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Sensing a Lagoon: Distance, Care, and Cormorants

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Abstract By questioning the dichotomy between epistemology 'from above' and 'from below', this article presents a multidimensional and multisensory analysis of the Venetian Lagoon ecosystem. It first investigates remote sensing techniques applied to Venetian coastal management, artisanal fishery, and archaeology, tracing the evolution of environmental remote sensing through the work of geographer Evelyn L. Pruitt, who coined the term. The focus then shifts to the cormorants inhabiting the lagoon, whose movement between air and water in search of food – sparking conflicts with fish farmers and anglers – reframes the divide between the world above and the one below the water's surface, offering a more-than-human perspective on the so-called vertical turn.

Keywords Venetian Lagoon. History of Remote Sensing of the Environment. Vertical Turn in Visual Culture. Cormorants (*Phalacrocorax carbo sinensis*). Multispecies Relations.

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1 Introduction

A flock of cormorants perches on a wooden structure rising from the lagoon waters near Ponte della Libertà, the bridge that links Venice to the mainland. In winter, their regular presence in this area is marked by the white excrements staining the upper poles. Yet, this detail does not take away from my fascination with their elegant presence and choreographic arrangement, which follows the geometry of the human-made structure, forming a small square within a larger rectangle **[fig. 1a-b]**. The sinuous bodies of the cormorants, their metallic black and bronze plumage visible in the classical spread-wing posture, punctuate the lagoon landscape. Mysterious and disquieting, they appear as the living counterparts to the symbolic birds carved into the *patere*, the ornamental bas-relief discs that adorn Venetian palaces.[1]

Figure 1a Cormorants perch on the infrastructure, marking the locations of methane gas valves in the Venetian Lagoon waters near Ponte della Libertà, December 2024. Photo by the Author

1 In Venetian religious and civil architecture, a *patera* is a bas-relief disc, typically carved in Istrian stone or marble and commonly used between the eleventh and fourteenth centuries to adorn medieval buildings with depictions of animals that carry moral or allegorical meanings. On Venetian *patere* and medieval bestiaries, see Marzemin 1937 and Riccioni 2019.

Figure 1b Detail of cormorants perching on infrastructure in Venice. Photo by the Author

The poses and behaviour of these animals, which have become increasingly pervasive in the Venetian Lagoon, not only reveal unexpected aspects of the lagoon's avifauna but also draws attention to the human infrastructure that the birds have appropriated. The wooden and metal poles on which they perch are protective structures designed to alert passing boats to the presence of methane gas valves in the water. This intricate network of underwater pipes – delivering gas, drinking water, and electricity to the lagoon's islands – is signalled by cylindrical pillars topped with spherical markers. Each sphere displays a letter that denotes the hidden element for which it stands: 'M' for methane, 'E' for electricity, and 'A' for aqueduct. Solitary cormorants can often be seen perched atop these metallic spheres, reminiscent of the celestial and terrestrial globes housed in the Doge's Palace.[2] Beneath them, traffic signs warn: "no mooring and anchoring". Given that the average depth of the Venetian Lagoon is only approximately 1.2 meters, boats must navigate along designated waterways marked by *briccole* – clusters of large larchwood poles bound together.[3] These typical elements of Adriatic lagoons not only guide navigation but also serve as daytime roosts for birds. Thus, on the one hand, specific features of the landscape reveal the otherwise

2 On the geographical maps and globes of the 'Scudo' Room in Venice Doge's Palace, see Gallo 1943. On the history of terrestrial and celestial globes, see Stevenson 1921.

3 In 2018, a boat collided with a steel pipeline of the aqueduct, causing significant damage and cutting off water supply to part of Venice (*Il Gazzettino* 2018b).

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hidden human infrastructure, visible only during construction or maintenance work.[4] On the other hand, what happens underwater directly influences the aesthetic experience of the landscape.[5]

This article explores two distinct ways of experiencing the Venetian Lagoon, both of which rely on distant perspectives to approach what lies beneath the water's surface. The first section examines the application of remote sensing techniques in the context of the lagoon environment, focusing on coastal management, artisanal fishery, and archaeology. These case studies provide a foundation for reflecting on the concept of remote sensing and tracing its evolution through the writings of Evelyn L. Pruitt, the geographer who coined the term 'remote sensing' while working on coastal erosion at the United States Office of Naval Research (ONR).[6] The first part of the paper concludes by addressing the trend in the humanities to contrast 'epistemology from above' with 'epistemology from below', while also proposing more nuanced and less dichotomous interpretations.

The second part of the essay shifts to a different perspective on remote sensing by seeking to understand how cormorants experience the lagoonscape.[7] Human understanding of animal behaviour often relies on remote observation, facilitated by optical tools such as binoculars and cameras that extend human vision. This observational approach is particularly useful for getting close to cormorants, which remain mostly silent in the Venetian Lagoon, producing resonant, guttural, and purring calls only at their Northern European nesting sites. The use of zooming instruments also enables a detailed description of the birds' ability to 'crack the water surface' while diving for food – often causing conflicts with fishermen. This behaviour offers a way to interpret the vertical turn analysed in this issue through a more-than-human lens.

By presenting studies in which remote sensing and distanced sight are not equated with detached mastery or transcendent power, but instead reflect a search for intimate environmental connection and care for the more-than-human, this article contributes to embodying

4 Venice's first aqueduct, built in 1884, is currently being replaced and can be seen when arriving in Venice via the Ponte della Libertà bridge.

5 On landscape semiotics, see Turri 2014.

6 Pruitt is commonly credited with coining the term 'remote sensing', though she notes that her main assistant, Walter Bailey, also contributed to shaping the concept (Pruitt 1979, 106; Walker 2006, 436).

7 The Venetian Lagoon is home to three species of seabirds from the Phalacrocoracidae (cormorant) family. The European Shag (*Gulosus aristotelis*) is present in small numbers, while the Pygmy Cormorant (*Microcarbo pygmaeus*) and the Great Cormorant (*Phalacrocorax carbo sinensis*) are present in substantial numbers during the wintering period. The data in this article specifically refer to the Great Cormorant (*Phalacrocorax carbo sinensis*). For an updated summary of the presence of the Pygmy Cormorant in the northern Adriatic, see Volponi 2024.

the view from above (Bellacasa 2017; Baldacci 2023). It highlights the interconnections between micro and macro, atmosphere and hydrosphere, and human and non-human, while challenging the horizon line imposed by Western visual traditions in the representation of places (Haraway 2001; Amad 2012; Quagliati 2024).

