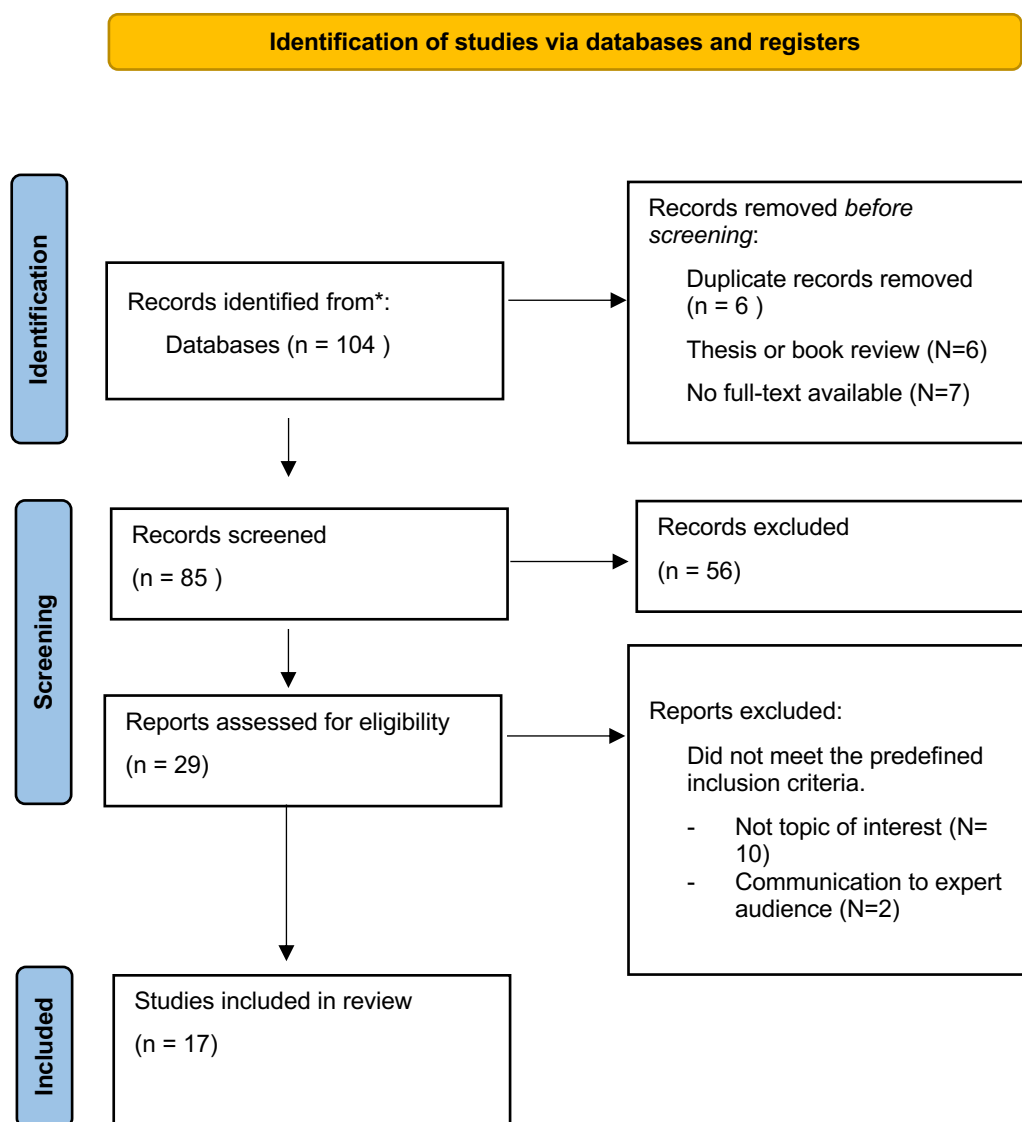
Identification of studies via databases and registers

Identification

Records identified from*:
Databases (n = 104)

Records removed *before screening*:
Duplicate records removed (n = 6)
Thesis or book review (N=6)
No full-text available (N=7)

Screening

Records screened
(n = 85)

Records excluded
(n = 56)

Reports assessed for eligibility
(n = 29)

Reports excluded:
Did not meet the predefined inclusion criteria.
- Not topic of interest (N= 10)
- Communication to expert audience (N=2)

Included

Studies included in review
(n = 17)

Figure 5: Prisma flow chart of the identification of studies via databases (Page et al., 2021)

4.1 Data collection process

To answer the research questions the following variables were used to analyze selected papers:

- Data set characteristics
- Type of visual
- Gestalt
- Semiotics
- Rhetorics
- Characteristics of (Visual) Storytelling
- Discussion points of the use of storytelling in science communication

In Appendix 2 a table is provided including a description of how these variables were scored. Variables identified in the selected articles were written down and organized into a table using the Microsoft Excel application (Appendix 3). Papers were categorized by main topic: either storytelling or science communication and the topic they were intended to communicate.

5. Results

5.1 Data set characteristics

With respect to the busiest publication periods, more than half of the studies that met the inclusion criteria were published in the past three years (N= 9), potentially indicating a rise of interest in this topic (Figure 6). The oldest publication was from 2005. Papers had been published in a wide variety of journals such as the "Journal of Environmental Management", "Sustainability Science", "Science Communication" and the "Information Visualization".

There were 9 papers about storytelling and 8 about visual science communication. Visuals were mostly used in communication about climate change and science (Table 1). Five papers did not discuss visuals and were either about rewilding communication (N=1) or storytelling frameworks (N=4).

