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STATUS OF WHITE-WINGED DOVE NESTING COLONIES IN TAMAULIPAS, MÉXICO

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ABSTRACT.—The core of eastern White-winged Dove (*Zenaida asiatica asiatica*) breeding habitat historically occurred in northern México and southern Texas. Much nesting-habitat loss has occurred in this region since the mid-1900s and several large nesting colonies of the historic complex have disappeared with others currently at risk. Little knowledge exists regarding the precise location of these colonies or their current status. We reviewed the literature, interviewed biologists, and conducted site visits to Tamaulipas, México during May–August 2004 and 2005 to construct a historical account of White-winged Dove colonies. We found references to 77 possible nesting colonies thought to exist over a 50-year period in Tamaulipas. However, 26 references represented alternative names for the same colonies resulting in 51 colonies. We located 31 of these colonies of which 13 were active and 18 were inactive. The remaining 20 were not described in sufficient detail to locate. Brush clearing was listed as a cause for 78% of the 18 inactive colonies followed by weather catastrophes (56%) and overharvest (39%). Collectively, these 3 factors appeared to be responsible for 94% of all colony loss. The historic, large colonies of the past are gone and likely will not return because of these factors, primarily because of brush clearing. *Received 4 April 2008. Accepted 8 September 2008.*

The eastern White-winged Dove (*Zenaida asiatica asiatica*) is a migratory species that historically nested in large, rural colonies during May to August in southern Texas and northeastern México (Cottam and Trefethen 1968). Colonies generally were in continuous nesting habitat varying in size from 5 ha to 1000s of hectares with nest densities ranging from 0 to 10 nests/ha outside of colonies to >500–1,000 nests/ha within colonies (Cottam and Trefethen 1968). The historic breeding range of the eastern White-winged Dove extended from southern Texas to southern Tamaulipas, México with the most productive nesting areas in the Tamaulipan thorn-scrub and semi-deciduous forests (Brown et al. 2007) of the Tamaulipan Biotic Province (Purdy and Tomlinson 1982, George et al. 1994, Schwertner et al. 2002).

Thousands of hectares of native, thorn-scrub vegetation have been lost in northeastern México and southern Texas resulting from land-use changes including agricultural practices, timber harvest, urban development, and dam construction. Much of this habitat loss and fragmentation has occurred within historic White-winged Dove nesting areas. Many nesting colonies of the historic complex that once existed have already disappeared, and others are currently at risk. Little knowledge exists regarding the precise sites of these colonies prior to the 1990s because of their remote locations and lack of global positioning systems (GPS) technology. Lack of knowledge of historic and current colony location is of considerable concern because this region once represented the primary breeding range of White-winged Doves. Understanding why some colonies persisted while others failed may provide insight useful in White-winged Dove conservation. Our objectives were to: (1) review all available literature to provide a historical account of White-winged Dove col-

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onies in northeastern México, and (2) document the physical location of historic and current colonies, their status, and possible causes of their disappearance.

METHODS

Study Area.—Our study concentrated in the northeastern Mexican State of Tamaulipas. The climate in Tamaulipas varies from semiarid to subtropical from north to south. Annual precipitation varies from 600 to 1,050 mm (Comisión Nacional del Agua 2005). Most rainfall is received during the spring and fall but local, heavy thunderstorms during summer also contribute substantial precipitation in some years. Maximum temperatures usually vary between 35 and 40° C during summer (Comisión Nacional del Agua 2005). Minimum temperatures during winter seldom fall below 2° C (Almaguer 2005). The current landscape is composed primarily of agricultural fields planted to grain sorghum (*Sorghum vulgare*) and corn (*Zea mays*). Other crops such as citrus (*Citrus reticulata*), cotton (*Gossypium hirsutum*), and melon (*Cucumis* spp.) also are prevalent. The most common crops in southern Tamaulipas are sugar cane (*Saccharum officinarum*) and agave (*Agave tequilana*). Pasturelands for livestock grazing are common throughout the state. There are remnant patches of native Tamaulipan brushland, mainly in central and southern Tamaulipas, and include the biotic communities of Tamaulipan thorn-scrub and Tamaulipan semideciduous forests (Brown et al. 2007). The native vegetation described by George et al. (1994, 2000) is composed of shrubs and small trees 3–10 m in height such as ebony (*Pithecellobium ebano*), huisache (*Acacia smallii*), mesquite (*Prosopis glandulosa*, *P. reptans*, and *P. juliflora*), brasil (*Condalia hookeri*), coma (*Bumelia celasterina*), barreta (*Helietta parvifolia*), guajillo (*Acacia berlandieri*), granjeno (*Celtis pallida*), anacahuita (*Cordia bossieri*), manzanita (*Malpighia glabra*), and several species of cacti (Cactacea).

