THE ORCHIDS OF "TORRES DEL PAINE" BIOSPHERE RESERVE: THE NEED FOR SPECIES MONITORING AND ECOTOURISM PLANNING FOR BIODIVERSITY CONSERVATION

LAS ORQUÍDEAS DE LA RESERVA DE LA BIOSFERA "TORRES DEL PAINE": LA NECESIDAD DE IMPLEMENTAR MONITOREO DE ESPECIES Y PLANIFICACIÓN ECOTURÍSTICA PARA LA CONSERVACIÓN DE LA BIODIVERSIDAD

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ABSTRACT

The orchid flora of Torres del Paine Biosphere Reserve (TPBR) is described based on botanical surveys, photographical records and herbarium collections carried out by the authors. This list comprises 3 genera and 9 species: *Chloraea chica*, *Chloraea leptopetala*, *Chloraea magellanica*, *Codonorchis lessonii*, *Gavilea araucana*, *Gavilea gladysiae*, *Gavilea littoralis*, *Gavilea lutea* and *Gavilea supralabellata*. *G. gladysiae* is a new record for this protected area and the first albino aberrant phenotype for flowers of *Chl. magellanica* is reported. A description of the species including key for determination, morphology, habitats, local abundances, flowering phenology and photographs is provided. The species richness here reported represents ca. 35% of orchids occurring in the Chilean temperate-austral floristic regions and 75% of the species described for the Magallanes Region, putting the

Torres del Paine Biosphere Reserve as one of the most representative protected areas for this taxonomical group in the region. Based on our results we addressed the need of establishing monitoring programs for orchids and promote them as flagship species in ecotourism planning in order to enhance species valuation and encourage biodiversity conservation.

Keywords. Chloraea, *Codonorchis*, *Gavilea*, Protected areas, Patagonian flora, flagship species.

RESUMEN

Se describen las Orquídeas de la Reserva de la Biosfera Torres del Paine sobre la base de exploraciones botánicas, registros fotográficos y colecciones de herbario llevadas a cabo por los autores. Esta lista comprende 3 géneros y 9 especies: *Chloraea chica*, *Chloraea leptopetala*, *Chloraea magellanica*, *Codonorchis lessonii*, *Gavilea araucana*, *Gavilea gladysiae*, *Gavilea littoralis*, *Gavilea lutea* y *Gavilea supralabellata*. *G. gladysiae* es un registro nuevo para esta área protegida y se reporta el primer fenotipo aberrante de flores albinas de *Chl. magellanica*. Se provee de una descripción de las especies que incluye morfología, habitats, abundancias locales, fenología de floración y fotografías. La riqueza de especies aquí reportada representa cerca del 35% de las orquídeas que se distribuyen en las regiones florísticas Templada-Austral y el 75% de las especies descritas para la Región de Magallanes, colocando a la Reserva de la Biosfera Torres del Paine como una de las áreas protegidas mas representativas para éste grupo taxonómico en Chile. Basados en nuestros resultados recalcamos la necesidad de establecer programas de monitoreo para las Orquídeas y promoverlas como especies emblemáticas en planificación ecoturística para así incrementar la valoración de las especies y reforzar la conservacion de la biodiversidad.

Palabras clave: *Chloraea*, *Codonorchis*, *Gavilea*, áreas protegidas, flora patagonica, especies emblemáticas.

INTRODUCTION

Biodiversity conservation has become a major challenge for managers in protected areas in Chile in the last years. Many of the protected areas show a massive increase in tourist visitation, which is intensifying the disturbance pressure on native terrestrial landscapes, ecosystems and species (Pauchard & Villarroel 2002, Navarro-Cerrillo et al. 2008). Disturbances derived from touristic activities like soil trampling, road extension or accidental fires are causing detrimental changes on native habitats that occasionally reduce the

abundances of native species, promotes biological invasions or alter successional pathways of native ecosystems (Dollenz & Ivanovic 1996, Vidal 2005, Domínguez et al. 2006, Vidal & Reif 2011). Consequently, not only the pristine biodiversity is irreversibly deteriorated, but also the quality of the recreational experience in the natural area depauperate.

