BIRD-HERPETOFAUNA INTERACTIONS IN THE USUMACINTA RIVER BASIN, MEXICO

INTERACCIONES ENTRE AVES Y HERPETOFAUNA EN LA CUENCA DEL RÍO USUMACINTA, MÉXICO

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Resumen.– Las interacciones interespecificas entre vertebrados de distintos grupos son comunes, pero también complejas y de gran importancia para la estructura de las comunidades. En particular, la depredación, considerada una interacción trófica, desempeña un papel significativo en la estructura de las redes tróficas y en los efectos selectivos sobre las presas en los ecosistemas naturales. En este trabajo aportamos nueva información sobre la relación trófica entre aves y herpetofauna (reptiles y anfibios) en la compleja y biodiversa cuenca del río Usumacinta, a través de 10 observaciones registradas entre 2012 y 2021. Las observaciones muestran interacciones con fines alimenticios de ocho especies de aves, incluyendo garzas (*Tigrisoma mexicanum*), charas (*Psilorhinus morio*), rapaces (*Caracara cheriway, Pseudastur albicollis, Harpagus bidentatus, Buteo plagiatus*), bucos (*Malacoptila panamensis*), y patos (*Dendrocygna autumnalis*), con serpientes (*Coniophanes quinquevittatus*), tortugas (*Chelydra rossignonii, Trachemys venusta*), lagartijas (*Iguana iguana, Sceloporus serrifer*), cocodrilos (*Crocodylus moreletii*), y ranas (*Smilisca baudinii*).

Palabras claves.– Amphibia, Aves, carroñero, depredación, interacciones interespecificas, relaciones troficas, Reptilia.

Abstract.– Interspecific interactions between vertebrates of different groups are common but also complex and of great importance for community structure. In particular, predation, considered a trophic interaction, plays a significant role in food webs structure and selective effects on prey in natural ecosystems. In this paper we provide new information on the trophic relationship between birds and herpetofauna (reptiles and amphibians) in the complex and biodiverse Usumacinta river basin, through 10 observations recorded between 2012 and 2021. The observations show interactions for feeding purposes of eight bird species, including herons (*Tigrisoma mexicanum*), jays (*Psilorhinus morio*), raptors (*Caracara cheriway, Pseudastur albicollis, Harpagus bidentatus, Buteo plagiatus*), puffbirds (*Malacoptila panamensis*), and ducks (*Dendrocygna autumnalis*), with snakes (*Coniophanes quinquevittatus*), turtles (*Chelydra rossignonii, Trachemys venusta*), lizards (*Iguana iguana, Sceloporus serrifer*), crocodiles (*Crocodylus moreletii*), and frogs (*Smilisca baudinii*).

Key words.– Amphibia, Aves, interspecific interactions, predation, Reptilia, scavenger, trophic relationships.

Interspecific interactions between vertebrates of various groups are common but also complex, and of great importance for community structure (Palomares & Caro, 1999; Arim & Marquet, 2004; Sergio & Hiraldo, 2008; Lourenço et al., 2011). Within these interspecific interactions, predation is defined as a trophic interaction in which one organism (predator) consumes another (prey) as a source of energy, and in vertebrate predators this interaction almost always implies the death of the prey (Lourenço et al., 2014). Predation plays a significant role in the food webs structure, and also has an important selective effect on preys in natural ecosystems (Brose et al., 2019). In this sense, certain species of reptiles are important part in the diet of predator bird species, especially raptors. For example, in the case of the Laughing Falcon (*Herpetotheres cachinnans*), its diet is composed mainly of snakes (Costa et al., 2014).

The Usumacinta river basin is a strategic area for biodiversity, freshwater supply, and a wide range of environmental services, which makes it highly relevant regionally and globally (De la Maza & Carabias, 2011; Carabias et al., 2015; Saavedra Guerrero

