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Source: The Wilson Journal of Ornithology, 128(1):180-184.

Published By: The Wilson Ornithological Society

DOI: <http://dx.doi.org/10.1676/1559-4491-128.1.180>

URL: <http://www.bioone.org/doi/full/10.1676/1559-4491-128.1.180>

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The Wilson Journal of Ornithology 128(1):180–184, 2016

Lethal Agonistic Behavior between Two Male Magellanic Woodpeckers *Campephilus magellanicus* Observed in the Cape Horn Area

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ABSTRACT.—Agonistic behavior in woodpeckers has been described for a wide range of species, although previous studies have not reported aggressive encounters resulting in the death of adults. In this study, we provide the first evidence of lethal agonistic behavior between two male Magellanic Woodpeckers (*Campephilus magellanicus*) inhabiting Patagonia. This species is commonly regarded as the largest extant *Campephilus* woodpecker. The agonistic encounter was video recorded within the core territory of the dead individual and his mate, a previously banded and monitored pair, as part of a monitoring research on this species carried out during the last 2 years. A week after the fight, we recorded a non-banded young male Magellanic Woodpecker accompanying the dead individual's mate. This young male Magellanic Woodpecker is potentially the offspring of the former pair or perhaps a new mate replacing the dead individual. From this observation, we deduced that the previously occupied territory of the dead individual, as well as its breeding role, was subjected to reallocation by competing adjacent woodpecker families. This mortality event offers novel insight into the behavior of Magellanic Woodpeckers and suggests that lethal agonistic behavior likely could contribute to territory plasticity and family structure in this species. *Received 9 January 2015. Accepted 29 July 2015.*

Key words: conspecific agonistic behavior, *Nothofagus* forest.

Agonistic encounters between conspecifics have a direct impact on mating success, breeding success, habitat exclusion, territory size, and even survival (Murray 1971, Heinsohn et al. 2005, de Jong et al. 2012). Woodpecker agonistic behavior ranges from passive interactions, without body

contact, up to extreme hostile events, including drumming (double-tap), vocalization, tapping, bill pointing displays, head movement displays, supplanting, chases, and attacks (e.g., Kilham 1969 [*Picooides villosus*], 1972 [*Campephilus melanoleucos*]; Reller 1972 [*M. carolinus*, *M. erythrocephalus*]; Brenowitz 1978 [*M. uropygialis*]; Husak 2000 [*M. aurifrons*]). In some territorial woodpecker species, such as *Melanerpes aurifrons*, agonistic behavior occurs mostly between individuals of the same sex and it is elicited through a repertoire of displays with varying levels of aggressiveness (see e.g., Husak and Maxwell 1998, Husak 2005).

Although agonistic behavior in woodpeckers has been described for a wide range of species, these studies have not reported aggressive encounters resulting in the death of adult conspecifics. In woodpecker species that are markedly territorial, agonistic behavior between adults, however, would compromise the survival of the belligerent individuals, as shown in other territorial species like Common Loons (*Gavia immier*; e.g., Piper et al. 2008). In this study, we provide the first evidence of agonistic behavior resulting in the death of an adult male Magellanic Woodpecker (*Campephilus magellanicus*). Previous studies have described non-lethal hostility between Magellanic Woodpecker individuals, including interactions such as drumming, recognition calls, chasing, and supplanting attacks (Short 1982, Ojeda 2004, Chazarreta et al. 2011, Ojeda and Chazarreta 2014). Furthermore during the breeding season, infanticide between Magellanic Woodpeckers can occur, with adults killing nestlings of other breeding pairs (Chazarreta et al. 2011), but there is no evidence of adults being killed by other adults.

OBSERVATIONS

We made observations in a wooded habitat located in Navarino Island (55° 4' S, 67° 39' W) during the spring of 2014. In this habitat, Magellanic

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TABLE 1. Summary of the family composition of the killed woodpecker's (M1) and each individual's age class across the study period. Last row corresponds to the pair's nesting success.

