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BULLETIN OF THE

TEXAS ORNITHOLOGICAL SOCIETY

Vol. 38, No. 2 July 2005 Pages 21–48

TEXAS BIRD RECORDS COMMITTEE REPORT FOR 2004

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The Texas Bird Records Committee (hereafter "TBRC" or "committee") of the Texas Ornithological Society requests and reviews documentation on any record of a TBRC Review List species (see TBRC web page at http://texasbirds.org/tbrc/ or Lockwood 2003). Annual reports of the committee's activities have appeared in the Bulletin of the Texas Ornithological Society since 1984. For more information about the Texas Ornithological Society or the TBRC, please visit www.texasbirds.org. The committee reached a final decision on 129 records during 2004: 100 records of 51 species were accepted and 29 records of 23 species were not accepted, an acceptance rate of 77.5% for this report. There were 148 observers who submitted documentation (to the TBRC or to other entities) that was reviewed by the committee during 2004.

In 2004 the TBRC accepted first state records of South Polar Skua, Glaucous-winged Gull, and Black-headed Nightingale-Thrush. In addition, the A.O.U. Committee on Classification and Nomenclature elevated Cackling

This Blue Mockingbird (TBRC 2004–46) in Pharr, Hidalgo County, sporadically since September 2003. The extended stay of this bird (as well as the other Blue Mockingbird found in Texas) has led some observers to question its origin. Photo by Rob Tizard.

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Goose to species status (Banks et al. 2004) bringing the official Texas State List to 627 species in good standing. This total does not include the five species listed on the Presumptive Species List.

In addition to the review of previously undocumented species, any committee member may request that a record of any species be reviewed. The committee requests written descriptions as well as photographs, video, and audio recordings if available. Information concerning a Review List species may be submitted to the committee secretary, Mark Lockwood, 402 E. Harriet Ave., Alpine, Texas 79830 (email: mark.lockwood@tpwd.state.tx.us). Guidelines for preparing rare bird documentation can be found in Dittmann and Lasley (1992) or at http://www.greglasley.net/document.html.

The records in this report are arranged taxonomically following the AOU Check-list of North American Birds (AOU 1998) through the 45th supplement (Banks et al. 2004). A number in parentheses after the species name represents the total number of accepted records in Texas for that species at the end of 2004. All observers who submitted written documentation or photographs of accepted records are acknowledged by initials. If known, the initials of those who discovered a particular bird are in boldface but only if the discoverers submitted supporting documentation. The TBRC file number of each accepted record will follow the observers' initials. If photographs or video recordings are on file with the TBRC, the Texas Photo Record File (TPRF) (Texas A&M University) number is also given. If an audio recording of the bird is on file with the TBRC, the Texas Bird Sounds Library (TBSL) (Sam Houston State University) number is also given. Specimen records are denoted with an asterisk (*) followed by the institution where the specimen is housed and the catalog number. The information in each account is usually based on the information provided in the original submitted documentation; however, in some cases this information has been supplemented with a full range of dates the bird was present if that information was made available to the TBRC later. All locations in italics are counties.

TBRC Membership — Members of the TBRC during 2004 who participated in decisions listed in this report were: John Arvin (Chair), Keith Arnold (Academician), Mark Lockwood (Secretary), Kelly Bryan, Eric Carpenter, Mel Cooksey, Petra Hockey, Brad McKinney, Jim Paton, Randy Pinkston, and Willie Sekula. During 2004, Arvin and Hockey retired from the committee, Pinkston was elected as Chairman, and Sekula and Carpenter were elected as regular members. The Academician and Secretary were re-elected.

Contributors — **A&SW -** Ann & Stephen Williams, **AF -** Anthony Floyd, **AG -** Andy Garcia, **B&JR -** Barbara & John Ribble, **BA -** Ben Archer, **BBa -** Bill Baker, **BBe -** Brandon Best, **BC -** Bill Clark, **BFr -** Brush Freeman, **BG -** Brian Gibbons, **BH -** Berlin Heck, **BLa -** Bubba La Mont, **BLe -** Bob Lewis, **BMa -** Bill Matthews, **BMc -** Brad McKinney, **BO -** Brent Ortego, **BP -** Barrett Pierce, **BR -** Barbara Ribble, **BRa -** Barbara Rapstein, **BS -** Brian Sullivan, **BT -** Barbara Tompkins, **BZ -** Barry Zimmer, **CBe -** Chris Benesh, **CBr -** Charles Brower, **CE -** Carol Edwards, **CFe -** Carol Ferguson, **CFo -** Cat Foster, **CH -** Charles Howell, **CL -** Charles Lyon, **CM -** Charles Mills, **CO -** Carolyn Ohl, **CSa -** Carlos Sanchez, **C-TL -** Cin-Ty Lee, **DaH -** David Holmes, **DC -** Dede Crusinberry, **DF -** Dane Ferrell, **DHo -** Doug Holder, **DLa -** Derald Lary, **DLe -** Daniel Leavitt, **DM -** Dorothy Metzler, **DO -** Dale Ohl, **DP -** Dwight Peake, **DQ -** David Quady, **DR -** Daniel Russell, **DT -** Daniel Tunstall, **DWa -** Dennis Walden, **DWo -** David Wolf, **EC -** Eric Carpenter, **EH -** Erik Huebner, **EK -** Ed Kutac, **ES -** Elton Stillwell, **F&JD -** Fred & Judy Donaldson, **FB -** Frank Bumgardner, **FC -** Fernando Cerra, **FJ -** Frank Johnson, **GeS -** Georgina Swartz, **GG -** Georgette Guernsey, **GSw -** Glenn Swartz, **GW -** Greer Willis, **HT -** Heidi Trudell, **JA -** John Arvin, **JaS -** James Stewart, **JB -** Jeff Bouton, **JF -** Jesse Fagan, **JG -** John Gee, **JH -** John Hoogerheide, **JiP -** Jimmy Paz, **JJ -** John Jasek, **JKe -** Jerri Kerr, **JKi -** John Kiseda, **JO -** John Odgers, **JPa -** Jim Paton, **J-SG -** Jean-Sebastien Guenette , **JSt -** Jim Stevenson, **J-ST -** Jo-Szu Tsai, **JWS -** J. W. Sifford, **JZ -** Jimmy Zabriskie, **KAC -** Kathy Adams Clark, **KB -** Kelly Bryan, **KS -** Ken Seyffert, **LBa -** Lynn Barber, **LBr -** Lucie Bruce, **LD -** Larry Ditto, **LJ -** Lawrence Jordan, **M&ME -** Marc & Maryann Eastman, **MAd -** Mark Adams, **MAn -** Michael Anderson, **MAu -** Mike Austin, **MB -** Melissa Bowles, **MC -** Mel Cooksey, **MD -** Mike Dillon, **MF -** Mark Flippo, **MHa -** Martin Hagne, **MHW -** Mimi Hoppe Wolf, **MI -** Marshall Iliff, **MiR -** Michael Retter, **MK -** Mark Korducki, **ML -** Mark Lockwood, **MO -** Mike Overton, **MRe -** Martin Reid, **MS -** Marsha Seyffert, **NBa -** Noreen Baker, **NBl -** Nick Block, **OC -** Oscar Carmona, **PeH -** Pete Hosner, **PHo -** Petra Hockey, **PS -** Peder Svingen, **PW -** Philip Wheeler, **RBa -** Rob Bates, **RBr -** Rik Brittain, **RDa -** Rich Damron, **RHi -** Ron Hillstromb, **RHo -** Ruth Hoyt, **RiW -** Richard Webster, **RK -** Rich Kostecke, **RMa -** Ron Martin, **RMS -** RoseMarie Stortz, **RPi -** Randy Pinkston, **RR -** Ross Rasmussen, **RT -** Rob Tizard, **RW -** Randall Whitman, **SA -** Scott Atkinson, **SB -** Susan Beree, **SCo -** Scarlet Colley, **SCr -** Scott Craig, **SG -** Steve Gast, **ShC -** Sherry Collins, **SIs -** Stan Isley, **SMa -** Steve Matherly, **SMo -** Shirley

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Acknowledgments — The TBRC is very grateful to the many contributors listed above, without whom this report would not be possible. The committee would also like to thank Ned Brinkley, Bill Clark, Chris Gibbins, Steve Howell, Mike Overton, Martin Reid, Bob Sargent, and Brian Wheeler for providing the TBRC with expert opinion concerning records reviewed during 2004. The author thanks Eric Carpenter, Petra Hockey and Martin Reid for reviewing previous drafts of this report.

Additional Abbreviations — AOU = American Ornithologists' Union; CU = Cornell University; NP = National Park; NWR = National Wildlife Refuge; SNA = State Natural Area; SP = State Park; TCWC = Texas Cooperative Wildlife Collection (Texas A&M University); WMA = Wildlife Management Area.

ACCEPTED RECORDS

Trumpeter Swan (*Cygnus buccinator*) (6). Two at Lake Marvin, *Hemphill*, from 8 December 2001–16 February 2002 (**BP**, KS; 2001–141; TPRF 2197). An imm. at Lubbock, *Lubbock*, on 15 November 2003 (**AF**; 2003–89).

Eurasian Wigeon (*Anas penelope*) (37). A male at Lake Rita Blanca, *Hartley*, on 23 April 2004 (**RMa**; 2004–66). A male at Lubbock, *Lubbock*, from 24 October-1 November 2004 (**BBe**, AF; 2004–85; TPRF 2226).

Red-necked Grebe (*Podiceps grisegena*) (19). One at Kurth Lake, *Angelina*, from 1 January-4 March 2004 (**GG**, DWo, MHW, DHo, JF; 2004–6; TPRF 2181). One at Lake Wright Patman, *Bowie*, on 24 January 2004 (**MD**; 2004–9).

Greater Shearwater (*Puffinus gravis*) (12). One off South Padre Island, *Cameron*, on 1 October 2004 (**BMc**, **PHo**, **EC**; 2004–80; TPRF 2223).

Manx Shearwater (*Puffinus puffinus*) (7). One at the South Padre Island jetty, *Cameron*, 13 September 2002 (**PHo**, **TF**, **MAu**, **MO**; 2002–101).

Leach's Storm-Petrel (*Oceanodroma leucorhoa*) (23). Up to two off South Padre Island, *Cameron*, on 20 June 2003 (**PHo**, **EC**, **MAu**; 2003–55).

Red-billed Tropicbird (*Phaethon aethereus*) (7). One off South Padre Island, *Cameron*, on 24 September 2004 (**EC**, **BMc**, **PHo**, **T&PF**, **MAu**, **LBa**; 2004–77; TPRF 2221).

Brown Booby (*Sula leucogaster*) (20). An adult 35 miles e. of Port Aransas, *Nueces*, on 27 July 2004 (**JH**; 2004–64).

Great Blue (White) Heron (*Ardea herodias occidentalis*) (4). One sub-adult at Texas City, *Galveston*, from 23 May-21 June 2004 (MAu, RDa, DP, LBa; 2004–49; TPRF 2212). One at the mouth of Carancahua Bay, *Calhoun*, 19–22 September 2004 (**BFr**; 2004–79).

Greater Flamingo (*Phoenicopterus ruber*) (6). A sub-adult at the Texas City Dike, *Galveston*, from 20–31 May 2004 (MAu, BRa, DP, LBa, NBa, MS, CSa, KAC, DT, FJ, JJ, RHi, F&JD, TC; 2004–47; TPRF 2211). A sub-adult at Bahia Grande (4.5 mi. SW of Port Isabel), *Cameron*, from 24 June-29 July 2004 (BMc, LBa, SCr, ML, EC, RPi; 2004–55; TPRF 2216).