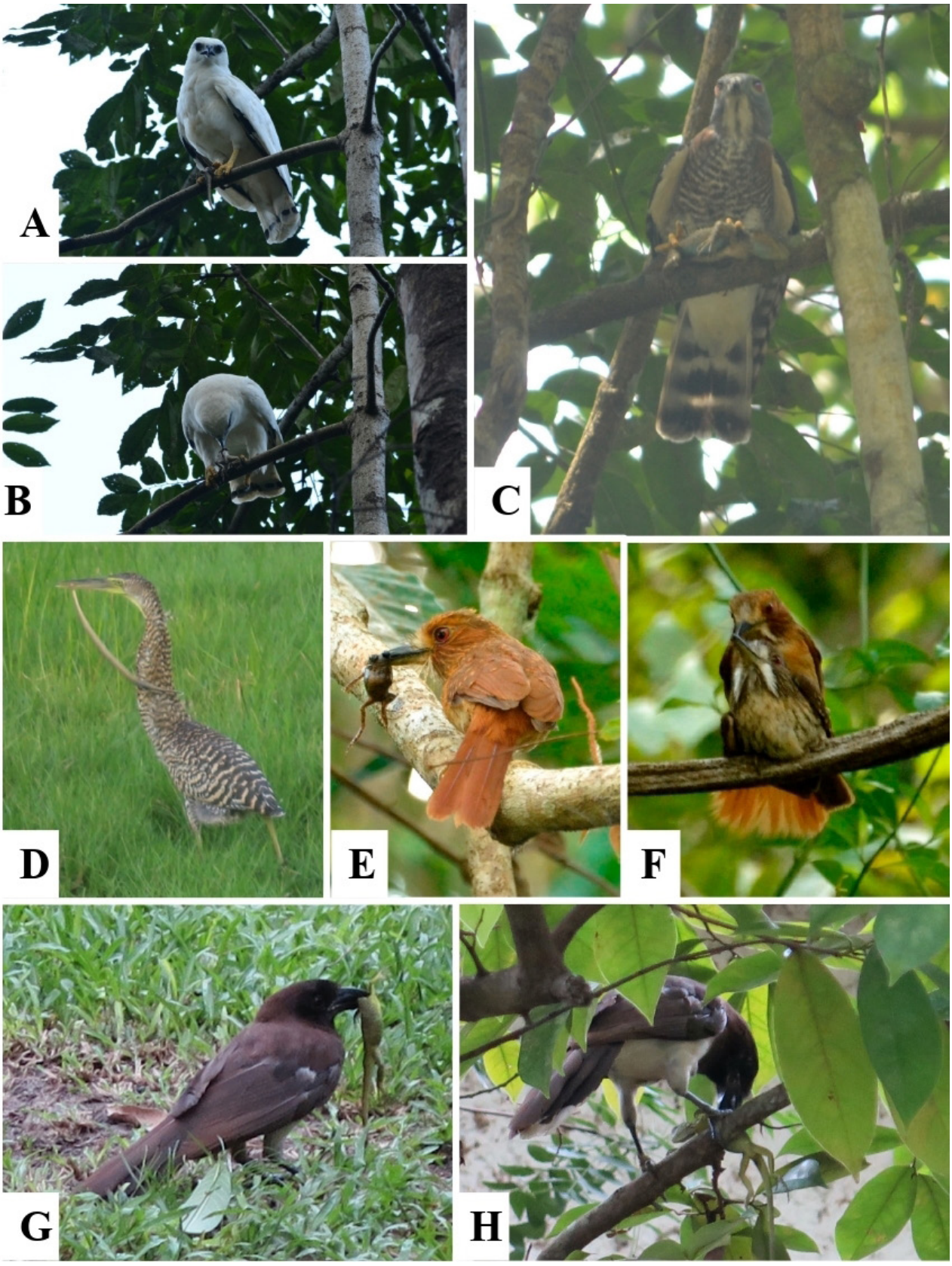
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Figura 1 (página anterior). Fotografías de interacciones entre herpetofauna y aves en la cuenca del río Usumacinta. A-B) *Pseudastur albicollis* alimentandose de *Sceloporus serrifer*; C) *Harpagus bidentatus* alimentandose de *Sceloporus serrifer*; D) *Tigrisoma mexicanum* alimentandose de una serpiente; E) Un macho *Malacoptila panamensis* alimentandose de una *Smilisca baudinii*; F) Macho y hembra *Malacoptila panamensis* copulando; G-H) *Psilorhinus morio* alimentandose de una Iguana *iguana*. Photos: Silvano López (A, B, C, E, F), Pierre Charruau (D, G, H).

