A CASE OF PROGRESSIVE GRAYING IN A GRAY GULL (*LEUCOPHAEUS MODESTUS*) IN MEJILLONES, NORTHERN CHILE

Un caso de encanecimiento progresivo en una gaviota garuma (*Leucophaeus modestus*) en Mejillones, norte de Chile

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RESUMEN.- La gaviota garuma (*Leucophaeus modestus*) es endémica del ecosistema marino de la corriente de Humboldt que habita el litoral costero a lo largo del centro-norte de Chile continental. Durante el invierno, las gaviotas garumas presentan un plumaje completamente gris, mientras que en verano, el plumaje de su cabeza se torna blanco. El 8 de agosto de 2024, registramos una gaviota garuma con su plumaje completamente blanco en una playa cerca de Mejillones, en la región de Antofagasta. Esta gaviota también tenía su pico y patas de color anaranjado, desprovistos parcialmente del pigmento negro característico de la especie. Las causas del encanecimiento progresivo en las aves no están completamente claras. Sin embargo, es posible que la exposición a factores naturales o antropogénicos causantes de estrés oxidativo altere el proceso de pigmentación y acelere el encanecimiento progresivo.

One reason birds are eye-catching is the variety of colors displayed in their plumage (Carello 2021). This varies by species, and it serves multiple functions, including mating (Jacobs *et al.* 2014), territory defense (Senar 2006), communication (Rowland 1979), and camouflage (Gupta *et al.* 2022). Given its interdependence with processes mediated by the environment, plumage coloration in each bird results from the combination of different pigments. Among these, carotenoids and melanin stand out as the most relevant (van Grouw 2006, Toews *et al.* 2017, Aguillon & Shultz 2023).

Synthesis of melanin and carotenoids is genetically determined. Thus, mutations can create heritable pigment deficiencies and color aberrations that can differ radically within the same species (Edelaar *et al.* 2011, Delord *et al.* 2012, Petry *et al.* 2017). Among the different types of color aberrations observed in birds, leucism is one of the most frequent (Silva-Alves *et al.* 2021), due to defects in melanin-producing cells (*i.e.*, melanocytes). This can result in partial or total absence of pigmentation in the plumage, beak, and legs (Valverde & García 2009). However, the recorded cases of leucism in natural populations rarely exceed 1%, and it is more likely that some of these cases were due to progressive graying rather than true leucism (van Grouw 2013, Tierney 2015, Novoa & Casanova 2020, Reyna-Bustos & Suárez-García 2024).

Progressive graying results from a gradual loss of melanocyte function and the subsequent suppression of melanin production, although the genetic basis of this condition remains unclear (Sarin & Artandi 2007, van Grouw 2021). Progressive graying also begins to appear once the animal reaches a certain age (Camacho *et al.* 2022). Hence, in the field, it would be difficult to determine which type of chromatic anomaly would present a bird that has completely lost its pigmentation. Both leucism and progressive graying differ from albinism, as the latter involves a failure in melanin synthesis due to a lack of a key enzyme (van Grouw 2021). This failure explains the existence of individuals completely white with red eyes (van Grouw 2021).

The Gray Gull (*Leucophaeus modestus*) is an endemic species of the Humboldt Current marine ecosystem, inhabiting from Ecuador to southern Chile (Chávez *et al.* 2014, Aguilar-Pulido *et al.* 2021). The Gray Gulls inhabit preferably sandy beaches and feed mainly on the Sand Crab (*Emerita analoga* [Martínez-Piña & González-Cifuentes 2017]). This species is distinctive because it breeds exclusively in remote areas from the Atacama Desert, forming large colonies with individuals moving daily between the coast and inland (Aguilar-Pulido *et al.*

2021). The plumage coloration of the Gray Gull varies seasonally. During winter, its plumage is completely gray (non-breeding plumage), while in summer its head turns white (breeding plumage). Because of this, Gray Gulls belong to the group of "hooded gulls."

On 8 August 2024 (austral winter), at 13:31 h, we recorded an adult Gray Gull with completely white plumage on a sandy beach near Mejillones, northern Chile (Fig. 1). We spotted that gull through 7x50 binoculars while conducting a bird census. This Gray Gull, at approximately 100 m from our position, also had its orange beak and legs partially lacking the characteristic black pigmentation (Fig. 2). On 7 February 2025 (austral summer), at 09:30 h, we again recorded a Gray Gull with the same plumage features in the same site. Thus, we supposed it was likely the same individual, as indicated by the similar pigmentation pattern, particularly on the beak and legs. This gull with atypical coloration was resting on the beach next to a group of 50 other individuals with typical plumage coloration (Fig. 1).

