

Design as a Tool for “Wicked Problems”: An Action-oriented Visual Narration

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Abstract: This paper explores the application of visual narratives in addressing "wicked problems" such as ecosystem imbalances and biodiversity loss. Firstly, it reviews the evolution of the design field's focus on "wicked problems" and how design has shifted from "post-intervention" processes to seeking more profound solutions. Subsequently, the paper presents a case study of the Tianjin Qilihai Wetland, demonstrating how design intervenes in local ecological and social issues as a tool and medium to tackle wicked problems. Based on this, four methods of action-oriented visual narrative are proposed: shifting from stakeholders' relevant maps to collaborator maps, self-organized visual materials, participatory experiences, and visual narratives of products in social contexts. These methods, through the lens of visual narratives, aid in understanding and addressing complex ecological and social issues. Finally, the paper concludes by emphasizing the advantages and significance of visual narratives in addressing wicked problems, underlining their key role in promoting the integration of design and social action to achieve more comprehensive and profound problem-solving.

Keywords: wicked problems, visual narratives, Qilihai Wetland

1. Introduction

In 2002, Paul J. Crutzen introduced the concept of the "Anthropocene" in the journal Nature. The article suggested that the beginning of the Anthropocene coincided with James Watt's invention of the steam engine in 1784 [1]. This undoubtedly indicates the decisive impact of the rise of the Industrial Revolution on the environment. Particularly over the past century, the rapid development of industrial civilization has led to a global ecological crisis, causing irreversible harm to the entire Earth's biosphere. In order to ensure human continuity, ecological civilization has become the prevailing trend for humanity. However, most ecological issues, social issues, economic issues, and other problems intersect, forming complex "wicked problems."

In 1973, Horst Rittel and Mel Webber first proposed the concept of "wicked problems." Rittel pointed out that most problems faced by designers can be classified as "wicked problems." He defined these problems as social system issues that inherently have flaws and information confusion during their formation, involving multiple users and decision-makers with conflicting values, making the entire system's network difficult to discern clearly. These problems possess complex and unique characteristics, such as ecosystem degradation and biodiversity loss. The process of solving

these problems itself is a process of understanding the problems, which is why "wicked problems" do not have a clear endpoint. When evaluating solutions to "wicked problems," judgments are often made based on the interests and values of various stakeholders, rather than simple right or wrong assessments. It is worth noting that any solution, when implemented, may lead to a chain reaction over an extended period [2]. Hence, each "wicked problem" is unique, making their handling extremely challenging.

Originally, design, as a professional activity, aimed to utilize industrial technology in the early 20th century to design mass-produced products. However, with the increasing public attention to "wicked problems" like climate crisis and biodiversity loss, the application of design has expanded into services and organizations, and its process has shifted from closed-ended to open-ended. As described by Ezio Manzini in the book "Design, When Everybody Designs," today's design is a culture and practice that focuses on achieving desired functionality and meaning in things. Design happens within an open collaborative process, where various actors can participate [3]. Visual narrative, as a means of conveying information through visual elements, becomes an essential tool for designers. Compared to textual language, visual narratives can better help the audience understand and remember complex information.

This paper takes the strategies adopted by the contemporary design field in addressing "wicked problems" within the context of the Anthropocene as its starting point. Through a design practice case study conducted by the author in the Qilihai Wetland, Tianjin, China, it explores how visual narratives, as tools for today's designers confronting "wicked problems," can inspire and propel actions among different stakeholders.

2. Design Intervention in “Wicked Problems”

Western societies' attention to "wicked problems" such as ecological imbalances and biodiversity loss began in the late 20th century. In 1962, Rachel Carson emphasized the importance of natural balance for human survival in her work "Silent Spring," triggering widespread concerns in Western society about environmental ecological issues [4]. However, in the capitalist society of that time, this concern did not receive universal support as it touched the interests of relevant entrepreneurs, and these problems lacked a direct and explicit solution. It was not until 1987 when the Brundtland Report proposed the concept of "sustainable development," bringing together economic, social, and environmental issues [5], which provided a new perspective for addressing these "wicked problems." This open interpretation led various groups, organizations, and countries with different objectives to jointly face the challenges of these "wicked problems."

