ORNITOLOGIA NEOTROPICAL 23: 407–415, 2012

TORRENT DUCK (*MERGANETTA ARMATA*) POPULATION TREND IN NORTHWESTERN PATAGONIA, ARGENTINA

Gerardo Cerón & Ana Trejo

Centro Regional Bariloche, Universidad Nacional del Comahue, Bariloche, Argentina. *E-mail:* gerard_gc@yahoo.com.ar

Resumen. – Tendencia poblacional del pato de los torrentes (*Merganetta armata*) en el noroeste de la Patagonia argentina. – El Pato de los Torrentes (*Merganetta armata*) es una especie poco conocida que habita exclusivamente en ríos de montaña de aguas rápidas desde Venezuela hasta Tierra del Fuego. En Argentina ha sido clasificada como Amenazada de Extinción. Por lo tanto, es necesario obtener información de base acerca de su estado poblacional para poder desarrollar medidas de conservación y manejo adecuadas. El objetivo de este trabajo fue determinar la tendencia poblacional del Pato de los Torrentes en el Parque Nacional Nahuel Huapi (noroeste de la Patagonia argentina). Para lograr el objetivo se muestrearon 38 secciones de ríos y arroyos con hábitat potencial adecuado para albergar al Pato de los Torrentes (sitos potenciales), al menos dos veces al año, desde el 2006 hasta 2011. De estos sitios, 17 eran sitios conocidos previamente (sitios históricos). En cada visita, se registraron la presencia de la especie, por observación directa o indirectamente mediante reconocimiento de sus heces, el número de individuos, sexo y evidencias de actividad reproductiva. Los sitios (sectores de ríos con rápidos) se clasificaron como ocupados (con presencia de patos) o abandonados. Posteriormente se realizó una distinción entre sitios transitorios (con presencia ocasional) y territorios de cría, que a su vez fueron divididos en territorios de cría exitosos o no exitosos. Detectamos una reducción en el porcentaje de territorios de cría exitosos de 35% en el 2006 a 6,5% en el 2011 y un incremento en el porcentaje de territorios abandonados (10% a 19,4% del 2006 al 2011, respectivamente) o transformados en sitios transitorios (25% a 32,3%). La información muestra una tendencia poblacional negativa en esta área. Se proponen como posibles causas de esta disminución a las actividades recreativas acuáticas y la competencia por alimento y predación por parte de especies introducidas.

Abstract. – The Torrent Duck (*Merganetta armata*) is a poorly known species that lives exclusively in Andean fast flowing rivers from Venezuela to Tierra del Fuego. In Argentina, it has been classified as 'Endangered.' Therefore, it is necessary to obtain baseline information about its population status in order to develop adequate conservation and management measures. The aim of this study was to determine the Torrent Duck population trend in Nahuel Huapi National Park (northwest Argentine Patagonia). From 2006 to 2011, we conducted at least twice per year, surveys in 38 sections of rivers and streams with potential suitable habitat for Torrent Duck (i.e., potential suitable sites). Of those sites, 17 were previously known (i.e., historical sites). At each visit, we recorded the species' presence through direct observations or recognition of their feces, number of individuals, sex, and evidence of breeding activity. Each site (section of river with rapids) was classified as abandoned or occupied. In the latter case, a distinction was made between transient sites (i.e., occasional presence) and breeding territories (successful or unsuccessful). A reduction in the percentages of successful breeding territories was observed from 2006 (35%) to 2011 (6.5%) and an increase of the percentages of territories abandoned (10% to 19.4%, respectively), and transient sites (25% to 32.3%). Given this information, a negative population trend can be assumed for the species in this area. We suggest as possible causes of this decrease, aquatic recreational activities and competition or predation by introduced species. *Accepted 12 October 2012.*

Key words: Torrent Duck, *Merganetta armata*, Anatidae, management measures, national parks management, Argentina, Patagonia.