The record area features coastal cliffs and extensive coastal plains, with a desert climate and sparse vegetation. Heavy seaport and industrial activity in this area has caused serious environmental damage, including high levels of air and water pollution that affect human health and the biodiversity of the bay (Valdés 2012, García-Ce-

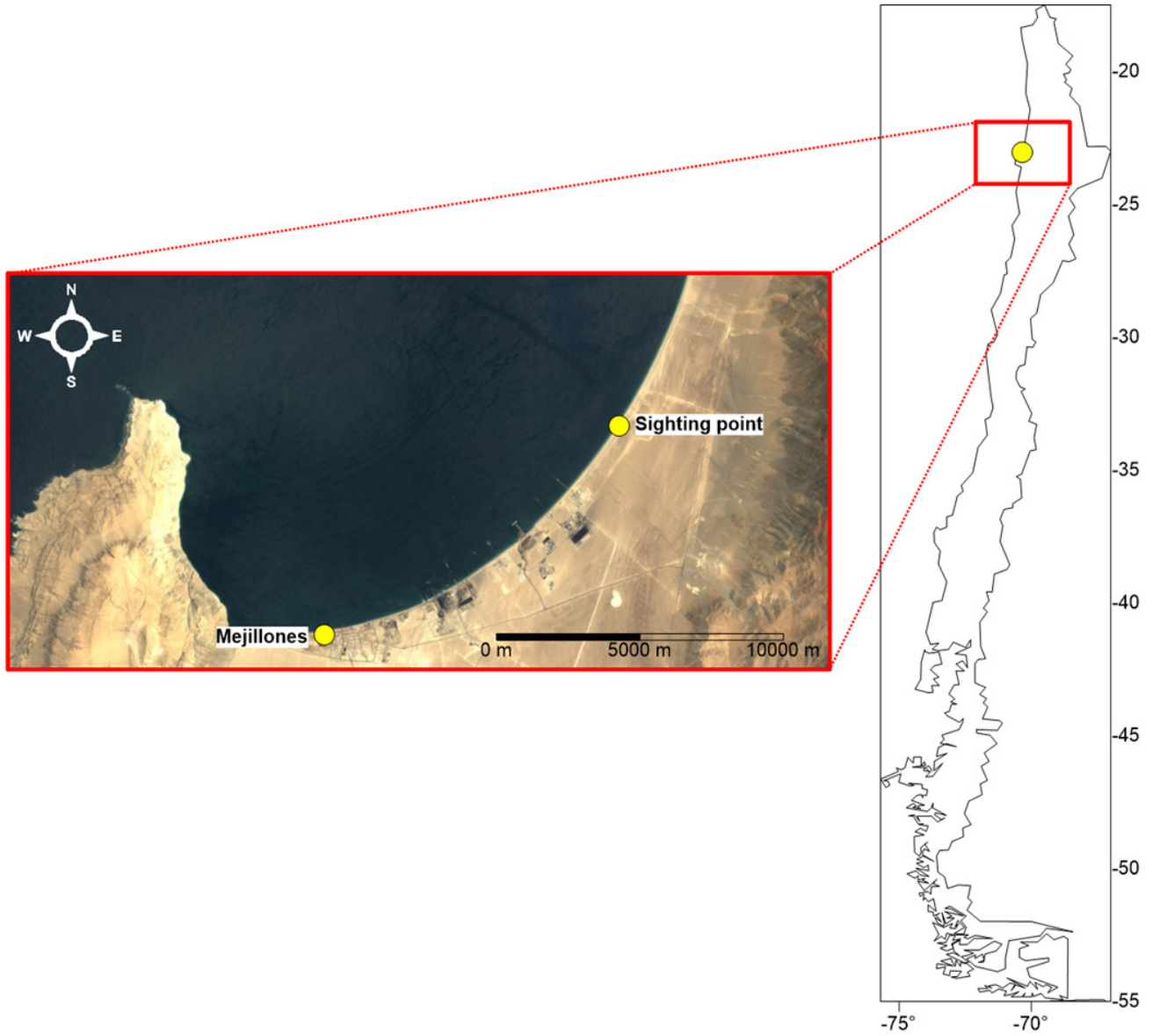

Figure 1. Record site of a Gray Gull (*Leucophaeus modestus*) with progressive graying in Mejillones, northern Chile. This gull was observed for the first time by authors on 8 August 2024. Apparently, the same individual was in the same site on 7 February 2025.

garra *et al.* 2024).