Figure 1 (previous page). Photography of bird-herpetofauna interactions in the Usumacinta river basin, México. A-B) *Pseudastur albicollis* feeding on *Sceloporus serrifer*; C) *Harpagus bidentatus* feeding on *Sceloporus serrifer*; D) *Tigrisoma mexicanum* feeding on a snake; E) A male *Malacoptila panamensis* feeding on a *Smilisca baudinii*; F) A male and a female *Malacoptila panamensis* copulating; G-H) *Psilorhinus morio* preying on a young Iguana *iguana*. Photos: Silvano López (A, B, C, E, F), Pierre Charruau (D, G, H).

et al., 2019; Charruau et al., 2022). It contains a great variety of vegetation types and diverse ecosystems such as forests, jungles, plains and mangroves (Meave et al., 2022). These characteristics favor the complexity of interspecific interactions and in particular of food webs. In this context, in this paper we present 10 occasional records of predatory interactions between herpetofauna (reptiles and amphibians) and bird species, recorded between 2012 and 2021, in the Usumacinta river basin. The scientific and common names of birds, reptiles and amphibians follow the nomenclature of the American Ornithological Society checklist (https://checklist.americanornithology.org/, Chesser et al., 2022), the reptile database (http://www.reptile-database.org/, Uetz et al., 2022), and Amphibian Species of the World (https://amphibiansoftheworld.amnh.org/, Frost, 2023), respectively.

Observation 1. White Hawk (*Pseudastur albicollis*) predation on Rough-scaled Lizard (*Sceloporus serrifer*). At 12:46 h on 11 November 2012, Silvano López observed and photographed a White Hawk hunting and feeding on a Rough-scaled Lizard in Yaxchilán Natural Monument, on the banks of the Usumacinta river (Lat. 16.897054°, Long. -90.964769°, WGS84, 150 m a.s.l.). The hawk was first detected when it perched in a 10 m high tree, below the forest canopy. While perched, the White Hawk tore the lizard with its beak while holding the body with its claws (Figs. 1A-B). The hawk remained on the perch for 15 min feeding, then flew out of the observers' detection range. The White Hawk is a silent perch hunter and is considered to have a "reptilian" diet, consisting primarily of snakes, lizards, frogs, small mammals, large insects, and occasionally birds (Stiles & Skutch, 2007; Draheim et al., 2012; Whitacre, 2012). Draheim et al. (2012) recorded the following lizards species in the diet of *P. albicollis*: Schwartze´s Skink (*Mesoscincus schwartzei*), Eastern Casquehead Iguana (*Laemanctus longipes*), Hernandez´s Helmeted Basilisk (*Corytophanes hernandesii*), several species of the lizards of the genera *Anolis, Ameiva* spp., and Brown Basilisk (*Basiliscus vittatus*). Our observation would represent the first documented White Hawk predation on Sceloporus *serrifer.*

Observation 2. Double-toothed Kite (*Harpagus bidentatus*) predation on Rough-scaled Lizard (*Sceloporus serrifer*). At 12:01 h on 26 March 2014, Silvano López observed and photographed a Double-toothed Kite hunting and feeding on a Rough-scaled Lizard in Yaxchilán Natural Monument, on the banks of the Usumacinta river (Lat. 16.875233°, Long. -90.974814°, WGS84, 150 m a.s.l.). The kite was detected perched on a horizontal wooden vine 20m high below the forest canopy. While perched the Double-toothed Kite tore the lizard with its beak while holding the body with its claws (Fig. 1C). According to Schulze et al. (2012), the diet of the Double-toothed Kite is mainly composed of insects (54%) and lizards (42.9%). Of the lizards reported in the diet of *H. bidentatus* are anolis, geckos, helmeted basiliks and scincids (Schulze et al., 2012; Whitacre, 2012). Our observation represents the first record of hunting and feeding by a Double-toothed Kite on a *Sceloporus* lizard, expanding the list of reptiles known to be preyed upon by the raptor.