Northern Goshawk (*Accipiter gentilis*) (19). An imm. on a private ranch on n. *Presidio* on 8 May 2003 (**KB**; 2003–62; TPRF 2167). An imm. at Fort Worth, *Tarrant*, on 12 November 2003 (**MRe**, **BMa**; 2003–23).

Short-tailed Hawk (*Buteo brachyurus*) (23). One dark-morph adult at Bentsen-Rio Grande Valley SP, *Hidalgo*, 5 April-3 May 2003 (**MI**, OC; 2003–31). One light-morph adult at Sabal Palm Sanctuary, *Cameron*, from 31 March-27 May 2004 (**CBe**, **RW**, JB, ShC, DC, BC; 2004–29; TPRF 2205). One dark-morph bird at Bentsen-Rio Grande Valley SP, *Hidalgo*, from 6–9 April 2004 (**JA**; 2004–57; TPRF 2217). One light-morph adult at Bentsen-Rio Grande Valley SP, *Hidalgo*, on 19 June 2004 (**BS**; 2004–72). One light-morph adult at Santa Ana NWR, *Hidalgo*, from 20 June-4 July 2004 (**BS**; 2004–73; TPRF 2219). One light-morph adult at Bentsen-Rio Grande Valley SP, *Hidalgo*, on 12 August 2004 (**JA**; 2004–76).

Surfbird (*Aphriza virgata*) (8). One west of McFaddin NWR, *Jefferson*, on 6 & 11 April 2003 (**EC**, MO; 2003–29).

Purple Sandpiper (*Calidris maritima*) (16). One at Port Bolivar, *Galveston*, from 29 April-4 May 2003 (TK; 2003–37; TPRF 2162).

This Thick-billed Kingbird (TBRC 2003–97) at Selkirk Island, Matagorda County, from 15 December 2003–24 March 2004, provided the eastern most record for this species in the United States. This same bird was present the previous winter at the same location. Photo by Brush Freeman.

Ruff (*Philomachus pugnax*) (27). One at Anahuac NWR, *Chambers*, on 17 April 2002 (**SS**; 2002–85; TPRF 2200). One at Anahuac NWR, *Chambers*, on 19 April 2003 (**C-TL**; 2003–34). One near Port Lavaca, *Calhoun*, from 8–9 August 2003 (**BFr**; 2003–66).

South Polar Skua (*Stercorarius maccormicki*) (1). One off South Padre Island, *Cameron*, on 1 October 2004 (**BMc**; **AG**; 2004–81; TPRF 2224). This is the first documented record for the state as well as the Gulf of Mexico.

Long-tailed Jaeger (*Stercorarius longicaudus*) (17). One off South Padre Island, *Cameron*, on 24 September-1 October 2004 (**BMc**, **EC**, **PHo**, **T&PF**, **MAu**, **LBa**; 2004–78; TPRF 2222).

Black-headed Gull (*Larus ridibundus*) (23). One adult at Cooper Lake, *Delta*, from 15–21 November 2003 (EC; 2004–8; TPRF 2182). One adult at Lake Wright Patman, *Bowie*/*Cass*, from 14–17 March 2004 (**MD**, **CM**; 2004–24; TPRF 2190).

Black-tailed Gull (*Larus crassirostris*) (2). One second-year bird at Corpus Christi, *Nueces*, on 6 March 2004 (**WS**, **B&JR**; 2004–23; TPRF 2189).

Mew Gull (*Larus canus*) (28). A first-winter bird at McNary Reservoir, *Hudspeth*, on 26 November 2003 (**EC**; 2003–90). One adult at Lake Worth, *Tarrant*, from 3–5 January 2004 (**MRe**; 2004–22; TPRF 2188). One adult at El Paso, *El Paso*, on 7 January 2004 (**JPa**; 2004–7).

(Vega) Herring Gull (*Larus argentatus vegae*) (1). One adult at Corpus Christi, *Nueces*, from 26 February-1 April 2000 (**WS**, MRe, B&JR, PS; 2001–15; TPRF 2196). This is the first documented record for this subspecies for the state and possibly the first for the lower forty-eight states. This subspecies is sometimes considered as a separate species (Olsen and Larsson 2004).

Thayer's Gull (*Larus thayeri*) (62). A first-winter bird at Lake Belton, *Bell*, from 28 October-11 November 2003 (**RPi**, EC; 2003–84; TPRF 2169). One third-winter bird at Pointe San Luis, *Galveston*, from 8–15 November 2003 (**MAu**, SMa; 2003–85; TPRF 2170). A first-winter bird at Bolivar Flats and East Beach, *Galveston*, from 13 November-12 December 2003 (**MAu**, NBl, RDa; 2003–88; TPRF 2171). A first-winter bird at El Paso, *El Paso*, on 29 November 2003 (**JPa**; 2003–91; TPRF 2172). A first-winter bird at Balmorhea Lake, *Reeves*, from 12 December 2003–9 January 2004 (**MAu**, ML, EC; 2003–96; TPRF 2175). An adult at Corpus Christi, *Nueces*, on 28 February 2004 (**WS**; 2004–16; TPRF 2185). A second-winter bird at Corpus Christi, *Nueces*, from 4–24 March 2004 (**MRe**, WS, PHo, B&JR; 2004–18; TPRF 2203). A fourth-winter bird at Corpus Christi, *Nueces*, from 4 March-9 April 2004 (**PHo**, WS, MRe; 2004–19; TPRF 2204). Thayer's Gull was removed from the Review List at the TBRC annual meeting on 26 June 2004. All records submitted before that date will be reviewed.

Iceland Gull (*Larus glaucoides*) (2). One first-winter bird at Dallas, *Dallas*, on 4 February 2001 (**BG**, **RR**; 2001–47).

Slaty-backed Gull (*Larus schistisagus*) (3). An adult at Balmorhea Lake, *Reeves*, 1–10 December 2003 (RMS, CO, DO, JG, CE, EC, ML; 2003–93; TPRF 2174). An adult at Corpus Christi, *Nueces*, from 21–24 December 2003 (**MC**, **WRu**; 2004–27; TPRF 2191).

This adult Slaty-backed Gull (TBRC 2003–93) at Balmorhea Lake, Reeves Co., from 1–10 December 2003, provided the second record for the state. The first record for the state was at the Brownsville Landfill in 1992. Photo by Mark W. Lockwood.

Glaucous-winged Gull (*Larus glaucescens*) (1). One adult at Fort Worth, *Tarrant*, from 6–8 January 2004 (**MRe**, LBa, B&JR; 2004–5; TPRF 2180). This is the first record for Texas.

Great Black-backed Gull (*Larus marinus*) (36). A first-winter bird at Galveston, *Galveston*, on 31 January 2004 (**MAu**; 2004–10).

Green Violet-ear (*Colibri thalassinus*) (42). One at Comfort, *Kendall*, from 1–11 May 2003 (**PW**, SWi; 2003–39; TPRF 2199).

White-eared Hummingbird (*Hylocharis leucotis*) (16). One on the Davis Mountains Preserve, *Jeff Davis*, on 19 June 2003 (**BFr**; 2003–54). A female at the Davis Mountains Resort, *Jeff Davis*, from 21–30 July 2004 (**M&ME**, RPi; 2004–61; TPRF 2218).

Costa's Hummingbird (*Calypte costae*) (14). A female/immature at El Paso, *El Paso*, on 24 October 2003 (**BZ**; 2003–100; TPRF 2177). An adult male at Panther Junction, Big Bend NP, *Brewster*, from 2–23 February 2004 (**MF**; 2004–11).

Allen's Hummingbird (*Selasphorus sasin*) (40). An adult male[1] at El Paso, *El Paso*, from 22–25 July 2002 (**BZ**, 2003–2; TPRF 2201). An adult male[1] in the Davis Mountains Resort, *Jeff Davis*, from 2 August-6 November 2003 (ML; 2003–76; TPRF 2168). One male (banded) at Houston, *Harris*, from October 2003–15 February 2004 (**A&SW**, SP; 2004–17; TPRF 2186). One immature male (banded) near Victoria, *Victoria*, from 7 December 2003–28 February 2004 (**BO**; 2003–92; TPRF 2173). A male[1] at Rockport, *Aransas*, from 31 December 2003–27 February 2004 (**SB**; 2004–12; TPRF 2183). One adult male (banded) at Corpus Christi, *Nueces*, on 10 January 2004 (**GSw**; 2004–4;*TCWC 14158). An adult male (banded) at West Columbia, *Brazoria*, on 30 January 2004 (**CBr**; 2004–13; TPRF 2184; *TCWC 14159). An adult male (captured) at Lake Jackson, *Brazoria*, on 14 February 2004 (**CBr**; 2004–30). [1]Identification based on photographs, diagnostic tail measurements not available. Allen's Hummingbird was removed from the Review List at the TBRC annual meeting on 26 June 2004. All records submitted before that date will be reviewed.

Greater Pewee (*Contopus pertinax*) (15). One at San Antonio, *Bexar*, from 27 December 2003–24 January 2004 (WS, RPi, EH, NBa, GeS; 2003–102; TPRF 2179). One on the Davis Mountains Preserve, *Jeff Davis*, on 21 May 2004 (**TG**; 2004–48)

Buff-breasted Flycatcher (*Empidonax fulvifrons*) (6). Up to six (three adults and three fledglings) at the Davis Mountains Preserve, *Jeff Davis*, from 8 April-5 July 2004 (**ML**, KB; 2004–37; TPRF 2207; TBSL 240).

Dusky-capped Flycatcher (*Myiarchus tuberculifer*) (25). An old record was accepted after the "discovery" of a museum specimen collected at Brownsville, *Cameron*, on 3 April 1893 (*CU 8040; TPRF 2198). One (or possibly two) at Boot Spring, Big Bend NP, *Brewster*, from 4 May-17 July 2004 (**EC**, LBa, ML; 2004–39; TPRF 2209; TBSL 240). Up to five adults at the Davis Mountains Preserve, *Jeff Davis*, from 15 June-5 July 2004 (**KB**, ML; 2004–54; TPRF 2215; TBSL 240).

Thick-billed Kingbird (*Tyrannus crassirostris*) (17). One at Selkirk Island, *Matagorda*, on 16 December 2002 (**SG**, **JaS**; 2004–2). One at the Davis Mountains Preserve, *Jeff Davis*, on 17 May 2003 (**ML**, **RDa**, **GW**; 2003–42; TPRF 2164). One at Selkirk Island, *Matagorda*, from 15 December 2003–24 March 2004 (**SG**, **JaS**, MAu, BFr, PHo, EC; 2003–97; TPRF 2176).

Fork-tailed Flycatcher (*Tyrannus savana*) (14). One adult at El Paso, *El Paso*, from 14–15 October 2004 (JPa, JZ; 2004–84; TPRF 2225).

Rose-throated Becard (*Pachyramphus aglaiae*) (31). A female at Santa Margarita Ranch, *Starr*, on 6 June 2004 (**JA**; 2004–56).