Our record is the first documented case of a Gray Gull with progressive graying in Chile. Previously, Torres & Franke (2008) reported a case of partial leucism in a Gray Gull in Peru. Although our records could also be a case of leucism, the irregular coloration pattern observed on the beak and legs suggests instead progressive graying. Moreover, leucism, total or partial, is identifiable by bilaterally symmetrical patches of pigmentation (Mora & Campos-Loría 2020, van Grouw 2021).

In the early stages of progressive graying, the affected feathers are usually randomly distributed throughout the bird, eventually becoming completely white. The loss of pigmentation may be a consequence of a gradual reduction in the oxidative activity of the melanin-synthesizing enzyme tyrosinase in the pigment cells, or due to the death of these cells (van Grouw 2018). Although the causes of this condition are not fully understood, exposure to natural and anthropogenic factors that promote oxidative stress (*e.g.*, extreme temperatures, radiation, and mutagens) could alter the pigmentation process and accelerate progressive graying (Winter 1985, Møller & Mousseau 2001, Izquierdo *et al.* 2018, Camacho *et al.* 2022).

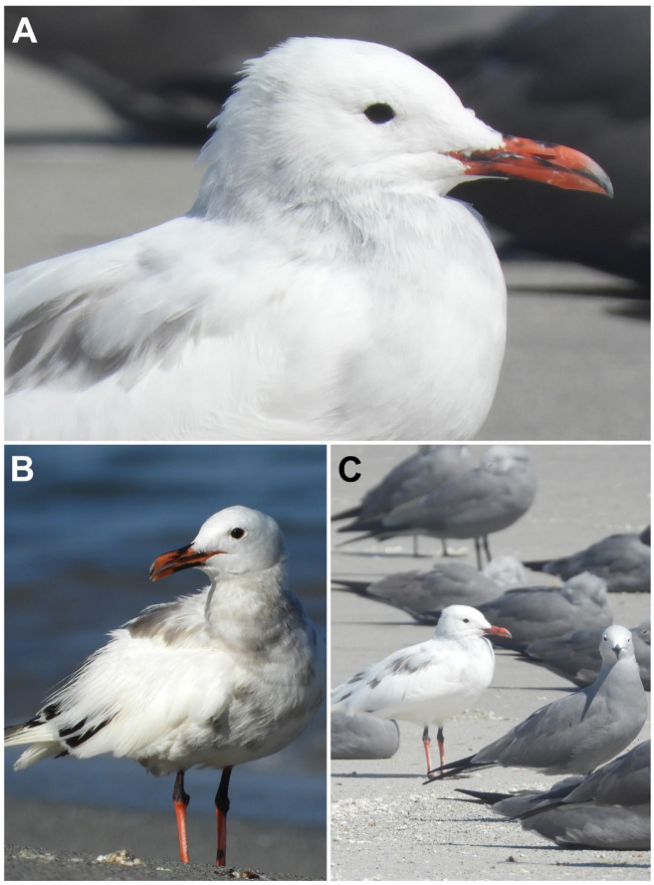

Figure 2. Gray Gull (*Leucophaeus modestus*) with progressive greying recorded on 8 August 2024 in a sandy beach in Mejillones, northern Chile. **A**. Completely white plumage and orange bill with irregular remains of the original black pigmentation. **B**. Possibly the same gull sighted on 7 February 2025, austral summer. **C**. The gull with progressive graying is next to other gray gulls with typical plumage coloration.

Diet may also trigger progressive graying, since nutritional deficiencies can alter melanin pigmentation during feather development (van Grouw 2018, Camacho *et al*. 2022). In Mejillones, contaminants can enter the food web through filter-feeding organisms, such as Sand Crabs (Valdovinos & Zúñiga 2002). These contaminants can reach avian predators and ultimately modify biochemical processes of feather pigmentation (Einoder *et al*. 2018). Individuals with abnormal plumage may be vulnerable to predators and illegal wildlife trade because they are conspicuous due to their distinctive plumage (Petry *et al*. 2017, Santos & Paula 2019). For example, Ellegren *et al*. (1997) showed that common swallows with chromatic aberrations had lower survival rates, primarily because predators could easily detect those with white plumage.

The indifference of Gray Gulls with typical coloration towards the gull with atypical coloration agrees with other cases of birds with chromatic aberrations. For example, Figueroa *et al.* (2011) observed that leucistic Turkey Vultures can interact and even reproduce normally with conspecific individuals with normal pigmentation. Thus, it is possible that the Gray Gull with progressive graying had reproduced with individuals with typical coloration. The fact that the individual was not isolated supports this idea, much so considering that the breeding season in Antofagasta begins in late August, with the first copulations, although these can occur until February (Aguilar *et al*. 2013).

