ISSN 1680-4031 (versión impresa)
ISSN 2310-4236 (versión digital)

BOLETÍN

DEL

Museo Nacional de Historia Natural del Paraguay

Bol. Mus. Nac. Hist. Nat. Parag.	San Lorenzo (Paraguay)	ISSN 1680-4031 (versión impresa) ISSN 2310-4236 (versión digital)	Vol. 20 (2)	Diciembre 2016	Páginas 81-214

BOLETÍN

DEL

Museo Nacional de Historia Natural del Paraguay

ISSN 1680-4031 (versión impresa)
ISSN 2310-4236 (versión digital)

El Boletín del Museo Nacional de Historia Natural del Paraguay se publica en un volumen y dos números por año. Publica trabajos originales sobre aspectos varios en las áreas de Botánica, Zoología, Paleontología y Geología Descriptiva, cubriendo la Región Neotropical, principalmente Paraguay y regiones limítrofes. Las opiniones vertidas en los artículos son entera responsabilidad de los respectivos autores.

Dirección de Investigación Biológica - Museo Nacional de Historia Natural del Paraguay

Dirección General de Protección y Conservación de la Biodiversidad
Secretaría del Ambiente
Presidencia de la República
Dirección: Sucursal 1 Campus U.N.A, 2169 CDP, Central XI, San Lorenzo, PARAGUAY
Telefax: +595-21-585208 / Correo Electrónico: boletin.mnhnpy@gmail.com

Director del Museo Nacional de Historia Natural del Paraguay: Luis Morán Añazco
Correo electrónico: cortitomoran@yahoo.es

Director General de Protección y Conservación de la Biodiversidad: Darío Mandelburger
Correo electrónico: dariomandel@gmail.com

Diciembre del año 2016.

Publicado primero en línea el 30 de Diciembre de 2016.

Ilustración de la portada: Macho de *Pachylis pharaonis* (Herbst) (Insecta: Hemiptera: Coreidae) [Fotografía: Bolívar R. Garcete-Barrett].

BOLETÍN

DEL

Museo Nacional de Historia Natural del Paraguay

CONTENIDO

Bol. Mus. Nac. Hist. Nat. Parag.	San Lorenzo (Paraguay)	ISSN 1680-4031 (versión impresa) ISSN 2310-4236 (versión digital)	Vol. 20 (2)	Diciembre 2016	Páginas 81-214

Bol. Mus. Nac. Hist. Nat. Parag. Vol. 20, nº 2 (Dic. 2016): 103-108

OBSERVATIONS OF NOVEL ADAPTIVE FORAGING STRATEGIES ADOPTED BY PARAGUAYAN BIRDS

Paul Smith [1, 2]

[1]Fauna Paraguay, Encarnación, Paraguay. www.faunaparaguay.com. E-mail: faunaparaguay@gmail.com.
[2]Para La Tierra, Reserva Natural Laguna Blanca, Santa Rosa del Aguaray, San Pedro, Paraguay.

Abstract.- Adaptive foraging strategies are beneficial behavioral modifications in response to environmental changes. Observed adaptive foraging strategies are reported for eleven species of Paraguayan birds in the families Falconidae, Rallidae, Caprimulgidae, Cuculidae, Furnariidae and Thraupidae. Spot-winged Falconet *Spiziapteryx circumcincta* is suspected to benefit from foraging opportunities created by electricity poles and limited habitat clearance. Slaty-breasted Wood-rail *Aramides saracura* and Black-goggled Tanager *Lanio melanops* are documented exploiting a garbage dump, and the latter is also observed gleaning insects from a building. Examples of adaptive and maladaptive consequences of foraging on insects attracted to lights are detailed in the migrant Scissor-tailed *Hydropsalis torquata* and Little Nightjars *Setopagis parvulus*. Four species of woodcreeper (Furnariidae: Dendrocolaptinae) and Brown Cacholote *Pseudoseisura unirufa* are shown to exploit the same resource (holes in concrete poles) apparently without competing. Hypotheses as to how this might arise are discussed, including the suggestion that bill morphology may cease to be adaptive in this case and actually limit exploitation potential.