Observation 3. Bare-throated Tiger-Heron (*Tigrisoma mexicanum*) predation on snake. According to Selas (2001), some reptiles, such as snakes, are easier prey for birds to capture, which implies lower energy expenditure. The Bare-throated Tiger-Heron generally inhabits fresh or brackish water areas without waves (MacKinnon, 2017), preferring open habitats and large bodies of water such as river banks, edges of estuaries and lakes, ponds, marshes and mangroves (Stiles & Skutch, 2007). Here we describe the record of predation of an undetermined species of snake by a Bare-throated Tiger-Heron in the ejido El Cometa (Lat. 18.517194°, Long. -92.425779°, WGS84, 0 m a.s.l.) in the municipality of Frontera, state of Tabasco, Mexico. On September 20, 2014 at 17:12 h, a juvenile individual of Bare-throated Tiger-Heron was observed holding a snake in its beak at the edge of a body of water in a pasture (Fig. 1D), the heron was moving away from the body of water and it could not be determined if it ended up eating it.

Observation 4. White-whiskered Puffbird (*Malacoptila panamensis*) predation on Common Mexican Treefrog (*Smilisca baudinii*). Puffbirds belong to the family Bucconidae which is a Neotropical family of forest or forest-edge birds (Howell & Webb, 1995). Their diet consists primarily of insects, other small invertebrates, and frogs and lizards (Stiles & Skutch, 2007). At 10:18 h on 12 April 2017, Silvano López observed an adult male White-whiskered Puffbird hunting and feeding on a Common Mexican Treefrog in Yaxchilán Natural Monument, on the banks of the Usumacinta river (Lat. 16.897054°, Long. -90.964769°,

WGS84, 150 m a.s.l.). The White-whiskered Puffbird was first detected perching on a 3 m high vine in the lower stratum of the forest. While perched, the puffbird held the frog in its beak and tapped it on the vine before eating it (Fig. 1E). After feeding, the same male was seen copulating with an adult female on a nearby liana (Fig. 1F).

Observation 5. Brown Jay (*Psilorhinus morio*) predation on Green Iguana (*Iguana iguana*). The Brown Jay is a bird of the family Corvidae, considered a generalist and omnivorous species as far as its diet is concerned; thus, most of the time they look for their food in trees, but they have no problem getting down to the ground. They generally feed on insects, fruits, a wide variety of invertebrates and vertebrates, with a preference for lizards. On June 29, 2017 at 18:35 h, at Rancho San Román, municipality of Palizada, state of Campeche, Mexico (Lat. 18.112599°, Long. -92.093182°, WGS84, 5 m a.s.l.), an individual of Brown Jay was observed hunting a juvenile Green Iguana. It captured it among the branches of a bush, and when it had it well secured by the neck (Fig. 1G), it lowered it to the ground and then climbed up another tree to feed on it (Fig. 1H). Iguanas are primarily herbivores and spend most of the day among the branches and canopy of trees or bushes to feed and bask in the sun. When in danger they often use their tail as a whip, however, survival success also depends on their ability to hide among vegetation, their ability to climb and even to fall and run at high speed. Its main predators apart from humans are considered to be felines, snakes, coatis, raccoons, dogs, domestic cats and birds, among which the Great-tailed Grackle (*Quiscalus mexicanus*) (Cupul-Magaña et al., 2018; Cruz-Sáenz et al., 2020) and the Yellow-crowned Night-heron (*Nyctanassa violacea*) stand out (Engeman et al., 2005).

Observation 6. Crested Caracara (*Caracara cheriway*) feeding on Mesoamerican Slider (*Trachemys venusta*) carcass. On September 23, 2017 at 11:23 h on the entrance road to the area known as La Veleta (Lat. 18.631914°, Long. -92.385231, WGS84, 2 m a.s.l.) in the municipality of Campeche, Campeche State, Mexico, a Crested Caracara was observed feeding on the carcass of a Mesoamerican Slider (Figs. 2A-B) with a carapace length of 20-25 cm. The Crested Caracara is a medium-sized raptor, with generalist and opportunistic habits, feeding mainly on carrion but also including a variety of live prey such as small and medium-sized vertebrates and even insects (Ramírez-Albores et al., 2017). The Mesoamerican Slider is a species of freshwater turtle native to southern Mexico, Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama and Colombia (Legler, 1990); it is commonly found in aquatic environments such as reservoirs, lagoons and rivers, preferring calm, permanent waters with a certain depth, vegetation and sunbathing areas. There are reports of predation of turtles by some old world bird species such as *Ardea cinerea* (Ehrlich, 2008; Martínez-Silvestre et al., 2020), *Corvus albus* (Fincham & Lambrechts, 2014), and *Pica pica* (Martínez-Silvestre & Soler-Massana, 2000). Although the size of the turtle is a determining factor in predation by birds, unlike ardeids, raptors and scavengers such as the Crested Caracara can consume carcasses they find, where the weight and size of the turtle is not a determining factor. As may be the case in our record since we did not observe if the Crested Caracara captured and killed the turtle.

