VISUAL COMPARISON *of* FOUR SUBSPECIES *of* BLACK-TAILED GODWIT

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Visual Comparison of Four Subspecies of Black-tailed Godwit

by

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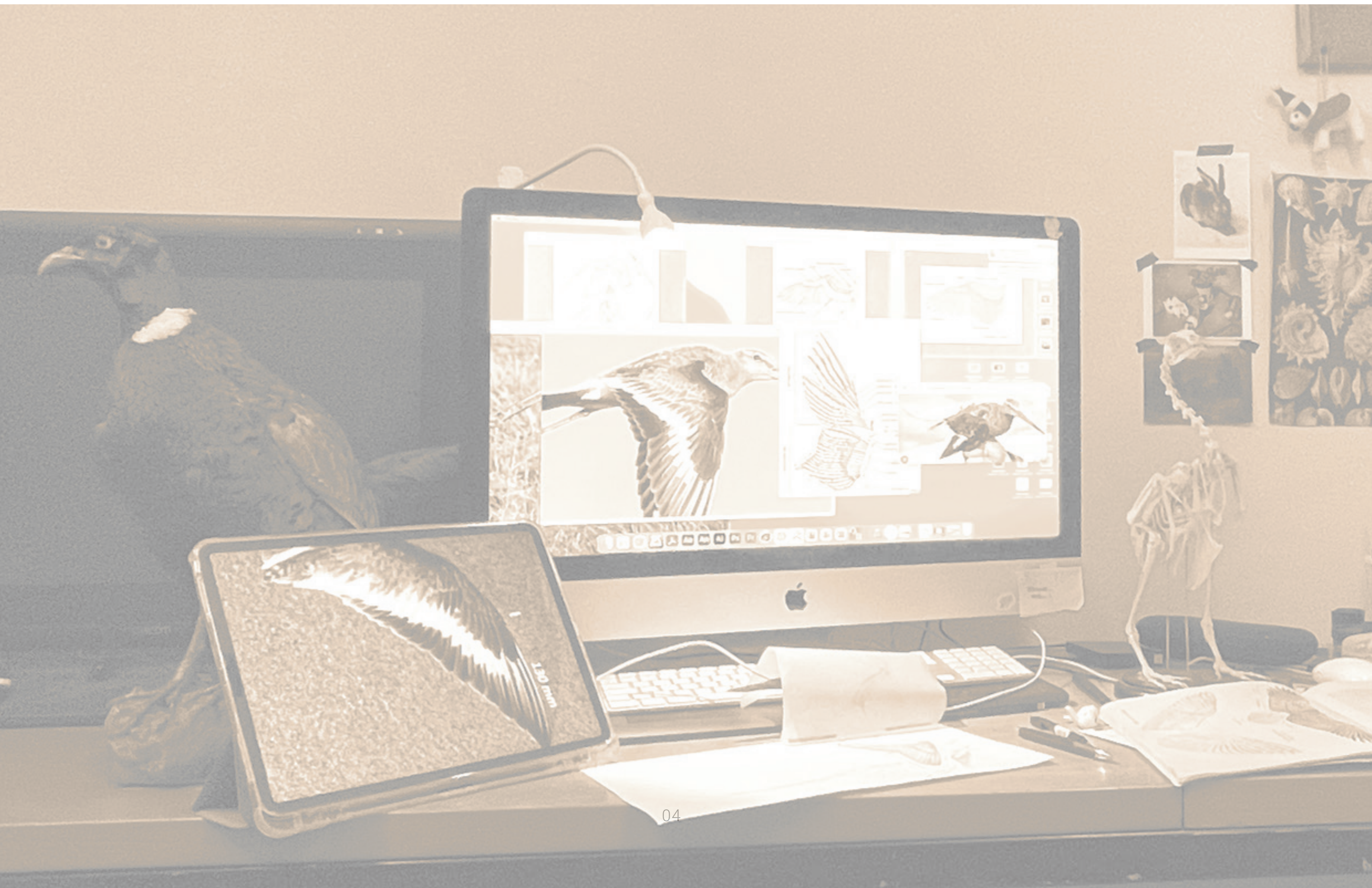
PREFACE

Birds, objects of worship and symbols of freedom across time and regions, have always fascinated me. Observing a flock of migrating birds makes me reflect on the passage of time and the changing of seasons and evokes a sense of wonder and amazement at the vastness of the world. Therefore, it was only natural for me to dedicate my thesis in scientific illustration to the topic of birds.

As an illustrator, I often begin a drawing or a painting by observing. In the process, I gain deeper insight into my subject matter. When creating a scientific illustration, a certain degree of truthfulness must be preserved; I must examine the object and subject thoroughly so that I may interpret them well and convey the knowledge I have achieved. Through my studies in this programme, and while working on this thesis subject, I have come to appreciate how this striving for accuracy has taught me much about the world.

Scientific illustration involves understanding complex and often excessive information and translating it into clear visual language while considering the needs and expectations of specific target audiences. This thesis documents my approach to and process for studying and comprehending each subspecies of the black-tailed godwit, *Limosa limosa*, and translating this knowledge into an illustration in a uniform style.



INTRODUCTION

The black-tailed godwit (*Limosa limosa*), which belongs to the Scolopacidae family, is a large, long-billed, long-legged wading bird with three well-known subspecies: *L. l. limosa* (Linnaeus, 1758), *L. I. islandica* (Brehm, 1831), and *L. l. melanuroides* (Gould, 1846). It is currently classified as Near Threatened. Its global population is estimated to be between 140,000 and 270,000 pairs. Over two-thirds of the population breeds in Europe, with a significant concentration of 85,000 to 100,000 pairs in the Netherlands alone.

This elegant bird is known for its beautiful plumage colour, remarkable long-distance migrations, and diverse diet. It shows a preference for insects, their larvae, annelids, molluscs, ragworms, crustaceans, spiders, fish eggs, and the spawn and tadpoles of amphibians. Additionally, it supplements its diet with plant material, including berries and seeds. Black-tailed godwits employ various feeding techniques, such as picking and forward-angled, prolonged probing, using touch or sight to locate their prey. They often exhibit gregarious feeding behaviour, gathering in communal night-time roosts in shallow water, especially during winter and migration. In terms of sound, the birds display distinctive vocalisations during breeding, mostly in flight: a repeated "gruu-too-gruu-too-" and a faster "whitu-whitu-". Outside breeding areas, they emit short nasal calls like "kek" and more subdued notes. During the flight, their calls include a quick "bi-bi-be!" and a lapwing-like "vää-it".

Until recently, only the subspecies *L. l. melanuroides* was recognised in the East Asian–Australasian Flyway (EAAF). However, field observations in the past decade have uncovered the presence of two distinct sizes of godwits, including larger flocks north of Bohai Bay, China. Upon comparing the morphological and genetic characteristics of the three already known subspecies with those of the larger godwits in Bohai Bay, researchers found that the Bohai godwits were significantly larger than *L. l. melanuroides* in all body dimensions. Additionally, mitochondrial DNA analyses revealed a unique haplotype of the godwits in Bohai Bay, and the genetic differences across the four subspecies were significant. This newly discovered subspecies was named *Limosa limosa bohaii* (Zhu, Piersma, Verkuil & Conklin, 2021).