Torres del Paine Biosphere Reserve is one of the most famous protected areas in Chile, because of the beautiful scenery, the ecosystem representativeness and the heterogeneity of its landscapes (Pisano 1974). This park has taken its name from the impressive granite mountain massif located at the center of the area which characterizes the entire park, but also a remarkable biodiversity can be observed. Landscape diversity includes glaciers, lakes, rivers, Andean desert (Pisano 1974). Ecosystems are also diverse including perennial and deciduous undisturbed old-forests, xerophyte and mesophytes shrublands, Patagonian steppe, Magellanic Tundra and also varied aquatic vegetation communities (Pisano 1974, Armesto et al. 1992, Clausen et al. 2006, Navarro-Cerrillo et al. 2008, Vidal & Reif 2011). Vascular plants is estimated over 450 species (Vidal 2007), and the fauna includes many mammals like guanacos, foxes, Patagonian huemul, wild cats and the mythic Puma (Garay & Guineo 2003). More than 130 bird species inhabit the park (Couve & Vidal 2007). Moreover it includes the highest raptor species richness reported in Chile (Jaksic et al. 2002). Thus, all these features have placed Torres del Paine National Park as one of the most reputed Chilean natural areas at an international level, achieving the UNESCO's Biosphere Reserve nomination in 1978. At present almost 150,000 tourists visit the area yearly and the visitors flow between 1990 and 2010 increased by more than 600% (CONAF, unpublished data).

Although the increase in visits at the area has evident economic benefits for the local people and given international renown to the area, the impact of activities derived from tourism on biodiversity has been occasionally catastrophic. For example, during the last 30 years the national forest service (CONAF) has reported 44 human-caused fires occurred in the protected area, which have affected around 47,000 ha, or ca. 19% of the park surface (CONAF, unpublished data). The last two fire events occurred in 2005 and 2011-12 and affected 32,000 ha in the park. It destroyed valuable habitats like deciduous forests (Navarro-Cerrillo et al. 2008, Vidal & Reif 2011) and shrublands dominated by *Junellia-tridens*, a southern-Patagonian endemic shrub. Thus, a vertiginous increase of ecotourism that hasn´t gone hand in hand with planning and nature conservation, and from a biological point of view, long-term conservation goals seem to be hard to achieve (Pauchard & Villarroel 2002).

Despite high biodiversity in Torres del Paine at this southern latitude (52° latitudes), a few taxonomical groups have received enough attention for scientific research. Among them, mammals like guanacos, pumas and foxes in the area have been relatively well studied (Ortega & Franklin 1988, Johnson & Franklin 1994, Franklin et al. 1999), as well as some birds like raptors (Sarno et al. 2000, Jaksic et al. 2002) and aquatic birds (Garay et al. 1991). Studies on habitats and ecosystems meanwhile, are scarce (Armesto et al. 1992, Clausen et al 2006, Vidal & Reif 2011) and other groups like vascular plants have been recorded just throughout surveys inside the Biosphere Reserve (Arroyo et al. 1992, Domínguez et al. 2006). However, no particular taxonomic plant groups have been investigated from an ecological perspective. Especially the orchids represent a very interesting group for taxonomists and ecologists, and have a great potential for ecotourism and conservation (Piluek & Triboun 2008, Cameron 2010). So far orchids have received little attention in the local and national scientific literature (Lehnebach & Riveros 2003, Novoa et al. 2006). They have been partially mentioned for the Torres del Paine in preliminary checklists and field guides (e.g. Domínguez 2004, Domínguez 2006, Vidal 2007), but until now, no one has compiled the available information in a comprehensive scientific paper. This lack of knowledge evidently reduces the potential of the orchids for ecotourism valuation and species conservation. In this work we present the first comprehensive description for the orchids in Torres del Paine. Our objectives include (1) to describe the orchid flora of the Torres del Paine Biosphere Reserve and 2) to propose some measures to increase the related conservation efforts.