	Role per year			
	2011	2012	2013	2014
Season ^a	SP	SU-AU-WI-SP	SU-SP	SU-SP
M1 ^b	Breeding adult	Breeding adult	Breeding adult	Non-breeding adult
F1 ^b	Breeding adult	Breeding adult	Breeding adult	Non-breeding adult
J1 ^c	Juvenile	Juvenile	Immature	Not present ^d
J2	Hatches	Fledging	Juvenile	Not present
Nesting	Successful	No attempt	Not successful	No attempt

^a SU = summer, AU = autumn, WI = winter, SP = spring.

^b Banded in 2012.

^c Banded in 2013.

^d Present in summer.

Woodpeckers nest and forage in old-growth and secondary-growth forest stands composed of *Nothofagus antarctica*, *N. betuloides*, *N. pumilio* and *Drimys winteri* (Vergara and Schlatter 2004). Social interactions between neighboring woodpecker families (composed of an adult pair and frequently 1–2 young; Ojeda 2004) usually take place in the overlapping zone between two territories, which, in terms of the home-range area varies between 5–36% (Ojeda and Chazarreta 2014; GES, unpubl. data). From 2011–2014, we captured and banded 48 woodpeckers belonging to 19 different family groups, with 30 of them being radio-tagged. A trained team carried out focal sampling on those birds to obtain more than 6,000 hr of observation. During activities relative to focal behavioral observations, an event of mortality produced by a fight between two adult male woodpeckers was recorded. One of these males (hereafter referred as 'M1') was previously captured and banded, with his female mate (hereafter referred as 'F1') who was also captured and banded in February 2012. The pattern of bands on this pair corresponds, on the right and left leg respectively, to yellow (males captured in 2012) and blue on the male, and orange (females captured in 2012) and white on the female. Observers visited the family of this radio-tagged male woodpecker during breeding and post-breeding seasons for 95 days and included records of nesting activities (see Table 1). The observations of the aggressive encounter and their potential implications are described in the following sections.

The encounter took place at 1240 CLST (GMT-3) on 16 October 2014 (early breeding season), corresponding to the first visit to this family for 2014's breeding season, in a stand of mixed *N. pumilio* and *N. betuloides* forest, located within

the core area of the M1's territory (i.e., at the proximities of a previously used nest; see Fig. 1). At this site, while MEL was monitoring nesting cavities, she saw the subject M1 starting an agonistic encounter with another male, an unbanded individual (hereafter referred as 'M2'), with both individuals engaging in a drumming session (~3 min) followed by a sequence of prolonged *cray-cra-cra-cra-cra-cra* calls (Short 1970), which serves both as intra-family recognition call and in the establishment and defense of territory (Short 1970; about three calls within 1 min). Afterwards, M2 flew to a nearby tree (~8 m) to M1 and started tapping, and later supplanting M1. Then, one individual chased the other away, both moving out from the observer's sight. After ~5 min, the observer heard a distress call long in duration, unusual for Magellanic Woodpeckers. This call had a repeated short *ngkah* nasal sound with only few repetitions during incoming attacks or imminent threats, and only as continuous repetitions during mist-net captures (GES, pers. obs.). The observer, then, moved towards the woodpecker's vocalization source, where she noticed that M2 was flapping his wings perched on the dorsal end of M1, whose wings were spread open on the forest floor. The fight between the two males occurred with M2 pecking the head and the body of M1, as recorded in a 3:42-min video using a Canon SX120 IS camera (Canon Inc., Tokyo, Japan; Supplemental material N° 1). F1 was perched and observing quietly without moving (F1 appears at sec 27 of the video). The distress calls of M1 were decreasing in intensity until vocalizations stopped (~8 mins after the first vocalization, see above). After vocalizations ceased, M2 kept pecking, resting between bursts, and ultimately flying away