When naturalists and biologists discover a new animal or plant species, one of their primary tasks is to thoroughly describe its physical characteristics and geographical range. Such discoveries help illuminate broader evolutionary patterns and deepen one's understanding of the interplay between living organisms and their environment. The ability to compare newly discovered species with related organisms is critical to this endeavour, as it enables scientists to contextualise and interpret their findings within the broader framework of biological evolution. Without comparison, identifying and pinpointing the differences becomes challenging. Then, how do scientists make comparison? One scientific approach entails meticulous measurement and documentation, followed by publishing the results. However, the accessibility of these data and publications can be complicated, especially for general public. This is where scientific illustration comes into play. Scientific illustrations offer a better alternative to simply reading figures or tables from a publication. They make the comparison more accessible and engaging, allowing for a clearer understanding of scientific concepts.

Thus, in this thesis, my illustrations aim to visually compare the four subspecies in three chapters. The first chapter compares the males and females of each subspecies; the second provides a breeding and wintering site map of each subspecies; and the final chapter focuses on the breeding and wintering landscapes of all four subspecies. Together, the chapters aim to provide a visual representation that meets the aforementioned scientific needs.

All the photo references of the birds used in this thesis were obtained from the eBird website (https://ebird.org/home), except for the photos of *L. l. bohaii* which my external advisor, Dr. Zhu Bingrun, provided.

chapter

01

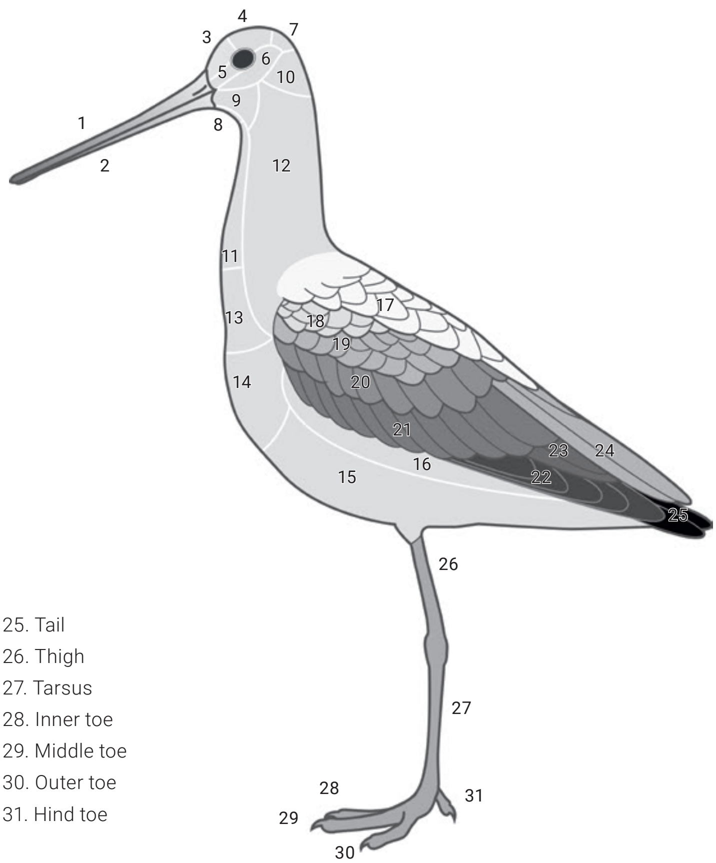
Males and Females of Each Subspecies

The measurements
The pose
The elaborate sketch
The colours
The sizes
The lighting
The infographic

During the breeding season, all four subspecies of the black-tailed godwit have striking appearances. Their heads, necks, and chests are a bright orange-chestnut colour, and their scapulars have patterns of orange and dark brown. This type of plumage is also known as the *breeding plumage*. Right after the breeding season, they start shedding the breeding plumage. The orange-chestnut colour turns a worn grey, and the bill colour that was yellowish-orange during the breeding season turns a dull pink. The black colour at the tip of the bill and tail, as well as the black and white wing bars, remain the same throughout the year. The illustrations in this chapter represent the colours and patterns of the breeding season, as they are the key features to distinguish each subspecies alongside size.

The illustrations in this chapter highlight the distinct sexual dimorphism within and between subspecies, including the newly discovered *Limosa limosa bohaii*, so that their unique features and physical characteristics can be compared and contrasted. To achieve this, each godwit needed to be depicted with a consistent pose, intensity, colour, light source, and viewpoint. For each subspecies, the male and female had to be illustrated.

Efficiency was also a key consideration during the creation of these illustrations. With a fixed timeframe for the project and a total of eight illustrations, it was important for me to maximise my productivity. The repetitive elements in each bird's image provided the best opportunity for an efficient way of working by means of digitally transforming the first image to produce the seven other illustrations of the remaining godwits



1. Maxilla	9. Cheek	17. Scapulars	25. Tail
2. Dentray	10. Nape	18. Lesser coverts	26. Thigh
3. Forehead	11. Throat	19. Middle coverts	27. Tarsus
4. Crown	12. Neck	20. Greater coverts	28. Inner toe
5. Lores	13. Jugulum	21. Secondaries	29. Middle toe
6. Ear coverts	14. Beast	22. Primaries	30. Outer toe
7. Occiput	15. Abdomen	23. Primary coverts	31. Hind toe
8. Chin	16. Flanks	24. Tertials	

Fig.1: External anatomy of black-tailed godwit.

The measurements

Body part measurements are important when highlighting morphological differences between each subspecies. Thus, to maintain accurate body proportions in the illustrations, actual measurement data needed to be utilised.

There were five measurements: length of the bill, total head, tarsus, tarsus-toe, and wing. Data on the lowest, maximum, and average values for each measurement were provided by the external advisor. Among those data points, the average values were used to illustrate the birds with typical and representative values of each measurement (Table 1). How each measurement was derived from the birds is depicted in the Fig.2-4.

The pose

The most common posture in the avian illustrations, the lateral view of the standing posture, was chosen, since the aforementioned measurements from the lateral view could be clearly shown in the illustration with this pose (Fig.1). However, two disadvantages to using this pose were found during the first sketch.

First, the wing length for the illustration was measured while the wing was slightly abducted and straightened against a ruler and the primary coverts were lightly pressed, with both thumbs against the long end of the ruler and the left-hand index finger against the short end (Fig.4). When the wing is naturally folded without this artificial action, the line of the wing flows in a curved line. Additionally, in the naturally folded position, the starting point of the wing length measurement is generally not visible, as it is covered by chest feathers (Fig.5). Given this, the wing length measurement could not be accurately applied within the illustrations. Instead, an infographic was created to demonstrate size differences and measurements of the birds more clearly in a simplified and comparable style, without solely relying on their depiction within the elaborated illustration.

The second problem was that the lateral pose did not simultaneously display tarsus length and tarsus-toe length. Therefore, I decided to draw a pose with one leg up. Unfortunately, high-resolution photo references of the

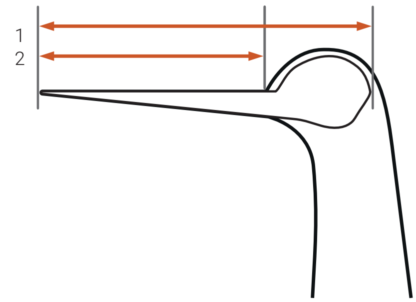


Fig.2: Measuring total head length (1) and bill length (2).

