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 Río 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; Jadzik, 2004; Krebsak, 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; Jadzik, 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 Lagunilllas, Metropolitana | Adult | Typical | N. Sallaberry |
| Mes       | Localidad                        | Estado       | Estatus       | Nombre       |
|-----------|----------------------------------|--------------|---------------|--------------|
| 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          | Juvenil      | 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               | Juvenil      | Typical       | N. Sallaberry |
| February 2008 | La Dehesa. Metropolitana         | Juvenil      | 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  | Quilimari. Coquimbo             | Adult        | Typical       | N. Sallaberry |
| February 2009 | Laguna Esmeralda. Metropolitana  | Adult        | Typical       | N. Sallaberry |
| February 2009 | Lo Barnechea. Metropolitana      | Juvenil      | 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       | Reptiles de Chile* |
| January 2016  | Viña del Mar. Valparaíso         | Adult        | Typical       | Reptiles de Chile* |
| January 2016  | El Monte. Metropolitana          | Juvenil      | 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* |
| Mes 2016  | Localidad  | Región  | Etapa | Tipología | Local monuments of Chile* |
|----------|------------|---------|-------|-----------|--------------------------|
| April 2016 | Rio Clarillo. Metropolitana | Juvenil | Typical | Reptiles de Chile* |
| July 2016 | Nahuelbuta. Araucanía | Adult | Typical | Reptiles de Chile* |
| September 2016 | Cerro Gasco, Maipú. Metropolitana | Juvenil | Typical | Reptiles de Chile* |
| September 2016 | Peñalflor. 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 José 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 | Juvenil | 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 | Juvenil | 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, Tilt. 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 | Pomaire. Metropolitana | Juvenil | Typical | Reptiles de Chile* |
| March 2017 | Cerro Condell, Curicó. Maule | Adult | Typical | Reptiles de Chile* |
| March 2017 | Peñalolén. Metropolitana | Adult | Typical | Reptiles de Chile* |
| March 2017 | Ovalle. Coquimbo | Juvenil | Typical | Reptiles de Chile* |
| April 2017 | Tucapel. Bío Bío | Adult | Typical | Reptiles de Chile* |
| April 2017 | Buin. Metropolitana | Juvenil | 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 | Quilota. Valparaíso | Juvenil | Typical | Reptiles de Chile* |
| May 2017 | Armerillo. Maule | Juvenil | 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 | Juvenil | Typical | Reptiles de Chile* |
| July 2017 | Olmué. Valparaíso | Adult | Typical | Reptiles de Chile* |
| August 2017 | Maria Pinto. Metropolitana | Juvenil | Typical | Reptiles de Chile* |
| Month       | Location                        | Age     | Type   | 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 | Mallarruco, 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 | Tinquén, 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* |
| November 2017 | Lo Barnechea, Metropolitana    | Juvenile| Typical| Reptiles de Chile* |
| November 2017 | Alto Macul, 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 Bio           | 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 Araucanía), 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                  | Georrefernce           | Development 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, Requínova (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 Cahuil, 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, Requínova           | 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 Butrera, Machalí                 | 364412mE/6232590mS     | Adult             | Typical   | D. Ramírez  |
| October 2016 | Fdo. S. Maria Miraflores, Codegua    | 351290mE/6222557mS     | Adult             | Melanism  | C. Fuentes  |
| October 2016 | Embalse Colihues, Requínova         | 347556mE/6208079mS     | Juvenile          | Typical   | D. Ramírez  |
| November 2016| Tinguiririca, San Fernando          | 320726mE/6162946mS     | Adult             | Melanism  | C. Parrague |
| November 2016| Camino a Pozas Verdes, Machalí       | 350522mE/6215656mS     | Juvenile          | Typical   | C. Fuentes  |
| November 2016| Planta Rosario, Rengo               | 330175mE/6198101mS     | Adult             | Melanism  | J. Villagrán |
| Mes          | Localidad                  | Coordenadas                | Estado        | Localización          |