.
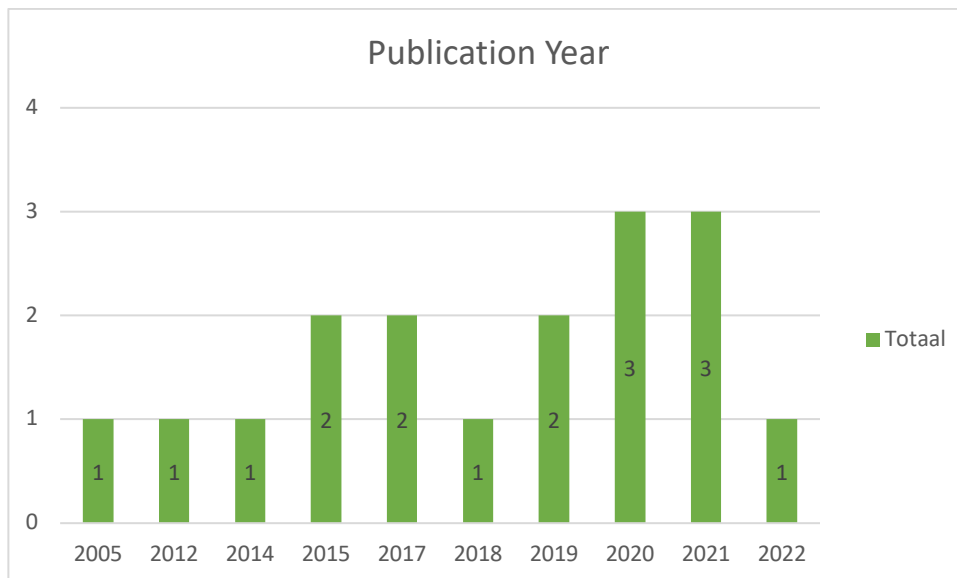
Figure 6: *Year of publication of included articles in this study. More than half of the papers was published in the past three years.*

Table 1: *The communication topic of the visuals discussed in the papers*

Topic	
Climate change	4
Science	5
Sustainability	1
N.A. *	5
Land management	1
Environmental risks	1

* *Did not discuss a visual*

5.2 Type of visuals

The articles discussed different types of visuals (Table 2). Four articles did not identify a specific visual and talked about static visuals as a group (non-moving visuals, such as: photos, graphs, illustrations). One article studied artworks (visuals which had been in exhibitions and included photos and statues, N=1) and other articles studied specific types of visuals, such as: film (N=2), infographics (N=3) and photo's (N=1) or cartoons (N=1).

Papers focusing on storytelling discussed film, infographics, and static visuals (Table 3). Visual science communication papers mostly discussed static visuals and infographic.

Table 2: *type of visuals discussed in the paper. Static visuals grouped the non-moving visuals (photographs, illustrations, infographics etc.) Artworks were visuals that had been in exhibitions.*

Visual type	
Artworks (static: photos or statues)	1
Cartoon	1
Film	2
Infographic	3
Photo's	1
Static visuals	4

Table 3: *Type of visual for storytelling and visual science communication. In storytelling, film was most discussed and in visual science communication the static visuals as a whole.*

Visual type per topic	
Storytelling	**4**
Film	2
Infographic	1
Static visuals	1
Visual Science communication	**8**
Artworks (static: photos or statues)	1
Cartoon	1
Infographic	2
Photo's	1
Static visuals	3

5.3 Gestalt

In visual science communication, the most important factor to reduce the signal-to-noise ratio was chunking information. Visuals and corresponding text were provided in "chunks" to improve readability as viewers could better absorb information opposed to when it was provided in one big chunk

By grouping information, a Visual Information Flow (VIF) arises: a natural way to read visual information which increased readability and learning. Grouping information reduces the cognitive load as the brain can more easily absorb small chunks of information. High cognitive load can be measured by high variations of pupil dilation. Chunking information and organizing them in a pathway resulted in littlest variation of pupil dilation, especially when the visual pathway followed a zigzag-pattern opposed other variations in patterns (horizontal or vertical) (Majooni et al., 2018). Placing corresponding information in chunks and leaving out distractions seemed to be the most important gestalt factor in visual science communication. (Figure 7).

In storytelling literature, gestalt principles were mostly used in ordering the sequence of visuals. Visuals needed to be structured in a way that the viewer was navigated trough the visuals. Placing the visuals in sequential order, in for example the common reading direction, told the reader how to progress through the story.
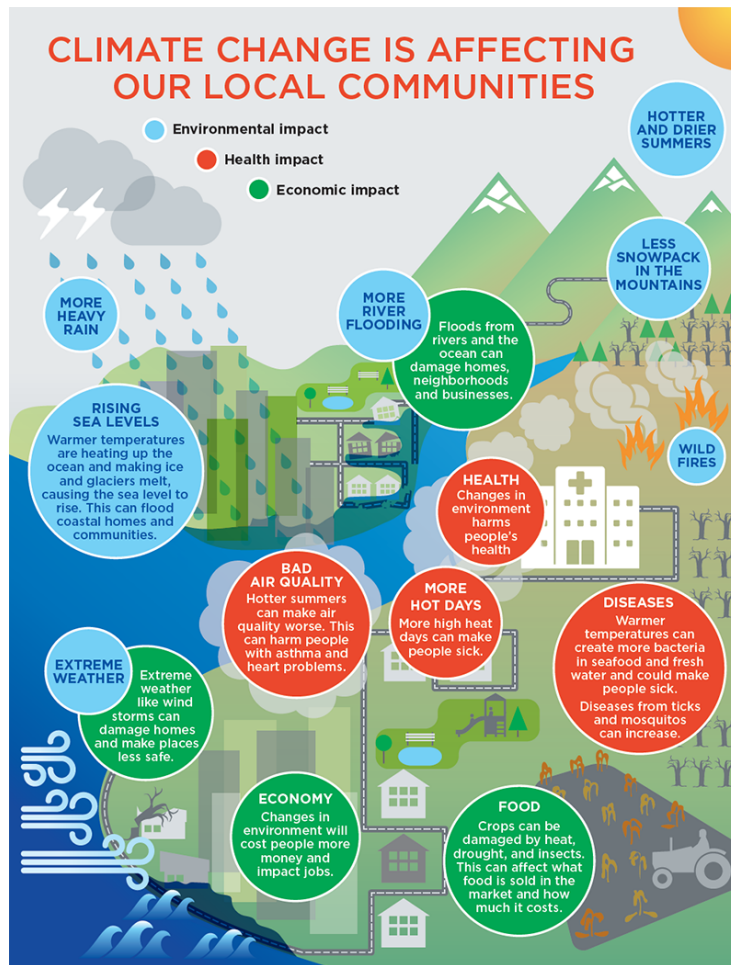
Figure 7: *Infographic applying some important gestalt principles. Information is chunked in different circles with different colours. However, a pattern in which the chunks are orded has not been applied in this visual. Unnecessary information is left out by simplification: the homes, flats and roads have a simple design. Designer: unknown.*

5.4 Semiotics

Semiotic were most often used in visual science communication about sustainability and climate change. For example, a polar bear was mentioned as a semiotic icon of climate change. Using this icon helped the viewer in quickly recognizing that climate change was communicated, facilitating fast and clear communication.