2 Remote Sensing of Coastal Environments

In 2005, the journal *Zeitschrift für Geomorphologie* published a supplementary issue on *Coasts under Stress*, which started with Paolo Ciavola's article "Sediment Resuspension in the Lagoon of Venice: Short-term Observations of Natural and Anthropogenic Processes" and ended with Harley Jesse Walker's "Evelyn L. Pruitt and Coastal Science", a tribute to the memory of the late Director of the Geography Branch of the ONR. A review of these two pieces provides a valuable introduction to key aspects of lagoon ecosystems and highlights the impact of industrialisation on the Venetian environment over the past century. Additionally, it offers an opportunity to discuss the crucial role of remote sensing in the management and preservation of coastal zones (Psuty, Sherman, Meyer-Arendt 2005).

Paolo Ciavola's research focuses on sedimentation dynamics in coastal lagoons through the analysis of waves, currents, and tides, as well as considering the impact of vessel traffic. In the 2005 article, the author details the underwater measurements conducted with a Remote Unit for Nearshore Transport Investigation (a small benthic lander) positioned on the lagoon bed next to the Malamocco-Marghera canal (Ciavola 2005). This shipping waterway, utilised by cargo ships, oil tankers, and cruise liners heading to the Marghera commercial and industrial port, is one of three inlets connecting the shallow, enclosed waters of the Venetian Lagoon to the Adriatic Sea.[8] Venetians often refer to it as *Canale dei petroli* (Petroleum Canal) because it was excavated to a depth of 14 meters in 1968 to facilitate oil traffic toward the factories of Porto Marghera – one of Europe's largest and most polluted petrochemical complexes located on the lagoon's eaves (Fabbri 2003; Casson 2007; Iovino 2016). The material excavated from Canale dei petroli was used to create artificial islands (*casse di colmata*) for the development of Porto Marghera's third industrial area. With the enactment of the 1973 Special Law for Venice (Legge 171/1973, Interventi per la salvaguardia di Venezia),

8 After years of protests by residents against the passage of cruise ships through the Giudecca Canal in Venice's historic city centre – citing damage to Venice's ecosystem and cultural heritage – the national government announced in 2021 that cruise ships would be rerouted, along with cargo ships and oil tankers, through the Malamocco-Marghera Canal (Testa 2011; Tattara 2014; Guaraldo 2021).

the reclamation was halted. By that time, however, approximately 20 million cubic meters of material had already been deposited.[9]

In Ciavola's experiment, sensors 'observed' natural and anthropogenic mechanisms driving sediment fluxes over a 16-hour period. Sensing, studying, and understanding the lagoon's waters have been vital since the time of the Republic of Venice (697-1797), which regarded the lagoon as its natural defensive wall. In mapping the lagoon environment, Venice's rich cartographic tradition reflects sustained efforts to preserve its 'breath' – the dynamic interchange between fluvial and saline waters. The lagoon "breathes with the moon", as the tides cause the waters to rhythmically rise and fall every six hours in an endless cycle (Bevilacqua 2000, 29; Iovino 2016, 50). The gravitational influence of celestial bodies on the lagoon's tides was already schematised in 1560 in Cristoforo Sabbadino's remarkable drawing, *Figura Lunare* **[fig. 2]** (Anselmi 2000), which illustrated the relationship between lunar phases and flood and ebb currents (*flusso e riflusso*).[10]

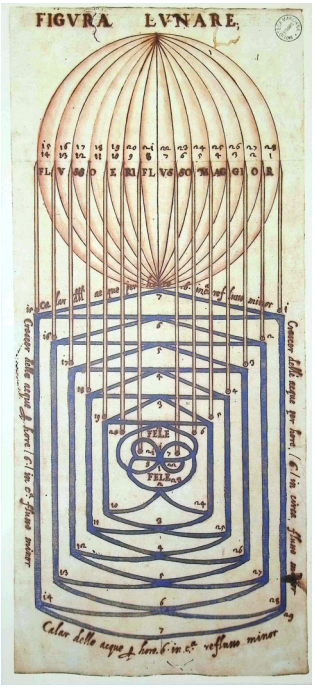

Figure 2
Cristoforo Sabbadino, *Figura Lunare*. 1560.
36 × 35.5 cm. Venice, Biblioteca Marciana BANCO 0004.257 (Anselmi 2000)

9 Today, the reclaimed areas have evolved into vital biotopes, providing essential habitats for a diverse array of bird species (Rallo 1978).

10 I am grateful to Chiara Famengo for introducing me to Cristoforo Sabbadino's *Figura Lunare*.

Sabbadino, a prominent hydraulic engineer for the Republic's Magistrates of the Waters, championed a transformative intervention in the lagoon's hydrology (Sabbadino 2011; cf. also Omodeo 2022a). He proposed diverting the major river deltas away from the lagoon to prevent fluvial sedimentation from reducing the water surface. The sediments would first clog the canals and, ultimately, turn the lagoon into dry land. Today, the challenges faced by the Venetian Lagoon are quite the opposite from what they were in the past, as danger no longer comes from the rivers, but from the sea: subsidence – resulting from groundwater extraction during the development of the industrial area of Marghera – and eustatism – the rise in sea levels caused by global climate change – could gradually transform the Venetian Lagoon into a gulf. The increasing frequency of exceptional tide peaks, known as *aqua granda*, prompted the development of the controversial MOSE project (an acronym for 'Modulo Sperimentale Elettro-Meccanico', or Experimental Electromechanical Module).[11] First made operational in 2020, this mechanical system of mobile barriers, installed on the seafloor at the lagoon's inlets (invisible when not activated), is designed – according to its proponents – to 'defend' and 'save' Venice from the sea by temporarily separating the lagoon waters from those of the Adriatic.[12] The name of the system itself references the biblical figure Moses (Mosè in Italian), who famously parted the Red Sea. However, questions remain unanswered about how this temporary separation from the source of risk – rising sea levels – will further transform Venice's amphibious character and its delicate relationship with the lagoon (Fabian, Centis 2022).