INTRODUCTION

The Torrent Duck (*Merganetta armata*) is one of only four anatid river specialists (Carboneras 1992). This species inhabits mountain rivers and streams of the Andes from Venezuela to southern Argentina and Chile (Carboneras 1992). Torrent Ducks feed primarily on benthic invertebrates (predominantly, immature aquatic insects) (Naranjo & Ávila 2003, Cerón *et al.* 2010). They collect these larvae from the surfaces and crevices of submerged rocks, by diving in shallow or deeper waters amidst fast currents, taking prey with the aid of a flexible slender conical bill (Navas 1977). While categorized globally as of 'Least concern' by IUCN (2012), two subspecies (*M. armata leucogenis, M. a. colombiana*) have been considered 'Vulnerable' (TWSG 2006). In Argentina, *M. armata* has been classified as 'Threatened' (López Lanús *et al.* 2008).

The Torrent Duck shows an extreme year-round territorial behavior and long-term pair bonds (Eldridge 1986). The strong territoriality that the species has, combined with the scarcity of suitable habitat, leads to naturally low population densities (Callaghan 1997) and abundant non-territorial individuals (i.e., floaters, *sensu* Winker 1998). As Newton (1998) highlighted, a strong territorial behavior of dominant individuals forces subordinate or young individuals into habitats of poor quality or imposes on them a non-territorial lifestyle with high mortality risks and low or null breeding success.

Surveys suggest that the distribution of the Torrent Duck may be patchy (Staus & Weast 2003), even in habitats that appear to be suitable. Thus, establishing a systematic population survey protocol may be quite challenging. Surveys to estimate population number trends should take into account not only abundance, but distinguishing successful breeding pairs that effectively contribute to maintaining the population level.

Knowledge regarding an endangered species' population status and trends is crucial for setting management measures. In Argentina, many national parks (NP) allow different types of human activities within these protected areas such as, recreational activities (trekking, kayaking, rafting, etc.), trespassing vehicles, and also human settlements in some places (Mermoz *et al.* 2009). These activities may have different degrees of impacts on endangered species. Other causes of population decline are: environmental variations, genetics (i.e., endogamy), habitat loss, and introduced species (Sinclair *et al.* 2006).

The aim of this study was to evaluate the Torrent Duck population trend in Nahuel Huapi National Park, northwestern Argentina, through a six-year survey of birds. Our focus was on territorial and non-territorial individuals and their reproductive status.

METHODS

Study area. Fieldwork was carried out in rivers and mountain streams in Nahuel Huapi National Park (NHNP), in the Austral temperate forests of northwestern Argentine Patagonia (Fig. 1). This park is the oldest and largest of the country, occupying approximately 710,000 ha and including a wide variety of habitats. Fourteen vegetation types have been described (Mermoz *et al.* 2009). The altitude range of the park is between 400 and 3491 m a.s.l., with a westward increase. The mountains have steep slopes, forming a landscape where most rivers and streams have sections with rapids (Mermoz *et al.* 2009). The average annual temperature in the area is 10º C, and annual precipitation varies between

500–3000 mm, mainly concentrated as rain and snow in winter, with hot and dry summers (Mermoz *et al.* 2009). There are two watersheds, the Manso river basin, which drains into the Pacific Ocean and the Limay river basin, which drains into the Atlantic Ocean. The first basin occupies 26% of the park area and includes Mascardi lake (Romero 2000), while the second one occupies the rest of the park's area and includes Nahuel Huapi lake (Mermoz *et al.* 2009) (Fig. 1).

In this study, we define a site as a section of a mountain river or stream, of variable length (60–3000 m) with suitable habitat for Torrent Ducks. Torrent Ducks inhabit sections of mountain rivers and streams with rapids and emergent boulders (Moffett 1970, Carboneras 1992). Moreover, suitable streams are characterized by clear water, a water flow maintained throughout the year, and a width of > 4 m (GC unpubl. data).