In terms of environmental messaging, it was found that indexical messages worked best in communicating about hurricane risks (Rickard et al., 2017). Because hurricanes are unpredictable in

occurrence and magnitude, they are environmental risks that are difficult to communicate. Indexical use of photos (house inundated by a hurricane is an index for hurricane danger), are more persuasive and resulted in higher evacuation intention than nonvisual or iconic visuals (risk map with indicated danger zones), especially to people who had never experienced hurricane before (Figure 8). The symbolism of a visual (such as a destroyed house) can elicit an emotional reaction and help to bring about an interpretation or experience that helps to convey the message.

In storytelling, semiotics were used to convey thoughts, movements, and emotions of the characters. Examples were text balloons and lines that depicted motion. Semiotics were also used to indicate the passing of time. Having one image with the sun low on the horizon and later in the story high in the sky, was a symbol for the passage of time. Signs were also used to concretize message to facilitate effective communication. Difficult or abstract terms could be visualized by icons or visual examples to make the term more concrete.
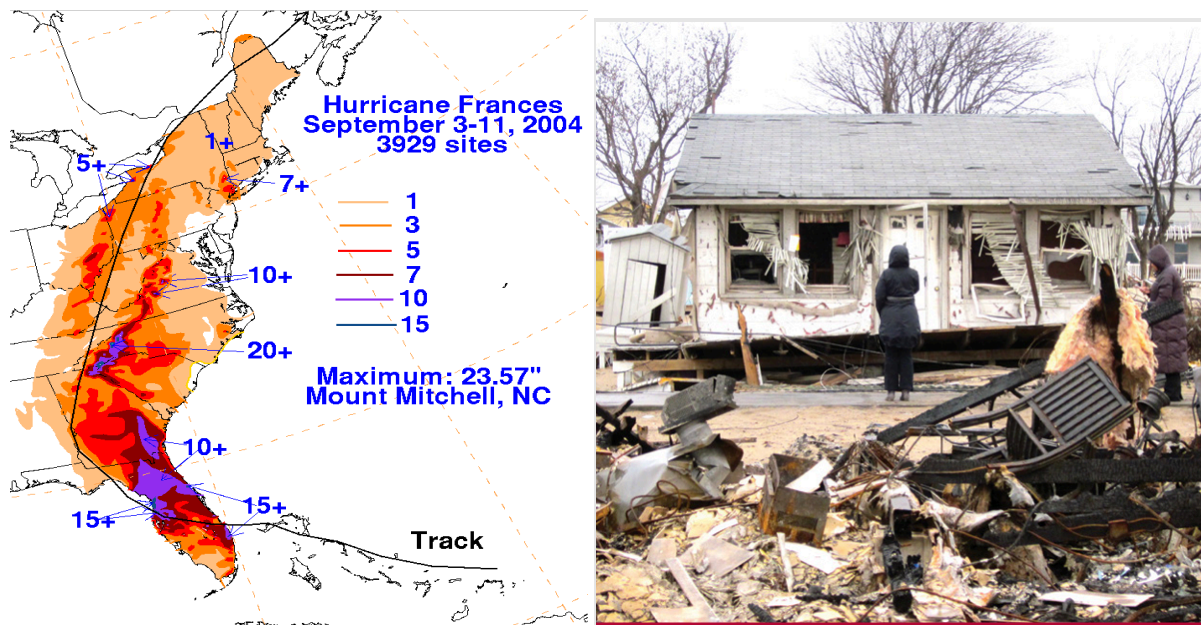

Figure 8: Iconic vs. indexical message. The hurricane map on the left is an iconic message for hurricane risks. The map and it's colours resemble hurricane damage. On the right is an indexical image of a house destroyed by a hurricane, indicating the danger of a hurricane.
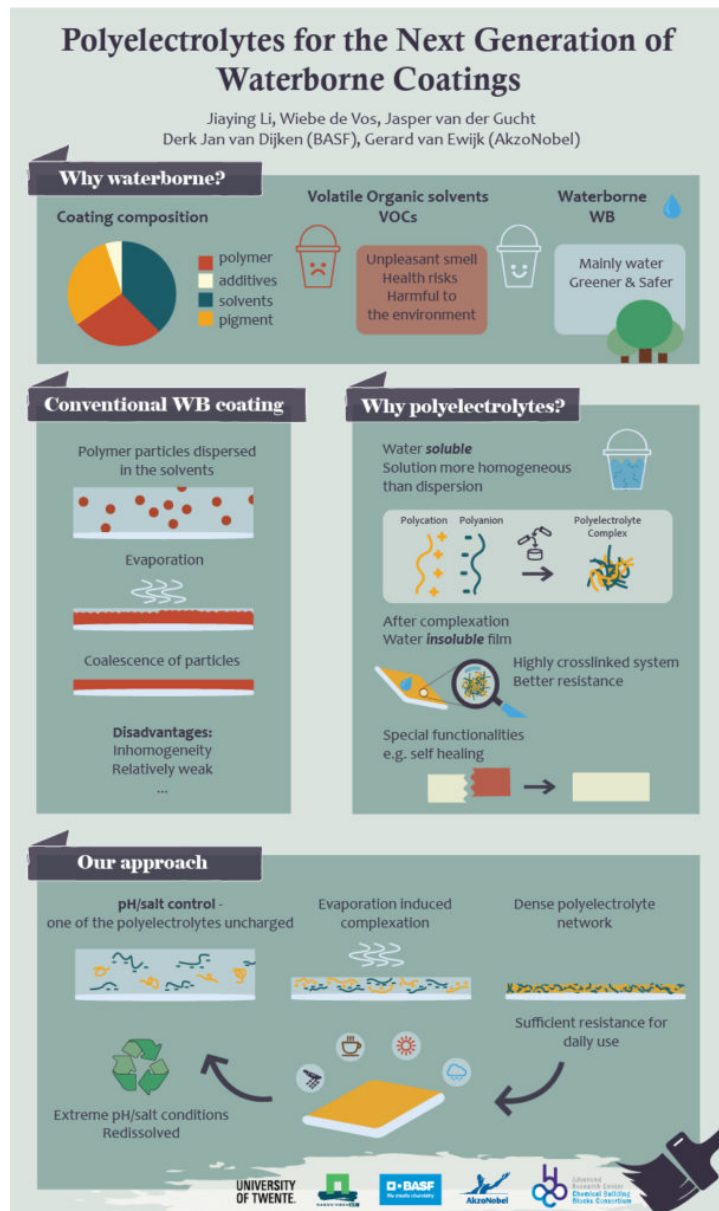
5.5 Rhetorics

In visual science communication, credibility was often considered by scientists and professionals. Information had to be presented as scientific and factual as possible to come over as a trusted source (Figure 9).