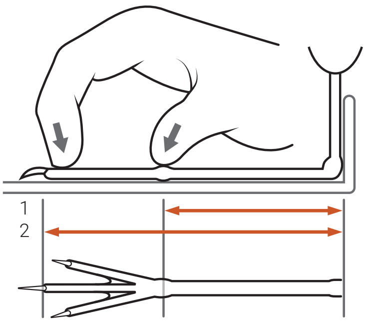


Fig.3: Measuring tarsus length (1) and tarsus-toe length (2).

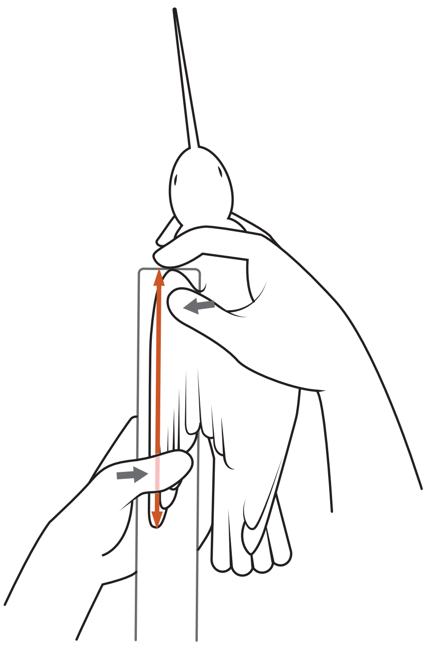


Fig.4: Measuring wing length.

birds in my desired pose were scarce, so I found a solution to splice and combine various body parts in Adobe Photoshop. To achieve a more organic and convincing final outcome, I reconstructed the skeletal frame for the pose and incorporated video footage of the godwits in motion as references. Subsequently, I made final adjustments based on these references to ensure accuracy.

Fig.5: The wings are natually folded and the arpal joint is covered by chest feathers. | Photo by Charles Fitxpatrick (ebird.org)

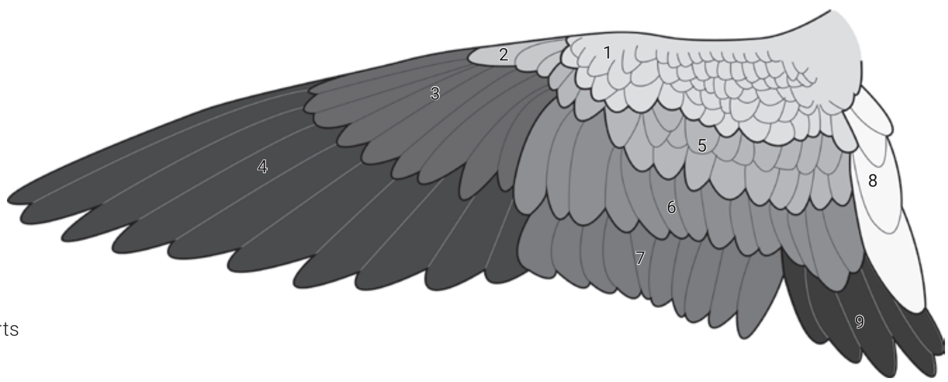
The elaborate sketch

The sketch, which served as the basis for the illustration, was done in pencil to achieve a traditional painting-like aesthetic. One of the most challenging parts of this stage was accurately depicting the wings. To gain a solid understanding of the anatomy of bird wings, I visited the Natural History Museum in Maastricht and the Naturalis Biodiversity Centre in Leiden to examine taxidermy specimens. While I did not obtain the information about the wings which I had hoped from the two museums, I gained a deeper understanding of other aspects, such as the structure of their feet and overall body shape. Ultimately, I referred to other sources, such as *Wing of a European Roller* by Albrecht Dürer (1471-1528) (**Fig.6**), and was able to enhance the quality of my drawing. With a better understanding of the wings, I could also better identify specific structures in the feathers which I had not noticed in my reference photos before. (**Fig.1, 7**) Afterwards, I implemented those in my sketch. However, this time, these specific patterns seemed overemphasised, resulting in feathers that looked too artificially neat. After correcting this, the final sketch was completed and digitalised (**Fig.8**).

		Male Avarage (range)	Female Avarage (range)
Bill length	*limosa*	89.7 (71 - 118)	105.44 (83 - 130)
	islandica	80.22 (72 - 88)	93.79 (79 - 102)
	melanuroides	73.86 (63 - 85)	84.34 (72 - 96)
	bohaii	92.72 (87 - 100)	105.65 (94 - 114)
Total head length	*limosa*	128.17 (111 - 152)	145.32 (122 -164)
	islandica	119.38 (111 - 129)	134.09 (120 - 144)
	melanuroides	107.33 (94 - 121)	118.57 (103 - 133)
	bohaii	127.25 (117 - 147)	141.35 (117 - 153)
Tarsus length	*limosa*	72.72 (60 - 89)	80.62 (67 - 100)
	islandica	68.57 (58 - 79)	75.4 (66 - 82)
	melanuroides	62. 78 (55 -70)	67.95 (57 - 75)
	bohaii	68.75 (65 - 75)	73.4 (67 - 79)
Tarsus - toe length	*limosa*	115.3 (102 - 134)	125.58 (109 - 144)
	islandica	111.04 (101 - 121)	120.38 (111 - 128)
	melanuroides	101.45 (92 - 111)	108.46 (97 - 116)
	bohaii	115 (106 - 123)	121.59 (110 - 136)
Wing length	*limosa*	214.34 (199 - 241)	225.18 (206 - 245)
	islandica	213 (203 - 223)	225.71 (211 - 234)
	melanuroides	194.38 (179 - 209)	204.67 (158 - 219)
	bohaii	199.88 (189 - 206)	209.41 (195 - 219)

Table 1: Dimension of each measurement (in mm).

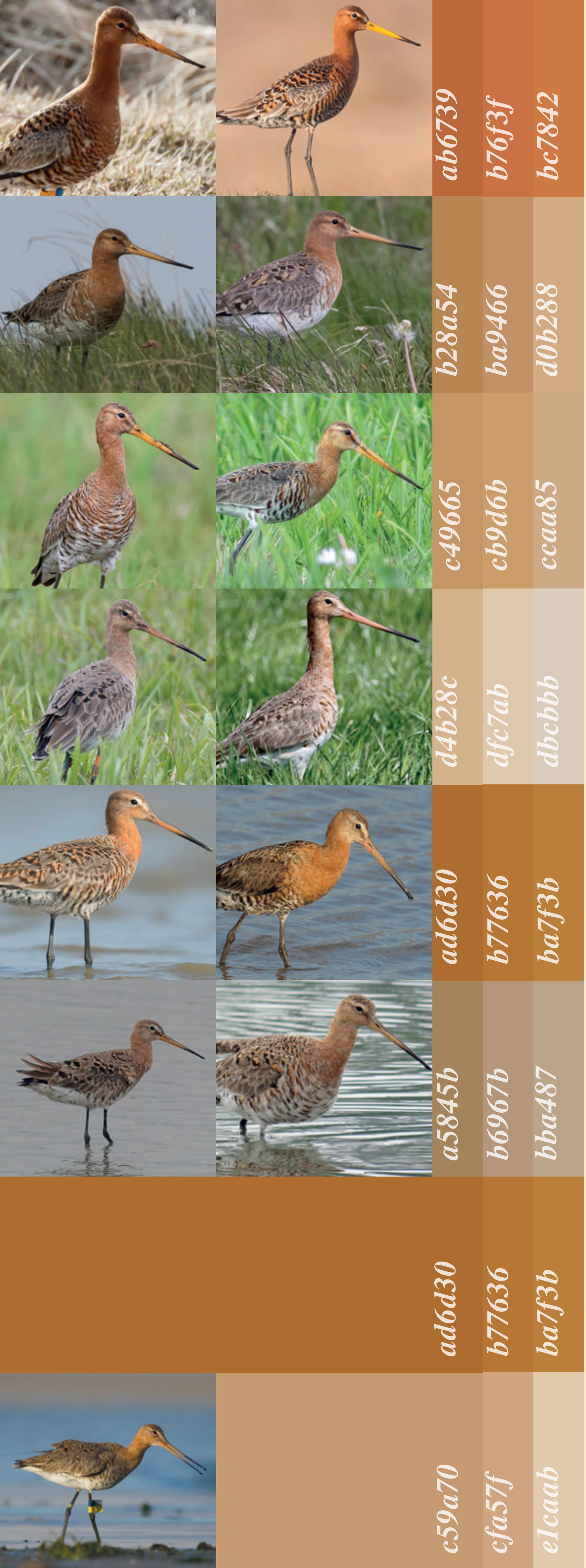
Fig.6: Albrecht Dürer, *Wing of a European Roller*, 1512,
Watercolour and gouache on vellum, 19.6cm*20cm.