The design field's attention to "wicked problems" stems from early pioneers such as Victor Papanek and Richard Buckminster Fuller. They emphasized the importance of design in achieving global sustainability and social justice [6], thereby guiding more designers to pay attention to related issues. However, when "green design" emerged in the 1980s, although ecosystem and environmental elements became important principles in design thinking, as a form of "post-intervention" it could only adopt remedial measures to mitigate or reduce harm within a certain range, without addressing the root problem. To seek more profound solutions, Terry Irwin from Carnegie Mellon University proposed "Transition Design" as a strategy to address "wicked problems" in the 21st century, such as climate change, biodiversity loss, depletion of natural resources, and widening wealth gaps. Irwin's theory emphasized the need for "global-localism," which involves locally-based, region-specific ways of living while maintaining global information and technological awareness and exchange [7]. Additionally, Professor Ezio Manzini from Politecnico di Milano in Italy also contributed to the transformation in the design field. He advocated sustainable design and social innovation on a global scale. Manzini proposed a focus on design process and methods, including new design tools, technologies, theories, and approaches, to

address and discuss environmental, economic, and social "wicked problems" [8]. These shifts mark a turning point in the practice and context of the design profession, driven by design ethics. This transformation is reflected not only in designers' attention to "wicked problems" and their strategies for solving them but also in their in-depth understanding and innovative application of design processes and methods.

Visual narrative, as a traditional design technique, utilizes visual elements familiar to designers, such as images, charts, and graphics, to convey information and tell stories. When facing complex problems, visual narratives can serve as an effective tool. In the early stages of research, visual narratives can help designers understand and construct narrative structures between systems. In the middle stage of research, visual narratives can be transformed into specific outputs to guide and coordinate actions of various stakeholders, promoting problem-solving. In visual narrative research related to "wicked problems," researchers can select events or phenomena from the real world and record and process them visually. This is not only a part of the research process but also could be the final scientific output. Visual materials created by researchers themselves can better control the data collection process and generate more contextually rich materials. In theory, this approach allows for a deeper understanding of the limitations of the materials, such as external influences and sample characteristics [9]. This paper presents a design practice case study conducted in the Qilihai Wetland, Tianjin, China, demonstrating how design intervenes in local ecological and social issues as a tool and medium to tackle "wicked problems." In this practice, we use visual narrative as a method and means to analyze and interpret the complex factors of local ecological issues and explore various design possibilities within the structure of contradictions.

3. Tianjin Qilihai Wetland Design Case

3.1. Background

Tianjin Ninghe is located in the northeastern part of Tianjin city. With a history of over 500 years as a fishing village, Ninghe County was established in the ninth year of Emperor Yongzheng in the Qing Dynasty (1731), and its residents mainly rely on fishing and salt production for their livelihood [10]. Aquaculture has been a traditional industry in the area and an important means of subsistence for the local residents. Qilihai Wetland, located in the southwest of Ninghe, (39°16'N~39°19'N, 117°27'E~117°38'E) is often referred to as the "kidney" of the Beijing-Tianjin-Hebei region due to its significant environmental, social, and economic value. Qilihai Wetland is an integral part of the Tianjin Ancient Coast and Wetland National Nature Reserve and an important geological relic. It consists of a core area, an experimental area, and a buffer area, with the core area preserving the most complete oyster reefs, shell banks, and ancient marsh lakes. These natural relics hold essential value and significance for interdisciplinary research in global paleogeography, paleoclimate, paleoecology, as well as for analyzing modern coastline evolution and sea level changes [11]. In terms of natural ecology, Qilihai Wetland boasts rich vegetation. According to statistics, between 2007 and 2014, the number of wild plant species increased by 34, and cultivated plant species increased by 109, with a total of 290 species of vegetation. However, the number of wild plant species is relatively low, and most of the increased species are crops planted to increase farmers' income and green landscape plants. The main reason is human activity, which has altered the wetland's diversity [12]. Wetlands not only provide abundant natural resources for humans but also serve as vital habitats for animals.