The target audience was considered important for determining the visual's design and how the informational message should be framed. The message was adjusted to the audience that had to be reached. For example, in climate change messaging, the message was adjusted to the audiences perceptions of climate change and their attitude toward it (Nicholson-Cole, 2005). To connect to the target audience, visuals were related to the audience spatially (environment was recognizable to that audience) and temporally (not too far in the future as that increased removal from the message).

One study mentioned how storylines in nature documentaries could be used to activate people to behave more pro-environmental (McCormack et al., 2021). Visual storytelling reduced the chance of people giving counter arguments as they are less aware of being manipulated by storytelling's entertaining nature. Explicit appeals should be limited, and humor was mentioned as a tool to lower the audience's guard.

One article discussed how rewilding was effectively framed in communication with a local community in Scotland. It was proposed to create a "repeopling" storyline where locals were put at the center in rewilding communication. In this study this was done by communicating the benefits that rewilding provided to the local community: "people, communities and livelihoods are key. Rewilding embraces the role of people – and their cultural and economic connections to the land" (Martin et al., 2021).

Figure 9 *Factual infographic. The authors used ethos to communicate that they are trustworthy recourse by including company- and institution logos at the bottom right.*

5.6 Characteristics of (Visual) Storytelling

Several key components of (visual) storytelling were discussed in selected literature. The most important components are listed here and discussed in the section below:

- The story plot focusses on the characters (protagonist) and their experiences
- The story plot includes a conflict which had to be resolved in which the character go through transformative change
- The story needs a chronical order (beginning, middle and ending)
- The story is relevant and credible in information that is presented

All of these components focus primarily on rhetorics; the message is made convincing by framing it in a storyline. A storyline was organized in a three-act structure which follows the chronical order of a story. First the characters are introduced (beginning), they are confronted with a conflict (midsection), and they resolve it by applying the insights they had during the story (Ending). Because the viewers see the character transform by overcoming the conflict, the empathic response increased attention, involvement, and information retainment of the communicated message. An example of a storyline is provided in Appendix 4, where the key components of storytelling can be recognized.

In creating a storyline two different narrative structures were identified. The observant structure uses the perspective of all actors in a story and is based on "what is happening" opposed to the expressive structure where emotions and feelings are described from the viewpoint of one of the actors.

5.7 Discussion points of storytelling in science communication

The high persuasive value of stories make that they were considered as "manipulative" or "activistic" (Dahlstrom, 2014). Dahlstrom (2014) mentioned that when storytelling takes an activistic turn, as in using storylines to force people in other thinking patterns or behaviours, several ethical questions arise.

When people do not know that they are manipulated with storylines it raised the question if the goal of communication should be to create an agreement to a preferred outcome or if personal autonomy to make choices should be promoted. In case of communicating (scientific) information the goal of storytelling should be comprehension and not persuasion (Dahlstrom, 2014).

Moreover, stories were mentioned to be ineffective if they were too simple or too complex. Stories could over-simplify information, creating misconceptions and thus creating distrust by the viewer (Fischer et al., 2020). On the other hand, storylines were considered not useful when the information was too complex as people did not understand what was communicated (Cortes Arevalo et al., 2020). Also, when audiences could not identify with the protagonist and the story did not adhere to their experiences, stories were not able to communicate the message.

6. Discussion

In the present study, the focus was on how and if storytelling could be an addition to visual communication about rewilding. The reviewed papers focused on visual communication and storytelling related to environmental processes, biology, or sustainability. Papers were analyzed by the identifying the following variables: gestalt, semiotics, rhetorics, characteristics of storytelling and discussion points in using storytelling.

It was found that gestalt principles were mostly used to improve the readability in visuals. Chunking or grouping information reduced cognitive load so that information could be more easily read and absorbed. In storytelling, the ordering of the sequence of visuals was mentioned as a gestalt principle. It had to be made clear where the story started and in what direction the visuals had to be read to progress through the story (Cohn, 2013). However, besides mentioning to organize visuals to the reading direction of the target audience, it was not discussed what other techniques should be applied to order the visuals in storytelling.

Semiotics in science communication were used for effective communication. Semiotic icons were used to facilitate recognition by the viewer, such as using a polar bear in climate change communication. Iconic animals are often used in nature conservation communication as flagship species (Jepson & Barua, 2015). These species are popular and likeable, thus are chosen as a marketing tool in raising funds to protect their habitat including all species that live there (Jepson & Barua, 2015). Nature areas are less marketable as sympathy is higher for certain inhabitants like the giant pandas, Bengal tigers and Asian elephants (Jepson & Barua, 2015). The giant panda is a successful flagship species as the donations they raised resulted in higher protection of their habitats (Entwistle, 2000). For rewilding communication this could mean that a likeable species has to be selected to represent a rewilded area.

Semiotic signs were also used to communicate emotions or elicit an emotional response and thus had an overlap with rhetoric principles. In storytelling, signs were used to communicate storyline aspects (passing of time or character's emotions). In environmental risk communication, indexical signs had the highest effect in informing about hurricane risk, as it resulted in the most evacuation

intentions (Rickard et al., 2017). However, in this study the indexical sign for hurricane danger was a photo of an inundated house. Why this was a successful indexical image for hurricane danger was unknown. What the effects would have been if another indexical sign had been chosen is unknown and thus should be studied further before this finding could be generalized for communicating environmental risks in visual science communication or visual storytelling.