Key Words: *Aramides saracura, Campylorhamphus trochilirostris*, *Drymornis bridgesii, Hydropsalis torquata, Lanio melanops, Lepidocolaptes angustirostris, Pseudoseisura unirufa, Setopagis parvula, Spiziapteryx circumcincta, Xiphocolaptes major*

Resumen.- Las estrategias adaptativas de obtención de alimento son modificaciones comportamentales en respuesta a cambios en el ambiente. Se reportan aquí las estrategias adaptativas de obtención de alimento observadas en once especies de aves de Paraguay en las familias Falconidae, Rallidae, Caprimulgidae, Cuculidae, Furnariidae y Thraupidae. El halconcito gris, *Spiziapteryx circumcincta*, parece beneficiarse de oportunidades de obtenención de alimento generadas por la existencia de postes eléctricos y la limitación del espacio libre. La saracura, *Aramides saracura*, y el frutero corona amarilla, *Lanio melanops*, son reportados sacando provecho de los tiraderos de basura, y en el caso del segundo, también se le observó recogiendo insectos de un edificio. Se detallan ejemplos de consecuencias adaptativas y mal adaptativas de recolección de insectos atraídos a luces en el atajacaminos tijereta, *Hydropsalis torquata*, y en el atajacaminios chico, *Setopagis parvulus*. Se observó que cuatro especies de trepatroncos (Furnariidae: Dendrocolaptinae) así como el caserote castaño, *Pseudoseisura unirufa*, explotan el mismo recurso (agujeros en postes de concreto) aparentemente sin competir entre ellos. Se discuten hipótesis sobre cómo ésto pudo haber surgido, incluyendo la sugesrencia de que la morfología del pico dejaría de ser adaptativa en este caso, para volverse en realidad un factor limitante en el potencial explotativo.

Palabras claves: *Aramides saracura, Campylorhamphus trochilirostris*, *Drymornis bridgesii, Hydropsalis torquata, Lanio melanops, Lepidocolaptes angustirostris, Pseudoseisura unirufa, Setopagis parvula, Spiziapteryx circumcincta, Xiphocolaptes major*

Adaptive behaviors are positive behavioral reactions to novel situations or environmental changes with a beneficial result to the individual. Though there are exceptions to the rule, standard optimal foraging theory suggests that individuals will favor techniques that provide maximum calorific intake with minimum energetic expenditure (Pyke *et al.,* 1977; Norberg, 1977). However such benefits may need to be weighed against other factors, including the potential risk to survival (Krebs, 1980; Lucas, 1983; Winterhalder, 1983). Adaptive foraging behaviors may involve minor and possibly unconscious alterations to normal feeding behavior inspired by clumped resources, such as hummingbirds using a feeder (Battistoni *et al.*, 2011); or radical innovative changes of behavior to exploit a rare or novel opportunity, as seen in

tits taking cream from milk bottles in the UK (Fisher & Hinde, 1950).

For many Neotropical bird species very little has been published about foraging strategies beyond brief descriptions of diet and/or typical foraging behavior. In this paper I detail departures from the published foraging strategies for eleven species of Paraguayan birds that were inspired by unusual or changing environmental conditions, and which may thus be considered novel adaptive responses.

RESULTS AND DISCUSSION

Spot-winged Falconet (*Spiziapteryx circumcincta*) (Falconidae)

This species has a limited range in Paraguay, being confined to the most arid areas of the Dry Chaco in the extreme west of Departamento Boquerón, most notably in the area in and around Parque Nacional Médanos del Chaco (S20º 07´, W61º 00´) (Guyra Paraguay, 2005). The relative scarcity of Paraguayan records, all involving isolated observations of single birds, have led to a supposition that the species is rare in the country (Hayes, 1995; Guyra Paraguay, 2004) or at best unobtrusive and difficult to observe. Little published data exists on foraging strategies in this species, but it has been said to "still hunt from cover" (Ferguson-Lees & Christie, 2001), and to feed on "insects (Orthoptera, cicadas), lizards and birds" (Bierregaard, 1994).