Historical Account.—We obtained copies of government (e.g., U.S. Fish and Wildlife Service [USFWS], Texas Parks and Wildlife Department [TPWD], Secretaría de Agricultura y Recursos Hidráulicos [SARH] [Secretary of Agriculture and Hydraulic Resources] and Secretaría del Medio Ambiente y Recursos Naturales [Secretary of Environment and Natural Resources]) visit reports which contained historical information of nesting colonies (e.g., general location, nesting habitat conditions, water and food availability, number of nesting White-winged Doves) to investigate the historic status of White-winged Dove nesting colonies in northeastern México. We also reviewed published studies related to nesting colonies of White-winged Doves in northeastern México.

Identification and Location of Colonies.—We conducted personal interviews with biologists who participated in colony visits in northeastern México during the last 20–30 years, and who had significant knowledge of White-winged Dove nesting areas. Biologists included: D. R. Blankinship (USFWS), G. L. Waggerman (TPWD retired), H. Ortega-Meléndez (Comisión Estatal de Vida Silvestre de Tamaulipas; CEVST), and H. V. Zamora-Treviño (Hábitat y Palomas del Noreste A. C.; HPN). We formed an international team to locate historic and current nesting colonies in Tamaulipas. The team consisted of G. L. Waggerman, H. Ortega-Meléndez, and H. V. Zamora-Treviño, S. Benn (TPWD), P. Castillo (CEVST), C. Chavez (SEMARNAT), F. Hernández (Caesar Kleberg Wildlife Research Institute; CKWRI), and D. G. Hewitt (CKWRI). We conducted site visits to colonies in Tamaulipas, México during May–August 2004 and 2005. Locations of all current and historic colonies were recorded using a hand-held, real-time differential GPS unit (Trimble™ GeoExplorer III, Trimble™ Navigation Limited, Sunnyvale, CA, USA). Delineation of entire colonies was not logistically practical and a series of 3–5 GPS coordinates were obtained within the colony area to georeference the site. Colonies were located using coordinates provided by TPWD, CEVST, and HPN personnel, and by following directions provided by biologists.

Assessment of Population Status of Colonies.—We estimated breeding densities of White-winged Doves at each colony during our visits using a call-count method (Uzzell 1949, Cottam and Trefethen 1968, Waggerman 1973, Sepúlveda et al. 2006). Colonies were categorized based on breeding density (i.e., low = 10–25 breeding pairs/ha; medium = 26–50 breeding pairs/ha; high = >50

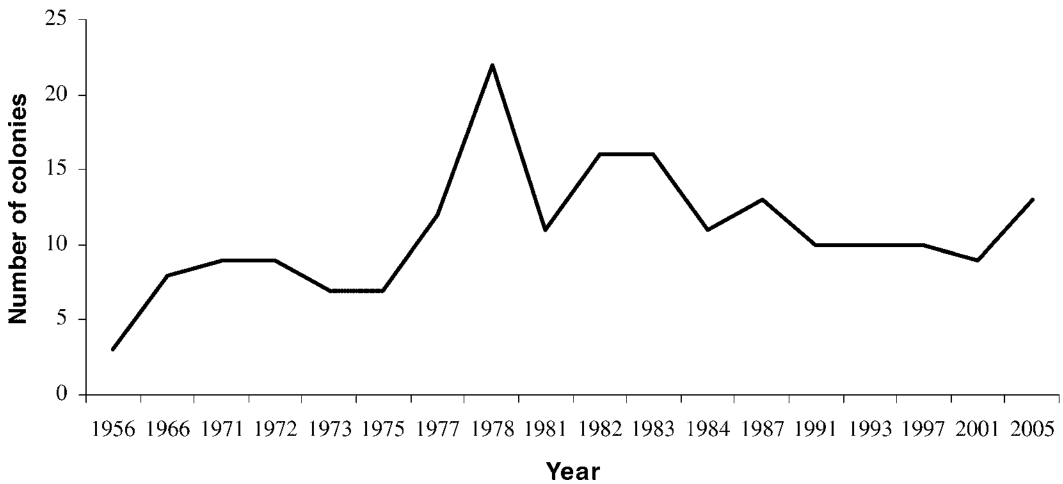

FIG. 1. Number of White-winged Dove nesting colonies in northeastern México, 1956–2005.