Lastly, rhetoric principles were used differently in visual science communication and visual storytelling. Visuals in science communication provided information as factual as possible to come over as a trustworthy resource. On the other hand, in storytelling the emphasis was to connect emotionally with the audience to increase involvement. Current science communication struggles achieving this involvement, especially now when people are becoming resistant to some topics, like climate change (McCormack et al., 2021).

The transformative change the characters go through provide an empathetic connection which results in narrative transportation (being lost in a story) and thus make it storytelling a strong communication tool. However, this also leads to the discussion on the ethicality of using storylines in communication. Because stories are "entertaining", it hides their attempt to inform or influence the receiver. Storytelling might have the goal to influence the viewer, which may make the sender come over as less trustworthy and raises questions about ethicality (Dahlstrom, 2014). Should the goal of communication be to stimulate the reader's autonomy or to influence people to a preferred outcome? And if people know that they are manipulated with storytelling, how would that effect the trust between the sender and the receiver of information?

Nevertheless, when storytelling is used to inform and not influence, it can be a good communication tool for science and nature communication (Dahlstrom, 2014). This would mean for rewilding to consider multiple different actors in the storyline. The study of Martin (et al., 2021) identified storylines for effective rewilding communication. "repeopling" was one of them. Putting the different perspectives of people and stakeholders in the rewilding communication would most likely lead to most involvement.

Lastly, visual storytelling should not oversimplify information. The oversimplification of information could lead to misconceptions which could also result in distrust in the viewer (Fischer et al., 2020). However, in communication to a non-expert audience some simplification is inevitable. Thus, in the storyline, information should be provided as complete as possible without overcomplicating it by using scientific terms or complex figures.

6.1 Implications for creating storylines in communicating rewilding

Based on available studies discussed in this paper, a storyline for communicating rewilding will be proposed. Gestalt principles are used to order the visual story and to leave out unnecessary details, like complex background. Semiotics will be used to support the communication of emotions, for example with the use of text balloons. A charismatic animal will be selected to represent the protected area in the storyline.

As "repeopling" was considered an important aspect in rewilding communication (Martin et al., 2021) and to create an emotional connection with the reader, the locals should be framed as the protagonists of the story. The conflict these protagonists have to face is how the nature they love and live in is deteriorating because of climate change. Rewilding can be a solution to this conflict, however, the protagonists fear for wildlife conflicts, floods, and a changing landscape. In the beginning they are skeptic of rewilding because of these fears.

In the midsection of the story, the three essential processes of rewilding and how it will affect the community, will be explained. During the story, the protagonists undergo a transformative change: as they learn more about how rewilding will affect their community, some of the fears they had, are taken away. Near the ending, they are being informed by the benefits and disadvantages of rewilding and know what it would be to live in a rewilded area. They are asked to join the discourse in how rewilding could take shape and that they are a vital part making it a success.

To prevent having an activistic message, the story should focus on informing end educating about rewilding. The goal of the message should not be to manipulate people into rewilding but to

invite them into the discourse. Creating possibilities for discourse was mentioned as a very important factor in rewilding communication (Martin et al., 2021).

6.2 The story of Rewilding

Beginning: Introduction of the locals, stakeholders (e.g., NGO's) and the animal representing the conservation area. Some of the locals are afraid of rewilding as it might negatively affect their lives. They do not want rewilding to take place in the area they live in. However, they also do not like how nature is deteriorating.

Midsection: Conflict: "Their" nature is deteriorating, and biodiversity is lost. Rewilding is proposed as a potential solution to create a resilient ecosystem and to save their nature. However, rewilding also includes conflicts of interest and uncertainty. The processes and the consequences (positive and negative) they have on the community are discussed.

Ending: People realize that rewilding could be the solution to the loss of nature. They are asked to get involved in the discussion in how and if rewilding should take shape.

6.3 Limitations and future research

There were little empirical studies on the effect of storytelling. Most studies discussed frameworks for using storytelling in science and nature communication. Information and frameworks were based on available knowledge from storytelling in marketing and health education. There were only four papers in this study about visual storytelling. Future research should focus on applying the storytelling frameworks to study how effective it is in communicating science and nature conservation.

Also, in this study, a wide variety of visuals were discussed. Most of them were static visuals, however, also artworks and films were included. It is not known how the visual medium affected the different variables in this study. It is expected that some mediums lend themselves better than others

for storytelling. Because this study does not differentiate between the different visual mediums it is unknown which is most effective in communicating rewilding.

In case of ethicality, the line between informing and influencing is sometimes thin. Storylines provide a great communication tool, especially nowadays, in a media landscape that is breathing narratives (Dahlstrom, 2014). Stories are used everywhere online and people on social media will get most of their information via storytelling methods. More research could be conducted on the ethical implications of storytelling and how it can be ethically used in science communication. It is proposed that the observant narrative structure is studied in scientific visual storytelling as it is a more neutral and objective storytelling structure.

Moreover, it is important to get to know more about what storylines live in societies. How do those storylines match with those of science communication? And what do people expect in communication about nature and conservation? It was found by Rabinovich (et al., 2012) that when the people expect to be persuaded by a messenger, they were more receptive to persuasion rather than informative messages, while the opposite was true for people who believed that they were purely being informed. Thus, it is very important that future studies find out what is expected from society in communication and how societies narrative agree with the storylines in science communication.

7. Conclusion

Current visual science communication uses rhetorics to frame their message in a factual and trustworthy way. Visual storytelling uses a storyline with a plot to involve their viewers. Its persuasive nature raise ethical questions as storytelling may be used in an activistic way. However, when the focus is on informing and not influencing a storyline can be designed to increase involvement with rewilding. In this story locals will be put as the protagonist who have to overcome the conflict of the choice between rewilding or not. To not have a persuasive message people are left with a choice in the end and are motivated to join the discussion about rewilding. Because a lot is still unknown about

visual storytelling more research should be conducted, however it seems a promising communication

tool as long as ethical implications are being considered.

8. Bibliography

Agrawala, M., Li, W., & Berthouzoz, F. (2011). Design principles for visual communication. *Communications of the ACM*, *54*(4), 60–69. https://doi.org/10.1145/1924421.1924439

Barraza, J. A., Alexander, V., Beavin, L. E., Terris, E. T., & Zak, P. J. (2015). The heart of the story: Peripheral physiology during narrative exposure predicts charitable giving. *Biological Psychology*, *105*, 138–143. https://doi.org/10.1016/j.biopsycho.2015.01.008

Bietti, L. M., Tilston, O., & Bangerter, A. (2019). Storytelling as adaptive collective sensemaking. *Topics in Cognitive Science*, *11*(4), 710–732.