Yellow-green Vireo (*Vireo flavoviridis*) (42). One at Corpus Christi, *Nueces*, on 25 May 2002 (**RBr**; 2002–63). One at South Padre Island, *Cameron*, from 21–31 May 2003 (**JA**, BMc; 2003–43; TPRF 2165). One at San Benito, *Cameron*, from 30 April-3 May 2004 (**BFr**; 2004–40). Up to three at Sabal Palm Sanctuary, *Cameron*, from 7 June-17 August 2004 (**JA**, ML, JiP; 2004–53; TPRF 2214). Yellow-green Vireo was removed from the Review List at the TBRC annual meeting on 26 June 2004. All records submitted before that date will be reviewed.

Black-whiskered Vireo (*Vireo altiloquus*) (21). One (or more) on w. Galveston Island, *Galveston*, 23 April, 14 and 19 May 2003 (**JSt**; 2003–46; TPRF 2166). One at Sabine Woods, *Jefferson*, from 28 April-4 May 2004 (**WRi**; 2004–58).

Tamaulipas Crow (*Corvus imparatus*). Two at Brownsville, *Cameron*, on 15 March 2003 (**LBr**, **JKe**; 2003–18; TPRF 2161). Four (two adult and two juveniles) at Brownsville, *Cameron*, from 2 May-26 July 2004 (**JB**, BP, LBa, BMc, J-SG; 2004–35; TPRF 2206).

Black-headed Nightingale-Thrush (*Catharus mexicanus*) (1). One at Pharr, *Hidalgo*, from 28 May-29 October 2004 (**RBa**, RT, JO, MAu, BP, PHo, LBa, FB, BMc, ML, EC, RPi, RHo, LD, DLa, FC, JB; 2004–50; TPRF 2213). This is the first record for Texas and the United States.

Aztec Thrush (*Ridgwayia pinicola*) (5). One at Boot Canyon, Big Bend NP, *Brewster*, on 18 April 2003 (**MO**; 2003–33).

Blue Mockingbird (*Melanotis caerulescens*) (3). One at Pharr, *Hidalgo*, sporadically from mid-September 2003–19 October 2004 (CFe, RT, BP; 2004–46; TPRF 2210). This is a returning, or possibly continuously present, bird accepted under TBRC 2002–110.

Yellow (Mangrove) Warbler (*Dendroica petechia oraria*) (4). One (not an adult male) near Port Isabel, *Cameron*, from 1 December 2003–1 March 2004 (**SCo**; 2003–101; TPRF 2178). One near adult male at Boca Chica, *Cameron*, from 17 April-5 June 2004 (**JA**, StW; 2004–38; TPRF 2208).

Gray-crowned Yellowthroat (*Geothlypis poliocephala*) (41). A male at the Sabal Palm Sanctuary, *Cameron*, from 8 February-12 August 2004 (BMc, LBa, JB, MAn, ML, EC, FC, CH; 2004–14; TPRF 2202).

Red-faced Warbler (*Cardellina rubrifrons*) (31). One at Boot Canyon, Big Bend NP, *Brewster*, on 27 April 2004 (**MK**; 2004–45). One at Boot Canyon, Big Bend NP, *Brewster*, on 7 August 2004 (**MF**; 2004–70). One at Franklin Mountains SP, *El Paso*, on 15 August 2004 (**JKi**; 2004–75; TPRF 2220).

Slate-throated Redstart (*Myioborus miniatus*) (7). A male at Boot Canyon, Big Bend NP, *Brewster*, from 2–3 May 2003 (**SIs**, CL, ML, EC, MAd; 2003–40; TPRF 2163; TBSL 237).

Rufous-capped Warbler (*Basileuterus rufifrons*) (21). One in the Chisos Mountains, Big Bend NP, *Brewster*, on 12 August 2004 (**DLe**; 2004–69).

Yellow-faced Grassquit (*Tiaris olivaceus*) (3). A female at Santa Ana NWR, *Hidalgo*, on 28 September 2003 (**MO**; 2003–75).

Baird's Sparrow (*Ammodramus bairdii*) (44). One at Rio Grande Village, Big Bend NP, *Brewster*, from 4–6 May 2003 (**RiW**; 2003–61). One near Marfa, *Presidio*, on 20 December 2003 (**ML**, **EC**; 2003–98).

Dark-eyed (White-winged) Junco (*Junco hyemalis aikeni*) (6). One at Smith Spring, Guadalupe Mountains NP, *Culberson*, from 3–4 January 2004 (KB; 2004–21; TPRF 2187).

Shiny Cowbird (*Molothrus bonariensis*) (12). A male at Harlingen, *Cameron*, on 24 October 2003 (**StW**; 2003–94). A male in e. *Jefferson* on 26 April 2003 (**T&PF**; 2003–36). A male at Comfort, *Kendall*, on 14 May 2004 (**ES**; 2004–52).

NOT ACCEPTED

A number of factors may contribute to a record being denied acceptance. It is quite uncommon for a record to not be accepted because the bird was obviously misidentified. More commonly, a record is not accepted

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because the material submitted was incomplete, insufficient, superficial, or just too vague to properly document the reported occurrence while eliminating *all* other similar species. Also, written documentation or descriptions prepared *entirely from memory* weeks, months, or years after a sighting are seldom voted on favorably. It is important that the simple act of not accepting a particular record should by no means indicate that the TBRC or any of its members feel the record did not occur as reported. The non-acceptance of any record simply reflects the opinion of the TBRC that the documentation, as submitted, did not meet the rigorous standards appropriate for adding data to the formal historical record. The TBRC makes every effort to be as fair and objective as possible regarding each record. If the committee is unsure about any particular record, it prefers to err on the conservative side and not accept a good record rather than validate a bad one. All records, whether accepted or not, remain on file and can be re-submitted to the committee if additional substantive material is presented.

Trumpeter Swan (*Cygnus buccinator*). Springlake, *Lamb*, on 14 February 2004 (2004–28).

Yellow-billed Loon (*Gavia adamsii*). Sugar Land, *Fort Bend*, on 5 March 2004 (2004–20).

Brown Booby (*Sula leucogaster*). South Padre Island, *Cameron*, on 8 January 2003 (2003–9).

Red-footed Booby (*Sula sula*). Boca Chica, *Cameron*, on 20 March 2003 (2003–27).

Jabiru (*Jabiru mycteria*). Longenbaugh, *Harris*, on 9 July 2004 (2004–59).

Hook-billed Kite (*Chondrohierax uncinatus*). Corpus Christi, *Nueces*, on 26 September 2003 (2003–82). Smith Point, *Chambers*, on 18 October 2003 (2003–83).

Northern Goshawk (*Accipiter gentilis*). Fort Worth, *Tarrant*, on 4 October 2003 (2003–79). White River Lake, *Crosby*, on 3 January 2004 (2004–3).

Short-tailed Hawk (*Buteo brachyurus*). San Marcos, *Hays*, on 20 November 2003 (2003–95).

Long-tailed Jaeger (*Stercorarius longicaudus*). Aransas Bay, *Aransas*, on 20 February 1987 (2003–60). This record had been previously accepted (TBRC 1988–161). The record was revisited because of the unlikely timing of occurrence and the expanded literature concerning jaeger plumage variation.

Black-tailed Gull (*Larus crassirostris*). Corpus Christi, *Nueces*, on 23 April 2004 (2004–41).

Thayer's Gull (*Larus thayeri*). Padre Island National Seashore, *Kleberg*, on 20 November 2003 (2004–26). Corpus Christi, *Nueces*, on 22 April 2004 (2004–42).

Iceland Gull (*Larus glaucoides*). Quintana, *Brazoria*, on 11 March 2003 (2003–26).

Great Black-backed Gull (*Larus marinus*). Sargent, *Matagorda*, on 20 December 2002 (2002–128).

Ruddy Ground-Dove (*Columbina talpacoti*). Harlingen, *Cameron*, on 1 August 2004 (2004–65).

Northern Pygmy-Owl (*Glaucidium gnoma*). Guadalupe Mountains NP, *Culberson*, on 24 July 2004 (2004–63). Big Bend NP, *Brewster*, on 13 August 2004 (2004–68).

Black Swift (*Cypseloides niger*). Port O'Connor, *Calhoun*, on 11 April 2004 (2004–33).

Green Violet-ear (*Colibri thalassinus*). Sabal Palm Sanctuary, *Cameron*, on 10 July 2004 (2004–60).

Gila Woodpecker (*Melanerpes uropygialis*). Dinosaur Valley SP, *Somervell*, on 6 September 2003 (2003–87).

Sulphur-bellied Flycatcher (*Myiodynastes luteiventris*). Yoakum, *DeWitt*, on 5 July 2003 (2003–99).

Connecticut Warbler (*Oporornis agilis*). Lubbock, *Lubbock*, from 6–7 October 2001 (2001–125). South Padre Island, *Cameron*, on 25 April 2004 (2004–36).

Gray-crowned Yellowthroat (*Geothlypis poliocephala*). Santa Ana NWR, *Hidalgo*, on 27 April 2004 (2004–43).

Baird's Sparrow (*Ammodramus bairdii*). Lake Bob Sandlin SP, *Titus*, on 29 September 2003 (2003–81). Longview, *Gregg*, on 20 December 2003 (2003–103).

Snow Bunting (*Plectrophenax nivalis*). *Lipscomb* on 2 April 2004 (2004–51).

CORRIGENDUM

The **Snowy Owl** (*Bubo scandiacus*) found southwest of Dalhart on 28 January 2002 (TBRC 2003–80) is from *Hartley*, not *Dallam*, as reported in the 2003 annual report (Lockwood 2004).

Two records of **Dark-eyed (White-winged) Junco** (*Junco hyemalis aikeni*) included in the 2002 annual report (Lockwood 2003), one at Palo Duro Reservoir, *Hansford* (TBRC 2001–61) and the other at Wolf Creek Park, *Ochiltree* (TBRC 2001–62), were both found on 24 January 2001 rather than 2002.

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COMPETITIVE IMPLICATIONS OF PERCH SITE USE BY THREE SYMPATRIC KINGFISHERS IN SOUTH TEXAS

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ABSTRACT.—Green (*Chloroceryle americana*), Ringed (*Ceryle torquata*) and Belted Kingfishers (*Ceryle alcyon*) were studied in the Rio Grande Valley, TX to determine interspecific features of perch sites. Microhabitat characteristics of perch sites appeared similar among the three species, but multivariate analysis indicated little overlap of physical characteristics for Green and Ringed Kingfisher perches. There was extensive overlap of Belted Kingfisher perch site features with those of the other two species during seasonal coexistence. Interspecific encounters between Belted and Ringed Kingfishers are described. Conditions facilitating competitive use of perch sites by kingfishers were associated with a water development project.

Key words: Kingfisher, behavior, perches, sympatry

Previous research (MacArthur 1968) resulted in the widely accepted tenet that competition is a prime factor in dictating avian community composition, although predation and environmental heterogeneity are suggested

Green Kingfisher perches averaged most nearly horizontal and closer to water than those of the other species. Photo by Steve Bentsen.

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Belted Kingfishers were observed using perches that also were used by the other two species. Photo by Steve Bentsen.

alternatives (Kryzysik 1979). Differences in microhabitat and food resources have been proposed as the primary means of minimizing interspecific competition (Diamond 1970, Schoener 1974, Pianka 1969). Hence, any overlap on a microhabitat gradient that directly reflects food utilization may result in competitive interactions.

Slud (1964) described ecological differences among kingfisher species along a body size gradient, while MacArthur (1971) suggested viewing food differences among sympatric kingfishers as a measure of ecological segregation correlated with body sizes. Remsen (1978) studied the latitudinal gradient in neotropical kingfisher diversity and found that prey size was the primary means of resource partitioning among species. Body size of kingfishers was strongly correlated with prey sizes and was an important factor in determining perch site characteristics, at least the vertical dimension. Consequently, the strong tie between kingfisher body size and prey utilization/perch site relationship potentially serves as a measure of competitive overlap in sympatric kingfishers exposed to other environmental conditions.