breeding pairs/ha). We also spoke with residents of towns in the vicinity of nesting areas regarding the historic and current status of White-winged Dove colonies. We interviewed biologists and residents about possible causes of colony disappearance (e.g., brush clearing for agriculture, dam construction, severe weather, hunting pressure, human disturbance, predation, use of pesticides, etc.).

RESULTS

Historical Account.—Visits to northeastern México were conducted by TPWD and USFWS since the early 1950s to locate White-winged Dove nesting areas with the cooperation of Tamaulipan and Mexican federal government agencies. Number of known White-winged Dove nesting colonies in northeastern México varied annually from 3 to 22 between 1956 and 2005 (Fig. 1). Population estimates fluctuated from a low of ~1 million White-winged Doves during the 1970s to 16 million during the 1980s (Table 1).

TABLE 1. Nesting colonies and postbreeding population size of White-winged Doves in Tamaulipas, México, 1966–1984.

Year	Total colonies	Total doves
1966[1]	8	5,324,200
1967[1]	8	5,731,300
1968[1]	8	6,239,200
1973[2]	6	1,728,896
1978[3]	22	8,955,460
1984[4]	16	16,500,000

[1] Blankinship 1970.
[2] Waggerman 1973.
[3] Ortega et al. 1978.
[4] Average numbers of White-winged Doves reported by Ortega and Zamora 1984.

The first documented colonies (n = 3) were discovered in 1950–1955 by Kiel and Harris (1956). A new project was initiated in 1966 to identify the location, history, and population of nesting colonies in northeastern México (Blankinship 1970). Nine major colonies (including the three reported by Kiel and Harris [1956]) were located and named during this period, all within the area of Tamaulipas between the Sierra Madre Oriental and Gulf of México. A post-reproduction population size of 5–6 million birds was estimated for Tamaulipas during the 1960s (Table 1), which subsequently decreased to an estimated 1.7 million during the early 1970s (Waggerman 1972, 1973).

The landscape on which colonies occurred changed drastically between 1968 and 1976. Thousands of hectares of native brush were either cleared for agriculture or flooded during the development of dams and irrigation systems during the ''Revolución Verde'' (Green Revolution) in México (Tomlinson 1981, Purdy and Tomlinson 1982). Construction of the Vicente Guerrero dam in 1972 transformed central Tamaulipas into a large sorghum and corn producing area. Two nesting colonies in the area were entirely flooded by the dam.

New colonies were subsequently discovered despite the loss of native brush as a result of establishment of new nesting areas by White-winged Doves. The reason for this relocation is unknown but probably occurred in response to the creation of favorable food and water conditions elsewhere (Ortega 1977, Ortega et al. 1978, Tomlinson 1981). The number of known colonies increased to 22 by the late 1970s, and the estimated White-winged Dove population had rebounded to 9 million birds (Ortega et al. 1978) (Table 1).

Construction of two more water reservoirs, Ramiro Caballero and Emilio Portes Gil, in the late 1970s and early 1980s, respectively, helped development of agriculture in southern Tamaulipas (Tomlinson 1981). Clearing of brush habitat, primarily to create improved pasture for cattle production, also occurred during this period (Tomlinson 1981). The population was reported to have increased despite clearing of brush in several important nesting colonies, possibly because of increased food supplies due to agricultural development (Ortega and Zamora 1984; Purdy and Tomlinson 1982, 1991).