MATERIALS AND METHODS

STUDY AREA

This study was conducted in Torres del Paine Biosphere Reserve, a 242,000 ha area which is located in the administrative province of Ultima Esperanza in the southwest of Chilean Patagonia. This protected area is dominated by both the Paine massif and the Grey glacier, which print to the area a great climatic and landscape heterogeneity (Pisano 1974). The mountain massif consist of Cretaceous sedimentarious rocks intruded by a Miocene-aged laccolith (Altenberger et al. 2003), reaching abruptly up to 3,050 m.a.s.l. (Paine Grande), while the Grey glacier represents the south end of the Southern Patagonian Ice Field, the second largest extra polar extent of ice. Climatologically the area belongs to the humid-supratemperate belt (Amigo & Ramírez 1998) of the Temperat-Austral floristic transition (Bannister et al. 2012), with average temperatures of 10.8°C in austral summer (January) and 2°C in the winter season (July). Although climate data are available from just one

meteorological station located at the park administration (CONAF 2007), a drastic environmental gradient in northwest-southeast direction can be distinguished from the colder and humid areas near the Grey glacier to the warmer and dryer areas Sarmiento Lake. Precipitation was estimated to vary from 1,400 mm to 350 mm per year and a concomitantly gradual change in vegetation cover can be observed from perennial *Nothofagus betuloides* forests to Patagonian steppe.

FIELD SURVEY AND TAXONOMICAL DETERMINATIONS

The field survey was carried out in different plant communities belonging to each of the biotic provinces defined by Pisano (1974). We surveyed orchids at each flowering season since 2003 until 2010 in all the terrestrial plant communities along the climatic gradient including the ecotone between perennial and deciduous forests, deciduous forests like the "Lenga" forests (*Violo-Nothofagion pumilionis*), "Nire" forests (*Agropyron-Nothofagion antarcticae*), mesophytic shrublands like "Chaura" shrublands (*Embothrio-Pernettyetum mucronatae*), xerophytic shrublands like "Neneo" shrublands (*Stipo-Mulinetum spinosi*), "Murta" shrublands (*Empetro-Oreopoletum*) and the "Mata Negra" shrublands (*Berberido-Junieletum tridentis*), xeric steppe like "Coirón" steppe (*Festucetum gracillimae*), humid steppes like "vega" steppes (*Geranio-Festucetum gracillimae*), high-Andean vegetation like the "Turba" tundra (*Donatienton fascicularis*), and also anthropic vegetation like prairies (*Poo-trifolietum repentis*), road borders and burned forests (Pisano 1974, Roig et al. 1985, Clausen et al. 2006, Vidal & Reif 2011). As the survey was not spatially and temporarily systematically designed, a measure of commonness was used to describe the degree of orchid population abundance using three criteria: "common" when > 10 populations has been seen during our survey; "rare" when between 5 to 9 populations has been seen on survey; and "very rare" when < 4 populations has been seen on survey. Plant collections were made on voucher specimens, and determinations were made using field guides (e.g. Novoa et al. 2006, Guerrido & Fernandez 2007, Vidal 2007) and confirmed by means of taxonomical literature (e.g. Correa 1956, Moore 1983, Chemisquy 2009). In addition, photographic records were made and flowering phenology data were recorded in the field. Voucher specimens were deposited at the herbarium of the Universidad Austral in Valdivia (VALD). Nomenclature follows Lehnebach (2003) and the "International Plant Names Index Project" (Croft et al 1999).

RESULTS

In total 9 orchid species were recorded (Fig. 1):

Fig. 1

Chloraea chica Kraenzl. & Speg., *Chloraea leptopetala* M.N. Correa, *Chloraea magellanica* Hook.f., *Codonorchis lessonii* (Brongn.) Lindl., *Gavilea araucana* (Phil.) M.N.Correa, *Gavilea gladysiae* Chemisquy, *Gavilea littoralis* (Phil.) M.N.Correa, *Gavilea lutea* (Pers.) M.N.Correa and *Gavilea supralabellata* M.N. Correa. These species are described in detail in the following. Determination keys for the species are given in the Table 1.