Braddock, K., & Dillard, J. P. (2016). Meta-analytic evidence for the persuasive effect of narratives on beliefs, attitudes, intentions, and behaviors. *Communication Monographs*, *83*(4), 446–467.

Cohn, N. (2013). Visual narrative structure. *Cognitive Science*, *37*(3), 413–452.

Cortes Arevalo, V. J., Verbrugge, L. N. H., Sools, A., Brugnach, M., Wolterink, R., van Denderen, R. P., Candel, J. H. J., & Hulscher, S. J. M. H. (2020). Storylines for practice: A visual storytelling approach to strengthen the science-practice interface. *Sustainability Science*, *15*(4), 1013–1032. https://doi.org/10.1007/s11625-020-00793-y

Dahlstrom, M. F. (2014). Using narratives and storytelling to communicate science with nonexpert audiences. *Proceedings of the National Academy of Sciences*, *111*(Supplement_4), 13614–13620. https://doi.org/10.1073/pnas.1320645111

de Joode, E. (2022, October 10). *Angst voor wolf groeit na meldingen van aanvallen op schapen, koeien en pony's*. https://nos.nl/artikel/2447852-angst-voor-wolf-groeit-na-meldingen-van-aanvallen-op-schapen-koeien-en-pony-s

Drew, S. E., Duncan, R. E., & Sawyer, S. M. (2010). Visual storytelling: A beneficial but challenging method for health research with young people. *Qualitative Health Research*, *20*(12), 1677–1688.

Egoh, B. N., Nyelele, C., Holl, K. D., Bullock, J. M., Carver, S., & Sandom, C. J. (2021). Rewilding and restoring nature in a changing world. *PLOS ONE*, *16*(7), e0254249. https://doi.org/10.1371/journal.pone.0254249

Entwistle, A. (2000). Flagships for the future? *Oryx*, *34*(4), 239–240. https://doi.org/10.1046/j.1365-3008.2000.00140.x

Fischer, D., Selm, H., Sundermann, A., & Storksdieck, M. (2020). Storytelling for sustainability: A definition and its implications for education and communication. In *Storytelling for Sustainability in Higher Education* (pp. 38–51). Routledge.

Gottschall, J. (2012). *The Storytelling Animal: How Stories Make Us Human*. Houghton Mifflin Harcourt.

Graesser, A. C., Olde, B., & Klettke, B. (2002). How does the mind construct and represent stories. *Narrative Impact: Social and Cognitive Foundations*, 229–262.

Harzing, A. W. (2007). *Publish or Perish, available from https://harzing.com/resources/publish-or-perish*.

Hu, J., Cheng, Y., Gan, Z., Liu, J., Gao, J., & Neubig, G. (2020). What makes a good story? Designing composite rewards for visual storytelling. *Proceedings of the AAAI Conference on Artificial Intelligence*, *34*(05), 7969–7976.

Huang, T.-H., Ferraro, F., Mostafazadeh, N., Misra, I., Agrawal, A., Devlin, J., Girshick, R., He, X., Kohli, P., & Batra, D. (2016). Visual storytelling. *Proceedings of the 2016 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies*, 1233–1239.

Jepson, P., & Barua, M. (2015). A theory of flagship species action. *Conservation and Society*, *13*(1), 95–104.

Jepson, P., Schepers, F., & Helmer, W. (2018). Governing with nature: A European perspective on putting rewilding principles into practice. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *373*(1761), 20170434. https://doi.org/10.1098/rstb.2017.0434

Joubert, M., Davis, L., & Metcalfe, J. (2019). Storytelling: The soul of science communication. *Journal of Science Communication*, *18*(5), E. https://doi.org/10.22323/2.18050501

Lorimer, J., Sandom, C., Jepson, P., Doughty, C., Barua, M., & Kirby, K. J. (2015). Rewilding: Science, practice, and politics. *Annual Review of Environment and Resources*, *40*, 39–62.

Majooni, A., Masood, M., & Akhavan, A. (2018). An eye-tracking study on the effect of infographic structures on viewer's comprehension and cognitive load. *Information Visualization*, *17*(3), 257–266.

Martin, A., Fischer, A., McMorran, R., & Smith, M. (2021). Taming rewilding - from the ecological to the social: How rewilding discourse in Scotland has come to include people. *Land Use Policy*, *111*, 105677. https://doi.org/10.1016/j.landusepol.2021.105677

Martinez-Conde, S., & Macknik, S. L. (2017). Opinion: Finding the plot in science storytelling in hopes of enhancing science communication. *Proceedings of the National Academy of Sciences*, *114*(31), 8127–8129. https://doi.org/10.1073/pnas.1711790114

McCormack, C. M., K Martin, J., & Williams, K. J. (2021). The full story: Understanding how films affect environmental change through the lens of narrative persuasion. *People and Nature*, *3*(6), 1193–1204.

Morris, B. S., Chrysochou, P., Christensen, J. D., Orquin, J. L., Barraza, J., Zak, P. J., & Mitkidis, P. (2019). Stories vs. facts: Triggering emotion and action-taking on climate change. *Climatic Change*, *154*(1), 19–36.

Nicholson-Cole, S. A. (2005). Representing climate change futures: A critique on the use of images for visual communication. *Computers, Environment and Urban Systems*, *29*(3), 255–273. https://doi.org/10.1016/j.compenvurbsys.2004.05.002

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., & Brennan, S. E. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *Systematic Reviews*, *10*(1), 1–11.

Perino, A., Pereira, H. M., Navarro, L. M., Fernández, N., Bullock, J. M., Ceaușu, S., Cortés-Avizanda, A., van Klink, R., Kuemmerle, T., & Lomba, A. (2019). Rewilding complex ecosystems. *Science*, *364*(6438), eaav5570.

Rabinovich, A., Morton, T. A., & Birney, M. E. (2012). Communicating climate science: The role of perceived communicator's motives. *Journal of Environmental Psychology*, *32*(1), 11–18.