An extension of the power lines from PN Teniente Enciso to the Nueva Asunción military base during 2013 saw the installation of concrete posts alongside the Ruta Trans Chaco (in this region a dirt road that sees little traffic) and minor forest clearance. On 29 July 2013 two individuals were observed perched on the newly installed posts, with a typical head-down hunting posture observing the cleared ground around the poles and another individual was observed under similar circumstances on a second visit to the area on 19 September 2013. Similar behavior has also been observed in Argentina where they spend a considerable amount of time sitting on exposed or semi-exposed perches on trees or posts (M. Pearman, pers. com.).

Though Brown & Amadon (1989) note that "natives" describe the species as a "highly-aggressive … bird-eater", its rounded wings and slow, flappy flight seem poorly adapted for pursuit hunting. Furthermore Brown & Amadon's (1989) statement that the species "sometimes suns itself on a … telephone pole", seems incredulous as an explanation at least in its Paraguayan range, where the mean annual temperature is above 25°C (range of monthly means over the period 1951-2011 = 14.2-32.1°C, source Mariscal Estigarribia weather station).

Stomach contents from Argentina, including beetles and caviomorph rodents (M. Pearman pers. com. in Ferguson-Lees & Christie, 2001), are suggestive that at least part of the diet is obtained by dropping to the ground onto prey. However, the habitat where this species is found in Paraguay is characterized by a paucity of large trees, and a dense, low, surrounding thorn forest. Still hunting from cover may thus be a result of the limited availability of suitable hunting perches close to areas of bare ground in this challenging environment. In Argentina Sánchez & Savigny (2005) note that the species is apparently expanding its range into suburban areas and exotic plantations. Consequently if the optimal hunting technique of this species is indeed still-hunting from an exposed perch over open ground, then the installation of these power lines may have created new foraging opportunities for this species, and it could in fact be benefitting from human expansion within its traditional range.

Slaty-breasted Wood Rail (*Aramides saracura*) (Rallidae)

During August 2006 individuals of this Atlantic Forest endemic species were seen regularly sifting through garbage in an open dump within the Atlantic Forest at Hotel Tirol (S27º 11´, W55º 46´), Departamento Itapúa. The birds were shy and fled upon noticing the observer, and it was

not possible to determine whether they were feeding on food remains discarded from the hotel or on invertebrates attracted to them.

Little data has been published on foraging habits in this species (Burn, 1996; Taylor & Van Perlo, 1998) but in Provincia Misiones, Argentina, there are reports of the species feeding alongside chickens and other domestic animals (J. Mazar Barnett in litt. in Taylor & Van Perlo, 1998). Though essentially a logical extension of what may be hypothesized to be normal foraging behavior, sifting through garbage is adaptive because it capitalizes upon an unnatural resource within the natural habitat. In other words, the bird is choosing to forage in an unnatural setting despite the availability of typical habitat in close proximity, presumably because of a higher concentration of potential prey.

Little Nightjar (*Setopagis parvula*), Scissor-tailed Nightjar (*Hydropsalis torquata*) (Caprimulgidae)

Feeding on insects attracted to lights is well documented in caprimulgids, and it has been hypothesized that artificial lights may even allow feeding to continue once natural environments nearby have become too dark for hunting to be effective (Holyoak 2001). Both of these species have been observed on several occasions feeding at lights in the Dry Chaco at the headquarters of Parque Nacional Teniente Enciso (S21º 12´, W61º 39´), Departamento Boquerón.

Scissor-tailed and Little Nightjars are of seasonal occurrence in the area of the park, the former typically being present in small numbers during the austral winter and the latter being temporarily abundant at least during September/October and February/March when it seems that as yet poorly understood movements are taking place. At least two other species occur in this area, the uncommon winter visitor Band-winged Nightjar (*Systellura longirostris*) and the resident forest-dwelling Rufous Nightjar (*Antrostomus rufus*). Neither of these two species has yet been observed to indulge in similar behavior. Additional behavioral or ecological factors thus may influence the adoption or otherwise of such behavior.

During the first week of October 2007 a huge aggregation of Little Nightjar numbering many thousands of birds was observed feeding on an emergence of winged termites over the paved Ruta Trans Chaco in the vicinity of the Mennonite Colonies of the Central Chaco (S22º 29´, W60º 00´). The insects were attracted to the lights of the passing vehicles and the birds swooped after them repeatedly, resulting in the death of large numbers of individuals through collisions with vehicles.