1. Lesser coverts
2. Alula
3. Primary coverts
4. Primaries
5. Middle coverts
6. Greater coverts
7. Secondaries
8. Scapulars
9. Tertials

Fig.7: External natomy of wing, dorsal view.

Fig.8: The final sketch, pencil on paper.



The colours

The work at this stage was done with digital techniques. Procreate was mainly used for colouring, and Adobe Photoshop was used in later stages for making the colour, size, and lighting adjustments.

The references for this illustration were digital photos, videos, and taxidermy specimens from the two museums I visited. To ensure consistency, applying uniform lighting to all eight godwits was important. Unfortunately, as their breeding locations did not overlap, it was not feasible to obtain image references under identical conditions for the four subspecies. To mitigate the aforementioned environmental differences and select precise colours, the following steps were taken.

First, three or four photographs taken under daylight were selected for each subspecies. Second, I extracted bright, dark, and medium-tone colours from the bird feathers present in each photograph. Third, I selected colours closest to the middle value of each tone. Lastly, I compared the selected colours with those of the reference photographs to ensure the credibility of the chosen colours (Fig.9). In the case of *L. l. bohaii*, as there was a lack of photo references, the colour selection was guided bt the advice of my external advisor, who suggested using a paler colour compared to *L. l. melanuroides*.

This process proved effective: The final colours significantly improved from the ones I had initially picked before applying these steps and were also approved by my advisor. (Fig.10)

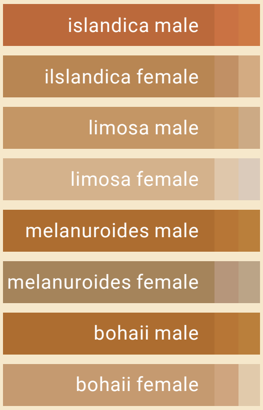


Fig.9: The chosen colours of each subspecies.

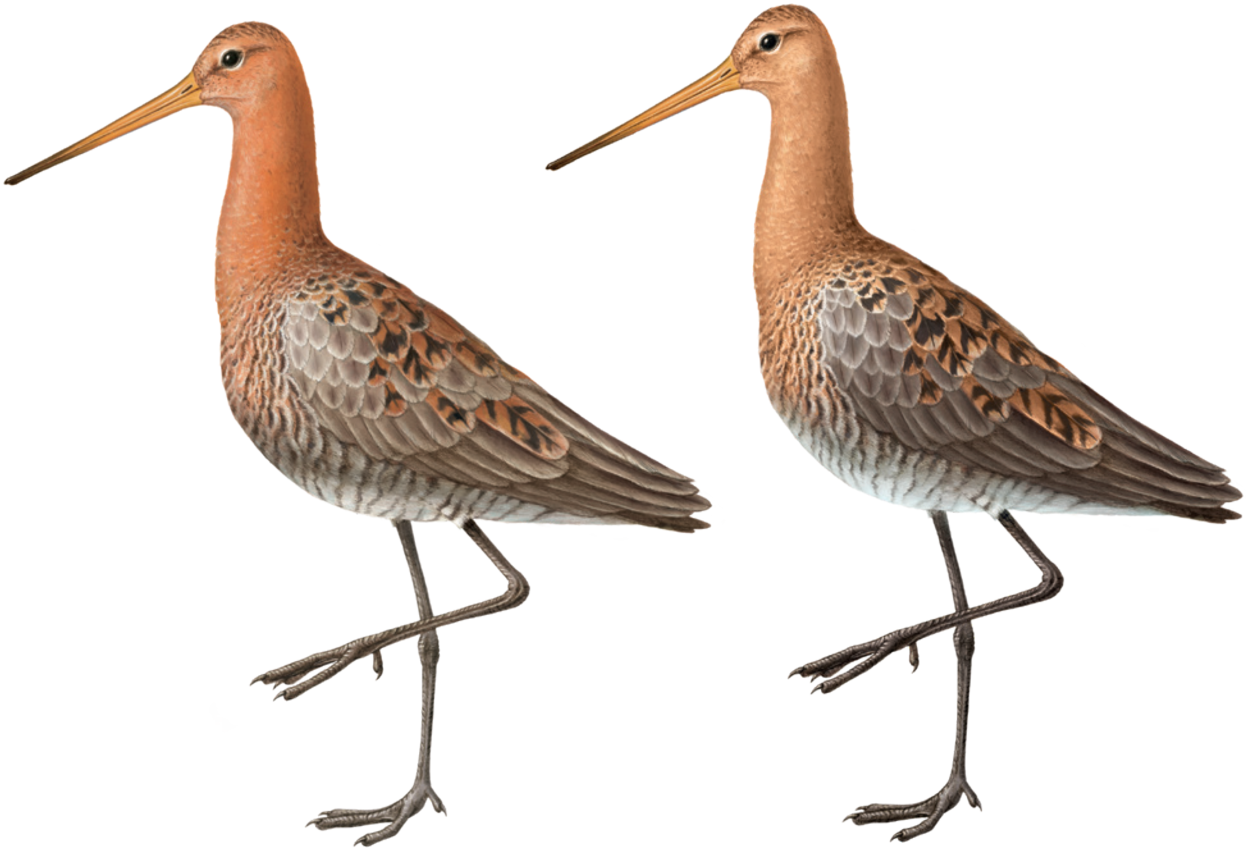


Fig.10: *L. l. limosa*, the first version (left) and final version (right). Digitally coloured.

The sizes

Assessing the size of the entire body with only measurements of specific body parts was challenging. Initially, I estimated the relative sizes by referring to photographic references, measurements of each subspecies, their average weight, and published papers containing morphological studies. The papers provided insights indicating that *L. l. islandica* is the smallest of the four subspecies, *L. l. limosa* is the largest of the three known species, *L. l. bohaii* is similar in size to *L. l. limosa* except for a thicker and longer bill, and *L. l. limosa* and *L. l. melanuroides* differ in size but share the same body shape.