Observation 7. Interactions between Snapping Turtle (*Chelydra rossignonii*), Black-bellied Whistling-Duck (*Dendrocygna autumnalis*), and Morelet's Crocodile (*Crocodylus moreletii*). On August 20, 2018 at 7:41 h, an interaction between a Snapping Turtle, a Black-bellied Whistling-Duck, and a Morelet's Crocodile was observed in the Lacanjá lagoon (Lat. 16.402596°, Long. -90.758045°, WGS84, 131 m a.s.l.), Montes Azules Biosphere Reserve, state of Chiapas, Mexico. This event was recorded and a 45-second video was obtained. In the first 30 seconds, the turtle can be seen to have trapped a duck, biting its legs, and the duck tries to flee by flapping its wings and squawking in alarm mode (Fig. 2C). After several attempts by the duck we observe the arrival of an adult Morelet's Crocodile that pounced on both species, trying first to capture the duck (Fig. 2D), which fled flying after the turtle released it, and then the turtle (Fig. 2E), which fled as well. This sequence lasts six seconds. In the last nine seconds, the crocodile can be seen standing still and then leaving.

Predator-prey interactions are difficult to observe because they are unpredictable events in time and space, very often occurring at short intervals (Lawrence & Peterson, 2010). Therefore, having captured an event involving three species in

Figura 2 (siguiente página). Fotografías de interacciones entre reptiles y aves en la cuenca del río Usumacinta. A) Cadáver de *Trachemys venusta*; B) *Caracara cheriway* alimentándose del cadáver de *T. venusta*; C) *Chelydra rossignonii* sujetando la pata de un individuo de *Dendrocygna autumnalis*; D) *Crocodylus moreletii* tratando de capturar a *Dendrocygna autumnalis*; E) *Crocodylus moreletii* tratando de capturar a *Chelydra rossignonii*. Fotos: Pierre Charruau (A, B), Alan Monroy Ojeda (C, D, E).

Figure 2 (next page). Photography of bird-reptile interactions in the Usumacinta river basin, México. A) Carcass of *Trachemys venusta*; B) *Caracara cheriway* feeding on the carcass of *T. venusta*; C) *Chelydra rossignonii* holding the leg of an indivual of *Dendrocygna autumnalis*; D) *Crocodylus moreletii* trying to capture the *Dendrocygna autumnalis* individual; E) *Crocodylus moreletii* trying to capture the *Chelydra rossignonii* individual and *Dendrocygna autumnalis* escaping. Photos: Pierre Charruau (A, B), Alan Monroy Ojeda (C, D, E).

