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Partial melanism as a frequent phenotypic variation of *Philodryas chamissonis* (Squamata: Dipsadidae) (Wiegmann, 1835) in the O'Higgins Region, Chile.

Melanismo parcial como una variación fenotípica frecuente de *Philodryas chamissonis* (Squamata: Dipsadidae) (Wiegmann, 1835) en la Región de O'Higgins, Chile.

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ABSTRACT

Unusual differences in coloration and design patterns have been described in some snake species around the world. These descriptions usually consider morphological abnormalities observed in single individuals, but not in a subgroup of the species, and few studies have evaluated the distribution of snake species subgroups with similar coloration and design patterns. In this study, we describe in central Chile the distribution of a subgroup, non-geographically isolated, of the endemic snake *Philodryas chamissonis*, presenting a similar design pattern named partial melanism, phenotypic variation showing a greater expression in the O'Higgins region, without records at the north of Maipo River.

Keywords: Snake, South America, coloration, morphology.

RESUMEN

Se han descrito diferencias inusuales en patrones de diseño y coloración en varias especies de serpientes en todo el mundo. Estas descripciones usualmente consideran las diferencias morfológicas observadas en individuos, pero no en un subgrupo de la especie. Pocos estudios han evaluado la distribución de subgrupos de especies de serpientes con patrones de diseño y coloración similares. En este estudio, describimos en Chile central, la distribución de un subgrupo, no aislado geográficamente, de la serpiente endémica *Philodryas chamissonis*, que presenta un patrón de diseño similar denominado melanismo parcial, una variación fenotípica que mayormente se expresa en la Región de O'Higgins, sin registros hacia el norte del Rio Maipo.

Palabras clave: Serpiente, Sudamérica, coloración, morfología.

INTRODUCTION

Chilean fauna is characterized by possessing a high level of endemism (Smith-Ramírez, 2004), especially in the Reptilia class, despite having a low diversity of native species (135 taxa; Ruiz de Gamboa (2016)) compared to countries with similar geoclimatic conditions (Greene & Jaksic, 1992); 49% of this taxa are found only in Chilean territory (Demangel, 2016).

Six species of terrestrial snakes are distributed in Chile (Vidal *et al.*, 2008; Demangel, 2016; Ruiz de Gamboa, 2016), all belonging to the family Dipsadidae, subfamily Xenodontinae (Zaher *et al.*, 2009): *Pseudoalsophis* (one species), *Tachymenis* (two species) and *Philodryas*, with three species: *P. tachymenoides* (Schmidt & Walker, 1943), *P. simonsii* (Boulenger, 1900) and *P. chamissonis* (Wiegmann, 1835). In the case of *P. chamissonis*, Donoso-Barros (1974) recognized two subspecies: *P. chamissonis chamissonis* and P. *chamissonis eremicola*, however, there is no current evidence to support this split.

The genus *Philodryas* is widely distributed from 8° to 42° S latitude, throughout the American continent (Thomas, 1976), with a total of 22 species (Zaher *et al.*, 2008). In continental Chile, *P. chamissonis* is an endemic species, and represents the colubrid with the greatest range, from Copiapó (26° S) to Valdivia (40° S) (Donoso-Barros, 1966), and from sea level up to 2364 m (Sallaberry-Pincheira *et al.*, 2011).

This extensive latitudinal distribution, facilitates the development of genetic variability as an evolutionary mechanism of improvement in adaptive capacity and acclimatization to the different environmental gradients throughout the territory, and historical geographical barriers, in the case of low mobility species such as reptiles, which generate important cases of genetic divergence (Avise, 2000). In fact, Pleistocene glaciations, as the last one occurring 23,000 - 17,000 years ago, covered much of the continental territory across the Los Andes mountain formation, even forming a constant ice cap between mountain range and the coastal region from 42° S latitude (McCulloch *et al.*, 2000). In this climatic scenario, and subsequent glacial retraction, the rivers that crossed our territory towards the coast (e.g. Aconcagua, Maipo, Cachapoal and Tinguiririca) might have presented considerably broader flows than currently, constituting important barriers for the dispersion of the species, and favoring the mechanisms of vicarious evolution with formation of new evolutionary units (Lamborot & Eaton, 1997; Lamborot *et al.*, 2003). These effects, during the quaternary glaciations might have contracted the distribution of the species, later to generated a postglacial expansion which could have reduced genetic diversity (Hewitt, 2000), which together with prevailing low temperatures, had to model the genetic distribution and adaptability of ectothermic species such as *P. chamissonis* (Sallaberry-Pincheira *et al.*, 2011).