Furthermore, the guidance of my advisor, who has rich field experience and knowledge of their relative sizes, was instrumental in this endeavour. I was fascinated that subspecies appeared to be similar in size based solely on the measurements of discrete body parts, in fact, exhibited significant differences in whole size. For instance, *L. l. melanuroides* could be picked up with one hand, while *L. l. limosa* required two hands, being substantially larger. Based on the aforementioned information, size adjustments were made gradually over several iterations until final confirmation was obtained from the advisor.

The lighting

At the outset of the project, I browsed existing avian illustrations for inspiration. I observed that many appeared to lack three-dimensional suggestion, likely due to an overemphasis on details, which often happens when one draws an animal that has fur, feathers, and patterns. Thus, my objective at this stage was to avoid losing the sense of three-dimensionality through using relatively strong light and shadows.

In 1847, Hermann Schlegel (1804-1884), a biologist, established a set of guidelines for scientific illustrations; the fifth rule regarding light stipulates the use of natural light from the left and advises against using excessively dark shadows. While I concurred with Schlegel's rule, I was also interested in exploring the effects of using very dark shadows in my work.

As soon as a strong shadow was applied, it was clear that the colour of the godwit's belly feathers was distorted, with white feathers appearing grey or light brown instead of white (Fig.11). If this were not a scientific illustration or if the entire body of the godwit were one colour, I might have considered utilising a strong shadow. However, the primary objective of scientific illustration is to convey information and serve as a tool for study. In this context, information refers to the bird's body shape, colour, pattern, size, and so on. Consequently, to ensure the accurate transmission of information, the intensity of the shadow had to be reduced so that it sufficiently showed a three-dimensional form but did not compromise information about the colour. In addition, I included a distinct form of core shadow that would not typically be visible under natural lighting and blue reflected light, as these birds were typically found on grass or in water (Fig.12).

Fig.11: *L. l. melanuroides*, strong shadow applied. (left)
Fig.12: *L. l. melanuroides*, the final version. (right)

L. l. islandica, male and female

L. l. limosa, male and female

L. l. bohaii, male and female

L. l. melanuroides, male and female

Fig.13: Males and females of each subspecies.

The infographic

Since the purpose of this infographic is to visualise the measurement comparison clearly, I decided to use a bar graph format. Initially, a draft with a single-page landscape layout was created (Fig.14). However, for the final version, I decided to utilise a double-page spread layout, taking into account the A5 format of my advisor's publication. To create a modern and simple feel, I chose grey as the base colour and bright, vivid colours for color-coding various measurements. Complementary colours were used between overlapping body parts to distinguish them.

My first draft had one major drawback: The godwits were too small for their size differences to be noticeable immediately. To address this, I increased the size of the birds and added a light-grey background. However, doing so resulted in a proportional increase in the size of the birds with spread wings at the bottom and caused them to overlap with each other. I decided that depicting just one wing was sufficient to convey information on wing length, but I used the full form of the bird in the first image on the far left as a visual aid. The intention is for the audience to think of a complete bird when viewing the repeating half-birds on the right.

Another issue was the direction of the bar graph and the necessity of the second graph. Although it was visually satisfactory, I judged that vertical bars would be more advantageous for reading the data. By switching to vertical bars and excluding the second graph, which was relatively less important, I found it easier to represent the data in its entirety (Fig.15).

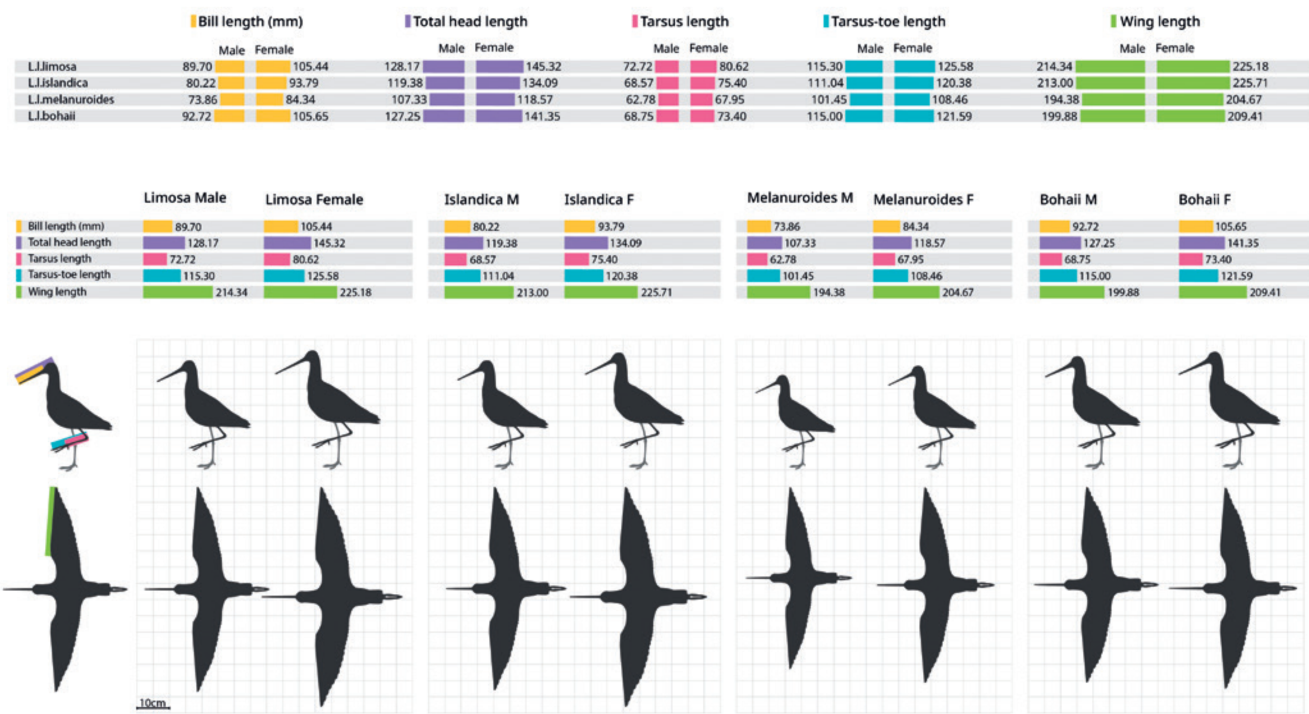


Fig.14: The first version of infographic.

Infographic displaying the size comparison of the black-tailed godwit subspecies.