Two neotropical kingfishers (Green, *Chloroceryle americana* and Ringed, *Ceryle torquata*) and the more temperate Belted Kingfisher, (*Ceryle alcyon*) are seasonally sympatric in portions of Central America, Mexico, and as far north as south Texas USA (Peters 1934, American Ornithologist's Union 1983). Fry (1980) extensively described the evolutionary relationship among these species. In south Texas, the small Green (18 cm length, 72 g) and large Ringed (38 cm, 290 g) Kingfishers are resident year-round along the Rio Grande, and the mid-sized Belted (28 cm, 128 g) is a winter resident (Oberholser 1974, Arvin 1977). Ringed Kingfishers have extended their range northward to Texas relatively recently (Oberholser 1974); the first known nesting occurring in 1970 (McGrew 1971). Within this area of recent sympatry, we analyzed perch characteristics and spatial distribution of these three kingfishers to test hypothesized competitive overlap, in light of the relationship suggested by Remsen (1978).

STUDY SITE

This study was conducted during January 1980 along the 2 km floodway immediately below Falcon Dam and spillway on the Rio Grande River, and along 5 km of main river channel immediately downstream of the floodway in Starr County, Texas, 210 km WNW of Brownsville. Impoundment of water began in 1953 and power generation was initiated upon completion of the dam in 1954 (International Boundary and Water Commission information pamphlet, undated). Black willow (*Salix nigra*), Mexican ash (*Fraxinus Berlandieriana*), and mesquite (spp) dominated the vegetation bordering the waterways. Patches of giant cane (*Arundo donax*), woody snags, and emergent rocks were scattered in the floodway. The main river channel largely was bounded by vertical sedimentary banks up to 15 m high and occasionally interrupted by tributary arroyos. In contrast, the floodway had sloping banks with few vertical, eroded banks.

METHODS

Perch sites of kingfishers were located using binoculars from an overlook at the downstream end of the Falcon Dam spillway. Perch sites were sketched to facilitate on-site identification and measurements of exact location. Perch site use was observed from 0730 h to 1800 h each day, resulting in approximately 30 hours of observation. Perch sites along the main river channel were located from a canoe and the area of the floodway-main channel confluence was searched on foot. Additional perches were identified during on-site data collection at previously located sites. Such perches were measured as they were encountered or sketched for later measurement. Perch sites used briefly by kingfishers startled by our presence were not included in the data set.

Data collected at each perch site included: species using perch site, time of use, support structure, height (m) above ground or water surface (HEIGHT), diameter (cm) of perch (DIAM), perch deviation from horizontal (ANGLE), angle of orientation relative to axis of the river channel (ORIENT), percent of perch structure over water (OVERH20), horizontal distance (m) to water (DISTH2O), number of projections apparently suitable for perching distal to the perch used (PROJECT), distance (m) to foliage at or above the perch if within 10 m, and shading of perch at the time of use. Parenthetical terms refer to variable names associated with the discrimination procedure described below. Distances, heights, and perch angle were measured with a Topcon range-height finder accurate to 0.5 meters within the ranges measured. Angles of orientation were measured within 2 degrees with a Silva Ranger compass. Visual estimates were made for shading and coverage over water. Water depth adjacent to each perch was noted but no specific measures were made at perch sites because intrasite differences precluded a meaningful standard measurement.

Continuous, numeric variables identified above were subjected to a multivariate linear discrimination procedure employing Mahalanobis' distance (Morrison 1976, Rao 1965) and available in the Statistical Analysis System software (Helwig and Council 1979). Variance-covariance structure differed sufficiently among species to require calculation of discrimination criteria from unpooled matrices. This procedure permitted subsequent reclassification of perch sites with proportions of correct assignments used as measures of species separation under several discrimination models. Qualitative attributes of perch sites were examined among species through Chi-square analysis with differences declared at $P<0.05$.

RESULTS

Characteristics of Perch Sites

Physical characteristics were examined and measured at 54 perch sites with approximately equal representation among the three species (Ringed = 18, Belted = 19, Green = 17). These sites represented individual use by a minimum of 5 Ringed, 3 Belted and 4 Green Kingfishers. Live willow was the predominant perch structure (60% of sites) used by all kingfisher species, but Green and Belted Kingfishers used a wider variety of structures ($X^2=15.60$, 8 df, $P<0.05$) than the Ringed (Fig. 1). The use of shaded versus unshaded perches differed among the species ($X^2=28.04$ 2 df, $P<0.01$). Fifteen of seventeen (88 percent) Green Kingfisher perches were shaded at the time of use. Unshaded sites represented 83 and 89 percent of Belted and Ringed Kingfisher perches, respectively. Perches with nearest foliage more than 10 m away were more frequent for the larger species (42.1, 38.9, and 11.8% for the Belted, Ringed, and Green respectively). Kingfisher behavior relative to water levels was previously described by Passmore and Thompson (1981).

Physical characteristics of 54 perches overlapped extensively among all species (Table 1). Perches selected by all species were of similar diameter regardless of the height and averaged within 15 degrees of perpendicular to the main axis of the river channel. Green Kingfisher perches averaged most nearly horizontal and closer to water (all < 0.4 m from water) than those of the other species. Mean height of Green Kingfisher perches was 1.9m; Moskoff (2002) noted a mean perch height of approximately 1.5m for Green Kingfishers in Costa Rica.

Multivariate Discrimination Among Species

Reclassification of perch sites based on discrimination criteria for four, six, and seven variable models revealed no misclassifications between Green and Ringed Kingfishers but extensive overlap existed among the Belted Kingfisher and the other species (Table 2). However, when HEIGHT was dropped from the analysis, misclassifications occurred among all species combinations even though correct classifications of Green Kingfishers remained high. HEIGHT considered alone classified perches for the largest and smallest species as well as the discrimination models; only 3 of 35 Green and Ringed Kingfisher perches overlapped in height (Table 2). Overlap suggested by the frequency of misclassifications associated with Belted Kingfisher perches

Table 1. Descriptive statistics (described in text) for seven physical variables at 54 perch sites of three sympatric kingfishers in the Rio Grande Valley, Texas.

VARIABLE	MEAN	STD ERR	CO VAR	MIN VAL	MAX VAL	MEAN	STD ERR	CO VAR	MIN VAL	MAX VAL
	Belted Kingfisher (N=19)					Ringed Kingfisher (N=18)				
DIAM (cm)	2.1	0.3	52.1	0.4	4.7	2.5	0.3	57	0.9	5.1
HEIGHT (m)	4.2	0.8	79.6	0.1	10.5	7.3	0.5	31.3	2.1	10.8
PROJECT	1.1	0.4	153.4	0	5	1.9	0.6	142.9	0	11
ANGLE	21.4	4.5	92.1	0	65	17.7	4.2	100.6	0	63
ORIENT	99.9	8.9	38.8	3	157	90.1	8.1	37.9	32	180
DISTH20 (m)	2.1	1	205.7	0	16.4	1.3	0.6	196.2	0	8.4
OVERH20 (%)	43.7	11.3	112.8	0	100	30.7	9.3	128.7	0	100
	Green Kingfisher (N=17)									
DIAM (cm)	2	0.4	89.4	0.6	7					
HEIGHT (m)	1.9	0.4	74.3	0.1	5					
PROJECT	1.8	0.6	130.7	0	7					
ANGLE	10.2	2.2	88	0	32					
ORIENT	104.8	7.4	29.1	58	163					
DISTH20 (m)	0.5	0.1	132	0	1.5					
OVERH20 (%)	34.4	10.8	129.4	1	100					

was mirrored when each variable was plotted against HEIGHT (Fig. 2). In all cases, minimal overlap existed between Ringed and Green Kingfisher perch characteristics while the range of factors observed for the Belted Kingfisher extended widely across those recorded for the other species.

Interspecific Encounters

Belted Kingfishers were observed using perches that also were used by the other species, but Green and Ringed Kingfishers were not observed using common perch sites. Use of a common perch site by Belted and Green Kingfishers was separated temporally, thus no interspecific aggression was observed but the potential existed for an agonistic encounter. Conversely, Belted Kingfishers were observed using at least three perches frequented by Ringed Kingfishers. A Ringed Kingfisher was observed supplanting a Belted Kingfisher from a 3 m high snag as the Ringed flew to perch on the same snag. The Ringed Kingfisher flew from this perch within 10 sec and the Belted Kingfisher returned to that perch approximately 5 min later. Belted Kingfishers were seen perched within 3 m of Ringed Kingfishers on two other occasions, but no displacement occurred.

DISCUSSION

There were no apparent reasons (i.e., climatic response, recent disturbance, recent arrival of migrants) to believe that our observations did not represent typical winter behavior for these species. Kingfishers behaved similarly during water fluctuation cycles. In July 1980, Ringed Kingfishers were distributed much the same as during winter; however, Green Kingfishers were less commonly seen and Belted Kingfishers were absent as expected. Ringed Kingfishers perched within 1 m of two of the same sites characterized during winter observations.

Some segregation apparently existed among these species both temporally and spatially as indicated by differential response to water conditions and dissimilarities in the physical attributes of perch sites. However, all species were spatially coincident much of the time and substantial overlap was evident in both univariate and multivariate consideration of the broad range of perch site attributes. As perch characteristics directly represent food resource characteristics (Remsen 1978), competition for food resources may exist among these species during winter sympatry. Such a relationship would be of little consequence if food were superabun-

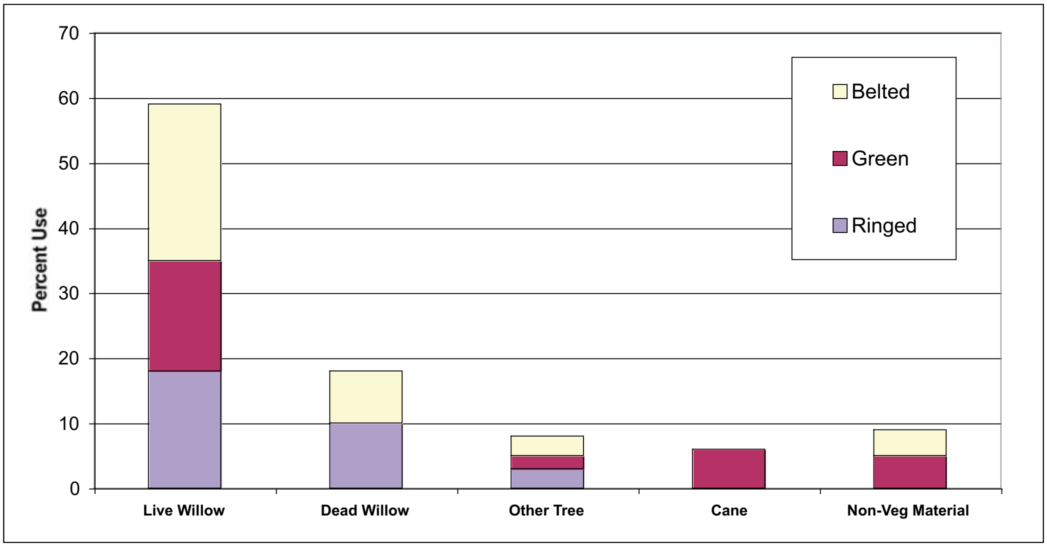

Figure 1. Percent use of five types of perch structures by three sympatric kingfisher species in the Rio Grande Valley, Texas.