Sallaberry-Pincheira *et al.* (2011) previously analyzed the genetic divergence of *P. chamissonis* using two mitochondrial DNA markers throughout its current distribution. Results confirmed the existence of four haplogroups, consistent with the different geographical and latitudinal patterns of Chile, and confirming the Maipo River as the historical geographical barrier separating two haplogroups named central and southern clades. This last clade would include the administrative territory of the O'Higgins region and the rest of the southern distribution territory, extending to Galvarino (Araucania region), considering therefore the specimens of this region, with characteristics or patterns of particular genetic expression that potentially may affect a phenotypic expression, different from the specimens that live from the Maipo River towards the north.

Philodryas chamissonis occupies a wide variety of habitats, from the extremely dry Atacama Desert to the cold Valdivian temperate rain forests (Donoso-Barros, 1966), and is morphologically described as a medium-sized colubrid, which can reach up to 220 cm in total length (Greene & Jaksic, 1992), with a typical color pattern consisting of a broad dorsal brown colored band, flanked by two thinner white-yellowish bands that run longitudinally down the body (Donoso-Barros, 1962). In this study, we describe this pattern as the "typical morph" (Figure 1). Demangel (2016) adds to description that the species has a whitish-gray ventral coloration and there are specimens with a tendency to melanism,

stating that some individuals had black spots of different sizes distributed irregularly throughout the body, while others are almost totally black (in his book, he accompany this description with a photograph of a specimen with partial melanism from Chacayes, Machalí, O'Higgins Region, Chile). Here we describe this last pattern or morph as a phenotypic variant called "partial melanism".

A large variety of color patterns have been described in snake species worldwide, patterns that have been naturally selected to favor survival of different species by increasing thermoregulation and concealment among others (Bechtel, 1978; 1991). The production of different color patterns in snakes depends on four types of chromatophores in the epithelium (melanophores, erythrophores, xanthophores and iridophores) (Laus & Buric, 2012). When the color pattern of an individual differs from other specimens of the same species, it is catalogued as an abnormality in the chromatogenesis, wich has been documented in various Viperidae and Colubridae species (Bittner, 2000; Jadzík, 2004; Krecsak, 2008; Pernetta & Reading, 2009; Laus & Buric, 2012). Melanophores are the chromatophores that produce black pigments in the skin. Partial melanism has been described in a variety of snake species and subspecies presenting no taxonomic value (e.g., *Natrix natrix, Thamnophis sirtalis*) (Bittner, 2000; Jadzík, 2004). However, most of the studies are individually based and few evaluate the chromatogenesis abnormalities in the complete distribution of a species.

This article describes the percentage of occurrence of the phenotypic variant called partial melanism in *P. chamissonis* recorded in the O'Higgins Region, and compares it to the complete distribution of the species, postulating that this morph has a greater expression in this territory than in the rest of its range.

Figure 1. Typical morph of *P. chamissonis*. Rio Cachapoal, Machalí, O'Higgins Region. Photograph: Diego Ramírez-Alvarez.

MATERIALS AND METHODS

We collected and evaluated records of *P. chamissonis* from the O'Higgins Region, sighted between the years 2006 and 2017, through the following routes:

A.- Personal collection by N. Sallaberry: carcasses found dead on highways and rural roads, collected between years 2006-2012 and maintained in 70% ethanol.

B.- Surveys of native fauna carried out by the wildlife unit of the Renewable Natural Resources Protection Department of the Agricultural and Livestock Service (SAG) of the O'Higgins Region, Chile. A total of 17 surveys were carried out between October 2014 and December 2017, during the summer season, with active day and night searches, in different environments and ecotypes of the region, favoring areas of low anthropogenic intervention. Each activity had a duration varying from 1 to 5 days, with the participation of 1 to 4 people per survey, which generated a total sampling effort of 1080 hours/man. All *P. chamissonis* sightings were recorded and tabulated.

C.- Review of photographic material of *P. chamissonis* from the O'Higgins Region, which was delivered to SAG by naturalists from this area, through the "Wildlife of O'Higgins Region Network" (https://www.facebook.com/groups/777592725622613).

D.- Three records from photographic material taken in the O'Higgins Region, reported in the book "Reptiles en Chile" (Demangel, 2016).

At the same time, records from other regions of the country were evaluated throughout the complete distribution of this species, by means of personal collections, photographs from different Chilean naturalists, and through the digital herpetological network "Reptiles de Chile" (https://www.facebook.com/groups/208533175833879).