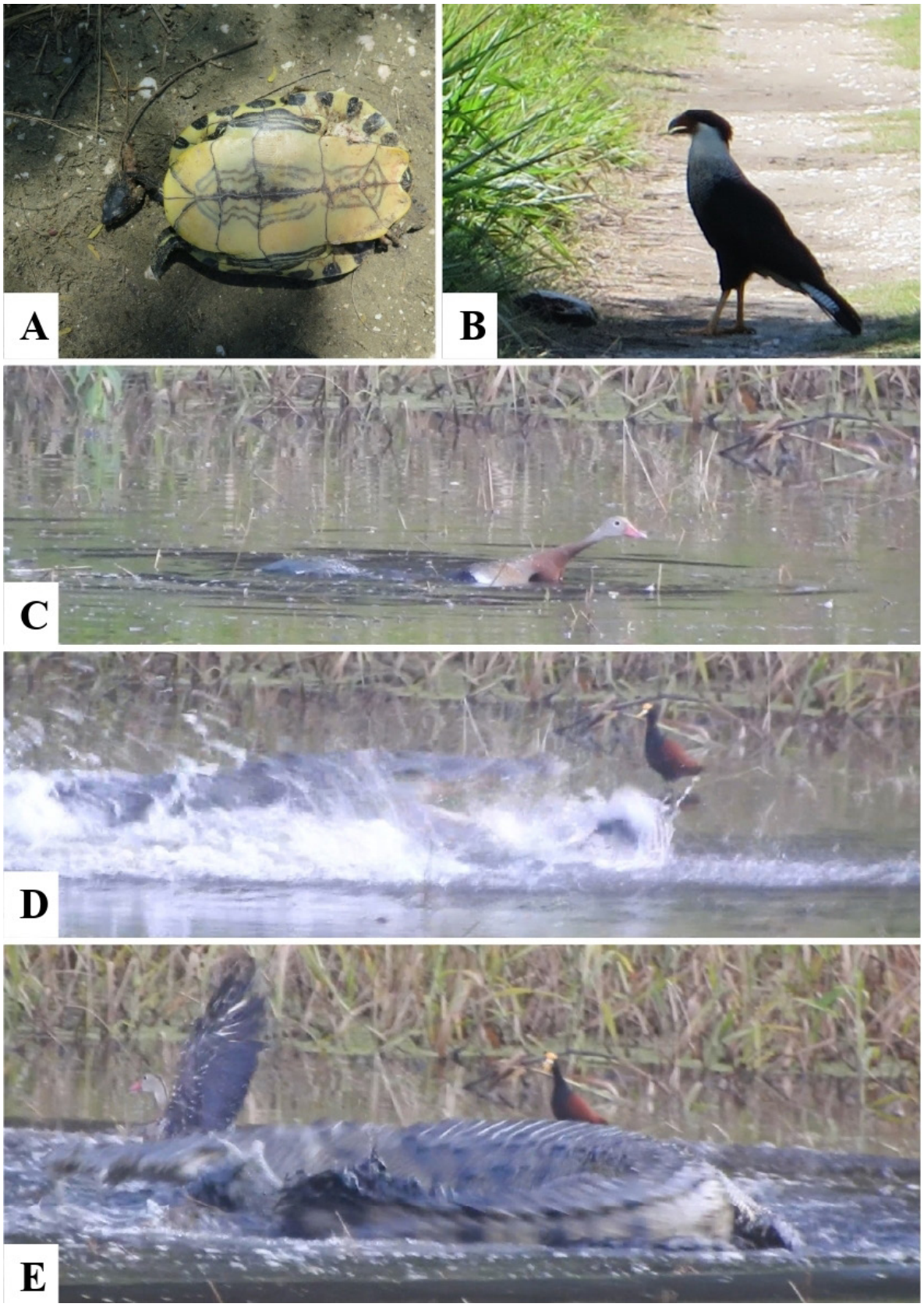
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Figura 3. Fotografías de interacciones entre reptiles y aves en la cuenca del río Usumacinta. A) *Tigrisoma mexicanum* sujetando a una cría de *Crocodylus moreletii;* B) *Tigrisoma mexicanum* sosteniendo en su pico a un ejemplar de *Coniophanes quinquevittatus;* C-D) *Buteo plagiatus* alimentandose de una *Iguana iguana.* Fotos: Victor M. Santiago Plata (A), Freddy Pérez Garduza (B), Francisco Centeno (C, D).

Figure 3. Photography of bird-reptile interactions in the Usumacinta river basin, México. A) *Tigrisoma mexicanum* holding a hatchling of *Crocodylus moreletii* in its beak; B) *Tigrisoma mexicanum* holding a specimen of *Coniophanes quinquevittatus* in its beak; C-D) *Buteo plagiatus* feeding on *Iguana iguana*. Photos: Victor M. Santiago Plata (A), Freddy Pérez Garduza (B), Francisco Centeno (C, D).

one body of water is of utmost importance. The aquatic habits of these three species made them converge at this site and although there was no successful predation during the observation we obtained valuable information about the relationship between these species. There are antecedents of predation of species of the family Anatidae by turtles of the genus *Chelydra* (Kenow et al., 2009; Davis, 2017) but this could be the first observation of attempted predation by *Chelydra rossignonii* on *Dendrocygna autumnalis*. For its part, *Crocodylus moreletii* is known to integrate waterfowl and turtles into its diet (Pérez-Higareda et al., 1989; Platt et al., 2006). However, in our case it is very likely that the crocodile was only trying to prey on the duck. Snapping Turtles are large turtles, such as the individual observed here, and even though the crocodile observed is also large, the size and hardness of the turtle's shell prevents the crocodile from ingesting or breaking it.