Table 1

LIST OF SPECIES

Chloraea chica

Morphology. Terrestrial herb with stems 20-50 cm, erect. Basal leaves 6-15 x 2-3 cm in a pseudo rosette, oblong-lanceolate, acute and tapering to wide. Cauline leaves narrower, sheatering the scape. Inflorescence in a lax raceme containing 5-20 bracteate flowers. Bract 7-9 x 2-4 mm, linear-lanceolate, acute, decreasing upwards. Flowers white or cream. Upper outer perianth-segment 8-10 x 3-5 mm, oblong, cucculate and acuminate at apex. Lateral outer perianth-segments lanceolate, acuminate, white with 3-4 longitudinal green veins. Upper inner perianth-segments 7-8 x 3-4 mm, oblong, obtuse, papillose on veins in basal half. Labellum 7-8 x 4-5 mm, entire to obscurely 3-lobed, obtuse, with irregularly lacerate margins, covered by yellow or greenish papillae. Column 7 mm. Capsule ovoid-oblong. *Habitat and commonness.* This species is common. According with Domínguez (2004), this species is very rare and habits in wetlands locally termed as "Vegas" (Clausen et al 2006). These habitats are dominated by species as *Samolus spatulatus* (Cav.) Duby (Domínguez 2004) and *Euphrasia subexserta* Benth., and located at small valleys containing wet and organic soils at the Patagonian steppe biotic province (*sensu* Pisano 1974). Although we found few populations at this habitat, the species becomes very common at shrublands dominated by *Gaultheria mucronata* (L.f.) Hook. et Arn. and *Empetrum rubrum* Vahl ex Willd. at the pre-Andean shrublands biotic province (*sensu* Pisano 1974). *Localities*. Cerro Paine cattle ranch, Amarga Lake to Sarmiento Lake trekking trail, De Los Cisnes Lake, De los Flamencos Lake, Paso Feria, Pehoé-Italiano trekking trail. *Phenology*. January to February.

Chloraea leptopetala

192 *Morphology*. Terrestrial herb with stems 30-50 cm, robust stems 30-50 cm, erect. Basal leaves
193 in a pseudo rosette, oblong-lanceolate, acute, sheathing at base and tapering to wide.
194 Inflorescence in a dense raceme producing 20-35 bracteates flowers. Bracts 14-17 x 4-6 mm,
195 linear to lanceolate, acute, green with dark-green veins. Flowers green-white. Upper outer
196 perianth-segment 13-15 x 3-5 mm, oblong to oblong lanceolate, acute. Lateral outer perianth-
197 segments linear, acute. Upper inner perianth-segments linear to lanceolate, acute. Labellum
198 12-15 x 3-5 mm, entire to obscurely 3-lobed, obtuse, with undulate to involute margins,
199 covered by white-yellow papillae. Column 8 mm. Capsule ovoid-oblong. *Habitat and*
200 *commonness*. Populations of this species are very rare in woodlands dominated by
201 *Embothrium coccineum* and *Escallonia rubra* at the pre-Andean shrubland biotic province
202 (*sensu* Pisano 1974). *Localities.* Cerro Paine range, Las Carretas trekking trail. *Phenology*.
203 December.