Rewilding Stories: People Power. (2018, September 4). *Rewilding Europe*. https://rewildingeurope.com/blog/rewilding-stories-people-power/

Rickard, L. N., Schuldt, J. P., Eosco, G. M., Scherer, C. W., & Daziano, R. A. (2017). The Proof is in the Picture: The Influence of Imagery and Experience in Perceptions of Hurricane Messaging. *Weather, Climate, and Society*, *9*(3), 471–485. https://doi.org/10.1175/WCAS-D-16-0048.1

Rodríguez Estrada, F. C., & Davis, L. S. (2015). Improving Visual Communication of Science Through the Incorporation of Graphic Design Theories and Practices Into Science Communication. *Science Communication*, *37*(1), 140–148. https://doi.org/10.1177/1075547014562914

Skulmowski, A., & Rey, G. D. (2020). The realism paradox: Realism can act as a form of signaling despite being associated with cognitive load. *Human Behavior and Emerging Technologies*, *2*(3), 251–258.

Sugiyama, M. S. (1996). On the origins of narrative. *Human Nature*, *7*(4), 403–425.

Sweller, J. (2011). CHAPTER TWO - Cognitive Load Theory. In J. P. Mestre & B. H. Ross (Eds.), *Psychology of Learning and Motivation* (Vol. 55, pp. 37–76). Academic Press. https://doi.org/10.1016/B978-0-12-387691-1.00002-8

van den Broek, J., Koetsenruijter, W., de Jong, J., & Smit, L. (2010). Beeldtaal. *Perspectieven Voor Makers En Gebruikers H*, *4*, 46–71.

Van Merriënboer, J. J. G., & Sweller, J. (2010). Cognitive load theory in health professional education: Design principles and strategies. *Medical Education*, *44*(1), 85–93. https://doi.org/10.1111/j.1365-2923.2009.03498.x

Appendix 1A: Search terms Google Scholar, Scopus & Web of science in the Program Publish or Perish

Title word: Storytelling

Key words:

"Visual storytelling" AND "storytelling" OR "narrative" AND "graphic" OR "Infographic" OR Illustration OR comic AND "science communication" AND Ecology AND Enviroment* OR Sustainab* OR Rewilding AND biolog*

Title word: None

"Visual" OR "Infographic" OR Illustration OR comic AND "science communication" AND Gestalt AND semiotics OR sign OR Icon AND Rhetorics or framing AND Ecology AND Enviroment* OR Sustainab* OR rewilding AND biology

Title word: Visual communication

Key words:

"Visual" OR "Infographic" OR Illustration OR comic AND "science communication" AND Ecology AND Enviroment* OR Sustainab* OR rewilding AND biology

Appendix 1B: **Examples of excluded titles**:

Menduni, E, & Catolfi, A (2013). Digital aesthetic forms between cinema and TV. The need for new research directions. G| A| M| E Games as Art, Media, Entertainment, gamejournal.it, https://www.gamejournal.it/author/gabriele-ferri/page/2/

Tang, T., Rubab, S., Lai, J., Cui, W., Yu, L., & Wu, Y. (2018). iStoryline: Effective convergence to hand-drawn storylines. IEEE transactions on visualization and computer graphics, 25(1), 769-778

Bernabei, R., Freeman, K., & Power, J. (2011). The Value of Storytelling in Product Design. In Handbook of Research on Trends in Product Design and Development: Technological and Organizational Perspectives (pp. 447-460). IGI Global.

Appendix 2: Variables scored in the selected papers

Variables were scored if they were mentioned explicitly in the papers or if their key concepts were implicitly mentioned.

	Description with key words	Scored when the following terms were mentioned
Data set characteristics	**Authors, Journal, publication date, main topic,**	-
Type of visual	The **type** or types of visuals that were discussed in the paper (e.g., **infographic, film, static visuals**)	-
Gestalt	Improving **readability** by bringing **order** in the visual. Scored when the paper mentioned how the visual should be organized.	Organization of visual elements Reduction "Signal-to-noise ratio" Readability Lay-out Reduce cognitive load
Semiotics	Use of **signs** to imply a meaning. Scored when the use of signs was mentioned in the paper.	Visual language Use of colour ** Signs Symbols Icons Indexical Semiotics

Rhetorics	**Persuasiveness** of the message. Scored when it was mentioned how the message was communicated to reach or convince the audience.	Sender of the message Target audience Framing of the message Use of colour ** Personalization or use of emotion Arguments Ethos / logos / pathos
Characteristics of visual storytelling	What are the characteristics of a story in communication. Scored when it was mentioned how a story should be created in visual storytelling for communication.	Structure of a story Story-elements Narrative Storytelling tecniques
Discussion points of storytelling	If the authors refer to cases in which storytelling should not be used in communication or disadvantages of using storytelling	Cons or disadvantages of storytelling Ethical implications

Made by Matteo Farinella
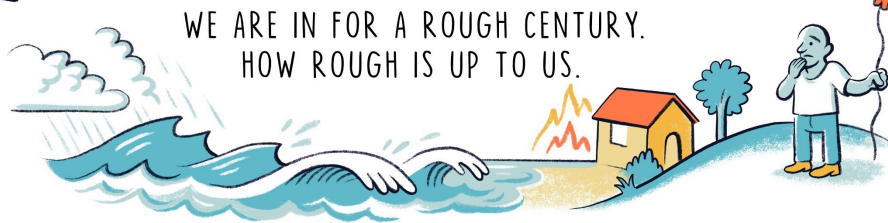
THAT'S BECAUSE IT TAKES DECADES FOR THE CLIMATE TO RESPOND TO AN UPTICK IN CO2.

CO2

TEMPERATURE

YEARS

ppm C°

THINK ABOUT HOW IT FEELS TO JUMP INTO BED: THE SHEETS FEEL COLD AT FIRST,

BUT EVENTUALLY, THE BED WARMS UP, RESPONDING TO YOUR BODY HEAT.

IF THE BLANKET IS TOO THICK, YOU START TO OVERHEAT.