Occasional sightings from the National Parks Technical Delegation staff conducted from 1997–2005 (APN 2011) provided us with information about 17 sections of mountain rivers and streams used by Torrent Ducks within the park (hereafter, historical sites). Data were taken non-systematically and included number of ducks, sex, and presence of ducklings or juveniles. Hydrographic and cartographic maps were used and exploratory visits were conducted to identify sections of rivers and streams that met the mentioned characteristics to define potential suitable sites for Torrent Ducks. We identified 49 potentially suitable sites and, in total, we surveyed 38 (77.5%) of them (i.e., 17 historical and 21 new sites) along this study. The remaining 11 sites were inaccessible for surveying. Starting in 2006, all historical sites were surveyed looking for ducks. Each year, some new sites with presence of ducks were found and added to those to be surveyed in subsequent years. Each new site (and all those previously surveyed) was visited at least twice per year, from January 2006 to April 2011, to ensure that species presence or absence was permanent for the area and not due to seasonal conditions (e.g., drought, freezing of the body of water, floods), or other adverse situations from a particular year. Accessible sites were surveyed by walking on the river bed (when water level and current velocity allowed it) or along the banks. Alternatively, if banks were too rugged, rafts were used. Distances covered during the research were estimated using Google Earth Pro.

Presence of ducks was verified through direct observations or feces recognition. Torrent Duck feces are unmistakable and easily identified by size (i.e., approximately 2.5 cm long), content (i.e., high proportion of sand and small pebbles mixed with fragment of invertebrates), and their location on emergent boulders. Search for feces was made after at least two days without rain to avoid feces disintegration.

Each site (historical and new ones, found during this study) where ducks were detected (occupied sites) were classified as: 1) territory (where pairs were spotted throughout the year), 2) transient site (where single individuals were observed), or 3) undetermined (where only feces were detected). Territories are caracterized by a continuum of rapids, occasionally alternated with calm waters. Calm waters are only used by ducks to move among rapids (GC unpubl. data). A further distinction was made between transient sites: isolated short rapids of a length considered too short to sustain a territory (i.e., < 60 m), or alternately, sites that were territories in previous years but where later on only single individuals were observed (former territories). A previously used site was considered as abandoned when no presence of ducks or feces was detected during at least two consecutive years.

For each occupied site, number and sex of Torrent Duck individuals were recorded. Pairs

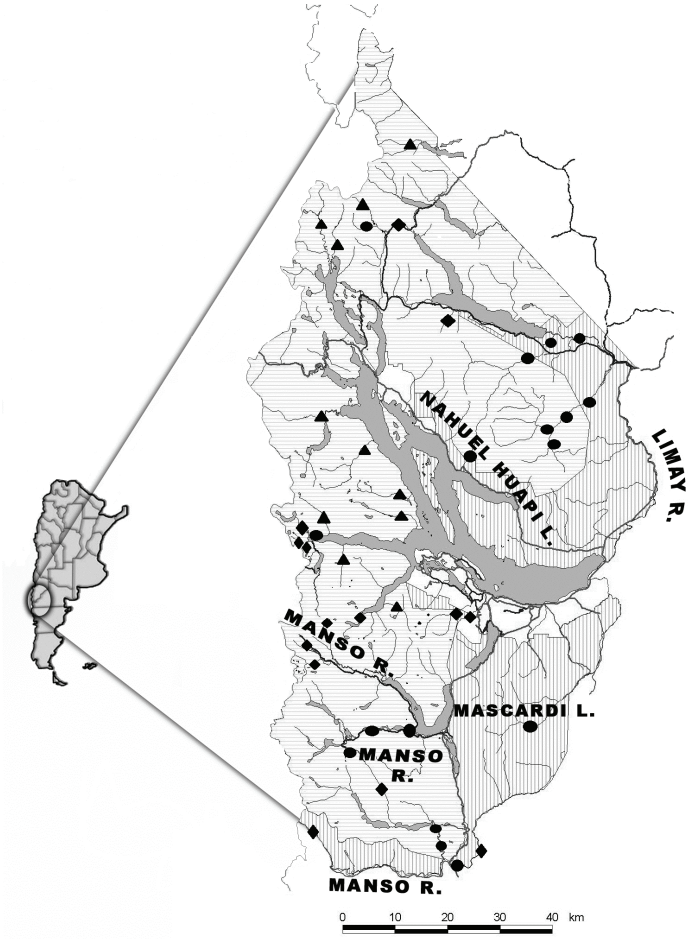

FIG. 1. Nahuel Huapi National Park, northwestern Argentine Patagonia. Historical records (circles), new sites with duck presence found during the study (diamonds), and inaccessible sites (triangles). The size of geometric figures indicates the relative site size. L: Lake, R: River.

were considered breeders if ducklings, juveniles, and/or breeding behavior (copulation, female incubating) were observed. Each breeding pair was classified as: (1) successful (when juveniles were observed), or (2) unsuccessful (when breeding activities, such as copulation, incubation, and/or presence of ducklings were observed but juveniles were not detected). To assess successful pairs, occupied sites with breeding pairs were visited monthly during breeding season. Potentially suitable river and stream sections were surveyed during the breeding season (November–February) to assess reproductive activity. Assuming that ducks only use portions of the rivers and streams with rapids, all rapids in the river were surveyed (all habitat available) to determine the presence/absence of birds. If a section of river had both rapids and calm water, it was sampled in its full length.