Paolo Ciavola's paper for the volume *Coasts under Stress* provided me with an opportunity to explore aspects of hydrodynamics and the geomorphological features of coastal lagoons, while contextualizing how Venetian environments are continuously monitored today and how they have been understood and managed in the past. Additionally, the paper highlights the scientific applications of remote sensing technologies (in this case, an observational platform on the seabed) for collecting data on dynamic underwater transformations.

While not directly concerned with the Venetian Lagoon, the concluding article of the supplementary issue of the *Zeitschrift*

11 The unprecedented flood of November 1966, which submerged Venice, Chioggia, and other built-up areas, led to the development of the MOSE project (De Zolt et al. 2006; Cavaleri et al. 2020). For insights into the history and future of MOSE and its impact on the lagoon ecosystem, see Fersuoch 2015; Del Bello 2018; Lionello et al. 2021.

12 MOSE is not the first attempt to protect the lagoon city from rising waters. In 1716, the Republic of Venice constructed the Murazzi, a long defensive breakwater made of white Istrian stone, designed by Vincenzo Maria Coronelli. Standing 4.5 meters above sea level, it stretches along the islands of Lido and Pellestrina up to Ca' Roman and the Sottomarina coast (Grillo 1989).

für Geomorphologie, titled "Evelyn L. Pruitt and Coastal Science", gives a broader perspective on the historical development of remote sensing and its applications in coastal research (Walker 2005). The *in memoriam* tribute, written by geographer Harley Jesse Walker, highlights Pruitt's pivotal contributions as Director of the Geography Branch of the ONR. It also discusses her instrumental role, alongside Richard J. Russell, in founding the Coastal Studies Institute at Louisiana State University, which significantly advanced coastal and marine science (Roberts, Coleman, Walker 2014). Similar to Ciavola's interests, the projects supervised by Pruitt investigated, among other topics, process sedimentology, coastal erosion, tidal flats, wave dynamics, and air-sea-land interactions. The innovation introduced by Pruitt and the ONR team in the 1960s tackled coastal research through the use of remote sensing. This approach went beyond traditional on-site observations and surveys, incorporating aerial photography and satellite imaging – technologies that became increasingly accessible after WWII – to identify distinct units that characterised deltas and marshlands (Walker 2005, 215).

In the post-war period, remote sensing was a new term, but not a new science. Broadly defined, remote sensing refers to the process of acquiring information about objects without making physical contact with them. Astronomy, for example, has always relied on the ability to sense from a distance (Clerke 1888). However, the advent of aviation shifted the perspective from turning eyes to the sky to looking down at the Earth. Moreover, the World Wars boosted aerial photoreconnaissance, establishing photo-interpretation as a recognised discipline that provided significant support to scientific research. The term 'remote sensing' started to be used by the scientists of the ONR to refer to the gathering and processing of information about the Earth's environment, particularly its natural resources (Simonett 1983, 1). Pruitt discussed the term's genealogy in a piece on the ONR geography programme:

> The term 'photograph' was too limited because it did not cover the regions in the electromagnetic spectrum beyond the 'visible' range, and it was in these nonvisible frequencies that the future of interpretation seemed to lie. 'Aerial' was also too limited in view of the potential for seeing the earth from space. A new term was needed, so 'remote sensing' was invented, and I am generally credited as its coiner. (Pruitt 1979, 106)

Pruitt's work at the Geography Branch highlights how, although remote sensing technology emerged from military-funded research during the Cold War, its conceptual underpinnings – unlike those of aerial photography – are grounded in environmental science, with a particular focus on water resource assessment and coastal

management. One of the earliest educational books on remote sensing, written by geologist Joseph Lintz and geographer David S. Simonett in 1976, highlights its application to lagoons, with a specific focus on the Venetian Lagoon. The authors underscore the role of remote sensing in identifying and quantifying environmental degradation, particularly the impact of large industrial complexes on artistic, cultural, and sociological centres. They argue that such data collection is crucial for developing regulatory, planning, and preventive strategies to safeguard these valuable sites (Linz, Simonett 1976, 576).

Monitoring, management, and control are often considered the primary objectives of remote sensing. However, a series of ONR-sponsored events showcasing the emerging field also underscored the limitations of human sensory perception and the challenges of interpreting non-human temporal and spatial scales. This was evident in the first symposium on remote sensing of the environment, held in February 1962 at the University of Michigan (see *Proceedings of the First Symposium on Remote Sensing of Environment* 1962). At this event, the application of remote sensing to various Earth science fields was introduced, alongside a comparison between machine sensors and human senses. The symposium proceeding explains that sight and hearing rely on the sensing of radiant energy, effectively making them remote sensors, whereas touch, taste, and smell depend on the transport of matter and require proximity to the source. In this perspective, as Haraway suggested (1991), the Western technoscientific gaze implicitly enforces a normative hierarchy, privileging the 'observational' senses as powerful while deeming the others 'clumsy'.

However, Gwynn H. Suits, head of the Infrared Laboratory at the University of Michigan, also addressed the limitations of human remote sensors during his welcome speech at the first remote sensing symposium: "Almost all of the turmoil of the earth is below the hearing range of our ears. Still, hearing covers about 10 octaves while sight covers barely one". Referring to electromagnetic radiation beyond the visible spectrum – such as radio waves, microwaves, and infrared – he added:

> We are still creatures of the sea in many ways. Ancient sea water still flows in our veins and fills our eyes. This water is largely opaque to all electromagnetic radiation save those with wavelengths between .35 and .7 microns and of course the gamma rays which penetrate practically everything anyway. (Suits 1962, 2)

The intimate relationship between fluids within and outside the human body underscores the continuum between humans and the environment. Additionally, the quotation above emphasises the

significance of interpretative processes, particularly rendering methods, in analysing satellite imagery captured in the non-visible portions of the electromagnetic spectrum **[fig. 3]**. Scientists engage in a continuous process of translating data into visual representations. When interpreting remote sensing data, key features include scale, colour, tone, pattern, shape, and texture. Focusing on the last feature, Andrea Ballestero suggests understanding remote sensing as a way of "touching with light". By doing so, she challenges the dichotomy between touch as proximate and vision as detached, seeking to move beyond the ocularcentrism ingrained in Western societies (Ballestero 2019).