Table 2. Reclassification of 54 kingfisher perch sites based on discrimination criteria developed from 4, 5, 6, and 7 variable models.

		Perch classified as			
Variables includes	**Perch used by**	**Green**	**Belted**	**Ringed**	**Misclassed (%)**
HEIGHT, DIAM ANGLE, ORIENT	Green	17	0	0	0
DISTH20, PROJECT OVERH20	Belted	4	15	0	21.1
	Ringed	0	5	13	27.8
HEIGHT, DIAM ANGLE, ORIENT	Green	17	0	0	0
DISTH20, PROJECT	Belted	5	12	2	36.8
	Ringed	0	4	14	22.2
HEIGHT, DIAM ANGLE, ORIENT	Green	16	1	0	0
	Belted	4	11	4	42.1
	Ringed	0	4	14	22.2
HEIGHT, DIAM ANGLE, ORIENT	Green	17	0	0	0
	Belted	6	7	6	63.2
	Ringed	1	3	14	22.2
DIAM, ANGLE ORIENT, DISTH20	Green	16	0	1	5.9
PROJECT	Belted	7	8	4	57.9
	Ringed	10	4	4	77.8
HEIGHT*	Green	15	2	0	11.8
	Belted	7	4	8	78.9
	Ringed	1	2	15	16.7

*Not a result of linear discrimination, but simply a classification provided for comparison based on nearness to mean heights for each species.

A Ringed Kingfisher was observed supplanting a Belted Kingfisher from a 3 meter high snag. Photo by Steve Bentsen.

dant and highly predictable (Cody 1974). Although we did not measure food base, it is possible that such conditions existed near Falcon Dam because of variable water fluctuation schedules which may function in concentrating "good" foraging conditions, thus accentuating competitive potential. The plausibility of temporal changes in foraging efficiency as a mechanism for coexistence was discussed by Brown (1989). Variation in water levels or flow coupled with seasonal presence of the Belted Kingfisher may further facilitate coexistence (Stewart and Levin 1973).

Fry (1980) described morphologic differences among these and other kingfisher species as evidence of past ecologic segregation, yet it is ironic that evidence of such segregation is not present when viewing an apparently critical resource such as perch sites. Given the overlap in use of perch sites between the Belted Kingfisher and the other species, it is unusual that such a relationship exists where the large Ringed Kingfisher is a recent addition to the avifauna and an extensive water control project is a similarly recent addition to the habitat setting.

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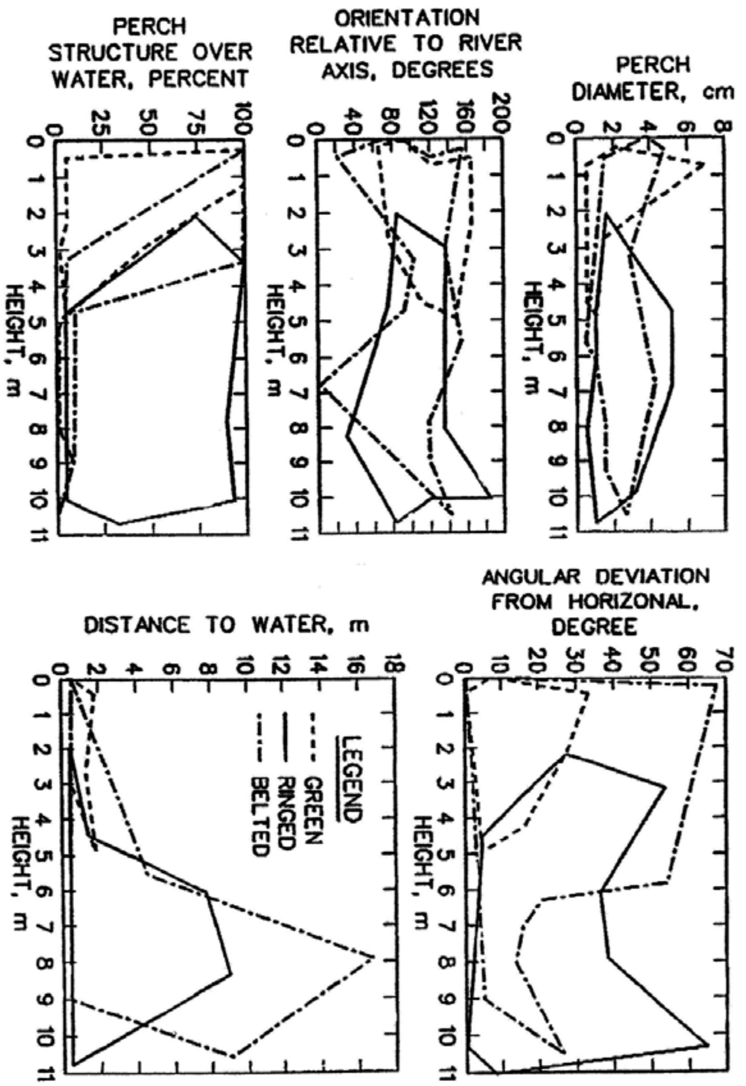

Figure 2. Relationships between height above substrate and five other physical features measured at 54 perches of three sympatric kingfisher species in the Rio Grande Valley, Texas.

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NATIVE TEXAS AVIFAUNA ALTERED BY SUBURBAN ENTRAPMENT AND METHOD FOR EASILY ASSESSING NATURAL AVIFAUNAL VALUE

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ABSTRACT.—Suburban sprawl in a central-Texas city gradually entrapped native nesting birds in a heavily wooded ravine. The birds were spot-mapped in 6-ha plots for 39 years, and the kinds and causes of avifaunal change were measured. Habitat area was reduced overall but not in study plots, which were partly modified by sewer-line construction, and temperatures became warmer. Permanent-resident populations were stable or grew with invasions by four species, while three species were lost. Summer-resident populations declined, and nine species were lost. At the end of study, survivors were largely permanent residents and arboreal and cavity nesters by contrast to lost ground and open nesters. Body size was inconsequential to survival. Entrapment promoted an avifauna partly supported by cultural resources and modified natural factors. By using guild proportions, native avifaunas may be assessed in support of the ecological and educational values of preservation.

As city expansion continues to erase, perforate, or surround wildlands that house native birds, knowledge of urban avian ecology and conservation becomes increasingly important (Tomialojc and Gehlbach 1988, Marzluff et al. 1998, McKinney 2002). Urban avifaunal studies are mostly short-term descriptions of community structure (Beissinger and Osborne 1982, Mills et al. 1989), rural to urban gradients (Blair 1996, Odell and Knight, 2001), or entrapment (Friesen et al. 1995). There are few long-term investigations (Aldrich and Coffin 1980, Whitcomb et al. 1981) or population studies (Tarvin and Smith 1995), especially those concerning native species in urban and contemporaneous adjacent rural sites (Tomialojc 1980, Eden 1985, Gehlbach 1994, 1996).

About 80% of Texans lived in cities with a rate of urban sprawl in the late 20th Century (ca. 270 ha/d) that surpassed all other U. S. states (Gehlbach 2002). In Texas, as elsewhere, urbanization altered vegetation structure, food, water, and predators among the many ecosystem links with native birds (Gehlbach 1994, 1996; Marzluff et al. 1998). Environmental changes in the wooded habitat of a central Texas suburb are known (Gehlbach 1996, 2002). The long-term effects of that suburb's entrapment of native breeding birds and a method for easily assessing natural avifaunal value and vulnerability are major objectives of the present investigation.

Specifically, I address the following questions: (1) Is the avifauna altered with more permanent-resident species and nesting pairs and fewer summer-residents as in other urban studies (McKinney 2002, Hennings and Edge 2003)? (2) What is the hierarchy of positive and negative impacts from cultural and modified natural factors other than the well-studied effects of habitat fragmentation? (3) Do body size, nest site, and habitat play a role in species persistence versus extirpation? (4) Is climatic change involved? (5) Can a native avian predator's (Eastern Screech-Owl, *Megascops* [*Otus*] *asio*) diet substantiate my census results? (6) Can avian guilds provide information of value for conservation?

STUDY AREA AND PLOTS

Nesting birds were studied in mature forest and woodland of the Woodway Ravine in the Cobbs Creek watershed on the Balcones (White Rock) Escarpment at 170–182 m elevation in Woodway, McLennan County, Texas (31° 30'

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N, 97° 12' W). This central Texas city is, by definition (Marzluff et al. 2001), a suburb of Waco. Cobbs Creek is a spring-fed tributary of the South Bosque River (Brazos River system) in a 5–25 m deep, limestone (Austin Chalk) ravine system that was completely surrounded with suburban residential development by 2003 (Fig. 1).

I lived beside the ravine before and during this study and learned about its birds in a 10-year pre-census period (1964–1973). My first 6-ha, lineal study plot (1974–1980) was along Whitehall Creek, the eastern upstream branch of Cobbs Creek in a naturally forested section of Whitehall Park (city park). In 1981–2003 I switched censuses to a 6-ha lineal plot on Sugar Creek, the western upstream branch of Cobbs Creek in the private Sugar Creek Preserve, 0.5 km west of Whitehall Creek, after verifying that the two plots were equivalent during concurrent studies in 1979–1981 (Fig. 1).

Vegetation of the ravine was closed-canopy deciduous forest along creeks and on creek terraces adjoining open-canopy, evergreen-deciduous woodland on hillsides. Before and during the pre-census period, 45 ha (41%) of the 110 ha of this vegetation were destroyed by suburban sprawl. Both study plots were protected from sprawl but had city utility easements, so sewer lines affecting ca. 8% of each were bulldozed on their creek terraces and lower hillsides.

METHODS

Rate of suburban development was measured by the number of residential building permits issued by the city for the ravine-border area. Annual permits were cumulated for analyzing most trends. The growing number of houses (suburban sprawl) is hypothesized (null) to be independent of avifaunal events. Usurpation of natural or semi-natural habitat by houses, yards, and outdoor activity is only one result of sprawl. Others include novel cultural resources such as bird nest boxes and baths, plantings, generation of a heat island (Landsberg 1981), and domestic pets.

Figure 1. Woodway Ravine study area in suburbia near Waco, Texas, February 1995. This aerial view from the ravine's headwaters at Rainbow Lakes (lower left) is toward the north-northeast with Texas Highway 6 and the South Bosque River arm of Lake Waco at the top left of the photo. Six hectare study plots are 1 at Whitehall Park (1974–1980) and 2 at the Sugar Creek Preserve (1981–2003).

The Northern Cardinal was the most commonly observed user of resources. Photo by Fernando Cerra.

Canopy trees in both plots were evaluated for species density, size (diameter [DBH] at 1.5 m), and status as alive or dead in transects of 12 point-quarters, 12 m apart, parallel to the creek on each hillside and along both sides of each creek on terraces in 1981. Data were reduced to modified Importance Value (IV = trees per species/48 trees + points of occurrence/12 total points) for species in each transect. Deciduous and evergreen foliage-types were the sums of these IVs (methods in Cottam and Curtis 1956).

Maximum and minimum air temperatures 1.5 m from my house and total precipitation in a clearing 10 m away were recorded weekly, 1985–2003. Both stations were in the woodland to forest transition on an east-facing hillside. Temperatures were recorded simultaneously 20 m below the house at the creek. Air temperatures were read 1.5 m above ground and soil surface temperatures beneath 1–3 cm of leaf litter (Gehlbach 1994). I hypothesized (null) that an observed heat island and global climatic warming (Karl and Trenberth 2003) did not influence the birds.