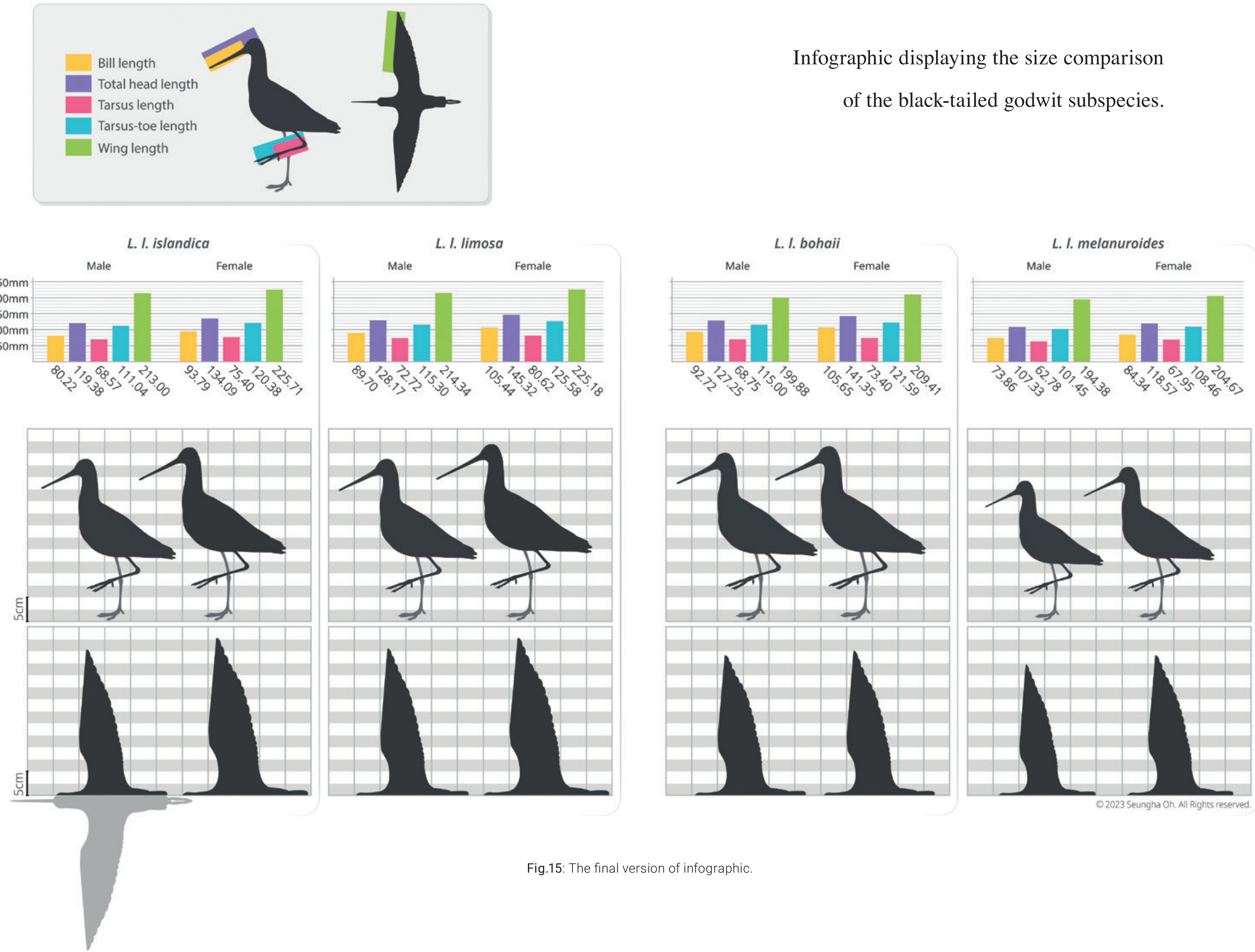


Fig.15: The final version of infographic.

chapter 02

The Breeding and Wintering Site Map of Each Subspecies

The breeding site map
The stopping site map
The breeding and wintering site map

Black-tailed godwits typically breed in wet meadows and grasslands in northern and central Europe and Asia. During the winter months, they migrate to coastal areas and wetlands in southern Europe, Africa, the Middle East, Asia, and Australasia. Some of them travel over 11,000 km during their migration, resulting in one of the most remarkable long-distance migrations among bird species.

It is essential to understand the distribution range of black-tailed godwits, which can aid researchers and policymakers in comprehending the ecological mechanisms and environmental factors that impact the species and its habitats. This understanding can provide valuable guidance in managing and safeguarding these areas. This chapter details the mapping process that illustrates the distribution range of each subspecies, facilitating comprehension of the bird's range.

Initially, my intention was to develop two maps: one for the breeding site and another for the stopping site. However, after a discussion with my advisor, we agreed to create a comprehensive map encompassing each subspecies' breeding and wintering sites. The design elements used, such as colours and styles, aim to create a sense of unity with the infographic produced in Chapter 1, enhancing the overall coherence of the work. All the maps were created using Adobe Illustrator.

The breeding site map

After drafting a simple-style map, I marked the breeding sites of each subspecies on it based on the data received from my advisor. Further, to provide more specific information, I added the names of the countries corresponding to the breeding sites. Additionally, a list of countries corresponding to the breeding sites was created separately (Fig.16). However, it is important to note that the degree of research on the distribution range varied across regions and subspecies. Therefore, some of the areas shown on the map are based on assumptions, and inclusion of the country names could have conveyed inaccurate information. Consequently, the final result only includes the map and breeding sites, without the infographic and country names.

The stopping site map

Due to the lack of accessible and reliable data, I sought advice on alternative sources of information. I was advised to use the data available on the eBird website, which provided information on the monthly sighting locations of each subspecies. Using this information, I marked the locations on a pre-made map to illustrate the rough direction of each subspecies' migration route (Fig.17). Subsequently, I extracted data on the northward and southward migrations of each subspecies separately and marked the places where the observations overlapped, concluding these were important stopping sites (Fig.18).

However, the data used in the two maps were based solely on observations from birdwatchers and not scientific studies. Therefore, it is possible that these marked areas are not stopping sites during migration. After I discussed the issue with my advisor, we concluded that the two migration maps have the potential for misleading information. Due to this reason and the inability to obtain more accurate data, these maps were excluded from the final illustration list of my advisor.

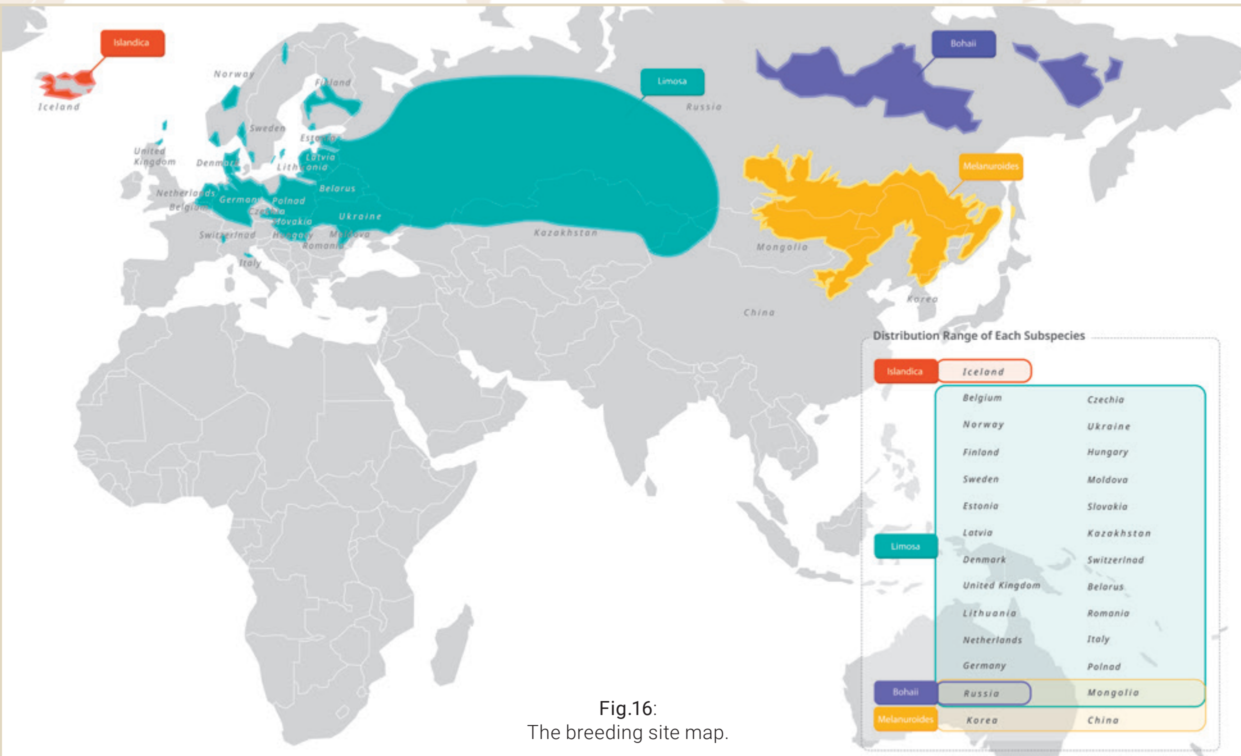


Fig.16:
The breeding site map.