In the food chain of the wetland ecosystem, birds occupy the top position, and their abundance and distribution are essential indicators reflecting the ecosystem's condition, monitoring biodiversity, and describing environmental quality. Tianjin is located in the East Asia-Australia migratory bird flyway, serving as an important stopover for waterbirds in eastern China's wetlands. A study in 2021

titled "Analysis of Winter Waterbird Diversity and Priority Conservation Areas in Tianjin" recorded 15 species of national key protected waterbirds in nine sample sites in Tianjin's four districts during winter. Among them, one species is classified as Critically Endangered (CR) on the IUCN Red List, two species as Endangered (EN), and four species as Vulnerable (VN) [13]. Among them, the Oriental White Stork (*Ciconia boyciana*) is a bird species listed as endangered by the IUCN and the Chinese government. The total known population is around 2000-2500 individuals. They are migratory birds that travel between Southeast Russia's Far East and Southeast Asia each year. Qilihai Wetland serves as an essential distribution and rest area for these storks and many other species [14].

3.2. Using the Human-bird Conflict as a "Point of Entry"

In December 2019, bird conservation volunteers in Tianjin Ninghe found eight critically endangered Oriental White Storks in a fish pond. After investigation, it was discovered that the pond owner had used an excessive amount of fungicides, which may have caused the death of these birds [15]. Additionally, there are other conflicts between humans and birds, such as firing shots at birds entering fish pond areas, leading to the scaring and subsequent death of some endangered and vulnerable bird species after colliding with power lines [16]. These incidents reveal the diverse perspectives and attitudes of local stakeholders towards ecological issues, including biodiversity conservation. For research with an ecological and biodiversity conservation focus, understanding the local context and the local people's ways of thinking about environmental issues is crucial. Moreover, in-depth research and understanding of the social complexity within environmental crises are also essential [17]. Irwin has compared the methods of transition design to Chinese acupuncture therapy. Therefore, for different "wicked problems" in different places, we first need a map labeled with "acupuncture points." Thus, we take these events as a point of entry and create a stakeholder-related map (Figure 1) to gain a visual index for a deep understanding of the relevant issues in the area [7].

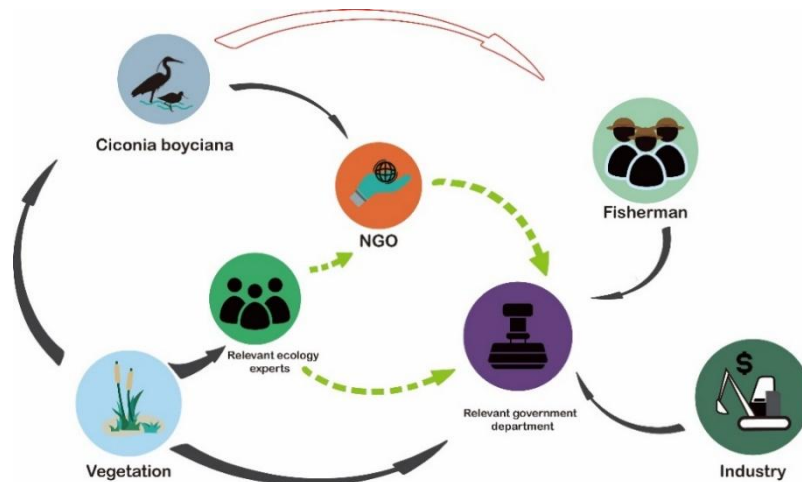


Figure 1: Stakeholder-related map.

4. Action-oriented Visual Narratives

4.1. From Stakeholder-related Map to Collaborator Map

In the initial stage of the project, we constructed a stakeholder-related map (Figure 1) to enable the design team to gain a deeper understanding of the "wicked problems" faced in the region and their related influencing factors. These stakeholders include both human and non-human entities, such as

non-governmental organizations, fishermen, local governments, ecological experts, and wild birds, among others. Each stakeholder plays a crucial role within this system, and their decisions are influenced by feedback from other stakeholders. However, the diverse intentions and goals may lead to stagnation in the socio-ecological system. Therefore, we need to establish more effective communication mechanisms among different stakeholders. By adopting research methods from anthropology and sociology, such as in-depth interviews and field research, we optimized the stakeholder-related map into a collaborator map (Figure 2) in the mid-term of the project, based on the principle of "collaboration." This collaborator map represents the ideal state of the optimized stakeholder-related map and serves as a visual guide to drive the design process. It is essential to note that the collaborator map is not static but rather expands and adjusts as the design research progresses.