Due to unknown sampling effort, nonsystematic collection of records, and informa-

tion extracted from pooled data, historical records (1997–2005) were not included in our analysis of inter-annual variations in population status.

RESULTS

During the study, 308 km of river were surveyed, searching duck's suitable habitat, 201 km were registered by foot and 107 km using rafts, and only 131 km are known to be or have been used by Torrent Ducks.

Occupied sites were situated between 409 and 1209 m a.s.l., coincident with the searched range. Based on historical records, 14 of the 17 occupied sites were classified as territories, and two of those had no records of ducklings or juveniles; and three as transient sites (Table 1). Two of the three transient sites had isolated rapids.

In 7 of 38 locations defined as potential sites based on map analysis, Torrent Ducks were not detected. During this study, 15 new territories, one transient site, and three undetermined sites, were located. During the six years of our survey, the percentage of territories that were abandoned (from 10.0% to 19.4%) or became transient sites (from 25.0% to 32.3%), increased (Table 1, Fig. 2). The percentage of territories with successful breeding pairs of Torrent Ducks diminished from 35.0% to 6.5% of total sites surveyed, showing a steady downward trend.

DISCUSSION

The most striking finding of our study is the marked decrease in the number of successful territories, the increase in abandoned territories, and those turned into transient sites during the years of our study. From 2006–2011, there was a reduction in the percentages of successful breeding territories, while the numbers of abandoned territories or reduced to transient sites increased. The negative population trend could be underestimated because the seven sites with suitable characteristics but without presence of ducks could be a former used site, what would increase the number of abandoned sites.

IUCN (2012) categorizes the Torrent Duck as of 'Least concern' due to its broad distribution but acknowledges a decreasing population trend. This study is the first work about this topic, making it difficult to compare our results with those obtained in other parts of the distribution of the species. The only previous published study, to our knowledge, is one regarding the number of Torrent Duck pairs in Otún river, Colombia. Naranjo & Ávila (2003) found 0.47 territorial pairs per km, and Cardona & Kattan (2010), working downstream, found 1.65 territorial pairs per km. Although these works were made in the same river, they were located in different protected areas (Ucumarí and Otún Quimbaya). The increase in abundance found can be caused by different situations, like local differences in food availability, due to river productivity which usually decreases upstream (Cummings 1974), therefore these results do not necessarily show a trend.

Studying the Blue Duck (*Hymenolaimus malachorhynchos*), another river specialist, in a Manganuiateao river section, New Zealand, Williams (1991) found an increase in numbers from four to nine pairs in nine years. Nevertheless, other authors (Adams *et al.* 1997) and IUCN (2012) report on negative population trends of the species in almost all areas of its distribution range.

The abandonment of territories and consequent decrease in the recruitment of young might be attributed to four different factors – catastrophes, recreational activities, invasive predators, and invasive competitors – that might be acting independently or synergetically. Being located in a protected area, habitat changes are mostly of catastrophic type. Cerón (2012) documented during 2009, in

TABLE 1. Survey results for sites of Torrent Ducks (*Merganetta armata*) in Nahuel Huapi National Park from 1997–2005 (historical records) to 2011. For each period, number (No.) of sites includes the active sites surveyed the preceding year plus all new active sites found that year. Percentages (calculated over the total number of sites of the period) are shown in parentheses. Definition of the different categories is explained detailed in the text.