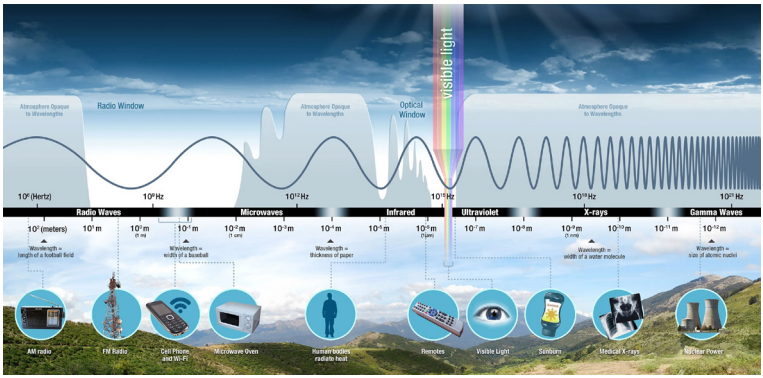

Figure 3 NASA Science Mission Directorate, *Introduction to the Electromagnetic Spectrum*. 2010. http://science.nasa.gov/ems/01_intro

Another significant dichotomy that has emerged within the environmental humanities in recent years is the contrast between 'histories from above' and 'histories from below' (Morrissey, Wilson 2016; Dawson 2024).[13] In visual studies, this polarisation is often framed as associating 'the view from above' with a cold, detached, and predatory gaze emblematic of military and capitalistic technoscience (Cuevas 2022; Levy 2023). Conversely, 'the view from below' is interpreted as a tender gaze – an ethical approach to addressing social injustices and fostering an emotional connection with the more-than-human world (Cormican, Marston William 2021). Yet, might it be possible to explore the connections between above and below the water's surface, rather

13 A broader overview of the development of 'history from below', including the influence of E.P. Thompson and Eric Hobsbawm, can be found in Bhattacharya 1983. On subalternity under colonialism and neoliberal globalisation through a feminist lens, see Spivak 2010. On 'knowledge from below' in early-modern Venice hydroculture, see Omodeo 2022b.

than reinforcing their opposition?[14] Writing about wetlands requires recognising the inherent interdependence of water, earth, and air. The Scirocco wind drives water over the salt marshes, temporarily submerging them, only for halophytic vegetation to emerge as the tide recedes. Understanding the natural mutations of these environments fosters a perspective centred on relationships, underscoring the fluid interplay of elements over rigid boundaries (cf. Gruppuso 2022).

Following Ballestero's line of research, the present article focuses on case studies where remoteness is not equated with detachment but instead becomes a synonym for environmental and more-than-human care. For example, a 2001 guide on good fishing practices and biodiversity protection in the Venetian Lagoon states: "To describe this complexity, the following satellite image is useful, allowing us to grasp at a glance the variety of environments that make up the 'mosaic' of the Venice Lagoon" (Franzoi et al. 2021) **[fig. 4]**.[15] Projects that merge the expertise of Venetian artisanal fishers with the work of scientists – who monitor key water parameters on-site and analyse high-resolution satellite images – demonstrate that an exchange of diverse knowledge systems can foster the sustainable use of lagoon resources while preserving biodiversity.

I would like to conclude this first part of the article with one final example of the interplay between underground, underwater, aerial, and outer space perspectives. Since the advancement of aviation and photoreconnaissance during World War I, archaeologists have supplemented on-the-ground survey inspection with aerial and, later, satellite imagery (Crawford, Keiller 1928; Forte, Campana 2016). Remote sensing and geophysical methods – including multispectral aerial and satellite images, magnetic gradiometry, electrical resistivity, ground-penetrating radar, and frequency domain electromagnetics – have been used to investigate the archaeology of Altinum, a Roman city along the inner margin of the Venice Lagoon. The city was abandoned between the sixth and seventh centuries AD as its inhabitants fled warfare and instability, seeking refuge on the lagoon island of Torcello. The ancient city, now farmland reclaimed between the nineteenth and early twentieth centuries, has remained largely undisturbed, as it was never buried under medieval or modern infrastructure, thereby preserving its archaeological record. This allowed non-invasive remote sensing techniques to reveal the *forma urbis* of Altinum, including key structures such as its theatres, temple, and forum (Mozzi et al. 2016).

14 This dichotomy between view 'from above' and 'from below' has been challenged by the approach of Forensic Architecture, which subverts the use of remote sensing instruments from a policing and monitoring apparatus to a tool for documenting human rights violations and environmental crimes (Weizman 2017).

15 All non-English quotations in this article have been translated by the Author.

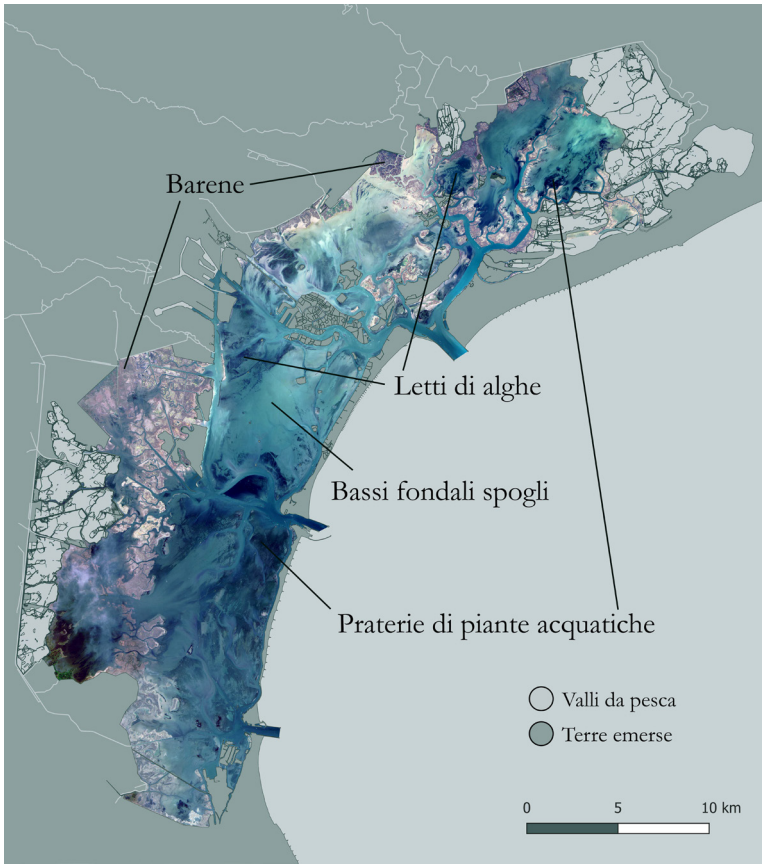

Figure 4 Satellite image of the Venetian Lagoon recorded during a low tide phase, spring 2020. Image used in the project *Assessment and Improvement of the Degree of Environmental Sustainability of Artisanal Fishery in the Natura 2000 Sites of the Venetian Lagoon*, funded by PO FEAMP 2014-2020 (Franzoi et al. 2021, 18)