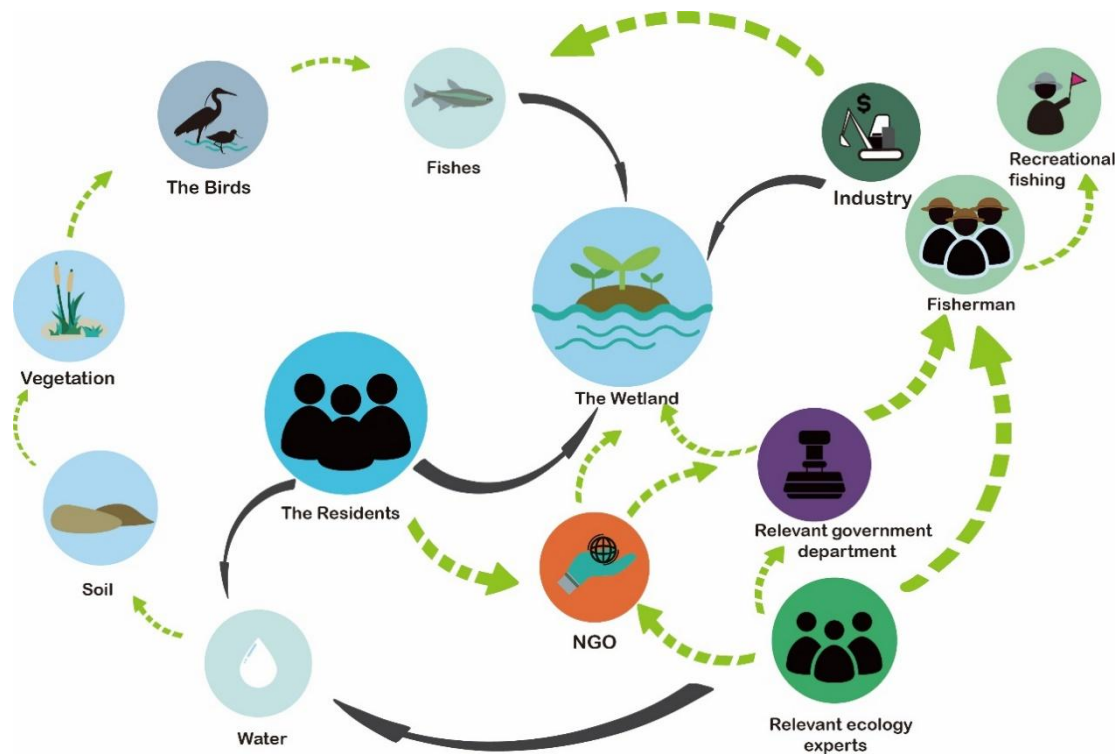


Figure 2: Collaborator map.

4.2. Self-organized Visual Materials

Luc Pauwels suggests that visual materials organized by researchers themselves can better aid communication and interaction within specific contexts [18]. The wetland introduction handbook aims to help the public gain a comprehensive understanding of the natural environment and human activities in and around the wetland (Figure 3). The handbook employs various visual methods to introduce the formation, ecological conditions, native flora and fauna, and the modern social ecological development history of the wetland in a friendly and understandable manner. Throughout the organization of visual materials in the wetland introduction, we adopted a self-organized visual material approach to ensure that the materials are easy to read while maintaining scientific accuracy and precision of information. For instance, in the presentation of bird species and local plants (Figure 4), we referenced the national bird database and local common species to contextually showcase common waterbirds and aquatic plants. Different habitat types were matched with specific bird species, enabling the public to better understand the habits of local waterbirds and their potential habitats.