Birds and Domestic Pets. Pairs of breeding birds were spot-mapped the same way in both plots 1–2 times weekly within 1–2 hr of sunrise and 1–2 hr after sunset on the same days with no precipitation or high wind. I used paths that allowed observation of plot edges and bordering suburban yards. Nest building, nests, or recent fledglings were breeding criteria. Censuses were in late February to mid-June (24–30 annually) or mid-May after 1994 (17–22 annually) with 2–3 spot checks in early July. Occasionally, I missed 1–2 weeks during late February to early April.

Domestic cats (*Felis domesticus*) and dogs (*Canus familiaris*) in the study plots during bird censuses were counted with care not to re-count the same animal. Also, I surveyed pets in all (38) households that bordered the west side of the younger study plot in 2003 and asked property owners about their control of pets, and if they knew about city and homeowners' association leash laws. I hypothesized (null) that pets had no impact on the avifauna.

Eastern Screech-Owls ate an array of birds and left feathers, bones, pellets, and cached bodies in tree cavities and nest boxes (Gehlbach 1994). I counted the prey items semi-weekly inside and bordering the study plots and separated the bias of added passage migrants from summer residents of the same species by omitting data on those species during the migration peak in the last week of April through first week of May. I hypothesized (null) that the owl's prey would not mirror my censuses.

Prey, roaming pets, avian species, and breeding pairs were averaged annually for investigating trends and differences between data sets (standard deviations of these mean annual counts were ≤ 0.05 every year). In 1979–1981, bird species and breeding pairs in both plots were censused concurrently to test inter-plot similarity. Species absent more than three consecutive years were considered extirpated (none reappeared). Omitting subsequent zero data, censused species were put in non-significant (stable), significant positive (increasing), and significant negative (declining) groups based on trends of their breeding pairs.

Species were also placed in one or more sets of contrasting guilds for analyses of vulnerability versus adaptability to entrapment and utility in assessing conservation value (Verner 1984, Croonquist and Brooks 1991). Contrasting guilds, based on observations and captures plus some weights from Dunning (1984), were: permanent vs. summer resident (neotropical migrant), small- ($<$ 42 g = geometric mean) vs. large-bodied; open- vs. tree-cavity nester; open-ground vs. open-arboreal nester; and forest vs. woodland nester ($\geq$ 75% of pairs in one habitat or the other).

Statistical Analyses. I employed Wilcoxon signed-rank tests (*Z*) to analyze annually repeated measures of avian species richness, breeding pairs, and also tree species' IVs between plots and habitats. Other two-sample comparisons were by Mann-Whitney tests (*U*). Avian species, inter-species, pet, and climatic trends (mostly relative to sprawl), were appraised with Spearman Rank correlations corrected for ties (r_s). Overall permanent- and summer-resident trends relative to sprawl were illustrated with best-fit regression models. Frequencies of species in guilds were compared with Fisher's Exact Tests (Fisher's *P*).

$P \leq 0.05$ distinguished measured differences and alternative hypotheses with three exceptions: repeated measures of species and breeding pairs in three 10-yr periods (≤ 0.03 per 2-way comparison), tree IVs on the four hillsides and four creek terraces (≤ 0.02 per 2-way comparison), and inter-guild frequency comparisons with inherently small samples ($P \leq 0.10$). For all multiple comparisons, I give the least acceptable test and probability values with direction of more or less reliable values in the same group.

Summary statistics are Mean $\pm$ 1 Standard Deviation and Coefficient of Variation (CV x 100), the latter indicating degree of avifaunal flux and hence adjustment or not to the changing natural and cultural environment (Boulinier et al. 1998). Sample sizes are as explained above for years, weather, and number of transects unless indicated otherwise.

RESULTS

Environment. Tree species' IVs were similar in paired comparisons of the hillside woodlands ($Z \leq 0.1$, $P \geq 0.11$) and creek-terrace forests ($Z \leq 1.1$, $P \geq 0.17$) between plots but differed between woodland and forest within plots ($Z \geq 4.7$, $P \leq 0.02$). Sugarberry (*Celtis laevigata*) led in both habitats, followed by Shumard Oak (*Quercus shumardii*), Eastern Red (*Juniperus virginiana*) and Ashe (*J. ashei*) junipers combined, White Ash (*Fraxinus americana*), and Scalybark Oak (*Quercus sinuata*) in woodland by contrast to Cedar Elm (*Ulmus crassifolia*), Black Walnut (*Juglans nigra*), Red Mulberry (*Morus rubra*), and American Elm (*U. americana*) in the forest.

Canopy structure also differed between habitats in each plot ($U \geq 221$, $P \leq 0.02$) and not between plots ($U \leq 2$, $P \geq 0.13$). Hillside woodlands had 242 $\pm$ 55 trees/ha, 22 $\pm$ 9 cm DBH, and were 19 $\pm$ 8% deciduous; creek-terrace forests had 59 $\pm$ 27 trees/ha, 31 $\pm$ 13 cm DBH, and were 97 $\pm$ 4% deciduous. All dead trees (10 $\pm$ 8% of total trees) were deciduous species and mostly (63%) $<$ 5 m from sewer lines, trails, and suburban yards, where soil mixing, compaction, and storm damage from exposure due to construction were observed cultural impacts. Terrace vegetation represented the eastern U. S. mixed mesophytic (deciduous) forest (Gehlbach 1988).

Roaming cats increased during suburban development ($r_s = 0.63$, $P < 0.003$), but dogs did not ($r_s = 0.13$, $P = 0.13$). The door-to-door survey in 2003 revealed one or more cats in eight (21%) of the 38 houses and one or more dogs in five (13%). Dogs were controlled except for occasional instances of temporary escape, but six cats (75%) roamed at will despite city and homeowners' association ordinances to the contrary. Twice during morning censuses, I saw cats carrying birds in the younger plot.

Air and ground temperature averaged 2.5° C colder at the creek than house (Gehlbach 1994), and mean maximums of air at the creek became colder in December-February coincident with the 1985–2003 suburban development ($r_s = -0.50$, $P = 0.04$). Similar cooling in March-May at the creek was marginal statistically ($r_s = -0.39$, $P = 0.10$). Mean maximum temperatures at the house increased by 0.2° C in December-February ($r_s = 0.51$, $P = 0.04$) and the same amount in March-May ($r_s = 0.59$, $P = 0.02$). There were no statistical trends in precipitation.

Avifaunal Patterns. While 31 species nested during pre-census observations, only 24 did so during censuses in both plots and averaged 16–17 species in three 10-year census periods (Table 1). Eastern Wood-

Table 1. Changes in a breeding avifauna in ravine forest and adjoining woodland entrapped by suburbia in central Texas. Mean ± 1 Standard Deviation and percent Coefficient of Variation in parentheses of annual data. Results of Wilcoxon signed-ranks tests (*Z*) between pairs of decades regarding species, pairs, and resident guilds are summarized at the bottom.

Years	Species	Total Pairs	Permanent Resident Pairs	Summer Resident Pairs
1974–1983	16.4 ± 1.3 (8)	32.3 ± 4.4 (14)	22.6 ± 4.8 (21)	9.7 ± 1.8 (18)
1984–1993	16.2 ± 1.2 (7)	40.7 ± 5.9 (14)	34.0 ± 6.7 (20)	6.7 ± 1.4 (21)
1994–2003	16.9 ± 1.0 (6)	46.1 ± 6.6 (14)	40.8 ± 3.8 (16)	5.2 ± 1.2 (23)
Z (*P*)	≤1.4 (≥0.03)	≥2.4 (≤0.02)	≥2.5 (≤0.01)	≥2.1 (≤0.03)

Pewee (*Contopus virens*), Red-eyed Vireo (*Vireo olivaceus*), Blue-gray Gnatcatcher (*Polioptila caerulea*), Wood Thrush (*Hylocichla mustelina*), Black-and-white Warbler (*Mniotila varia*), Summer Tanager (*Piranga rubra*), and Orchard Oriole (*Icterus spurius*) were open-nesting summer residents that disappeared from the older-plot by 1974 and not found in the younger plot.

Concurrent censuses of older and younger plots in 1979–1981 showed the same species composition and no statistical differences in average species richness and number of breeding pairs ($Z \leq 0.8$, $P \geq 0.12$). These similarities, the equivalent arboreal vegetation and hence natural resources validated the continuous data sequence from older to younger plot and were substantiated with continued, though occasional, qualitative observations of the older plot.

Breeding pairs increased 26% after the first 10 census years, which incorporated the shift in data from older to younger plot (Table 1). In the last 10 years, avian population growth slowed to 14%. Most growth resulted from an annual average increase of 0.4 pairs of permanent residents. Coincidently ($r_s = -0.69$, $P < 0.001$), summer residents declined by an annual average of 0.1 pairs but approached relative stability, when housing development stabilized about 2001–2003 (Fig. 2).

The flux (CV) in species richness and total pairs was the same or similar in each 10-year census period, in part because permanent resident numbers increasingly stabilized, as summer residents destabilized (Table 1). Perhaps instructive of adaptability to change is the fact that permanent-resident flux declined despite extirpations and invasions in this guild (Table 2) during the last sewer line construction and plant succession in the damaged area from 1986–1994. Did cultural resources compensate for lost or modified natural resources and favor permanent residents?

Summer-resident flux included sporadic absences of 1.5 ± 0.5 yr (n = 4 yr) among four survivors and 2.2 ± 0.6 yr (n = 3 yr) in three extirpated species. A similar unmeasured pattern characterized summer residents lost in the pre-census period, suggesting that such absences forecast extirpation. Because the mean CV of six extirpated birds was three times larger than that of eight concurrently stable species (103% versus 34%; $U = 9$, $P = 0.05$), greater population flux may presage extirpation.

Annual numbers of nesting Eastern Screech-Owls and their permanent- and summer-resident prey were nonconcordant ($r_s \leq 0.27$, $P \geq 0.18$). Nor was there a trend in permanent-resident prey relative to suburban sprawl ($r_s = 0.06$, $P = 0.76$). But summer-resident prey declined as sprawl increased ($r_s = -0.40$, $P = 0.04$), substantiating my censuses (Fig. 2). However, this trend only vaguely resembled census data ($r_s = 0.32$, $P = 0.11$), probably because predation by the owls depended on nesting demand and alternative prey, which varied annually (Gehlbach 1994) by contrast to census protocol.

Annual increases in March-May air temperatures at the house coincided with the overall increase in permanent residents ($r_s = 0.59$, $P = 0.02$) and the summer-resident decline ($r_s = -0.47$, $P = 0.05$). This decline was also congruent with warmer December-February periods ($r_s = -0.63$, $P = 0.01$) but surely spurious, since summer residents were absent until mid-March. No other guild-weather associations were evident.