Maladaptive behavioral changes are detrimental or lethal to the individual. They arise when individuals are unable to accurately assess the costs and benefits of a particular strategy and hence make suboptimal choices (Hollander *et al.*, 2011). Migratory species especially may be time-constrained and must make use of environmental clues that reflect habitat condition, and consequently impact on food availability and fitness (Orians & Wittenberger, 1991; Marshall & Cooper, 2004; Hromada *et al.*, 2008). In this case an abundance of food attracted to vehicle lights represented a lethal maladaptive choice for many individuals but a successful, if high risk, pay off for others.

Brown Cacholote (*Pseudoseisura lophotes*) (Furnariidae), Narrow-billed Woodcreeper (*Lepidocolaptes angustirostris*) (Furnariidae, Dendrocolaptinae), Great Rufous Woodcreeper (*Xiphocolaptes major*) (Furnariidae, Dendrocolaptinae), Scimitar-billed Woodcreeper *(Drymornis bridgesii*) (Furnariidae, Dendrocolaptinae), Red-billed Scythebill (*Campylorhamphus trochilirostris*) (Furnariidae, Dendrocolaptinae)

Individuals of all these species habitually and methodically search bored holes on concrete posts holding up power lines at PN Teniente Enciso, Departamento Boquerón (S21º 12´, W61º

39´). The 9 m high rectangular posts were first installed in late 2004 (M. Torales pers. com.) and the upper end of the post each contains 14 round holes of 20 mm diameter on each face that are bored through to the other side. Searching of these holes by these species has been observed there regularly, particularly during the first hours of daylight, since the author´s first visit in July 2006. Though it may be viewed to some degree as an extension of the typical foraging methods employed by these species on vertical services, the wide variety of strategies employed by these species in a natural setting is reflected in the great diversity of bill form that they exhibit (Marantz *et al.*, 2003). Probing already bored holes thus involves an adaptive divergence from the typical evolutionary uses of these differing bill forms in some cases.

The exploitation of this single resource by multiple related species raises interesting research questions. Interspecific observational learning and cultural transmission about the location and nature of potential feeding places may have occurred (Krebs, 1973; Vickery *et al.*, 1981) or alternatively the resource may have been discovered accidentally and independently by each of the species through their habit of perching on vertical surfaces.

Chapman & Rosenberg (1991) noted considerable dietary overlap in some Amazonian woodcreepers, and that resources were partitioned in relation to substrate use and foraging height. Puebla-Olivares (2001) also found that dietary overlap occurred in Mexico, but that resources were partitioned according to prey size rather than prey type. Pierpont (1986) positively correlated overlap in diet and substrate use in Peruvian woodcreepers with interspecific territoriality and aggression, demonstrating that those species in direct competition were the most likely to exclude each other aggressively. A lack of observed aggression in this case may thus be hypothesized to reflect a lack of competition among the species.

Bill morphology and variations in feeding ecology may not only affect diet (Torok, 1990; Chapman & Rosenberg, 1991; Gurd, 2007), but can also result in a differing capacity for the exploitation of a fixed resource. In this case, woodcreepers are probing holes in concrete poles which they are not able to modify through employment of their typical feeding techniques. Depth of probing is restricted by bill length, extent of aperture of the mandibles is related to thickness of the bill and the angle of the probe is determined by bill curvature. Consequently the ability to exploit this resource is limited and not enhanced by their bill morphology. Coupled with possible partitioning in relation to prey size as suggested by Puebla-Olivares (2001) this potentially could partition the resources in a manner largely unrelated to behavior, thereby enabling successful and continual exploitation by a variety of species (Marantz *et al.*, 2003).

Black-goggled Tanagers (*Lanio melanops*) (Thraupidae), Narrow-billed Woodcreeper (*Lepidocolaptes angustirostris*) (Furnariidae, Dendrocolaptinae)

Black-goggled Tanager is omnivorous, but primarily insectivorous, with army ant following and sallying for insects already documented in their normal foraging behaviour (Isler & Isler, 1999). Two variations on this foraging style were observed at Hotel Tirol (S27º 11´, W55º 46´), Departamento Itapúa.