204 *Chloraea magellanica*

205 *Morphology.* Terrestrial herb with stems 15-60 cm, erect. Basal leaves 10-20 x 2-5 cm in a
206 pseudo rosette, lanceolate, acute, sheathing at base and tapering to wide. Inflorescence in a lax
207 raceme containing 3-6 bracteate flowers. Bract 25-35 x 7-10 mm, ovate, acute decreasing
208 upwards, green with dark-green veins. Flowers white with green reticulate veins. Upper outer
209 perianth-segment 25-35 x 5-10 mm, oblong to oblong lanceolate, acute to subobtuse,
210 sometimes cucculate at apex, white with green reticulate veins. Lateral outer perianth-
211 segments lanceolate, acuminate at apex, fleshy, white at the basal half, greenish distally,
212 reticulated by dark green veins. Upper inner perianth-segments 20-25 x 8-12 mm ovate to
213 elliptic, acute, reticulate. Labellum 15-20 x 8-10, ovate, entire to obscurely 3-lobed, obtuse,
214 covered by greenish capitate papillae, fleshy at apex. Column 12-16 mm. Capsule cylindrical-
215 ovoid. A population with albino-flowers and whitish-green leaves it was found near to
216 Sarmiento Lake, in the Patagonian steppe dominated by *Festuca gracillima* Hook.f. and
217 *Mulinum spinosum* (Cav.) Pers. *Habitat.* The individuals are not completely albinos, but a
218 gradual lost in chlorophyll foliar content was observed (Fig. 2).

219 Figure 2

220 *Habitat and commonness.* Populations of this species are common and widely distributed in
221 the area, including the Patagonian steppe, pre-Andean shrublands, including those dominated
222 by *Gaultheria mucronata*, *Escallonia rubra* (Ruiz et Pavon) Pers. (*sensu* Pisano 1974), and
223 woodland communities dominated by *Nothofagus antarctica* (G.Forster) Oersted and forests

dominated by *Nothofagus pumilio* (Poepp. et Endl.) Krasser (Vidal & Reif 2011). *Localities.* Cerro Paine cattle ranch, Cordón Masle, Paine Grande, Basin of Nordenkjoeld Lake, Salto Grande trekking trail, Paso Feria, Asencio Valley, Pehoé-Grey trekking trail. *Phenology.* January to March.

Codonorchis lessonii

Morphology. Terrestrial herb with stems 5-50 cm, decumbent to erect containing 1 or 2 cataphyll at the base of the stem. Leaves 20-25 x 20-25 mm, membranous, verticillate at the stem half, ovate, entire, sub-acute to obtuse, cuneate at base, sessile. Bract 8-10 x 2-5 mm, ovate, acute. Flowers solitary, terminal. Outher perianth-segments 8-20 x 6-8 mm, white, lnceolate, acute. Lateral inner perianth-segments 6-15 x 3-10 mm, ovate-lanceolate, acute, white, containing purplish spots. Labellum 5-15 x 3-10, ovate to lanceolate, acute, white and covered by yellow capitate papillae, fleshy at apex. Collumn 10-13 cm. Capsule cylindrical-ellipsoid. *Habitat and commonness.* Populations of this species are common inside the forests dominated by *N. pumilio* in organic soils and closed canopy forests (Vidal & Reif 2011), and also in the understory of forests dominated by *N. betuloides* (Domínguez 2004). *Localities.* Cerro Paine, Cordón Masle forests, Pingo valley, Mount Ferrier. *Phenology.* December to February.

Gavilea araucana

Morphology. Terrestrial herb with stems 50-70 cm, erect. Basal leaves 13-25 x 2-4 cm in a pseudo rosette, linear-lanceolate, acute and tapering to wide. Cauline leaves narrower sheatering the scape. Inflorescence in a lax raceme containing 15-20 bracteate flowers. Bract 13-15 x 3-5 mm, oval-lanceolate, acute. Upper outer perianth-segment 14-16 x 4-5 mm, oval-lanceolate, acuminate, acute. Lateral outer perianth-segments 25-27 x 6-7 mm ovate-lanceolate, aristate, white-greenish with green veins. Upper inner perianth-segments 12-14 x 5-7 mm, ovate to elliptic, papillose in veins in basal half. Labellum 8-10 x 9-11 mm, 3-lobed, as long as or slightly longer than wide, subcordate. Lateral lobes orbicular to elliptic. Median lobe 4-5 mm wide, triangular to trulliform with lacerate margins, aristate, covered by greenish papillae. Column 5-7 mm. Capsule ovoid-oblong. *Habitat and commonness.* This species is common. Although Domínguez (2004) mentions the presence of only 3 populations of this species in the entire area, we found frequently populations in forest gaps produced by landslides, which are a very common habitat at the mountain areas. In those areas low shrubland vegetation is dominated by *Gaultheria mucronata* and *Empretrum rubrum*, at the