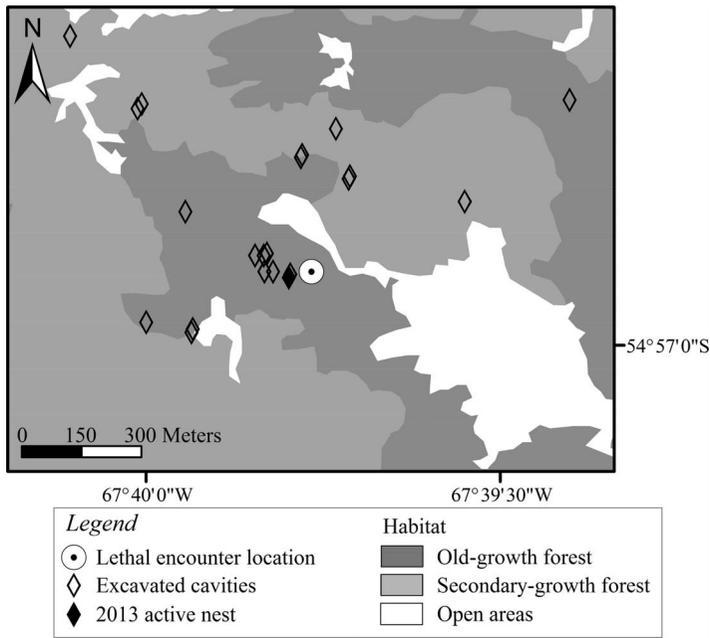


FIG. 1. Map showing woodpecker-made cavities, the active nest during the 2013 breeding season, and the place of the lethal agonistic encounter.

in the same direction as F1. Two mins after, a set of double-taps was heard from a tree 20 m away from the location of the death. The visible ventral side of the dead woodpecker was covered with blood, facing down, and with several feathers missing from his head (see the carcass of M1 in Fig. 2).

The subsequent necropsy of M1, performed by a trained museum collections preparator, indicated 12 lacerations on the frontal cranium, 6 on the left ischium, 2 on the right pectoralis major, 2 on the left humerus, and 1 on the mid-synsacrum area, with a total of 23 lacerations all within 5 mm wide. The necropsy showed that missing patches of skin and feathers on the head occurred along the frontal cranium and did not extend into the parietal region of the skull. M1 weighed 335 g with the stomach contents of four wood-boring larvae. However, the testes of M1 were not enlarged as typical for the breeding season. Hemorrhagic shock from the cranial lacerations was the presumed cause of death. There was no visible evidence of ecto/endo-parasites or clear physical abnormalities aside from the reduced testes size. No further analyses of parasite load or tissues were assessed.

A week after the record of this encounter, we visited the former territory of M1 and registered the presence of F1 accompanied by an unbanded

male woodpecker, with speckled tertiary feathers. We captured and radio-tagged this unbanded male, and we recorded no nesting attempt for this pair during the 2014 breeding season.

DISCUSSION

Our observations are consistent with previous descriptions of agonistic behavior in woodpecker species, revealing both, new behavioral information, and intraspecific killing as an additional source of mortality for this species.



FIG. 2. The body of the dead male woodpecker lying on the ground after an intraspecific agonistic encounter with another male.

Lethal or extreme agonistic encounters between adult woodpeckers is a putative result of the usurpation of territories or mating competition and also may be a compensatory response to the despotic use of available resources, such as nesting or roosting cavities (Newton 1998). Indeed, adult Magellanic Woodpeckers react aggressively when juveniles approach their active nests (Chazarreta et al. 2011). Recent studies on Navarino support that woodpeckers are sensitive to cavity use by other species; ~9% of woodpecker-excavated cavities were used by secondary cavity-nesters (A. Wynia, pers. comm.). A similar idea is presented by Davis et al. (2005) in their study on *Picoides borealis* where the researchers report only primary cavity occupants responding to experimental trials at roost cavities. Hence, defense of nesting habitat and/or cavities is a possible explanation for the aggression level exhibited during the encounter.

The death of M1 contributes to our understanding of the social structure of the local woodpecker population. Male and female mate turnover events appear not to be rare in our study site (0.3 mate turnover per breeding season, $n = 23$) suggesting plasticity in the inter-familial social structure of woodpeckers. We were not able to keep monitoring F1 and the new male, from which we have no previous information. Another observation of the death of a male individual in a breeding pair occurred during the same year as M1. Depredated by the invasive American mink (Jiménez et al. 2014; GES, pers. obs.), this male individual was replaced within a month.