|--------------|----------------------------|----------------------------|---------------|-----------------------|
| Noviembre 2016 | Santa Irene, Palmilla     | 291366mE/6181271mS        | Juvenil       | Typical              | K. Brzovic         |
| Diciembre 2016 | La Blanquina, Codegua     | 347179mE/6228721mS         | Adult         | Melanism             | A. Villarroel     |
| Diciembre 2016 | Cerro San Juan, Machalí   | 348833mE/6216387mS         | Adult         | Typical              | C. Fuentes        |
| Enero 2017    | Millahue, San Vicente de T| 296814mE/6177393mS         | Adult         | Melanism             | P. Churrucio      |
| Enero 2017    | Lago Rapel, Las Cabras    | 273466mE/6214136mS         | Adult         | Melanism             | R. Manterola      |
| Febrero 2017  | Puertecillo, Litueche     | 228683mE/6227119mS         | Adult         | Melanism             | D. Ramírez        |
| Febrero 2017  | Pailimo, Litueche         | 247785mE/6196829mS         | Adult         | Typical              | D. Ramírez        |
| Febrero 2017  | R.N. Río Cipreses, Machalí | 366546mE/6203306mS       | Adult         | Melanism             | K. Halyburton     |
| Marzo 2017    | Los Maquis, Pelequén, San| 333961mE/6181434mS         | Juvenil       | Typical              | R. Román          |
| Marzo 2017    | Las Humos, San Fernando   | 366056mE/6147302mS         | Adult         | Typical              | D. Ramírez        |
| Marzo 2017    | Parque Safari, Rancagua   | 334101mE/6215930mS         | Juvenil       | Typical              | D. Ramírez        |
| Marzo 2017    | Panahue, Santa Cruz       | 285310mE/6165910mS         | Juvenil       | Typical              | D. Ramírez        |
| Marzo 2017    | Planta Tr. aguas, Chépica | 290853mE/6154153mS         | Adult         | Typical              | A. Villarroel     |
| Junio 2017    | Barreales, Santa Cruz     | 281163mE/6169967mS         | Adult         | Melanism             | D. Ramírez        |
| Julio 2017    | Río Claro Cauquenes, Machalí | 354373mE/6205882mS   | Juvenil       | Typical              | C. León           |
| Agosto 2017   | Río Cachapoal, Rancagua   | 337525mE/6214777mS         | Juvenil       | Typical              | P. Román          |
| Septiembre 2017 | Río Cachapoal, Rancagua | 351910mE/6206767mS         | Adult         | Melanism             | C. Álvarez        |
| Septiembre 2017 | Estero Los Leones, Machalí | 347421mE/6209594mS   | Adult         | Typical              | D. Ramírez        |
| Octubre 2017  | Codegua, Chimbarongo      | 321857mE/6149871mS         | Adult         | Melanism (both)      | W. Meneses        |
| Octubre 2017  | Río Cachapoal, Machalí    | 350689mE/6208121mS         | Juvenil       | Typical              | D. Ramírez        |
| Octubre 2017  | La Capellanía, Santa Cruz | 283659mE/6163735mS         | Adult         | Typical              | D. Ramírez        |
| Octubre 2017  | Peralillo                 | 271846mE/6181660mS         | Adult         | Melanism             | F. Aliaga         |
| Octubre 2017  | Pangal, Machalí           | 367405mE/6210388mS         | Adult         | Typical              | F. Zúñiga         |
| Octubre 2017  | Termas de Cauquenes, Machalí | 356958mE/6209434mS | Adult         | Typical              | C. León           |
| Noviembre 2017 | Requínoa                  | 332998mE/6204625mS         | Adult         | Typical              | M. Gómez          |
| Noviembre 2017 | Centro urbano, Rancagua   | 340543mE/6217492mS         | Juvenil       | Typical              | O. Navea          |
| Noviembre 2017 | Coya, Machalí             | 359497mE/6214655mS         | Adult         | Melanism             | T. Palma          |
| Noviembre 2017 | Los Nogales, Machalí      | 348106mE/6213426mS         | Adult         | Typical              | C. Fuentes        |
| Noviembre 2017 | Las Mercedes, Requínoa    | 331874mE/6207256mS         | Adult         | Melanism             | S. Cox            |
| Noviembre 2017 | Río Cachapoal, Rancagua   | 335657mE/6215807mS         | Adult         | Melanism             | C. Álvarez        |
| Noviembre 2017 | Las Canteras, Pelequén    | 325243mE/6182849mS         | Juvenil       | Typical              | R. Román          |
| Noviembre 2017 | Pelequén                  | 325708mE/6183145mS         | Adult         | Melanism             | R. Román          |
| Diciembre 2017 | Marchigue                 | 259095mE/6191125mS         | Adult         | Typical              | M. Valdés         |
| Diciembre 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.

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.

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