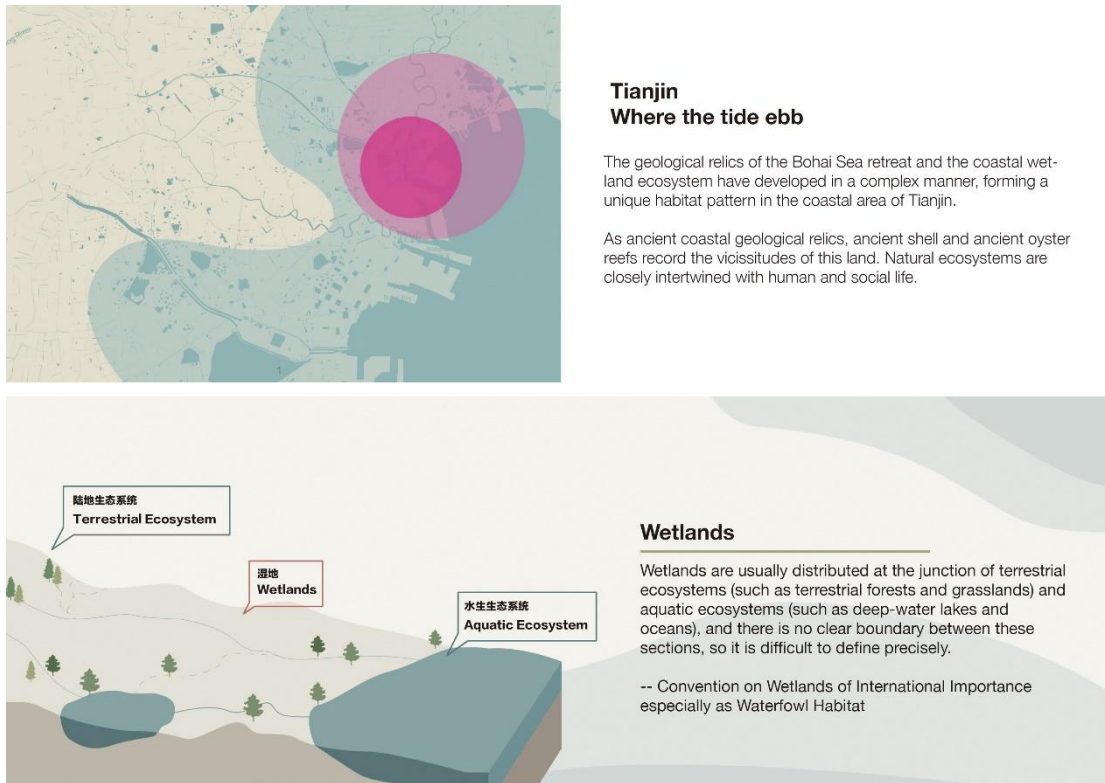


Figure 3: Wetland introduction handbook.

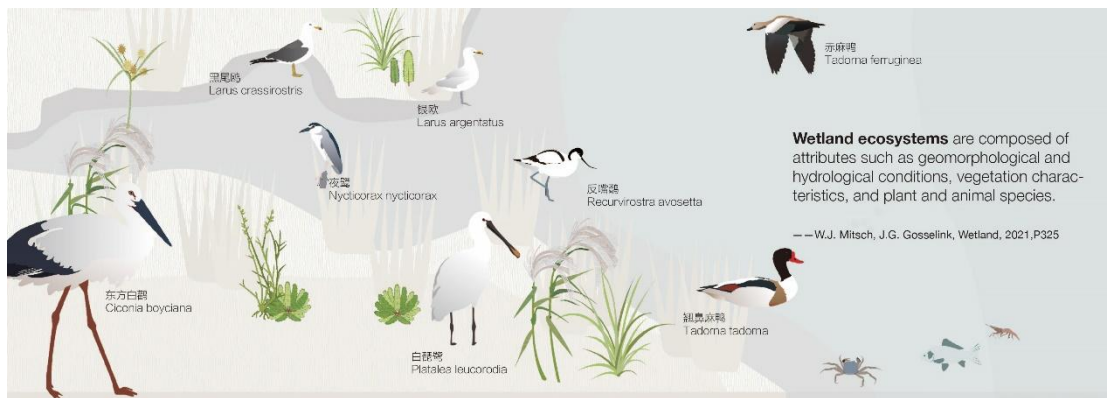


Figure 4: Bird species and local plants.

4.3. Participatory Experience

Participatory experience is vital in visual narratives; it can help change the relationship between researchers and participants and allow participants to contemplate research topics and their relationships in daily life by reducing researchers' intervention [19]. In our wetland research, we used LEGO models and WeChat stickers to provide participatory experiences. We designed a LEGO model of an Oriental White Stork, which is an educational visual image (Figure 5). Children can experience and understand the behavior and habits of the Oriental White Stork in the wetland by assembling the LEGO model. This hands-on experience may leave a profound impression on children and stimulate their curiosity. Additionally, we released WeChat stickers of the Oriental White Stork on the social networking platform, making the relatively unfamiliar image of the Oriental White Stork accessible to the public (Figure 6). The widespread use of these stickers on

social media can help draw attention to the Oriental White Stork, a wild animal in need of special protection.