During August 2006 several individuals were observed sallying for insects over an open garbage dump with the forest. The birds sallied in short flights (c 3-4 m) from a low perch approximately 30 cm above the ground at the edge of the dump, snapping at insects attracted to the garbage. One male also hovered briefly over the garbage at a height of approximately 40 cm and plunged into grass growing amongst it before returning to its perch with an insect. This is an adaptive behavior presumably inspired by a concentration of insect prey, but does not involve a radical diversion from normal foraging behavior.

At sunrise on 15 September 2007 a small

flock were observed perched on a low wall, periodically flying up to glean moths from the partially mirrored windows of the events hall. The behavior continued for approximately ten minutes before the birds retreated into the forest. Though clearly related to normal gleaning behavior, the fact that the birds had emerged from the forest to exploit the insects that had been attracted to lights during the previous evening suggests a considerable degree of adaptation, requiring a departure from both the normal habitat preference (forest interior) and the ability to over-ride the usual caution associated with the proximity of humans. This suggests that the nutritional pay offs from such behavior were correspondingly high enough to offset the risks (Krebs, 1980). Similar behavior was also observed at first light on two consecutive mornings (12 and 13 October 2013) by a Narrow-billed Woodcreeper *Lepidocolaptes angustirostris,* gleaning insects attracted to lights from under a roof at the accommodation building at Fortín Toledo, Departamento Boquerón (S22º 19´, W60º 21´)

CONCLUSIONS

These observations demonstrate that foraging strategies in birds are not fixed and in some cases may be highly adaptable in response to changing local conditions. The published literature is guilty in some instances of over-generalizing foraging behavior and diet, and thus fails to properly emphasize the plasticity of such approaches. Such knowledge of adaptability is important when identifying potential threats to species resulting from habitat modification, and also in prioritizing conservation actions effectively. The full extent of foraging behaviors in most Neotropical birds remains underestimated; more detailed studies on individual and community foraging strategies are urgently required to fill the existing gaps in our knowledge.

ACKNOWLEDGEMENTS

Many thanks to Mark Pearman for his useful comments on certain parts of the manuscript. Thanks also to the people, too numerous to mention individually, who have accompanied me in the field over the years when these observations were made. The hospitality of Mario Torales at Parque Nacional Tte Enciso and Juan Campos at Toledo is greatly appreciated during our frequent visits to the Chaco.

LITERATURE

Battistoni, M., E. Beck, S. Remsen & F. Wang. 2011. Energy optimization and foraging preference in hummingbirds. Dartmouth Undergraduate Journal of Science, Spring: 34-36.

Bierregard, R. O. 1994. *Spiziapteryx circumcinctus*. Pp 254-255 *In*: del Hoyo, J., A. Elliott, & J. Sargatal (eds). Handbook of the Birds of the World Volume 2 New World Vultures to Guineafowls. Lynx Edicions, Barcelona, Spain.

Burn, H. 1996. Genus *Aramides*. Pp. 175-177 *In*: del Hoyo, J., A. Elliott, & J. Sargatal (eds). Handbook of the Birds of the World. Volume 3. Hoatzin to Auks. Lynx Edicions, Barcelona, Spain.

Brown, L. & D. Amadon. 1989. Eagles, Hawks and Falcons of the World. Wellfleet Press, New Jersey, USA, 945 pp.

Chapman, A. & K. V. Rosenberg. 1991. Diets of four sympatric Amazonian woodcreepers (Dendrocolaptidae). Condor, 93: 904–915.

Fisher, J. & R. A. Hinde. 1950. The opening of milk bottles by birds. British Birds, 42: 347-357.

Gurd, D. B. 2007. Predicting resource partitioning and community organization of filter-feeding dabbling ducks from functional morphology. American Naturalist, 169: 334-343.

Guyra Paraguay. 2004. Lista Comentada de las Aves del Paraguay. Guyra Paraguay, Asunción, Paraguay, 200 pp.

Guyra Paraguay. 2005. Atlas de las Aves de

Paraguay. Guyra Paraguay, Asunción, Paraguay, 212 pp.

Hayes, F. E. 1995. Status, distribution and biogeography of the birds of Paraguay. American Birding Association Monographs in Field Ornithology, 1: 1–230.