Although the mortality record presented here does not pinpoint the main cause of such aggression, it provides novel ethological information about levels of aggression in Magellanic Woodpeckers, corroborating previous studies on breeding biology of these birds, as well as raising new questions for this topic. We suggest that studies focused on both breeding and non-breeding behavior are necessary in order to better understand how social interactions affect territoriality and mating competition in Magellanic Woodpeckers. In addition, further studies assessing how territorial behavior shapes home range could provide valuable information on habitat selection and sexual competition in woodpeckers.

ACKNOWLEDGMENTS

Special thanks to the two reviewers who helped improve this work, and to J. E. Jiménez and M. Nazar who supported

field equipment. FONDECYT Grant No. 1131133 provided the funds for this study. This study was conducted under a Servicio Agrícola y Ganadero Scientific Capture Permit (Res. No. 7415/2014). RAV acknowledges support from FONDECYT Grant No. 1140548. Research on Navarino Island also has the support of the Institute of Ecology and Biodiversity by way of grants ICM-P05-002, and PFB-23-CONICYT.

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The Wilson Journal of Ornithology 128(1):184–190, 2016

Nest Architecture, Clutch Size, Nestling Growth Patterns and Nestling Attendance of the Fire-eyed Diucon (*Xolmis pyrope*) in North-Central Chile

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ABSTRACT.—We present descriptions of nest architecture, clutch size, nestling growth and nestling attendance for the Fire-eyed Diucon (*Xolmis pyrope*), based on nests found at the Fray Jorge National Park, Chile, at the northernmost part of its distribution. Nests were cup-shaped structures averaging 283.5 ± 26.6 mm in width and 123.1 ± 6.8 mm in height ($n = 5$), found in matorral steppe habitat and Olivillo humid forest relicts. Nests contained 2–3 eggs. Nestling growth in Fray Jorge's nests was nearly two times slower than in populations from central Chile, as suggested by our calculations of the constant rate ($K = 0.277$) and the T_{10-90} period (12.9). During 20 hrs of video recording, the breeding adults spent a total of 3.4 hrs at the nest. Both parents attended the nest, and the rates of visits, nestling provisioning and fecal sac removal increased with nestling development. We observed that adults can still care for the young at least 2 weeks after fledging, covering an area of 2.3 ha while searching for food. This information could be valuable for further studies on geographic variation in the species' behavioral ecology. *Received 6 April 2015. Accepted 17 September 2015.*

Key words: egg size, incubation period, nesting ecology, nestling growth, parental care, population variation.

The Fire-eyed Diucon (*Xolmis pyrope*) is a medium-size tyrannid that breeds from north-central Chile (Coquimbo Region, 30° S) and west-Argentina (Neuquén Province, 38° S) to Tierra del Fuego and Isla Navarino (Magallanes and Chilean Antarctica Region, 55° S) (Jaramillo 2003). Very little is known about the breeding ecology of the

eight species of *Xolmis* (Fitzpatrick et al. 2004; but see Mezquida 2002, de la Peña 2005), which is mostly limited to brief descriptions of their nests and eggs (Heming et al. 2013). However, recently Marín (2013) compiled all available information on the natural history of the Fire-eyed Diucon in central Chile, providing new and thorough descriptions of its breeding phenology, the duration of incubation and nestling period, and patterns of nestling growth, based on 33 nests.

Although the breeding ecology of the Fire-eyed Diucon is now much better known, the available information is geographically limited, since most studies have been localized in the south-central part of its distribution, mainly between 33–38° S (for a review see Marín 2013). Additional data from other localities are needed to make inter-population comparisons throughout the species distribution, which will be essential to determine if breeding patterns vary geographically (see Heming et al. 2013). Here, we provide complementary information from the northernmost part of the distribution of the Fire-eyed Diucon, including (i) description of nest architecture and materials used for nest construction, (ii) duration of incubation and nestling periods, (iii) estimation of some nestling growth parameters, (iv) descriptions of nestling attendance and its phenological variation, and (v) notes on parental care after fledging.

METHODS

Our observations were conducted in Fray Jorge National Park (30° 38' S, 71° 40' W; see Quirici et al. 2014, Kelt et al. in press), located in the

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