Period	No. of sites	Abandoned sites		Occupied sites				Undetermined presence
		Transient	Territories	Transient		Territories		
				Isolated rapids	Former territories	Successful	Unsuccessful	
1997–2005	17	-	-	3 (17.6)	-	12 (70.6)	2 (11.8)	-
2006	20	-	2 (10.0)	3 (15.0)	5 (25.0)	7 (35.0)	3 (15.0)	-
2007	20	-	2 (10.0)	3 (15.0)	7 (35.0)	5 (25.0)	3 (15.0)	-
2008	24	1 (4.2)	2 (8.3)	3 (12.3)	8 (33.5)	6 (25.0)	4 (16.6)	-
2009	27	1 (3.7)	3 (11.1)	3 (11.0)	10 (37.1)	3 (11.1)	5 (18.5)	2 (7.4)
2010	29	1 (3.5)	5 (17.2)	3 (10.0)	10 (34.8)	4 (13.8)	4 (13.8)	2 (6.9)
2011	31	1 (3.2)	6 (19.4)	3 (9.6)	10 (32.3)	2 (6.5)	6 (19.4)	3 (9.6)

NHNP, a case of a previously successful territory that was permanently abandoned because of a flood. Flood-caused abandonment of territories has also been observed in Chile (Pernollet 2010). However, we suspect that human-caused threats figure more prominently in the declining trends, consequently endangering the long-term survival of the population. From 2004–2011, the annual number of tourists who entered Nahuel Huapi National Park was over 300,000, and from 2009–2011, the annual number of tourists using raft services varied from 11,400–13,400 (APN 2012). The high number of tourists not only generates a growing impact on sites already assigned for public use, but also causes continued pressure on the NP administration to authorize and regulate new activities and use new areas within the park. Recreational water activities (rafting, kayaking, and fly-fishing) are carried out intensively in some areas of the park. In NHNP, commercial rafting began by the end of the 1990s (APN 2012) but data about fly fishing and kayaking is not available. The negative impact of aquatic activities on the Torrent Duck's behavior has already been reported for Patagonia (Sanguinetti 2008). Another possible cause of territory abandonment might be the introduced American Mink (*Mustela vison*), a generalist predator known to have a moderate to high impact on breeding waterfowl (Niemimaa & Pokki 1990, Ferrera & MacDonald 1999, Peris *et al.* 2009). American Minks escaped from farms had invaded NHNP from the south by the end of the 1970s (Chehébar 1985), and now are widespread in all rivers and streams of the study area (GC pers. observ.). There is a record of one individual seen preying upon *Merganetta armata* ducklings in Lanín NP (Marcelo Ochoa, 1999 pers. com.). While the impact of the American Mink on waterfowl is reported to be variable (Ferrera & MacDonald 1999), it could be that a high Mink population could severely impacts on a habitat-restricted species, such as the Torrent Duck, that has naturally low populations and a comparatively small clutch size for anatids (a maximum of five eggs and an average of three; Carboneras 1992). In

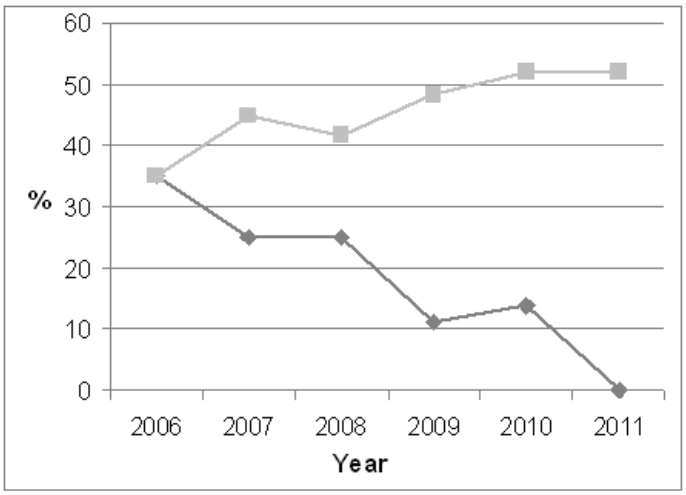

FIG. 2. Decrease of sites with successful pairs (diamonds) and increase in abandoned territories or become transient sites (squares), from 2006 to 2011. Data are expressed in percentages.

New Zealand, adults, youngs, and eggs of Blue Ducks are predated by Stoat (*Mustela arminea*) a mustelid similar to American Mink, but less aquatic (Adams *et al.* 1997).