Chromatic abnormalities could be evolutionarily advantageous in certain types of habitats (Edelaar *et al.* 2011). However, since the gray gull's plumage coloration pattern is gray, the loss of pigmentation could negatively affect an individual's fitness. For example, the dark plumage provides protection against solar radiation, increasing resistance to UV abrasion and favoring thermoregulation (Dufour *et al.* 2020). In sunbirds, melanin content is strongly related to heat absorption and thermal balance, whereas white plumages tend to reflect sunlight, altering the body's thermal balance (Rogalla *et al.* 2021).

In South America, reports of birds with chromatic aberrations are scarce and dispersed. Most of the published reports do not accurately establish the prevalence and ecological implications. It is possible that the low occurrence of gray gull with chromatic alterations is a consequence of a lack of observations, leading to an underestimation of a condition that is likely more frequent in nature than is currently known.

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CITED LITERATURE

Aguilar R., M. Perucci, T. Cisternas, M. Torres, M. Silva, A. Marín, A. Silva & P. Bolados. 2013. La nidificación de la gaviota garuma y su vulnerabilidad a las actividades antrópicas en el Desierto de Atacama. Fondo de Protección Ambiental 2012, Ministerio de Medio Ambiente, Antofagasta, Chile. 38 pp.

Aguilar-Pulido, R., C. Catoni, G. Luna-Jorquera, M. Perucci, M. Dell'omo, G. Zavalaga & A. Simeone. 2021. Distribución, características y situación actual de las colonias reproductivas de la gaviota garuma (*Leucophaeus modestus*) en el desierto de Atacama, norte de Chile. *Revista Chilena de Ornitología* 27: 21-36.

Aguillon, S.M. & A.J. Shultz. 2023. Community-sourced sightings of atypical birds can be used to understand the evolution of plumage color and pattern. *Ornithology* 140: 1-9.

Camacho, C., P. Sáez-Gómez, P. Hidalgo-Rodríguez, J. Rabadán-González, C. Molina & J.J. Negro. 2022. Leucistic plumage as a result of progressive greying in a cryptic nocturnal bird. *Scientific Reports* 12: 3411.

Carello, C. 2021. Learning to discern color aberration in birds. *Colorado Birds* 55: 148-152.

Chávez-Hoffmeister, M.J.D., C. Carrillo-Briceño & S.N. Nielsen. 2014. The evolution of seabirds in the Humboldt Current: New clues from the Pliocene of central Chile. *Public Library of Science (PLOS) ONE* 9: e90043.

Delord, K., C. Barbraud & S. Bertrand. 2012. Rare colour aberration in the Guanay Cormorant *Phalacrocorax bougainvillii*. *Marine Ornithology* 40: 123-124.

Dufour, P., J. Guerra-Carande, J. Renaud, J.P. Renoult, S. Lavergne & P.A. Crochet. 2020. Plumage colouration in gulls responds to their non-breeding climatic niche. *Global Ecology and Biogeography* 29: 1704-1715.

Edelaar, P., J. Donázar, M. Soriano, M.A. Santillán, D.R. Gonzalez-Zevallos, J.P. Garcia-Borboroglu & F.R. Quintana. 2011. Apparent selective advantage of leucism in a coastal population of Southern caracaras (Falconidae). *Evolutionary Ecology Research* 13:187-196.

Einoder, L.D., C.K. MacLeod & C. Coughanowr. 2018. Metal and isotope analysis of bird feathers in a contaminated estuary reveals bioaccumulation, biomagnification, and potential toxic effects. *Archives of Environmental Contamination and Toxicology* 75: 96-110.

Figueroa, J., M. Stucchi & G. Mori G. 2011. Casos de leucismo en el Gallinazo de Cabeza Roja (*Cathartes aura*) en la isla Lobos de Tierra, Perú. *Boletín Informativo UNOP* 6: 14-18.

García-Cegarra, A.M., A. Hall & E. Martínez-López. 2024. Bycatch and pollution are the main threats for Burmeister's porpoises inhabiting a high-industrialized bay in the Humboldt Current System. *Environmental Research* 251: 118621.

Gupta, S., A. Agrawal & K. Saxena. 2022. Defense strategies in birds of Charadriidae Family. *Proceedings of the Zoological Society* 75: 395-412.