Species and Guild Dynamics. Of summer residents with 30-year histories, the Ruby-throated Hummingbird (*Archilochus colubris*) and Great Crested Flycatcher (*Myiarchus crinitus*) were marginally stable, perhaps because the hummingbird used feeders and increased edge habitat for nesting, while the flycatcher used additional nest sites in dead trees and nest boxes (see below). Yellow-billed Cuckoos (*Coccyzus americanus*) declined for unknown reasons, and White-eyed Vireos (*V. griseus*) were the only summer resi-

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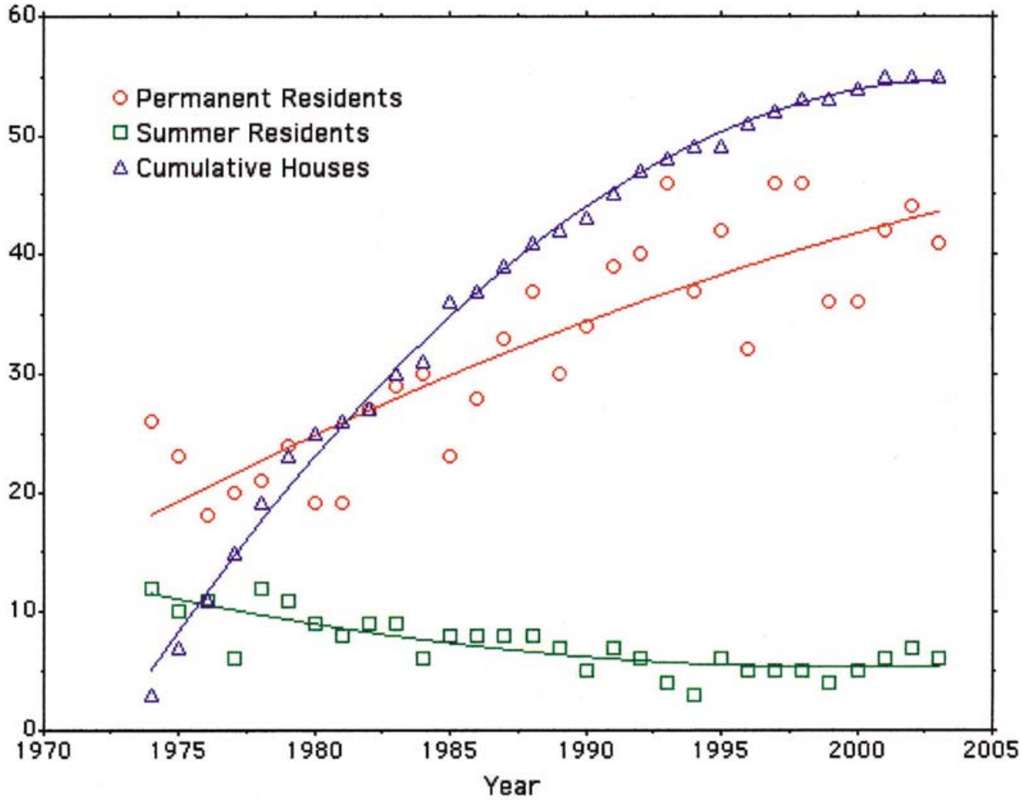

Figure 2. Trends of the cumulative number of new houses bordering study plots and number of permanent- and summer-resident nesting pairs of birds in 6-ha plots of ravine forest and adjoining woodland, 1974–2003. Best-fit models for pairs regressed on houses are: permanent residents, $y = -44875.07 + 44.29x - 0.01x^2$ ($2° r^2 = 0.78$, $P < 0.001$); summer residents, $y = 37537.98 - 37.54x + 0.01x^2$ ($2° r^2 = 0.65$, $P < 0.001$).

dents that increased, possibly because they nested in the increasingly shrubby sewer-line and suburban border (Table 2).

Thirteen (42%) species of the original 31 were summer residents, dropping to six (25%) of 24 during censuses. Nine (62%) were extirpated by contrast to only three (17%) permanent residents of the 18 throughout the study (Fisher's $P = 0.003$). The demise of summer residents was highest early in suburban sprawl by contrast to permanent residents lost in 1986–1994 during the last period of sewer-line construction and plant succession. Of the six most persistent summer residents, four (67%) continued to decline, and two disappeared in 1986–1994 (Table 2).

Four invasions also occurred in 1986–1994, when the avifauna fluctuated by an average 1.1 species annually versus 0.7 species previously. Invading Downy Woodpeckers (*Picoides pubescens*), Bewick's Wrens (*Thryomanes bewickii*) and House Finches (*Carpodacus mexicanus*) spread on shrubby suburban edges and open-canopy sewer lines, two cultural habitats that also featured the most Northern Cardinals (*Cardinalis cardinalis*) and White-eyed Vireos. White-winged Doves (*Zenaida asiatica*) invaded urban Waco in the early 1980s but did not nest on plot edges until 1994.

Extirpated birds in the 18-member small-body guild were the summer-resident Black-chinned Hummingbird (*A. alexandri*) and permanent-resident Ladder-backed Woodpecker (*Picoides scalaris*) together with the six pre-census summer residents (total 44%). Of 13 species in the large-body guild, Black Vulture (*Coragyps atratus*), Chuck-will's-widow (*Caprimulgus carolinensis*), Inca Dove (*Columbina inca*) and pre-census Wood Thrush disappeared (31%). These proportions are no different statistically (Fisher's $P = 0.69$), hence body size might not have factored into extirpation (Table 2).

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Table 2. Status of breeding birds in ravine forest and adjoining woodland entrapped by suburbia in central Texas, 1974–2003. Species are categorized as stable ($P > 0.05$) or by trend ($P \leq 0.05$) relative to cumulative number of new house building permits and listed by strength of correlation coefficient (r_s) in each category; some were extirpated (*) or invaded (**). Span of breeding years includes sporadic 1–3 yr absences. Also shown are average mass (g), nest site (C = tree cavity, O = open arboreal, G = open ground), mean ± 1 SD of breeding pairs, seasonality (P = permanent resident, S = summer resident), and primary nesting in closed-canopy forest (F) or open-canopy woodland (W).

Category **Species (Breeding Years)**	r_s	**Mass**	**Nest**	**Pairs**	**Status**
Stable ($P > 0.05$)					
Great Crested Flycatcher (30)	−0.31	33	C	1.1 ± 0.5	S, F
Eastern Screech-Owl (30)	0.30	172	C	1.5 ± 0.7	P, F
Red-bellied Woodpecker (30)	0.28	62	C	1.3 ± 0.8	P, F
Blue Jay (30)	0.24	86	O	3.1 ± 1.1	P, F
American Robin (30)	0.17	80	O	0.3 ± 0.5	P, F
Carolina Chickadee (30)	0.10	10	C	3.4 ± 1.0	P, F
Ruby-throated Hummingbird (30)	−0.09	3	O	0.5 ± 0.5	S, F
Mourning Dove (30)	−0.08	120	O	3.1 ± 1.9	P, W
Declined ($P \leq 0.05$)					
Black-chinned Hummingbird (15*)	−0.86	3	O	0.7 ± 0.9	S, W
Inca Dove (14*)	−0.85	48	O	0.6 ± 0.9	P, W
Black Vulture (18*)	−0.76	2000	G	0.5 ± 0.7	P, F
Yellow-billed Cuckoo (30)	−0.46	64	O	1.5 ± 0.8	S, F
Ladder-backed Woodpecker (19*)	−0.45	30	C	0.5 ± 0.5	P, W
Chuck-will's-widow (18*)	−0.42	120	G	0.7 ± 0.7	S, F
Increased ($P \leq 0.05$)					
Downy Woodpecker (19**)	0.89	25	C	1.4 ± 0.6	P, W
Carolina Wren (30)	0.87	21	C	4.2 ± 1.9	P, F
Northern Cardinal (30)	0.87	42	O	7.0 ± 2.9	P, W
White-winged Dove (10**)	0.79	150	O	2.1 ± 0.9	P, W
Bewick's Wren (11**)	0.71	10	C	0.6 ± 0.5	P, W
House Finch (11**)	0.55	20	O	0.4 ± 0.3	P, W
American Crow (30)	0.52	450	O	0.7 ± 0.4	P, F
Northern Mockingbird (30)	0.51	47	O	2.7 ± 1.6	P, W
Tufted Titmouse (30)	0.48	22	C	2.8 ± 0.9	P, F
White-eyed Vireo (30)	0.42	11	O	1.9 ± 0.9	S, W

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Table 3. Environmental impacts on native breeding birds in ravine forest and adjoining woodland entrapped by suburbia in central Texas, 1964–2003 (* = factor measured annually and correlated [$P \le 0.05$] with species' mean annual numbers or ** = observed qualitatively and repeatedly). Data are number and percent in parentheses of all bird species affected positively and negatively in each resident guild. Factors are arranged from most positive (net species promoted) to most negative (net species demoted).

	18 Permanent Residents (%)		**13 Summer Residents (%)**	
Factor (Net Effect)	**Positive**	**Negative**	**Positive**	**Negative**
Bird Feeders** (14)	12 (67)	0	2 (15)	0
Bird Baths** (12)	12 (67)	0	0	0
Cultivated Plants** (12)	9 (50)	0	3 (10)	0
Sewer-Line Scar** (2)	8 (44)	0	3 (23)	9 (69)
Dead Trees** (7)	6 (33)	0	1 (8)	0
Nest Boxes** (7)	6 (33)	0	1 (8)	0
Food Plants** (6)	6 (33)	0	0	0
Warmer Climate* (4)	6 (33)	0	0	2 (15)
Pesticides** (–1)	0	1 (5)	0	0
New Predators* (–7)	0	2 (11)	0	5 (38)
Reduced Habitat Area** (–7)	0	0	0	7 (54)

Only the Ladder-backed Woodpecker disappeared among nine cavity-nesting species. By contrast, half of the 22 open nesters were lost, a 4.5-fold higher proportion (Fisher's $P = 0.10$). Furthermore, all three open-ground nesters (Black Vulture, Chuck-will's-widow, Black-and-white Warbler) were lost by contrast to only nine (47%) of the remaining open-arboreal nesters. This 2.2-fold greater proportion (Fisher's $P = 0.09$) corroborates the well-known jeopardy of ground nesting in suburbia (see discussion).

Eleven species nested primarily in woodland, 13 in forest (Table 2), and three in each guild declined or were extirpated (Fisher's $P = 0.81$). Both habitats were truncated by some suburban yards at certain plot edges, where all surviving species were observed to use one or more of suburbia's planted and built nesting, feeding, drinking, and bathing sites. Thus, choice of original nesting habitat did not preclude using novel cultural resources, which may have fostered the permanent residents in particular (Table 3).

Seven species' declines were correlated with increasing or stable pairs of four predators (depredations observed). Increasing domestic cats paralleled five declines ($r_s \ge -0.64$, $P \le 0.003$); whereas, Eastern Screech-Owls and American Crows (*Corvus brachyrhynchos*) each paralleled three declines, and Blue Jays (*Cyanocitta cristata*) paralleled two, but the trends of these native predators and their potential prey ($r_s \le -0.52$, $P \le 0.02$) were not as strong as those of the cat. All guilds were represented among the declining species, which increases the likelihood of negative predatory impact.

Further evidence was found in the Eastern Screech-Owl's three negative correlations, which paralleled the incidence of correlated species as prey: Inca Dove ($r_s = -0.49$, 33 individuals), Ladder-backed Woodpecker ($r_s = -0.43$, 3), and Chuck-will's-widow ($r_s = -0.37$, 1). Yet the owl's stable population was positively related to stable or increasing populations of three other cavity nesters ($r_s \ge 0.38$, $P \le 0.05$): Red-bellied Woodpecker (*Melanerpes carolinus*), Carolina Chickadee (*Poecile carolinensis*), and Tufted Titmouse (*Baeolophus bicolor*; Table 2).