The Venetian Lagoon also includes submerged archaeological sites. *Panorami sommersi. Le origini di Venezia* (Submerged Panoramas. The Origins of Venice) is a 2022 documentary showcasing these submerged Roman-era sites, first uncovered through the pioneering research of Ernesto 'Tito' Canal and more recently studied by archaeologists from Ca' Foscari University of Venice. A lagoon environment expert, Canal located stones accidentally found by fishermen in their nets. Buried under deposits of clay, silt, and sand, and submerged in water, traces of Roman structures on the lagoon floor were initially detected using probes, hand coring, and an echosounder **[fig. 5]**. With these tools penetrating the lagoon's stratigraphy, Canal could perceive what lay beneath the water's surface and reconstruct the Roman

city by remotely 'touching' the lagoon floor (using steel probes or acoustic waves). To verify his findings, he collaborated with divers, whose underwater movements are shown in the documentary, revealing more-than-human life and human-made infrastructures **[fig. 6]**. Due to the scarce light in the lagoon's waters, where visibility ranges from half a meter to one meter, "one sees by touching, gets moved by touching". The archaeological work depends heavily on atmospheric conditions and the state of the sea: "On certain days, there are currents on the lagoon floor that differ from those on the surface. These currents move the fine and very mobile sediments on the lagoon floor, and you find yourself in total darkness in the final meter [of diving]" (Gottardello 2022).

In the last decade, a new approach to spatial complexity has encouraged a shift toward a volumetric understanding of environments – one that moves beyond the two-dimensional horizontal surface, long dominant in geographic studies (Elden 2013). This shift becomes especially evident in the search for submerged archaeological data in the lagoon, where even volumetric thinking proves insufficient. Fully engaging with the voluminous materiality of this place demands a dynamic interplay among remote sensing technologies, embodied perception, and the more-than-human landscape – together revealing a spatial experience that is deeply layered, entangled, and immersive.

Figure 5 Self-taught archaeologist Ernesto Canal conducting hand coring in the 1980s to detect Roman remains in the lagoon waters. Historical footage featured in Samuele Gottardello's documentary *Panorami sommersi: le origini di Venezia*, 2022, 10′22″

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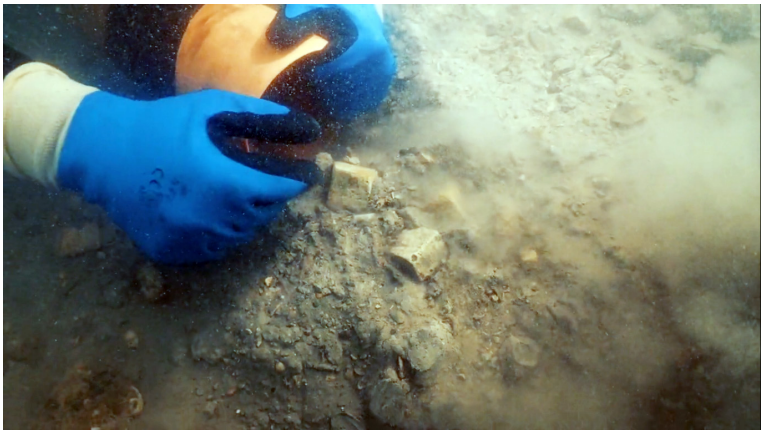

Figure 6 A diver exploring an underwater archaeological site in Venice. Samuele Gottardello, *Panorami sommersi: le origini di Venezia*, 2022, 32′54″

3 Sensing a Lagoon Through the Cormorant Dimension

Laguna. Conservazione di un ecosistema (Lagoon. Conservation of an Ecosystem) was a 1984 exhibition organised at Palazzo Grassi by the Venetian section of the World Wide Fund for Nature (WWF), with the support of the city Department for the Environment. The initiative aimed to promote environmental protection after the almost irreversible degradation of the lagoon's natural resources caused by reclamation, industrial settlements, pollution, and poaching. According to Italy's WWF president, Fulco Pratesi, the exhibition

> [was] meant to convey how Venice is not a jewel dropped from other galaxies into an entirely foreign, detached environment. It demonstrates how the St. Mark's Basilica and Procuracies, the typical Venetian narrow streets and small squares are nothing but a skilful and perfect extension of reeds and salt marshes, mudflats and sandbanks. (Rallo, Semenzato 1984, 7)

The exhibition also launched the idea of establishing a national park, modelled on those of the Danube Delta, Camargue, and Doñana, to preserve Italy's largest wetland. Although the city administration revoked the scaled-down version of the park in 2016, which was intended to protect only the northern lagoon, the 1984 initiative remains a key reference as the first exhibition to raise public awareness of the lagoon's ecosystem through scientific popularisation.

Designed for a non-specialist audience, Cristiano Zentilini's illustrations, featured in the exhibition, are particularly relevant to

the theme of this article **[fig. 7]**. One horizontal drawing schematically represents the lagoon ecosystem and its food chain:

> The lagoon environment is characterised by highly variable and challenging physico-chemical conditions for the survival of organisms. However, the high concentration of nutrients allows for significant growth of phytoplankton, and consequently zooplankton: the primary source for increasingly complex food chains. (Rallo, Semenzato 1984, 86)

Using fine arrows, the illustrator meticulously maps the interactions among underwater organisms and their links to animals above the water's surface. A wooden mooring pole, or *palina*, anchored in the lagoon bed, serves as a substrate for oysters and mussels underwater. Above the waterline, it becomes a perch for seabirds like cormorants, apex predators that primarily feed on mullets, flounders, sand smelts, and gobies.