Izquierdo, L., R.L. Thomson, J.I. Aguirre, A. Díez-Fernández, B. Faivre, J. Figuerola & J.D. Ibáñez-Álamo. 2018. Factors associated with leucism in the common blackbird *Turdus merula*. *Journal of Avian Biology* 49: e01778.

Jacobs, A.C., J.M. Fair & M. Zuk. 2015. Coloration, paternity, and assortative mating in western bluebirds. *Ethology* 121: 176-186.

Martínez-Piña D. & G. González-Cifuentes. 2017. Las aves de Chile, guía de campo y breve historia natural. Ediciones del Naturalista, Santiago, Chile. 538 pp.

Møller, A.P. & T.A. Mousseau. 2001. Albinism and phenotype of barn swallows (*Hirundo rustic*a) from Chernobyl. *Evolution* 55: 2097-2104.

Mora, J.M. & M.N. Campos-Loría. 2020. Encanecimiento progresivo en el garrapatero pijuy (*Crotophaga sulcirostris*) en Costa Rica. *Huitzil* 21: e582.

Novoa, F. J. & L. Casanova. 2020. Registro de leucismo en petrel gigante antártico (*Macronectes giganteus*) en isla Larga, Región de Aysén, Chile. *Huitzil* 21: e600.

Petry, M.V., L.L. Corrêa, V.R.F. Benemann & G.B. Werle. 2017. Brown plumage aberration records in Kelp Gull (*Larus dominicanus*) and Magellanic Penguin (*Spheniscus magellanicus*) in southern Brazil. *Revista Brasileira de Ornitologia* 25: 125-127.

Reyna-Bustos, O.F. & O. Suárez-García. 2024. Two new reports of leucistic birds from Mexico. *Huitzil* 25: e676.

Rogalla, S., A. Patil, A. Dhinojwala, M.D. Shawkey & L. D'Alba. 2021. Enhanced photothermal absorption in iridescent feathers. *Journal of the Royal Society Interface* 18: 20210252.

Rowland, W.J. 1979. The use of color in intraspecific communication. Pp. 379-421 *in* Burtt, E.H. Jr, (ed.). *The behavioral significance of color*. Routledge. New York. USA.

Sarin, K.Y. & S.E. Artandi. 2007. Aging, graying and loss of melanocyte stem cells. *Stem Cell Reviews* 3: 212-217.

Senar, J.C. 2006. Bird colors as intrasexual signals of aggression and dominance. *Bird Coloration* 2: 125-193.

Silva-Alves, V.D., N.L. Sander & O.M.A. Nogueira. 2021. First record of leucism in *Megaceryle torqua-*

ta (Coraciiformes: Alcedinidae) in Pantanal, Brazil. *Brazilian Journal of Biology* 82: e236178.

Tierney, N. 2015. Irish Ringing Report for 2015. *Irish Birds* 10: 271-286.

Toews, D.P., N.R. Hofmeister & S.A. Taylor. 2017. The evolution and genetics of carotenoid processing in animals. *Trends in Genetics* 33: 171-182.

Torres, M. & I. Franke. 2008. Reporte de albinismo en *Podiceps major*, *Pelecanus thagus* y *Cinclodes fuscus* y revisión de aves silvestres albinas del Perú. *Revista Peruana de Biología* 15: 105-108.

Valdés, J. 2012. Heavy metal distribution and enrichment in sediments of Mejillones Bay (23 S), Chile: a spatial and temporal approach. *Environmental Monitoring and Assessment* 184: 5283-5294.

Valdovinos, C. & M. Zuñiga. 2002. Copper acute toxicity tests with the sand crab *Emerita analoga* (Decapoda: Hippidae): a biomonitor of heavy metal pollution in Chilean coastal seawater? *Bulletin of Environmental Contamination & Toxicology* 69: 393-400.

Valverde, M. & M. García. 2009. Aberraciones en la pigmentación del plumaje de Aves Marinas de la costa peruana. *The Biologist* 7: 99-105.

van Grouw, H. 2006. Not every white bird is an albino: sense and nonsense about colour aberrations in birds. *Dutch Birding* 28: 79-89.

van Grouw, H. 2013. What colour is that bird? The causes and recognition of common colour aberrations in birds. *Brit. Birds* 106: 17-29.

van Grouw, H. 2018. White feathers in black birds. *British Birds* 111: 250-263.

van Grouw, H. 2021. What's in a name? Nomenclature for colour aberrations in birds reviewed. *Bulletin of the British Ornithologists' Club* 141: 276-299.

Winter, P. 1985. Partial albinism in a melanistic mew gull. *Western Birds* 16: 187-188.

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