For each record, the data of date of observation, locality, georeference (if possible), state of development, morph and author of the observation were registered.

RESULTS

A total of 107 records of *P. chamissonis* from other Chilean regions (from Atacama to Araucanía), different to the O'Higgins Region, were obtained in this study (Table 1). All these records presented a typical morph pattern. However, after the period of bibliographic review and photographic evaluation carried out for this study (2005-2017), recent photographs (2018-2020) of *P. chamissonis* specimens with partial melanism pattern have appeared in different naturalistic social networks, attributed to location to Maule region (at south of O'Higgins Region), which would indicate the presence of this morphotype at least in the O'Higgins and Maule Regions.

Date	Locality, Region	Development stage	Morph	Source
September 2005	Peñalolén. Metropolitana	Adult	Typical	N. Sallaberry
October 2006	La Hermita. Metropolitana	Adult	Typical	N. Sallaberry
October 2006	Caleta Arrayan. Coquimbo	Adult	Typical	N. Sallaberry
October 2006	La Serena. Coquimbo	Adult	Typical	N. Sallaberry
November 2006	Parque O'Higgins. Metropolitana	Adult	Typical	N. Sallaberry
December 2006	Villa Paulina. Metropolitana	Adult	Typical	N. Sallaberry
January 2007	Laguna Esmeralda. Metropolitana	Juvenile	Typical	N. Sallaberry
January 2007	Camino Lagunillas. Metropolitana	Adult	Typical	N. Sallaberry

January 2007	La Hermita. Metropolitana	Adult	Typical	N. Sallaberry
January 2007	Tilama, Quilimari. Coquimbo	Adult	Typical	N. Sallaberry
January 2007	Galvarino. Araucanía	Adult	Typical	N. Sallaberry
March 2007	Camping Ballena. Valparaíso	Adult	Typical	N. Sallaberry
March 2007	Palo Colorado. Coquimbo	Adult	Typical	N. Sallaberry
March 2007	Palo Colorado. Coquimbo	Juvenile	Typical	N. Sallaberry
March 2007	Palo Colorado. Coquimbo	Adult	Typical	N. Sallaberry
September 2007	San Felipe. Valparaíso	Adult	Typical	N. Sallaberry
November 2007	Pirque. Metropolitana	Adult	Typical	N. Sallaberry
November 2007	Los Maitenes. Valparaíso	Adult	Typical	N. Sallaberry
November 2007	Farellones. Metropolitana.	Adult	Typical	N. Sallaberry
November 2007	Camino Farellones. Metropolitana	Adult	Typical	N. Sallaberry
December 2007	Ciudad de los Valles. Metropolitana	Adult	Typical	N. Sallaberry
February 2008	Pencahue. Maule	Adult	Typical	N. Sallaberry
February 2008	Ruta 5 Sur. Maule	Juvenile	Typical	N. Sallaberry
February 2008	La Dehesa. Metropolitana	Juvenile	Typical	N. Sallaberry
February 2008	Caleta Arrayan. Coquimbo	Adult	Typical	N. Sallaberry
November 2008	Farellones. Metropolitana	Adult	Typical	N. Sallaberry
December 2008	Los Molles. Coquimbo	Adult	Typical	N. Sallaberry
December 2008	Farellones. Metropolitana	Adult	Typical	N. Sallaberry
January 2009	Empedrado. Maule	Adult	Typical	N. Sallaberry
January 2009	Quilimarí. Coquimbo	Adult	Typical	N. Sallaberry
February 2009	Laguna Esmeralda. Metropolitana	Adult	Typical	N. Sallaberry
February 2009	Lo Barnechea. Metropolitana	Juvenile	Typical	N. Sallaberry
December 2009	Cuesta Ibacache. Valparaíso	Adult	Typical	N. Sallaberry
May 2010	Cauquenes. Maule	Adult	Typical	N. Sallaberry
November 2010	Mantagua. Valparaíso	Adult	Typical	N. Sallaberry
December 2010	Mallarauco. Metropolitana	Adult	Typical	N. Sallaberry
September 2015	Viña del Mar. Valparaíso	Adult	Typical	Reptiles de Chile*
November 2015	Lampa. Metropolitana	Adult	Typical	Reptiles de Chile*
December 2015	RN Radal 7 Tazas. Maule	Adult	Typical	C. Castro
January 2016	Viña del Mar. Valparaíso	Adult	Typical	Reptiles de Chile*
January 2016	El Monte. Metropolitana	Juvenile	Typical	T. Castellano
February 2016	Quebrada de la Plata. Metropolitana	Adult	Typical	Reptiles de Chile*
February 2016	Rio Clarillo. Metropolitana	Adult	Typical	Reptiles de Chile*
April 2016	Cachagua. Valparaíso	Adult	Typical	Reptiles de Chile*
April 2016	Curauma. Valparaíso	Adult	Typical	Reptiles de Chile*
April 2016	Embalse Puclaro. Coquimbo	Adult	Typical	Reptiles de Chile*