pre-Andean biotic province (*sensu* Pisano 1974). Some populations were also found in forest gaps at relatively high elevation (ca 700 m) in Cerro Paine cattle ranch. *Localities*: Asencio valley, Cerro Paine rangeland, Paso Feria. *Phenology*: November to January.

Gavilea gladysiae

Morphology. Terrestrial herb with stems 40-55 cm, erect. Leaves 14-21 x 2-3.5 cm in a pseudo rosette, oblong to linear-lanceolate, fleshy, apex acute, tapering to wide. Inflorescence in a dense raceme producing 10-17 flowers. Bracts 17-27 x 4-6 mm, acuminate. Flowers greenish yellow. Upper outer perianth-segment 16-19 x 4-6 mm, oblong, acuminate, recurved, membranaceous, nerved. Lateral outer perianth-segments 10-14 x 3-5 mm, acuminate, membranaceous, nerved. Upper inner perianth-segments 9-12 x 35-55 mm, acuminate, nerved, with green excrescences over the veins, covering basal third of the segment. Labellum 8-13 x 5-7 mm, apex cuspidate, margin repand, nerved. Column 6-7 mm. Capsule oblong-ovate. *Habitat and commonness*. This species is very rare. We found populations of this species in woodlands dominated by *Embotrium coccineum* and shrublands dominated by *Gaultheria mucronata* and *Escallonia rubra* at the pre-Andean biotic province (*sensu* Pisano 1974). According with Chemisquy (2009), this species growths also into forests formed by *Nothofagus* species, protected by the effect of wind. Although the habitat of this species is widely distributed into the study area, *G. gladysiae* seems to be a very rare species, founding only a few populations of this species. *Localities*: near refugio "Paine Grande" and along Las Carretas trekking trail. *Phenology*: December.

Gavilea littoralis

Morphology. Terrestrial herb with stems 30-50 cm, erect. Leaves 10-20 x 3-4 cm in a pseudo rosette, oblong lanceolate, subobtuse, tapering to wide. Inflorescence in a dese raceme producing 10-18 flowers. Bracts 10-20 x 2-6 mm, lanceolate, acute. Flowers yellow with green veins. Upper outer perianth-segments 10-14 x 4-6 mm oblong to lanceolate acuminate, with green veins. Lateral outer perianth-segments 11-14 x 4-6 mm, oblong to lanceolate, acuminate, with green veins. Upper inner perianth-segments 9-11 x 3-6 mm, oblong, obtuse, covered by green excrescences over the veins. Labellum 8-9 x 10-11 mm 3-lobbed. Lateral lobes oblong, obtuse, nerved, margin repand. Median lobe oblong, obtuse, sometimes retuse, covered by yellow-orange papillae. Column 5-6 mm. Capsule ovoid. *Habitat and commonness*. This species is rare. We found populations of this species in low-shrublands dominated by *Gaultheria mucronata* (Domínguez 2004, Vidal 2007) at the pre-Andean biotic

province (*sensu* Pisano 1974). Localities: Pingo valley, Paso Feria, Ferrier Mount, Grey trekking trail. *Phenology*: December.