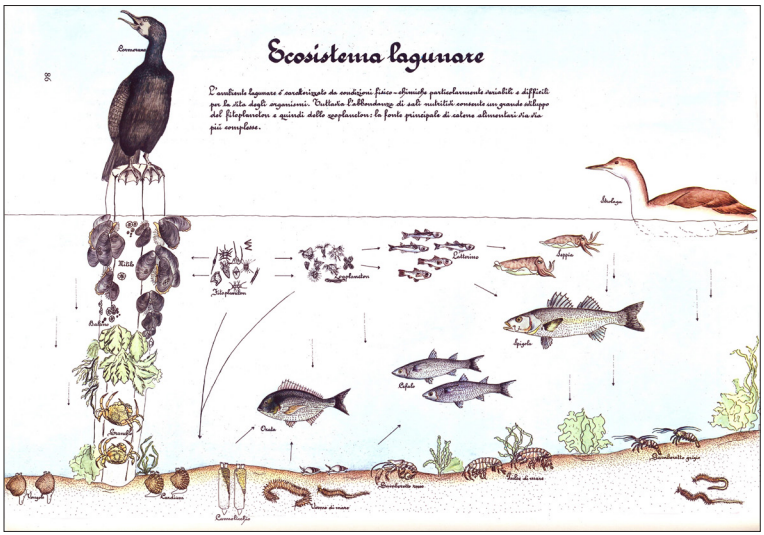

Figure 7 Cristiano Zentilini, *Lagoon Ecosystem*. Illustration from the exhibition *Laguna, conservazione di un ecosistema*, 1984. Venice, Biblioteca Marciana MOSTRE VE 0117 (Rallo, Semenzato 1984, 86)

Great Cormorants (*Phalacrocorax carbo sinensis*) appear in many of the illustrations included in the exhibition catalogue. From a contemporary perspective, their inclusion seems unsurprising, given how common it is to spot these birds in the lagoon today. However, naturalists of the past regarded the *corvo marin*, literally 'sea raven', or *marangòn* (as the cormorant was known in nineteenth-century

dialect) as a rare presence in the lagoon, observed almost exclusively during the winter months.[16] This trend continued until the mid-twentieth century, by which time cormorants had nearly vanished from most European countries due to human persecution, chemical pollution in fish (DDT and PCB), and habitat destruction.

Although conflicts between humans and cormorants often arose from competition for fish, these birds were also hunted purely for 'sport', as their meat was not prized for consumption.[17] Arthur Conan Doyle's 1881 article "After Cormorants with a Camera", published in the *British Journal of Photography*, provides a vivid account of such recreational killing on the Isle of May (Stiegler 2024, 19-24). Doyle describes a trip aimed at appropriating wild nature through a dual form of shooting: killing as many "fine, old, pre-Adamite cormorants 'with a most ancient and fish-like smell'" as possible while simultaneously photographing them in the moments of their death (Doyle 1881a, 533). By the end of the day, the hunters had killed "forty-three cormorants, nine rock pigeons, two mallets, a curlew, and a bo'sun gull" (Doyle 1881b, 545). All that remained of these birds were the photographs. In a markedly different vein, eight years after Doyle's publication, Florence Merriam Bailey's *Birds Through an Opera-Glass* was among the first field guides to promote the ethical study of avifauna, replacing the rifle with binoculars and cameras and once again 'touching with light' to observe and study birds in their natural habitats. Remote observation played a key role in the rise of bird protection societies and in a growing sensibility towards animal welfare (Lundquist et al. 2025).

Nevertheless, it was not until the 1960s that attitudes towards cormorants began to shift. To prevent cormorant extinction, protection measures were undertaken in Northern European nesting sites, and most countries subscribed to the European Community Bird Directive in 1979 (now Directive 2009/147/EC) that made it illegal to disturb, capture, or kill cormorants – except under derogation. These measures led to a conspicuous growth in breeding populations in the Netherlands, Denmark, Sweden, Germany, and Poland, with immediate repercussions also in the wintering sites of southern Europe and the Mediterranean (Cherubini, Manzi, Baccetti 1993). In 1988, the Italian National Wildlife Institute (Istituto Nazionale per la Fauna Selvatica, now ISPRA) published *Lo svernamento del Cormorano in Italia* (The Wintering of the Cormorant in Italy), the first national report documenting the increasing winter presence of these

16 Contarini 1847; A.P. Ninni 1866, 54; E. Ninni 1938; Bon, Richard, Semenzato 1993, 138.

17 Cf. the account by ornithologist Ettore Arrigoni degli Oddi of a cormorant shot in the Venetian Lagoon, which mentions the bird's unpleasant taste and strong fishy odour after being roasted (Arrigoni degli Oddi 1919).

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aquatic birds. The study also pointed to major regional data gaps, including incomplete records for the Venetian Lagoon (Baccetti 1988). Regular censuses in the lagoon began in 1989, with evening counts conducted in January near known roosting sites. These recorded 580 individuals in 1989, rising to 4,601 in 2015, then stabilising over the past decade.[18] Nesting has been recorded in the Venice Lagoon since the late 1990s, despite most cormorants in the region being wintering individuals that migrate annually from Northern Europe, typically arriving in Venice between October and November and departing in March (Semenzato, Tiloca 1999, 129).

While scientists view the favourable conservation status of the species at the European level as a successful indicator certifying the health and fishiness of coastal stretches, many Venetian fish farmers and anglers still perceive these birds as an alarming threat, despite their now stable population (*Il Gazzettino* 2018a; cf. Wild 2012). The most significant damage is reported in the *valli da pesca*, traditional fish farms located along the lagoon's edges, where a distinctive form of aquaculture is practiced (Provincia di Venezia Assessorato 1997). To mitigate cormorant predation in these structures, commercial fishers began installing protective nets and received regional compensation for losses. Although the cormorant is protected under Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds, selective culling has been authorised by the Italian Institute for Environmental Protection and Research (ISPRA) in fish farms starting since 1997 (see also Delibera Giunta Regionale del Veneto no. 2072 of 3 August 2001). However, these measures resulted in only a modest reduction in predation, with a recorded yearly decrease of just 13% in the month of December (Borgo et al. 2004).