April 2016	Rio Clarillo. Metropolitana	Juvenile	Typical	Reptiles de Chile*
July 2016	Nahuelbuta. Araucanía	Adult	Typical	Reptiles de Chile*
September 2016	Cerro Gasco, Maipú. Metropolitana	Juvenile	Typical	Reptiles de Chile*
September 2016	Peñaflor. Metropolitana	Adult	Typical	Reptiles de Chile*
September 2016	Valle Alegre. Valparaíso	Adult	Typical	Reptiles de Chile*
November 2016	Colina. Metropolitana	Adult	Typical	Reptiles de Chile*
November 2016	San Jose del Maipo. Metropolitana	Adult	Typical	Reptiles de Chile*
November 2016	Bosque El Pañul. Metropolitana	Adult	Typical	Reptiles de Chile*
November 2016	Salto de Apoquindo. Metropolitana	Juvenile	Typical	Reptiles de Chile*
December 2016	Cuesta Chacabuco. Valparaíso	Adult	Typical	A. Villarroel
December 2016	Marga Marga. Valparaíso	Adult	Typical	Reptiles de Chile*
December 2016	Limache. Valparaíso	Juvenile	Typical	Reptiles de Chile*
December 2016	Palmas de Ocoa. Valparaíso	Adult	Typical	Reptiles de Chile*
December 2016	El Durazno. Metropolitana	Adult	Typical	Reptiles de Chile*
January 2017	Cerro El Roble, Tiltil. Metropolitana	Adult	Typical	Reptiles de Chile*
January 2017	La Ligua. Valparaíso	Adult	Typical	Reptiles de Chile*
January 2017	Quilpué. Valparaíso	Adult	Typical	Reptiles de Chile*
February 2017	Los Ángeles. Bío Bío	Adult	Typical	Reptiles de Chile*
February 2017	Florida. Bío Bío	Juvenile	Typical	Reptiles de Chile*
February 2017	Pomaire. Metropolitana	Juvenile	Typical	Reptiles de Chile*
March 2017	Cerro Condell, Curicó. Maule	Adult	Typical	Reptiles de Chile*
March 2017	Peñalolen. Metropolitana	Adult	Typical	Reptiles de Chile*
March 2017	Ovalle. Coquimbo	Juvenile	Typical	Reptiles de Chile*
April 2017	Tucapel. Bío Bío	Adult	Typical	Reptiles de Chile*
April 2017	Buin. Metropolitana	Juvenile	Typical	Reptiles de Chile*
April 2017	La Campana. Valparaíso	Adult	Typical	Reptiles de Chile*
April 2017	El Quisco. Valparaíso	Adult	Typical	Reptiles de Chile*
May 2017	Quillota. Valparaíso	Juvenile	Typical	Reptiles de Chile*
May 2017	Armerillo. Maule	Juvenile	Typical	Reptiles de Chile*
May 2017	Llay Llay. Valparaíso	Adult	Typical	Reptiles de Chile*
June 2017	Pichidangui. Valparaíso	Adult	Typical	Reptiles de Chile*
June 2017	Catapilco. Valparaíso	Adult	Typical	Reptiles de Chile*
June 2017	Arauco. Araucanía	Adult	Typical	Reptiles de Chile*
July 2017	Buin. Metropolitana	Juvenile	Typical	Reptiles de Chile*
July 2017	Olmué. Valparaíso	Adult	Typical	Reptiles de Chile*
August 2017	Maria Pinto. Metropolitana	Juvenile	Typical	Reptiles de Chile*