The Tamaulipas White-winged Dove population had grown to 15–18 million by 1984 (Ortega and Zamora 1984) (Table 1) with only 11 known nesting colonies. Much of northeastern México experienced severe weather conditions from the mid-1980s through 1990. Hurricane Gilbert passed directly over much of the prime nesting habitat in Tamaulipas in 1988 causing extensive damage to White-winged Dove nesting areas from wind and flooding (Tomlinson 1988). Severe droughts also affected Tamaulipas during this time, and some nesting areas were severely damaged (Tomlinson 1991).

Tamaulipas no longer supported the large White-winged Dove populations of the late 1960s, early 1970s, or 1980s by the late 1990s (Tomlinson 1997). Populations were estimated to have declined by as much as 75% of mid-1980s levels (Tomlinson 1997, 2001). The large colonies of White-winged Doves present during the 1960s to mid-1980s were no longer in existence (Tomlinson 2001). However, northern and central Tamaulipas still had large fields of sorghum which attracted large numbers of White-winged Doves from the remaining colonies (Tomlinson 2001). Two new nesting colonies were located in central and northern Tamaulipas in the early 2000s.

There are no recent studies that estimate the size of the White-winged Dove population in northeastern México. However, nest monitoring has been conducted since 1982 in the largest White-winged Dove nesting colony, Parras de la Fuente, with a size of ~3,100 ha and a dove population estimated at 5 million (CEVST 2007). Small, intermittent nesting colonies have been surveyed by Mexican non-government organizations in past years, and recent surveys of White-winged Dove populations in urban areas of Tamaulipas also have been conducted.

Identification and Location of Colonies.— We generated a list of 77 nesting colonies thought to exist between 1950 and 2005 in Tamaulipas from the reports, literature, and people interviewed (Sánchez Johnson 2007). However, 26 colonies in this list represented alternative or duplicate names for some colonies resulting in 51 colonies actually identified. We were only able to locate 31 during our visits (Table 2); the remaining 20 colonies were not described in sufficient detail to locate. However, we were able to obtain a description of the general location for most of the colonies from the literature (Table 3).

Assessment of Nesting Colonies Status.— Thirteen of the 31 colonies located were active, and 18 were inactive (Table 2). Six of the active colonies had high White-winged Dove densities (>50 pairs/ha), four had moderate densities (>26–50 pairs/ha), and three had low (≤26 pairs/ha; Table 2). The cause of colony disappearance involved primarily brush clearing, weather catastrophes (i.e., drought and hurricanes), and hunting pressure. Loss of colonies often could not be attributed to a single cause but rather to multiple causes. Two of five colonies listed with sole causes for disappearance were attributed to brush clearing, one to weather catastrophes, and two to harvest pressure.

Brush clearing was listed as a cause for 78% (n = 14) of the 18 inactive colonies, weather catastrophes for 56% (n = 10) and overharvest for 39% (n = 7) when allowing for multiple causes. Collectively, these three factors were responsible for 94% (n = 17) of all colony loss. Other causes mentioned for colony disappearance included diminishing

TABLE 2. Population estimates (pairs/ha) and coordinates of historic and current White-winged Dove nesting colonies during this study (n = 31), Tamaulipas, México, May–August, 2004–2005.

ID #	Colony name	Latitude	Longitude	White-winged Dove density (pairs/ha)
1	Loma Colorada	27° 47′	98° 11′	Inactive
3	Rancho Agua Marina	22° 78′	98° 71′	Inactive
7	San José de las Rusias	23° 55′	98° 04′	Inactive
8	La Encarnación	23° 37′	98° 03′	Inactive
9	Los Santos	22° 82′	98° 81′	Inactive
10	Escandón	22° 72′	98° 67′	Inactive
11	La Chijolosa	22° 80′	98° 58′	Inactive
13	El Tejón	25° 07′	98° 04′	Inactive
14	Panales	24° 32′	98° 19′	Inactive
15	Parras de la Fuente	23° 85′	98° 46′	>100
18	San Rafael	25° 08′	98° 23′	Inactive
19	Nuevo Padilla	24° 06′	98° 88′	50
22	Villa Blanca	22° 78′	98° 49′	Inactive
23	Los Camoteros	22° 56′	98° 66′	Inactive
24	Abasolito	24° 04′	98° 32′	40
31	El Carmen	22° 91′	99° 02′	60
32	Tanque Viejo	23° 66′	98° 15′	Inactive
33	El Comanche	24° 63′	98° 82′	15
34	Las Animas	22° 63′	98° 68′	Inactive
35	El Rosillo	22° 90′	98° 56′	Inactive
36	La Lupita	24° 06′	98° 88′	40
37	Santa María y San Manuel	24° 04′	98° 86′	50
39	San Lorenzo	22° 96′	98° 82′	85
41	Cañones de Burgos	24° 78′	98° 81′	15
42	Flechadores	24° 52′	98° 68′	15
43	Guanajuato	23° 16′	98° 79′	60
44	Las Colinas	23° 68′	98° 68′	Inactive
47	Las Tunas	23° 79′	98° 11′	Inactive
49	La Monitora	24° 91′	98° 04′	Inactive
50	El Zarape	24° 77′	98° 00′	100
51	Yara	24° 03′	98° 80′	75