THE SAME THING HAPPENS WITH THE CLIMATE. WE GENERATE POLLUTION,
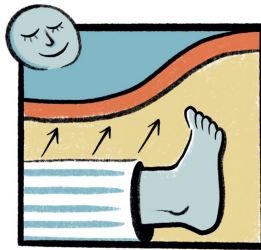
THAT POLLUTION FORMS A BLANKET AROUND THE EARTH,

THAT BLANKET TRAPS HEAT, AND THE PLANET GROWS WARMER AND WARMER.
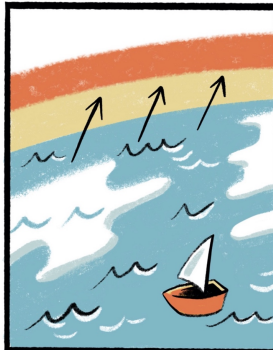
SO, WHEN PEOPLE POINT TO WILDFIRES IN CALIFORNIA OR AUSTRALIA
AND SAY, "THIS IS THE NEW NORMAL," THEY'RE WRONG.

IT'S GOING TO GET
A WHOLE LOT WORSE...
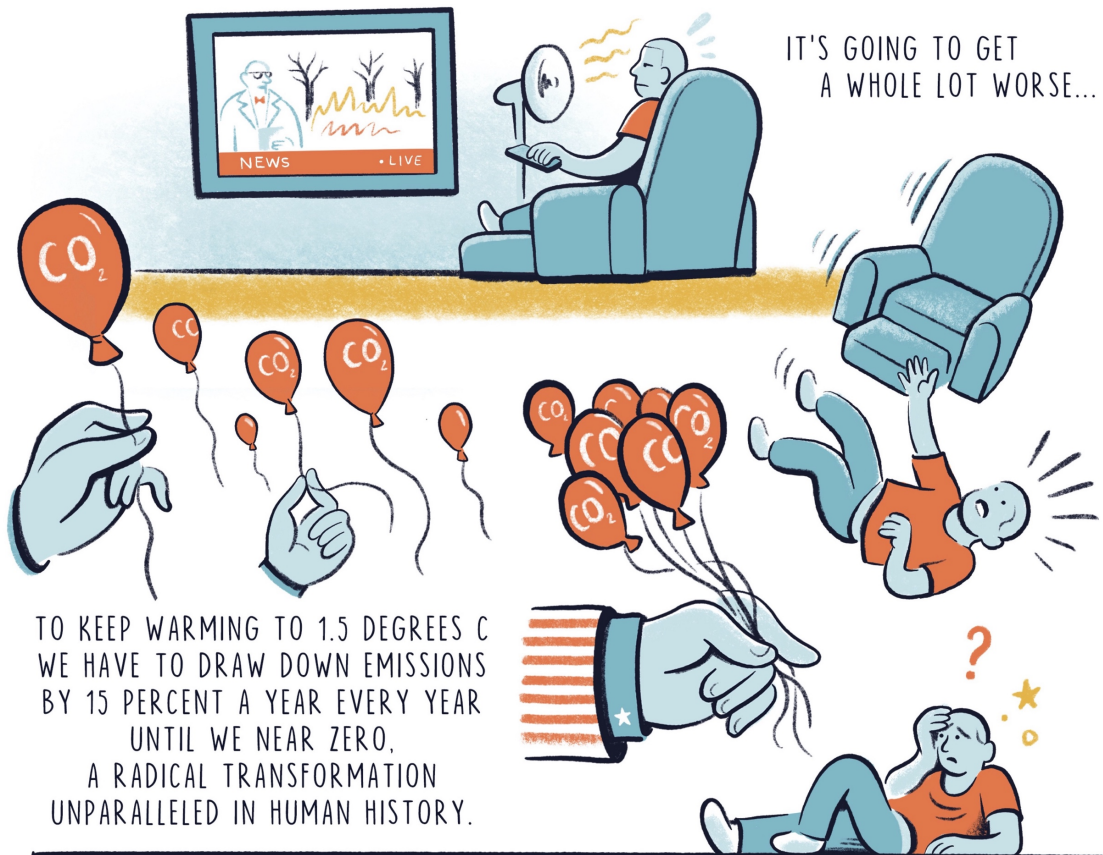
TO KEEP WARMING TO 1.5 DEGREES C
WE HAVE TO DRAW DOWN EMISSIONS
BY 15 PERCENT A YEAR EVERY YEAR
UNTIL WE NEAR ZERO,
A RADICAL TRANSFORMATION
UNPARALLELED IN HUMAN HISTORY.
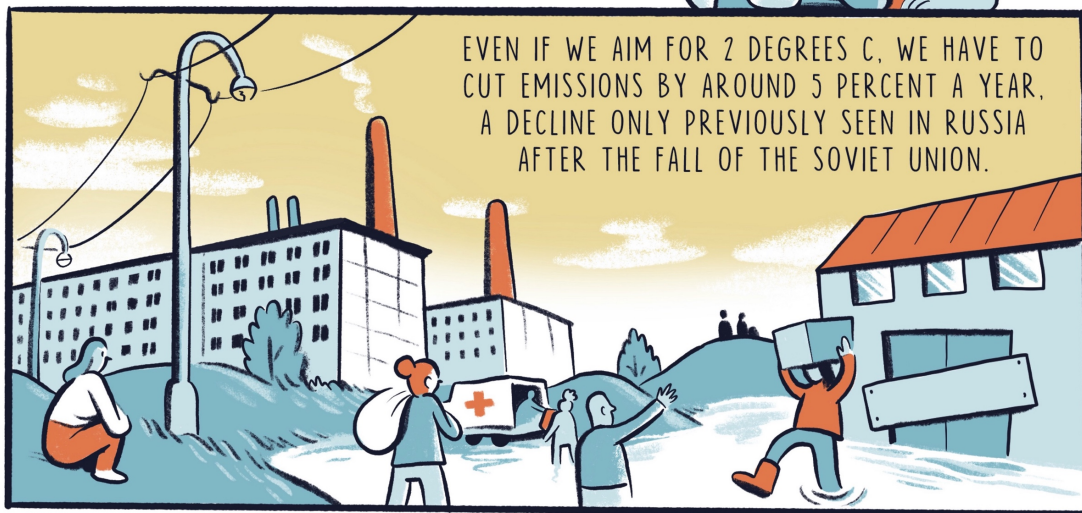
EVEN IF WE AIM FOR 2 DEGREES C, WE HAVE TO
CUT EMISSIONS BY AROUND 5 PERCENT A YEAR,
A DECLINE ONLY PREVIOUSLY SEEN IN RUSSIA
AFTER THE FALL OF THE SOVIET UNION.