August 2017	Pañul. La Florida. Metropolitana	Juvenile	Typical	Reptiles de Chile*
September 2017	Los Ángeles. Bío Bío	Adult	Typical	Reptiles de Chile*
September 2017	Lampa. Metropolitana	Adult	Typical	Reptiles de Chile*
September 2017	Mallarauco. Metropolitana	Adult	Typical	Reptiles de Chile*
September 2017	Cajón del Maipo. Metropolitana	Adult	Typical	G. Morales
September 2017	Reñaca, Viña del Mar. Valparaíso	Adult	Typical	C. Vogel
October 2017	Buin. Metropolitana	Adult	Typical	Reptiles de Chile*
October 2017	Tunquén. Valparaíso.	Adult	Typical	Reptiles de Chile*
October 2017	Talinay. Coquimbo	Adult	Typical	Reptiles de Chile*
October 2017	Nueva Imperial. Araucanía	Adult	Typical	Reptiles de Chile*
October 2017	La Reina. Metropolitana	Adult	Typical	Reptiles de Chile*
October 2017	Lo Barnechea. Metropolitana	Juvenile	Typical	Reptiles de Chile*
November 2017	Alto Macul. Metropolitana	Adult	Typical	Reptiles de Chile*
November 2017	Lo Barnechea. Metropolitana	Adult	Typical	Reptiles de Chile*
November 2017	Quintero. Valparaíso	Juvenile	Typical	Reptiles de Chile*
November 2017	El Monte. Metropolitana	Adult	Typical	Reptiles de Chile*
November 2017	Los Ángeles. Bío Bío	Adult	Typical	Reptiles de Chile*
December 2017	El Arrayan. Metropolitana	Adult	Typical	Reptiles de Chile*
December 2017	Paso Nevado. Maule	Adult	Typical	Reptiles de Chile*
December 2017	Vitacura. Metropolitana	Adult	Typical	A.Zalaquett
December 2017	El Melado. Maule	Juvenile	Typical	Reptiles de Chile*
Not available	Altos de Cantillana. Metropolitana	Adult	Typical	D. Demangel**
Not available	Los Molles. Valparaíso	Juvenile	Typical	D. Demangel**
Not available	Chicauma. Metropolitana	Adult	Typical	D. Demangel**
Not available	Copiapó. Atacama	Adult	Typical	D. Demangel**

Table 1. *P. chamissonis* records from other Chilean Regions (Atacama to Araucania), distinct to the O'Higgins Region.

* Evaluation of photographic records from the Herpetological network Reptiles de Chile.

** Evaluation of photographic records from the book "Reptiles en Chile" Demangel 2016.

A total of 77 records of *P. chamissonis* were obtained in the O'Higgins Region (Table 2). Of those, 33 individuals (42.8%) presented the phenotypic pattern of partial melanism, in different degrees of pigment coverage, from small diffuse black spots along the body to dark individuals with black pigmentation over a large area of their body, generally over a soft pink or grey basal colour (Figures 2-3). No completely melanic specimens were observed.

Figure 2. Different presentation of partial melanism morph in some *P. chamissonis* specimens from O'Higgins Region. Photographs: Diego Ramírez-Alvarez, Eneas Acevedo, Wily Meneses.

Figure 3. Parcial melanism specimen body views. A: Dorsal, B: Lateral, C: Ventral. Photograph: Diego Ramírez-Alvarez.