food supplies, brush flooded by dams, application of pesticides, and nestling predation, but these causes were infrequently referenced.

We were able to obtain possible reasons for disappearance for 14 of 20 colonies not located in this study. Cause of disappearance for the remaining six colonies was unknown. These six colonies were assumed inactive because they were not mentioned as active colonies in recent reports. Seven of eight unlocated colonies listed with sole causes for disappearance were attributed to brush clearing and one to harvest pressure. Brush clearing was listed as a cause for 86% (n = 12) of the 14 inactive colonies, weather catastrophes for 43% (n = 6), and overharvest for 7% (n = 1) when allowing for multiple causes. Collectively, these three factors were responsible for 100% (n =14) of colonies lost.

DISCUSSION

Disappearance of White-winged Dove nesting colonies in northeastern México probably resulted from three major causes—loss of nesting habitat by brush removal, weather catastrophes (i.e., drought and hurricanes), and hunting pressure—with brush removal being the predominant cause. The negative effects of habitat fragmentation on species viability are well documented (Turner 1996, Vergara and Simonetti 2004). Fragmentation of nesting habitat is known to affect predation rates and nesting behavior. Nest depredation has been documented to vary as a function of patch size with smaller patches experiencing higher predation rates (Loiselle and Hoppes 1983, Sieving 1992). Habitat loss and fragmentation can have major effects (Bélisle

TABLE 3. Description of the general location of historic nesting colonies (n = 20) not described in sufficient detail to permit relocation.

ID #	Colony name	General location	Source
2	Padilla	W of Padilla town in central Tamaulipas, approximate location: 24° 01′ N, 98° 76′ W	Kiel and Harris 1956
4	Camargo	Close to Camargo town in NW Tamaulipas	SARH 1968
5	San Fernando Lake	32 km east of San Fernando town in N Tamaulipas, approximate location: 24° 82′ N, 97° 88′ W	Blankinship 1970
6	Río Purificación	6 km NE of Padilla town in central Tamaulipas, approximate location: 24° 01′ N, 98° 83′ W	SARH 1968
12	San Fernando River	24 km ESE from San Fernando town in N Tamaulipas, approximate location: 24° 79′ N, 97° 96′ W	Waggerman 1972
16	Los Amigos	Close to San Fernando town in N Tamaulipas	Ortega 1977
17	Los Caballos	NW of San Fernando town	Ortega 1977
20	Nuevo Padilla B	W of Padilla town in central Tamaulipas	Ortega et al. 1978
21	Santa Engracia	Close to Santa Engracia town in W central Tamaulipas	G. L. Waggerman, pers. comm.
25	Nicolás Bravo	N of Abasolo town in central Tamaulipas	Ortega et al. 1978
26	Vicente Guerrero	Close to Lake Vicente Guerrero in central Tamaulipas	Ortega et al. 1978
27	Los Vergeles A	E of Abasolo town in central Tamaulipas	Ortega et al. 1978
28	Los Vergeles B	E of Abasolo town in central Tamaulipas	Ortega et al. 1978
29	Gutiérrez de Lara	E of Abasolo town in central Tamaulipas	Ortega et al. 1978
30	El Balconcito	SE of Abasolo in central Tamaulipas	Ortega et al. 1978
38	Aragón	E of Ciudad Mante in S Tamaulipas	Tomlinson 1983
40	Laguna Madre	NE of San Fernando town in N Tamaulipas (24° 34.7′ N, 97° 50.3′ W)	Tomlinson 1987
45	La Esperanza	SE San Fernando town in N Tamaulipas	Ojeda and Cisneros 1991, Tomlinson 1991
46	Guadalupe Victoria	NE San Fernando town in N Tamaulipas	Ojeda and Cisneros 1991, Tomlinson 1991
48	Rayo del Sol	Location not described	Brito and Cervantes 1993