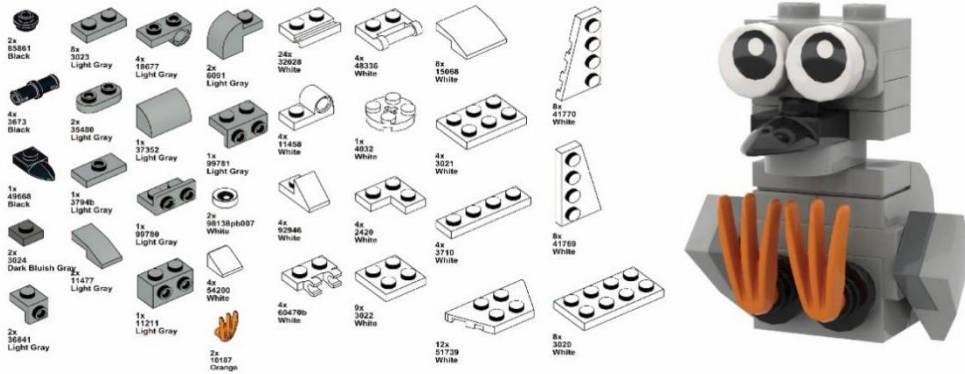


Figure 5: LEGO model of oriental white stork.



Figure 6: WeChat stickers.

4.4. Visual Narratives of Products in Social Context

As designers, we can think about and address social issues through proposing product design solutions. There are various visual expressions in product design, including but not limited to the appearance of designed items. For example, the introduction and promotion of products in a social context may also utilize visual narratives [20]. In this project, we focus on the relationship between human activities and the Oriental White Stork and use it as a starting point to design the Fish Pond Protector and Easy-Assemble Bird Nests. The Fish Pond Protector aims to protect the labor achievements of fishermen while avoiding harm to the Oriental White Stork. Individual fishponds have richer fish resources than natural wetlands, making them more attractive to the Oriental White Stork, leading to conflicts between fishermen and wild birds. Through studying the behavior of birds, we discovered that birds can see ultraviolet light (Figure 7). This finding inspired our design: we installed facilities in the fishpond to prevent birds from seeing the fish in the pond, thus avoiding economic losses for fishermen.

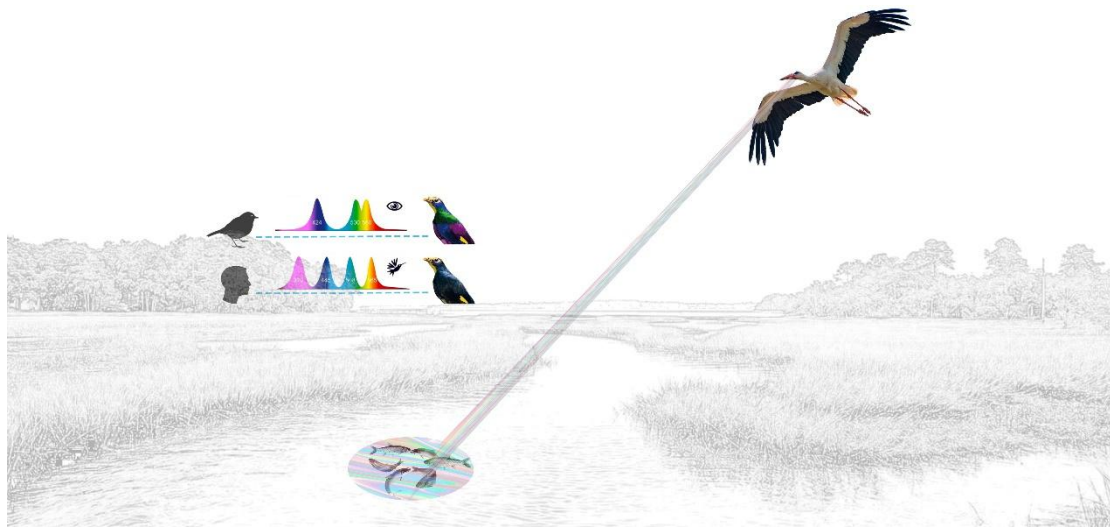


Figure 7: Bird-guiding design.