Finally, another possible explanation for decreased reproductive success is resource competition for food with introduced salmonids (Carboneras 1992). Salmonids were introduced in Patagonia in the 1930s, and now are established in almost every river and stream of the park (Pascual *et al.* 2007). Naranjo & Avila (2003) tested this hypothesis in Colombia, finding dietary overlap but no competition. However, their study was based on a very small sample and did not take into account seasonal variations, thus it does not permit drawing reliable conclusions. Fernandez Cánepa (2012), working in NHNP, found dietary overlap in late summer but did not assess competition. Further research studies with different fish sizes at different times of year are needed to exclude or clearly indicate the impact of introduced salmonid species.

Although we cannot ensure that any of these possible threats are responsible for the decline in territory occupancy, these factors should be monitored to assess their role. Torrent Ducks seem to be undergoing a population decline in Nahuel Huapi National Park and possibly in other parts of their range (Green 1996). Therefore, each active territory where these birds breed successfully must be of high conservation priority for the national parks and other administrators of protected areas.

ACKNOWLEDGMENTS

We are grateful to the following individuals, companies, and institutions: S. Seijas, C. Pozzi, V. Cussac, M. Machuca; Argentina National Parks Administration, and particularly, the management of NHNP (Resource Management, Public Use, and Environmental Education areas); rafting and kayaking guides and companies (especially Aguas Blancas and Extremo Sur), Puravida Patagonia, Transitando lo Natural, and Activepatagonia teams. We appreciate the improvements in English usage made by Phil Whitford through the Association of Field Ornithologists' program

of editorial assistance, Adriana Troncoso, and Allison Simler. This study was partially financed by Centro Regional Bariloche, Universidad Nacional del Comahue (Project B124), Optics for the Tropics, and Oportunidades Internacionales de Conservación, Investigación y Educación initiative.

REFERENCES

Adams, A., D. Cuninningham, J. Molloy, & S. Phillipson. 1997. Blue Duck (Whio), *Hymenolaimus malacorhynchos* recovery plan. Threatened species recovery plan Series No. 22. Department of Conservation, Wellington, New Zealand.

Administración de Parques Nacionales. 2011. Sistema de Información de Biodiversidad. Downloaded on 25 September 2012 from www.sib.gov.ar.

Administración de Parques Nacionales. 2012. Estadísticas de ingresos y actividades de visitantes al Parque Nacional Nahuel Huapi. Estadísticas Uso Público. Parque Nacional Nahuel Huapi, Bariloche, Argentina.

Callaghan, D. 1997. Conservation status of the Torrent ducks *Merganetta*. Wildfowl 48: 166–173.

Carboneras, C. 1992. Family Anatidae (ducks, geese and swans). Pp. 536–628 *in* del Hoyo, J., A. Elliott, & J. Sargatal (eds). Handbook of the birds of the world. Volume 1: Ostrich to ducks. Lynx Edicions, Barcelona, Spain.

Cardona, W., & G. Kattan. 2010. Comportamiento territorial y reproductivo del pato de torrentes (*Merganetta armata*) en la Cordillera Central de Colombia. Ornitol. Colomb. 9: 38–45.

Cerón, G. Abandono de un territorio de pato de los torrentes (*Merganetta armata*) luego de una avalancha. 2012. Nuestras Aves 57: 25–27.

Cerón, G., A. Trejo, & M. Kun. 2010. Feeding habits of Torrent Ducks (*Merganetta armata armata*) in Nahuel Huapi National Park, Argentina. Waterbirds 33: 228–235.

Chehébar, C. E. 1985. A survey of the Southern River Otter *Lutra provocax* Thomas in Nahuel Huapi National Park, Argentina. Biol. Conserv. 32: 299–307.

Cummins, K. W. 1974. Structure and function of stream ecosystem. BioScience 24: 631–640.

Eldridge, J. L. 1986. Observations on a pair of Torrent Ducks. Wildfowl 37: 113–122.

Fernández Cánepa, G. 2012. Solapamiento dietario entre el pato de los torrentes (*Merganetta armata armata*) y los salmónidos en el Parque Nacional Nahuel Huapi en verano. M.Sc. thesis, Univ. del Comahue, Río Negro, Argentina.