Hollander, F. A., H. Van Dyck, G. San Martin & N. Titeux. 2011. Maladaptive habitat selection of a migratory passerine bird in a human-modified landscape. Plos One, 6(9): 1-11.

Holyoak, D. T. 2001. Nightjars and their Allies. Oxford University Press, Oxford, UK. 848 pp.

Gill, F. & D. Donsker (eds). 2010. IOC world bird names (version 3.4). Available at http://www.worldbirdnames.org/ [Accessed "5 September 2013"].

Hromada, M., M. Antczak, T. J. Valone & P. Tryjanowski. 2008. Settling decisions and heterospecific social information use in shrikes. Plos One, 3(12): 1-5.

Isler, M. L. & P. R. Isler. 1999. Helm Identification Guides: Tanagers. Christopher Helm, London, UK. 406 pp.

Krebs, J. R. 1973. Social learning and significance of mixed-species flocks of chickadees (*Parus* spp.). Canadian Journal of Zoology, 51: 1275-1288.

Krebs, J. R. 1980. Optimal foraging, predation risk and territory defence. Ardea, 68: 83-90

Lucas, J. R. 1983. The role of foraging time constraints and variable prey encounter in optimal diet choice. American Naturalist, 122: 191-209.

Marantz, C.A., A. Aleixo, L. R. Bevier, & M. A. Patten. 2003. Dendrocolaptidae. Pp 358-447. *In*: del Hoyo, J., A. Elliott, & D. Christie (eds). Handbook of the Birds of the World Volume 8 Broadbills to Tapaculos. Lynx Edicions, Barcelona, Spain.

Marshall, M. R., & R. J. Cooper. 2004. Territory size of a migratory songbird in response to caterpillar density and foliage structure. Ecology, 85: 432-445.

Norberg, R. A. 1977. An ecological theory on foraging time and energetics and choice of optimal food-searching method. Journal of Animal Ecology, 46: 511–529.

Orians, G. H. & J. F. Wittenberger. 1991. Spatial and temporal scales in habitat selection. American Naturalist, 137: 29-49.

Payne, R. B. 2005. The Cuckoos. Oxford University Press, Oxford, UK, 644 pp.

Pierpont, J. 1986. Interspecific aggression and the ecology of woodcreepers (Aves: Dendrocolaptidae). PhD. diss., Princeton University, New York, USA. [Not seen by author.]

Puebla-Olivares, F. 2001. Aspectos ecológicos de la familia Dendrocolaptidae (Aves) en la localidad de Yaxchilán, Chiapas, México. Tesis de maestría, Universidad Nacional Autónoma de México, México DF.

Pyke, G. H., H. R. Pulliam & E. L. Charnov. 1977. Optimal foraging: a selective review of theory and tests. Quarterly Review of Biology, 52: 137-154.

Sánchez, K. B. & C. Savigny. 2005. Nuevos registros del halconcíto grís (*Spiziapteryx circumcinctus*) en el sudeste de la Provincia de Buenos Aires, Argentina. Nuestras Aves, 49: 35-36.

Taylor, B. & B. Van Perlo. 1998. Rails. A Guide to the Rails, Crakes, Gallinules and Coots of the World. Pica Press, Surrey, UK, 600 pp.

Torok, J. 1990. Resource partitioning among three woodpecker species *Dendrocopos* spp. during the breeding season. Holarctic Ecology, 13: 257-264.

Vickery, W. L., L. A. Giraldeau, J. J. Templeton, D. L. Kramer & C. A. Chapman. 1981. Producers, scrounging and group foraging. American Naturalist, 137: 847-863.

Winterhalder, B. 1983. Opportunity-cost foraging models for stationary and mobile predators. American Naturalist, 122: 73-84.

INSTRUCCIONES PARA LOS AUTORES

El Boletín del Museo Nacional de Historia Natural del Paraguay se publica en un volumen por año, dividido en dos números. Los manuscritos recibidos hasta el 1 de abril podrán ser considerados para la edición de junio (nº 1) y los recibidos hasta el 1 de octubre para la edición de diciembre (nº 2). Sin embargo, la entrega de un manuscrito dentro de un determinado periodo no garantiza su publicación en la edición inmediata siguiente, dependiendo ésta del tiempo que toma el proceso de revisión al que es sujeto. En caso de no tener un número completo para la edición de junio, se publicará un volumen de doble número en diciembre.