Gavilea lutea

Morphology. Terrestrial herb with stems 20-60 cm, erect. Leaves 10-15 x 2-5 cm in a pseudo rosette, ovate to oblong, subobtuse, tapering to wide. Inflorescence in a dense raceme producing 10-18 flowers. Bracts 15-30 x 4-11 mm, lanceolate, acuminate. Flowers yellow with green veins and papillae. Upper outer perianth-segments 11-14 x 3-6 mm oblong to lanceolate, acute to acuminate, with green veins. Lateral outer perianth-segments 14-16 x 3-5 mm, yellow, lanceolate, caudiculate, green and fleshy at apex. Upper inner perianth-segments 11-14 x 2-6 mm, ovate, obtuse. Labellum 4-7 x 3-4 mm, 3-lobbed. Lateral lobes oblong, obtuse, nerved, margin repand, without papillae. Median lobe oblong to triangular, obtuse, covered by yellow papillae. Column 3-5 mm. Capsule ovoid-oblong. *Habitat and commonness*. This species is common. We found populations of this species in low-shrublands dominated by *Gaultheria mucronata* (Domínguez 2004, Vidal 2007) at the pre-Andean biotic province (*sensu* Pisano 1974) and inside *Nothofagus pumilio* forests (Vidal & Reif 2011) at the Deciduous Magellanic forest biotic province (*sensu* Pisano 1974). Localities: Pingo valley, Paso Feria, Verde Lake, Ascencio Valley, French Valley. *Phenology*: December to February.

Gavilea supralabellata

Morphology. Terrestrial herb with stems 20-30 cm, erect. Leaves 5-8 x 1-2 cm, lanceolate, acute. Inflorescence in a dense raceme producing 10-15 flowers. Bracts 11-16 x 4-8 mm, lanceolate, acuminate. Flowers yellow with green veins and papillae. Upper outer perianth-segments 15-18 x 3-5 mm, lanceolate, acute, with green veins. Lateral outer perianth-segments 15-20 x 3-5 mm, yellow, lanceolate, caudiculate, green and fleshy at apex. Upper inner perianth-segments 12-14 x 3-5 mm, lanceolate, acute. Labellum 9-10 x 4-5 mm, entire or obscurely 3-lobbed, obtuse, fleshy at apex, densely covered by stitipate green papillae. Column 4-6 mm. Capsule ovoid-oblong. *Habitat*. This species is common. We found populations of this species in low-shrublands dominated by *Gaultheria mucronata* (Domínguez 2004, Vidal 2007) at the pre-Andean biotic province (*sensu* Pisano 1974) and inside *Nothofagus pumilio* forests (Vidal & Reif 2011) at the Deciduous Magellanic forest biotic province (*sensu* Pisano 1974). Localities: Pingo valley. *Phenology*: December to February.

320 DISCUSION

321 The richness of the orchids reported here adds one new species for the Torres del Paine
322 Biosphere Reserve and the first aberrant albino-flowers individually found *in situ* for
323 *Chloraea magellanica*. These findings put this area as one of the most diverse for this
324 taxonomical group, as it contains about 35% of the orchids described for the Chilean
325 Temperate-Austral floristic regions (*sensu* Bannister et al. 2012) and 75% of the orchids
326 recorded in the Magallanes Region (Henríquez et al. 1995, Domínguez 2004, Novoa et al.
327 2006). The high proportion of orchids occurring in Torres del Paine Biosphere Reserve
328 address two issues which would be able to implement here for conservation purposes: (1)
329 first, the need of develop species taxonomic inventories for biodiversity monitoring (Noss
330 1990, Cameron 2010) and (2) the potential of ecotourism planning to increase biodiversity
331 valuation.