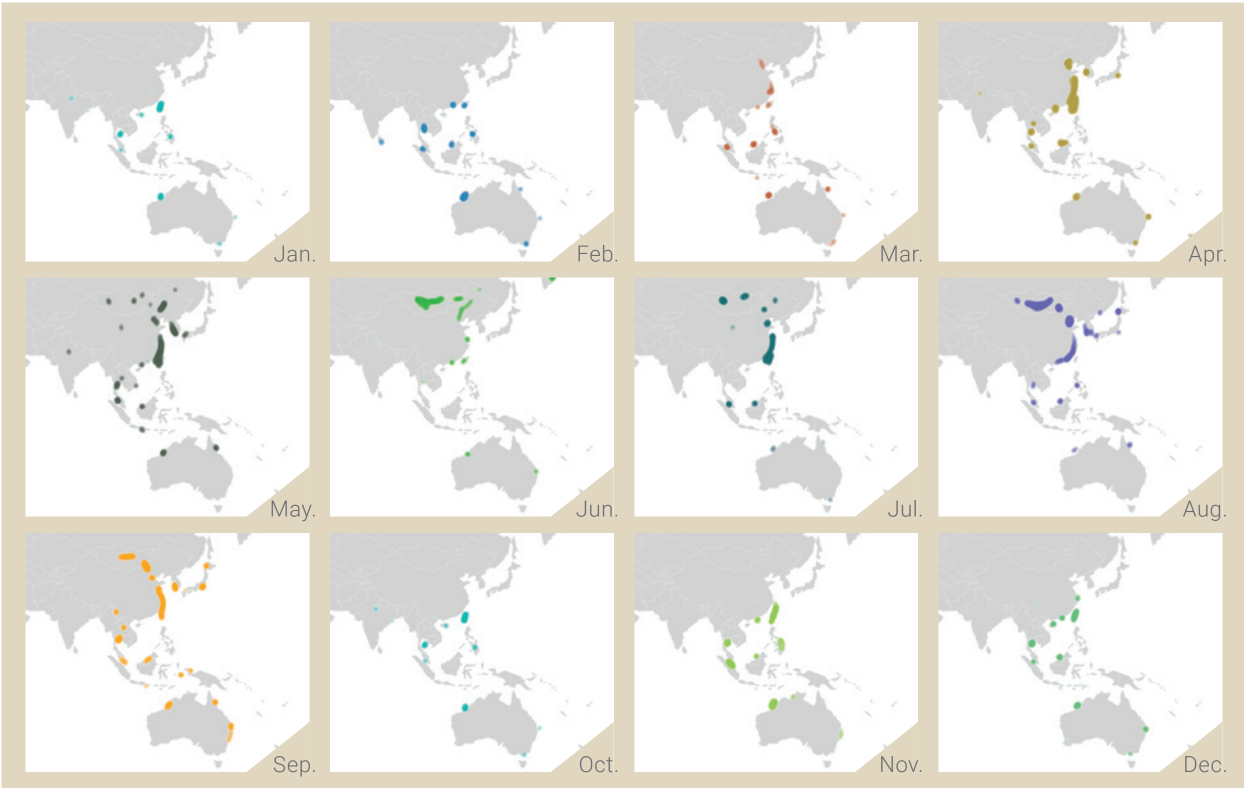


Fig.17:
Monthly sighting locations of *L. l. Melanuroides.*

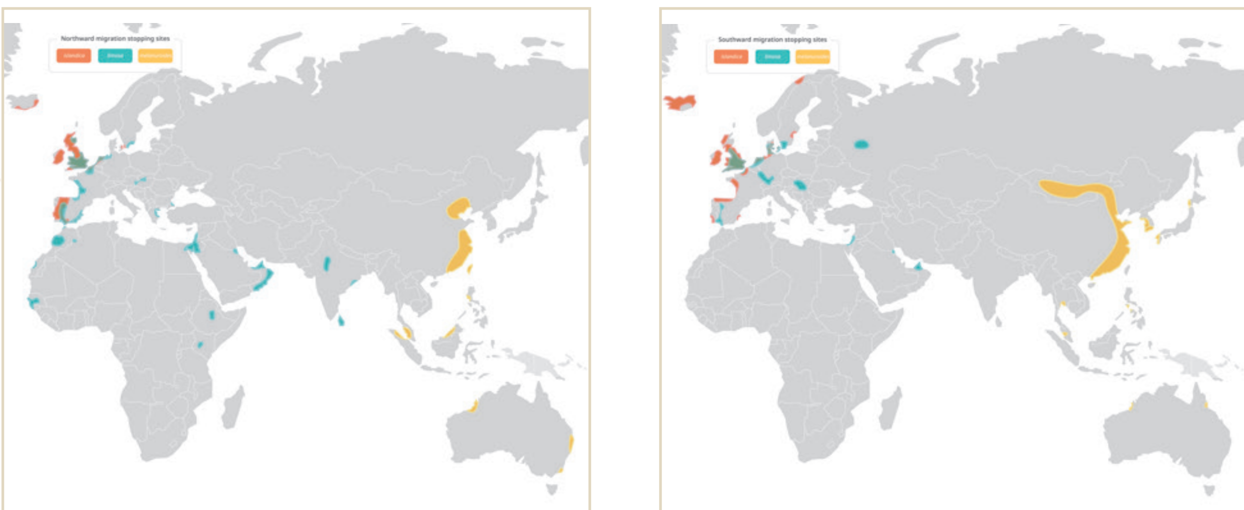


Fig.18:
The northward (left) and southward (right) migration stopping site map(assumption).

Fig.19: The breeding and wintering site map.

The breeding and wintering site map

Instead, we combined each subspecies' breeding and wintering sites into a single map by incorporating the wintering site data into the previously generated breeding site map (Fig.19). Regrettably, the stopping sites could not be included in the final map due to insufficient data. Nevertheless, this consolidated approach proved more effective in conveying comprehensive information on a single map.

chapter

03

The breeding sites
The wintering sites

The Landscapes of Breeding and Wintering Sites of Each Subspecies

The illustrations in this chapter provide a more detailed view of the breeding and wintering sites displayed as maps in Chapter 2. Specifically, this chapter aims to illustrate the environments in which each subspecies breeds and spends the winter.