The Easy-Assemble Bird Nest is a low-cost, easy-to-assemble bird nest structure designed to assist bird volunteers in protecting birds. The Oriental White Stork is one of the migratory birds passing through this wetland and sometimes chooses to breed here. However, due to the wetland's lack of tall trees, they often nest on high-voltage towers, which is dangerous for both birds and humans. Therefore, we designed this easy-to-build nest structure, suitable for 1-2 people, for volunteers with limited manpower. By combining flexible and rigid materials, the stability can be maintained up to a height of 7.5 meters, providing a safe nesting site for the Oriental White Stork (Figure 8).

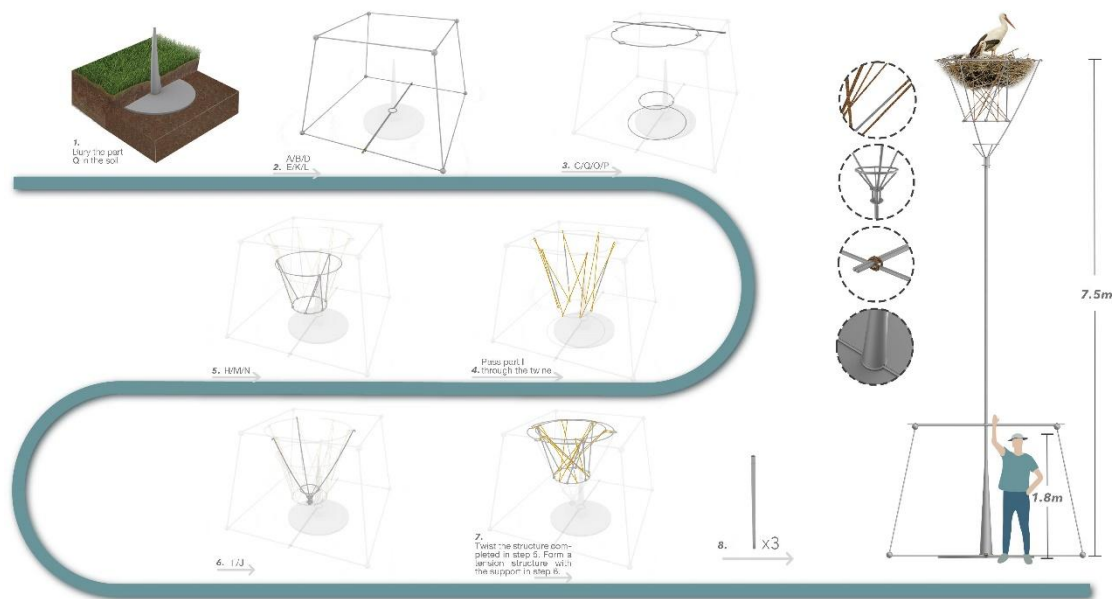


Figure 8: Artificial bird nest.

5. Conclusion

In the case study of Tianjin Qilihai Wetland, we explored the application of visual narratives in addressing ecological and social "wicked problems." We further proposed four action-oriented methods guided by visual narratives: 1) the transformation from a stakeholder-related map to a

collaborator map, serving as a visual index for gaining a deeper understanding of the region's related issues; 2) the use of self-organized visual materials to ensure readability and scientific accuracy of information; 3) the introduction of participatory experiences to change the relationship between researchers and participants, encouraging participants to contemplate research topics and their relationships in daily life; 4) visual narratives of products in a social context, contemplating and addressing social issues through proposing product design solutions. These methods, through the medium of visual narratives, assist people in better understanding and addressing complex ecological and social issues.

The practical work demonstrated the advantages of visual narratives, which present complex information in an intuitive and understandable manner through images, visual symbols, and other forms. This makes visual narratives a powerful tool for information dissemination and meaning construction. When facing complex ecological and social problems, visual narratives help us gain a deeper understanding of the essence of the problems. The ultimate goal is to provide people with a comprehensive and systematic perspective and thinking path, promoting the understanding of different stakeholders and fostering the development of social actions. Traditional design approaches may not offer effective solutions when dealing with "wicked problems" like ecology and biodiversity. However, by employing the visual media that designers excel in and utilizing narratives as a tool, we can ignite broader social attention and discussions, further guiding the actions of different stakeholders. The action-oriented approach of visual narratives aims to integrate design with social actions, achieving more comprehensive and profound problem-solving. Through visual narratives, we can transform complex issues into actionable maps and various solutions, enabling the public to understand and participate, thus driving systemic and effective actions.

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