Beyond the measurable damage, the cormorant has increasingly become a scapegoat for broader and more complex challenges facing the fishing industry, despite expert assessments suggesting that its impact is largely confined to areas with high fish densities (Raicaldo 2023).[19] The shift from a rare presence in the past to a common sight today has led people to mistakenly regard cormorants as an alien

18 For information on cormorant population trends in the Venetian Lagoon, see the annual reports by the International Waterbird Census, coordinated over the past decades by the Associazione Faunisti Veneti, available online at: `https://www.faunistiveneti.it/pubblicazioni/#1478699679065-38d7dc79-8a6f`. For data from the early years of the census in the lagoon, see Cherubini, Manzi, Baccetti 1993.

19 On the problems of the Venetian Lagoon's artisanal fisheries, see Silvestri, Pellizzato, Boatto 2006; Granzotto et al. 2001; Santana 2022.

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invasive species.[20] There is a common belief among part of the fishing community that 'the cormorant is not ours', meaning that it is not an autochthonous species intimately rooted in the lagoon environment.[21]

This conviction, however, contrasts with Vittore Carpaccio's painting *Hunting on the Lagoon*, which natural and art historians consider a realistic depiction of the lagoon environment in the late 1400s **[fig. 8a]** (Dal Pozzolo 1999; Bon, Semenzato 2023).[22] The scene is set in a fishing and hunting valley, characterised by huts made of marsh reeds (*casoni*) and barriers designed to capture specific fish species during their migratory periods. The focus of the composition is on Venetian patricians engaged in hunting loons and grebes using bows equipped with clay bowls instead of arrows. The killing of inedible species with such unconventional tools could be interpreted as a form of challenging recreation, or, as some sources suggest, as a method to avoid damaging the birds' down feathers, which were used for garment stuffing (Bon, Semenzato 2024, 154). In the background, Carpaccio depicts a variety of waterbirds associated with the upper Adriatic species documented in written sources from the period. These include a heron perched on top of a building, a flock of waterfowl – likely geese – a crane, and gulls resting on the palisade. The painting also features an easily recognisable cormorant, perched in its characteristic semi-open wing posture on a pole driven into the water **[fig. 8b]**. Other cormorants are shown on the boats, possibly alluding to the fishing practice, common in Japan and China, where trained cormorants were used by anglers to catch fish – although this practice was rare in Europe (Beike 2012).

20 Cormorants, unlike African sacred ibises and blue crabs, were not introduced by humans in the Venetian Lagoon and are therefore not classified as an invasive alien species (Beike 2014). For the European Commission's definition and management of invasive alien species (IAS), see `https://environment.ec.europa.eu/topics/nature-and-biodiversity/invasive-alien-species_en`. The term has been critically examined by Colautti and MacIsaac (2004), Hettinger (2012), Inglis (2020), among others. For insights into how the public and experts perceive the relationship between the origin ('nativeness') of species and their behaviors and impacts ('invasiveness'), see Van der Wal et al. 2015.

21 I thank Eleonora Puliero for sharing an early preview of her ethnographic fieldwork conducted among fishermen.

22 The painting *Hunting on the Lagoon*, housed at the Getty Center in Los Angeles, is the upper portion of a larger vertical panel that was sawn apart before the nineteenth century. The lower portion, titled *Two Venetian Ladies*, is housed at the Museo Correr in Venice. For a reconstruction of the history of these two paintings, including the missing elements, their context of production, and the evolving interpretations by art historians over time, see Marcantoni 2008.

Figure 8a Vittore Carpaccio, *Hunting on the Lagoon*. Ca. 1490-95. Oil on panel, 75.6 × 63.8 cm. Los Angeles, Getty Center, Museum North Pavilion, Gallery N204

Figure 8b
Detail of Vittore Carpaccio's *Hunting on the Lagoon*. Ca. 1490-95

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Despite the constantly evolving nature of species distribution, the symbolic representation of the Western cormorant has largely remained negative throughout history. Over the centuries, cormorants have been associated with the devil, death, and bad omens, later evolving into a symbol of greed (Wild 2012; King 2013; Wires 2014). Their ability to catch fish swiftly has contributed to the perception of an insatiable appetite and inherently selfish nature – a view that partially persists today and is reinforced by their occasional cooperative hunting behaviour.

Biologically, however, the cormorant is a remarkable example of evolutionary adaptation. These birds are exceptional divers, chasing fish underwater with powerful propulsion from their webbed feet **[fig. 9]**. Unlike most birds, they can move their aquamarine eyes, which are shielded by a transparent nictitating membrane that enhances their underwater vision. The hooked tip of their upper bill helps them grasp prey effectively. To increase their speed while diving, their wings are relatively short, imposing high energy costs during flight, and their feathers are less water-repellent than those of other waterbirds, such as ducks. This is why they are often seen standing with their wings spread open to dry toward the sun. In the past, this striking appearance, marked by a glossy black plumage, has evoked images of crucifixions and contributed to enduring symbolic associations with darkness and the ominous.

Figure 9 A European Shag (*Gulosus aristotelis*) swimming underwater in search of prey in Trieste, August 2020. In the Venetian Lagoon, poor water clarity makes observing Great Cormorants diving extremely difficult. Photo by the Author

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These physical traits may shed light on the origin of the Venetian name for the cormorant, *marangone*, which derives from the Latin *mergere*, meaning 'to immerse' or 'to dive'. Interestingly, this etymology has long been linked, probably mistakenly, with the *marangoni*, the skilled naval carpenters of the Venetian Arsenal active since the fourteenth century, who were known for their ability to repair ships, sometimes even below the waterline (Schmitt 2008). Despite such evocative associations, the cormorant has long remained culturally marginal. In poetry, the cormorant stands in stark contrast to Coleridge's and Baudelaire's albatross, and in fiction, it lacks an equivalent to Bach's *Jonathan Livingston Seagull* (Coleridge 1798; Baudelaire 1861; Bach 1970).