Se aceptan trabajos de investigación originales en las áreas de Botánica, Zoología, Paleontología y Geología Descriptiva, cubriendo la Región Neotropical y preferentemente el Paraguay y regiones limítrofes. Se aceptan trabajos en Español, Portugués o Inglés.

Los manuscritos deben presentarse en archivo electrónico generado en Microsoft Word, en papel tamaño A4 con todos los márgenes de 2,5 cm y texto en fuente Times New Roman tamaño 11. No se aceptarán pies de página.

Las figuras deben ser originales, con número de referencia escrito a lápiz al dorso o en su defecto archivos electrónicos numerados, de buena resolución en formatos JPG, TIF o PNG. Los pies de ilustración deben ir en hoja aparte, indicando claramente los números de referencia de las ilustraciones originales o los archivos respectivos. Las tablas deben ir por separado, en versión electrónica, en archivo generado en Microsoft Excel.

Toda la documentación relacionada con el artículo debe enviarse a la la dirección electrónica del Boletín: boletin.mnhnpy@gmail.com. Se pide que los autores provean nombre, dirección postal y correo electrónico de al menos dos revisores potenciales.

La primera página del manuscrito debe llevar los siguientes datos: **1)** título conciso e informativo en letra mayúscula, **2)** nombre del autor o autores, **3)** dirección completa del autor o autores (incluyendo dirección electrónica si existe), **4)** resumen en español, **5)** *abstract* en inglés, **6)** palabras clave en español y **7)** *key words* en inglés.

El cuerpo del manuscrito puede constar de las siguientes partes ordenadas, cada una claramente titulada: **1)** Introducción, **2)** Materiales y Metodología, **3)** Resultados y Discusión, **4)** Conclusión, **5)** Agradecimientos y **6)** Literatura. Se aceptan modificaciones de este esquema siempre que sigan una secuencia lógica equivalente a lo propuesto.

Los trabajos deberán respetar las disposiciones de los códigos de nomenclatura Zoológica y Botánica vigentes. Los nombres científicos deben escribirse en *itálicas*. Se sugiere que los nombres científicos se escriban completos, incluyendo autor(es), al menos la primera vez que se mencionan. La citación de autores de nombres científicos es obligatoria en trabajos de índole taxonómico. Los nombres genéricos al principio de una oración deben escribirse completos.

Las citas bibliográficas deberán hacerse de acuerdo a los siguientes ejemplos: López (1992) o (López, 1992). Cuando un trabajo tiene dos autores se mencionarán ambos apellidos y cuando sean más se citará como en los ejemplos: López *et al*. (1991) o (López *et al*., 1991).

En la sección Literatura se deben incluir los trabajos citados en el manuscrito o que merecen mención justificada por su importancia en el tema tratado. Las referencias deben ir por orden alfabético y cronológico y cada una siguiendo el modelo de secuencia: Autor. Año. Título. Publicación serial o Casa editora y Ciudad, Volumen (Número): Intervalo o total de páginas. Abajo hay algunos ejemplos:

Carpenter, J.M. 1986. A synonymic generic checklist of the Eumeninae (Hymenoptera: Vespidae). Psyche, 93(1-2): 61-90.

Carpenter, J.M. & J. Vecht. 1991. A study of the Vespidae described by William J. Fox (Insecta: Hymenoptera), with assessments of taxonomic implications. Annals of Carnegie Museum, 60(3): 211-241.

Polazek, A., S. Abd-Rabou & J. Huang. 1999. The Egyptian species of *Encarsia* (Hymenoptera: Aphelinidae); a preliminary review. Zoologische medelingen Leiden, 73: 131-163.

Hanson, P. & A.S. Menke. 1995. The sphecid wasps (Sphecidae). Capítulo 17, pp. 621-646, *in* Hanson P. & I.D. Gauld (editores). The Hymenoptera of Costa Rica. Oxford Science Publications/The Natural History Museum, London. 893 pp.

