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# Torrent Ducks (*Merganetta armata*) Diving and Feeding in Hot Springs

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**Abstract.**—Opportunistic behavior in birds can enhance the ability of a species to expand their distribution. Currently, there is no documentation of any bird diving and feeding in hot springs with temperatures greater than 30 °C. A pair of Torrent Ducks (*Merganetta armata*) feeding in a hot spring with temperatures between 36-50 °C is described. The diet and food availability in this hot spring was studied in a Torrent Duck territory. While the sector of stream with hot waters represents only 13% of the territory of the Torrent Duck pair, prey collected there represented 30% of their diet. This is an extreme example of how this highly specialized species can also use a wide variety of environments. *Received 11 October 2014, accepted 11 January 2015.*

**Key words.**—hot springs, geothermal habitat, *Merganetta armata*, opportunistic behavior, Torrent Duck.

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Behavioral plasticity allows an animal species to adapt to habitat heterogeneity and possible changes in the environmental conditions (Moran 1992; Snell-Rood 2013). By having a wide spectrum of behavioral tolerance, individuals can use resources in different patches of a non-homogeneous matrix environment (Snell-Rood 2013). In addition, behavioral responses to environmental changes can be beneficial if they prevent individuals from suffering fitness loss under the new conditions. This behavioral plasticity can reduce the potential for extinction of a population and provide additional time for genetic adaptation (Pigliucci 2001).

Species and individuals that show plasticity in their behavior and habitat are defined as generalists, exploiting a wide range of resources. Common attributes of a generalist are the capability to exploit multiple habitat types or food sources, while a specialist species is expected to be limited to only one or a few habitats.

The Torrent Duck (*Merganetta armata*) is one of the few avian species that use fast flowing rivers as their primary habitat (Carboneras 1992). Adult pairs defend territories of approximately 1-2 km of fast flowing rivers and streams (Moffett 1970) and are resident throughout the year. They feed mainly on aquatic invertebrate larvae that live adhered to the surface of the rocks. This duck can live in rivers located in areas with very different

characteristics, such as cold forests in Argentinean Patagonia, the temperate rainforest in Colombia and even on arid steppes; Torrent Ducks have an altitude range between 4,500 m above sea level to sea level.

Here, I describe a Torrent Duck pair diving and feeding in a hot spring, with temperatures reaching 50 °C. The diet of this pair in this particular environment was quantified, and results are compared with prey availability.

## METHODS

### Study Area

The study area (36° 40' S, 70° 36' W; 1,747 m above sea level) is located in the Domuyo Provincial Park, Neuquén Province, northwestern Patagonia, Argentina. It is a typical Patagonian steppe with an average annual temperature of 17 °C and an annual precipitation of 650 mm, concentrated in winter (Lonac 2006). Field work was carried out in Aguas Calientes, a typical mountain stream, with geothermal inputs that increase the water temperature up to 70 °C and gradually decrease the water temperature to 26 °C (in summer), along 750 m. Here, a Torrent Duck territory was identified and its size was determined by following the pair using binoculars.

### Data Collection

To study the diet of this Torrent Duck pair, 10 feces were collected from the territory during early December 2013 (austral spring). Feces found in emergent boulders were identified by size and content (Naranjo and Ávila 2003). Food availability was estimated at sites where the focal pair of Torrent Ducks had been observed feeding. Aquatic invertebrates were sampled using a Surber

net and imitating the Torrent Duck feeding strategies (Cerón and Trejo 2009). Additionally, at each sample point, water temperature was measured and the proportion of different types of river substratum was calculated to correct prey availability by microsites as in Cerón and Boy (2014). The feeding behavior in the hot spring was not described.

#### Analysis

Identification of macroinvertebrates was conducted using the methodology of Lopretto and Tell (1995); individuals of each taxon were counted and weighed to estimate their abundance and biomass in each sample point. Then, feces contents were analyzed in the laboratory and prey items were identified by comparison with a reference collection made with sclerotized parts of macroinvertebrates from the Surber net samples.

### RESULTS

The Torrent Duck territory was linear: 1,100-m long, with approximately 150 m of hot waters. The territorial Torrent Duck pair fed actively in the stretch of the territory with water temperatures between 36 and 50 °C.

From the six invertebrate families found in the hot water (Table 1), two of them represented 92.8% of the numbers and 99.9% of the biomass found in the diet of the Torrent Duck pair (Table 2). Throughout the territory, the Torrent Duck pair fed on three primary prey items, and one species (*Neoephydra* sp.) was restricted to the thermal portion of the stream. This prey item represented 30.9% of the biomass in the diet, with 69.0% from *Sthetelmis* sp. and 0.1% from Chironomidae (Table 2).

### DISCUSSION

The pair of Torrent Ducks opportunistically observed feeding in this study showed them to be exploiting the high densities of *Neoephydra* sp. larvae and pupae found only in the hot waters, which represent only 13% of the territory. Across the thermal section of the stream, cyanophyte algae are the only photoautotroph and are consumed by the single species (*Neoephydra* sp.).

The feathers of Torrent Ducks have evolved to protect the birds from the cold Andean waters; however, they are also useful to insulate them against these hot temperatures. Nevertheless, it is striking how the relatively thin and transparent nictitating membrane (G. Cerón, pers.obs.) can protect their eyes at 50 °C.

Torrent Ducks generally show a strong plasticity in their diet, feeding in each particular site upon the most accessible prey (Cerón *et al.* 2010; Cerón and Boy 2014). Here, Torrent Ducks feed in the hot waters year round, even in winter when snow reaches up to 2 m (S. Di Martino, pers. commun.).

In an evolutionary context, Torrent Ducks once used the fast flowing rivers without competitors, and they would exploit white water Andean rivers. This may have resulted from a mixture of features: strong year round territoriality in a very unstable environment (floods, invertebrate cycles, temperature changes, etc.) and low dispersal and movement capability. Thus, these evolutive pressures would

**Table 1. Torrent Duck (*Merganetta armata*) food availability at three different temperatures of the Aguas Calientes hot spring stream.**

Prey Item	Sample Size	Water Temperature (°C)	Density (individuals/m <sup>2</sup> )	Biomass (g/m <sup>2</sup> )
<b>Diptera</b>				
<i>Neoephydra</i> spp.	502	50	1,859	4.02
<i>Neoephydra</i> spp.	3,257	36	12,064	26.01
Chironomidae	196	26	725	0.13
<b>Trichoptera</b>				
<i>Orthotrichia</i> spp.	426	26	1,579	0.66
<b>Coleoptera</b>				
<i>Sthetelmis</i> spp.	16	26	58	0.66
<b>Amphipoda</b>				
<i>Hyalella</i> spp.	127	26	472	0.55

**Table 2.** Diet of Torrent Ducks (*Merganetta armata*) in Aguas Calientes hot spring. Frequency is the percent calculated from total number of prey. Water temperature is the temperature of the water where the taxa were sampled.

Prey Item	Frequency (%)	Biomass (%)	Water Temperature (°C)
Coleoptera			
<i>Sithetelmis</i> sp.	52.0	69.0	26
Diptera			
<i>Neophydra</i> sp.	40.8	30.9	36-50
Chironomidae	7.2	0.1	26

result in long-term benefits to the species, which may be able to colonize a wide variety of environments with the presence of white waters by using their specialized body construction combined with a plastic behavior.

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