Altogether, the predators showed 14 positive trends with eight coexisting species. Except for invading White-winged Doves, these were small-bodied and stable or increasing permanent residents in both cavity- and open-nesting guilds. But invading domestic cats only correlated positively with the invading dove, while owls and crows each had three and jays six positive trends ($r_s \ge 0.38$, $P \le 0.05$). Considering the net number of negative trends together with increasing cats and crows by contrast to stable owls and jays (Table 2), the hierarchy of most to least potentially important predator is predicted to be cat, crow, owl, and jay.

White-winged Dove, Downy Woodpecker, American Crow, Blue Jay, Northern Cardinal, and House Finch each increased ($r_s \ge 0.40$, $P \le 0.05$), while Chuck-will's-widow and Ruby-throated Hummingbird declined ($r_s \ge -0.51$, $P \le 0.04$) coincidentally with rising mean maximum March-May temperatures in suburbia. This suggests that the urban heat island effect, global warming, or both may not be a problem to these permanent residents but possibly detrimental to the summer residents.

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DISCUSSION

Disproportionate losses of summer residents and open nesters from fragmented forests is well known (Aldrich and Coffin 1980, Lynch and Whigham 1984, Askins et al. 1990), and the vulnerability of both guilds is evident in my study. Pre-census losses followed reduced habitat area and continued with the first episode of sewer-line construction, while later losses followed the second sewer-line event. Seven summer residents (22%, 0.8/year) disappeared initially. After 18 years without sewer-line construction and avian losses, two more summer residents (8%, 0.2/year) expired along with three permanent residents.

Nest site contributed more than residency to some losses. The permanent-resident Black Vulture and migratory Chuck-will's-widow, both ground nesters, were visibly disturbed by fire ants (*Solenopsis invicta*), 1972 invaders, domestic pets (nestling Chuck-will's-widow killed by a cat), and humans (nestling vulture shot and killed). However, among arboreal nesters, the permanent-resident, open-nesting Inca Dove and cavity-nesting Ladder-backed Woodpecker, plus open-nesting migratory Black-chinned Hummingbird, could have been eliminated indirectly by fire prevention that allowed tree growth and reproduction to greatly increase woodland density.

The differential loss of open nesters, especially those on the ground by contrast to open arboreal nesters, is a known urban effect (Wilcove 1985, Martin 1993). Along with negative impacts by novel terrestrial predators, invading birds have been implicated. Unlike some fragmented habitat and urban studies (Brittingham and Temple 1983) but like others (Hennings and Edge 2003), competitive exotic *(Sturnus vulgaris*, *Passer domesticus*), native parasitic (*Molothrus ater*), and native predatory (*Quiscalus mexicanus*) birds were mostly edge visitors and did not nest inside plots.

The increased amount of dead wood provided indirectly by sprawl was selected for drilling by Red-bellied and Downy woodpeckers. Eastern Screech-Owls, Great Crested Flycatchers, Carolina Chickadees, and Tufted Titmice also nested in the additional holes and in nest boxes, each site more or less commonly depending on species preference (Figs. 3, 4). For example, nest boxes supplied Carolina Wrens (*Thryothorus ludovicianus*) once, but Bewick's Wrens only used boxes, and their invasion into the younger plot coincided with a newly placed array of 10 boxes at one house.

Besides dead wood, nest boxes, feeders, and birdbaths, suburbia supported permanent residents with vegetation change (Vale and Vale 1976). This included repeated avian use of cultivated shrubs, even-age trees, food plants, and open-canopy sewer lines with shrubby vegetation. Increasingly warmer winter and nesting-season temperatures may foster the cultivars and hence the birds indirectly. Novel vegetation was often used by and may have promoted increasing species and supported stable ones (Tables 2, 3), which dominated and hence characterized the avifauna with 87% of species and 83% of nesting pairs by the end of study.

Fifteen species with 30-year records were the most commonly observed users of cultural resources (Tables 2, 3). Their mean population sizes and CVs were negatively correlated ($r_s > -0.57$, $P \leq 0.03$), suggesting that suburban sprawl contributed to their stability as well as growth. The seven most numerous (62% of pairs) in the following most-to-least order of abundance were: Northern Cardinal, Carolina Wren, Carolina Chickadee, Blue Jay, Mourning Dove (*Z. macroura*), Tufted Titmouse, and Northern Mockingbird (*Mimus polyglottos*). Their CVs were 43.1 ± 12.7 versus 72.0 ± 41.9 for the other persisting birds in both resident guilds ($U = 11$, $P = 0.04$), suggesting particular adaptation to suburbia.

American Robin (*Turdus migratorius*), Blue Jay, American Crow, Tufted Titmouse, Northern Cardinal, and House Finch are identified with buildings and edge habitats in eastern U.S. cities and deciduous-forest patches; whereas Red-bellied and Downy woodpeckers, Eastern Wood-Pewee, Great Crested Flycatcher, Red-eyed Vireo, Wood Thrush, and Black-and-white Warbler are not (Mancke and Gavin 2000). Nest sites of the first group included suburbia in my study, while species in the second group only nested inside plots, except the two woodpeckers that occasionally nested in bordering suburban yards.

Aside from intolerance of cultural environments, many deciduous-forest birds do not tolerate reduced habitat area per se (Lynch and Whigham 1984, Robbins et al. 1989). Whitcomb et al. (1981) noted that summer residents except Eastern Wood-Pewee and Great Crested Flycatcher are intolerant of forest patches ≤14 ha; whereas the permanent-resident Red-bellied and Downy woodpeckers, Blue Jay, American Crow, Carolina Chickadee, Carolina Wren, American Robin, and Northern Cardinal are just as frequent or more so in such small fragments. In my study the pewee and other lost pre-census species might be considered intolerant of small fragments, but the flycatcher is not.

In mid-Atlantic states of the eastern U.S., Boulinier et al. (1998) listed Red-bellied Woodpecker, American Crow, and Tufted Titmouse as area-sensitive and Chuck-will's-widow and Eastern Wood-Pewee as not, but

Figure 3. Large brood of nestling Carolina Chickadees in a nest box. Adults prefer to partially excavate natural cavities and woodpecker holes for nesting, so they used only 0–2% of 10–16 boxes annually in the study plots.

that dichotomy too does not accurately describe my study's findings. Nevertheless, reduced habitat was a likely negative factor for the extirpated Summer Tanager, Red-eyed Vireo, Black-and-white Warbler, Blue-gray Gnatcatcher, and Wood Thrush, all considered area-sensitive by Boulinier et al. (1998).

I suggest that present differences are related to regional avian adaptations to naturally patchy habitat at the species' western edge of nesting range in central Texas. Here, the eastern deciduous forest reaches its present western limit, where it is fragmented by the relatively dry post-glacial (Holocene) climate and survives mostly in sheltered ravines and canyons (Gehlbach 1988, 1991). Central Texas is the western limit for the above-noted Chuck-will's-widow, Red-bellied Woodpecker, and Great Crested Flycatcher plus Ruby-throated Hummingbird, White-eyed Vireo, Tufted Titmouse, Carolina Chickadee, Carolina Wren, and all extirpated birds in my study except Blue-gray Gnatcatcher.

Black Vulture, White-winged and Inca doves, and Northern Mockingbird are permanent residents of tropical affinities not studied by Whitcomb et al. (1981), Boulinier et al. (1998), or Mancke and Gavin (2000). They tolerate or prefer small wooded patches and the widely spaced, uniform-age plantings that include food plants in suburbia. Northern Mockingbirds prosper in suburbia (Aldrich and Coffin 1980), and I have watched White-winged Doves choose suburbia in their ongoing northward invasion in Texas. Conversely, Black Vultures rarely nest in suburban forest patches or forested yards and only if human activity is minimal.

Pesticides are a certain negative impact, evidenced by my long-term investigation of Eastern Screech-Owls in study plots, adjacent suburban yards, and elsewhere (Gehlbach 1994, 1996). Three of 13 banded pairs with consecutive $\geq$5-years of positive productivity at yard or study-plot nests hatched no eggs the year after Dursban treatments in their foraging ranges. Other banded adults and fledglings showed abnormal neurological symptoms in Dursban-treated yards and then disappeared. No such observations were made in untreated foraging ranges or in a rural population.

Assessment of Natural Avifaunal Value.- The entrapped suburban avifauna responded to 11 cultural and modified natural factors, which were repeatedly observed or measured as potentially influencing multiple species (Table 3). Summed effects were strongly positive (95%) for permanent residents and strongly negative (72%) for summer residents (Fisher's $P < 0.001$). Thus, more permanent residents utilized or tolerated sewer-line construction and reforestation, planted vegetation, dead trees, bird feeders, baths, boxes, and climatic warming; whereas, summer residents were depressed or deposed by reduced habitat area, sewer-lines, novel predators, human intruders, and the warmer weather.

Such opposing effects on the two resident guilds are conservation concerns and easily evaluated in selecting and managing urban green space. All guilds can be employed to appraise natural value and vulnerability with numerical data on species and breeding pairs. For example, calculate summer resident species/all residents x 100 and open nesting species/all nesters x 100, which proportions are usually correlated ($r_s = 0.67$, $P < 0.001$ in this study) and must be used separately or multiplied for comparative purposes. A larger fraction reflects more natural value but greater vulnerability and hence conservation priority in selecting among habitats and management procedures.

Figure 4. Pre-nesting pair of Eastern Screech-Owls on old bird-nest material in a box (larger-darker female on the left). The owls used 38–83% of 18–21 nest boxes annually in a 2.7 km^2 area that included both study plots.

The present study corroborates others in wooded habitats (Lynch and Whigham 1984, Wilcove 1985, Askins et al. 1990, Martin 1993) that summer residents and open nesters suffer most from cultural impacts. Few tolerate the effects or use cultural resources relative to permanent residents (Tables 2, 3). Proportions of resident-type and nest-type guilds detect more vulnerability than either one alone, because they represent different niche parameters. For example, among my study's few remaining summer residents are a 6–7 month resident open-shrub nester (White-eyed Vireo), and two 3–4 month residents that nest in open-tree (Yellow-billed Cuckoo) or tree-cavity (Great Crested Flycatcher) sites.

Additional information is gained from breeding pairs, which reflect consuming biomass and hence resource abundance, while species represent niches and resource presence. Species and pairs methods should be used separately or multiplied, because they are most likely to be correlated ($r_s \geq 0.43$, $P \leq 0.02$, present study). Moreover, while guild assessments serve initial decision-making, annual reassessments are required to monitor the often sporadic changes during urbanization and adjust management strategy. This study indicates that one or a few breeding seasons do not adequately portray changes in an avifauna altered at different rates over several decades of suburban sprawl (Fig. 2, Table 1).

Without continuously observing many different environmental factors, it would be difficult if not impossible to record the contrasting impacts of culture and nature on different avian guilds. Long-term, multi-factor studies have been advocated in ecology generally (Likens 1983), for avifaunas (Wiens 1984), and for urban birds specifically (Marzluff et al. 1998, 2001); but are rare, even though urbanization is a well-known cause of species endangerment and extirpation (Czech et al. 2000, Marzluff 2001). Clearly, we must consider long-term multi-factor study and assessments of vulnerability, if we are concerned about conservation

ACKNOWLEDGMENTS

Nancy Gehlbach knows the same ravine birds, supplied many observations, and read all versions of the manuscript. Kevin Gutzwiller, John Marzluff, Chandler Robbins, and Roland Wauer read various drafts and made many helpful suggestions. I am grateful to these people and to Darrell Vodopich and Baylor University for logistical support.

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