Date	Locality, Province	Georreference	Develop-ment stage	Morph	Author
October 2006	Calleuque, Peralillo	273096mE/6189957mS	Adult	Melanism	N. Sallaberry
November 2008	Puente Negro, San Fernando	333175mE/6156217mS	Adult	Typical	N. Sallaberry
January 2013	Av. El Parque, Rancagua	342719mE/6216066mS	Adult	Melanism	E. Acevedo
November 2013	Popeta, Rengo	335667mE/6188324mS	Adult	Melanism	D. Jorquera
January 2015	Paniahue, Santa Cruz	285492mE/6166091mS	Adult	Melanism	D. Ramírez
March 2015	Rio Azufre, San Fernando	364583mE/6147156mS	Adult	Typical	D. Ramírez
September 2015	Carrizales, C del Cobre, Machalí	352328mE/6215053mS	Adult	Melanism	F. Rodenas
October 2015	Popeta, Rengo	335103mE/6186973mS	Adult	Melanism	D. Jorquera
October 2015	San Juan (Área Urbana), Machalí	343957mE/6217245mS	Juvenile	Typical	D. Ramírez
October 2015	Sendero de Chile, Machalí	352335mE/6210770mS	Juvenile	Typical	C. Iglesias
November 2015	Cerro Trocalán, Requínoa (2 specimens mating)	338188mE/6207151mS	Adult	Melanism (both).	F. Lecaro
November 2015	Área verde Urbana, Rancagua	339596mE/6217632mS	Adult	Melanism	D. Ramírez
November 2015	R.N. Rio Cipreses, Machalí	365857mE/6206031mS	Adult	Typical	D. Rojas
December 2015	Camino Sauzal, Machalí	348455mE/6209934mS	Adult	Melanism	D. Ramírez
February 2016	Chancón, Rancagua	329355mE/6230301mS	Adult	Typical	D. Ramírez
March 2016	Popeta, Rengo	337120mE/6186891mS	Adult	Typical	D. Jorquera
March 2016	Cerro Poqui (base), Coltauco	313940mE/6215194mS	Adult	Melanism	D. Ramírez
April 2016	Coya, Machalí	359236mE/6213476mS	Juvenile	Typical	F. Molina
May 2016	Camino a Los Cristales, Rengo	346205mE/6180364mS	Adult	Typical	D. Jorquera
May 2016	Las Nieves, Rengo	340188mE/6183803mS	Adult	Melanism	D. Jorquera
August 2016	Av. El Parque, Rancagua	343145mE/6216884mS	Adult	Typical	E. Acevedo
September 2016	Laguna Cáhuil, Pichilemu	774712mE/6179381mS	Juvenile	Typical	D. Ramírez
September 2016	Codao, Peumo	297259mE/6198451mS	Adult	Melanism	F. Molina
September 2016	Laguna del Cura, Pichilemu	772345mE/6185120mS	Juvenile	Typical	CH. Iglesias
September 2016	Cerro San Juan, Machalí	349978mE/6217085mS	Adult	Typical	D. Ramírez
October 2016	Cerro Trocalán, Requínoa	339887mE/6209503mS	Adult	Typical	C. Fuentes
October 2016	Camino Sauzal, Machalí	352330mE/6208317mS	Juvenile	Typical	F. Cabello
October 2016	Llanos de Quinahue, Santa Cruz	283198mE/6163827mS	Adult	Melanism	D. Ramírez
October 2016	La Buitrera, Machalí	364412mE/6232590mS	Adult	Typical	D. Ramírez
October 2016	Fdo. S. Maria Miraflores, Codegua	351290mE/6222557mS	Adult	Melanism	C. Fuentes
October 2016	Embalse Colihues, Requínoa	347556mE/6208079mS	Juvenile	Typical	D. Ramírez
November 2016	Tinguiririca, San Fernando	320726mE/6162946mS	Adult	Melanism	C. Parraguez
November 2016	Camino a Pozas Verdes, Machalí	350522mE/6215656mS	Juvenile	Typical	C. Fuentes
November 2016	Planta Rosario, Rengo	330175mE/6198101mS	Adult	Melanism	J. Villagrán