Observation 8. Bare-throated Tiger-Heron (*Tigrisoma mexicanum*) predation on Morelet's Crocodile (*Crocodylus moreletii*). We report on the predation of a hatchling Morelet's Crocodile by a Bare-throated Tiger-Heron (Fig. 3A) in the state of Tabasco, southern Mexico. At 12:00 h on 27 August 2018, a camera trap placed on the banks of La Gloria stream in the community of Bitzales seventh section in the municipality of Macuspana (Lat. 18.07489°, Long. -92.506938°, WGS84, 8 m a.s.l.), captured several images where an adult individual of Tiger Heron is observed with a Morelet´s Crocodile hatchling in its beak, first held by the base of the head and in another image from the base of the tail. *Crocodylus moreletii* is known to inhabit mainly fresh or brackish waters with slow currents and abundant vegetation cover, and like the Tiger Heron lives in lagoons, rivers, dams, swamps, marshes and canals, and is relatively abundant in the region (Platt et al., 2010; Flores-Escalona et al., 2021). Crocodiles participate in the dynamics of trophic processes regardless of their size and life stage, since as adults they are effective predators of various groups, but in early stages (i.e., eggs, hatchlings) they serve as food for larger mammals, birds and fish (Somaweera et al., 2013). In crocodilians, the vulnerability of hatchlings to predators is reduced by different adaptations: parental protection that can occur for days to years depending on the species, secretive and aggregatory behaviors of hatchlings, and morphological traits such as color patterns and dermal armor (Somaweera et al., 2013). *Crocodylus moreletii* hatchlings were already recognized as part of the Bare-throated Tiger-Heron diet (Álvarez del Toro, 1974; Somaweera et al., 2013).

Observation 9. Bare-throated Tiger-Heron (*Tigrisoma mexicanum*) predation on Fife-striped Snake (*Coniophanes quinquevittatus*). This is the third time that the Bare-throated Tiger-Heron is mentioned as the predator species in this study. Although in its description it is common to mention that Bare-throated Tiger-Heron feeds on fish, crabs, amphibians, small mammals and some reptiles, when they refer to snakes they mention it in a general way since it is often not possible to identify the species preyed upon (see observation 3). On this occasion we had the opportunity to observe the predation and identify the snake species, which in this case is a Fife-striped Snake (Fig. 3B). This species of snake is terrestrial and semi-aquatic, inhabits permanent or seasonal bodies of water and bases much of its diet on aquatic species such as freshwater prawns (Pérez-Higareda et al., 2007). The image was captured with a camera trap installed for a crocodile nest study, in an area of the Unidad de Manejo Ambiental (UMA) Nicte-ha in Ciudad del Carmen, state of Campeche, Mexico (Lat. 18.268868°, Long. -91.673978°, WGS84, 0 m a.s.l.), on September 15, 2019 at 18:50 h. Although the photo does not show the Tiger Heron swallowing the snake, it can be seen that it is holding it in its beak.

Observation 10. Gray Hawk (*Buteo plagiatus*) predation on Green Iguana (*Iguana iguana*). Gray Hawks are bold and dashing raptors and their diet consists primarily of lizards, small birds, and occasionally insects and small mammals (Clark & Schmitt, 2017). At 10:31 h on 21 August 2021, Francisco Centeno observed and photographed a Gray Hawk hunting a Green Iguana in Yaxchilán Natural Monument, on the banks of the Usumacinta river (Lat. 16.870087°, Long. -90.981469°, WGS84, 110 m a.s.l.). The hawk was first detected when it perched on a 7 m leafless tree next to the river. The hawk was holding with his left foot a live juvenile Green Iguana that was resisting and trying to break free (Fig. 3C). Then, the hawk took several bites on the neck and sides of the iguana (Fig. 3D).

The observations described show interspecific interactions with feeding purposes of eight bird species (four raptors, one heron, one jay, one duck, and one puffbird) with seven reptile species (two of snake, two of turtle, two of lizard, and one of crocodile) and one amphibian species, providing new information on the trophic relationship between birds and herpetofauna in the Usumacinta river basin.

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