Richards, O.W. 1978. The social wasps of the Americas excluding the Vespinae. British Museum (Natural History), London. 580 pp.

INSTRUCTIONS TO AUTHORS

Boletín del Museo Nacional de Historia Natural del Paraguay is published a volume a year, divided in two numbers. The manuscripts received as late as April 1 are to be considered for the June edition (nº 1) and those received as late as October 1 for the December edition (nº 2). Nontheless, delivery of a manuscript along a certain period does not guarantee its publication in the very next edition, depending it on the time taken by the revisonary process. A double number volume will be published in December if no papers were available to complete de June edition.

The editorial accepts original research papers on several aspects of Botany, Zoology, Paleontology and Descriptive Geology, covering the Neotropical Region, preferably Paraguay and neighbouring areas. Papers wrote in Spanish, Portuguese or English will be accepted.

The manuscripts should be submitted as electronic files in Microsoft Word format, in A4 size paper with 25 mm margins and text in Times New Roman font, size 11. Footnotes will not be accepted.

Figures should be submitted as original hard copies, with reference numbers penciled on back or, alternatively as numbered electronic files with good resolution in JPG, TIF or PNG format. The figure legends must go in a separate page, clearly indicating the reference numbers of the original ilustrations or files. Tables should be sent separately as electronic files made in Microsoft Excel format.

All the documentation related to the manuscript must be sent to the e-mail address of the Boletín: boletin.mnhnpy@gmail.com. Authors are asked to provide name, address and e-mail of at least two potential referees.

The first page of the manuscript must contain the following data: **1)** short and concise title in capitals, **2)** name of the author(s), **3)** complete address of the author(s) (including e-mail address if available), **4)** Spanish *resumen*, **5)** English abstract, *6) palabras clave* in Spanish and 7) key words in English.

The manuscript body could be composed by the following ordered parts, each one clearly entitled: **1)** Introduction, **2)** Materials and Methods, **3)** Results and Discusion, **4)** Conclusions, **5)** Aknowledgements and **6)** Literature. Modifications could be acepted if they follow a logic sequence equivalent to the one here proposed.

Papers must respect the rules of the codes on Zoology and Botany in force. Scientific names must be in *italics*. It is suggested that scientific names should be mentioned complete, including author(s) at least in the first mention. Authority is mandatory in taxonomic papers. Generic names must be completely spelled at the beginning of a sentence.

References in the text should folloow the examples: López (1992), or (López, 1992). Papers with two authors should mention both names, and papers with more authors should follow the examples: López *et al*. (1991), or (López *et al*., 1991).

The Literature section must include all the works referred in the text and could include those with justified influence on the subject. References should go in alphabetic and chronologic order, each one according to the following model: Author. Year. Título. Serial publication or editorial house and city, Volume (Number): Page range or total. Examples are given bellow:

Carpenter, J.M. 1986. A synonymic generic checklist of the Eumeninae (Hymenoptera: Vespidae). Psyche, 93(1-2): 61-90.

Carpenter, J.M. & J. Vecht. 1991. A study of the Vespidae described by William J. Fox (Insecta: Hymenoptera), with assessments of taxonomic implications. Annals of Carnegie Museum, 60(3): 211-241.

Polazek, A., S. Abd-Rabou & J. Huang. 1999. The Egyptian species of *Encarsia* (Hymenoptera: Aphelinidae); a preliminary review. Zoologische medelingen Leiden, 73: 131-163.

Hanson, P. & A.S. Menke. 1995. The sphecid wasps (Sphecidae). Capítulo 17, pp. 621-646, *in* Hanson P. & I.D. Gauld (editores). The Hymenoptera of Costa Rica. Oxford Science Publications/The Natural History Museum, London. 893 pp.

Richards, O.W. 1978. The social wasps of the Americas excluding the Vespinae. British Museum (Natural History), London. 580 pp.

BOLETÍN

DEL

Museo Nacional de Historia Natural del Paraguay

CONTENIDO

Bol. Mus. Nac. Hist. Nat. Parag.	San Lorenzo (Paraguay)	ISSN 1680-4031 (versión impresa) ISSN 2310-4236 (versión digital)	Vol. 20 (2)	Diciembre 2016	Páginas 81-214