November 2016	Santa Irene, Palmilla	291366mE/6181271mS	Juvenile	Typical	K. Brzovic
December 2016	La Blanquina, Codegua	347179mE/6228721mS	Adult	Melanism	A. Villarroel
December 2016	Cerro San Juan, Machalí	348833mE/6216387mS	Adult	Typical	C. Fuentes
January 2017	Millahue, San Vicente de TT	296814mE/6177393mS	Adult	Melanism	P. Churruca
January 2017	Lago Rapel, Las Cabras	273466mE/6214136mS	Adult	Melanism	R. Manterola
February 2017	Puertecillo, Litueche	228683mE/6227119mS	Adult	Melanism	D. Ramírez
February 2017	Pailimo, Litueche	247785mE/6196829mS	Adult	Typical	D. Ramírez
February 2017	R.N. Rio Cipreses, Machalí	366546mE/6203306mS	Adult	Melanism	K. Halyburton
March 2017	Los Maquis, Pelequén, San Fernando	333961mE/6181434mS	Juvenile	Typical	R. Román
March 2017	Vegas de Los Humos, San Fernando	366056mE/6147302mS	Adult	Typical	D. Ramírez
March 2017	Parque Safari, Rancagua	334101mE/6215930mS	Juvenile	Typical	D. Ramírez
March 2017	Paniahue, Santa Cruz	285310mE/6165910mS	Juvenile	Typical	D. Ramírez
March 2017	Planta Tto. aguas, Chépica	290853mE/6154153mS	Adult	Typical	A. Villarroel
June 2017	Barreales, Santa Cruz	281163mE/6169967mS	Adult	Melanism	D. Ramírez
July 2017	Rio Claro Cauquenes, Machalí	354373mE/6205882mS	Juvenile	Typical	C. León
August 2017	Rio Cachapoal, Rancagua	337525mE/6214777mS	Juvenile	Typical	P. Román
September 2017	Rio Cachapoal, Rancagua	351910mE/6206767mS	Adult	Melanism	C. Álvarez
September 2017	Estero Los Leones. Machalí	347421mE/6209594mS	Adult	Typical	D. Ramírez
October 2017	Codegua, Chimbarongo (2 specimens mating)	321857mE/6149871mS	Adult	Melanism (both).	W. Meneses
October 2017	Rio Cachapoal, Machalí	350689mE/6208121mS	Juvenile	Typical	D. Ramírez
October 2017	La Capellanía, Santa Cruz	283659mE/6163735mS	Adult	Typical	D. Ramírez
October 2017	Peralillo	271846mE/6181660mS	Adult	Melanism	F. Aliaga
October 2017	Pangal, Machalí	367405mE/6210388mS	Adult	Typical	F. Zúñiga
October 2017	Termas de Cauquenes, Machalí	356958mE/6209434mS	Adult	Typical	C. León
November 2017	Requínoa	332998mE/6204625mS	Adult	Typical	M. Gómez
November 2017	Centro urbano, Rancagua	340543mE/6217492mS	Juvenile	Typical	O. Navea
November 2017	Coya, Machalí	359497mE/6214655mS	Adult	Melanism	T. Palma
November 2017	Los Nogales, Machalí	348106mE/6213426mS	Adult	Typical	C. Fuentes
November 2017	Las Mercedes, Requínoa	331874mE/6207256mS	Adult	Melanism	S. Cox
November 2017	Rio Cachapoal, Rancagua	335657mE/6215807mS	Adult	Melanism	C. Álvarez
November 2017	Las Canteras, Pelequén	325243mE/6182849mS	Juvenile	Typical	R. Román
November 2017	Pelequén	325708mE/6183145mS	Adult	Typical	R. Román
November 2017	Pelequén	325708mE/6183145mS	Adult	Melanism	R. Román
December 2017	Marchigue	259095mE/6191125mS	Adult	Typical	M. Valdes
December 2017	Cementerio, Olivar	332517mE/6213925mS	Adult	Melanism	L. Muñoz

December 2017	R.N. Rio Cipreses, Machalí	366633mE/6203283mS	Adult	Typical	P. Ubilla
December 2017	La Estrella	255352mE/6211933mS	Adult	Typical	C. Ramirez
December 2017	Pangalillo, Machalí	352529mE/6213084mS	Adult	Typical	E. Acevedo
Not available	Termas del Flaco, San Fernando	Not available	Adult	Typical	D. Demangel*
Not available	Chacayes, Machalí	Not available	Adult	Melanism	D. Demangel*
Not available	Chacayes, Machalí	Not available	Adult	Typical	D. Demangel*

Table 2. *P. chamissonis* records from O'Higgins Region.
*Photographic records in Demangel 2016.