2001) on species exhibiting high breeding-site fidelity such as White-winged Doves (Cottam and Trefethen 1968). Schwertner et al. (2002) noted that scattered patches of native vegetation in a fragmented landscape increased energetic costs and predation risk of White-winged Doves. White-winged Doves are thought to use the same exact nesting site used in the previous breeding season, rebuilding the actual nest if necessary (Cottam and Trefethen 1968). Destruction of preferred nesting areas would result in displacement from traditional use areas.

The species has been able of persist and, in some instances, thrive in spite of habitat loss and fragmentation. One possible reason for its persistence may be its adaptability. Unlike some bird species which are area sensitive (Blake and Karr 1987, Soulé et al. 1988, Cornelius et al. 2000, Donovan and Lamberson 2001), White-winged Doves are capable of nesting in a wide variety of patch sizes as well as a variety of plant species (Swanson and Rappole 1992, Hayslette et al. 2000). This nesting-habitat plasticity has been observed in other migrant birds that have become well adapted to fragmented forests in the Neotropics (Robbins et al. 1987, 1992). Persisting White-winged Dove populations in Tamaulipas may be attributed to their recent expansion into urban areas (Mathewson 2002), an expansion possibly attributed to loss of rural nesting habitat. This contrasts to other species of neotropical migrants which have experienced population declines in response to urbanization (Jokimäki and Suhonen 1998, Friesen et al. 1995, Boren et al. 1999, Allen and O'Connor 2000, Kluza et al. 2000).

Although White-winged Doves have been able to persist in the altered landscape of northeastern México, habitat loss and fragmentation has had adverse impacts on White-winged Dove colonies. Population size has diminished greatly from the mid-1980s to the present. Whereas millions of birds historically existed in several large colonies during the 1980s, currently only one large colony exists (Parras de la Fuente). Destruction of nesting habitat has been the primary cause for this decline and continues to threaten existing White-winged Dove populations. The historic, large colonies of the past are gone and likely will not return because of habitat loss.

Weather catastrophes and excessive hunting also may have contributed to historical White-winged Dove population declines (Marsh and Saunders 1942, Kiel and Harris 1956, Purdy and Tomlinson 1991). Our interviews with biologists and local residents suggested that excessive harvest was possibly linked with the disappearance of 25% of the historic colonies. Whether overharvesting was the direct cause of disappearance or simply exacerbated the effects of habitat loss is not clear.

It is plausible the negative effects of weather catastrophes on White-winged Dove colonies were not limited to habitat but also negatively impacted population demography. For example, severe drought can affect avian foraging, home-range size, and habitat use. Foraging distance tends to increase when food resources become scarce (Liu et al. 2003, Yackel-Adams et al. 2006). Proximity to and availability of food and water are considered primary determinants of nesting-habitat suitability for White-winged Doves (Cottam and Trefethen 1968, Blankinship 1970). Thus, although the effects of drought have not been directly documented for White-winged Doves, it is conceivable that lower productivity occurred during drought and negatively impacted historic colonies. Hurricanes also negatively affected habitat of White-winged Dove nesting colonies (Waggerman 1973, Tomlinson 1988); however, habitat transformations resulting from increased precipitation on a semiarid region (e.g., increasing foliar cover, food resources, and water availability) could have possibly benefited White-winged Doves.

We encountered numerous obstacles in reconstructing the historical account for the Tamaulipan colonies despite the meritorious work of early biologists. Numerous colonies had duplicate or alternative names and descriptions of some colony locations were not sufficient to permit relocation. Differences in monitoring methodologies complicated data compilation and interpretation. We recommend that current monitoring studies and data collection protocols be refined to prevent further confusion. Continued cooperation between the Mexican and USA governments is fundamental to protect the remaining White-winged Dove nesting areas in Tamaulipas given the loss of historic nesting colonies and continued clearing of nesting habitat.

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