332 (1) Taxonomic inventories for biodiversity monitoring. Because of the heterogeneity of
333 the landscapes and habitats occurring along the environmental gradient in Torres del Paine
334 Biosphere Reserve, a taxonomical inventory on orchid species would be useful for mapping
335 the geographical range throughout metapopulations. Special research is necessary to select
336 species as indicators for a determined kind of environmental performance (Noss 1990). For
337 example, *Codonorchis lessonii* was found only inside the forests below the canopy, indicating
338 its intolerance to high levels of light, or in other words, it is a good indicator for undisturbed
339 old growth forests (Vidal et al. 2011). In a similar sense, some orchids are recognized to be
340 highly sensitive with regard to plant-pollination and plant mycorrhiza interactions (Lehnebach
341 & Riveros 2003). Thus they indicate the presence of other organisms (e.g. insects and fungi)
342 and functional diversity (e.g. breeding systems) which are harder and more expensive to
343 monitor. Plants are easy to record because of their restricted vagility and conspicuousness. A
344 well-trained observer can therefore monitor the continuity of the populations initially
345 recorded or add further recordings. Unfortunately, until now management plans in Torres del
346 Paine have not included local information of plant population distributions. Even the plant or
347 animal species lists are incomplete and outdated (CONAF 2007). Taxonomic inventories on
348 orchid plant populations could be easily realized including information related to habitat
349 structure, composition, topography, geographical location, human and natural disturbances
350 and phenological stages. All this information can be helpful not only for establishing
351 biodiversity indicators related to orchids distribution but also for predictive distribution
352 mapping for places where they are harder to monitor (Noss 1990, Salem 2003, Remm &

353 Remm 2009), as well as the response of such populations to the deleterious effects of human
354 disturbances or climatic change.

355 (2) Ecotourism planning to increase biodiversity valuation. In TPBR an explosive
356 increase of tourists has been experienced during the last 2 decades, as a consequence of the
357 beauty of the landscapes and ecosystem representativeness. Concomitantly, a growing hotel
358 infrastructure and services including trekking, ridings and nature tours give the change to
359 explore the area. In 2010 about 150.000 tourists visited the area, but little information on
360 plants and vegetation landscape is available for tourists interested on "botanizing" or
361 exploring the vascular flora of the area (e.g. Guerrido & Fernandez 2007, Vidal 2007). This
362 lack of knowledge not only makes it difficult to valuate the biodiversity, but also pauperize
363 the tourist experience on a place having a not yet well explored potential. To implement
364 touristic routs, to see orchids as flagship species would be a useful issue in order to increase
365 the valuation of biodiversity. Flagship species are recognized as charismatic species in
366 protected areas that, as popular symbols, increase the public conscience for biodiversity
367 conservation (Walpole & Leader-Williams 2002, Arango et al. 2007) and economic value
368 (Cameron 2010). Although plants are rare examples as flagship species, orchids seems to
369 have all properties for that: they have an important ecological role in nature, they are
370 ecological indicators, they are beautiful, they are sensible to influences by man and they are
371 available during a great amount of time during the tourist season, because of its longer
372 flowering periods. Planning touristic trails to see orchids and establishing them as flagship
373 species, would be an initial idea to increase the valuation of biodiversity in Torres del Paine.
374 Tourist guides can support important information for managers related to the location of new
375 populations, phenological periods and habitat features because they travel continuously on
376 remote areas of the park and can detect easily changes affecting populations. But a planning is
377 needed, to instruct the guides to identify orchid species, as well as to avoid the tourist
378 temptation to collect them as souvenirs. Tourist guides can acts as administrators of the park
379 while they are guiding tourist groups.

380 Despite ecotourism always represent a potential threat for pristine areas, it would have an
381 important role to play on biodiversity conservation. For example, the establishment of
382 flagship species for conservation purposes has been perceived as an ecological sustainable
383 initiative (Krüger 2005). It promotes public awareness for the protection of species, including
384 raising funds for related taxonomic, ecological or restoration research. Reciprocally, tourism
385 agencies would increase the quality of the product by training well-informed field guides,

giving the tourist scientific-based information. Although the number of orchid species in Torres del Paine is certainly not impressive, their relatively narrow distributional range to the temperate-austral Chilean floristic regions, supports the idea that they are important for conservation issues including its promotion as flagship species. Torres del Paine contains now an unexplored potential for the conservation and valuation of its natural patrimony, but first basic information related to nature history and ecology of the species is needed, to select flagship species features and promote public conscience for species conservation: paraphrasing the environmentalist Baba Dioum, "we cannot protect what we do not know".

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