Ferreras, P., & D. W. MacDonald. 1999. The impact of American Mink *Mustela vison* on water birds in the upper Thames. J. Appl. Ecol. 36: 701–708.

Green, A. J. 1996. Analysis of globally threatened Anatidae in relation to threats, distribution, migration patterns and habitat use. Conserv. Biol. 10: 1435–1445.

IUCN (International Union for the Conservation of Nature). 2012. IUCN Red list of threatened species. Version 2012.1. Downloaded on 25 September 2012 from www.iucnredlist.org.

López Lanús, B. P., E. Grilli, A. Coconier, A. Di Giácomo, & R. Banchs (eds) 2008. Categorización de las aves de la Argentina según su estado de conservación. Informe de Aves Argentinas/AOP y Secretaría de Ambiente y Desarrollo Sustentable, Buenos Aires, Argentina.

Mermoz, M., C. Úbeda, D. Grigera, C. Brion, C. Martín, E. Bianchi, & H. Planas. 2009. El Parque Nacional Nahuel Huapi. Sus características ecológicas y estado de conservación. Ed. APN. Parque Nacional Nahuel Huapi, San Carlos de Bariloche, Argentina.

Moffett, G. M. 1970. A study of nesting Torrent Ducks in the Andes. Living Bird 9: 5–27.

Naranjo, L., & V. Ávila. 2003. Distribución habitacional y dieta del pato de torrentes en la cordillera central de Colombia. Ornitol. Colomb. 1: 22–28.

Navas, J. R. 1977. Aves Anseriformes. Fauna de agua dulce de la República Argentina. Vol. XLIII. Aves. Fasc. 2. Anseriformes. FECIC, Buenos Aires, Argentina.

Newton, I. 1998. Population limitation of birds. Academic Press, San Diego, California, USA.

Niemimaa, J., & J. Pokki. 1990. Food habits of the mink in the outer archipelago of the Gulf of Finland. Suomen Riista 36: 18–30.

Pascual, M. A., V. Cussac, B. Dyer, D. Soto, P. Vigliano, S. Ortubay, & P. Macchi. 2007. Fresh-

water fishes of Patagonia in the 21st century after a hundred years of human settlement, species introductions, and environmental change. Aquat. Ecosyst. Health Managem. 10: 212–227.

Peris, S. J., J. Sanguinetti, & M. Pescador. 2009. Have Patagonian waterfowl been affected by the introduction of the American mink *Mustela vison*? Oryx 43: 648–654.

Pernollet, C. 2010. Selección de hábitat y efectos de las crecidas en el pato cortacorrientes (*Merganetta armata armata*) en dos ríos intervenidos de la región de O'Higgins (Chile central): implicancias para su conservación. M.Sc. thesis, Univ. de Chile, Santiago de Chile, Chile.

Romero, A. 2000. Auditoría Ambiental "Rafting en el Río Manso Inferior". A technical report submitted to Administración de Parques Nacionales, Argentina. Ed. APN. Parque Nacional Nahuel Huapi, San Carlos de Bariloche, Argentina.

Sanguinetti, J. 2008. Monitoreo del impacto de rafting sobre el pato del torrente (*Merganetta armata*) en el Río Hua Hum (Parque Nacional Lanín). P. 128 *in* Libro de Resúmenes, XII Reunión Argentina de Ornitología, 5–8 mayo 2008. Aves Argentinas, San Martín de los Andes, Argentina.

Sinclair, A. R. E., J. M. Fryxell, & G. Caughley. 2006. Wildlife ecology, conservation, and management. Blackwell Publishing, Oxford, UK.

Staus, N., & E. Weast. 2003. A survey of Peruvian Torrent Ducks (*Merganetta armata leucogenis*) on two rivers in Perú. Ornitol. Neotrop. 14: 269–273.

TWSG (Threatened Waterfowl Specialist Group). 2006. Threatened waterfowl species and subspecies. TWSG News 15: 4.

Williams, M. 1991. Social and demographic characteristics of Blue Duck *Hymenolaimus malacorhynchus*. Wildfowl 42: 65–86.

Winker, K. 1998. The concept of floater. Ornitol. Neotrop. 9: 111–119.