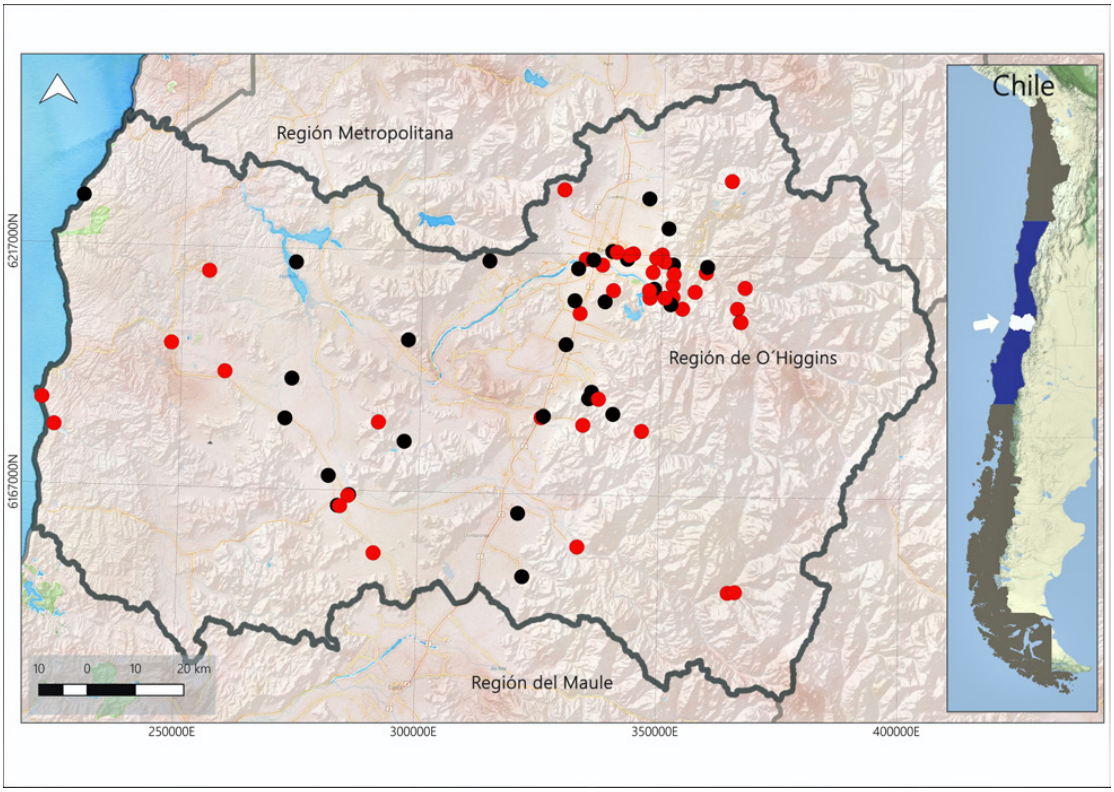

Figure 4. Distributional map of *P. chamissonis* with the different morphs recorded in the O'Higgins Region. Red dots: typical morph, and black dots: partial melanism morph. Blue area shows the total distribution of P. chamissonis.

In the O´Higgins region, records of specimens with partially melanic morph range altitudinally between 30 and 1139 m.a.s.l. (Puertecillo and R.N. Rio Cipreses, respectively), and latitudinally, from Codegua (34°03'S) in the north, to Chimbarongo (34°46'S) in the south, occupying a large diversity of habitats, such as xerophytic scrubland (Peumo), littoral (Puertecillo), urban green areas (Rancagua), cultivated fields (Paniahue, Chimbarongo), sclerophyll forest (Requínoa, Coltauco) and montane pre-Andean forest (Chacayes, Las Nieves, Popeta) (Figure 4). Therefore, we do not identify any association between the occurrence of this morph and some particular altitudinal/latitudinal distribution or habitat.

DISCUSSION

Thomas (1976) establishes the origin of the genus *Philodryas* (within the Tachymenoides complex) in the central Andes, extending to the south coastal line of Peru during the Miocene, when the mountain range had a considerably lower altitude than today. After the Miocene, the altitudinal growth of the Andes mountain range (Gregory-Wodzicki, 2000), and the formation of the Atacama Desert, isolated the population of *Philodryas* spp. in the southwest zone of the Andes, favoring the allopatric speciation of *P. chamissonis* (Thomas, 1976). Colonization of the Chilean territory by the species occurred from north to south, through different ecosystems and climatic variants, which in an ectothermic species like this, imposed significant selective forces, generating intraspecific divergence and reducing the gene flow between the different environments (Sallaberry-Pincheira *et al.*, 2011). This evidence supports the development of haplogroups with different genetic expression potential, being the one that distributed to the south of Maipo River the most consistent of these. Maipo River was a determining barrier in the last Pleistocene glaciation, with a glacial coverage that even reached the central valley in the southern area of Santiago (Lamborot & Eaton, 1997), and a wide river flow, which generated allopatric distribution and corresponding genetic divergence to south (Sallaberry-Pincheira *et al.*, 2011). Within this haplogroup, the first populations of *P. chamissonis* in the process of expansion towards the south correspond to those of the O'Higgins Region, which would conform the ancestral region of the southern haplogroup.

Two different records obtained in this study correspond to videotape and photograph of specimens with partial melanism in the process of mating (Figure 5), which shows that there is a natural crossing of specimens with this morph, generating a greater possibility of transmitting this morphological trait, if it is genetically transmitted, to their offspring.

Partial melanism was only observed in adult specimens, not in juveniles, so further studies should address the possibility that it is a characteristic that is expressed only at a certain level of maturity. Dark color in snakes has been proved to result in better thermoregulation than in white individuals, and more melanin in skin protects the internal organs from deleterious solar radiation; therefore, this partial melanism might be naturally selected due to its advantageous effects on the species (Krecsák, 2008). More studies need to be conducted to evaluate why and in which individuals this characteristic is occurring and if a positive correlation is found with species fitness.

Figure 5. *P. chamissonis* specimens with partial melanism in mating process. Red circle: cloacal union, and blue circles: heads of both specimens.
Photograph: Wily Meneses.

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