Initially, I had concerns about whether the illustrations in this chapter would be sufficiently scientific. However, as the landscapes became more concrete, these concerns were relieved. In addition to the scientific information the images convey, I have realised that the landscapes' inherent beauty is intricately connected to the purpose of this project. Images appeal to our emotions, and through them, we recognise objects more vividly and specifically. Therefore, visually appealing scientific illustrations not only can enhance the overall presentation and engagement of scientific information, but also have the potential to evoke an emotional response and foster a connection between the audience and the depicted subject. By capturing the beauty and intricacies of the natural world, they can instill a sense of wonder, curiosity, and concern for the conservation and preservation of biodiversity, which is one of the purposes of this project.

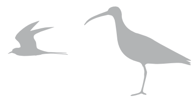
Fig.20.1: Process of creating a landscape 1.
Fig.20.2: Process of creating a landscape 2.
Fig.20.3: Process of creating a landscape 3.

The workflow for creating all eight illustrations was the same. First, I determined the background area for each site per my advisor's request. Using several photographic references for each area, I created a landscape for each site, attempting to capture its unique characteristics (Fig.20.1). To avoid repetition, I diversified some images by depicting them at different times of the day. Next, I composed each image considering which animals to include in addition to the godwits, their relative sizes, and how the godwits behave in each season. Adobe Photoshop was used for the aforementioned steps (Fig.20.2). Then, the final images were created using Procreate. Background and other features, such as animals, were painted on separate layers to facilitate the subsequent modification, which is one of the most beneficial features of digital painting. Lastly, after discussing with the external advisor, I made the final adjustments using Procreate and Adobe Photoshop (Fig.20.3).

Fig.21: The breeding site of *L. l. islandica.*

The breeding sites

When initially creating the breeding-ground illustrations, my placement of the godwits was primarily driven by aesthetic considerations. However, each bird has its own territory during the breeding season, resulting in a relatively low population density. Therefore, acting on advice from my advisor, I ultimately decided to include only approximately ten godwits in each image.



1 2

The landscape 1 | Breeding site of *L. l. islandica*

Location: Iceland, meadow
Animal community: 1. Arctic tern, 2. whimbrel

The landscape 2 | Breeding site of *L. l. limosa*

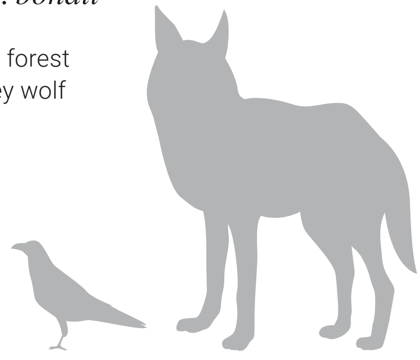
Location: The Netherlands, farmland
Animal community: 1. Eurasian skylark, 2. Eurasian oystercatcher, 3, 4. farm sheep and cow

Fig.22: The breeding site of *L. l. limosa.*

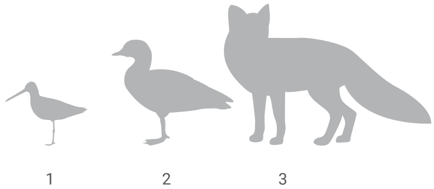
The landscape 3 | Breeding site of *L. l. bohaii*

Fig.23: The breeding site of *L. l. bohaii*.

Location: Far east Russia, edge of the boreal forest
Animal community: 1. Common raven, 2. grey wolf



In this image, I had to consider whether it was appropriate to place the predator close to t he prey, as this is not something that typically occurs in nature. However, I decided to include predators in the illustration in order to show the animal community present in the landscape, despite the potential discomfort it may cause to some viewers. Ultimately, the predators were placed at a certain distance from the prey on the screen, but close enough for viewers to recognise them. The same approach was taken in the following illustration depicting *melanuroides*' breeding site.



The landscape 4 | Breeding site of *L. l. melanuroides*

Location: Mongolia, meadow
Animal community: 1. Asian dowitcher, 2. ruddy shelduck, 3. red fox

Fig.24: The breeding site of *L. l. melanuroides*.

The wintering sites

Each godwit has its territory during the breeding season, but not during the wintering season. Therefore, the population density is much higher during the wintering season. In terms of colour, as mentioned in the first chapter, the birds have a uniform brownish-grey colour, and their bills turn dull pink. The most enjoyable part of drawing the wintering sites was making more diverse landscapes than the breeding sites. Gradually becoming accustomed to working on the digital landscape while working on the breeding site landscapes, I started focusing on the beauty of the landscape itself. Consequently, I was able to create a more natural and visually captivating image.

The landscape 5 | Wintering site of *L. l. islandica*

Loclation: Spain, flooded rice field
Animal community: 1. Black-headed gull, 2. common shelduck, 3. greater flamingo

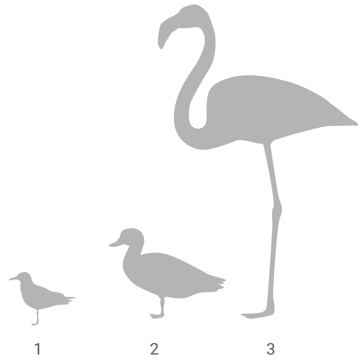
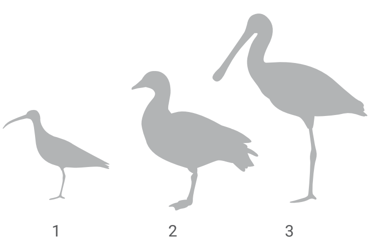


Fig.25: The wintering site of *L. l. islandica*.

Fig.26: The wintering site of *L. l. limosa.*

The landscape 6 | Wintering site of *L. l. limosa*

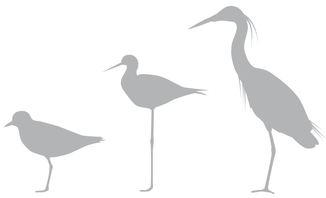
Location: Senegal, coastal mudflat
Animal community: 1. Whimbrel, 2. Egyptian goose, 3. Eurasian spoonpill



The landscape 7 | Wintering site of *L. l. bohaii*

Location: Thailand, flooded rice field
Animal community: 1. Pacific golden plover, 2. black-winged stilt, 3. little egret

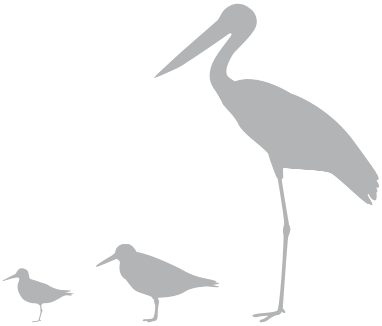
Fig.27: The wintering site of *L. l. bohaii.*



The landscape 8 | Wintering site of *L. l. melanuroides*

Fig.28: The wintering site of *L. l. melanuroides*.

Location: Northwest Australia, Roebuck Bay
Animal community: 1. Black-necked stork, 2. pied oystercatcher, 3. great knot



Conclusion

The act of creating an image is a way to better understand the world. As I delved deeper into the different subspecies of godwits, I began to appreciate their subtle differences, which had previously escaped my notice. Even when encountering birds on my daily walks, I found myself paying more attention to their characteristics and behaviours. Such an experience was deeply rewarding in addition to the pleasure of creating illustrations.

I hope that people who see the illustrations in this project can experience the same joy that I felt while creating them. Furthermore, I hope that the illustrations can serve as a tool to educate others on the differences between these beautiful birds and the environments in which they live, ultimately contributing to the creation of a world where humans and nature coexist.

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부족한 저를 믿고 지지해 주신 부모님께 감사와 사랑을 전합니다.

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