In recent years, however, the artistic and cultural spheres have shown a growing interest in this species, particularly in Northern Europe. In these regions, cormorants often nest in colonies on isolated islands, where the vegetation dies off after a few years due to guano accumulation. From a human perspective, these stark, barren landscapes stand out as scars in the otherwise verdant Nordic scenery. This tension between natural processes and cultural perception is explored in *Chorus sinensis*, an audiovisual choral piece dedicated to the Great Cormorant. Created between 2019 and 2022 in the coastal areas of the Bothnian Sea and Archipelago, where human and seabird territories intersect **[fig. 10]** (Taipale, Eerala, Naukkarinen 2021), the project acknowledges the bird's historically negative portrayal, as described by Karoliina Lummaa:

> A big blackguard of a bird that depletes fisheries and, with its droppings, brings death to verdant places pleasing to the human eye. […] Black bird, white droppings; a black-and-white image of a bird. […] That is what it looks like when you regard the bird and its nature from on high, scanning for signs of nuisance and disorder. (Lummaa 2021)

Figure 10 Jan Eerala, frame from *Chorus sinensis*, 2021. The Conference of the Birds project: Finland Nest, Pohjankalliot, Bothnian Sea. https://theconferenceofthebirds.net/finland/

The work poses a series of questions: Can other narratives and representations of the Great Cormorant emerge? Is this bird worthy of a human song? Can there be poetry about a bird that never sings, one often deemed a nuisance? What will be the Great Cormorant's story in the future? Inspired by the guttural sounds produced by cormorants at their breeding colonies – an aspect rarely explored in artistic compositions for a species largely considered silent – a composer, an audiovisual artist, a curator, a literary scholar, a costume designer, and singers collaborate to give voice to these birds. Their choral performances took place on Pohjankalliot, a rocky island that serves as a habitat for cormorants and other seabirds. *Chorus Sinensis* suggests that moving beyond the human-animal conflict when considering cormorants may open new ways of perceiving coastal environments and provide alternative tools for ethical engagement with the environmental crisis.

Cormorants have gradually become iconic elements of the Venetian lagoonscape. Over the past few years, their image has begun appearing on t-shirts and bags in sustainable fashion shops, on leaflets from Ca' Foscari University's Research Institute for Green and Blue Growth, and on posters as a symbol of resistance against extractive tourism **[fig. 11]**. While some fish farmers still perceive their ability to break the water's surface as a threat, a shift in public perception toward cormorants in Venice is becoming evident. Rather than being interpreted as an invasion, their presence acts as a lens for understanding the lagoon's dynamics, opening up unexpected perspectives. As noted earlier, their perching behaviour brings attention to submerged human infrastructures, while their activity above and below the water offers clues about aquatic life and the health of the lagoon. When they spread their wings to dry, they indicate the sun's position and the direction of the wind. Tracking their movements across the lagoon leads us from the inlets where the MOSE system is installed to their night roosts, which they share with other species – whether in the trees of fish-farming areas in the northern lagoon, on the transmission towers of the industrial zone, or in the abandoned clay quarries of the hinterland, now converted into protected oases. Following their migratory routes to breeding sites further reveals the intricate ecological networks linking the Mediterranean coasts and lagoons with those of Northern Europe. Their historical near-extinction serves as a stark reminder of the devastating effects of chemical pollution on the environment and the contemptuous human attitude towards animals. Finally, their mastery of both air and water currents suggests a way to rethink the conceptual divide between the world above and the world below the water's surface.

Figure 11
Marta Sottoriva, poster for a demonstration against big ships organised by Comitato NoGrandiNavi and supported by Collettivo Universitario Liberi Saperi Critici Venezia, April 2024. Photo by the Author

4 Conclusions: Towards a More-than-Human Vertical Turn

The preceding two sections have examined ways of sensing the Venetian Lagoon from a distance: the first presents a number of remote sensing technologies used to understand this coastal environment, while the second engages with the movements, behaviours, and habits of cormorants. Although these two approaches may initially appear unrelated, both are challenged by the visual limitations imposed by the lagoon's waters **[fig. 12]**. Despite their differences, both sections ultimately address the lagoon's inherent opaqueness (cf. Glissant 1997) and emphasise the interdependence of visible and hidden layers of the lagoon ecosystem as well as the porous boundary between above and below. Whether through satellite imaging or birdwatching, either approach attempts to move beyond the notion of 'close-up at a distance' and clear telescopic vision. The analysis of remote sensing exposes the limitations of human sight, while the attempt to approach the lagoon from the perspective of the cormorant shifts the focus away from managing a so-called 'problematic' species toward cultivating a deeper curiosity – one that echoes Jacques Derrida's reflections in *The Animal That Therefore I Am* and enables a reinterpretation of the 'vertical turn' (cf. also Despret 2021).

Historically, the concept of vertical space has come to the fore with the development of aerial ascent in the eighteenth century and to new building techniques that, by the end of the nineteenth century, metaphorically 'scraped the sky'. The challenge of producing vertical aerial photographs, perfectly perpendicular to the Earth's

surface – valued for their measurability – was initially driven by military needs in the early twentieth century and later applied across various fields of knowledge. The space race further expanded the notion of verticality, but it was the war on terror at the beginning of the twenty-first century that prompted a critical analysis of satellites and drones as instruments of imperial hegemony. This phase also opened up recognition of the underground as a hidden space of tunnels, infrastructure, and exploited natural resources natural resources, prompting a reformulation of vertical space as extending from orbit to the Earth's depths.[23] At the same time, the space below the Earth's surface gained increasing significance within the environmental humanities, driven by the search for evidence of a new geological epoch, unofficially called the Anthropocene.

Figure 12 The moment a cormorant breaks the water's surface in the lagoon waters in front of Pellestrina, sunset, February 2025. Photo by the Author

Within a history of verticality shaped by human power dynamics, this article has tried to imagine a more-than-human, non-graspable vertical space – one that may not even be truly vertical, but oblique, steady, wet, dry, fishy, metallic, silent, guttural – like that of a cormorant. There are various ways to sense the lagoon: with feet, hands, nose, ears, mouth, and eyes, as Tiziano Scarpa writes in

23 For a comprehensive overview of the approaches to verticality summarised in this paragraph, see the bibliography in the introduction of Sandoz and Weber (2022) and Kurgan (2013).

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his "sensual guide" *Venice is a Fish* (2009). It can also be imagined through non-human senses, as Carlos Casas suggested in the exhibition *Bestiari* (2024).[24] The lagoon can even be sensed from a distance – not as a sign of detachment, but as an expression of care.

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24 Cf. *Bestiari* by Carlos Casas, a collateral event of the 60th Venice Biennale, curated by Filipa Ramos. Available at: https://www.e-flux.com/announcements/589447/carlos-casasbestiari/.

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